Aquatics resources – climate change impacts

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Water impacts

Canada has 9% of the Earth's freshwater, yet only 0.5% of the planet's population (1). In Manitoba, 100,000 lakes cover approximately 17% or 101,600 km2 of our province's surface area (2). We are immeasurably fortunate – water is a precious resource, so much that it is sometimes called blue gold. The value of freshwater reaches far beyond human consumption. Aquatic ecosystems (lakes, rivers, streams and wetlands) provide the following services and benefits:

- they contribute to biodiversity
- flood control
- water filtration and purification
- hydroelectric generation
- recreation and tourism opportunities
- habitat for economically important fisheries
- locations for hands-on learning experiences

Unfortunately, many freshwater ecosystems and the services they provide are threatened. Changes in land use, environmental pollution, water diversion, over fishing and the introduction of foreign species have harmed our freshwater resources (3). Climate change will continue to disrupt and harm our lakes, rivers and wetlands. Changes in temperature and precipitation will greatly influence the movement of water through the atmosphere and landscape (iv). Increased evaporation, decreased summer precipitation, and warmer water temperatures also promise to change the way we use water. These changes will combine to negatively impact both water quality and quantity.

Oceans

When Manitobans think of the ocean, our minds either travel to the West or East coast. We often forget that Manitoba is a coastal province. Hudson's Bay is a part of the Arctic Ocean.

The world's oceans cover over 70% of the planet's surface. Although the water is salty and undrinkable, it is difficult to over-estimate the value of this vast mass of water. It helps regulate the global climate and to ensure that a constant flow of vital nutrients is cycled throughout the biosphere (1). Climate change impacts in the world's ocean will have far-reaching effects. Marine and coastal ecosystems may collapse, creating a disastrous domino effect of extinction and loss. Marine animals, plants and invertebrates are not the only creatures in danger. People have much to lose if the world's oceans falter under the added burden of climate change.

Sea-level rise

Climate warming will lead to the thermal expansion of water and melting of glacial and polar ice, causing a rise in sea level (2). Rising oceans would permanently flood highly populated coastal cities all over the world, and submerge the atoll nations of the Pacific and Indian Oceans. Precious marine wetland habitats such as mangrove forests and coastal wetlands would be lost to the rising waters.

Disease and toxic algal blooms

In waters already choked with algae fertilized by nitrate and phosphate pollutants, warmth only encourages algal growth. Algae can be a reservoir and amplifier of dangerous diseases such as cholera, a serious threat for countries with poor water and sanitation (3). Off the East Coast of Canada, the deaths of humpback whales and dolphins have been attributed to algae blooms and viruses (4). Some algal blooms, such as red tides, are also toxic to humans.

Storms, erosion and sediment

An increase in the number and severity of storms and storm surges would have serious consequences for coastal habitats, as well as fishery and aquaculture industries (5). Increased sea levels and storms would interact to erode beaches, damage coral reefs, and overwhelm coastal wetlands and settlements. Higher storm surges would also pull more sediments and pollutants into the water (6), increasing the turbidity and likelihood of algal blooms.

Ocean circulation

Winds are created by the unequal warming of the earth's surface. Many climate change scenarios predict that polar regions will experience higher temperatures, reducing the thermal gradient between the poles and the equator (7). Major ocean surface currents generated by the drag of strong wind on water would weaken or even change. Patterns of vertical water movement would also be altered, devastating marine life that depend on the upwelling of nutrient-rich waters and the downwelling of oxygen-rich waters (8). Since the 1950's, zooplankton in the California current have decreased by 70% as the sea surface has warmed (9). This may explain the mass starvations of seabirds such as sooty shearwaters and Cassin's auklets in recent years (10).

Marine life in jeopardy

The world's oceans support a dazzling array of life forms, from massive marine mammals to microscopic crustaceans. Climate change is already disrupting marine food chains. In the Antarctic, penguins are starving for lack of krill, tropical coral reefs are bleaching and breaking, Pacific salmon are moving north, and polar bears in Manitoba cannot gain enough weight to raise their cubs.

Water quality

Less water from precipitation and glacial runoff will have an enormous impact on water quality in Manitoba and across the Prairies. With less renewal there will be less water in lakes, ponds and rivers. As such, they will be less able to dilute pollutants like pesticides, fertilizer and runoff from livestock.

For people

People will be at greater risk of contracting waterborne illnesses. (See Drinking water) Water bodies will be less able to buffer the effects of acid rain. Increased nutrient levels will cause algal

blooms and eutrophication, making drinking water unpalatable and potentially toxic. Unfortunately, Canadian freshwater supplies face many threats in addition to climate change that will seriously jeopardize water quality in the future: (1)

- Increased virulence – There are more diseases in the water.
- Chlorine issues – Many water-related health problems cannot be solved with more chlorine. Cryptosporidium and microcystis are resistant, while bladder cancer and developmental abnormalities may actually be chlorine-induced.
- Insufficient regulations – Municipal and/or provincial regulations that are not effective in protecting the water.
- Soil erosion, the destruction of wetlands and riparian habitat from poor land-use practices.
- Industrial farms – An increase in industrial farms that release that same amount of pollutants as a moderately sized city.

For nature

Quality issues are not reserved just for people and drinking water. Runoff transports more than water into lakes, rivers and streams. Dissolved organic carbon (DOC) is carried from the surrounding watershed into water bodies. DOC – often in the form of natural pigments, like tannins – is critical to the health of aquatic organisms. It prevents the penetration of harmful ultraviolet radiation into the water column. A lack of DOC has resulted in sunburnt fish in some Canadian lakes.

Problems for fish go beyond sunburn. Cold water fish will have to migrate to higher latitudes and altitudes to escape warming water bodies. Global warming caused by a doubling of carbon dioxide in the atmosphere will reduce habitat for cold water fish species (brook trout, for example) by 57%. Many Canadian fish species will have limited escape options as many of our major river systems flow East/West as opposed to North/South.

Water quantity

Although overall precipitation levels may not change significantly, we may see an overall reduction in the quantity of water in the province as precipitation patterns change and as the glaciers in the Rockies melt away. This can effect our energy supply as well as water for nature, humans, livestock, and industry.

Snow

Winter precipitation plays an important role in topping up lakes and rivers. Most Canadian streams and rivers have an annual maximum flow in the spring from snowmelt. Manitobans are familiar with this phenomenon. About 25 to 50% of the total annual river flow occurs as snowpacks melt. (1) With less snow, river and streamflow would experience a net drop, and the wetlands and riparian zones that rely on occasional spring flooding would suffer. (2)

The loss in winter runoff may be offset by increases in springtime precipitation. Manitoba is projected to experience a 20% increase in springtime rainfall. However, problems occur when spring rains fall too quickly, causing floods. Spring runoff is best when it occurs slowly, releasing water into the environment where is may be absorbed by the soil and plants before filling up water bodies.

Ice cover

With less snow and warmer temperatures, water bodies do not build up a solid, thick layer of ice. This can be particularly inconvenient – and dangerous – for northern communities who rely on winter trucking across lakes to bring in supplies. (3) A thick layer of ice is ecologically important as well. During the spring, ice jams on rivers cause periodic flooding of nearby wetlands, recharging them with water. Without this overflow, wetlands dry out and valuable habitat lost. The Canadian Prairies are the most important region in North America for breeding waterfowl. (4) Breeding waterfowl populations could drop by 50% in response to reduced precipitation and temperature increases up to 4°C. (5)

Rain

Rains replenish Prairie rivers, wetlands and lakes. However, summer precipitation declines of up to 10% to 20% are forecasted for Manitoba. (6) At the same time, average temperatures are projected to rise, increasing the rate of evaporation from existing water bodies. Droughts may become even more common. The outlook looks even more serious when considering future water needs. The same conditions that make water supplies scarce also create a greater demand. Crops will need more irrigation. Livestock will need more water to stay cool and hydrated. A growing population will demand access to safe, reliable freshwater. Acute water problems in the United States and other countries will also threaten Canadian water security.

Glaciers

Much of the useable freshwater in Western Canada comes from the snow and ice fields of the Rockies. (7) At the mouth of the Saskatchewan River, 87% of the flow is meltwater from the icy peaks of the Rocky Mountains. (8) Glaciers are receding and thinning as the climate warms. River and stream flows will drop significantly without input from the huge glacial storehouses of freshwater. Already, flows in the major rivers of the western prairies have been reduced to 20-70% of their historic flows. (9) The Athabasca Glacier (a popular tourist destination in the Rocky Mountains) has receded 1.5 km in the last century.

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