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## Rapid Changes across Canada's Oceans and Their Impact on Coastal Communities

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The sea around us is rapidly changing. For the last century, humans have fished global wild stocks to feed a growing population, extracted millions of gallons of oil from the seabed to fulfill socio-economic needs, shipped goods globally, and discarded waste into the ocean's blue waters (Halpern et al. 2019). In addition, the ocean has absorbed over 90% of the anthropogenic carbon dioxide released since the Industrial Revolution, heating up over 1°C over the last 50 years (IPCC 2019). Climate change has caused multiple shifts in ocean conditions, such as warming temperatures, decreasing salinities and pH, increasing harmful algal blooms, and expansion in the distribution of pathogenic agents, all of which have been associated with negative impacts on marine fauna and flora (Gao et al. 2018). Overall, these changes are affecting interdependent marine social-ecological systems. Unlike the large changes discussed in Chapter 4, rapid environmental changes are events of large magnitudes that occur on a short time frame of less than a year (i.e., weekly, monthly, seasonal) and are typically more localized in spatial scale (i.e., local, regional) (Okey et al. 2014). These changes are characterized by increasing interannual variability affecting the physical, biogeochemical, and ecological systems, with downstream effects on human societies (Riche, Johannesen, and Macdonald 2014).

Each coast in Canada has experienced different types of rapid change, with some commonalities. For example, events such as marine heatwaves have been experienced in all ocean basins and are expected to increase

in frequency with global warming (Oliver et al. 2018; Smale et al. 2019) (Figure 3.2). Despite the differences in the type and magnitude of rapid changes across the three oceans, their impacts on Canada's ocean economic sectors – e.g., oil and gas, transportation, fisheries, coastal tourism – will be considerable, with far-reaching consequences for Canadians. Moreover, due to the close connection and interdependence between natural and social systems, such changes have repercussions for human societies that depend on marine resources. Coastal communities in Canada, especially Indigenous Peoples, have a strong bond with the ocean and its marine fauna (see Chapter 2). In many Indigenous societies, marine animals such as salmon, orcas, and bowhead whales represent values related to family, community, and protection, among others (Bennett et al. 2018). Indigenous Peoples have long applied their place-based knowledge to sustainably manage the natural resources within their traditional territories over generations (Ford et al. 2008; Pearce et al. 2015). Thus, rapid changes in the environment represent an increased source of pressure and have had, and will continue to have, direct impacts on the management of fish for food security, cultural ceremony, and local economies. However, our ability to predict long-term (slow) large change is much more advanced than for rapid change. The unpredictability and uncertainty of rapid change events increase the vulnerability to change for Canada's oceans, their living organisms, and dependent societies. Developing a better understanding of their potential impacts will enhance our capacity to