KATIE KISH & ERIC MILLER

Researching Canada's Ecological Footprint and Biocapacity

An initiative at York University is measuring how humanity's consumption of renewable resources has changed over the last 50 years – since the first Earth Day in 1970. Research out of York's Ecological Footprint Initiative (EFI) in the Faculty of Environmental and Urban Change, involves faculty, staff and students, to bridge the gap between government and the academy to create useful policy to change the way humans use the Earth's resources and the planet's capacity to provide them. The EFI is training the next generation on sustainability informatics and leading cutting edge research on National Footprint Accounting, provincial biocapacity accounting, assessing the footprint science, and understanding what demand exists for the footprint across Canada.

According to the Ecological Footprint, if everyone in the world lived like a Canadian, we would need 4.72 Earths to sustain us. This measurement comes from the Ecological Footprint and Biocapacity (EFB) databases which provide the most integrative metrics for measuring the demand and supply of carrying capacity. It is an accounting system of indicators that measure Earth's resources and biological production, and human demand on nature. Doing so produces an overall view of the biologically productive area (footprint size) necessary for humans at all scales - global, national, regional, and individual.

Ecological Footprint measures any population's demand for carrying capacity, in units that are comparable to any portion of the planet's supply of Biocapacity, which consists of the elements labelled in Figure 1.

Ecological Footprint and Biocapacity are measured in "global hectares" (gha) to allow for comparisons across the planet and over time. A local hectare anywhere on the planet can be equated with a global hectare using a system of conversion factors that account for its capacity relative to the global average. Biocapacity can be calculated for anything with a defined boundary such as activities, institutions, individuals, and populations of all global, national, or regional scales.

The framework is applied to real-world data, such as the work currently happening at the Footprint Initiative at York University. At York, we use many international data sources, predominantly from various statistical agencies at the United Nations and the International Energy Agency.

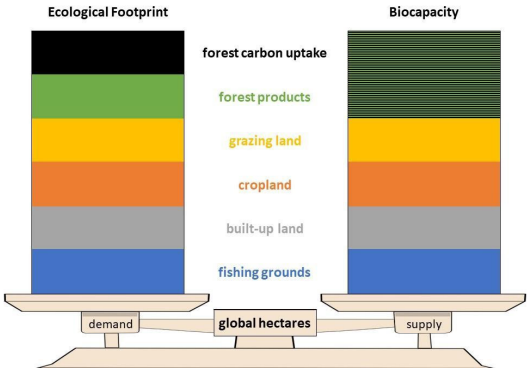

Figure 1: The elements that make-up the Earth's biocapacity

Applying this concept globally, we see in Figure 2 that humanity's Ecological Footprint in 2017 exceeded the supply of Biocapacity. This means that humanity's consumption in 2017 exceeded the planet's carrying capacity, resulting in the further accumulation of carbon emissions and ongoing pressures on biodiversity.

We can look at Canada's supply of, and demand for, carrying capacity in 2017 (Figure 3). Out of approximately 1000 hectares of lands and waters in Canada, about 750 million hectares can sustain one of the components of ecological footprint. These hectares provide the equivalent of 550 million global hectares of biocapacity. Canada's lands and waters

Research Digest

Coca-Cola, Pepsico & Nestle - The Most Polluting Companies Worldwide

On December 2nd, 2020, Break Free From Plastic (BFFP) released its third annual report, "Branded Vol III: Demanding Corporate Accountability for Plastic Pollution", revealing that Coca Cola, Pepsico and Nestle are the most polluting companies in the world, for the third time in a row(1).

BFFP is a global movement that was launched in 2016 and has been releasing reports since 2018, identifying the most polluting organizations around the world. They work with thousands of volunteers and non-governmental organizations on a global scale to count and document the brands on plastic waste found in different countries around the world. This year they found that the amount of plastic waste generated by Coca Cola was 13,834 pieces across 51 countries - more than the waste collected by Pepsico and Nestle combined.

The annual survey is conducted by 15,000 volunteers in 55 different countries, where they collected 346,494 pieces of plastic from their surrounding environment. BFFP states that these multinational organizations are pumping out so much single-use plastic that plastic production could be "doubled by 2030 and tripled by 2050". These staggering numbers will have an impact on human health, ecological systems, and of course, climate change.

If you're familiar with the topic of waste pollution, you're probably familiar with the Ellen Macarthur Foundation. 7 of the top 10 worst polluters - including Coca-Cola Company, Pepsico and Nestle - signed the Ellen MacArthur Foundation's New Plastics Economy Global Commitment in October 2018, which requires them to "eliminate all unnecessary plastic" while reusing or recycling plastics in a circular system, as well as create more sustainable substitutes for their packaging. However, the foundation reported that its signatories have only reduced use of virgin plastic by 0.1 percent from 2018 to 2019. Meanwhile, Coca-Cola increased the amount of plastic it uses. 2020 is looking like more of the same. The only way to stop this is to eliminate plastic production, phase out single-use plastics, and implement robust, standardized reuse systems.

tend to provide carrying capacity at less than the global average rate. Therefore the hectares are deflated to get global hectares.

Of this biocapacity, about 78% was needed to sustain the Ecological Footprint of economic activities within Canada in 2017. About 57% of this footprint was used to produce exports, which is disproportionately large considering that Canada exports about 30% of domestic production. In 2017,

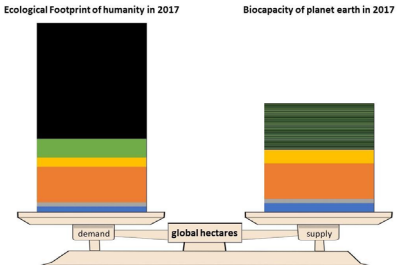

Figure 2: Canada's demand and supply of biocapacity in 2017

more than twice as much Biocapacity was used per dollar of Canadian exports than per dollar of Canadian imports; this difference was even larger in prior years. Canada effectively imports carrying capacity embedded within products and services produced in the rest of the world but consumed in Canada. When we take the EF of production and subtract the EF of exports and add the EF of imports, we arrive at Canada's ecological footprint of consumption (the final bar on the graph).

Having just explored the supply and demand of the EFB through a Social Science and Humanities Research Council grant, we are now looking towards the future, including a research agenda on the EFB and current key policy recommendations.

A Research Agenda

For the final stage of the research collection process, we spoke with key environmental stakeholders across Canada regarding how they currently use or would like to use the Ecological Footprint. The first area of interest from the stakeholders regards provincial biocapacity accounting to understand better what capacity exists, how natural space is used over time, and to decide on specific regions such as the greenbelt.

The second is regarding municipal decision-making. Most government members were at the municipal level, and they require better tools to engage with the day-to-day efforts happening at the local level. Most have declared a climate emergency, but now they need to know how their budgeting, infrastructure decision making, local manufacturing efforts, etc., can respond to that emergency. Given this, they have quite different data requirements than what we currently offer – they require disaggregated data to assist in these kinds of decisions. This exposes a very clear and long-term research agenda for the footprint.

Finally, even if stakeholders were unfamiliar with the biocapacity accounting system, all of them knew about the online individual footprint calculator (link to calculator). The calculator is used to determine an individual's footprint size or how many earths it would take to support their lifestyle. Stakeholders applauded this for educational initiatives. However,

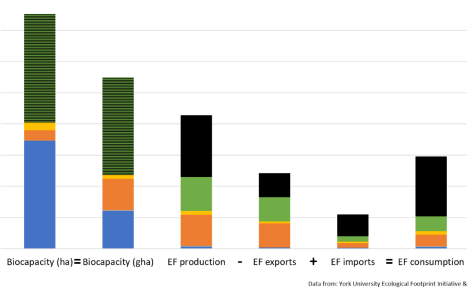

Figure 3

many asked if this leads to broader cultural change and questioned how it takes different regional cultures into account. This is another question for the future of the Footprint and Biocapacity.

Policy Recommendations

There is pan-Canadian interest in nature-based solutions to reduce climate change and to reverse the

decline in biodiversity. To succeed with nature-based solutions for climate and biodiversity, Canada needs:

An integrative area-based accounting of carrying capacity. After all, our success or failures will relate in large part to how we manage land use. The path to a carbon-neutral Canadian economy – and the same for the global economy - involves challenging trade-offs, such as using arable lands for afforestation to sequester carbon versus producing ethanol, versus food, versus settlements. These demands can add pressure upon scarce biodiversity.

Sub-nationally scalable measures that relate to trade flows to inform provinces tasked with managing most of Canada's lands and waters. Canada and its provinces and territories have a high degree of trade dependence with the rest of the world. Carrying capacity in Canada is embedded within all that we export and all that we import. As the rest of the world works to reduce emissions and conserve its biodiversity, there will be significant implications for Canada and the provinces and territories through trade linkages.

Impact (multiplier) metrics to reveal how economic sectors relate to carrying capacity, directly and indirectly through supply chains. Jobs and GDP are not sufficient metrics to inform economic policy in the 21st century - every dollar of stimulus that government contemplates should be informed about its impacts upon carrying capacity.

All of these are within reach using Ecological Footprint and Biocapacity accounts to measure and manage Canada's use of the Earth's regenerative carrying capacity.

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Research Digest

Human Ingenuity Strikes Again!

The day has come when humans are able to generate electricity from a source as accessible as gravity. The Scottish company, Gravitricity, has developed a novel technology that converts the energy from the raising and lowering of weights into electricity.

The process really is as simple as it sounds - dropping heavy weights down deep holes. Of course, the weights also have to be attached to special cables and winches that rotate as the weights move up and down thus harnessing the energy that is generated. The technology has proven to work well in decommissioned mine shafts and can also work alternatively by lowering the weights from tall towers.

Why use gravity to produce electricity in the first place? Using gravity is more sustainable than using large batteries, like lithium, since batteries require the extraction of specialty materials and gravity is just, well, constantly available and renewable. Once the weights reach the bottom of the mine shaft, they are raised back up, allowing power to be absorbed and recharged.

Using gravity has also proven to be the most flexible method of generating electricity, which makes it unique to its competing technologies and allows it to suit different energy uses. For example, it can be used to output energy at a slow rate over long periods of time or very quickly, producing short bursts of high energy.

Finally, it is estimated that using gravity will be the cheapest electrical option once it is commercialized since its main components simply require concrete weights and formerly-used mine shafts. Plus, one Gravitricity device can last up to 50 years with no degradation. If only Isaac Newton could see this!