THE VALUE OF NATURAL CAPITAL IN CANADA'S NATIONAL PARKS AND NATIONAL MARINE CONSERVATION AREAS

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ABSTRACT

Growing attention is being given to protected areas and the ability of their natural capital assets to provide a varied and long-term stream of benefits to individuals and society in general. These areas are often heralded for ensuring natural capital assets persist, but value is often limited to the economic impact of visitor expenditures and the associated effects on regional and national economies. Few studies have attempted to quantify the economic value of natural capital assets in protected areas, especially in Canada. This study uses a benefit transfer approach to produce an initial estimate of the potential economic value of ecosystem services and natural capital associated with the terrestrial and marine environments in Canada's federal system of national parks and national marine conservation areas. The results suggest that the economic value of these assets ranges between CA$ 156 billion and CA$ 588 billion annually.

Key words: protected areas, ecosystem services, benefits transfer.

INTRODUCTION

Thirty years ago, Costanza and Daly (1992) used the term natural capital to define stocks of natural assets, such as forests and water bodies, that provide a future flow of goods and services. The authors advanced the positions that the maintenance of the Earth's total natural capital at current levels was a necessary minimum condition of sustainability, and that growth cannot be indefinitely sustainable on a finite planet. Their subsequent study (Costanza et al., 1997) resulted in the first known published estimate of the economic value of planetary ecosystem services, which in their words addressed a central problem: "*A large part of the contributions to human welfare by ecosystem services are of a purely public goods nature. They accrue directly to humans without passing through the money economy at all. In many cases people are not even aware of them*" (p. 257). The social benefit of planetary ecosystems services was estimated to be US$ 33 trillion per year; by contrast, the annual total global gross national product at the time was estimated at US$ 18 trillion. The authors argued that their valuation represented a starting point for further study and was intended to demonstrate the importance of ecosystem services and the potential impact to societal welfare if compromised. They further laid the groundwork for ecosystem service valuations in resource management decision making.

Since their early work, advancements have been made in understanding society's dependencies on natural capital assets, valuation methods, and their integration into societal decision making. The 2005 Millennium Ecosystem Assessment established scientific consensus that humans had extensively changed ecosystems in a short time span and if policy and practice do not bring about a change in human activities, nature's capacity to provide for the needs of future generations was at risk (M.E.A., 2005). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services found that while there has been a multifold increase in the global value of crop production and timber harvest since 1970, these gains have contributed to declines in essential regulatory and maintenance services (IPBES, 2019). Other major initiatives, including The Economics of Ecosystems and Biodiversity (TEEB, 2013), Wealth Accounting and the Valuation of Ecosystem Services (World Bank, 2021), The Economics of Biodiversity: The

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Dasgupta Review (Dasgupta, 2021), and the Mapping and Assessment of Ecosystems and their Services (European Commission, 2021), have further explored the inherent problem in accounting for the intangible value of nature to human well-being.

In North America, Sutton et al. (2019) attempted to account for the total value of national parks in the contiguous United States by conducting a land cover analysis and benefits transfer method using the TEEB global database of ecosystem service values. The authors drew attention to the US$ 3 billion annual budget (2016) for national parks as being unable to address the deferred maintenance of built infrastructure of US$ 12 billion and as a public good having value beyond the US$ 32 billion contribution to the US economy and close to 300,000 local jobs. Using a benefits transfer approach, the authors estimated total annual ecosystem services at US$ 98.7 billion per year (from 7.7 million ha). The authors further posit that if the natural capital asset was managed like a built asset and the annual value of ecosystem services was used as a substitute for gross earned revenue, the annual budget for the US National Park Service would be in the order of US$ 27 billion (30 per cent of US$ 98 billion) (Sutton et al., 2019).

Early efforts in Canada to value ecosystem services of protected areas has been limited to case studies. As part of a federal government interdepartmental project on Measuring Ecosystem Goods and Services (MEGS), the ecosystem services for Thousand Islands National Park were estimated to be CA$ 14.7 million annually (2012 CAD) (Statistics Canada, 2013); Wilson (2012) estimated approximately CA$ 12.5 million annually (2011 CAD) in benefits from proposed land for Rouge National Urban Park. These two studies built on the work of Troy and Bagstad (2009) who used a land cover approach to apply monetary values for multiple regulatory and cultural services across landscapes in southern Ontario, included protected areas. Vogt, Troy and Johnson (2013) used artificial intelligence and standard value transfer analyses to estimate ecosystem services at several provincial parks in the Province of Ontario.

Early studies contributed to the growing body of knowledge surrounding natural capital in national parks and tested the use of remotely sensed land cover extent and a benefits transfer approach to produce valuation estimates. The concept of ecosystem services is a valuable tool for economic analysis and should not be discarded because of disagreements among economists and their assumptions regarding sustainability, justice and efficiency (Farley, 2012; Kadykalo et al., 2019; Schröter et al., 2014; Small et al., 2017). Many approaches for estimating ecosystem service value exist, but their appropriateness under specific conditions or logistical limitations are not uniform (Whitham et al., 2015). The land cover extent and value of ecosystem services from the Canadian network of federally protected areas has not been estimated to date and represents a knowledge gap. This study uses spatially explicit, remotely sensed satellite data to understand the land cover extent of the natural capital asset and applies estimates of monetary value from other Canadian studies in similar landscape settings to transfer benefits. This paper represents a first effort to understand the extent and potential economic value of the ecosystem services and natural capital assets within Canada's system of national parks and marine conservation areas. This work can be regarded as a foundation upon which to build a natural capital appraisal programme in the future focused on asset extent, condition and economic value, and will help to further demonstrate the important contribution protected areas make to the well-being of Canadians.

Protected areas in Canada

Canada has 37 national parks, 10 national park reserves, one national urban park and five national marine conservation areas (collectively referred to as national parks and marine conservation areas or protected areas henceforth), protecting an area of terrestrial and marine/freshwater ecosystems approximately equivalent to the size of Sweden. This system protects and preserves the country's natural landscapes and marine areas for present and future generations, is representative of the country's ecosystems, and is managed according to the principle of ecological integrity. These protected areas are also an integral part of Canada's tourism industry. They attract millions of visitors annually, 25 million in 2019–2020 alone (Parks Canada, 2019), and visitor-related spending contributes approximately CA$ 3.0 billion to Canada's gross domestic product (Parks Canada, 2018). The natural environment is integral to the economic contribution earned by communities and governments, but no equivalent analysis of the value of their natural environment has been undertaken to date. A natural capital appraisal approach could make a significant contribution as Canada moves to establish new protected areas as part of the Government of Canada's commitment to protect 30 per cent of its lands and waters by 2030 (Government of Canada, 2021).

METHODS

This study uses a natural capital appraisal and benefits transfer approach (unit value transfer) to estimate the economic value of ecosystem services associated with federally administered national parks and national marine conservation areas in Canada. Natural capital appraisal is rooted in social cost-benefit analysis, the estimation of economic surplus, and is aligned with the natural capital approach as a way of conceptualising nature as a system of stocks, flows and services that benefit humanity (Faccioli et al., 2023). The methodology was also informed by environmental accounting efforts (King et al., 2022) and case studies in Dartmoor and Exmoor National Parks in England (Faccioli et al., 2023) and their efforts to measure stock extent and the creation of flow accounts using exchange and welfare values. However, no attempt is made in this study to link natural capital in protected areas to Canada's system of national economic accounts. Landsat satellite data were employed to determine asset extent, and ecosystem service values were taken from the scientific literature with applicability to the Canadian context, to produce initial estimates of the potential economic value of ecosystem services from Canadian protected areas. The study approach builds on earlier studies and is pragmatic in that it uses both market and non-market values from the literature to estimate the economic value of the natural capital asset.

To ensure consistency in geographic coverage and land cover classifications ('asset types'), satellite data were used to quantify land cover ('asset extent') in national parks and marine conservation areas. The Landsat data provide a consistent land cover to determine asset type and extent and allow for aggregation at the individual site level, administrative region or the system of protected areas. The most recent Landsat satellite data (2020 data; released publicly in 2023) at a 30-metre resolution were obtained from the Commission for Environmental Cooperation for the North American Land Change Monitoring System (NALCMS). The land cover data are among the higher spatial resolutions publicly available and are used extensively by governments and other organisations to inform environmental planning, wildlife habitat mapping and ecosystem monitoring (C.E.C., 2022). The 19 land cover classes in NALCMS are based on the Land Cover Classification System standard developed by the Food and Agriculture Organization of the United Nations.

A geographic information system was used to integrate a spatial area boundary layer of protected areas, available publicly from the Canadian Protected and Conserved Areas Database (CPCAD) (Government of Canada, 2022), with the land cover data from NALCMS. The digital boundary for each national park and marine conservation area was clipped to the NALCMS raster image, extracted in pixels, and converted to hectares by GIS specialists for accuracy and analysis. A total of 46,953,339 million hectares were extracted from across 53 federal protected areas. Total hectares by land cover type (14 in total were relevant) were converted for each protected area. The land cover types were aggregated to eight to help with interpretation and align with monetary values: barren lands, forested lands, grasslands, shrublands, water, wetlands, snow and ice, and marine.

Ecosystem service values (ESV) were assigned to the extent of each asset type in each protected area. The ideal scenario would be to assign monetary values to the ecosystem services associated with each land cover type from economic valuation studies of lands managed in Canada's protected areas. No known study to date has yielded values for ecosystem services for a system of protected areas under the jurisdiction of the Government of Canada, nor have similar studies been done for protected areas operated by other levels of government (e.g. provincial parks) that would provide sufficient national coverage in geographic scope and environmental diversity. To address this gap, a benefit transfer approach was employed to derive the value of ecosystem services for each land cover type. To be a valid transfer of benefits, the study site and the policy site must have similar ecosystem type, ecosystem service characteristics and contextual factors (Unai & Muradian, 2010).

Table 1 summarises the ESVs (CA$ per hectare per year) by land type or 'asset type' that were drawn from published literature with a priority placed on Canadian monetary values, where available, that were a best fit for similar land cover types present in NALCMS. ESVs were often not singular in nature, but were composed of a number of value estimates based on different services and valuation methods, a common artefact in this field of work. For example, ESVs for grasslands may include market pricing for such factors as agricultural products, replacement cost of global climate regulation, non-market values for erosion control, pollination services and biodiversity habitat. A single ESV for all asset types was not employed, as it was not deemed practical given the national scope of this study and diversity of protected areas.

Table 1 Ecosystem Service Values (ESV) employed by asset type

	ESV (CA$/hectare/year)		
Asset type	**Low**	**Medium**	**High**
Barren lands[1]	$6,896	$6,896	$6,896
Forests[2]	$4,557	$17,875	$31,193
Grasslands[3]	$1,219	$3,682	$6,144
Shrublands[4]	$564	$1,229	$1,894
Freshwater[5]	$154	$8,165	$16,175
Wetlands[6]	$3,767	$34,237	$64,705
Marine[7]	$3,411	$3,411	$3,411

Sources:
1 - Anielski & Wilson, 2010 (A)
2 - TD Bank Group and the Nature Conservancy of Canada, 2017 (B), Dupras et al., 2016 (C)
3 - B, C and Wilson, 2014. (D).
4 - D and A
5 - A and C
6 - C and D
7 - Costanza et al., 2014.

Multiple values for the same land type were identified in the literature, in some cases with significant range. ESVs for fresh water, for example, ranged from a high of CA$ 16,175 (2020 CAD) to a low of CA$ 154 (2020 CAD) per hectare. To address the variation in values, high, medium and low monetary values were identified. Where only two values were identified, a medium estimate was calculated as the average of the available values. Considering a range for a preliminary estimate is prudent as it is indicative of a level of uncertainty when estimating ESVs for such a large and diverse protected system. Best fit ESVs for all land cover types were identified from the literature except for snow and ice; no value could be identified for this asset. All values used were in Canadian dollars; where best fit values were in other currencies, they were converted to Canadian dollars (2020) to ensure consistency. The total annual value of ecosystem services was estimated by multiplying per hectare monetary values by total hectares of each land cover type (asset extent) in each of the 53 protected areas and then summed.

RESULTS

The natural environment protected in Canada's federal system of national parks and national marine conservation areas is diverse and extensive. Table 2 summarises the geographic extent and the estimated potential annual ecosystem services of the system by asset type. In terms of terrestrial area, barren lands comprised the largest acreage (9.164 million ha or 19.52 per cent) followed by forested lands (7.259 million ha or 15.46 per cent). Wetlands, an important natural environment for water retention and regulation, was among the smallest of the identified asset types; wetlands accounted for 2.533 million hectares (5.40 per cent) of natural assets. The marine component of the protected areas encompasses 12.248 million hectares and approximately 26 per cent of the total geographic area.

The potential economic value of the ecosystem services from Canada's national parks and national marine conservation areas is estimated to range from a low of CA$ 156 billion to a high of CA$ 588 billion annually, with a medium estimate of CA$ 372 billion annually. Forested lands represent the largest contributor. The large expanses of deciduous and coniferous forests that define many national parks had annual services valued at between CA$ 33 billion and CA$ 226 billion annually, with a medium estimate of approximately CA$ 130 billion (or approximately 35 per cent of annual

Table 2 Estimated total potential ESV by asset type

Asset type	Area		Total annual ESV** (CA$ billion/year)		
	Hectares (million)	%	Low estimate	Medium estimate	High estimate
Barren lands	9.164	19.52	$63	$63	$63
Forests	7.259	15.46	$33	$130	$226
Grasslands	5.283	11.25	$6	$19	$32
Shrublands	3.151	6.71	$2	$4	$6
Freshwater	3.341	7.12	$0.5	27	$54
Wetlands	2.533	5.39	$10	$87	$164
Marine	12.248	26.09	$42	$42	$42
Snow and ice*	3.972	8.46	$0	$0	$0
Total	**46.953**	**100**	**$156**	**$372**	**$588**

*No ESVs available; **in 2020 CAD

Table 3 Estimated total potential ESV by service type

Service	Annual ecosystem services (CA$ billion/year)		
	Low estimate	Medium estimate	High estimate
Climate regulation	$80	$94	$107
Habitat /refugia	$18	$89	$161
Nutrient cycling	$40	$47	$55
Waste treatment	$3	$34	$66
Disturbance regulation	$0	$29	$57
Water supply	$7	$26	$45
Water regulation	$0	$18	$35
Pollination	$1	$9	$18
Pest and disease control	$1	$9	$16
Gas regulation	$0	$6	$11
Erosion control	$1	$4	$8
Other	$5	$7	$9
Total	**$156**	**$372**	**$588**

services). Grassland environments had an annual service value at between CA$ 6 billion and CA$ 32 billion (medium estimate of approximately CA$ 19 billion). The three forms of water-related assets (freshwater, wetlands, marine) contributed between CA$ 53 billion and CA$ 260 billion in annual services, with marine environments representing 27 per cent (CA$ 42 billion; medium estimate) of the contribution.

When viewed through the lens of natural functions, Canada's federal protected areas contribute a diverse suite of services that have broader benefits to Canadians. Table 3 summarises the estimated total potential annual service by type. Approximately CA$ 94 billion (medium estimate) (25 per cent) of annual potential ecosystem services is associated with climate regulation, such as oxygen production, water vapour and carbon capture. Another CA$ 90 billion (24 per cent) is associated with wildlife habitat and refugia. The supply of fresh water through glacial and snowmelt runoff and the fluvial functions of lakes/rivers yielded CA$ 26 billion (medium estimate) (7 per cent) of the service functions. Other significant functions include waste treatment (CA$ 35 billion or 9 per cent), water supply (CA$ 26 billion or 7 per cent) and regulation of water levels (CA$ 18 billion or 5 per cent).

National parks and national marine conservation areas are as diverse as the landscapes they protect. Table 4 summarises annual potential total ecosystem service value for each of the protected areas by region of the country. Protected areas in Canada's north collectively have the largest overall valuation, with total ecosystem valuation estimated to range from a low of CA$ 125 billion to a high of CA$ 390 billion annually, with a medium estimate of CA$ 258 billion annually. In terms of individual areas, Wood Buffalo National Park is the largest terrestrial park with an area of approximately 4.56 million hectares, and protects large expanses of forested lands, shrublands and grasslands. It has the largest ecosystem valuation of the protected areas studied (a range of between CA$ 14 billion and CA$ 148 billion annually or CA$ 3,070 to CA$ 32,456 per hectare). By comparison, Point Pelee National Park is among the smallest of Canada's national parks. Comprised mainly of forests and wetlands, it sits within critical North American bird and Monarch Butterfly migratory routes at Canada's most southerly latitude. With a studied land area of only 1,515 hectares, Point Pelee National Park has an estimated ecosystem valuation of between CA$ 5 million and CA$ 41 million annually (CA$ 3,300 to CA$ 27,063 per hectare). These two ecologically diverse parks are equally rich in ecosystem services, despite their differences in size, geography and assets.

Table 4 Estimated total potential ESV by protected area*

	Area	Natural Asset (% of hectare)							Annual ecosystem service value (CA$ billion/year)		
Protected area	Hectares* (million)	Barren land	Forest	Grass land	Shrub land	Fresh water	Wet lands	Marine	Low estimate	Medium estimate	High estimate
Atlantic region	**2.44**	**26.96**	**35.34**	**10.01**	**6.28**	**8.67**	**11.61**	**1.54**	**$10.09**	**$32.52**	**$55.11**
Akami Uapishku Kakkasuak Mealy Mountains	1.07	1.80	56.44	5.09	7.03	8.69	20.54	0.41	$3.85	$19.54	$35.22
Cape Breton Highlands	1.00	0.20	73.35	0.98	7.77	1.29	15.72	0.24	$0.38	$1.78	$3.19
Fundy	0.02	0.01	97.62	0.05	0.00	0.84	0.05	0.15	$0.09	$0.36	$0.63
Gros Morne	0.18	4.22	46.11	0.00	16.48	10.55	22.14	0.38	$0.62	$3.16	$5.71
Kejimkujik	0.04	0.01	83.38	0.07	0.00	15.41	0.00	0.88	$0.16	$0.65	$1.15
Kouchibouguac	0.02	0.12	67.20	2.02	0.03	3.12	10.16	15.79	$0.10	$0.39	$0.68
Prince Edward Island	0.00	8.40	40.83	4.97	0.15	6.29	2.64	14.16	$0.01	$0.03	$0.05
Sable Island	0.00	0.07	0.57	40.81	0.30	17.51	0.10	39.67	$0.01	$0.01	$0.02
Terra Nova	0.04	0.16	73.69	0.00	4.10	7.22	12.64	1.78	$0.16	$0.67	$1.31
Torngat Mountains	0.96	63.96	0.27	18.98	3.91	8.84	0.00	2.63	$4.71	$5.93	$7.15
Central region	**1.52**	**0.01**	**17.86**	**0.10**	**0.49**	**74.35**	**0.06**	**6.88**	**$1.80**	**$14.49**	**$27.20**
Bruce Peninsula	0.02	0.03	84.91	1.77	0.10	8.82	0.03	0.00	$0.06	$0.25	$0.44
Fathom Five	0.00	0.00	11.37	0.17	0.00	88.41	0.00	0.00	$0.01	$0.11	$0.20
Forillon	0.02	0.00	95.53	0.04	0.83	0.15	0.04	2.77	$0.11	$0.42	$0.74
Georgian Bay Islands	0.00	1.70	84.44	2.40	1.08	9.60	0.00	0.00	$0.01	$0.02	$0.04
La Mauricie	0.05	0.00	82.49	0.25	8.03	8.69	0.03	0.00	$0.21	$0.84	$1.47
Lake Superior	1.09	0.00	0.43	0.01	0.03	99.53	0.00	0.00	$0.19	$8.93	$17.67
Mingan Archipelago	0.01	1.02	74.08	0.60	5.10	3.19	7.52	0.00	$0.04	$0.16	$0.28
Point Pelee	0.00	0.07	67.85	0.00	1.06	22.38	3.96	0.00	$0.00	$0.02	$0.04
Pukaskwa	0.18	0.00	93.09	0.49	1.11	5.28	0.01	0.00	$0.79	$3.16	$5.54
Rouge	0.00	0.09	13.92	0.06	0.11	0.17	0.49	0.00	$0.01	$0.02	$0.03
Saguenay-St. Lawrence	0.12	0.00	0.13	0.01	0.00	15.93	0.00	83.87	$0.36	$0.52	$0.68
Thousand Islands	0.00	0.36	86.77	0.80	1.16	7.82	0.72	0.00	$0.01	$0.04	$0.07

Protected area	Area	Natural Asset (% of hectare)							Annual ecosystem service value (CA$ billion/year)		
	Hectares* (million)	Barren land	Forest	Grass land	Shrub land	Fresh water	Wet lands	Marine	Low estimate	Medium estimate	High estimate
Western region	**4.73**	**18.73**	**39.48**	**7.19**	**3.73**	**5.90**	**13.86**	**9.66**	**$19.20**	**$67.28**	**$115.26**
Banff	0.69	42.06	39.20	8.41	3.00	1.93	0.03	0.00	$3.30	$7.15	$11.00
Elk Island	0.02	0.00	65.33	2.70	11.96	16.54	2.06	0.00	$0.06	$0.27	$0.48
Glacier	0.14	25.28	42.30	9.44	11.43	0.77	0.01	0.00	$0.52	$1.33	$2.15
Grasslands	0.08	6.93	0.26	85.33	1.94	0.74	0.20	0.00	$0.12	$0.30	$0.47
Gulf Islands	0.00	0.65	72.98	0.68	0.87	0.41	0.00	22.78	$0.02	$0.05	$0.09
Gwaii Haanas	0.50	1.14	26.68	0.78	1.30	0.47	0.00	70.36	$1.82	$3.53	$5.25
Jasper	1.12	40.29	41.72	7.47	3.30	2.12	0.33	0.00	$5.40	$12.18	$18.96
Kootenay	0.14	23.96	55.07	13.97	4.32	0.97	0.00	0.00	$0.60	$1.67	$2.73
Mount Revelstoke	0.03	16.61	51.92	8.32	18.72	0.74	0.02	0.00	$0.10	$0.29	$0.48
Pacific Rim	0.05	0.07	51.37	0.03	0.51	3.36	0.00	44.34	$0.20	$0.57	$0.93
Prince Albert	0.40	0.00	66.91	2.25	3.04	12.75	14.73	0.00	$1.45	$7.20	$12.92
Riding Mountain	0.31	0.00	86.74	0.16	1.10	6.69	4.86	0.00	$1.27	$5.43	$9.58
Wapusk	1.15	0.73	18.44	5.29	4.34	13.64	50.32	7.24	$3.61	$25.5	$47.35
Waterton Lakes	0.05	15.71	23.74	32.94	22.78	3.97	0.00	0.00	$0.13	$0.36	$0.58
Yoho	0.13	35.39	46.95	6.00	4.08	1.34	0.00	0.00	$0.60	$1.45	$2.29
Northern region	**38.00**	**20.05**	**11.21**	**12.36**	**7.41**	**4.53**	**4.19**	**30.65**	**$125.27**	**$257.79**	**$390.18**
Aulavik	1.22	14.11	0.00	34.08	46.77	4.31	0.00	0.73	$2.05	$3.88	$5.70
Auyuittuq	1.95	31.23	0.00	14.66	0.01	7.22	0.00	4.87	$4.90	$6.73	$8.56
Ivvavik	0.98	23.81	3.00	10.49	49.77	2.92	9.12	0.89	$2.51	$6.41	$10.32
Kluane	2.20	31.41	9.52	1.44	4.71	1.83	0.02	0.00	$5.84	$9.12	$12.39
Náátsʼįhchʼoh	0.49	30.07	36.52	13.34	18.45	1.06	0.43	0.00	$1.97	$4.68	$7.39
Nahanni*	3.00	21.57	48.60	13.71	8.56	1.56	5.65	0.00	$12.42	$38.62	$64.82
Qausuittuq	1.10	19.64	0.00	62.33	5.10	1.86	0.00	11.07	$2.78	$4.67	$6.57
Quttinirpaaq	3.79	57.14	0.00	1.70	0.00	3.85	0.00	6.57	$15.87	$17.20	$18.52
Sirmilik	2.22	36.44	0.00	26.74	1.01	2.67	0.00	1.39	$6.42	$8.37	$10.32
Tallurutiup Imanga	10.84	0.08	0.00	0.06	0.00	0.02	0.00	99.85	$37.00	$37.00	$37.00
Thaidene Nene	1.41	1.61	22.56	21.52	19.74	27.68	6.90	0.00	$2.55	$13.80	$25.03
Tuktut Nogait	1.90	19.20	2.63	62.22	10.09	5.86	0.00	0.00	$4.28	$8.90	$13.42
Ukkusiksalik	2.09	71.77	0.02	3.82	0.08	9.61	0.00	14.70	$11.52	$13.33	$15.14
Vuntut	0.44	8.12	4.35	18.91	42.98	8.35	17.29	0.00	$0.84	$4.06	$7.28
Wood Buffalo	4.56	0.04	43.73	8.63	12.44	9.69	25.42	0.00	$14.32	$81.02	$147.72

* 0.00 ha means less than 12,000 hectares (most <3,000 hectares)

Marsh with Canoeists, Point Pelee National Park © Scott Munn, Parks Canada

DISCUSSION

National parks and national marine conservation areas sustain ecologically representative and biologically diverse environments delivering essential services. The study presented here is in keeping with global efforts to value, in as many ways as possible, nature's importance to human welfare and to foster further environmental protections.

Efforts to measure the extent and value of natural capital, and change over time where possible, helps decision-makers understand the natural capital managed and can support decision making. Approximately 80 municipalities in Canada currently recognise natural assets, including those in their parklands, as infrastructure. They have undertaken inventory exercises and valuations of annual ecosystem services under their jurisdiction to help manage them and support community well-being (e.g. flood control, water filtration, mitigate urban heat island effects) (Eyquem et al., 2022). Natural capital in national parks and national marine conservation areas is managed for current and future generations. In the context of protected areas, measuring the extent and value of natural capital, and by extension demonstrating benefits of healthy environments, can assist with justifying investments in land acquisition to expand the network of protected areas, expand the size of a protected area, or connect protected areas through ecological corridors. It can also help inform and justify restoration efforts to yield the most value. Further, overlaying ecosystem services and valuations with built infrastructure, such as hiking trails, boardwalks and parking lots, can help better integrate environmental and tourism related planning in protected areas.

As countries worldwide move towards a more sustainable future, the contributions humanity has freely received from nature can no longer be valued at nothing. This study presented a natural capital and benefit transfer approach to produce an initial estimate of the potential economic value of ecosystem services associated with the terrestrial and marine environments in Canada's federal system of protected areas. The results suggest that between CA$ 156 billion and CA$ 588 billion in potential total ecosystem services are being managed annually in the country's national parks and national marine conservation areas.

To scope the magnitude of the total ecosystem services calculated in this study, several comparative examples are provided as a sensitivity analysis. The IPBES Regional Assessment Report estimates the monetary value of ecosystem services for Canada at US$ 3,590 per hectare per year (or CA$ 4,783) (IPBES, 2018). When applied to 46.953 million hectares in this study, regardless of asset type, it yields an estimated economic value of CA$ 225 billion in annual ecosystem services for Canada's federal protected areas. When the TEEB values used by Sutton et al. (2019) are converted to 2020 CAD and applied to this study's extent and asset types, it yields an estimated economic value of CA$ 178 billion. The economic value of this comparative example would be substantially higher if values were added for perennial ice/snow (4.0 million ha) and the coastal marine area (12.2 million ha) in US parks. Hrkac (2021) applied values from the Ecosystem Services Valuation Database (ESVD) to the land cover of British Columbia's provincial parks and protected areas (14.1 million ha) to estimate the value of ecosystems services at approximately CA$ 132 billion per year. Using the author's 2020 CAD values applied to this study's extent and asset types, it yields an estimated economic value of CA$ 440 billion per year for federal national parks and marine conservation areas. The above noted examples (CA$ 132 billion to CA$ 440 billion) serve as simple benchmarks, suggesting that the preliminary estimate undertaken here (between CA$ 156 billion and CA$ 588 billion) is reasonable and the range is broadly within scope for such an extensive natural capital asset.

This initial monetary assessment is preliminary and exploratory in nature, drawing on accepted methodologies in the literature. It is acknowledged that there are some limitations. First, monetary values could not be assigned to the nearly 4 million hectares of identified snow and ice assets, as no known values existed at the time of writing. Marine environments are also limited in their assessment due to the complexity of defining and valuing biodiversity and ecosystem services of near, mid and offshore waters. Further work is needed in this area to enhance marine natural capital appraisal, especially as governments commit to expanding marine protected areas. Second, the monetary approach employed is aligned with other Western-based scientific valuations. It does not take into consideration Indigenous world views or incorporate Indigenous knowledge. It is anticipated that this work will develop in time, involving different approaches to refine and fully develop the concept of value (Claude-Belislea et al., 2021; Sangha et al., 2018). Finally, it is acknowledged that the estimate presented here is associated with a fixed moment in time. Ecosystems are in a constant state of change as biotic and abiotic elements of the environment are cycled. The natural environment in protected and conserved areas is ever changing with the forces of nature, but also in response to other influences such as changing climate, invasive species, hyper abundant species, and to changes in uses on adjacent lands and waters. The estimates of the annual ecosystem services will evolve as the terrestrial and marine environments managed within them change over time. As a result, the estimate could serve as a base case to compare over time.

National parks and national marine conservation areas are iconic symbols of Canadian identity and the value Canadians place on protecting the environment. They support tens of thousands of jobs in communities across the country. While it is inherently understood that nature is important and is valuable, this study has provided a tangible way to demonstrate the immense value that Canada's protected areas bring to Canadian society.

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DISCLAIMER

The views and opinions expressed in this paper are those of the authors and do not necessarily reflect the official policy or position of any agency, organisation or employer.

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RESUMEN

Cada vez se presta más atención a las áreas protegidas y a la capacidad de sus activos de capital natural para proporcionar un flujo variado y a largo plazo de beneficios a los individuos y a la sociedad en general. A menudo se anuncia que estas áreas garantizan la persistencia de los activos de capital natural, pero su valor suele limitarse al impacto económico del gasto de los visitantes y a los efectos asociados en las economías regionales y nacionales. Pocos estudios han intentado cuantificar el valor económico de los activos de capital natural en las áreas protegidas, especialmente en Canadá. Este estudio utiliza un enfoque de transferencia de beneficios para elaborar una estimación inicial del valor económico potencial de los servicios ecosistémicos y el capital natural asociados a los entornos terrestres y marinos del sistema federal de parques nacionales y áreas de conservación marina nacional de Canadá. Los resultados sugieren que el valor económico de estos activos oscila entre 156.000 y 588.000 millones de dólares canadienses anuales.

RÉSUMÉ

Les zones protégées et la capacité de leur capital naturel à fournir un flux varié et à long terme de bénéfices aux individus et à la société en général font l'objet d'une attention croissante. Ces zones sont souvent saluées pour la pérennité de leur capital naturel, mais leur valeur est souvent limitée à l'impact économique des dépenses des visiteurs et aux effets associés sur les économies régionales et nationales. Peu d'études ont tenté de quantifier la valeur économique des actifs du capital naturel dans les zones protégées, en particulier au Canada. Cette étude utilise une approche de transfert de bénéfices pour produire une première estimation de la valeur économique potentielle des services écosystémiques et du capital naturel associés aux environnements terrestres et marins du réseau fédéral de parcs nationaux et d'aires marines nationales de conservation du Canada. Les résultats suggèrent que la valeur économique de ces actifs se situe entre 156 et 588 milliards de dollars canadiens par an.