

6. Water

The Headwaters of North America

The aquatic environment of the Crown of the Continent is just as remarkable as its terrestrial landscape and is treasured for many of the same reasons—its beauty, its relatively pristine condition, and its ecological integrity. The



Crown of the Continent can be thought of as the headwaters of North America, as it includes a rare “triple divide,” a point where precipitation drains into three oceans: the Pacific, the Arctic, and the Atlantic. In other words, the only ocean into which the Crown of the Continent doesn’t drain is the Indian Ocean, on the other side of the world.

Rivers

The Crown of the Continent includes the upper reaches of nineteen major rivers, tumbling from mountain heights, recharged each



spring with the winter’s snow-melt. Major rivers include:

- The Blackfoot, Clearwater, Clark Fork, Flathead, Tobacco, Swan, and Stillwater drainages of the Columbia River Basin

in Montana.

- The Elk, Wigwam, and upper reaches of the Flathead (North Fork of the Flathead) rivers in the Columbia River Basin in British Columbia.
- The Milk, Dearborn, Sun, Teton, and Marias rivers in the Missouri River Basin of Montana. (The Milk also flows through southern Alberta.)
- The St. Mary, Waterton, and Belly rivers, which start in Montana and flow into Alberta, and the Oldman and Castle rivers of Alberta. These flow into the Saskatchewan River and into Hudson Bay.

The Crown’s water is a vital resource. Besides being the lifeblood of both aquatic and terrestrial ecosystems, water is necessary for human economies. Rivers generate hydropower at Hungry Horse Dam on the South Fork of the Flathead River and Kerr Dam on the Flathead River, below Flathead Lake. The Oldman River Dam in Alberta has recently been retrofitted to generate hydropower.

Smaller hydroelectric dams exist on the Clark Fork, at Milltown, and on the Swan River, at Bigfork.

Rivers, streams, and groundwater are important sources of irrigation water, without which most cultivated areas of the Crown would not be suited for farming. This is particularly true on the arid, east side of the ecosystem, where reservoirs at Bynum, Valier, Sherburne, and lower Two Medicine Lake provide necessary water for grain, alfalfa, and other water-loving crops. The waters from the Crown also fill more than 50 reservoirs in southern Alberta, on which the province's huge agricultural industry depends.

Rivers support complex ecosystems. The waters of the Crown of the Continent contain all their native fishes, just as the land supports nearly all its terrestrial animals and birds. However, some of those fishes are threatened, as the natural river systems have been impacted by humans.

Rivers cannot be defined by riverbeds alone. Water flows both on the surface and underground, through a complex, inter-stitched aquatic network. The underground river zone, called the *hyporheric* or *interstitial* zone, supports aquatic invertebrate life of its own, directly tied to the quantity and quality of the water flowing in the streambed itself. Some of the pioneering science in the discovery and understanding of the hyporheric zone ecosystem was done in the Crown of the Continent by Dr. Jack Stanford and others at the University of Montana Biological Field Station at Yellow Bay.

Lakes

Another striking feature of the Crown's watershed is its glacial lakes. These lakes tend to be deep, cold, and remarkably clean. Many are quite large. Flathead Lake is the largest natural freshwater lake in the western United States and one of the 300 largest lakes in the

world.

It is 47 kilometers (29 miles) long, 27 kilometers (17 miles) wide and has 50,400 surface hectares (126,000 acres). The University of Montana Biological Field Station at



Yellow Bay has monitored Flathead Lake for 100 years. Smaller Montana lakes include Swan, Seeley, Lindbergh, Holland, and Whitefish lakes. Big Salmon Lake is the largest lake in the Bob Marshall Wilderness Complex. Outside of Waterton-Glacier International Peace Park, all large lakes occur on the wetter, western side of the ecosystem.

Upper Waterton Lake is the deepest lake in the Rockies and in Alberta, at 147 meters (482 feet), and is the largest in a chain of lakes that are the focal point of Waterton Lakes National Park. In total, the park has 80 lakes and ponds. Maskinonge is the shallowest of the Waterton Lakes chain, and an important wetland stopover for migrating waterfowl.

Glacier National Park has 750 lakes, of which 131 are named. Glacier's largest lake is Lake McDonald, at 16 kilometers (10 miles) long and 143 meters (472 feet) deep. Other large lakes include Kintla, Bowman, and Quartz in the west side of Glacier Park, and St. Mary and Two Medicine lakes on Glacier Park's east side. The large lakes of Glacier and Waterton Lakes national parks are fjord-like bodies of water, filling the troughs carved

by Pleistocene glaciers and dammed behind glacial debris called *terminal moraines*, or behind particularly hard layers of rock that withstood the erosive force of glaciers.

The Crown's big lakes tend to be cold. The mean winter temperature in Upper Waterton Lake is less than 4°C (40°F). Water temperatures peak in August, but the summer surface temperature remains less than 10°C (50°F). Only the surface and shallow waters get that warm, with the depths remaining cold. Few of the lakes in the Crown exceed 15°C (60°F). These cold temperatures limit the growth of plankton and other microorganisms, and thus fish and other organisms are not naturally abundant, especially when compared to warmer, nutrient-rich waters elsewhere. In other words, the water has low natural productivity.

The clear waters reflect blue and green wavelengths of light, and this results in the breathtaking clarity and characteristic blue-green or turquoise color of its mountain waters. The color is enhanced by sunlight reflecting off fine sediment from glaciers, called *glacial flour*, sus-

suspended in the water of both streams and lakes. While the color is striking, streams here naturally carry lower levels of glacial flour than many water bodies north of the Crown, such as Peyto Lake in Banff National Park.

Rivers flowing east or northeast from the Crown of the Continent tend to run through

softer, more claylike sediments after they enter the prairie. Here, rivers pick up more sediment than do streams on the west side of the mountains and are not as clear. Explorers named the Milk River because the silty water reminded them of the color of milky tea.

In the high country, thousands of mountain cirques contain beautiful, small, alpine lakes, which are technically known as *tarns*. These are popular hiking destinations and important microhabitats. Some alpine lakes freeze solid in the winter, but many do not. However, most cirque lakes are naturally isolated by downstream waterfalls and do not naturally contain fish. Nonetheless, these so-called barren lakes do have a natural ecosystem of invertebrates, amphibians, and other organisms.

East of the Rocky Mountain Front, the prairie is dotted with pothole lakes, such as Duck Lake on the Blackfoot Indian Reserva-

tion, that are very different from the Crown's mountain lakes. Such potholes were formed by chunks of buried glacial ice, which later melted and left depressions in the land that subsequently

filled with water. Prairie potholes are naturally devoid of fish, having no outlet or inlet. However, larger potholes have been stocked and are quite productive. Duck Lake is a popular destination for fishing for trophy trout and an economic asset on the Blackfoot Reservation. The Mission, Flathead, and



Tobacco valleys are also dotted with glacial potholes, important habitat for waterfowl, painted turtles, and other creatures.

Water remains important to industry, but is not as important for transportation as it once was. In the days before mechanical log loaders made log yards practical, lakes and ponds were used to raft logs for sawmills, and steam ships carried cargo on big lakes like Flathead.

Before logging trucks, logs were floated downstream on rivers in a heavy-handed process that used a series of splash dams and dynamite charges.

Free-Flowing Rivers

In modern North America, free-flowing rivers are increasingly rare. Across southern Canada and the United States, rivers are harnessed between dams and dikes to prevent floods, provide for irrigation and livestock,



supply domestic water, and to generate power. The Crown's largest river engineering project is Hungry Horse Dam, which flooded the South Fork of the Flathead under a 96-kilometer (50-mile) long reservoir. In Alberta, the only dam actually within the Crown is the Oldman, but waters that originate in the Crown irrigate about 250,000 hectares of farmland. Major hydro engineering projects also include the St. Mary Dam, the Waterton River Dam, and the

Pine Coulee Dam on Willow Creek. Smaller dams are on Lower Two Medicine Lake, Swiftcurrent Lake, the North Fork of the Sun River, Birch Creek, the Teton River, and other east side water bodies.

Like forest fires, floods are inconvenient and expensive for human settlements. One of the most famous flood years here was 1964, when spring rain fell on a deep snowpack and triggered massive flooding throughout the Crown of the Continent. The 1995 spring flood of the North Fork of the Flathead inundated Polebridge and washed away several homes and a bridge at the international border. That same year, floods hit Waterton Lakes National Park and neighboring watersheds. Cattle were drowned, and homes, roads, and bridges were destroyed.

Like fires, flood is a dynamic force that has occurred for thousands of years. Controlling floods, like suppressing fires, weakens the natural fabric of life. However, most rivers of the Crown remain free flowing. Rivers such as the Elk, in British Columbia, and the North Fork and Middle Forks of the Flathead, in B.C. and Montana, are free flowing their entire lengths. Even on controlled rivers like the Marias, much of the Crown of the Continent is upstream from the effects of the dams.

Free-flowing water is crucial for river ecosystems. Species like cottonwood trees not only benefit from floods, but depend on them. Cottonwoods are fast-growing, deciduous trees that demand large quantities of water. They skirt the banks of rivers and lakes throughout the Crown.

Cottonwood trees are ecological keystones, providing nesting cover for scores of species of birds, hiding cover for whitetail deer, food for beaver, and denning sites for black bears. The shade provided by cotton-

wood trees keeps water cool, stabilizes riverbanks, and performs countless other ecologic functions.

Cottonwood trees distribute tiny seeds, sent aloft in cotton in the summer. Where dams cut off spring flows, they deprive cottonwood seeds of the water they need to germinate. The seeds also need riverbank cobble, scoured by periodic floods, to be successful. On altered rivers, cottonwood trees gradually age and die without producing a new generation to replace the old. For example, on the controlled portions of the Waterton and St. Mary rivers in Alberta, cottonwoods have declined in extent 25% and 55% respectively. The loss of cottonwood trees has ripple effects throughout the riparian or riverside ecosystem.

Floodwaters also deposit fine sediment in



flood zones, making the soils in these areas particularly rich for plant and animal life

alike. Aquatic insects also thrive when rivers perform naturally. These insects are the basis of the river food chain. It is no coincidence that the free-flowing Elk River and the North Fork of the Flathead River are among the best habitat for bull trout and westslope cutthroat trout.

The North Fork and Middle Fork of the Flathead River, along with the South Fork

above Hungry Horse Reservoir, are recognized as Wild and Scenic Rivers under federal United States law. This totals some 469 kilometers (291 miles). In fact, the Flathead River system helped inspire the people who drafted the Wild and Scenic River Act.

Some of the cleanest water in the world



is found in the Crown of the Continent. This is because of natural conditions, as well as the relative lack of human settlement and industry. Boaters launching from the shores of Upper Waterton or McDonald lakes are often amazed at the depth to which they can see objects on the bottoms of those waters. Remote, large lakes in Glacier Park, particularly Kintla and Bowman, have some of the lowest levels of chlorophyll and phosphorus ever measured. (In some places, such as eastern Canada and the northeastern United States, very clear water is associated with problems such as acid rain. However, in the Crown of the Continent, water clarity reflects pristine conditions, and acid rain is not yet a problem.)

Because water is so clear, even relatively small disruptions can cause dramatic changes in water quality. The water here is particularly sensitive to pollution (for example, from

sewage or road runoff), which adds nutrients and thus increases productivity. When organic productivity goes up, it may indicate water quality is going down. Additional nutrients may result in blooms of algae, which are naturally rare here, but which become increasingly frequent as lakes are polluted with sewage, agricultural waste, and other runoff.

Water quality (which refers to physical, chemical, and biological factors) can be impaired by both natural and human events. The physical characteristic of water clarity varies with the seasons. Rivers that run clear most of the year, for example, may be cloudy when spring runoff carries sediment. Key factors affecting water quality include water flow, water temperature, turbidity, sedimentation, water chemistry, and microbiology. Potential sources of pollution include municipal and private sewage systems, urbanization, agricultural and livestock runoff, siltation from road building and other industrial activity. Airborne pollution from industry, automobiles, and woodsmoke can also pollute water when it settles on lake surfaces.

While water quality generally remains quite high, the increasing human population is reducing the Crown of the Continent's water quality. Studies since 1978 show that the water quality of Flathead Lake has declined. Algae blooms have become more common, and phosphorous and nitrogen levels have increased. Non-point pollution, such as surface runoff from city pavements and roads, seepage from septic tanks, or farm practices, is another major source of pollution. Mining waste has introduced heavy metals into some waters, such as the Clark Fork River.

As clean and as protected as the Crown of the Continent watershed is, it is not completely free of pollution. Even protected lakes in national parks receive some pollution, such as inadvertent seepage from Lake McDonald Lodge's sewage system in Glacier National

Park. There is a warning against eating too many large lake trout in Flathead Lake, because of PCBs and mercury found in the flesh of older fish. No one is sure where those contaminants are coming from.

Furthermore, even high mountain snowpack contains contaminants, evidently from minute particles of airborne pollution. Snow in the Canadian Rockies was found to have traces of pollutants from agriculture in south-east Asia, illustrating once again how all of earth's life is interconnected to the global ecosystem.

However, the undeveloped mountains of the Crown provide a reliable source of clean water. In an effort to protect water quality, cities like Columbia Falls, Whitefish, and Kalispell have modernized their sewage treatment systems. Loggers and others working in the woods often use voluntary "best management practices" to limit the impact their work has on lakes and streams.

Farmers need to pump water from rivers to irrigate their crops. At a supportable rate and scale, this does not necessarily degrade the river ecosystems. However, during drought years, irrigation can "dewater" streams, leaving them too shallow and warm to support native life forms.

Dams can fracture watersheds, harming formerly intact aquatic ecosystems, as the waters become divided between dams, culverts, and other structures. For example, the Clark Fork River was historically connected to all three forks of the Flathead River, the Swan River, and other drainages. Today, dams at Flathead Lake, Swan River, and Hungry Horse divide those waters into several sub-populations. As with fractured islands of terrestrial habitats, smaller, fractured segments of river habitat are more susceptible to local extinction than larger, better-connected segments.

An important element of protecting water

quality is protecting wetlands. Aside from being important wildlife habitat, wetlands can be effective filters, keeping surface runoff and other pollution out of rivers and lakes. Wetlands are relatively rare in the Crown, given the steep terrain, but do exist near streams and in places of gentle topography. At places like

Freezout Lakes and Ninepipe National Wildlife Refuge, wetlands have been enhanced with dikes and dams in programs particularly aimed at boosting waterfowl numbers for hunters. The Swan Valley has a complex of several kinds of wetlands.



Sources

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Major Rivers in the Crown of the Continent Ecosystem

