SCIENCE SPOTLIGHT

A WHALE OF A TIME

GEN ACTION

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Canada

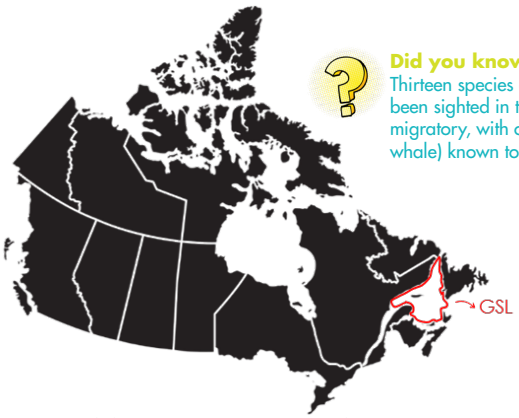
RIPLEY'S AQUARIUM OF CANADA

A Whale of a Time

Origin Story:

CLIMATE CHANGE AND WHALES

Among the many bodies of water in Canada is the Gulf of St. Lawrence (GSL). It is an estuary – an ecosystem where a river unites with the ocean – off the eastern coast of Canada. It is an important ecosystem to many organisms, but of particular note are whales! Whales are wondrous creatures – some are enormous yet eats miniscule things, they are air breathers yet they live underwater, their ancestors were land-dwellers but they migrated to the ocean[1], and they have been on Earth for about thirty million years now (their ancestors even longer!)[2].



Did you know?
Thirteen species of whales have been sighted in the GSL. Most are migratory, with only one (beluga whale) known to live there year-round.

The Gulf of St. Lawrence (GSL). It is a body of water that is surrounded by Quebec, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador.

Whales, like other species, have gone through a lot during their time on Earth and this continues to be the case. Climate change, for example, is one of the most pressing issues facing life on Earth. According to the IPCC (Intergovernmental Panel on Climate Change), a 1.5°C rise in temperature could put 4% of vertebrates, 6% of insects, and 8% of plants on land at risk of losing their natural range[3]. A 2°C rise in temperature could double or triple those values, and cause several ecosystems to struggle[3]. Have you ever wondered how climate change affects whales? For the longest time whales were believed to be able to cope through the impacts brought about by climate change by adjusting their behaviours… but is that still the case? Let's find out!

BUN IN THE OVEN?

It turns out that whales are, in fact, not having a whale of a time. A team of scientists, made up of Joanna Kershaw, Christian Ramp, Richard Sears, and others, observed that the reproductive success of humpback whales that visit the GSL has declined. The team noticed that humpback whales, from 2004 to 2018, were not giving birth as often compared to previous years (a decline in reproductive success). And through further investigation, the team found that there is a relationship between this decline and climate change's impact on the Gulf of St. Lawrence's ecosystem.

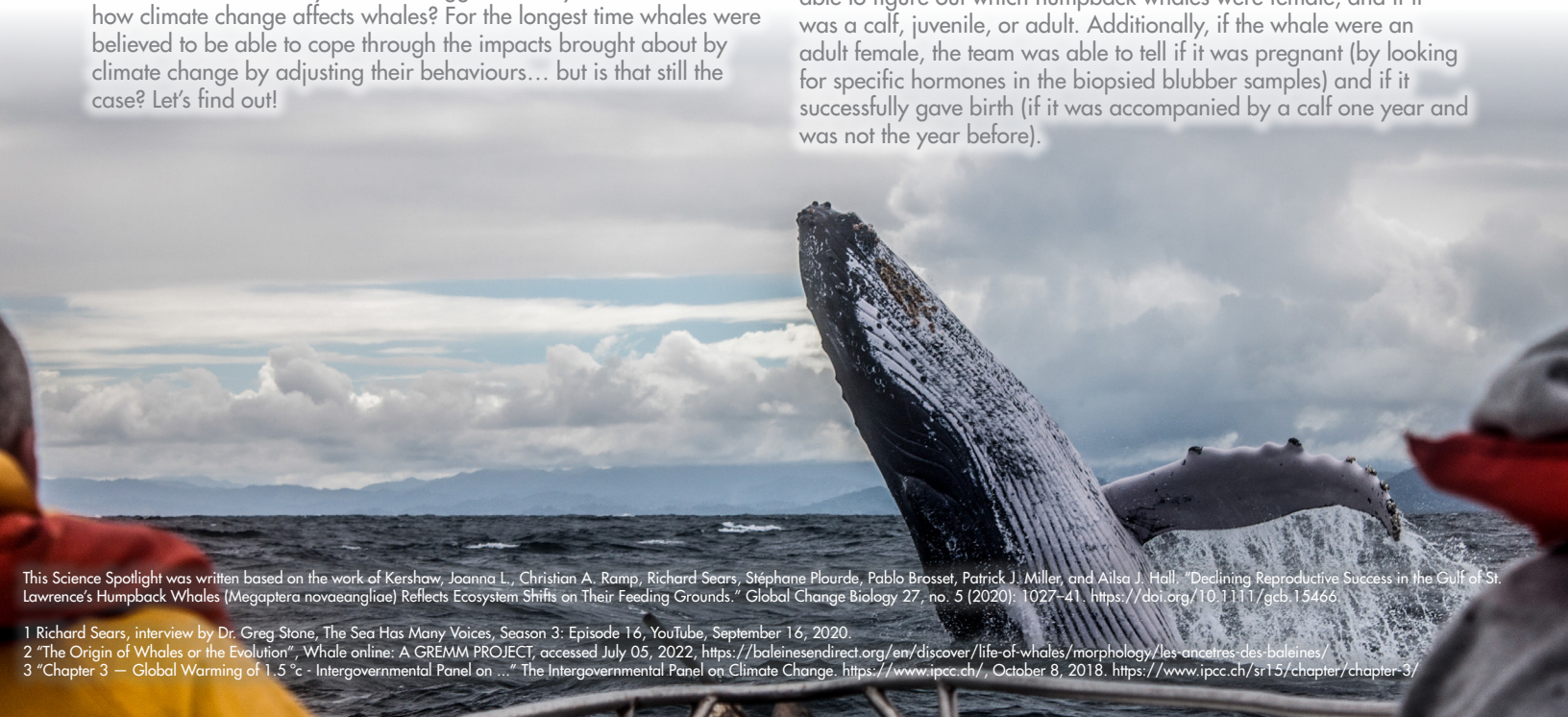
Considering how complicated it is to study humpback whales in the ocean, and that ecosystems (such as the GSL) undergo constant change – one might wonder, how did the team reach that conclusion? They had to do a few things: (1) keep track of humpback whales and their status through photo-identification and blubber biopsies, (2) quantify climate change's impact on the GSL, and (3) put their data side-by-side to analyze its relationship.

PHOTO-IDENTIFICATION AND BLUBBER BIOPSY

Some members of the team also worked for Mingan Island Cetacean Study (MICS), which gave the team access to an archive of whale data. Included were photo-identified humpback whales with accompanying blubber samples that were collected whenever possible over forty years. Photo-identification relies on identifying individual animals through their photographs. These photos highlight unique markings or colouration on an individual.

So, how does collecting data from a whale work exactly? Every year MICS researchers would ride inflatable boats into the GSL, carrying cameras and crossbows with hollow-tipped arrows that only penetrates the whale's skin on a superficial level. This process is known as blubber biopsy. The skin and blubber sample was analyzed/biopsied at a later date.

From the blubber biopsy and photo-identification, the team were able to figure out which humpback whales were female, and if it was a calf, juvenile, or adult. Additionally, if the whale were an adult female, the team was able to tell if it was pregnant (by looking for specific hormones in the biopsied blubber samples) and if it successfully gave birth (if it was accompanied by a calf one year and was not the year before).



This Science Spotlight was written based on the work of Kershaw, Joanna L., Christian A. Ramp, Richard Sears, Stéphane Plourde, Pablo Brosset, Patrick J. Miller, and Ailsa J. Hall. "Declining Reproductive Success in the Gulf of St. Lawrence's Humpback Whales (Megaptera novaeangliae) Reflects Ecosystem Shifts on Their Feeding Grounds." Global Change Biology 27, no. 5 (2020): 1027–41. https://doi.org/10.1111/gcb.15466.

1 Richard Sears, interview by Dr. Greg Stone, The Sea Has Many Voices, Season 3: Episode 16, YouTube, September 16, 2020.
2 "The Origin of Whales or the Evolution", Whale online: A GREMM PROJECT, accessed July 05, 2022, https://baleinesendirect.org/en/discover/life-of-whales/morphology/les-ancetres-des-baleines/
3 "Chapter 3 — Global Warming of 1.5 °c - Intergovernmental Panel on …" The Intergovernmental Panel on Climate Change. https://www.ipcc.ch/, October 8, 2018. https://www.ipcc.ch/sr15/chapter/chapter-3/

IMPACT OF CLIMATE CHANGE ON THE GSL

The team of scientists used information and data from past research and from Fisheries and Oceans Canada to learn how climate change has impacted the GSL. The team found that due to climate change the GSL has experienced changes in water temperature, what time in the year ice forms and melts, and in its water chemistry. To account for how these changes impacted the GSL ecosystem, the team gathered population data for microscopic plants (phytoplankton), microscopic animals (zooplankton), and forage fish (herring, mackerel, capelin). These organisms are what humpback whales have been observed to prey on in the GSL; their scarcity (if conditions are bad) or abundance (if conditions are good) is telling of how climate change is affecting the GSL's ecosystem.

WHAT DOES THE DATA SAY?

As mentioned earlier, humpback whales in the GSL are not having a whale of a time. Specifically, the team found that although there were pregnant humpback whales observed in the GSL from 2004 to 2018, there was a mismatch with the number of calves observed. Meaning that some of the pregnant females failed to give birth successfully.

When this finding was put alongside the humpback whale prey population data, the team found that a scarcity in prey population a year before in the GSL precedes reproductive decline in humpback whales a year after. The team shared that this could be because giving birth successfully and sustaining a calf requires massive amounts of energy; if they cannot get the energy they need, then reproductive failure ensues, or they might not attempt to reproduce at all until conditions return to a favourable state.

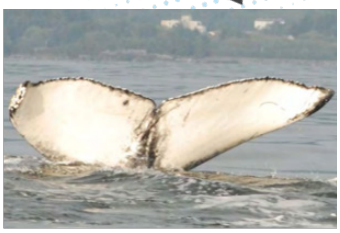
Try This at Home:

PHOTO-IDENTIFICATION

Recall that photo-identification relies on taking photographs of the unique markings and/or colouration (also called identifier) of an individual animal. For humpback whales, their identifier is the unique colouration on the underside of fluke/tail fin. Spot the difference between the six humpback whales.

Now, try photo-identification for yourself! If you have a pet, try and find an identifier on your pet. Then compare it to photos on the internet or other pets, from friends or neighbours, of the same kind.

You can also try to identify animals in the wild! Go to your backyard or to a park, observe the animals that you find, look for identifiers, then take photos! Remember that your photo must include the identifier, you can even take note of the identifier in a notebook or a spreadsheet.



Climate Action:

TECH PURCHASE AWARENESS

At some point, you may have thought: "How can I help whales?" The issue highlighted in this spotlight may seem local and disconnected from everything else in the ocean – but that is not the case! Climate change is a global issue. We have all contributed to it, and we can all help mitigate it. Whatever you do, no matter how small nor easy, will help slow down climate change and its impacts. And now, more than ever, is the time to act. Here is a suggestion that you can consider to help ease our impact on the Earth!

An action as small as limiting your new tech purchases can help slow climate change down. A lot of technological devices have a longer lifespan than we think. Instead of buying new tech every year or two, consider using your current tech until it reaches the end of its life. This can help mitigate climate change because many of the components are made of plastic. The production of plastic ends up releasing a good amount of greenhouse gas into the atmosphere, thereby making climate change worse. Plastic itself is bad for the environment! Once it reaches the ocean anything made of plastic will eventually breakdown into smaller pieces and stay in the ocean for approximately one thousand years. It could stay afloat or sink, and get eaten by animals – such as whales. Additionally, sourcing the materials and manufacturing the tech can be disruptive to ecosystems and the organisms in it.

MEET OUR LOCAL SCIENCE HERO:

Richards Sears is one of the scientists that contributed to figuring out how climate change has impacted humpback whales. He is also the president and founder of the Mingan Island Cetacean Study (MICS), a non-profit organization dedicated to observing and learning about whales, which is located on the Quebec side of the Gulf of St. Lawrence. Richard answered some of our questions, as shared here.

Q: Do you have any advice for kids and youth that dream of becoming scientists in the future?

A: First, stay curious. Marvel in all aspects of life on this planet. Cherish this globe where life has come to be but is now increasingly threatened. Second, study hard and have fun. If one does not love this work, one will not do a good job. Lastly, enter college with an open mind. Be open to trying new things when you observe wildlife, look for any source of field experience, and go for graduate degrees if you think it will help you achieve your goal.

Q: What made you decide to study whales? Is there a reason, or a moment that comes to mind, that made you think "I want to study whales"?

A: It was when I saw my first blue whale. I was always curious about the sea and what was beneath its surface. I was twenty-four years old at the time, working at a field station in Quebec observing salmon. The director of the station allowed me to take an inflatable boat out into the ocean and observe whales as sightings were common near the station during summer. And there it was, my first blue whale!

Q: What is your favourite part about being a scientist?

A: My favourite part is discovering something new or unknown about the species that we study – observing how they use their habitat, how they disperse, their distribution and interactions in the GSL and the North Atlantic Ocean. I also just love the feeling of being on water, searching for whales, and recognizing individuals that we have photo-identified and observing their behaviour.

Climate Change
Past, Present, and Future

Earth is the only planet in the solar system known to support life. What makes our home so special? Earth has an atmosphere, a layer of gases between our planet and space. Some of these gases, like carbon dioxide, are called **greenhouse gases**. They are crucial parts of our atmosphere; they trap in the heat of the sun, similar to how heat is trapped in a greenhouse, or in a car on a hot day. This process, called the **greenhouse effect**, keeps Earth's temperature warm enough for living things to thrive.

The sun's rays hit our round, tilted planet unevenly. This uneven heating of Earth's surface leads to differences in temperature, which drives weather patterns. We call the patterns in temperature and weather over long periods of time **climate**. Different parts of the world have vastly different climates; it depends on how much heat they receive, as well as what landscape features are nearby. Water, mountains, ocean currents, and forests all impact our climate. In turn, living things around the world have adapted to the climate they live in.

Something, though, is changing. Over the past two hundred years, humans have been burning fossil fuels, such as coal and oil, to make energy to power our daily lives. Fossil fuels are made from decomposed plant matter and microscopic life millions of years old. This matter is full of carbon, and, burning it releases, or emits, billions of tonnes of **carbon dioxide** gas into the atmosphere every year. When too much carbon dioxide is emitted, the delicate balance of greenhouse gases maintaining

Earth's climate is upset. More and more heat is trapped, causing the planet to warm. Weather patterns change, water levels rise, storms get worse.

Climate has changed many times throughout Earth's history, from ice ages to periods much hotter than today. So why is this time any different? Scientists agree on two things. One, temperatures are rising faster than they ever have in documented climate history. Two, this climate change is driven by human activities, due primarily to greenhouse gas emissions.
Climate change is already impacting people's ways of life all over the world. Powerful storms, droughts, forest fires, and floods are threatening people's access to food, water, and safe homes.

The most important step we can take to prevent serious climate change is to reduce greenhouse gas emissions. Incredibly brave and caring people around the world are finding new ways to reduce emissions and make our communities climate resilient every single day. And you can join them! These Science Spotlights are here to help us learn more about climate change and how you can take action.

Our Commitment to the Decolonization of Science

Institutions of GenAction initiative respect and affirm the inherent and Treaty Rights of all Indigenous Peoples across what we now know as Canada. We give thanks to the Indigenous Peoples who care for this land since time immemorial and pay respect to their traditions and ways of knowing. We acknowledge their many contributions to innovations in Science, Technology, Engineering, and Mathematics, past and present, and are committed to deepening engagement and collaborating with Indigenous Peoples as partners in order to advance truth and reconciliation and the decolonization of science.

Climate Change: Past, Present, and Future is based on...Delmotte, Masson, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, et al. 2021. "Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change." Intergovernmental Panel on Climate Change. Cambridge University Press. In Press.