32_Canada

October 15, 2025

1 How have Canada's terrestrial protected areas evolved relative to marine protected areas between 2014 and 2024?

1.1 Abstract

Using World Bank World Development Indicators, this study examines the evolution of Canada's environmental conservation efforts between 2014 and 2024, focusing on the protection of land and marine ecosystems. The analysis compares two key indicators: terrestrial protected areas (% of total land area) and marine protected areas (% of territorial waters). Over the ten-year period, both indicators increased, but at markedly different rates — terrestrial protected areas expanded gradually, while marine protected areas grew substantially. This divergence reflects Canada's stronger policy emphasis on ocean conservation in recent years, driven by international commitments such as the UN Convention on Biological Diversity and national marine protection targets. The results underscore Canada's progress toward large-scale marine conservation and highlight the ongoing challenge of expanding land-based protection to similar levels. Together, these trends reveal a dual trajectory of environmental stewardship that prioritizes ocean ecosystems while maintaining steady, though slower, growth in terrestrial preservation.

1.2 1. Question

How have Canada's terrestrial protected areas evolved relative to marine protected areas between 2014 and 2024?

- **Terrestrial protection proxy**: Terrestrial protected areas (% of total land area)
- **Marine protection proxy**: Marine protected areas (% of territorial waters)

1.3 2. Data

- **Source**: World Bank World Development Indicators (WDI)
- **Indicators**:
  - Terrestrial protected areas (% of total land area)
  - Marine protected areas (% of territorial waters)
- **Coverage**: Canada, 2014–2024
- **Notes**: National-level data only

1.4 3. Method

1. Filtered dataset for Canada and the relevant conservation indicators.
2. **Selected relevant columns**: Year, Indicator Name, and Value.

3. Pivoted terrestrial and marine protection data into separate series, ordered chronologically from 2014 to 2024.
4. Produced a dual-line graph comparing terrestrial and marine protected areas to visualize conservation progress and relative growth over time.

(Analysis is descriptive; no causal inference applied.)

1.5 4. Results

- **Terrestrial protected areas**: Increased moderately over the 2014–2024 period, reflecting gradual expansion of land-based conservation zones.
- **Marine protected areas**: Rose sharply, especially after 2016, as new large-scale marine reserves were established.
- **Comparison**: While both forms of protection improved, marine protected areas grew at a significantly faster pace, narrowing the historical imbalance between land and ocean conservation.

(Figure 1. Canada Terrestrial vs Marine Protected Areas, 2014–2024)

(Table 1. Pivoted dataset summary)

1.6 5. Interpretation

- Canada's steady terrestrial increase reflects ongoing, though slower, progress in expanding protected land networks.
- The sharp marine growth aligns with national commitments to protect 30% of marine areas by 2030 under global biodiversity frameworks.
- This divergence suggests stronger policy prioritization and investment in marine ecosystems relative to terrestrial ones.
- Continued focus on land-based expansion is essential to ensure balanced progress across ecosystems.
- Together, these patterns demonstrate Canada's evolving environmental strategy — one that increasingly emphasizes ocean conservation while sustaining gradual terrestrial protection.

1.7 6. Limitations

- National-level data obscure regional variations in protection coverage and enforcement quality.
- WDI data rely on national reporting, which may lag behind policy announcements or local implementation.
- Descriptive analysis cannot identify underlying political, economic, or ecological drivers of conservation expansion.

1.8 7. Next Steps / Extensions

- Compare Canada's progress to other high-income countries meeting the "30 by 30" global conservation target.
- Disaggregate data by province and territory to identify regional strengths and gaps in protection coverage.
- Examine how new marine protections affect biodiversity, fisheries management, and coastal communities.

- Assess the potential for scaling up terrestrial conservation through Indigenous-led and community-based stewardship initiatives.

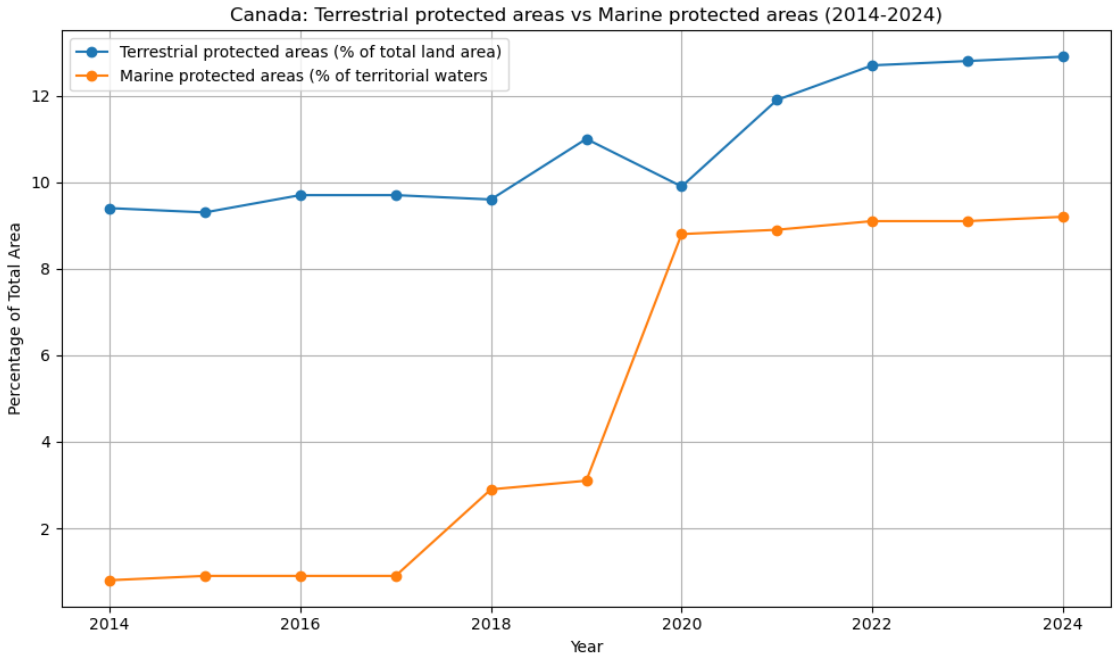
[1]:
```
# How have Canada's terrestrial protected areas evolved relative to marine␣
 ↪protected areas between 2014 and 2024?

import pandas as pd
import matplotlib.pyplot as plt
import os

# Folders
data_raw_folder = "data_raw/"
data_clean_folder = "data_clean/"
figures_folder = "figures/"

# Load CSV
filename = "climate-change_can_filtered.csv"  # Filtered dataset with only␣
 ↪relevant rows
df = pd.read_csv(os.path.join(data_raw_folder, filename))

# Keep only needed columns
df = df[["Year", "Indicator Name", "Value"]]

# Convert Year and Value to numeric, drop invalid rows
df["Year"] = pd.to_numeric(df["Year"], errors="coerce")
df["Value"] = pd.to_numeric(df["Value"], errors="coerce")
df = df.dropna(subset=["Year", "Value"])

# Pivot indicators into separate columns
df_pivot = df.pivot(index="Year", columns="Indicator Name", values="Value").
 ↪reset_index()
df_pivot = df_pivot.sort_values("Year")

print("Pivoted Canada dataset:")
display(df_pivot)

# Interpolate missing values for smooth plotting (optional)
df_plot = df_pivot.interpolate(method='linear')

# Plot the two indicators
plt.figure(figsize=(10,6))
plt.plot(df_plot["Year"], df_plot["Terrestrial protected areas (% of total land␣
 ↪area)"],
         marker='o', linestyle='-', label="Terrestrial protected areas (% of␣
 ↪total land area)")
plt.plot(df_plot["Year"], df_plot["Marine protected areas (% of territorial␣
 ↪waters)"],
```

```
        marker='o', linestyle='-', label="Marine protected areas (% of␣
 ↪territorial waters")

plt.title("Canada: Terrestrial protected areas vs Marine protected areas␣
 ↪(2014-2024)")
plt.xlabel("Year")
plt.ylabel("Percentage of Total Area")
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.savefig(os.path.join(figures_folder,␣
 ↪"canada_terrestrial_protected_areas_vs_marine_protected_areas.png"))
plt.show()

# Save cleaned CSV
df_pivot.to_csv(os.path.join(data_clean_folder,␣
 ↪"canada_terrestrial_protected_areas_vs_marine_protected_areas"), index=False)
```

Pivoted Canada dataset:

Indicator Name	Year	Marine protected areas (% of territorial waters)
0	2014	0.8
1	2015	0.9
2	2016	0.9
3	2017	0.9
4	2018	2.9
5	2019	3.1
6	2020	8.8
7	2021	8.9
8	2022	9.1
9	2023	9.1
10	2024	9.2

Indicator Name	Terrestrial protected areas (% of total land area)
0	9.4
1	9.3
2	9.7
3	9.7
4	9.6
5	11.0
6	9.9
7	11.9
8	12.7
9	12.8
10	12.9


Canada: Terrestrial protected areas vs Marine protected areas (2014-2024)
Terrestrial protected areas (% of total land area)
Marine protected areas (% of territorial waters
Percentage of Total Area
Year
2
4
6
8
10
12
2014
2016
2018
2020
2022
2024

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