



for a living planet



CANADIAN LIVING PLANET REPORT 2007



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WWF

(also known as World Wildlife Fund in the USA and Canada) is one of the world's largest and most experienced independent conservation organizations, with almost 5 million supporters and a global network active in over 100 countries. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.



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Founded in 1826, the Zoological Society of London (ZSL) is an international scientific, conservation, and educational organization. Its mission is to achieve and promote the worldwide conservation of animals and their habitats. ZSL runs London Zoo and Whipsnade Wild Animal Park, carries out scientific research in the Institute of Zoology, and is actively involved in field conservation worldwide.



GLOBAL FOOTPRINT NETWORK

promotes a sustainable economy by advancing the Ecological Footprint, a tool that makes sustainability measurable. Together with its partners, the Network coordinates research, develops methodological standards, and provides decision makers with robust resource accounts to help the human economy operate within the Earth's ecological limits.

EDITOR IN CHIEF

Shawn Mitchell¹

EDITORS

Audrey Peller³

LIVING PLANET INDEX

Louise McRae²

Jonathan Loh²

Ben Collen²

Sarah Holbrook²

Rajan Amin²

Julia Latham²

Sandra Tranquilli²

Jonathan E.M. Baillie²

ECOLOGICAL FOOTPRINT

Audrey Peller³

Steven Goldfinger³

Mathis Wackernagel³

Justin Kitzes³

Jonathan Loh²

Paul Wermer³

Robert Williams³

SCENARIOS

Mathis Wackernagel³

Justin Kitzes³

Steven Goldfinger³

Audrey Peller³

Jonathan Loh²

1. WWF-Canada

245 Eglinton Avenue East
Suite 410

Toronto, ON M4P 3J1, Canada
www.wwf.ca

2. INSTITUTE OF ZOOLOGY

Zoological Society of London
Regent's Park
London NW1 4RY, UK
www.zoo.cam.ac.uk/ioz

3. GLOBAL FOOTPRINT
NETWORK

312 Clay Street
Suite 300

Oakland, CA 94607, USA
www.footprintnetwork.org

INTRODUCTION

ECOLOGICALLY, WE'RE IN THE RED

At some point in our lives, we all learn how to manage our bank balance. We know that the total value of the cheques we write shouldn't add up to more than the balance in our account – because going into the red has some nasty consequences.

This *Living Planet Report* is built on a lot of hard scientific data. But at the end of the day, it's basically telling us that our planetary account is overdrawn.

Think of the planet and all the natural resources it contains as a chequing account (a joint account shared by several billion people). Every day we write cheques against the balance of our natural resources by doing things like turning on the air conditioner, driving a car, or building a house. This report crunches the numbers and shows that, given Earth's balance, we're writing way too many cheques.

The good news is that we have time and opportunity on our side. We can curb our ecologically irresponsible spending habits and give the planet the time it needs to rejuvenate. And given half a chance, the

planet will replenish most of the resources we've used up – which is a much better deal than we'll ever get from a traditional bank.

IT'S SIMPLE ACCOUNTING

This *Living Planet Report* is built around two measures. The *Living Planet Index* (Figure 1) measures the health of the planet's ecosystems. The *Ecological Footprint* (Figure 2) calculates how much of those ecosystems are needed to produce the resources we use and to absorb the waste we generate.

THE LIVING PLANET INDEX represents the balance in our planetary bank account. Our ECOLOGICAL FOOTPRINT represents the value of the cheques we are writing – how much of those resources are used in our daily activities.

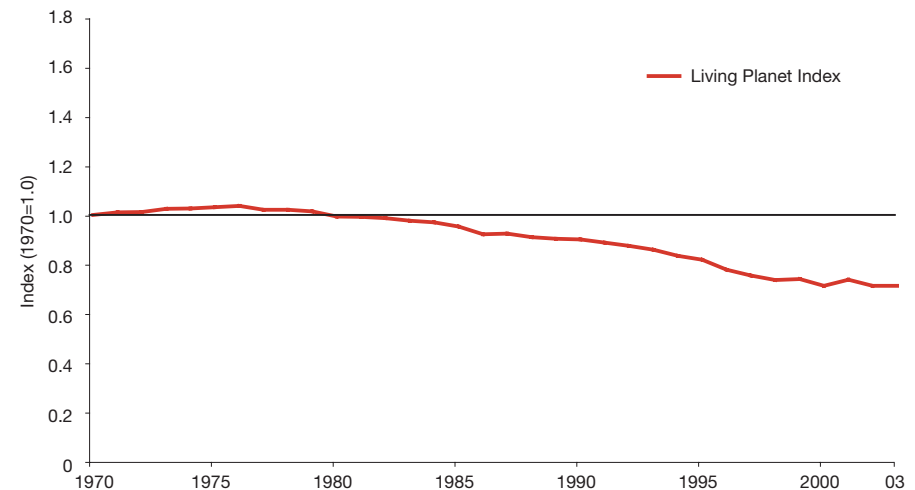
The bottom line is that, unless something changes, our average global Ecological Footprint will use up the resources of two whole Earths by 2050. And if everyone on the planet consumed resources the way Canadians do, we would need 4.3 Earths just to keep up (Figure 3).

Since we have only one Earth, it's clear that something has to give. This isn't rocket science; it's simple accounting.



Everyday activities that depend on the Earth's resources are like cheques written against the planet's ecological bank account.

Fig. 1: GLOBAL LIVING PLANET INDEX, 1970–2003



INTRODUCTION

LIVING WITHIN OUR PLANETARY MEANS

We are writing cheques our planet can't cash. On a global scale we're already seeing the consequences: climate change and extreme weather, the collapse of fisheries around the world, shrinking supplies of clean water, and the destruction of natural habitats.

To turn around these negative trends, we need to take stock. Where we are today? Where we are heading? What can we do to make sure that the natural resources we need will be there for us in the future?

After all, our quality of life – and our survival as a species – ultimately depends on living within our ecological means.

Achieving sustainability means using resources at a rate that can be maintained over the long term, rather than using them up. Think of it as living off the interest on our global bank account instead of spending the principal.

CANADA CAN LEAD THE WAY FORWARD

Canada can help lead the world toward more sustainable lifestyles and economies. But we have a ways to go. Currently, Canada enjoys an incredible wealth of ecological and natural resources, yet we also have one of the highest levels of resource consumption per capita in the world.

If our country is going to become an environmental and economic leader, we need accurate information about the state of our environment and the demands

we're putting on it. We also need to understand how this information relates to the health of the planet as a whole. This is exactly the kind of information that this *Living Planet Report* provides.



More extreme weather is just one of the consequences of living beyond our ecological means.

Fig. 2: HUMANITY'S ECOLOGICAL FOOTPRINT, 1961–2003

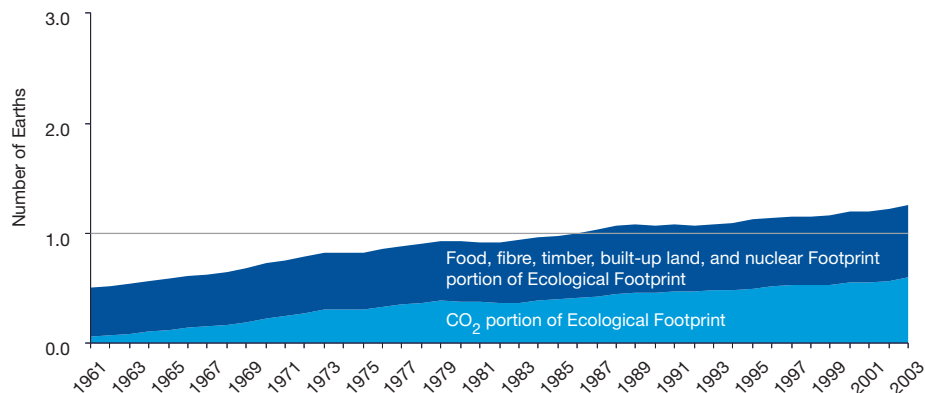
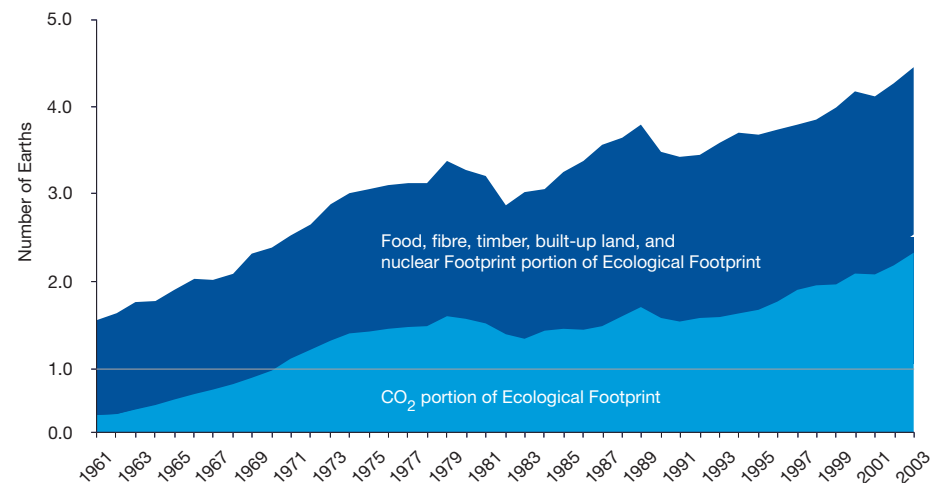


Fig. 3: NUMBER OF EARTHS IF THE WORLD CONSUMED AT CANADIAN LEVEL, 1961–2003



INTRODUCTION

MEASURING THE HEALTH OF OUR PLANET

Biodiversity is the sum of life on this planet – all the species and all the different habitats they depend on.

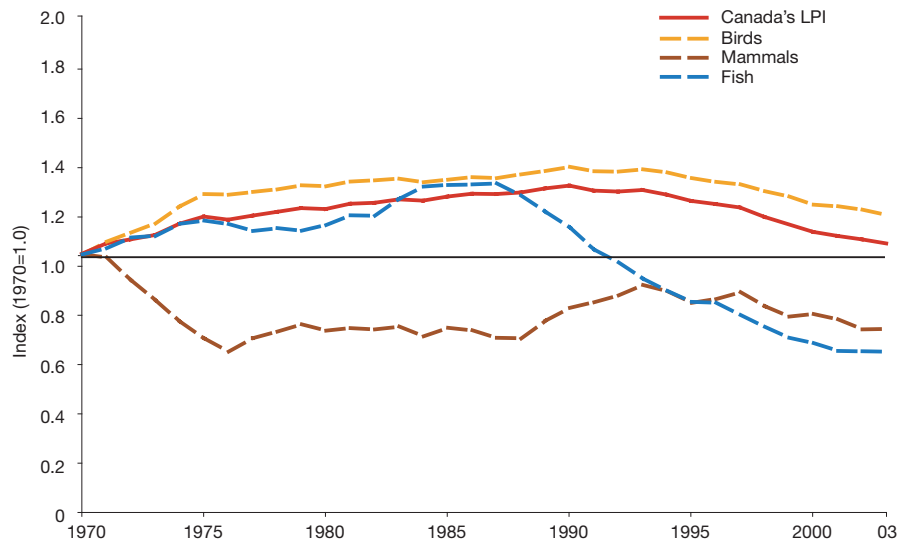
The Living Planet Index (LPI) measures trends in the Earth's biodiversity. It tracks population trends for more than 1,300 vertebrate species – fish, amphibians, reptiles, birds, and mammals – around the world. Healthy populations reflect healthy

ecosystems, which in turn reflect a healthy balance between nature and human consumption.

A STAGGERING DECLINE

Between 1970 and 2003, the global LPI fell by about 30 percent (Figure 1). This staggering decline suggests that the balance between nature and human consumption is dangerously unstable.

Fig. 4: CANADA'S LIVING PLANET INDEX, 1970–2003



Because collecting and analyzing data can take several years, the most recent ecological statistics available are from 2003. This is similar to Statistics Canada reports, which are based on the most recent census data, collected every five years.

The picture in Canada is not much rosier. To create the Canadian LPI, we looked at 1,057 population trends from 393 vertebrate species that live here (Figure 4). Between 1970 and 1989, these populations increased slowly, thanks in part to effective conservation, and then held relatively steady until 1994.

But between 1995 and 2003 they decreased sharply – by almost 25 percent. This is a sign that threats like habitat loss and invasive species are stopping some species from recovering and causing others to decline.

The pages that follow provide a closer look at Canada's biodiversity and some of the key trends that emerge from the Canadian LPI.



Healthy ecosystems can support lots of life.

CANADA'S LIVING PLANET INDEX

EVALUATING THE STATE OF CANADA'S NATURE

Evaluating the state of nature in Canada is complicated because we're a big country with a lot of biodiversity. The good news is that we've made significant conservation gains over the past thirty years. However, as we move forward, the need for conservation has never been greater.

ON LAND: MAMMALS IN TROUBLE

Overall, the trends for terrestrial species have stayed fairly steady between 1970 and 2003 (Figure 5). However, Figure 5 also shows that mammal populations dropped by 40 percent during this period.

That's worrying, especially because a third of terrestrial mammal species in Canada were already in decline before 1970.

On the other hand, bird populations as a whole have not fared quite so badly. This indicates that they're generally coping well and have benefited from conservation efforts. But while the general trend is better than the trend for mammals, certain species such as grassland birds have declined (Figure 6).

One of the main problems facing terrestrial species is the loss of habitat. For example, most large mammals such as lynx don't have the big protected areas they need to survive.¹ Meanwhile, grassland birds are suffering as the prairies they depend on disappear.

Fig. 5: CANADA'S TERRESTRIAL LIVING PLANET INDEX, 1970-2003

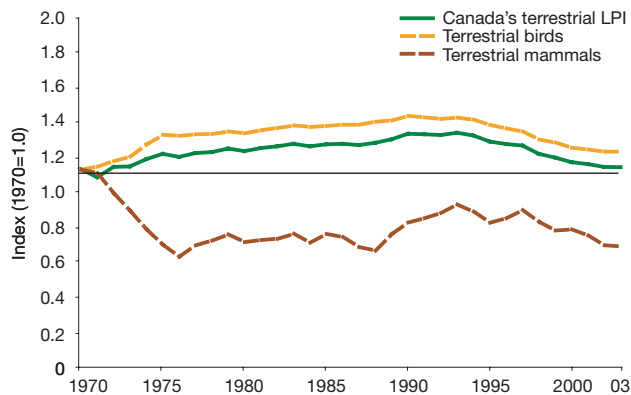


Fig. 6: LPI OF CANADA'S GRASSLAND NESTING BIRDS, 1970-2003

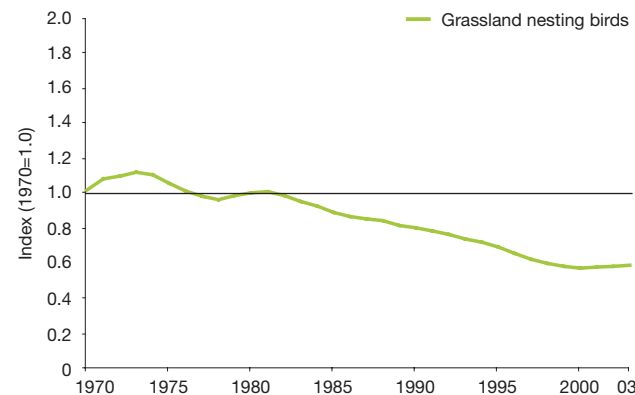
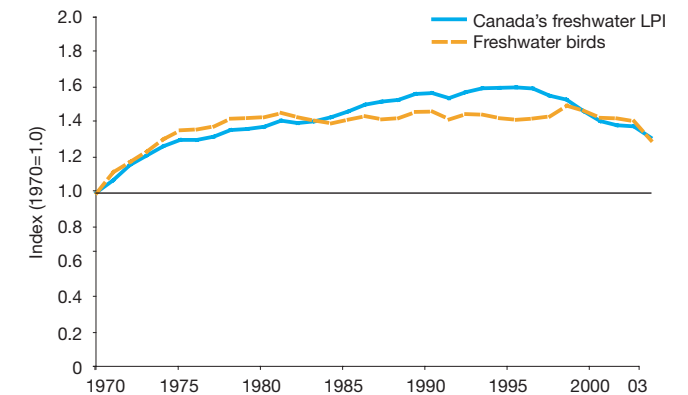


Fig. 7: CANADA'S FRESHWATER LIVING PLANET INDEX, 1970-2003



CANADA'S LIVING PLANET INDEX

LAKES AND RIVERS: SPECIES IN DECLINE

Canada has about 20 percent of the world's freshwater supply, so protecting our lakes, rivers, and wetlands is important both nationally and globally. This index shows that while population numbers for freshwater species generally increased until 1995, they dropped between 1996 and 2003 (Figure 7).

This recent trend reflects declines in fish, reptiles, amphibians, and some birds (Figure 8) – again, mainly due to a loss of habitat.

OCEANS: OVER-FISHING

The marine story is similar. Ocean populations generally increased from 1970 to 1988, thanks to the recoveries of certain marine mammals and birds. But between 1988 and 1998, over-fishing contributed to a significant decline in marine populations and a catastrophic 40 percent drop in fish stocks (Figure 9). Clearly our oceans deserve better.



Without the big areas of wilderness they need to survive, most large mammals are in decline.

Fig. 8: LPI OF DECLINING FRESHWATER BIRD SPECIES IN CANADA, 1970–2003

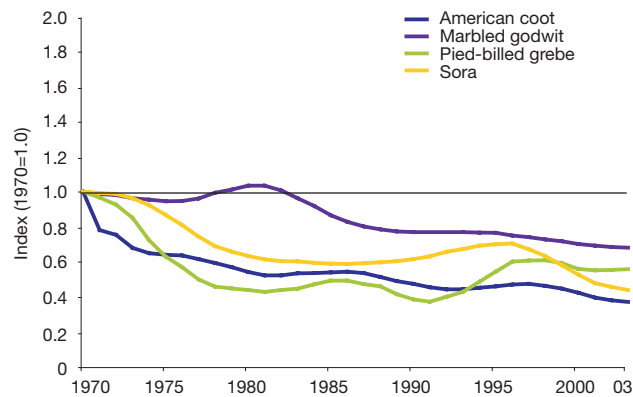


Fig. 9: CANADA'S MARINE LIVING PLANET INDEX, 1970–2003

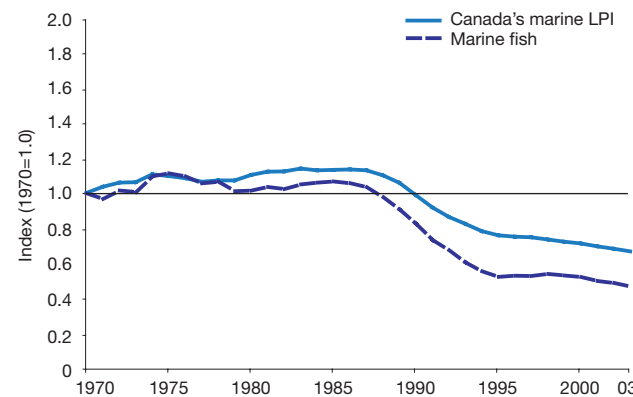
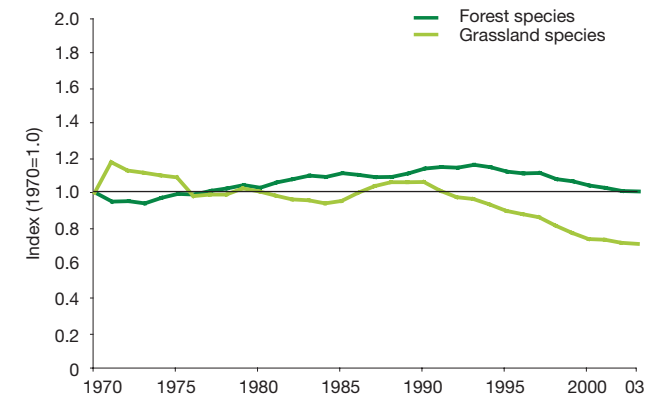


Fig. 10: LPI OF CANADA'S FOREST AND GRASSLANDS SPECIES, 1970–2003



CANADA'S LIVING PLANET INDEX

MIXED EFFORTS, MIXED RESULTS

The mix of positive and negative trends revealed by Canada's Living Planet Index between 1970 and 2003 may reflect our inconsistent approach to conservation. For instance, the number of hectares of protected areas in Canada (mostly in the form of parks) nearly doubled between 1980 and 2000, adding up to just over eight per cent of the total area of the country.

That's certainly impressive. But at the same time, Canada's protection of freshwater and marine habitat was less than one per cent of the total area of the country. This helps to explain why the state of biodiversity in Canada is neither all good, nor all bad.

PRAIRIES AND FRESHWATER UNDER PRESSURE

Figure 10 is a good example. While forest-dwelling species have held fairly steady, grassland species decreased. It's no coincidence that Canada's boreal and taiga forests remain relatively intact due to their remoteness, helping to sustain

forest species. Meanwhile, there has been more and more urban development and agricultural activity on the prairies, contributing to a 43% decline in grassland species.

Healthy freshwater ecosystems are also crucial for the survival of resident and migrant birds (as well as many other species, including humans). If these birds are in trouble, it's usually a sign that we're in trouble too. And between 1970 and 2003, four of these species declined by 30 to 65 percent – probably a result of degraded natural habitat (Figure 8).

OCEANS HIT THE WORST

But it is our oceans that have suffered the worst of all. Figure 11 shows the persistent decline in Canada's Atlantic cod stocks, which began in 1970 and got worse throughout the 1980s. Despite the fact that most cod fishing was banned in 1992, this species has not yet recovered.

Other species of groundfish are also showing signs that all is not well in our oceans. For example, pollock and American plaice have declined more than 50 percent since 1970. If we don't take drastic measures to reverse this trend,

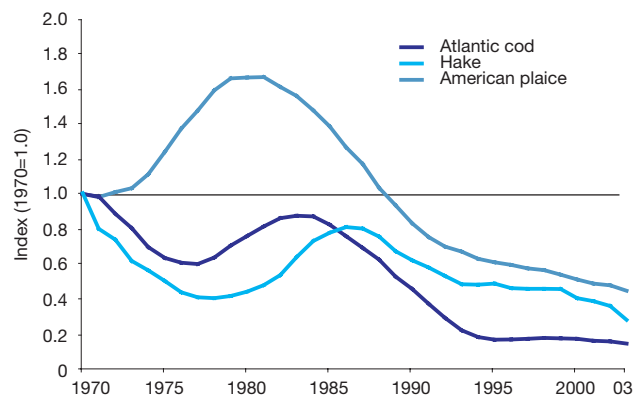
they are in real danger of meeting the same fate as the cod – or worse.

THE BOTTOM LINE

Many countries in Europe would love to be in Canada's position – to still have a chance to protect, manage and restore their rich natural heritage. But these nations lost their ability to save threatened species and habitats decades ago.

The same could happen to us. If we aren't careful, uncontrolled economic growth will jeopardize the conservation gains we've made and could stymie other opportunities to protect and restore our vital ecological resources.

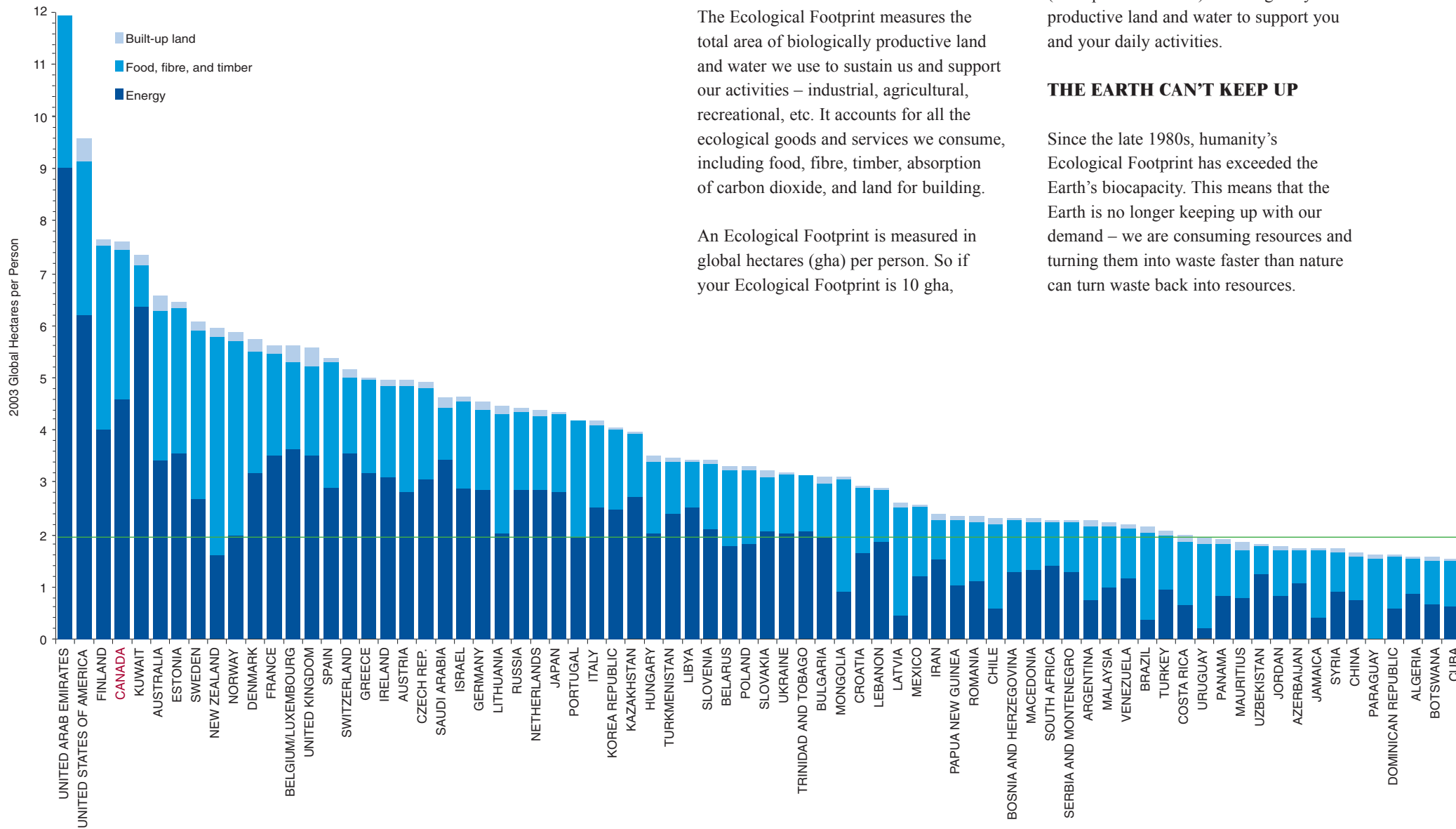
Fig. 11: **THREE LPis FOR GROUND FISH IN CANADA'S ATLANTIC WATERS, 1970–2003**



While Canada has created many protected areas on land, we have a poor track record of protecting our lakes, rivers, and oceans.

CANADA'S ECOLOGICAL FOOTPRINT

Fig. 12: ECOLOGICAL FOOTPRINT PER PERSON, BY COUNTRY, 2003



MEASURING OUR IMPACT

The Ecological Footprint measures the total area of biologically productive land and water we use to sustain us and support our activities – industrial, agricultural, recreational, etc. It accounts for all the ecological goods and services we consume, including food, fibre, timber, absorption of carbon dioxide, and land for building.

An Ecological Footprint is measured in global hectares (gha) per person. So if your Ecological Footprint is 10 gha,

for example, it takes ten global hectares (0.1 square kilometre) of biologically productive land and water to support you and your daily activities.

THE EARTH CAN'T KEEP UP

Since the late 1980s, humanity's Ecological Footprint has exceeded the Earth's biocapacity. This means that the Earth is no longer keeping up with our demand – we are consuming resources and turning them into waste faster than nature can turn waste back into resources.

All species, including humans, use the biologically productive areas of the planet for the goods and services they provide – things like food and waste absorption. BIOCAPACITY is the ability of ecosystems to provide these goods and services. Like Ecological Footprints, it is measured in global hectares (gha). In total, Earth has 11.2 billion gha of biocapacity.

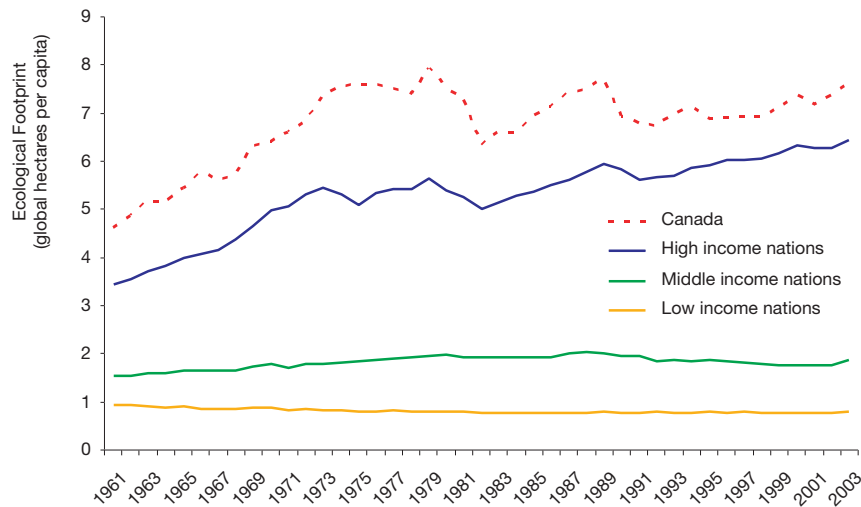
In 2003, our demand for ecological resources was 25 percent higher than the Earth's ability to generate them (Figure 2).

If we continue to write ecological cheques we can't cash, our ecosystems will become weaker and many plants and animals will disappear. Ultimately, we risk losing the very biological productivity that we depend on as a species.

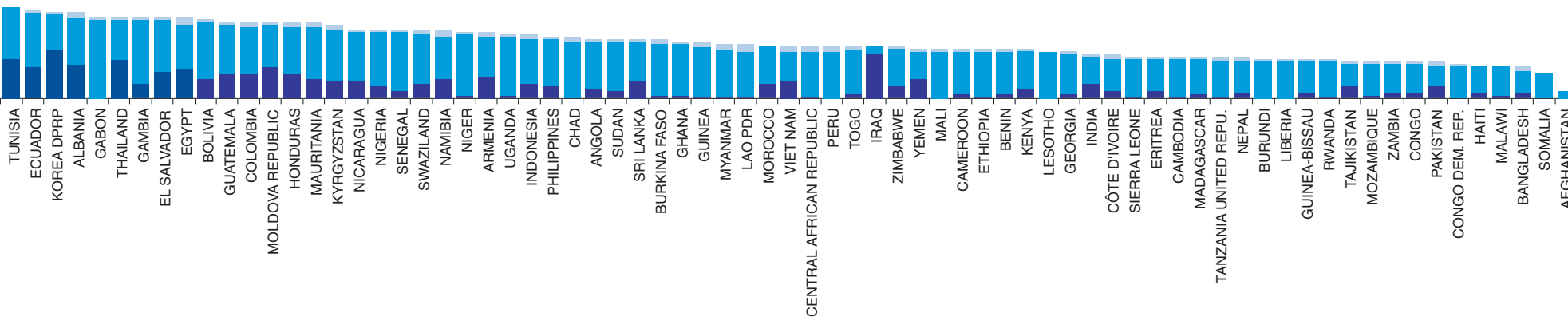
AN ECOLOGICALLY EXPENSIVE LIFESTYLE

As Canadians, we have the fourth highest Ecological Footprint per person in the world (Figure 12) – more than ten times higher than that of low-income countries like Bangladesh (Figure 13). This means we have some work to do if we want to reverse these negative trends in Canada and become a world leader in balancing our ecological chequing account. Think of it as fiscal conservatism for the environment.

Fig. 13: **ECOLOGICAL FOOTPRINT OF CANADA AND HIGH, MIDDLE, AND LOW INCOME NATIONS**



2003 world average biocapacity per person: 1.8 global hectares, ignoring the needs of wild species



CANADA'S ECOLOGICAL FOOTPRINT

CANADA'S FOOTPRINT: 3.5 TIMES THE GLOBAL AVERAGE

From 1961 to 2003, the average Canadian's Footprint grew from 4.6 to 7.6 global hectares per person (Figure 14). That's approximately 3.5 times greater than the 2003 global average (2.2 gha). Even more importantly, it's 4.3 times greater than the amount of biocapacity that the Earth can provide for each person (1.8 gha).

ENERGY CONSUMPTION IS A KEY DRIVER

So what makes Canada's Footprint so big? Mainly our insatiable appetite for oil and gas. Figure 14 shows Canada's per capita Footprint broken down by components – and the largest contributor is energy consumption. Currently, we have the fourth highest per capita carbon Footprint of any country, thanks to our fossil fuel consumption.

Fossil Fuel and Carbon Footprints

Burning fossil fuels like oil and natural gas releases carbon dioxide, one of the planet-warming gases that are causing climate change. A carbon Footprint measures the biocapacity required to absorb the carbon dioxide that is released by burning fossil fuels.

Indeed, the carbon component of our Footprint grew from about 17 percent in 1961 to more than 50 percent in 2003. This reflects carbon dioxide emissions from fossil fuels we burn for transportation, electricity, household heat and hot water, and industrial activities serving Canadian consumers.

Fig. 14: CANADA'S ECOLOGICAL FOOTPRINT BY COMPONENT, 1961–2003

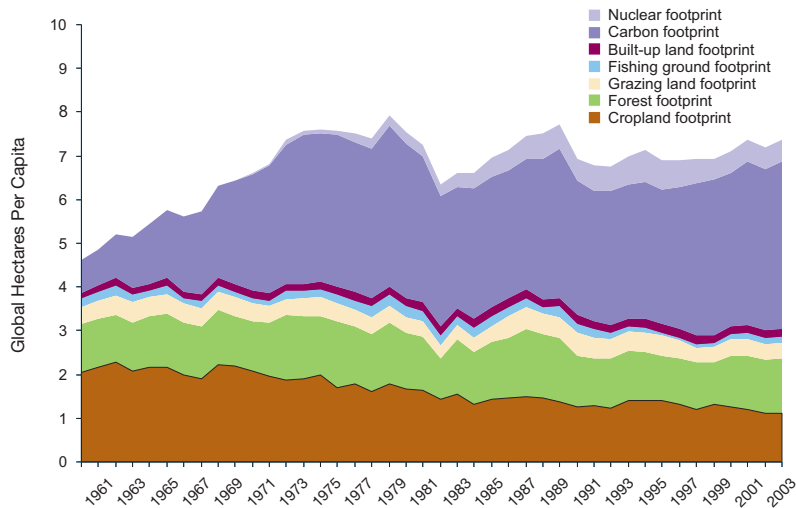
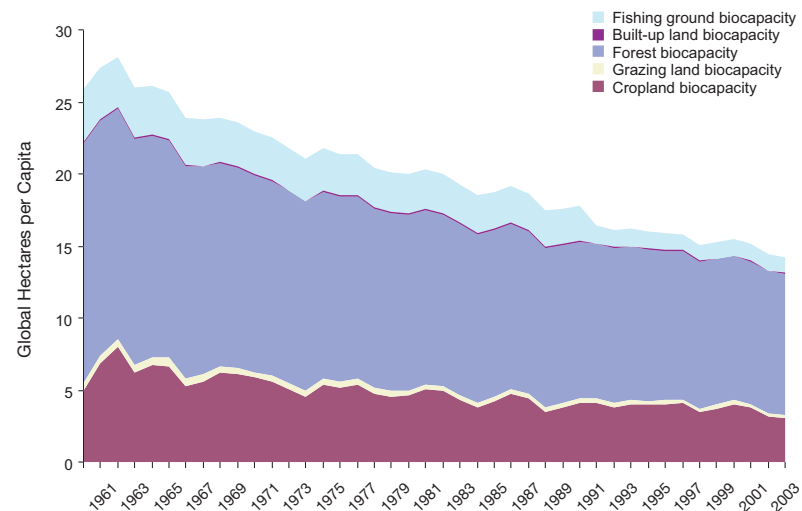


Fig. 15: CANADA'S BIOCAPACITY BY COMPONENT, 1961–2003



CANADA'S ECOLOGICAL FOOTPRINT

A GROWING POPULATION

For the time being, Canada's biocapacity remains larger than our oversized Footprint, mostly due to our vast forest area (Figure 15). However, this does not mean that our natural environment can support more consumption. As Canada's population increases, our biocapacity will have to be shared among more people – which means our per capita biocapacity is shrinking (Figure 16).

It's also important to recognize that Canada's biocapacity isn't just being used up here at home. Because we export things like food and natural resources around the world, Canada's biocapacity is also affected by external factors.

TIME TO GET A GRIP

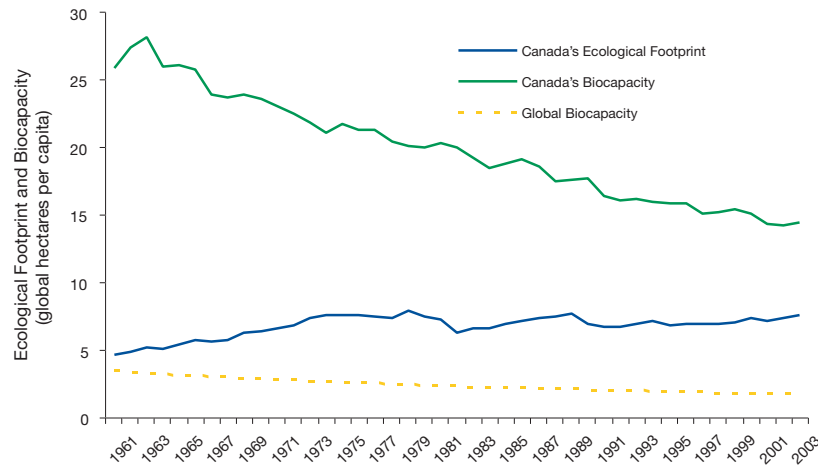
Unless something changes, our Footprint will continue to grow and we'll become more and more dependent on fewer and fewer ecological resources.

The bottom line is that we don't need to consume as much as we do to maintain our excellent standard of living. We just need to get a grip on the situation.



As Canada's population grows, we'll have to share our ecological wealth among more people.

Fig. 16: **ECOLOGICAL FOOTPRINT AND BIOCAPACITY TRENDS**



OVERSHOOT

ENDING OVERSHOOT

In 2003, the average biocapacity available per person on Earth was 1.8 gha. However, the average Ecological Footprint per person was 2.2 global hectares. That means humans used 25 percent more biocapacity than the Earth could sustain. Biologists call this *overshoot* (Figure 17).

Unfortunately, the overshoot is going to get worse. If we remain on our current course, by 2050 humanity will be using ecological resources at twice the rate that Earth can generate them (Figure 18).ⁱⁱ The planet simply won't be able to handle this kind of overshoot.

THE TIME TO ACT

We don't have to go down this path. We don't have to stand by while ecosystems buckle under the weight of over-consumption. And we don't have to suffer the dramatic decline in quality of life that inevitably comes with ecological collapse. It's in our power to eliminate overshoot.

To do this, we need to close the gap between humanity's Ecological Footprint and the planet's biocapacity. There are basically two ways to tackle this problem. We can increase the Earth's biocapacity, or we can reduce the average Ecological Footprint.

Fig. 17: FOOTPRINT AND BIOCAPACITY FACTORS THAT DETERMINE OVERSHOOT

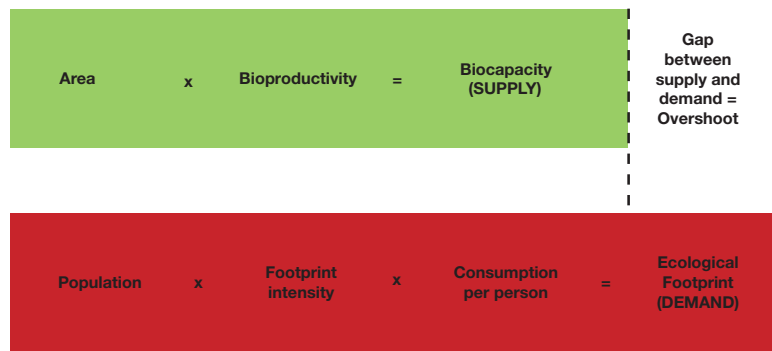
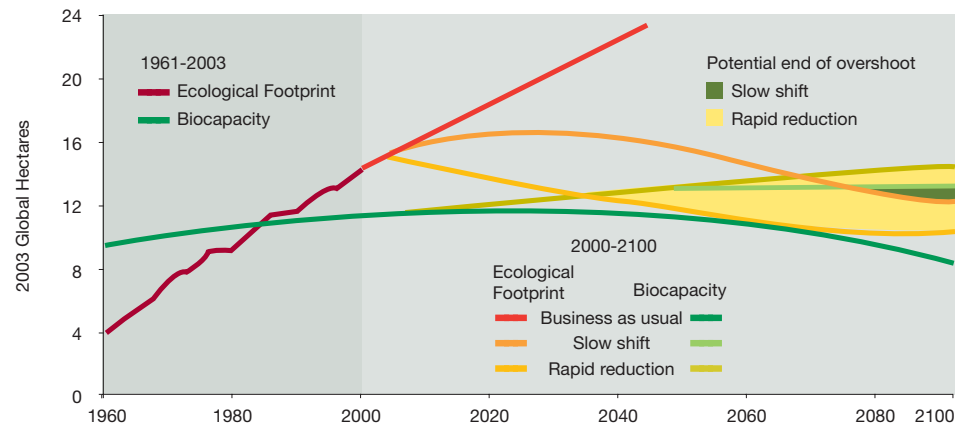


Fig. 18: BIOCAPACITY AND ECOLOGICAL FOOTPRINT SCENARIOS, 1961–2100



OVERSHOOT

Increasing biocapacity means squeezing more productivity out of the Earth. That only makes sense if we can do it without investing more ecological resources than we actually get in return – a difficult task. Traditionally, boosting productivity has been ecologically expensive. We've used fossil fuels to create fertilizers and run farm machinery, or we've planted vast fields of a single crop, hurting biodiversity.

While boosting our biocapacity would be nice, shrinking humanity's global Ecological Footprint is a must. To do that, we need to reduce at least one of three key factors:

- 1) Population size
- 2) The amount of resources each person consumes
- 3) The average resource intensity of goods and services consumed

SETTING A NEW COURSE

Figure 18 shows two alternatives to business-as-usual for the planet. One path shows a slow shift from our current course. In this case, overshoot is eliminated toward the end of the century, at which point we begin reserving a modest amount of biocapacity for the use of wild species.

The other path takes us more quickly to sustainability, eliminating overshoot by mid-century and leaving even more biocapacity to support wild species.

In both scenarios, we keep adding to our ecological debt as we run smaller and smaller ecological deficits until we begin running surpluses and, eventually, eliminate overshoot. The larger the ecological debt we accumulate, the greater the risk of permanent damage to the Earth. Of course, this risk must be weighed against the potential economic and social costs of each path.

Any strategy to eliminate overshoot involves difficult choices. How much should our Footprint shrink? When can we achieve those reductions? And how will we share these reductions among individuals, nations, or regions? These types of political discussions are not easy, but they are necessary if we hope to build a sustainable future.



By reducing our Footprint, we'll be making sure that future generations can enjoy a good quality of life.

ACHIEVING SUSTAINABILITY

THE WRONG KIND OF LEADERSHIP

Canada is incredibly fortunate. We live in an economically and ecologically wealthy country with a higher standard of living than most other nations. However, that standard of living contributes to an Ecological Footprint that is significantly higher than the global average – 3.5 times the global average, in fact, and the fourth highest in the world (Figure 12).

HAVING A GLOBAL IMPACT

Because we use ecological resources and services from all over the world, our Canadian Footprint affects ecosystems across the planet.

From 1992 to 2003, the average per capita Footprint in low- and middle-income countries changed little. During that same period, however, the average per capita Footprint in Canada increased 13 percent (Figure 13). This suggests that wealthy nations like ours must accept the bulk of the responsibility for overdrawing the world's ecological chequing account.

BALANCING OUR FOOTPRINT WITH QUALITY OF LIFE

To achieve global sustainability, we need to strike the right balance between our standard of living and our Ecological Footprint.

A good standard of living scores 0.8 or higher on the United Nations Development Programme's Human Development Index (HDI). This widely used measure looks at life expectancy, literacy, education, and per capita GDP. At the same time, living within the carrying capacity of the planet means that the average person's Footprint must be less than 1.8 gha, given today's global population.

While Canada has one of the highest HDIs in the world, it also has one of the largest per capita Footprints. Clearly, the planet doesn't have enough biocapacity to support our current lifestyle on a global scale. But a high standard of living doesn't have to depend on a high per capita Footprint. For example, the Netherlands has an HDI score that's similar to Canada but a per capita Footprint roughly half the size of ours.

SUSTAINABILITY IS ACHIEVABLE

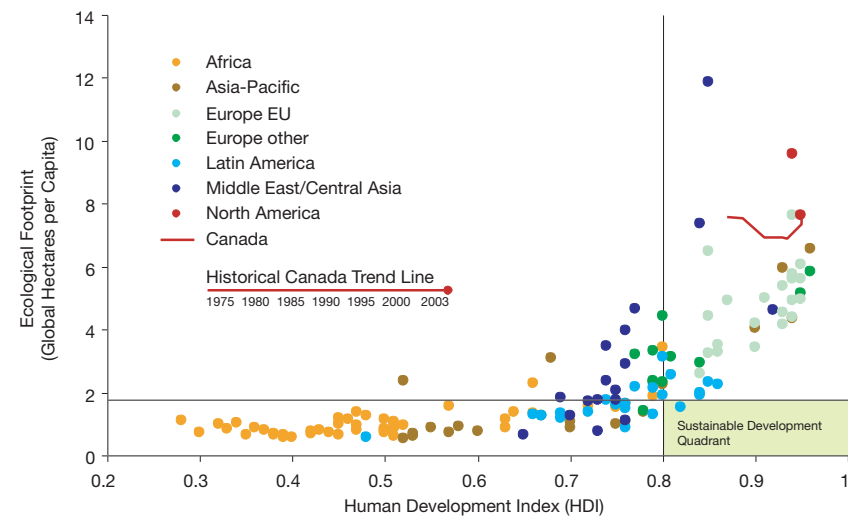
Figure 19 shows how countries around the world score on these two minimum criteria for sustainability. HDI is on the horizontal axis, while Footprint on the vertical axis. Successful countries fall in the green quadrant of the graph, meeting both criteria.

All North American and European Union countries met the HDI threshold for high human development in 2003. However,

they also far exceeded the Footprint cut-off for sustainable development. Meanwhile Asia-Pacific and African countries on average have Footprints that are less than 1.8 gha per person, but few of them met the HDI threshold for high human development.

In fact, as of 2003, Cuba was the only country in the world to meet both standards, the minimum criteria for sustainability. While sustainability is achievable, humanity as a whole has failed to achieve it.

Fig. 19: HUMAN DEVELOPMENT AND ECOLOGICAL FOOTPRINTS, 2003



WHAT CANADA CAN DO

Increasingly, Canada seems to be strong in sustainability theory, but weak in practice. It's true that some Canadian governments, businesses and individuals have shown innovation and leadership on this front. But given the data presented in this report, it's clear that as a nation we have to do more. We have to do it faster. And we have to do it together.

WE NEED VISION AND COMMITMENT

In the past, Canada has shown progressive vision on a variety of public policy issues. Now we must embrace bold policies on sustainable development – policies that translate into real action. Policies that get real results. We can turn this situation around – but we don't have much time.

Just as young drivers are taught to avoid collisions by looking down the road as they drive, Canadians must look to the future when making decisions about the environment. We can't just think about next month, next year, or next election. We have to reflect on the long-term consequences of the choices we make.

It's not necessarily about avoiding ecological collapse. It's about protecting global health, ensuring global prosperity, and securing a better future for our friends and family.

CUT THE EARTH SOME SLACK

In the long run, Canadians cannot have clean air, clean water, a healthy economy, large natural spaces for recreation – and one of the highest rates of resource consumption in the world. The trends are clear: as consumption goes up, the state of nature goes down, including fundamental standards that we take for granted, such as clean air and water.

In the 1950s, commercial fishing technology peaked around the world. No one imagined we could exhaust the ocean's supply of fish – least of all cod fishers. But in the 50 years that followed, many commercial fish stocks were fished out, and the most dramatic decline occurred right off of Canada's own Grand Banks. The cod fishery collapsed and many maritime communities followed suit.

The point isn't just that too much consumption was responsible for bringing a species like cod to the brink of extinction. The point is also that individual livelihoods and entire regional economies were essentially wiped out as a result.

The fact is that we depend on Earth's natural resources, not just for the amazingly diverse lifestyles that we enjoy, but for the stuff of *life* itself. It's time we cut our Earth some slack.

CREATING REAL CHANGE

We must look at sustainability as a serious challenge. But we must also look at it as a tremendous opportunity for Canada, along with other forward-thinking nations, to show true leadership and create real change.

Canadians can do just that in the following key areas:

Climate change – We must follow through on our commitment to the Kyoto Protocol, significantly reducing greenhouse gas emissions up to and beyond 2012.

Green energy – We must reduce our average carbon Footprint by consuming less oil and gas and investing more in the development of renewable and alternative energy sources.

Conservation – Canada is already a world leader in sustainable forestry, with the most hectares of commercial forests certified by the Forestry Stewardship Council (FSC). Now we must apply the Marine Stewardship Council (MSC) standard to Canadian fisheries.

Green infrastructure – We must develop resource-efficient infrastructure and transportation systems that are oriented toward public transit to significantly reduce Canada's average Footprint, while making our urban centres healthier and more "liveable."

Environmental assessment – We need to start accounting better for the impact that industry has on species and wild spaces. That means engaging in more stringent conservation planning and environmental assessments before major development projects happen.

WHAT CANADA CAN DO

Embrace the aims and principles of One Planet Living (OPL) – We must consider what it means to minimize our collective footprint on the planet. The concept of OPL addresses everyday concerns about our homes, clothes, food, health, education, recreation, transportation, and energy consumption. It aims for:

- Zero carbon
- Zero waste
- Sustainable transportation
- Sustainable materials
- Local and sustainable food
- Sustainable water
- Natural habitats and wildlife
- Culture and heritage
- Equity and fair trade
- Health and happiness



Canada needs to get on board with more sustainable transportation.



The more local our diet, the less energy it takes to put food on our plates.



Recycling programs can help us conserve natural resources and achieve zero waste.



Switching to greener energy sources will shrink our carbon Footprint.

TECHNICAL NOTES

LIVING PLANET INDEX

Data Collection

The species population data used to calculate the index are gathered from a variety of sources published in scientific journals, in NGO literature, or on the worldwide web. Data used in constructing the index are a time series of either population size or a proxy of population size.

All population time series have at least two data points and are collected by methods that are comparable across years, so that it is possible to determine a trend. A population estimate taken at one point in time is not used with a second estimate from another survey of the same population at another point in time, unless it was clear that the second was meant to be comparable with the first.

Plants and invertebrates were excluded, as few population time series data were available. It is assumed, therefore, that trends in vertebrate populations are indicative of overall trends in biodiversity.

Calculation of the Indices

Index values were calculated using generalized additive modelling as implemented in Buckland et al. (2005)ⁱⁱⁱ (Table 1), and confidence limits around index values were generated using a bootstrap resampling technique as implemented in Loh et al. (2005)^{iv} (Table 2).

The global LPI is aggregated by system – terrestrial, freshwater, and marine – each carrying equal weight. However, as the Canada dataset is much smaller, it was deemed inappropriate to aggregate the index for Canada in the same way (Figure 20).

Table 1: NUMBER OF SPECIES CONTRIBUTING TO THE TERRESTRIAL, FRESHWATER, AND MARINE INDICES WITHIN EACH VERTEBRATE CLASS

	Terrestrial	Freshwater	Marine	Total
Fish		25	31	56
Reptiles and Amphibians	5	20		25
Birds	196	52	7	255
Mammals	44	2	11	57
Total	245	99	49	393

Table 2: LPI WITH 95% CONFIDENCE INTERVALS

INDEX	Number of species	Percentage Change 1970–2003	95% Confidence Intervals	
			Lower	Upper
Global LPI	1313	-29%	-40%	-16%
Canada's LPI	393	5%	-33%	65%
Bird	255	17%	-28%	91%
Mammal	57	-28%	-91%	441%
Fish	56	-38%	-83%	120%
Terrestrial	245	3%	-39%	74%
Bird	196	11%	-35%	89%
Mammal	44	-37%	-96%	787%
Freshwater	99	47%	-54%	363%
Bird	52	48%	-60%	454%
Marine	49	-36%	-79%	106%
Fish	31	-54%	-90%	111%
Forest	187	2%	-44%	81%
Grassland	75	-23%	-75%	131%
Grassland nesting birds	16	-41%	-93%	457%
American coot	1	-66%	-63%	-65%
Marbled godwit	1	-34%	-32%	-32%
Pied-billed grebe	1	-37%	-35%	-35%
Sora	1	-57%	-59%	-59%
Atlantic cod	1	-86%	-88%	-88%
Hake	2	-72%	-93%	35%
American plaice	1	-55%	-143%	-6%

Fig. 20: HIERARCHY OF INDICES WITHIN THE LIVING PLANET INDEX

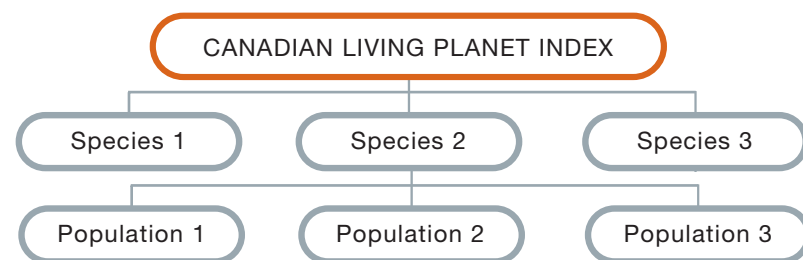


Figure 20: Hierarchy of indices within the Living Planet Index. Each population carries equal weight within each species; each species carries equal within the overall Canadian LPI.

TECHNICAL NOTES

Table 2 shows the number of species contributing to Canada’s LPI from a total number of 1,057 vertebrate populations. Bird species clearly dominate the dataset and so are largely responsible for the trends observed. However, their overall population trends are not always typical of other species. Where other reliable indices have been produced, these have been displayed on the appropriate figures to allow an insight into the hidden trends.

ECOLOGICAL FOOTPRINT

How is the Ecological Footprint calculated?

The Ecological Footprint measures the amount of biologically productive land and water area required to produce the resources an individual, population, or activity consumes and to absorb the waste they generate, given prevailing technology and resource management. This area is

expressed in global hectares, hectares with world-average biological productivity. Footprint calculations use yield factors (Table 3) to take into account national differences in biological productivity (e.g., tonnes of wheat per UK hectare versus per Argentina hectare) and equivalence factors (Table 4) to take into account differences in world average productivity among land types (e.g., world average forest versus world average cropland). Footprint and biocapacity results for nations are calculated annually by Global Footprint Network. The continuing methodological development of these National Footprint Accounts is overseen by a formal review committee (www.footprintstandards.org/committees). A detailed methods paper and copies of sample calculation sheets can be obtained at no charge: see www.footprintnetwork.org.

What is included in the Ecological Footprint? What is excluded?

To avoid exaggerating human demand on nature, the Ecological Footprint includes only those aspects of resource consumption and waste production for which the Earth has regenerative capacity and where data exist that allow this demand to be expressed in terms of productive area.

For example, freshwater withdrawal is not included in the Footprint, although the energy used to pump or treat it is. Ecological Footprint accounts provide snapshots of past resource demand and availability. They do not predict the future. Thus, while the Footprint does not estimate future losses caused by present degradation of ecosystems, if persistent this degradation will likely be reflected in future accounts as a loss of biocapacity.

Footprint accounts also do not indicate the intensity with which a biologically productive area is being used, nor do they pinpoint specific biodiversity pressures. Finally, the Ecological Footprint is a biophysical measure; it does not evaluate the essential social and economic dimensions of sustainability.

Why are Footprint and biocapacity in the scenarios expressed in “2003” global hectares?

The absolute value of a global hectare changes slightly each year, as both the total number of bioproductive hectares and world average productivity per hectare change annually. To simplify discussion of time trends in the Earth’s biocapacity, and how this factor affects the degree of overshoot, the scenarios are reported in constant 2003 global hectares. Similar to the use of inflation-adjusted dollars in economic statistics, the use of a constant global hectare – in this case, referenced to the average productivity of a global hectare in 2003 – shows how absolute levels of consumption and bioproductivity, rather than just the ratio between them, are projected to change over time.

Table 3: YIELD FACTORS, 2003

	Primary Cropland	Forest	Pasture	Ocean Fisheries
World	1.0	1.0	1.0	1.0
Algeria	0.6	0.0	0.7	0.8
Guatemala	1.0	1.4	2.9	0.2
Hungary	1.1	2.9	1.9	1.0
Japan	1.5	1.6	2.2	1.4
Jordan	1.0	0.0	0.4	0.8
Lao PDR	0.8	0.2	2.7	1.0
New Zealand	2.2	2.5	2.5	0.2
Zambia	0.5	0.3	1.5	1.0

Table 4: EQUIVALENCE FACTORS, 2003

	[gha/ha]
Primary Cropland	2.21
Marginal Cropland	1.79
Forest	1.34
Permanent Pasture	0.49
Marine	0.36
Inland Water	0.36
Built	2.21

How does the Ecological Footprint account for the use of fossil fuels?

Fossil fuels such as coal, oil, and natural gas are extracted from the Earth's crust rather than produced by ecosystems. When burning this fuel, carbon dioxide is produced. In order to avoid carbon accumulation in the atmosphere, the goal of the UN Framework Convention on Climate Change, two options exist:

a) human technological sequestration, such as deep well injection; or b) natural sequestration. Natural sequestration corresponds to the biocapacity required to absorb and store the CO₂ not sequestered by humans, less the amount absorbed by the oceans. This is the Footprint for fossil fuel. Currently, negligible amounts of CO₂ are sequestered through human technological processes.

The sequestration rate used in Ecological Footprint calculations is based on an estimate of how much carbon the world's forests can remove from the atmosphere and retain. One 2003 global hectare can absorb the CO₂ released by burning approximately 1,450 litres of gasoline per year.

The fossil fuel Footprint does not suggest that carbon sequestration is the key to resolving global warming. Rather the opposite: it shows that the biosphere does not have sufficient capacity to cope with current levels of CO₂ emissions. As forests mature, their CO₂ sequestration rate approaches zero, the Footprint per tonne of CO₂ sequestration increases, and eventually, forests may even become net emitters of carbon.

How does the Ecological Footprint account for nuclear energy?

The demand on biocapacity associated with the use of nuclear power is difficult to quantify. Also, many of its impacts are not addressed by the research question behind the Footprint. For lack of conclusive data, the Footprint of nuclear electricity is presently assumed to be the same as the Footprint of the equivalent amount of electricity from fossil fuels. Global Footprint Network and its partners are working to refine this assumption. The Footprint of nuclear electricity currently represents approximately five per cent of the total global Ecological Footprint.

How is international trade taken into account?

The national Ecological Footprint accounts calculate each country's net consumption by adding its imports to its production and subtracting its exports. This means that the resources used for producing a car that is manufactured in Japan, but sold and used in India, will contribute to the Indian, not the Japanese consumption Footprint.

The resulting national consumption Footprints can be distorted, since the resources used and waste generated in making products for export is not fully documented. This affects the Footprints of countries whose trade-flows are large relative to their overall economies. These misallocations, however, do not affect the total global Ecological Footprint.

Does the Ecological Footprint take into account other species?

The Ecological Footprint describes human demand on nature. Currently, there are 1.8 global hectares of biocapacity available per person on planet Earth, less if some of this biologically productive

area is set aside for use by wild species. The value society places on biodiversity will determine how much of a biodiversity buffer to set aside. Efforts to increase biocapacity, such as monocropping and application of pesticides, may also increase pressure on biodiversity; this can increase the size of the biodiversity buffer required to achieve the same conservation results.

Does the Ecological Footprint say what is a "fair" or "equitable" use of resources? The Footprint documents what happened in the past. It can quantitatively describe the ecological resources used by an individual or a population, but it does not prescribe what they should be using. Resource allocation is a policy issue, based on societal beliefs about what is or is not equitable. Thus, while Footprint accounting can determine the average biocapacity that is available per person, it can not stipulate how that biocapacity should be allocated among individuals or nations. However, it provides a context for such discussions.

How do I calculate the Ecological Footprint of a city or region?

While the calculations for global and national Ecological Footprints have been standardized within the National Footprint Accounts, there are a variety of ways used to calculate the Footprint of a city or region. The family of “process-based” approaches use production recipes and supplementary statistics to allocate the national per capita Footprint to consumption categories (e.g., food, shelter, mobility, goods and services).

Regional or municipal average per capita Footprints are calculated by scaling these national results up or down based on differences between national and local consumption patterns. The family of input-output approaches use monetary, physical or hybrid input-output tables for allocating overall demand to consumption categories.

There is growing recognition of the need to standardize sub-national Footprint application methods in order to increase their comparability across studies and over time. In response to this need, methods and approaches for calculating

the Footprint of cities and regions are currently being aligned through the global Ecological Footprint Standards initiative.

For more information on current Footprint standards and ongoing standardization debates, see www.footprintstandards.org.

For references and additional information about Footprint methodology, data sources, assumptions, and definitions please visit: www.footprintnetwork.org/2006technotes.

ENDNOTES

ⁱ WWF-Canada, *The Nature Audit* (Toronto: 2003).

ⁱⁱ This figure is based on United Nations projections that factor in moderate increases in population, food and fibre consumption, CO₂ emissions, and agricultural productivity.

ⁱⁱⁱ Buckland, S.T., Magurran, A.E., Green, R.E., and Fewster, R.M., 2005. Monitoring change in biodiversity through composite indices. *Phil. Trans. R. Soc. B.* 360: 243–254.

^{iv} Loh, J., Green, R.E., Ricketts, T., Lamoreux, J., Jenkins, M., Kapos, V., and Randers, J., 2005. The Living Planet Index: using species population time series to track trends in biodiversity. *Phil. Trans. R. Soc. B.* 360: 289–295.

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WWF-Canada

245 Eglinton Avenue East
Suite 410

Toronto, Ontario M4P 3J1

Telephone: 416-489-8800

Toll free: 1-800-26-PANDA

Fax: 416-489-3611

wwf.ca