Yukon state of the environment

interim report 2022

A report on enviromental indicators

Yukon

Acknowledgements

Reviewers and contributors

Government of Yukon

Department of Environment: Nicole Luck, Michal Wojcik, Alison Fung, Marie Ducharme, Alexandre Mischler, Anthony Bier, Holly Goulding, Jonathan Kolot, Ghislain de Laplante, Amélie Janin, Nicole Novodvorsky, Jessica Elliot, Jean Langlois, Tyler Kuhn, Amy Law, Bruce Bennett, Shailyn Drukis, Thomas Jung, Kristenn Magnusson, Maud Henaff and Cameron Sinclair

Department of Energy, Mines and Resources: Robert Legare, Krysti Horton

Yukon Bureau of Statistics: Zane Hill, Gary Brown

Others

City of Whitehorse: Brandon Crawford

Fisheries and Oceans Canada: Oliver Barker

Research institutions

- **Yukon Environmental and Socio-economic Assessment Board:** Nick Grzybowski
- **Yukon University Research Centre:** Alison Perrin

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On the cover: A child enjoys playing in a puddle at Dezadeash Lake. Photo by Sara Nielsen.

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Introduction

The Yukon state of the environment report provides an annual overview of the status of the Yukon's environment, covering key indicators spanning climate change, land, air and water.

The ***Environment Act*** requires release of a full report every three years, and an interim report in the years in between. This interim report builds and comments on data presented in the ***Yukon state of the environment report 2020.***

The conclusions in this interim report are based on information available up to the end of the 2021 calendar year. The report draws from scientific experts, government agencies and non-government organizations. Assessment of some indicators is still ongoing.

For a more complete snapshot of all indicators, please consult the previous full report published in 2020.

Highlights

Climate change

Arctic sea ice extent and volume

Arctic sea ice extent and volume is an important indicator of global climate change and currently demonstrates a significant downward trend, indicating loss in the thickness and coverage of sea ice.

Long-term precipitation and temperature variation

The Yukon's annual precipitation is projected to increase by four to 17 per cent in the next 50 years and 6 to 33 per cent by the year 2100.

Over the past 50 years, annual temperatures in the Yukon have increased by 2.2°C, and are expected to increase by 0.7 to 3.7°C in the next 50 years and 1.2 to 7.0°C by the year 2100.

Air

There was no new air quality indicator data available in 2021.

Water

Snow accumulation

There has been a significant increase in the peak Snow Water Equivalent (the amount of liquid water volume held within a snowpack that becomes available when melted) at nine of the 58 snow survey sites monitored throughout the Yukon and neighbouring jurisdictions.

Extreme high and low water in lakes and rivers

Maximum and minimum Łù'àn Mān (Kluane Lake) water levels have significantly decreased since 2016 because of the retreat of the Kaskawulsh glacier. The melt diverts the glacier's water to the Alsek drainage, away from A'ąy Chù' (Slims River), which was once a major contributor to the lake. A recent study suggests that water levels will remain low in Łù'àn Mān and the Kluane River from now on.

Yukon River ice breakup at Dawson City

Yukon River ice breakup in Dawson has been occurring earlier on average in recent years. The timing of river ice breakup influences the severity of the breakup.

Land

Population of the Yukon

From June 2020 to June 2021, the total Yukon population increased by 920 people, or 2.2 per cent.

Status of parks and protected areas

Currently, the Yukon has 98,695 km^2 of land designated for conservation purposes. Of that, 92,307 km^2 is protected lands, just over 19 per cent of the Yukon's total area.

Number, type and location of environmental and socio-economic assessments

In 2021, 196 project proposals were submitted to the Yukon Environmental and Socio-economic Assessment Board for assessment.

Recreational land use

Total campground occupancy was up 16 per cent compared to 2020, while still 20 per cent lower than pre-COVID numbers in 2019.

Waste handled at the Whitehorse Waste Management Facility

Waste generated per person in the City of Whitehorse went up by roughly 70 kg per person, from 570 kg in 2020 to 640 kg in 2021. This is a 12.3 per cent increase from 2020.

Fish and wildlife

Presence of alien and introduced species

As of December 2021, an estimated 244 exotic species have been identified in the Yukon.

Winter tick surveillance

Consistent with findings in other jurisdictions, the heaviest tick burden detected in the Yukon was on Moose.

Sustainability of Lake Trout fisheries

Current data suggests that throughout 2021 the majority of the recreational Lake Trout harvest was sustainable across the Yukon, maintaining high-quality angling opportunities.

Number of spawning Chinook Salmon

In 2021, the spawning escapement goal for Yukon River Chinook Salmon was not met, with an estimate of just over 31,000 fish reaching their spawning grounds in the Yukon.

Monitoring wild sheep and goat health

The *Mycoplasma ovipneumoniae* bacterium was not detected in any of the 114 thinhorn sheep and 58 other ungulates tested in 2021.

Climate change

1. Trends in the Yukon's greenhouse gas levels

Refer to the ***Our Clean Future 2021 annual report*** for the latest reporting information.

2. Arctic sea ice extent and volume

Significance

- Sea ice melt is the most apparent global indicator of climate change, and particularly relevant for the circumpolar North. The Arctic Ocean is a confluence of the ice, ocean, and atmosphere, and the demonstrated loss of sea ice extent shows the impact of climate change on these interrelated systems.
- Sea ice volume gives a better indication of the impact of climate change on the Arctic Ocean than sea ice extent because it also takes into account the thickness of ice. Sea ice extent can be monitored with satellite images, while sea ice volume requires the application of a model to satellite data and so has an added level of uncertainty.

What is happening

- Figure 1 shows the monthly average area (in millions of square kilometres) of Arctic and other Northern sea ice from 1979 to present. It is measured in September when the sea ice minimum extent can be observed.
- Figure 2 shows the monthly sea ice volume (in 1,000 cubic kilometres) of Arctic and other Northern sea ice from 1979 to present. It is measured in September when the sea ice minimum extent can be observed.
- Arctic sea ice volume shows a significant downward trend, indicating that global climate change is affecting ice coverage in the Arctic and northern oceans. The loss of sea ice impacts northern populations, like the Inuvialuit, that rely on ice for hunting and travel. It impacts Arctic wildlife populations that also rely on sea ice.

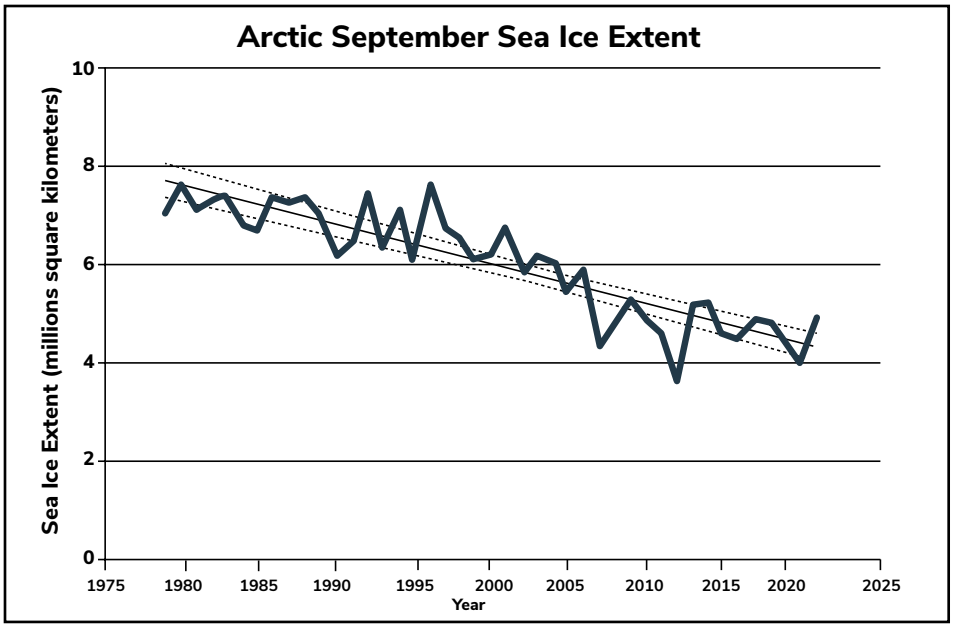

Figure 1:
Arctic September sea ice extent 1979-2021.
Source: Polar Science Center, University of Washington. Graph prepared by YukonU Research Centre, Yukon University, 2021.

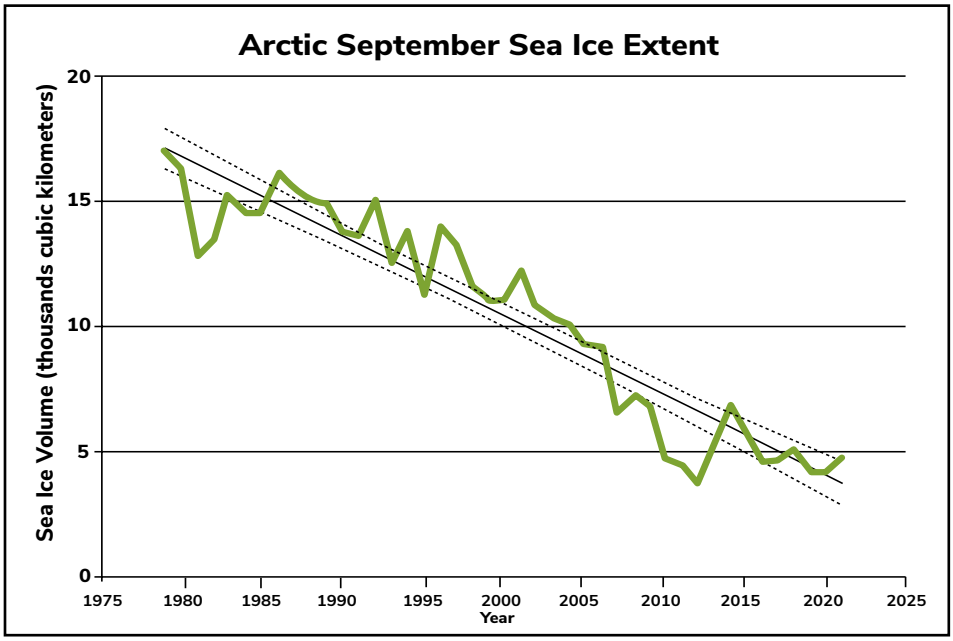

Figure 2:
Arctic September sea ice volume 1979-2021.
Source: Polar Science Center, University of Washington. Graph prepared by YukonU Research Centre, Yukon University, 2021.

Taking action

- The Government of the Yukon is actively working to reduce the Yukon's greenhouse gas emissions through the Yukon's climate strategy, ***Our Clean Future***.

Incorporating traditional knowledge

Inuvialuit Traditional and Local Knowledge (TLK) experts have warned that the land and waters of the Inuvialuit Settlement Region are not what they used to be. According to one expert, "prevailing winds previously blew from the northwest, but now are more forceful and blow from the east. High water levels make it difficult to distinguish where the banks of rivers are located. Strong winds are causing arid conditions in the Delta, and fewer blizzards have been observed in the winter [in some places]."

Furthermore, the changing climate introduces unique challenges to preserving the Inuvialuit way of life. For example, climate change is restricting travel and access to the land – "people have had to change their travel patterns because of an increase in rain, which sits on top of sea ice and 'rots' it, rendering the ice potentially unsafe for travel." (Inuvialuit Regional Corporation 2021)

Data quality

- For sea ice extent, data is derived from daily satellite images averaged over the month, collected by the National Snow and Ice Data Centre at University of Colorado Boulder.
- For sea ice volume, this data is based on satellite data combined with a thickness and total energy distribution sea ice model.
- Sea ice volume calculations are inherently less certain than ice extent observations; however, volume provides a clearer indication of sea ice change. Uncertainty is +/-24 per cent in volume and +/-36 per cent in the trend.
- There is more certainty in recent calculations compared to older calculations due to ongoing improvements in monitoring techniques.

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3. Long-term precipitation and temperature variation

Significance

- Temperature is the most common climate variable to monitor. Using the anomaly shows the departure from the 30-year (1961-1990) climate baseline, showing how much change has happened over the temperature record.
- While the data shows an annual increase of 2.2°C over the past 50 years, winter temperatures have increased by 4.7°C. There is less observed warming in the other seasons.
- The projected precipitation anomaly shows us the relative change in percentage for total annual precipitation projected until the year 2100.
- The projected temperature anomaly shows us the relative change in average annual Yukon temperature projected until the year 2100.
- The Yukon will continue to warm under all scenarios.

What is happening

- While there is variation in the amount of change from year to year, the trend over time shows an increase in annual average temperature in the Yukon.
- There is a lot of variability in precipitation from year to year and from one location to the next; however, more change and increased precipitation is expected for the Yukon in the future.
- The graph in Figure 4 shows the projected increase in the Yukon's annual temperature based on three different emission scenarios. All three scenarios result in temperature increase, but the projected amount of increase varies.

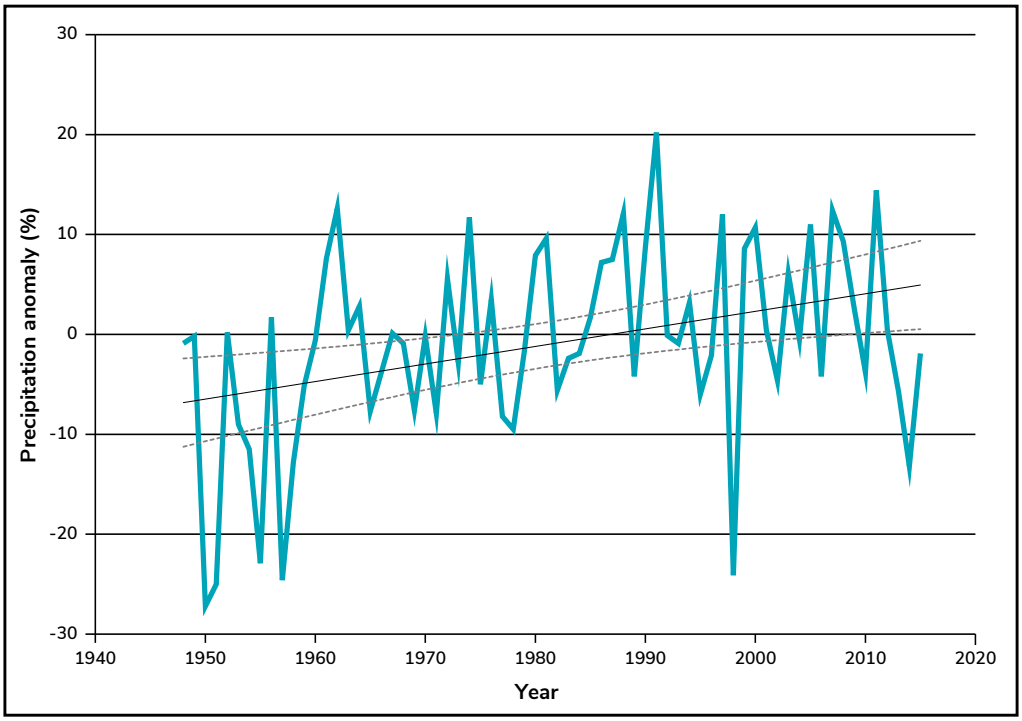

Figure 1:
Yukon annual precipitation variability, 1950 to 2016.
Source: Environment and Climate Change Canada, Climate Research Branch, Climate Trends and Variations Bulletins, 2016.

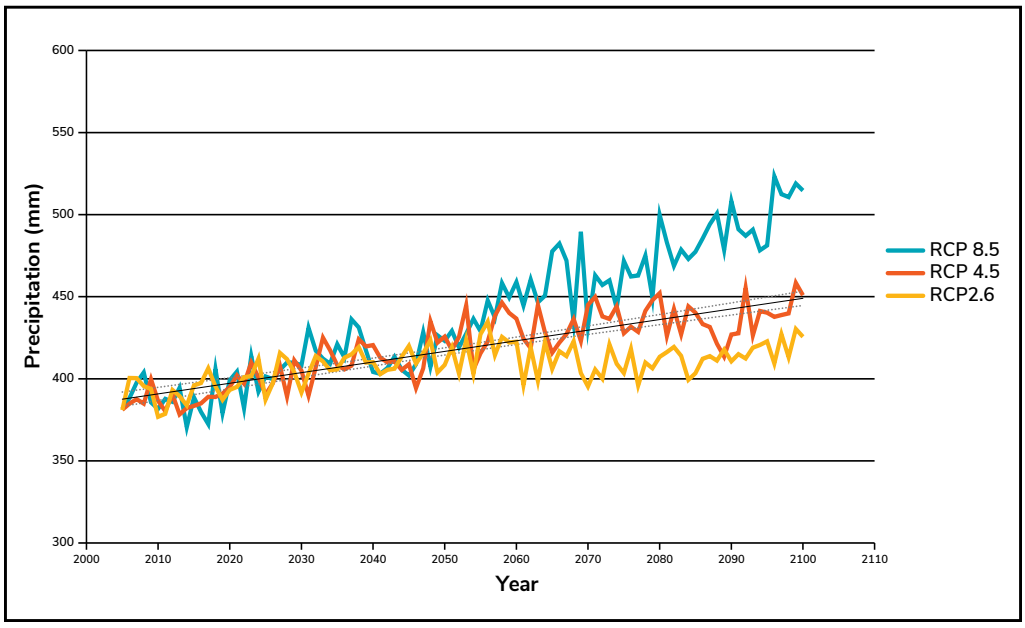

Figure 2:
Yukon projected annual precipitation anomaly, three scenarios.
Source: YukonU Research Centre, Yukon University, 2021.

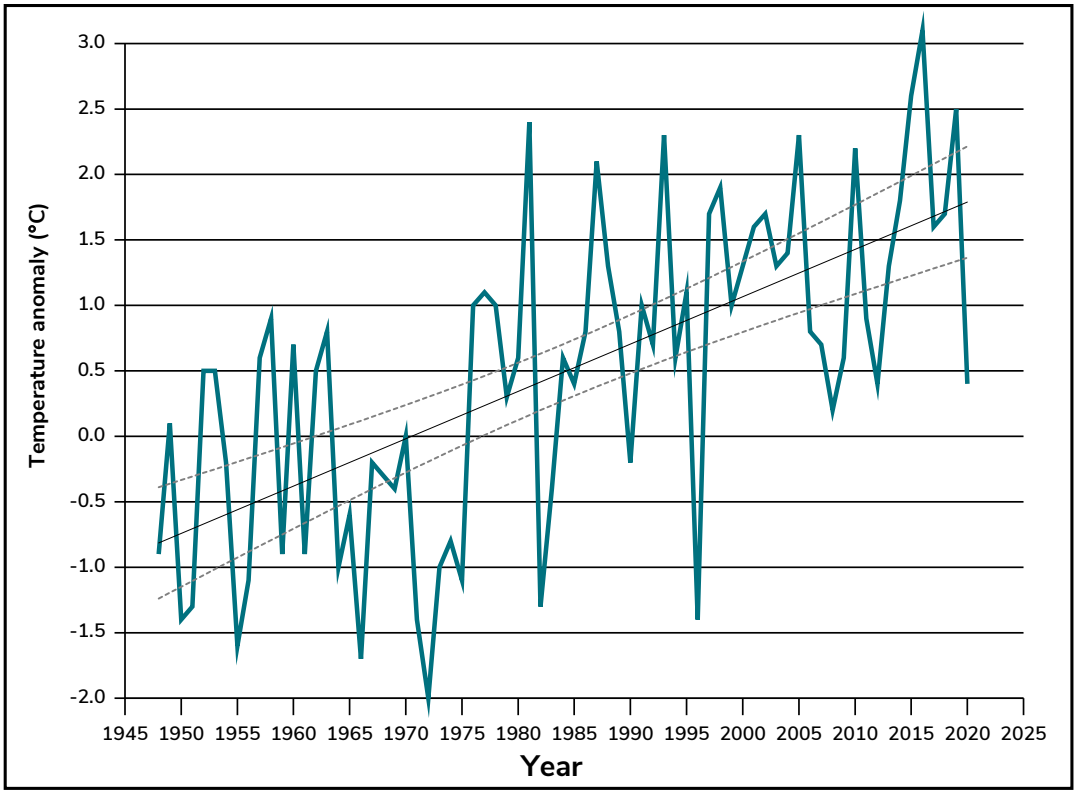

Figure 3: Yukon annual temperature anomaly, 1948 to present. Source: YukonU Research Centre, Yukon University, 2021.

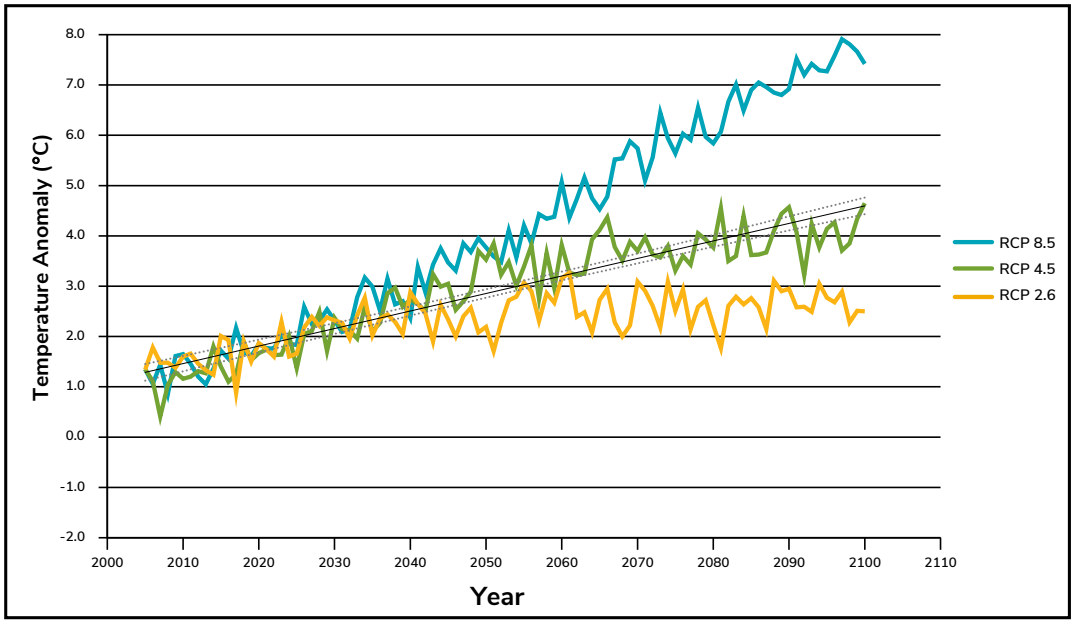

Figure 4: Yukon projected annual temperature anomaly, three scenarios. Source: YukonU Research Centre, Yukon University, 2021.

Taking action

- The Government of Yukon is actively working to reduce the Yukon's greenhouse gas emissions through the Yukon climate strategy *Our Clean Future*. See the ***Our Clean Future 2020 annual report*** for progress.

Data quality

- The data is provided by Environment and Climate Change Canada and includes the Yukon and northern BC; however, not all regions of the Yukon are represented in all years.
- As northern BC is included in this data, the results may be skewed towards the southern Yukon.
- All projections have limitations, so it is important to compare them alongside trends and alongside each other. By showing three different emission scenarios, a range of possible futures is considered.

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Environment and Climate Change Canada, Climate Research Branch. 2021. Annual 2020 Climate Trends and Variations Bulletin [cited 2022 Jan 18]. Available from: https://www.canada.ca/en/environment-climate-change/services/climate-change/science-research-data/climate-trends-variability/trends-variations/annual-2020-bulletin.html

Air

4. Levels of particulate matter

No new data was available this year. Refer to *Yukon state of the environment interim report 2021* for the latest reporting information.

5. Organic pollutants

No new data was available this year. Refer to *Yukon state of the environment report 2020* for the latest reporting information.

Water

6. Snow accumulation

Significance

The amount of snow on the ground across the Yukon is determined by measuring the snow water equivalent (SWE) at a number of snow survey sites. The SWE is a measurement of the liquid water volume held within a snowpack that becomes available when melted. The SWE accumulated throughout the winter has an influence on a number of hydrological and related processes:

- the SWE can influence the timing and severity of river ice breakup;
- a larger-than-average SWE increases the likelihood of high spring flows;
- a high SWE can provide greater insulation to the ground surface from cold winter air temperatures, and may promote increased rates of permafrost thaw during the following summer;
- low SWE can increase the likelihood of wildfires at the beginning of summer;
- in the long term, changing SWE can generate shifts in vegetation;
- the duration of the snow season has a significant impact on transportation; and
- temperatures being equal, greater SWE results in longer snow coverage duration.

What is happening

Since the start of records in 1958, the peak snow water equivalent (SWE) has increased by one per cent per decade, on average, across the 58 stations we currently monitor. This represents a total increase of 6.7 per cent, or 23 mm. There has been a significant increase in the peak SWE at 9 of the 58 snow survey sites monitored throughout the Yukon and neighbouring jurisdictions. Only one site showed a significant decrease.

The greatest increase in SWE was observed at Log Cabin (BC), at a rate of seven per cent (22 mm) per decade. Other sites showing a significant increase in snowpack are scattered throughout the territory, with a small concentration of sites in the Carmacks and Southern Lakes regions. Withers Lake, in the Stewart River watershed, was the only site showing a decrease of four per cent (-13.5 mm of SWE) per decade. All snow survey data is available on the Government of Yukon's open data portal: open.yukon.ca/data/datasets/yukon-snow-survey-network.

Taking action

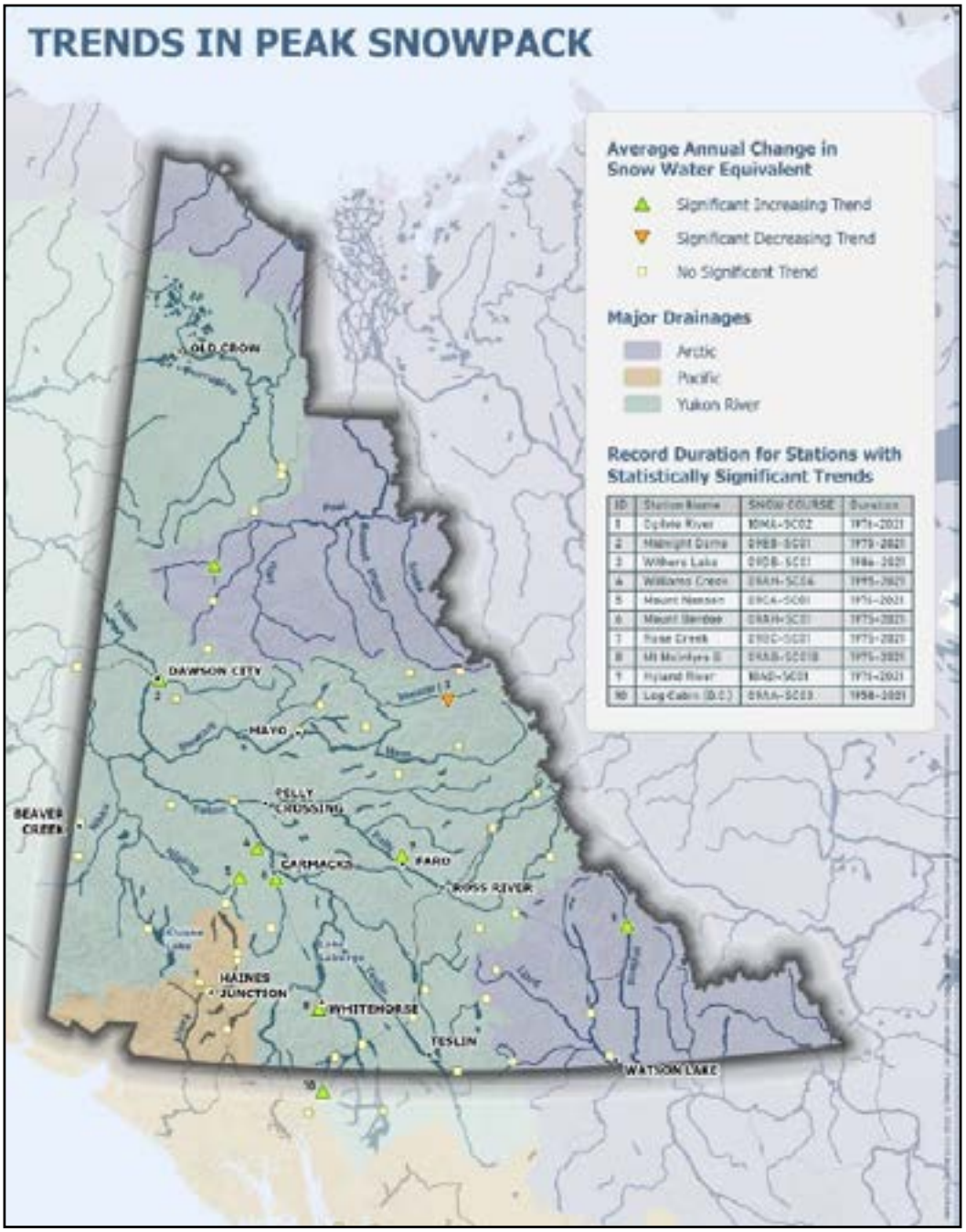
The Government of Yukon's Water Resources Branch staff continue to collect data, as do their partners in the Yukon's remote areas, including staff and private contractors from the Government of Yukon, Vuntut Gwitchin First Nation, Parks Canada and the Yukon Energy Corporation. The Government of Yukon compiles and quality controls all snow accumulation data.

Data quality

There are currently 53 snow survey sites located across the Yukon and an additional five stations in adjacent areas of Alaska and British Columbia. These stations provide the data used by the Government of Yukon to produce the Yukon Snow Survey Bulletin and Water Supply Forecast, issued in March, April and May each year. Most areas of the Yukon have good spatial coverage (Figure 1). There are snow monitoring stations in five out of the Yukon's six main watersheds.

This indicator only examines trends in the maximum amount of snow; however, a shift in the timing of snowmelt has also been reported in various studies. The data collected by the Government of Yukon is not adequate for detecting changes in the timing of snowmelt at this time.

Figure 1: Trends in peak snowpack.



Natural resource officer Corey Mackie at the Log Cabin snow course, April 1, 2021.
Photo by Eugene Jardine.

MacMillan Pass precipitation and snow depth station, September 22, 2021.
Photo by Alexandre Mischler.

7. Extreme high and low water in lakes and rivers

Significance

High and low river flows and lake levels in the Yukon are susceptible to change from a range of processes, which can result in different responses in different regions of the territory.

Changes to the timing of snowmelt, the amount and phase (rain or snow) of precipitation, permafrost thaw and active layer thickening, shifts in vegetation, and melting glaciers are some of the processes that are expected to alter extreme high and low river flows and lake levels.

Higher river flows can cause increased sedimentation and contaminant movement in river systems, affecting human health, drinking water and ecosystems. Increased peak flows and more intense river ice breakup conditions can increase flooding potential in populated areas, which can impact safety for people, and result in infrastructure loss and economic costs.

In contrast, low flows can result in increased concentrations of ions, such as dissolved metals, which can negatively affect aquatic ecosystems. Changes in river flows can affect resource development, such as hydropower production, mining practices or agriculture.

Changes in surface and groundwater availability and quality can affect the accessibility of water for communities and local needs. Increased flows in winter, which normally correspond to a low flow time of year, are one of many confirmed climate change-driven hydrological trends. Increases in winter flows result from increased groundwater discharge due to changing permafrost conditions (including both increased active layer thickness and permafrost degradation), warming air temperatures, a shorter cold season, and in some locations, increased precipitation. This trend is expected to continue with future warming.

What is happening

For this indicator we have used place names as outlined in the ***Gazetteer of Yukon*** (YGNP 2022); however, we are aware that more place names exist. For example, the Yukon River Basin spreads across a number of language groups and as such, it has many Indigenous names beyond the two provided here: Tàgé Cho in Northern Tutchone, and Tágà Shäw in Southern Tutchone. Both translate to “Great River.”

River flows

Forty locations across the Yukon were analyzed to determine the presence of trends in annual minimum and maximum river flows. The majority of these locations are stations monitoring hydrological conditions on large rivers (rivers that have drainage areas greater than 1,000 km^2) in the following basins:

- Tàgé Cho / Tágà Shäw (Yukon River): 23 stations;
- Alsek River: 7 stations;
- Liard River: 4 stations;
- Teetł’it Gwinjik (Peel River): 3 stations; and
- Ch’ōdènjik (Porcupine River): 3 stations.

Teetł'it Gwinjik, the Gwitch'in name for the Peel River translate to:

- Teetl'it - headwaters region.
- Gwinjik - along the course of river.

Ch'ōdènjik (Porcupine River) translates to "porcupine quills river."

Annual minimum flows have increased significantly at 30 stations and have not decreased at any of the stations (Figure 1).

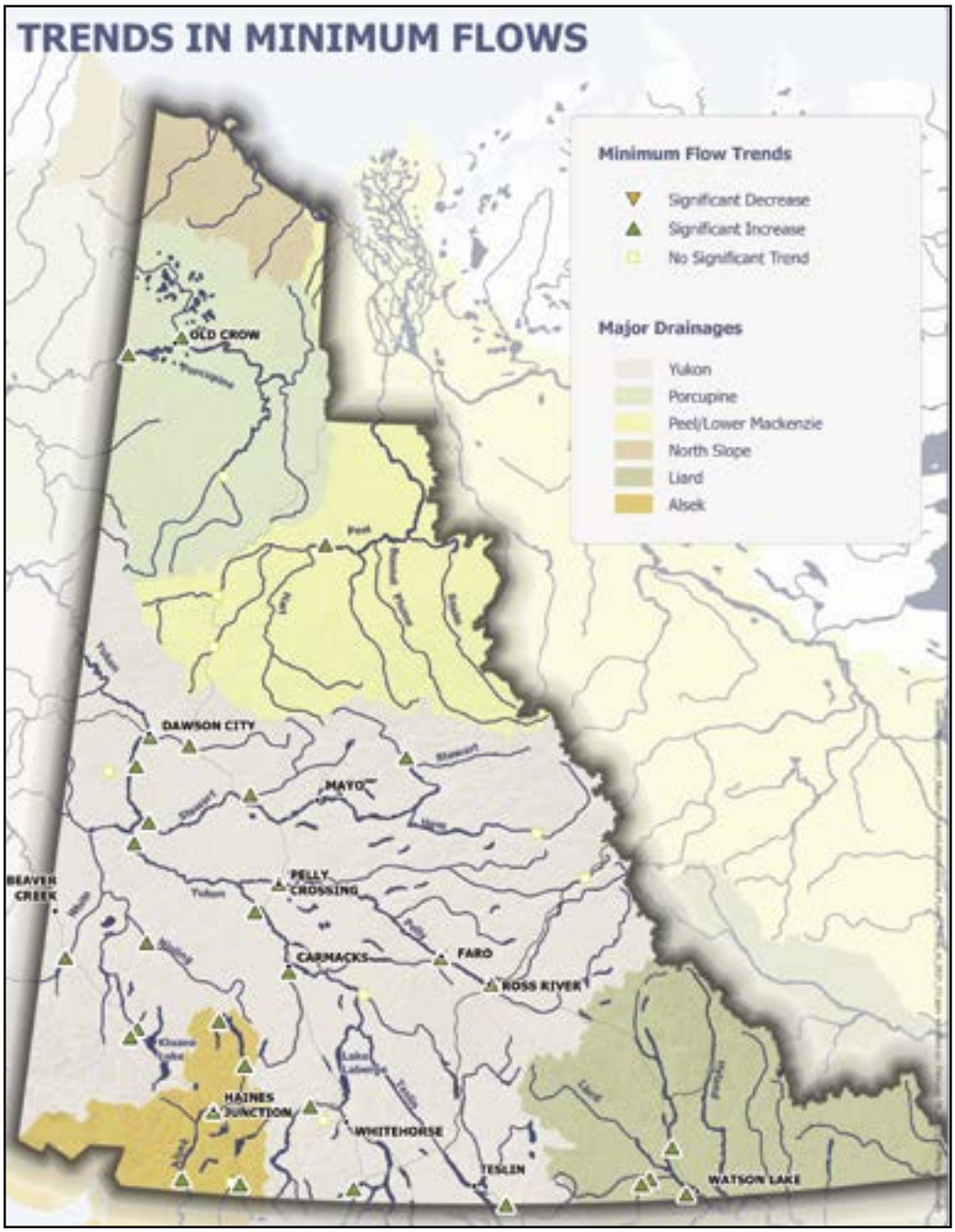


Figure 1: Trends in annual minimum river flow.

Annual maximum flows have increased significantly only at the **Alsek River** above Bates River. Three locations **(Ross River at Ross River, Takhini River near Whitehorse** and **White River at Kilometre 1881.6)** showed a significant decreasing trend in annual maximum flow. The remaining 36 locations did not display significant change in annual maximum river flow (Figure 2).

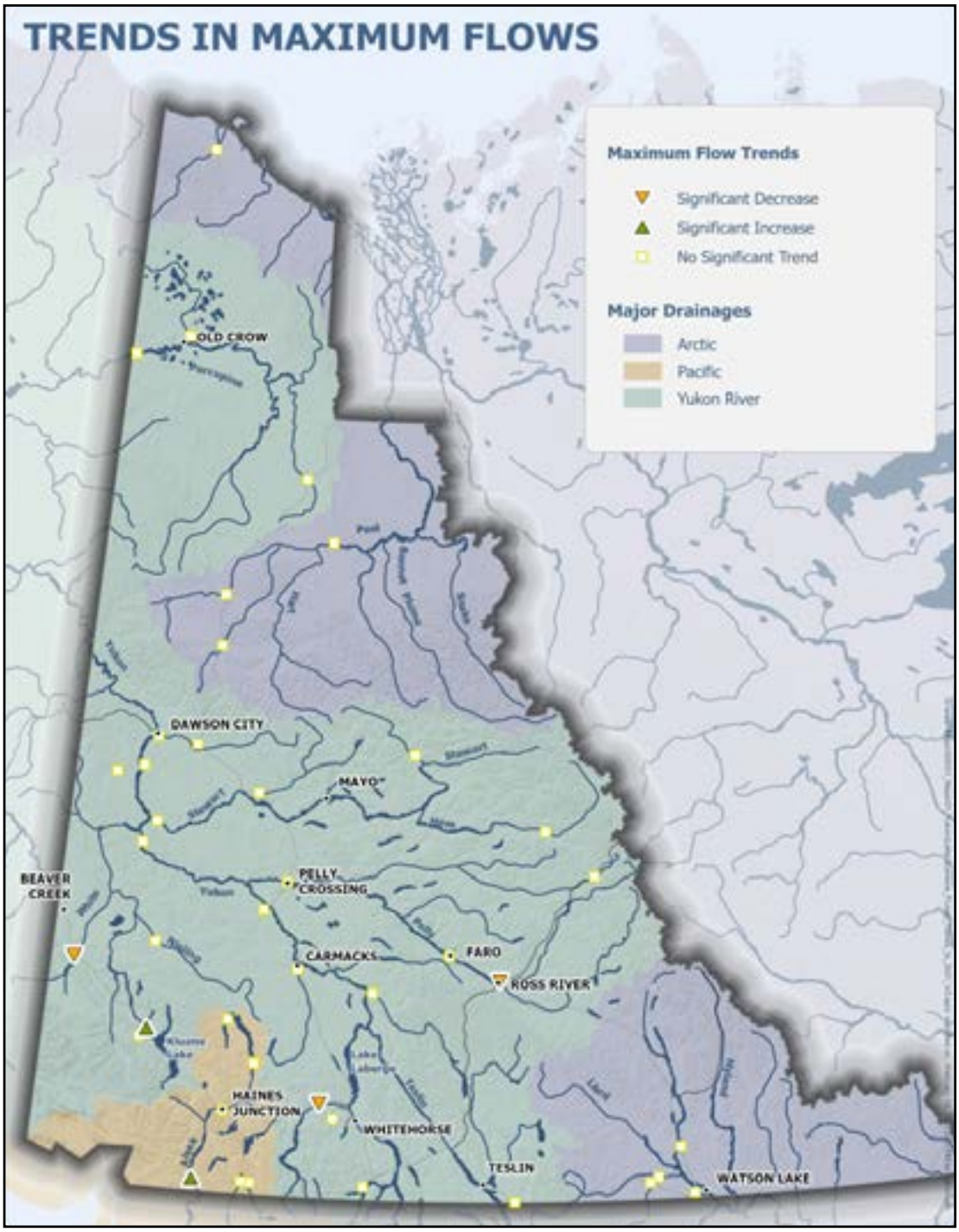


Figure 2: Trends in annual maximum river flow.

Annual water levels

Annual minimum and maximum water level trends were analyzed for four Yukon lakes:

- Bennett Lake;
- Łù'àn Mān (Kluane Lake);
- Tthechàl Mān (Sekulmun Lake); and
- Teslin Lake.

Maximum and minimum Łù'àn Mān (Kluane Lake) water levels have significantly decreased since 2016 due to the retreat of the Kaskawulsh glacier, diverting its meltwater to the Alsek drainage, away from Ä'äy Chù (Slims River), once a major contributor to the lake. A recent study suggests that water levels will remain low in Łù'àn Mān and Kluane River from now on (Loukili and Pomeroy 2018).

Bennett Lake showed a significant decline in minimum water levels over time, while Teslin Lake and Tthechàl Mān (Sekulmun Lake) showed significant increases in their minimum water levels.

Tthechàl Mān means "stone scraper lake" in Southern Tutchone, while Łù'àn Mān means "big whitefish lake". **A'ąy Chù'** means "it stands [alone by itself]."

Data quality

The Water Survey of Canada conducts long-term measurements of large rivers and lakes. They provide summaries of annual peak high and low flows based on daily mean flow and water levels. Data from the Water Survey of Canada (available from wateroffice.ec.gc.ca) is typically re-analyzed and released two years after data collection. Currently, data is approved to 2018. The current analysis considers stations that have at least 20 years of data.

The trend in peak flows does not necessarily indicate a trend in monthly, seasonal or annual flows. Therefore, these trends should be used with caution when looking at the total amount of water in a system. Such a trend would require an assessment of the mean annual flows.

Extreme flows in rivers, particularly high flows, are often the most difficult to interpret due to the changing hydraulic conditions during high water. This means that these flows are typically associated with a higher degree of uncertainty, which may be of similar magnitude to the changes in long-term trends. It is therefore important to not give too much value to any single site, but rather to look at the larger picture.

The period of record for the majority of hydrometric systems in the Yukon is short relative to the dynamics of a changing climate system. Natural climate oscillations, such as the Pacific Decadal Oscillation, can influence river systems and complicate the interpretation of trends.

Profile: 2021 flooding in the Southern Lakes and Táa'an Mān (Lake Laberge)

In spring 2021, there was higher than average snowpack in many Yukon watersheds, which resulted in high water events. Record high water levels on the Southern Lakes and Táa'an Mān (Lake Laberge) were due in large part to the highest ever recorded snowpack in the Upper Yukon River Basin, approximately double the average value.

Peak water levels were reached on July 10 and 11 for Bennett, Tagish and Marsh lakes, with levels approximately 20 centimetres higher than during the previous record flood in 2007. At its peak on July 16, Táa'an Mān was more than 40 centimetres higher than the peak in 2007. Notable high water events also occurred elsewhere, including on Teslin Lake and Tàgé Cho (Yukon River) at Carmacks.

Weather conditions over the winter, spring and summer set the stage for the floods in the Southern Lakes. This included a record snowpack accumulated in the Upper Yukon River Basin, followed by a cool spring that delayed snowmelt. Above-average temperatures in June, culminating in a heatwave in late June into early July, caused the large amount of remaining snow to melt quickly. This resulted in rapidly rising water levels that reached record-setting peaks in the Southern Lakes, more than a month earlier than is typical for this system.

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Bennett Lake, Carcross, Yukon.

MacMillan River at Bridge no. 1 with Itzi Mountain in the background. Photo: Alexandre Mischler.

Flooding shores of Marsh Lake. Photo: Vince Fedoroff/Whitehorse Star.

Alexandre Mischler conducting a water level survey during spring freshet on Tay Creek.
Photo: Devon O'Connor.

Jonathan Kolot configuring a boat-mounted Acoustic Doppler Current Profiler on Koidern River. Photo: Alexandre Mischler.

Devon O'Connor manoeuvring a boat-mounted Acoustic Doppler Current Profiler during spring freshet flow measurement on Tay Creek. Photo: Alexandre Mischler.

Tutshi River between White Pass and Tutshi Lake. Photo: Alexandre Mischler.

8. Yukon River ice breakup at Dawson City

Significance

Over the past century, breakup has been occurring earlier in the spring. This is a strong indicator of a changing climate. Even if warmer winter temperatures contribute to reducing the ice cover thickness, and therefore its resistance, the combined effect of larger snowpacks and increased air temperature variability will have an impact on ice jam frequency and intensity in ways not yet to be confirmed.

River ice conditions affect transportation routes, both for winter roads and wildlife corridors; the reduced river ice season is already having an impact on the Yukon population. In recent years, changing freeze-up patterns resulted in challenges to certify an ice bridge between West Dawson and Dawson.

The timing of river ice breakup is one factor influencing breakup severity and associated negative impacts:

- An early rise in river discharge results in the mobilization of a very resistant ice cover, which can translate into damaging ice jams.
- A delayed snowmelt period may generate a sudden and significant runoff and a largescale mobilization of river ice, which can also lead to ice jam floods.

Both conditions can have detrimental impacts on communities and infrastructure.

What is happening

In Dawson City, the Yukon River breakup occurred on May 6, 2021 around 10 am. River ice breakup on the Yukon River at Dawson City now occurs almost eight days earlier on average since data collection began in 1896 (Figure 1). This trend towards earlier breakup dates is statistically significant. Six of the 11 earliest recorded breakup events at Dawson City have occurred in the past 30 years. The two earliest recorded breakups occurred in the past six years (2016 and 2019, both on April 23).

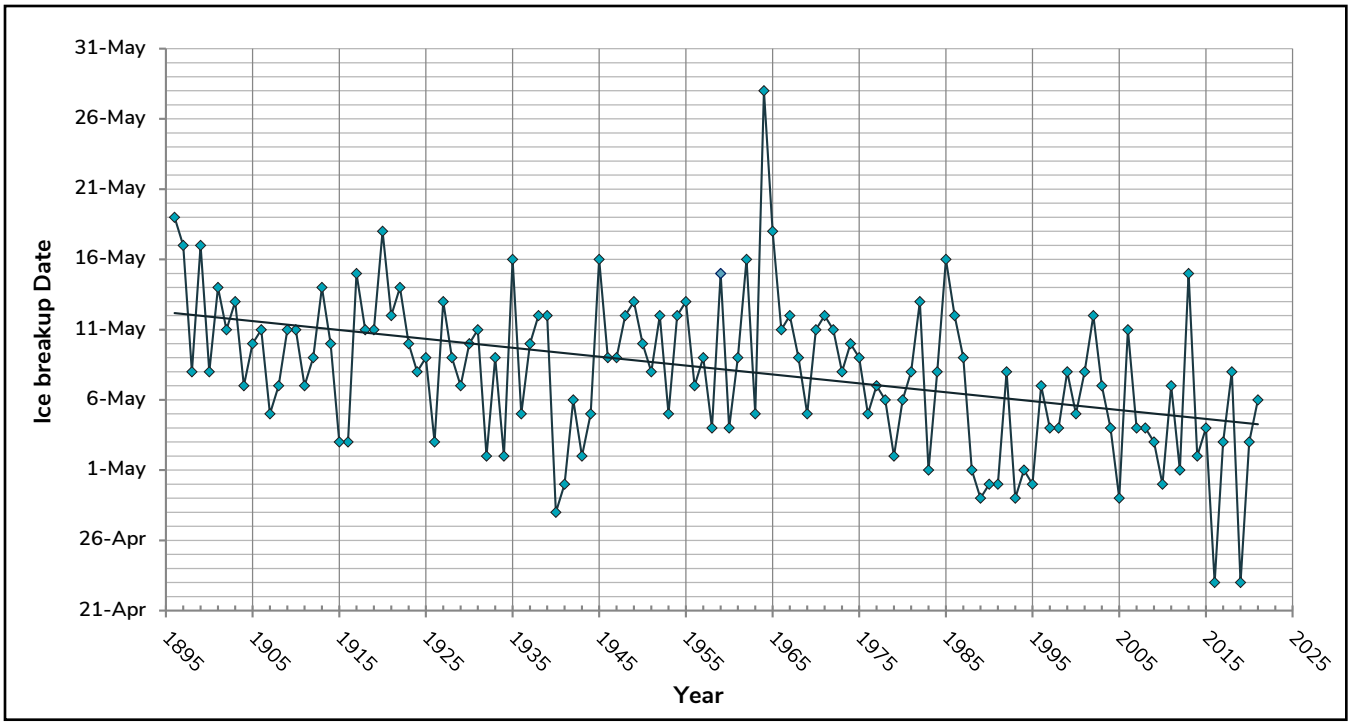


Figure 1. Yukon River at Dawson breakup date by year, 1986 to 2021.

Data quality

Records documenting the timing of breakup on the Yukon River at Dawson City began in 1896. The date of breakup has since been continuously recorded as part of the Yukon River breakup contest. In recent years, the timing of breakup has been recorded with a tripod placed on the ice that is connected to a timer. When the tripod moves downstream with the first movement of the ice, the clock stops and records the official breakup time.

Incorporating traditional knowledge

Local and traditional knowledge and observations can contribute valuable information to understanding and predicting river breakup and ice jams. For example, in winter 2021 local observations indicated that a section of the Yukon River in front of the village of Moosehide had frozen over for the first time in living memory. This information helped hydrologists infer and communicate an increased likelihood of ice jamming.

After the breakup of the Yukon River at Dawson, the ice jammed about 10 kilometres downstream of Dawson for approximately six hours, raising water levels by over 1.7 metres in Dawson. This resulted in minor flooding at Moosehide before the jam started moving downstream.

Yukon River in Dawson City shortly after breakup, May 6, 2021 at 11 a.m. Photo: Sebastian Jones.

Yukon River Ice just before breakup. Photo: Holly Goulding.

Yukon River Ice just before breakup. Photo: Holly Goulding.

9. Water quality

Significance

The Water Quality Index (WQI), developed by the Canadian Council of Ministers of the Environment, indicates the status of water quality and the suitability of streams to support aquatic life. It can be used to reflect the overall and ongoing condition of the water and for tracking changes over time.

Specifically, the WQI measures the frequency and extent to which selected parameters exceed water quality guidelines at individual monitoring sites. Using three factors (scope, frequency and amplitude), it creates a numerical ranking for the suitability of water for use by aquatic life. Guideline values are meant to protect all forms of aquatic life and all stages of an aquatic life cycle. A site will have a lower WQI rating when some water quality guidelines for the site are exceeded (Canadian Council of Ministers of the Environment 2014).

What is happening

Water quality samples are collected every month in 13 rivers across the territory by Government of Yukon staff and partners. First Nation partners include the Daylu Dena Council, Tr'ondëk Hwëch'in, Vuntut Gwitchin First Nation and the First Nation of Na-Cho Nyäk Dun. The data from these samples are compiled and available on the Government of Canada Open Data portal: open.canada.ca/en/open-data.

Analysis of the data by Environment and Climate Change Canada enables calculation of the WQI using three consecutive years of data. However, the most recent WQIs were calculated using only two years of data, as too few samples were collected in 2020 due to the COVID-19 pandemic.

Figure 1. WQI scores for Yukon monitoring stations calculated as three-year rolling averages.

Excellent (95-100)	Good (80-94)	Fair (65-79)	Marginal (45-64)	Poor (0-44)

Location	Year 2005 - 07	Year 2005 - 08	Year 2007 - 09	Year 2008 - 10	Year 2009 - 11	Year 2010 - 12	Year 2011 - 13	Year 2012-14	Year 2013 - 15	Year 2014 - 16	Year 2015 - 17	Year 2016 - 18	Year 2017 - 19	Year 2018 - 19
Klondike River upstream of Bonanza Creek	66.8	66.4	67.4	74.2	74.2	74.2	74	73.8	73.7	73.7	86.6	80.1	80.4	80.2
Liard River at Upper Crossing	87.2	93.6	93.6	87.2	85.5	80.6	80.6	N/A	80.6	80.6	80.5	80.6	80.6	80.6
South McQuesten River downstream of Flat Creek	64.4	64.3	64	70	69.5	70.1	70.4	70.6	70	63.8	63.7	63.5	64.1	64.1
Yukon River upstream of Takhini River	100	100	100	93.6	93.6	93.6	93.6	93.6	93.6	100	100	93.6	93.6	93.6
Ogilvie River above Engineer Creek	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	72.9	73.2
Alsek River above Bates River in Kluane National Park	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	87.3	87.6
Porcupine River above Old Crow River	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	70.4	70.3

Excellent (95-100)	Aquatic life is not threatened or impaired. Measurements never or very rarely exceed water quality guidelines.
Good (80-94)	Aquatic life is protected with only a minor degree of threat or impairment. Measurements rarely exceed water quality guidelines and, usually, by a narrow margin.
Fair (65-79)	Aquatic life is protected, but at times may be threatened or impaired. Measurements sometimes exceed water quality guidelines and, possibly, by a wide margin.
Marginal (45-64)	Aquatic life frequently may be threatened or impaired. Measurements often exceed water quality guidelines by a considerable margin.
Poor (0-44)	Aquatic life is threatened, impaired or even lost. Measurements usually exceed water quality guidelines by a considerable margin.

All four watercourses monitored over the last decade (Klondike, Liard, South McQuesten and Yukon rivers) have water quality scores that have remained relatively constant during that period, and scores for the 2018-2019 period are consistent with previous years. The South McQuesten River downstream of Flat Creek has the lowest water quality index in the Yukon.

Taking action

It is important to have healthy fresh water for Yukoners now and in the future. To do this, we must take collective responsibility for potential impacts on our water. In 2020 to 2022, the Government of Yukon conducted a study about the cumulative impacts to the water quality of the South McQuesten River. We are in the process of developing water quality objectives for the South McQuesten River for use by water managers and other water stewards who have an interest in protecting the river.

Data quality

The Water Quality Index (WQI) scores are calculated by Environment and Climate Change Canada. They are calculated as an average over several successive several years, which provides additional confidence in ratings. Normally the index is calculated over a three year period. However, the pandemic limited the data available this year and as such, the latest index are averages of two years of
data (2018-2019).

Water quality samples are obtained by Government of Yukon staff and local partners following standardized protocols and analyzed in Environment and Climate Change Canada laboratories, which are accredited by the Canadian Association for Laboratory Accreditation. Environment and Climate Change Canada performs further quality assurance and quality control to ensure datasets meet minimum data requirements for the analysis, and that calculation standards are respected.

The WQI index is based on a number of measured variables deemed to be most important. The set of variables is specific to each location, and therefore varies from site to site.

Incorporating traditional knowledge

The Government of Yukon's Water Resources Branch works with many partners, including Yukon First Nations governments and organisations, to better understand the water that sustains us all. In 2020, the Water Resources Branch launched an initiative to enhance our understanding and make space for Indigenous Ways of Knowing in the work we do.

An important part of this work includes strengthening our partnerships with Yukon First Nations. In 2021, the Water Resources Branch initiated a new partnership with the First Nation of Na-Cho Nyäk Dun to conduct joint water monitoring of three stations within Na-Cho Nyäk Dun Traditional Territory. These stations are located in the South McQuesten River, Haggart Creek and Cache Creek. Cache Creek is of particular interest because its water quality has drastically changed over the years.

The Water Resources Branch looks forward to continued collaborations with Indigenous partners. In addition to partnerships with First Nations, the Water Resources Branch is exploring ways to shift how we connect to the land at the sites we monitor and the kinds of information we collect.

Profile: South McQuesten River Study

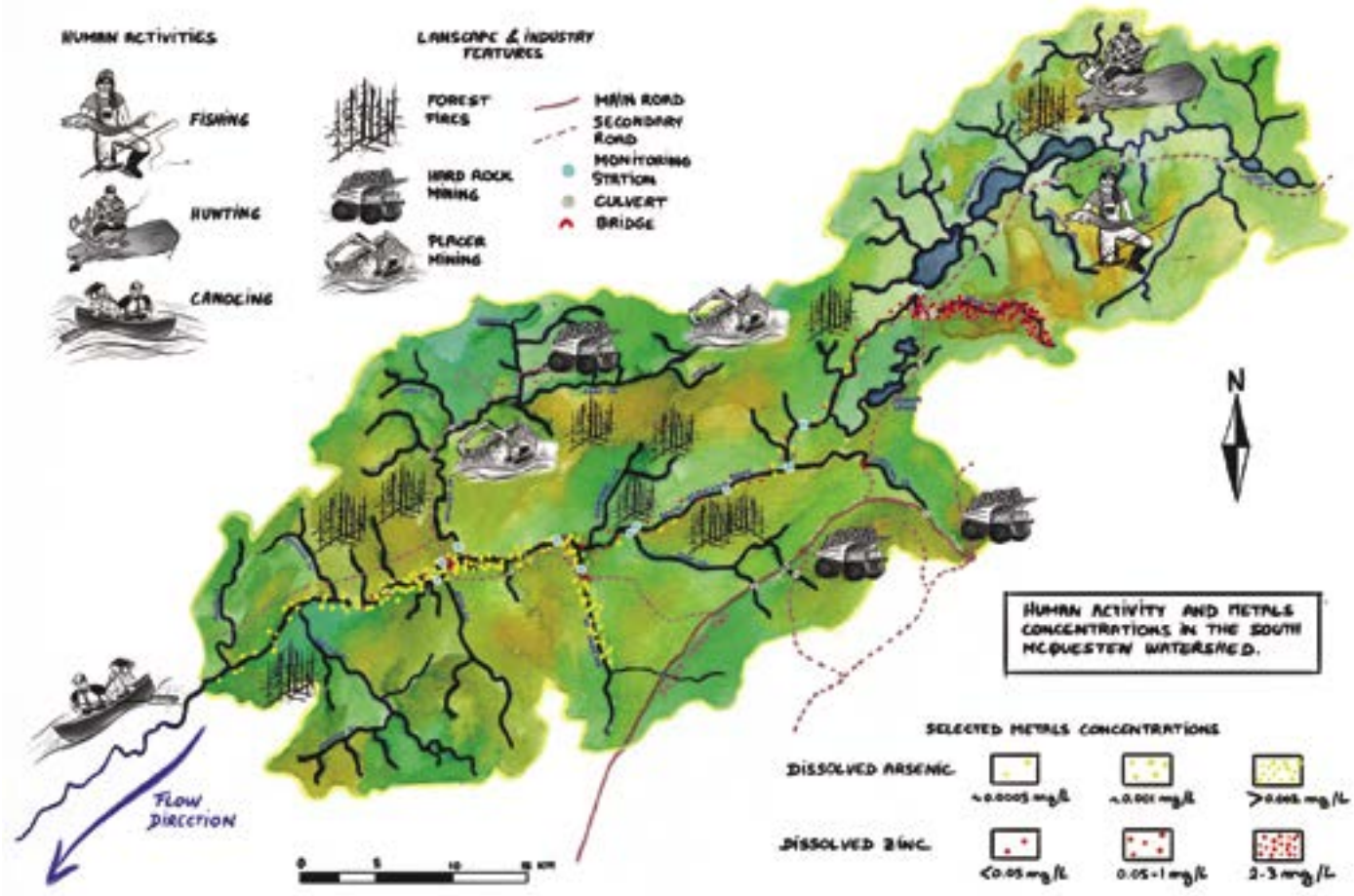
Yukoners use the South McQuesten River for a range of activities including hunting, trapping, fishing, recreation, and quartz and placer mining. The Government of Yukon completed a study to understand the cumulative impacts to the water quality of the South McQuesten River from modern and past development, as well as from natural sources.

The goals of the study were to:

- review the monitoring data along the river from historical monitoring stations;
- determine how water quality has changed over time; and
- develop water quality objectives for this river to inform future water management.

As part of this process, the Government of Yukon engaged with residents, rights holders and stakeholders in the South McQuesten River watershed to identify the best water management approach for the river.

This illustration was developed to communicate the various human activities in the South McQuesten watershed and concentrations of metals in waterways:



Human activity and metals concentrations in the South McQuesten watershed.
Illustration by Esther Bordet, Yukon Graphic Illustrations.

References

Canadian Council of Ministers of the Environment. 2014. Canadian Environmental Quality Guidelines [Cited 2022 Feb 2]. Available from: http://ceqg-rcqe.ccme.ca/en/index.html.

Government of Canada. n.d. National Long-term Water Quality Monitoring Data [cited 2022 Feb 2]. Available from: https://open.canada.ca/data/en/dataset/67b44816-9764-4609-ace1-68dc1764e9ea.

Ketza Mine Water Quality Sampling. Photo: Stephanie Lyons.

Ketza Mine water quality sampling. Photo: Stephanie Lyons.

Land

10. Population of the Yukon

Significance

Human population can have an impact on the state of the environment based on:

- how many people there are (population growth);
- where those people live (population distribution); and
- how close in proximity they live (population density).

Keeping track of these three population indicators can help in analyzing and predicting the impact that human activities can have on the environment.

What is happening

The Yukon has a very low population density overall. In the 2021 census, there were 0.1 people for every square kilometre in the Yukon. The Yukon's population is not distributed evenly. Many more people reside in southern Yukon, with approximately 79 per cent living in the Whitehorse/Marsh Lake area. The population density of this area, however, is still low at 3.8 people per square kilometre, because the population total incorporates Whitehorse and all surrounding areas (e.g., Ibex Valley, McPherson/Grizzly Valley, Marsh Lake and Mount Lorne).

Key comparisons:

- From June 30, 2011 to June 30, 2021, the Yukon's population increased by 7,659 people, or 21.6 per cent.
- From June 2020 to June 2021, the total Yukon population increased by 920 people, or 2.2 per cent.
- The greatest increases in population growth occurred in Whitehorse Area, Dawson City, Faro and Haines Junction.
- The Yukon's community populations have been fairly stable since 1990 except in Faro. The population in Faro was tied to the operation of the Faro mine that closed in April 1993, reopened in August 1995, then closed permanently in January 1998.

For more information on Yukon community socio-economics, visit the Government of Yukon Socio-Economic Web Portal at community-statistics.service.yukon.ca.

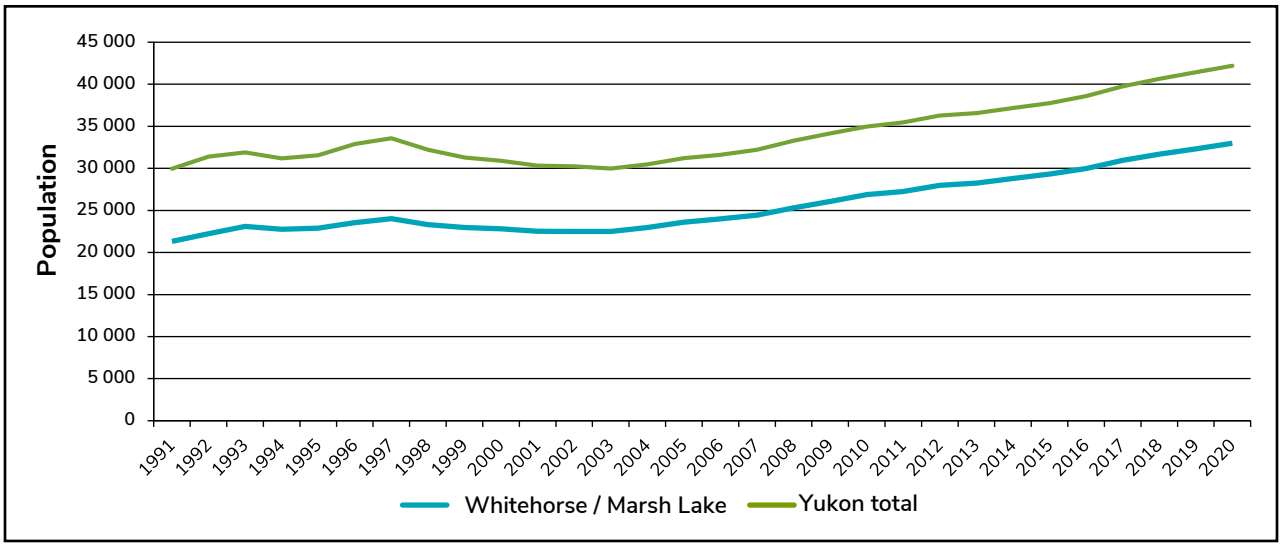


Figure 1: Population of the Yukon, 1991 to 2021. Source: Yukon Bureau of Statistics.

Data quality

Population density is calculated during the Statistics Canada census. Therefore, the most current data is from 2021. For the census, Statistics Canada divides data into 37 geographic census subdivisions that are different from the community divisions that the Yukon Bureau of Statistics uses for population estimates. For this reason, use population density information with care.

11. Regional land use planning

Significance

Land use planning is used to support effective land and resource management and are important obligations arising from Yukon First Nation Final Agreements. Chapter 11 of the Yukon First Nation Final Agreements established the regional land use planning process and represents a commitment by the governments to conduct regional land use planning in the Yukon.

Through land use planning, a regional commission, appointed by the Yukon and First Nations governments, prepares a regional land use plan in consultation with First Nations, stakeholders and residents. The plans are approved by the Yukon and First Nations governments and guide the future use and sustainable development of land in the planning region.

Regional planning is intended to reflect the traditional knowledge, experience and recommendations of residents, as well as incorporate science and broad socioeconomic and environmental interests. Developing long-term land use plans through public processes helps governments recognize and balance competing views about how lands and natural resources should be used.

What is happening

The Yukon Land Use Planning Council has proposed seven planning regions in the Yukon with two regional land use plans currently under development.

Regional land use plans under development

Dawson

Status: Current

The Dawson Regional Planning Commission released a draft land use plan on June 15, 2021 for public engagement ending November 1, 2021. During that period, the Commission also hosted a Cumulative Effects Workshop in September 2021 and a Dawson Region Wetlands Workshop in October 2021. Several public engagement sessions occurred in Dawson, Mayo and Whitehorse during this time. Following public engagement, the Commission began to consider all input received, and began working towards the next major phase of planning, moving from a Draft Plan to a Recommended Plan. Public engagement on the Recommended Plan began on September 19 and will run until November 20, 2022.

> "Land stewardship and maintaining a connection to the land are central to Tr'ondëk Hwëch'in culture. Heritage is not something from the past, but rather a way of life reflected in the beliefs, values, stories, knowledge and practices passed on from generation to generation. The Tr'ondëk Hwëch'in Final Agreement recognizes and protects this way of life which is based on an economic and spiritual relationship between Tr'ondëk Hwëch'in and the land. Other First Nations' and residents' perspectives on culture and heritage in the planning region are equally important to consider." (Dawson Regional Planning Commission 2021)

Peel Watershed

Status: Current

- By signing the ***Peel Watershed Regional Land Use Plan*** in 2019, the parties agreed to making special management areas legally protected areas. The parties are now working to identify the specific legal designation for each area.

Incorporating traditional knowledge

In 2021, the Yukon Land Use Planning Council contracted and released the ***Review of the Presence/Use of Traditional Knowledge in Regional Land Use Planning***. This report examined "nine regional land use plans in the Yukon, Northwest Territories, Nunavut and northern British Columbia to consider how traditional knowledge was used and how plans address broader Indigenous concepts about their relationship to the land and their way of life rooted in the land" (McKee 2021).

In the Yukon, two regional land use plans were reviewed:

- Peel Watershed Regional Land Use Plan; and
- North Yukon Regional Land Use Plan. Nichih Gwanał'in – Looking Forward (NYLUP)

References

Dawson Regional Planning Commission. 2021. Dawson Regional Planning Commission Draft Plan – June 2021. Dawson Regional Planning Commission, Whitehorse, Yukon, Canada. Available from: https://dawson.planyukon.ca/index.php/publications/draft/2011-draft-regional-plan/file.

McKee G. 2021. Review of the Presence/Use of Traditional Knowledge in Regional Land Use Planning. Prepared for Yukon Land Use Planning Council, Whitehorse, Yukon, Canada. Available from: https://planyukon.ca/index.php/documents-and-downloads/yukon-land-use-planning-council-documents/discussion-papers/1281-tk-rlup-2021/file.

12. Community and local area planning

No new data was available this year. Refer to ***Yukon state of the environment report 2020*** for the latest reporting information.

13. Status of parks and protected areas

Significance

Protecting parts of the land base provides a foundation for protecting biodiversity and ecological and cultural heritage.

The amount of land protected is indicative of the Government of Yukon's progress towards conserving biodiversity. The Government of Yukon reports protected area numbers internationally to support Canada's national and international targets and commitments.

What is happening

- Currently, the Yukon has 98,695 km^2 of land designated for conservation purposes. Of that, 92,307 km^2 is protected lands, just over 19 per cent of the Yukon's total area.
- In December 2021, portions of the special management areas (SMAs) identified in the ***Peel Watershed Regional Land Use Plan*** were included in the Yukon's protected area numbers. This is an addition of 35,420 km^2.
- Because the Yukon only reported the areas of the SMAs not under mineral disposition, this number is slightly smaller than the actual total area of the SMAs.
- For a full snapshot of the status of other parks and protected areas besides the Peel region, see the ***Yukon state of the environment report 2020***,

Taking action

Ongoing implementation of the Peel plan will determine the specific legal designations for those protected areas. New protected areas are anticipated to be established as a result of the Dawson regional land use planning process.

Data quality

- Numbers are based upon the calculated areas of Peel SMA map polygons, with the areas within the SMAs under mineral disposition as of November 1, 2021 being removed. The numbers were calculated this way with the agreement of all the parties to the ***Peel Watershed Regional Land Use Plan.***
- The Yukon Land Use Planning Council provided the Peel SMA polygons.
- Yukon's Protected Areas are annually reported to the Canadian Protected and Conserved Areas Database which supports Canada's national and international reporting on protected areas.

References

Peel Watershed Planning Commission. 2019. Peel Watershed Regional Land Use Plan. Government of Yukon, Whitehorse, Yukon, Canada. Available from: https://yukon.ca/en/peel-watershed-regional-land-use-plan.

14. Number, type, and location of environmental and socio-economic assessments

Significance

Environmental and socio-economic assessment is a process that identifies the potential environmental and socio-economic effects of proposed project activities that are required to be assessed under the ***Yukon Environmental and Socio-economic Assessment Act***, before they are authorized and carried out.

The Yukon Environmental and Socio-economic Assessment Board (YESAB) conducts assessments in the Yukon. When a potential adverse effect is identified and determined to be significant and adverse, YESAB assessors recommend mitigations to reduce, control or eliminate the effect. If the significant adverse effects cannot be mitigated, YESAB assessors must recommend that the proposed project not proceed.

YESAB directs its recommendations to decision bodies, which are federal, territorial or First Nations governments or agencies, who make the final decisions. The number, type, complexity and location of projects assessed by YESAB can indicate development pressures on environmental and socio-economic values; such as:

- impacts on wildlife and their habitat;
- impacts on air and water quality;
- impacts on fish and fish habitat, and
- permanent land conversion.

What is happening

- In 2021, 196 project proposals were submitted to YESAB for assessment. The Faro Mine Remediation proposal submitted for screening at the executive committee level is still in progress. Four common sectors that submit project proposals for assessment at the designated office level are placer mining, land development, quartz mining and transportation (Figure 1).

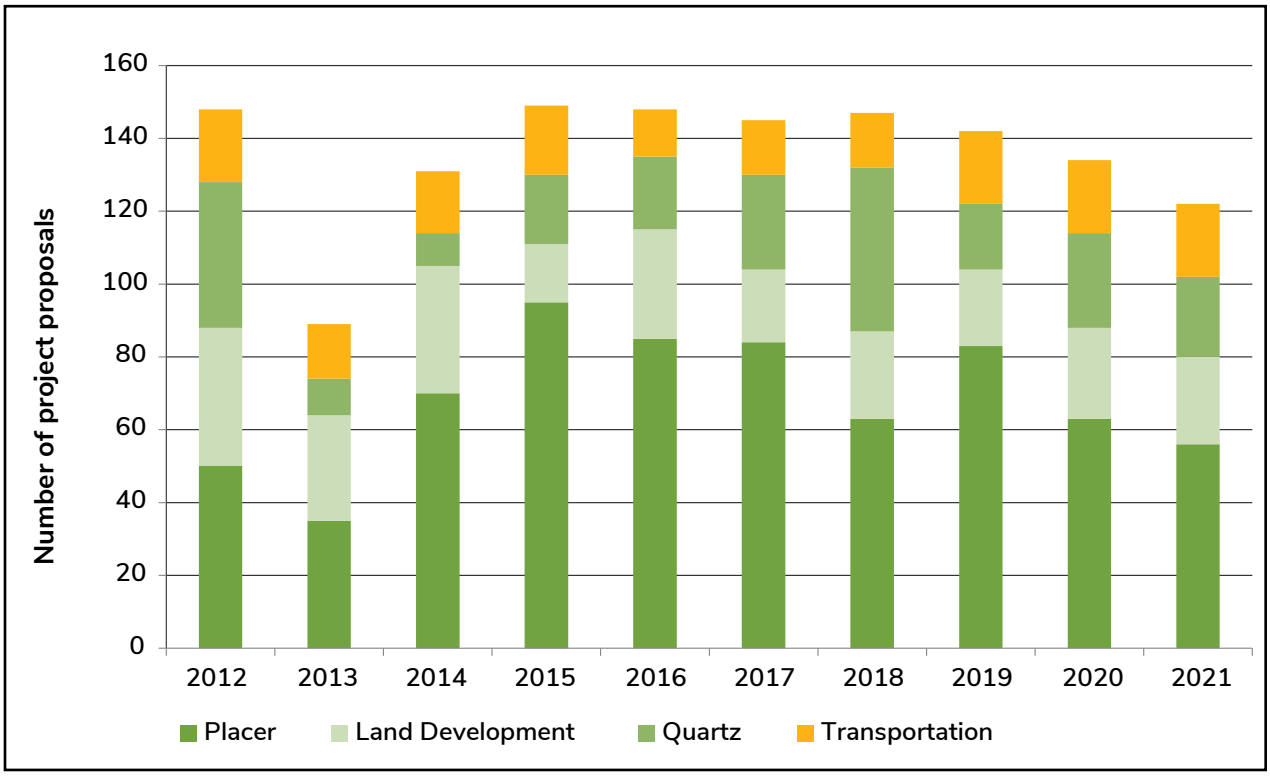


Figure 1: Total project submissions, 1991 to 2021. Source: YESAB 2021.

- In 2021, the majority of project proposals were received in the Dawson City, Haines Junction and Whitehorse districts (Figure 2). Whitehorse, given its population density, generates a large number of project submissions for residential and commercial activities. Examples include access roads, subdivisions, road upgrades and lot enlargements. Dawson City is a well-known mining district with a long history of placer mining. Haines Junction saw a range of project submissions including quartz, placer, tourism and energy.

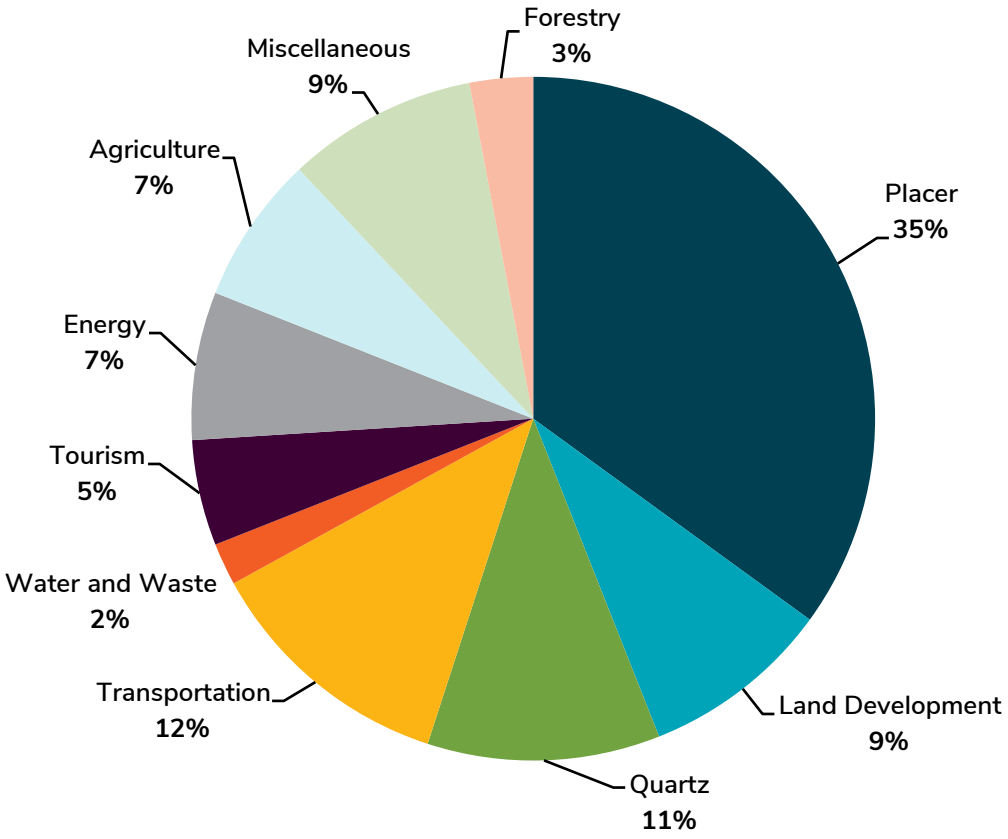


Figure 2: YESAB percentage of projects assessed by sector, 2021. Source: YESAB 2021.

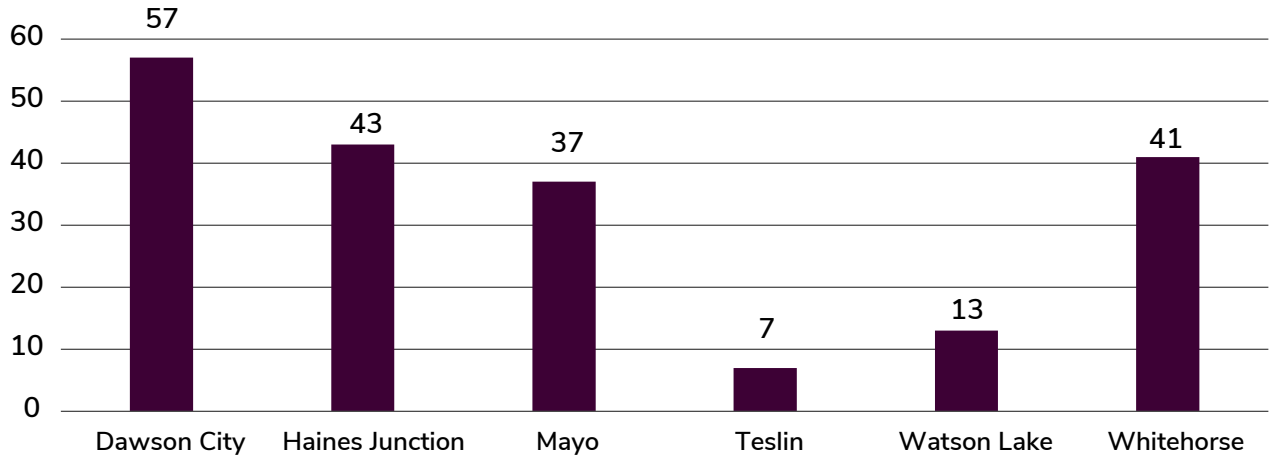


Figure 3: YESAB, project proposal submissions by Designated Office, 2021.
Source: YESAB 2021.

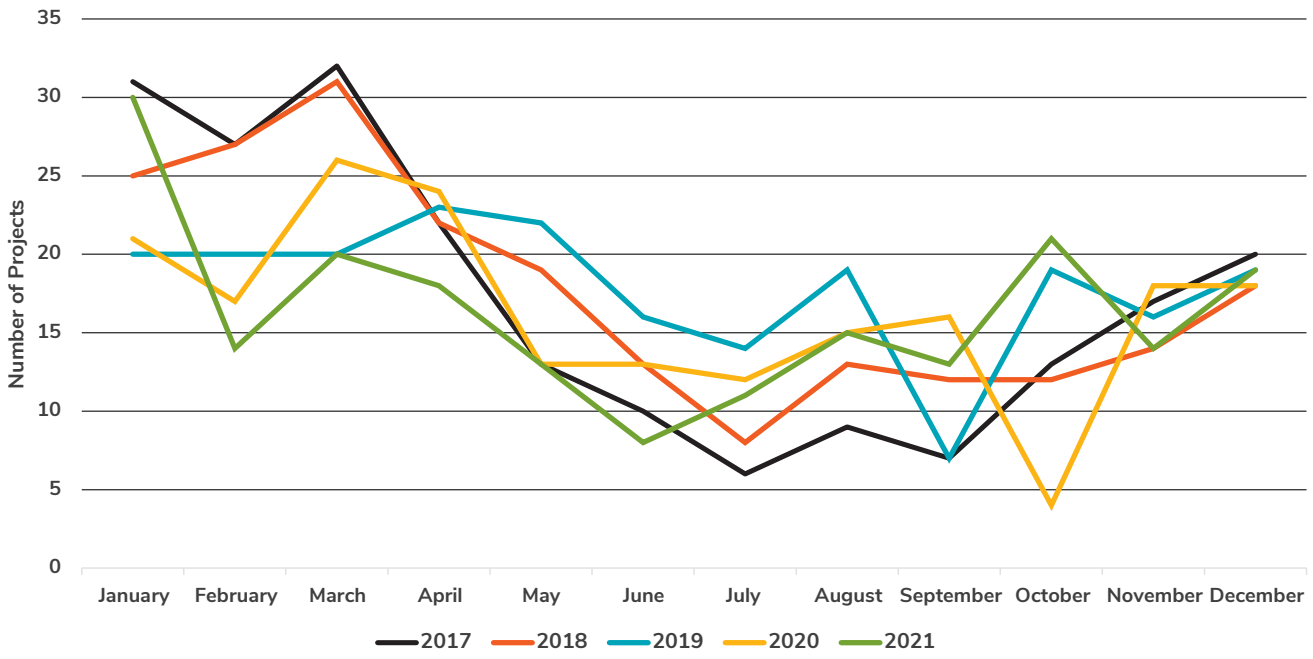


Figure 4: Designated office project submissions by month and year. Source: YESAB 2021.

Information regarding individual projects can be found on the YESAB On-line Registry (yesabregistry.ca).

15. Recreational land use

Significance

The Government of Yukon operates and maintains 42 road-accessible campgrounds. These provide access to outdoor recreation opportunities such as fishing, hiking, boating and wildlife viewing. Camping in territorial parks is an important outdoor recreation service that the Government of Yukon offers to citizens and visitors from around the world.

Each year, the Government of Yukon's Parks Branch collects data on campground visitation. The visitation data provides a picture of how Yukoners and tourists use the campgrounds in the territorial parks system. By understanding the trends in visitation, we can determine where our budget, staffing and infrastructure should be allocated, and where they are likely to be needed in the future. The data analysis can also help us understand how policies and regulations affect user behaviour (e.g., introducing a 24-hour limit for reserving campground sites).

2021 Campground visitation highlights

- 2021 was another busy year in our territorial parks and the first year of a new, longer serviced camping season (May to September).
- We hosted over 52,000 people for over 48,000 campsite-nights at our road-accessible campgrounds.
- This includes nearly 3,600 campsite-nights that both Yukoners and non-residents enjoyed during the extended season in early May and late September.
- In fact, 2021 set a new record for campground use by Yukon residents, at more than 36,000 campsite-nights.
- Total campground occupancy was up 16 per cent compared to 2020, while still 20 per cent lower than pre-COVID numbers in 2019.

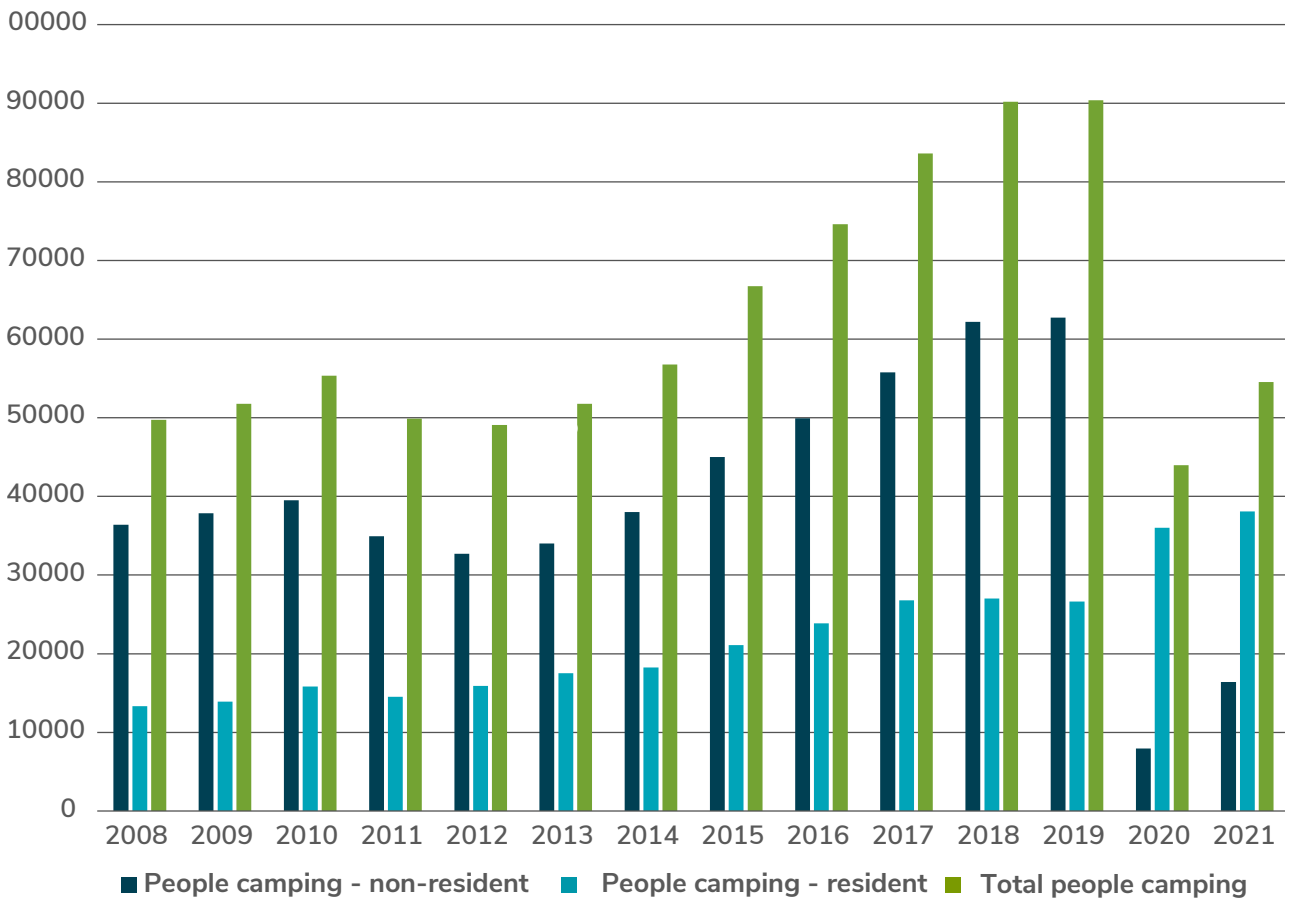


Figure 1: Number of people camping.

Taking action

Major actions in the *Yukon Parks Strategy* include:

- extending the serviced campground season to five months, from May 1 to September 30;
- building a new campground near Whitehorse with up to 150 campsites;
- developing new trails in territorial parks;
- increasing accessible wilderness experiences at boat-in and hike-in campsites;
- an online reservation system pilot project for some campsites; and
- expanding park infrastructure and adding additional campsites at existing campgrounds.

Other actions include developing a parks system plan to guide the development of existing and emerging parks and the establishment of future parks.

Other initiatives include developing a collaborative park management framework jointly with interested First Nations and Inuvialuit, partnering with Indigenous guardians, and engaging in discussions with Indigenous partners to explore how the idea of Indigenous Protected and Conserved Areas may apply in the Yukon.

Data quality

The Government of Yukon's Parks Branch tracks overnight visitation through campground registrations.

Registered visitors are calculated by person nights divided by average number of nights. This number includes repeat visitors.

There are other campsites operated throughout the territory, including the Government of Canada-operated Kathleen Lake Campground in Kluane National Park and Reserve, First Nations-owned and managed campgrounds, and several private RV campgrounds. Data from these sites are not included in this summary.

References

Government of Yukon. 2020. Yukon Parks Strategy. Parks Branch, Whitehorse, Yukon, Canada. Available from: https://yukon.ca/en/yukon-parks-strategy.

16. Waste handled at the Whitehorse waste management facility

Significance

Solid waste disposal in landfills can pose environmental and health risks, as well as land use planning challenges. Waste is costly to manage, whether it is sent to landfills, diverted through recycling and composting, or shipped outside the territory for treatment.

Landfill closure liability is a standard Public Sector Accounting Board principle that requires owners of landfills to account for the full costs of the closure and post-closure of a landfill.

In the Yukon, this has put financial pressure on municipalities to incorporate the liability, but has also provided an incentive for waste diversion as a means of lengthening the life of a landfill.

What is happening

The City of Whitehorse routinely monitors the amount of waste handled by the waste management facility. This includes waste that enters the landfill and waste that is diverted away from the landfill through composting or recycling (Figure 1).

Waste that enters the landfill come from four major sources:
Institutional, commercial and industrial;

- construction and demolition;
- residential, which includes domestic and household waste; and
- outside city limits – waste from outlying communities taken on a fee-for-service basis in order to lessen the landfill burden on those communities.

Fast facts

- **640 kilograms** – the total average, annual amount of waste per person landfilled in Whitehorse in 2021. This is a 12.3 per cent increase from 2020 (570 kg per person).
- **33 per cent** – the percentage of waste diverted from the Whitehorse landfill through recycling, composting, and reuse efforts. This is a one per cent increase from 2020, where the diversion rate was at 32 per cent.

In November 2018 the Canadian Council of Ministers of the Environment endorsed a Canada-wide aspirational waste reduction goal, meant to encourage and highlight waste reduction progress in Canada. The Canada-wide goal is to reduce average waste to 490 kg per person (a 30 per cent reduction) by 2030, and to 350 kg per person (a 50 per cent reduction) by 2040.

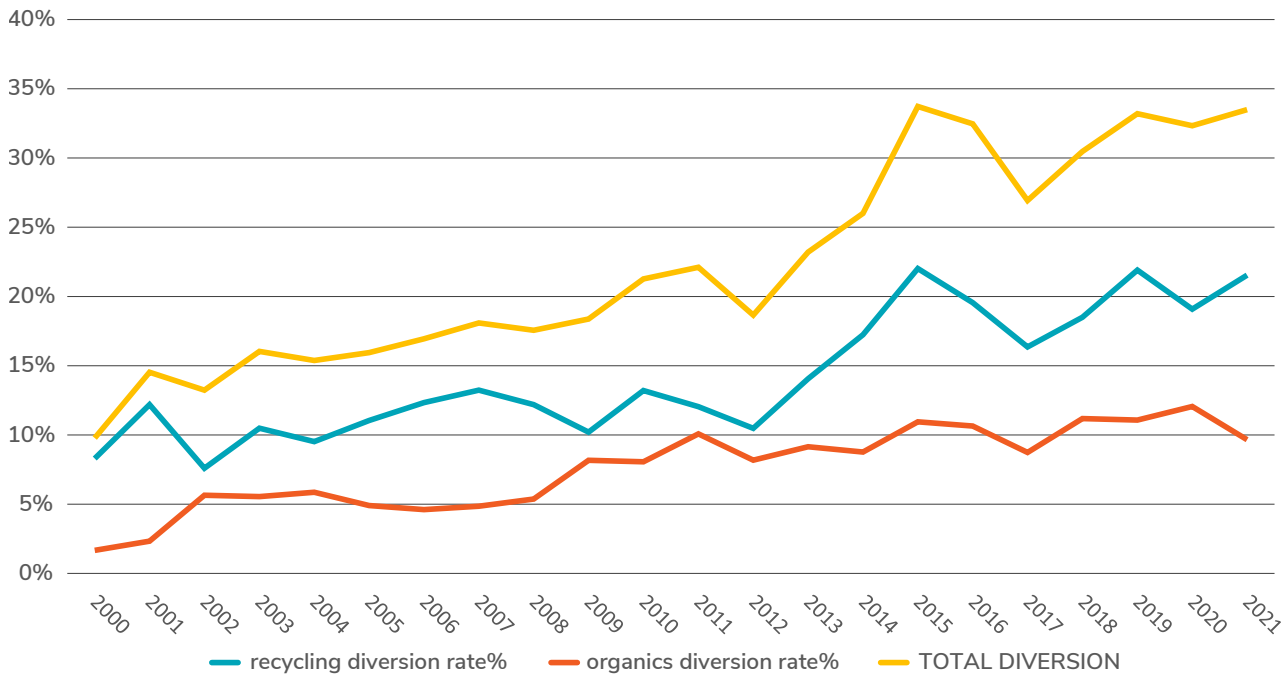


Figure 1: Diversion rate of organic and recycling materials vs. overall diversion rate of materials with data from the Whitehorse Waste Management Facility.

- Increases in the overall diversion rate since the early 2010s can be attributed to the City's 2013 *Solid Waste Action Plan*. Programs and policies which targeted diversion of cardboard and organics from the commercial sector have been planned and realized throughout 2015 – 2020.
- A decrease in the overall diversion rate in 2017 can be attributed to an increase in waste landfilled (in particular, construction waste from the demolition of F.H. Collins Secondary School).
- A further decrease in overall diversion rate between 2020 and 2021 can be attributed to a 19 per cent increase in construction and demolition waste.

Taking action

- In 2018, the City of Whitehorse changed its Waste Management Bylaw to ensure that the food service sector, followed by the multi-family residential sector, must participate in an organics collection service.
- In 2019, the City of Whitehorse expanded service to the vast majority of food service businesses, and continued the program expansion with multi-family residential by 2021.
- Preliminary data for the growth of organics diversion is promising.
- Organics from food service providers, cardboard and clean wood have become controlled waste under the City of Whitehorse's Waste Management Bylaw, which means that they are no longer welcome in the landfill and must be sorted.
- In October 2018, many electronic devices became banned waste under the City of Whitehorse Waste Management Bylaw, as a result of electronic waste being added to the Designated Materials Regulation. This change was part of a coordinated effort with the Government of Yukon. E-waste is now diverted for recycling through an e-waste collection depot established by the Government of Yukon.
- In 2015, the City undertook "back-end enforcement" of solid waste, establishing a compliance program at the working face of the landfill. Loads are inspected for compliance with the Waste Management Bylaw and a mixed load fee is charged to create an economic incentive to divert waste properly.
- Other initiatives include:
  - the creation of a multi-lingual waste sorting guide using visual education to help residents and businesses comply with the Waste Management Bylaw;
  - offering one-on-one assistance to businesses to identify waste diversion opportunities; and
  - creating a waste-sorting app called "What Goes Where?"
- City of Whitehorse compost is an OMRI (Organics Materials Review Institute) listed product. This means the quality of the compost is very high and can be used in organic gardens. In 2019 and 2020, demand for compost nearly exceeded available supplies.
- The compost facility is being upgraded to accommodate the growth of the program with funding support from the Government of Canada and Government of Yukon. The $4.4 million upgrade began in 2019 and was completed in Spring 2021. The upgrade, which includes a concrete pad for processing, will increase processing capacity, and reduce environmental impact of the compost process by capturing process water for re-use.
- A capital project is currently in the works for transfer station upgrades at the Whitehorse Waste Management Facility, including a new weigh scale, gatehouse and plans for reorganization of the public drop-off area. These upgrades are in the works for 2022 – 2024.
- The Government of Yukon announced in late 2021 that an Extended Producer Responsibility (EPR) policy will be in effect by 2025. This policy will help address current materials of concern including packaging and printed paper, automotive waste fluids and household hazardous waste products.

- As of 2022, the City of Whitehorse is currently working on updating its Solid Waste Action Plan (SWAP). This updated SWAP will address current issues including increasing overall diversion rates, updating relevant City bylaws including the Waste Management Bylaw, working with the construction and demolition section and institutional, commercial and industrial sector to increase diversion, seeking feedback from stakeholders and implementing new education and outreach initiatives. The plan is projected to be finalized and implemented sometime in 2023.

Data quality

- The Whitehorse population estimates are based on total Whitehorse area (excluding Marsh Lake but including people residing outside city limits) and were obtained from the Yukon Bureau of Statistics.

References

Canadian Council of Ministers of the Environment. n.d. Aspirational Canada-wide Waste Reduction Goal. Available from: https://ccme.ca/en/current-activities/waste.

Statistics Canada. 2015a. Table 17- 10-0009-01 (formerly CANSIM 051-0005) - Population estimates, quarterly [modified 2021 Dec 16, cited 2022 Feb 14].
Available from: www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710000901.

Statistics Canada. 2015b. Table 38-10- 0032-01 (formerly CANSIM 153-0041) - Disposal of waste, by source, Canada, provinces and territories, every 2 years (tonnes) [modified 2020 Jul 9, cited 2022 Feb 14].
Available from: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3810003201.

Whitehorse landfill.
Photo: City of Whitehorse.

17. Forest health

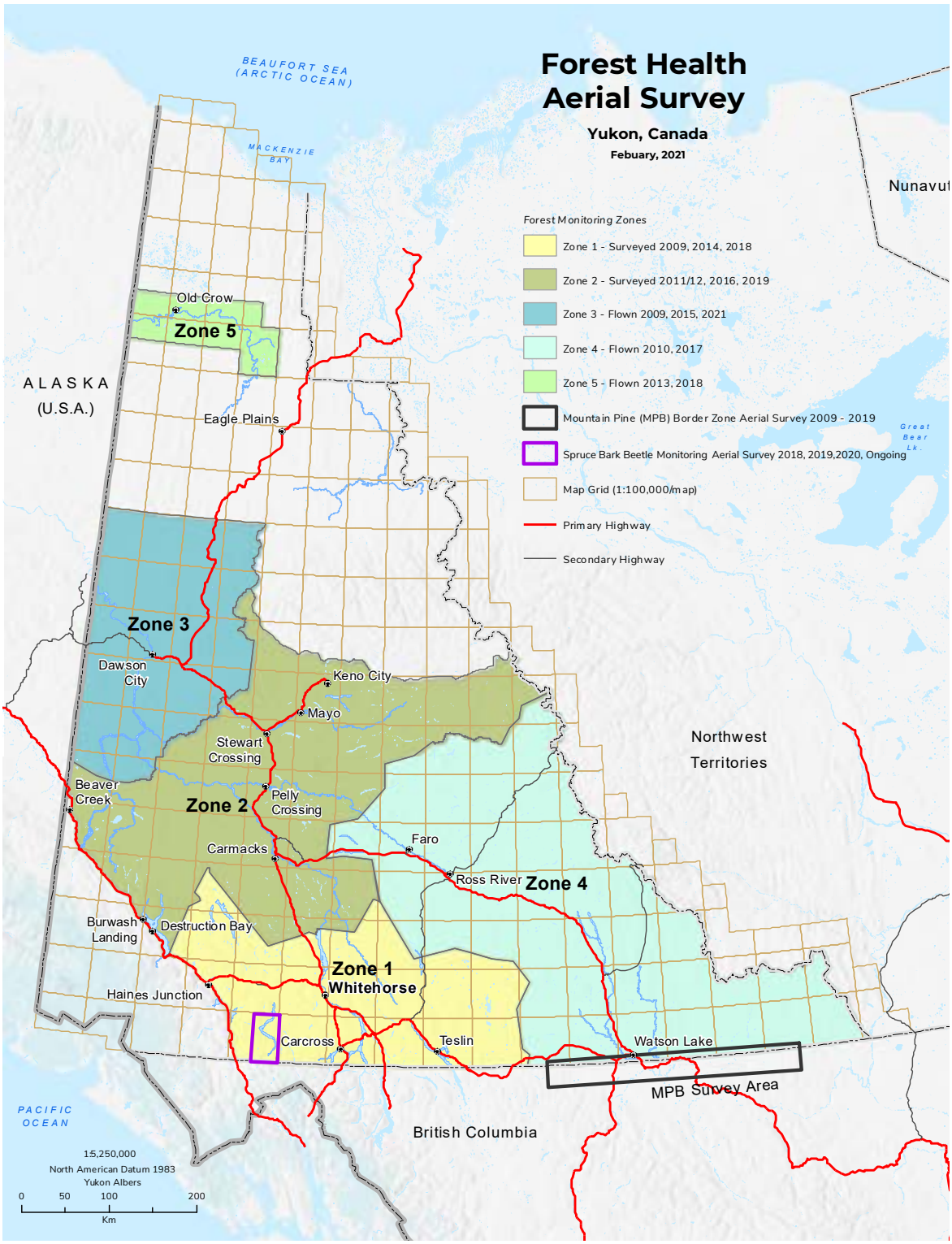
Significance

Native forest insects pose little concern at population levels that don't cause damage. Insects become an issue when their populations grow too large or when alien or native species show invasive behaviour. Active management interventions may be considered when an insect or disease outbreak has a measurable impact on ecology or the economy (Natural Resources Canada 2020).

The Government of Yukon's Forest Management Branch implemented a risk-based approach to monitoring forest health that is in line with the ***National Forest Pest Strategy*** in 2009 (Government of Canada 2020).

The objectives of the approach are:

- to provide a Yukon-wide overview of forest health issues;
- to focus monitoring activities on high-risk forest health agents in high value forest regions; and
- to contribute to the ***National Forest Pest Strategy*** goals, one of which is developing early detection and reporting capacity of forest health pests.



Map 1. Yukon Forest Health Zones map shows areas flown from 2009 to 2021.

What is happening

As a part of the Forest Management Branch's Risk-based Forest Health Monitoring Program, the following activities were conducted in 2021:

- aerial overview surveys;
- Mountain Pine Beetle pheromone bait deployment; and
- spruce beetle monitoring in the Kusawa Lake area.

Aerial overview surveys were conducted in Forest Health Zone 3 (FHZ 3, Map 1). In 2021, the Forest Management Branch also responded to a variety of public reports; they conducted ongoing bark beetle monitoring near Haines Junction, ground surveys and pheromone trapping to assess bark beetle risk near Deep Creek, and windthrow assessment in Takhini River Valley.

Forest health disturbances

The Forest Management Branch maps two types of disturbances.

- **Biotic disturbances** are living disturbances, and include native and invasive insects and diseases.
- **Abiotic disturbances** are non-living disturbances caused by weather or wildfires.

Declines and pest complexes are generally a combination of biotic and abiotic factors. Unless otherwise stated, the following summarizes disturbances mapped in FHZ 3.

Biotic disturbances

Spruce Bark Beetle *(Dendroctonus rufipennis)*

- In 2021 aerial surveys recorded 2,274 hectares of trace (less than one per cent) attack, east of Dawson, near Brewery Creek in FHZ 3.
- Ongoing monitoring of the spruce beetle infestation at Kusawa Lake mapped 1,394 hectares of trace (less than one per cent) attack in stands previously infested, e.g., with red and grey trees.
    - The ratio of old attack to new attack continues to be low.
    - The Forest Management Branch will continue to monitor this area as part of their proactive approach to forest health management.

Photo 1. Scattered "faders" (yellowing of needles indicating current attack) associated with 2020 spruce beetle flight and attack at Kusawa Lake in FHZ 1.

Aspen Serpentine Leafminer *(Phyllocnistis populiella)*

- This leafminer has been present in Trembling Aspen stands every year for the last three decades with variation in annual levels, severity and extent. In 2021, area infested increased tenfold to 53,101 hectares, up from 5,366 hectares in 2015. The silver leaf tone characteristic of Aspen Serpentine Leaf miner was noted throughout the host range (Photo 2).
- The longevity of this outbreak is thought to be contributing to aspen decline, as over half of the infested stands showed signs of decline and reduced growth due to reduced photosynthetic activity associated with underside leaf mining.

Photo 2. Scattered light to moderate Aspen Serpentine Leafminer in FHZ 3.

Large Aspen Tortix *(Choristoneura conflictana)*

- In FHZ 3 the area defoliated by Large Aspen Tortrix decreased slightly to 33, 139 hectares from 44, 414 hectares in 2015, most of which was east of the Yukon River and along the Klondike River east of Dawson.
  - The majority (83 per cent) was in association with aspen decline, as dieback associated with successive years of defoliation persists in previously defoliated stands.
- Defoliation totaling 643 hectares was also noted in FHZ 2 in infested stands adjacent to FHZ 3.

Photo 3. Severe Large Aspen Tortrix defoliation in FHZ 3.

Eastern Spruce Budworm *(Choristoneura fumiferana)*

- Aerial surveys were conducted near Stewart Crossing following reports, in both 2019 and 2020, of defoliation on spruce near Stewart Crossing area on Ferry Hill and along the ridges above Silver Trail highway.
- Aerial surveys found no evidence of defoliation; however, forestry crews observed light patches of defoliation on spruce at McQuesten River (Photo 4). Visible defoliation in the Yukon aligns with the current outbreak occurring in the Northwest Territories.
- Aerial overview surveys will be conducted in 2022 along the McQuesten River to determine the extent and severity of this infestation, as well as high hazard stands in the Peel River drainage near the Northwest Territories.

Photo 4.
Spruce Budworm defoliation in the crowns of White Spruce adjacent to the McQuesten River in FHZ 2.

Foliar diseases

- Foliar diseases, including rusts, occur on virtually every tree and shrub species in the Yukon, with higher incidence generally associated with increases in precipitation.
- Many foliar diseases require alternate hosts to complete their life cycles.

Spruce Needle Rust *(Chysomyxa ledi)*

- Discoloration of foliage by Spruce Needle Rust was recorded over 6,997 hectares in 2021 (Photo 5), mostly the southern portion of FHZ 3 on both sides of the White River and west side of Yukon River, with a few areas east of Dawson City.
- This foliar disease was prevalent in 2011, and thought to be quite extensive based on the reports of a yellowish hue to the Yukon River by residents. Spruce stands just west of Dawson City, adjacent to the Top of the World Highway, were most severely affected. The area affected was quite extensive, with almost all current year's needles lost to this foliar disease. In mid-summer, there were reports from Dawson that the surface of the Yukon River was bright orange, a result of the millions of spores that had been shed from rust-infected needles from upstream spruce stands (Photo 6).

Photo 5. Moderate discoloration of mature spruce caused by spruce needle rust near Independence Creek, east of White River.

Photo 6. Severe infection of spruce needle rust on current year's growth in 2011.

Abiotic disturbances

Windthrow

- Windthrow means trees uprooted by strong winds.
- Shallow-rooted tree species or those on coarse or shallow soils are more prone to windthrow.
- In 2021, 914 hectares of Lodgepole Pine and spruce windthrow were mapped in the Takhini River Valley, north of Mount Vanier (Photo 7).

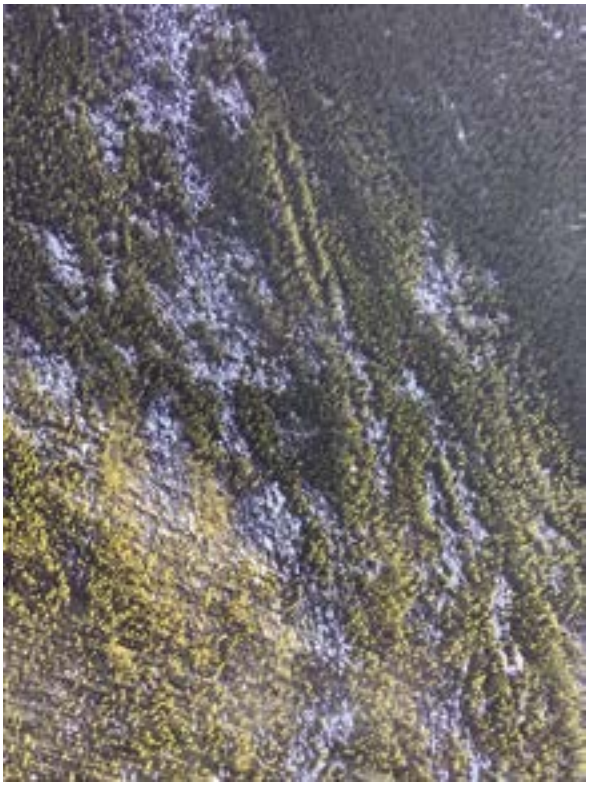


Photo 7.
Old and new windthrow of Lodgepole Pine and spruce near Takhini River in FHZ 1.

Flooding

- Only three hectares in four different locations were mapped in 2021, down from 67 hectares in 2015.

Pest complexes

Aspen decline

- Aspen decline or dieback refers to mortality or damage to forests due to a combination of biotic and abiotic factors (Photo 8).
- Spatial analysis and ground checks have found a relationship between aspen decline symptoms and frequency and severity of defoliator outbreaks.
  - Reconnaissance plots in 2016 in the highway corridor between Dawson and Whitehorse confirmed the spatial analysis results. Stands which experienced two or more years of defoliation showed signs of decline.

- In FHZ 3, the area with symptoms of aspen decline increased tenfold to 55, 250 hectares from 5,621 hectares in 2015.
  - Half of the area with aspen decline were in areas with Large Aspen Tortrix.
- Mapping aspen decline is challenging, as more subtle symptoms of aspen decline require perfect lighting for aerial detection, while stands with advanced symptoms are not as noticeable as all of the stems have fallen to the ground. It is possible that some stands which were previously severely affected have since fallen apart, or have regenerated to Trembling Aspen.

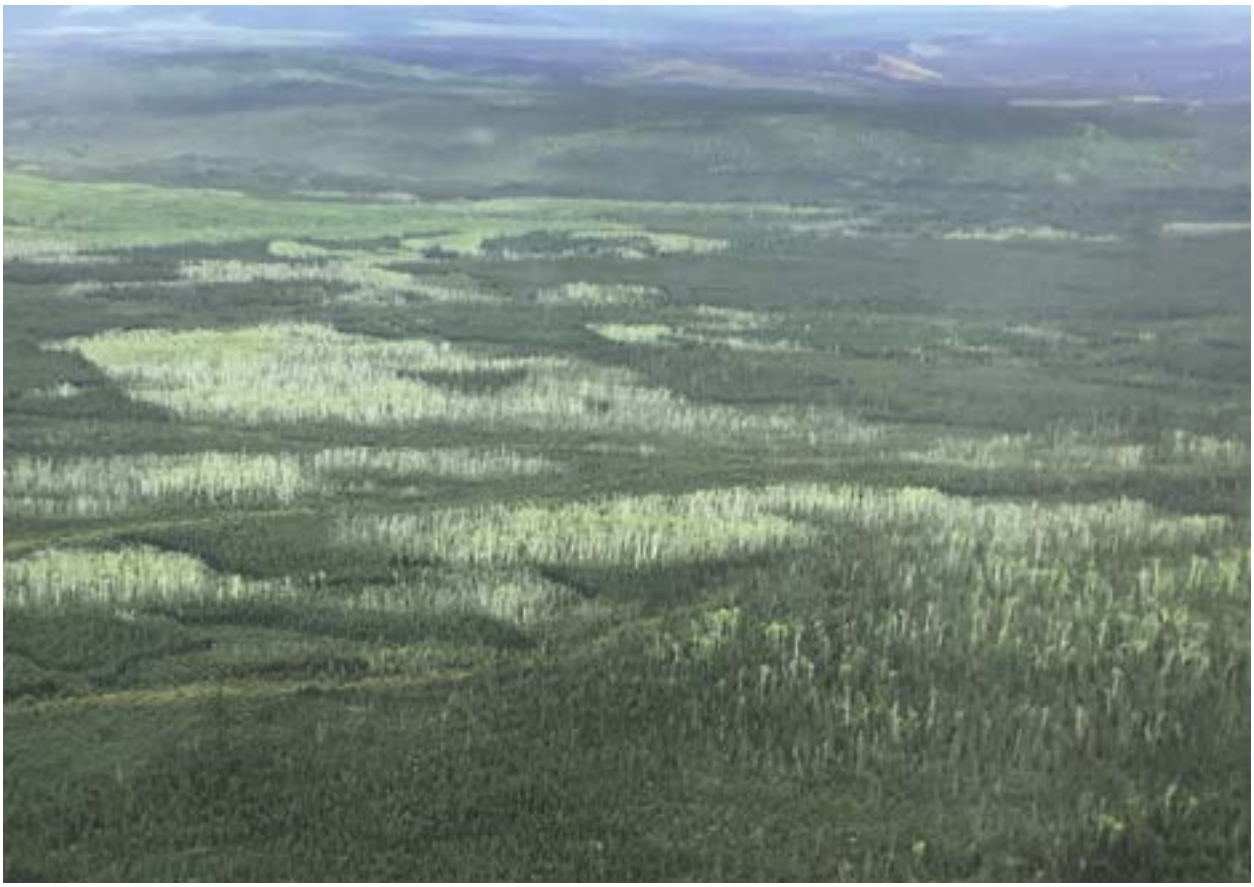


Photo 8. Severe aspen decline with Aspen Serpentine Leafminer in FHZ 3.

Table 1. Summary and history of forest health disturbances recorded in FHZ 3 in 2009, 2015 and 2021, and a small portion of FHZ 1 and FHZ 2 where special surveys were conducted.

	FHZ 1		FHZ 2	FHZ 3		
Disturbance Type	**2019**	**2021**	**2021**	**2009**	**2015**	**2021**
Biotic						
Aspen Serpentine Leafminer		4,705	197	180,118	3,801	24,468
Aspen Serpentine Leafminer/Large Aspen Tortrix				0	177	15,333
Large Aspen Tortrix		1,760		0	42,849	5,457
Large Aspen Tortrix/Aspen Serpentine Leafminer				3,130	1,388	
Spruce beetle	709 (old)	1,394 (old with <1% current attack)		32	0	2,274 (old with <1% current attack)
Willow Blotch Miner		0.25		1,429	30	
Spruce needle rust			224			6,997
Porcupine						
Abiotic						
Flooding				259	67	3
Drought - spruce				613	0	
Landslide				23	0	
Windthrow		914 (old and new)		13	0	
Pest Complexes						
Aspen decline			810	602	5,621	14,268
Aspen Serpentine Leafminer/aspen decline			2,369			12,030
Aspen Serpentine Leafminer/Large Aspen Tortrix/aspen decline						920
Large Aspen Tortrix/aspen decline			643		0	27,678

	FHZ 1		FHZ 2	FHZ 3		
Disturbance Type	2019	2021	2021	2009	2015	2021
Large Aspen Tortrix/aspen decline/Willow Leaf Miner						4
Aspen decline/Aspen Serpentine Leafminer						350
Spruce beetle/flooding						2
Porcupine/Pine Engraver Beetle		0.5				
Windthrow/Pine Engraver Beetle		118				

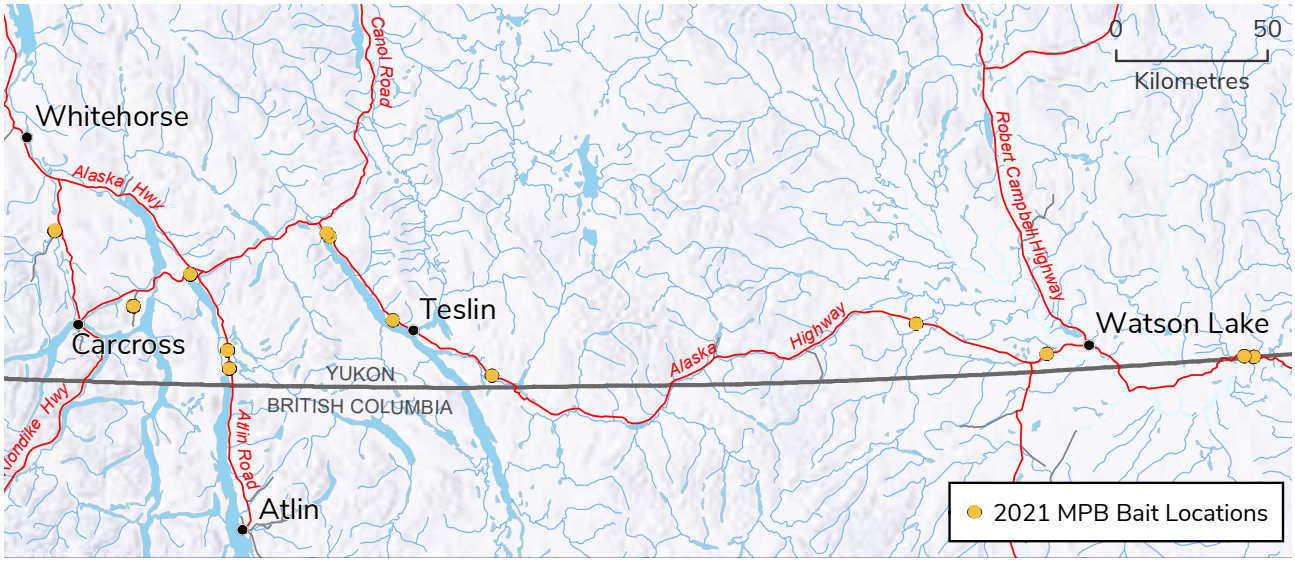
Taking action

In addition to the annual aerial survey monitoring of the forest health zones, the Government of Yukon's Forest Management Branch undertakes special projects as described below.

Proactive management of Mountain Pine Beetle

Since 2010, the Forest Management Branch has conducted proactive aerial surveys in the border area in the southeast Yukon. This border zone straddles the Yukon/BC border with 5 km in the Yukon and 25 km in BC, and contains highly susceptible Lodgepole Pine stands. In 2019, Yukon aerial surveys were discontinued following several years of no detection of Mountain Pine Beetle in the border zone. The Forest Management Branch reviews BC's aerial surveys annually to determine if Yukon monitoring will be reinstated based on results of the BC aerial surveys. Unconfirmed 2021 findings from BC's aerial surveys in the border zone found four MPB spots, totaling 13 trees in the border zone. The Forest Management Branch resumed monitoring the border zone in 2022, starting with ground-truthing the four spots to confirm the presence of Mountain Pine Beetle.

The Forest Management Branch has also been setting up and monitoring 15 pheromone bait tree stations in the southern Yukon and northern BC since 2009 to detect the presence of Mountain Pine Beetle (Map 2). These pheromone baits do not attract Mountain Pine Beetle over long distances, but will draw them to the baits if they are already in the area. They also do not attract other species of bark beetles. No presence of Mountain Pine Beetle was found in 2021.



Map 2. Location of mountain pine beetle pheromone baiting sites in the southern Yukon.

Proactive management of Spruce Bark Beetles: pheromone trapping in the historical outbreak area

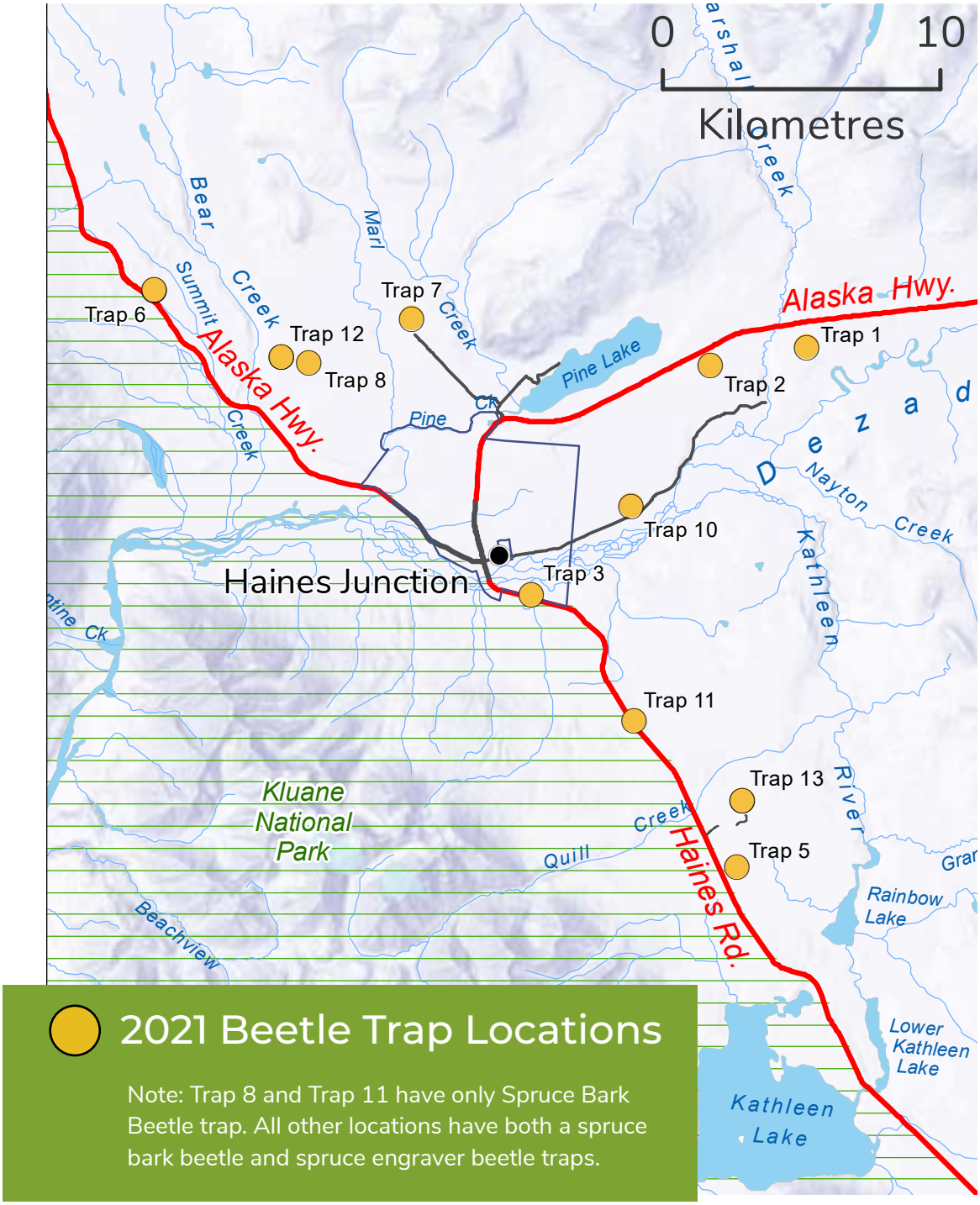
In 2018, a Spruce Bark Beetle *(Dendroctonus rufipennis)* monitoring program using Lindgren funnel traps was established in the Haines Junction area and has been ongoing since then (Map 3). In 2021, the monitoring program expanded to include Northern Spruce Engraver, *Ips perturbatus*.

The objectives of the program were fourfold:

1. to monitor populations of both beetle species in Haines Junction timber harvesting planning areas;
2. to better understand the timing of their flight period in the Haines Junction area;
3. to determine the spatial distribution of both species in the Haines Junction area; and
4. to detect increases in either species should they occur.

Trap catches for Spruce Bark Beetles in 2021 were very low, with only 43 spruce beetles caught in 10 traps spanning 10 locations (Map 3). This is down by almost half of that captured in 2020, and marks the third consecutive year of decreasing populations.

Trap catches for the Northern Spruce Engraver Beetle in 2021 were very high, with over 15,000 northern spruce engraver beetles caught in eight traps spanning eight locations (Map 3).
To date Ips-induced mortality has not been observed on standing trees, as they are likely attacking slashed down woody material within the recently harvested areas. The Forest Management Branch will continue to monitoring the Haines Junction area for outbreaks of beetles due to the high amount of Northern Spruce Engraver Beetles caught in 2021.

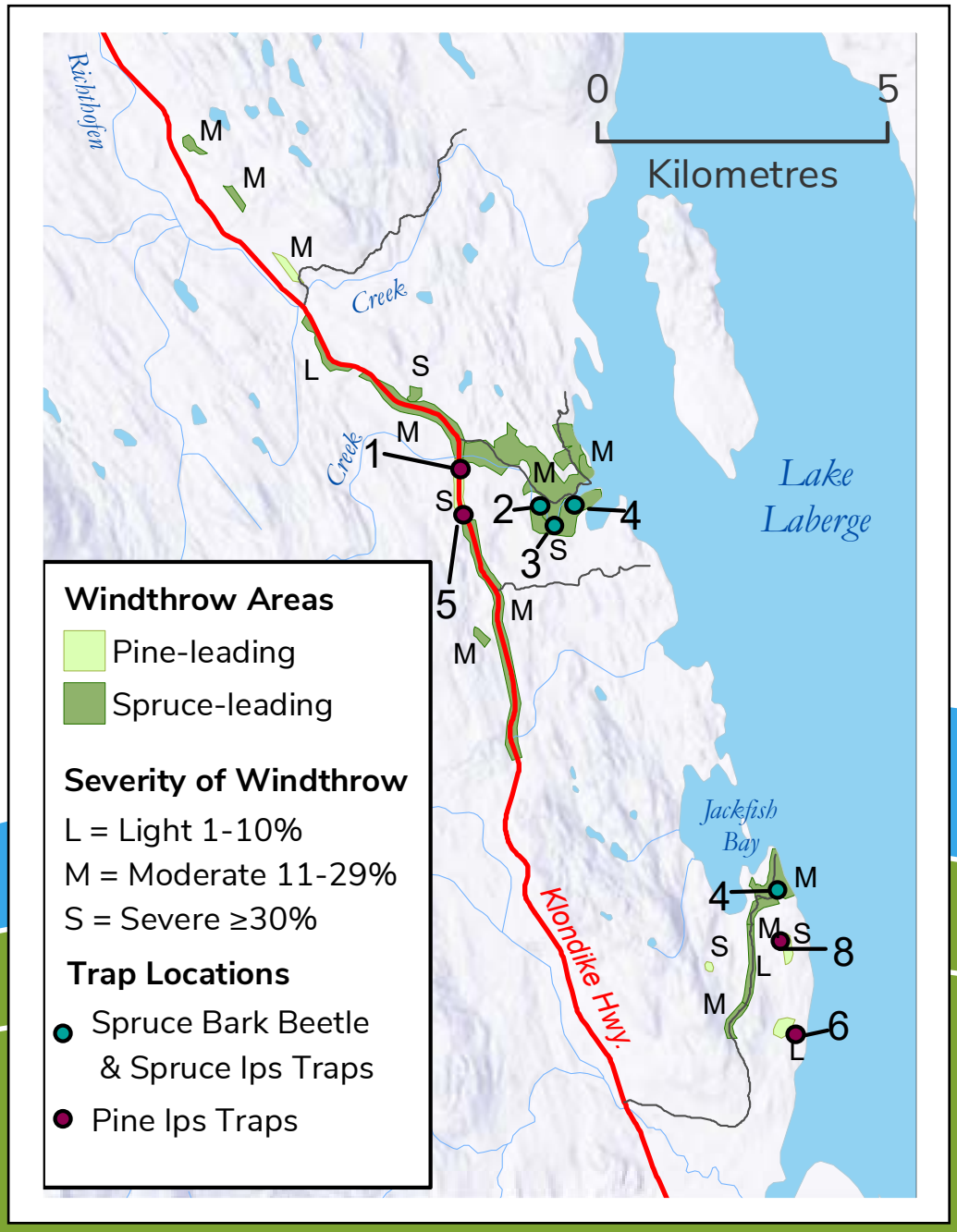


Map 3. Location of bark beetle pheromone monitoring traps near Haines Junction.

Bark beetle risk assessment at Deep Creek

In October of 2020 a windthrow event occurred north of Whitehorse at Deep Creek near Lake Laberge (Map 4). In accordance with proactive management, the Forest Management Branch completed a pest risk analysis to determine if any risk existed to standing forests from current or future bark beetle populations resulting from the windthrow. At the time, Spruce Bark Beetle, Northern Spruce Engraver Beetle, and Pine Engraver Beetle were deemed pests of concern.

Part of the risk response outlined in the 2020 Deep Creek Pest Risk Analysis was ongoing monitoring to re-evaluate the risk. This was accomplished via ground assessments and pheromone trapping. In 2021 all three beetle species were captured, with the highest counts from Northern Spruce Engraver Beetle. This was also the only beetle found attacking the windthrow (Photo 10), albeit at low levels. No successful attacks were noted in adjacent healthy trees. Monitoring continues in 2022.



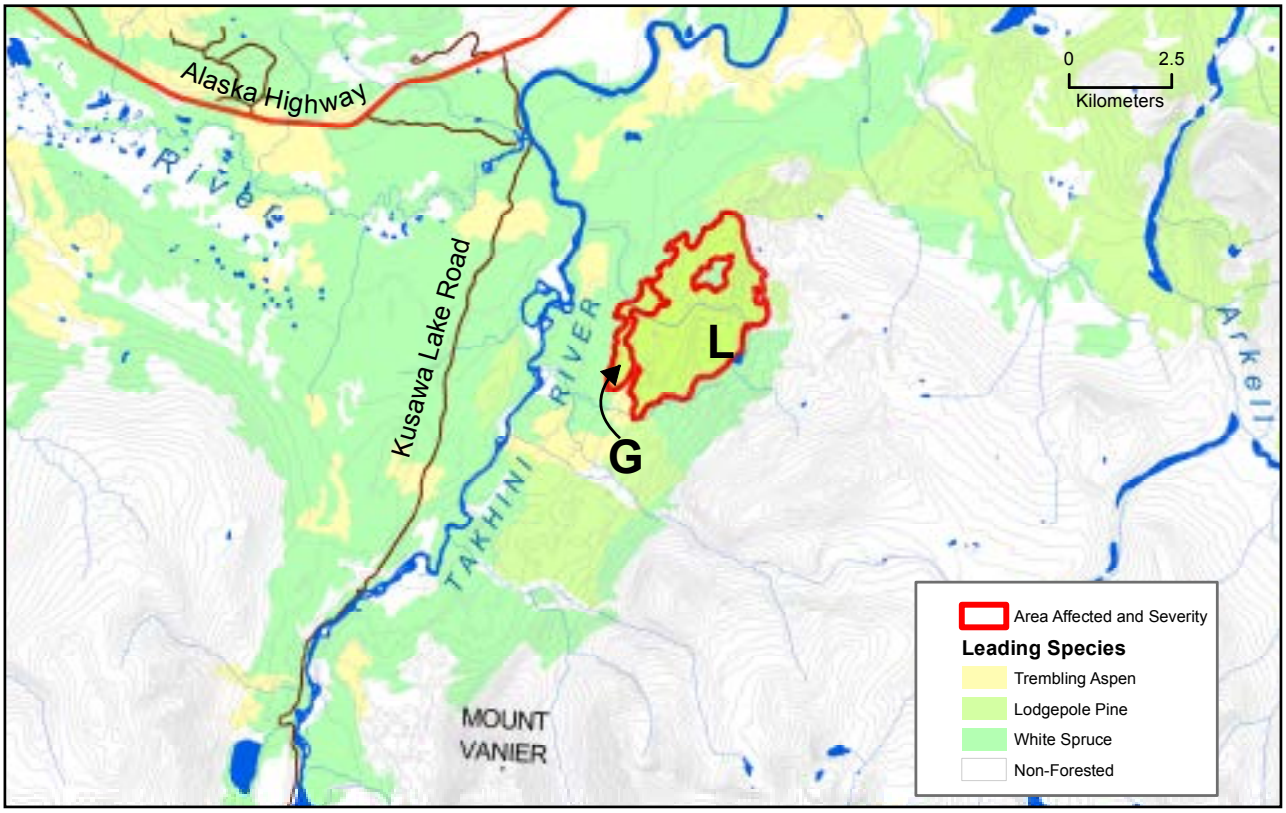
Map 4. Windthrow severity and location of pheromone monitoring traps in relation to leading species near Deep Creek.

Ground assessments at Takhini River Valley

Lodgepole Pine and spruce windthrow was examined in the Takhini River area to determine causal factor and identify any current or future risks (Map 5). Ground assessments found:

- that trees had all fallen in one direction indicating windthrow rather than root disease; and
- windthrow is cumulative in that it has occurred over a period of time, and not all from one wind event.

Old Pine Engraver beetle *(Ips pini)* attack was also observed, including top kill in standing dead trees weakened by attack of Lodgepole Pine Beetle *(Dendroctonus murrayanae)*. Both beetle species attack Lodgepople Pine that are weakened, including by windthrow. No new beetle attacks were observed.



Map 5. Location of Lodgepole Pine and spruce windthrow near Takhini River.

Data quality

- From 1950 to 1995, the Forest Insect and Disease Survey (FIDS) was conducted by the Canadian Forest Service. From 1995 both the Canadian Forest Service and the Forest Management Branch conducted aerial surveys monitoring Spruce Bark Beetle near Haines Junction. In 2009, with National Forest Pest Strategy funding, the Forest Management Branch adopted the aerial overview survey program and have been conducting annual aerial surveys since then. The Forest Management Branch has conducted forest health aerial surveys at a landscape level since 2009 to identify both biotic and abiotic disturbances.
- Aerial overview surveys and ground field checks are a relatively simple and low-cost method for effectively monitoring forest health over large areas (Ciesla 2000; Mitton and Grant 1980). Aerial overview surveys are also adequate for regional and provincial summaries and to meet national requirements for the Forest Health Network (BC Ministry of Forests, Lands and Mines and CFS 2000).
- As a result, aerial overview surveys are the primary tool for monitoring forest health in Yukon. The forest health aerial overview survey standards used by the BC Ministry of Forests, Lands and Natural Resource Operations are also used in the Yukon, which ensures continuity across shared boundaries. Field checks are important for validating the data collected from the aerial surveys. Researchers check a portion of surveyed areas to confirm the identity and severity of the pest or disease disturbance.
- As of 2013, all five forest health zones in the Yukon were monitored by aerial overview survey. Baseline data has been collected from each forest health zone. Hence, from 2014 on, mapping resolution moved from eight-kilometre gridlines to 12-14 kilometre gridlines. During the monitoring of the forest health zones, researchers may select disturbances for further monitoring in the same year. If necessary, these disturbances are identified as ongoing monitoring areas to be included along with the forest health zones scheduled for aerial surveys during the current year.

The Forest Management Branch's Forest Health Program contains ground survey protocols to predict insect population trends, as well as evaluate the potential risk from various insect pests.

Further information

Forest management information: Yukon.ca/en/science-and-natural-resources/forests.

The Forest Management Branch produces an annual forest health report, which presents the biotic and abiotic disturbance(s) detected by the annual forest health survey. The survey is performed in a different area (forest health management zone) each year.

Annual forest health reports:
Yukon.ca/en/science-and-natural-resources/forests/learn-about-forest-health.

Forest health brochures featuring main pests and pathogens of the Yukon:
Yukon.ca/en/science-and-natural-resources/forests/learn-about-forest-pests-and-diseases.

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18. Wetlands

Significance

Wetlands can be essential for maintaining water flows, flood protection, purifying water, recharging/discharging groundwater, and providing habitat for fish and wildlife. Some wetlands support traditional subsistence and cultural activities and provide for recreation. Wetlands can also provide a number of additional valuable functions including:

- slowing the flow of water, thereby reducing erosion;
- providing habitat for plants that help stabilize stream banks and shorelines;
- creating and fertilizing floodplains;
- supporting the food chain;
- storing large quantities of soil carbon;
- enhancing aesthetics; and
- serving as a rich arena for education.

The Government of Yukon recognizes five classes of wetlands, as defined in the Canadian Wetlands Classification System (1997): bogs, fens, swamps, marshes and shallow open water. These classes are determined by soil, vegetation, water and other ecological characteristics.

The largest concentrations of wetlands in the Yukon are located in areas with continuous permafrost beneath them, in particular in the northern Yukon (for example, the Old Crow Flats); however, wetlands and wetland complexes are present throughout the territory.

Wetlands are important for a disproportionally high number of species compared to many other habitats, which is reflected in the number of protected areas in the Yukon that include wetlands.

What is happening

The Government of Yukon is furthering wetlands management through development of policies, decisions and guidance at a broad territory-wide, regional, and local watershed level.

There are a number of important wetlands identified as “significant” in the Government of Yukon’s Wildlife Key Areas inventory, accessible by using the online GeoYukon map tool. Many of our existing and proposed protected areas include important wetland habitat.

As needed, wetland inventory is conducted to support various governments and nongovernment projects and planning processes.

There are bird monitoring programs in place in a number of wetland complexes recognised for their value to migratory birds, which can provide an indication of wetland ecological health (i.e., waterfowl monitoring.)

Taking action

The Government of Yukon remains committed to finalizing a wetlands stewardship policy for the Yukon in 2022. We invited other governments and external organizations with an interest in wetlands to be partners in developing the policy. Roundtable meetings occurred throughout 2018 and 2019. In 2020, we have continued to develop this policy, completing a review and discussion of a draft policy with our partners. In December 2021, we completed a broader public review of a draft policy. Find more about the process on Yukon.ca/engagements/yukon-wetlands.

The Dawson Regional Land Use Planning Commission released their draft land use plan in 2021. Wetlands are a key ecological value within this land use plan, and the Commission, along with the parties to the plan, continue to work to define a wetlands stewardship regime that will provide effective conservation and opportunities for industrial activity within the Dawson planning region.

At a more local level, the Government of Yukon has established an interim approach (Government of Yukon 2020) to managing impacts of placer mining on wetlands in the Indian River area. Under this interim approach, specific requirements for protection of certain classes of wetlands are defined, as well as commitments to progressive reclamation for placer mining in the area. The interim approach has also committed us to working with Tr’ondëk Hwëch’in to develop reclamation guidelines and conduct further study on wetlands in the area.

Additionally, the Government of Yukon is responsible for undertaking sub-regional and local area planning that are intended to reduce land use conflicts and promote the orderly development of land for the economic, social and environmental well-being of Yukoners. This includes consideration and protection of ecological values, which can include wetlands.

While comprehensive wetland mapping has not been carried out in the Yukon, wetlands have been mapped as part of ecosystem mapping projects done to support regional land use planning, and detailed local mapping has now been completed in several regions with high development interests. The Government of Yukon has recently completed local wetland inventory within the Indian River area (see Yukon.ca/science-and-natural-resources/mining/view-map-indian-river-wetlands), and the Beaver River watershed (report in preparation). Additionally, work is underway to complete wetland inventories for the Mayo and McQuesten watersheds, and the Peel planning region. In 2021, Ducks Unlimited Canada and Tr'ondëk Hwëch'in also completed a wetland inventory for the Dawson planning region. Building off of these mapping exercises, the Government of Yukon is developing two related guidance documents: wetland mapping standards that will support all future wetland mapping efforts in the territory, and preliminary work towards an updated wetland classification for the territory.

We are currently undertaking a series of projects to explore the impacts of development activities on wetlands. In 2022, we completed a multi-year pilot project to develop a tool for determining the health of shallow open water wetlands. For this work, we sampled more than 100 wetlands throughout the territory to determine what the natural ("reference") state of wetlands is. The results and recommendations from this pilot project, including consideration of the broader utility of this shallow water wetland health indicator tool, are still being considered. In 2020, we also initiated a wetland health assessment project related to a proposed road development in the Beaver River watershed of the central Yukon. In summer 2022, we revisited and sampled additional wetlands in this watershed. A final report is anticipated in 2023.

Incorporating traditional knowledge

Throughout the development of the territory-wide wetlands policy, we have been working collaboratively with our First Nations partners to ensure their knowledge and cultural values are considered during policy development. In response to the Yukon Water Board's Public Interest Hearing on wetlands and placer mining, and through the most recent round of public engagement related to the territory-wide policy, Yukon First Nations have shared their relevant traditional knowledge. Within these processes, Yukon First Nations have consistently raised the importance of wetlands in their ability to undertake their traditional cultural practices. To ensure that their right to undertake these traditional cultural practices, along with their established rights to access water in its natural state, they have consistently advocated for the protection or conservation of the Yukon's wetlands. This is reflected in the prominence of consideration of wetlands within recent project-level environmental assessment comments in the central Yukon, as well as within the completed North Yukon and Peel Watershed regional land use plans and the ongoing efforts to complete a Dawson regional land use plan.

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Fish and wildlife

19. Presence of alien and introduced species

Significance

Introduced alien (or exotic) species are plants, animals and microorganisms introduced outside their normal range by humans. Not all alien species harm an ecosystem. Some are introduced on purpose for conservation, in gardens, to increase hunting or fishing opportunities, and other reasons.

Invasive species are alien species whose introduction has an environmental, economic or social cost (CBD Secretariat n.d.). Invasive species can cause loss of biodiversity, reduce property value or reduce the quality and abundance of resources to humans, including the loss of plants traditionally used by First Nations.

Besides the impact on native biodiversity, invasive species come at a cost.

Costs can be:

- financial, such as the cost of highway maintenance, and competition and control in agriculture;
- social, such as the loss of a wilderness experience; and
- environmental, such as increasing wildlife attractants to roadsides or reclaimed mine sites.

Climate change is reducing the resiliency of native ecosystems to be resistant to the spread of exotic species. With increasing globalization, there are more opportunities for introduction of alien species. With warmer winters and wetter summers, established species are spreading more rapidly.

What is happening

The Yukon is second only to Nunavut as a jurisdiction in North America with the lowest percentage of exotic species (NatureServe 2022). Three per cent of the more than 8,000 species known to be wild in the Yukon are considered introduced, or have introduced populations.

- As of December 2021, an estimated 244 exotic species have been identified in the Yukon. Of these, 155 are currently believed to be present (Government of Yukon 2022; Figure 1), 39 are believed to be absent, and the presence of 50 additional species is unknown.
- Thirty-five species have a high to medium invasiveness rank in the Yukon (Government of Yukon 2022). All but two of these species are plants. Chytrid Fungus, which harms Yukon amphibians (Government of Yukon 2013) and Seven Spotted Lady Beetle, which is believed to be replacing the Yukon's Transverse Lady Beetle (COSEWIC 2016, CABI 2020), are also considered to be invasive in the Yukon.

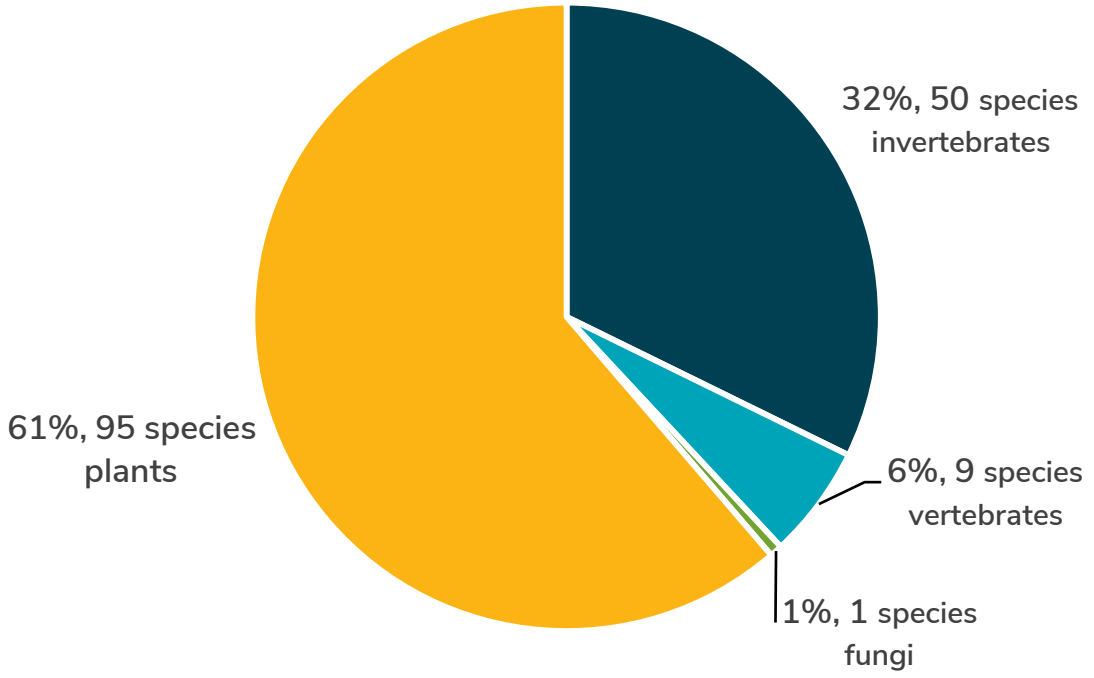

Figure 1: Exotic species present in the Yukon.
Source: Government of Yukon, Yukon Conservation Data Centre (2022) species database.

Taking action

The Government of Yukon supports the Yukon Invasive Species Council to provide information on species introduced to the Yukon. Find them at: yukoninvasives.com.

The Yukon Conservation Data Centre uses reports, collections and photographs through the platform iNaturalist.ca to help gather information on the distribution of species introduced to Yukon. The Yukon Conservation Data Centre makes data publicly available to anyone wishing to access information on species or ecosystems of conservation concern. This includes lists of species, range maps and identification guides.

The Government of Yukon provides additional information about the Yukon's aquatic invasive species at: Yukon.ca/aquatic-invasive-species.

Data quality

The Yukon Conservation Data Centre gathers information on nearly 10,000 wild species of plants, animals and fungi. This includes information on which are naturally occurring and which are known or are likely to become invasive.

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20. Species management plans

Significance

Species management plans address conservation and population management concerns for fish or wildlife populations. They are used to help:

- develop or revise approaches to monitoring and managing a population; and
- regulate human interaction with these species.

Management plans are developed in response to local or territorial population management needs, or as required through the federal species at risk legislation. Tracking the implementation of management plans helps to demonstrate commitment to continued action on managing species.

What is happening

Wolf plan implementation review

In 2021, the Government of Yukon completed an implementation review of the *Yukon Wolf Conservation and Management Plan* to assess the progress of plan implementation and ensure that the plan is meeting the needs of Yukoners.

Grizzly Bear management in the Inuvialuit Settlement Region

In 2020-21, the Wildlife Management Advisory Council (WMAC) supported the kick off of a planning process for a new Inuvialuit Settlement Region Grizzly Bear Co-management Plan. The Inuvialuit Settlement Region plan will take into consideration the considerable research and knowledge documented for Yukon North Slope Grizzly Bears, as well as the conservation requirements put forward in the new Yukon North Slope Wildlife Conservation and Management Plan.

Management plan for the Chisana caribou herd

The *Chisana Caribou Herd Management Plan 2010-2015* was approved in 2011 and the Government of Yukon is in the process of completing a review to assess the progress of the plan's implementation and ensure that the plan is meeting the international conservation needs of the herd. A fall census of the Chisana caribou herd occurred in October 2021.

This plan guides the management and conservation of the Chisana caribou herd, a small international herd shared with Alaska. Based on recent radio collar and fall composition count data, partners remain committed to the direction outlined in the management plan to maintain a healthy herd.

Taking action

View the species management plans for specific action items on species at: Yukon.ca/wildlife-habitat-planning.

Incorporating traditional knowledge

All species plans have provisions to include traditional knowledge alongside conventional science-based understanding, data and knowledge. People involved in creating these plans are constantly learning better ways to express this intention and to demonstrate it through practice.

In 2020, the Habitat and Wildlife Planning team created a strategic guide for planners and those working on plans. It introduces the concept of **braiding**, using the metaphor of intertwining traditional, local and scientific knowledge to promote evidence and experience-based ways of knowing and decision-making.

Once the new Management Plan for the Chisana Caribou Herd is drafted and brought to the international working group, there will be opportunities for local and traditional knowledge to be braided into the new plan.

References

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21. Caribou population and distribution

No new data was available this year. Refer to the ***Yukon state of the environment interim report 2021*** for the latest reporting information.

22. Caribou mercury levels

No new data was available this year. Refer to ***Yukon state of the environment report 2020*** for the latest reporting information.

23. Density of snowshoe hares

Significance

Despite its small size, the Snowshoe Hare *(Lepus americanus)* is the engine that drives much of the food web in the North American boreal forest. Long-term studies in the Yukon and elsewhere show that hares make up much of the available food for a host of predators, including furbearing animals that are important to the lifestyle and livelihood of many Yukoners (Figure 1). Some species specialize on eating Snowshoe Hare – especially Canada Lynx *(Lynx canadensis)* – and they are also valued by people as a small game species.

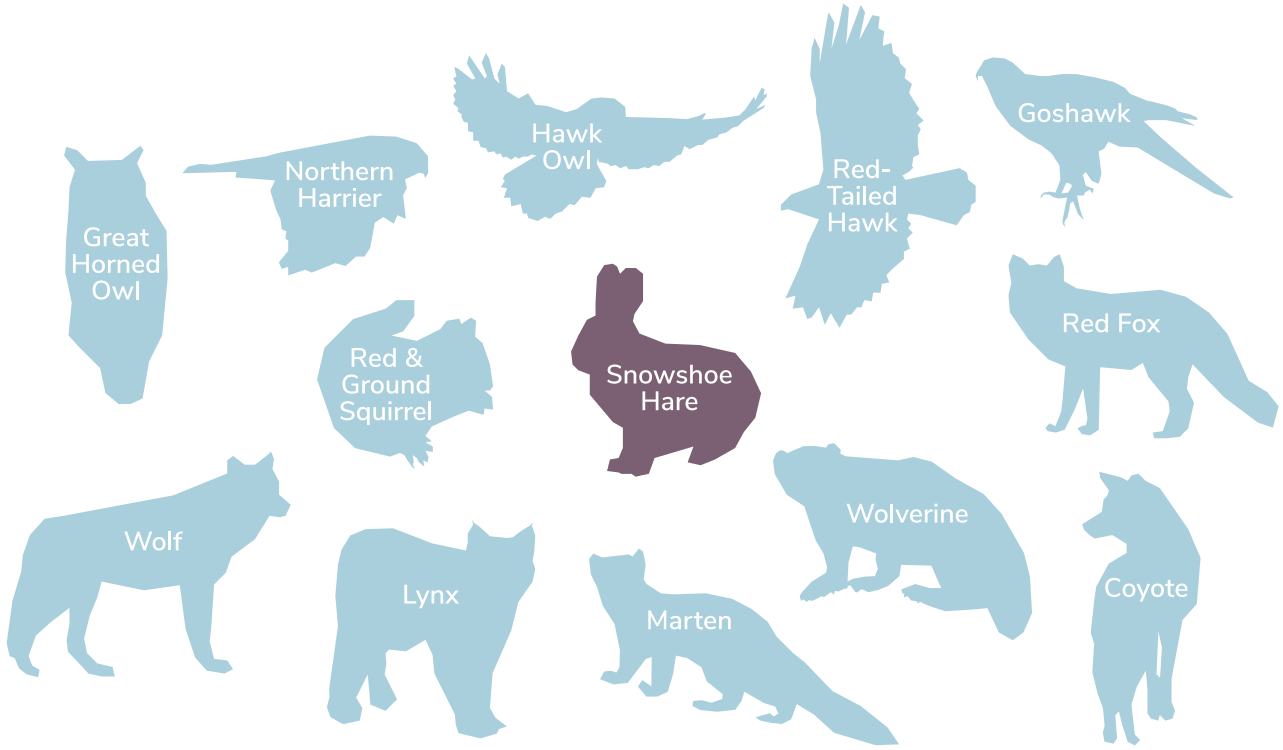

Figure 1: Predators of Snowshoe Hare.

The number of Snowshoe Hares is naturally cyclic with a period of nine to 10 years. At the "peak" phase of the cycle, hares may reach densities as high as five per hectare, while at the "low" phase they may be as little as 0.1 per hectare.

The number of hare regulates the population of the predators that rely on them. When hare numbers are high, so is the number of their main predators and, conversely, when hare numbers are low, the number of predators also declines. Hare abundance also has a significant impact on the plants that they eat, and other mammals that predators eat when Snowshoe Hare numbers are low.

Snowshoe Hare are a "keystone species" in the Yukon's boreal forest.

What is a keystone species?

A **keystone species** is a species that has a large impact on the entire ecosystem. Without the presence of keystone species, the ecosystem would be quite different and other species that depend on the keystone species may be absent altogether. Changes in the abundance of a keystone species have a disproportionate affect on other species, causing ripple effects in the ecological system.

In recent years, the concept of a keystone species has been broadened to include both ecological and cultural keystone species. Besides Snowshoe Hare, another ecological keystone species in the boreal forest are American Beavers *(Castor canadensis)*. The main example of a cultural keystone species for people in the boreal forest is Moose *(Alces americanus)*.

What is happening

Changes to the Yukon's boreal forest are impacting both hares and their cycles.

Information from First Nations hunters and scientific studies agree that hare cycles in the Yukon do not oscillate as much as they did in the 1970s and 1980s; that is, the highs are no longer as high as they once were (Figure 2). Reasons for this change are unknown.

Moreover, climate change related impacts such as increases in the severity and frequency of forest fires (and associated salvage logging), shrubification, changes in the depth and duration of snowpack, as well as the arrival of new species – such as Coyotes *(Canis latrans)* – are all a cause of concern for hare populations and the species that rely on them.

Results show that Snowshoe Hare cycles are synchronous across the Yukon (i.e., population highs and lows occur at the same time). Densities of hares in the Yukon last peaked in 2017, and the population is at its cyclic low, which has impacts for the boreal food web by affecting both predators and alternate prey, ranging from squirrels *(Tamiasciurus hudsonicus)* to sheep *(Ovis dalli)*.

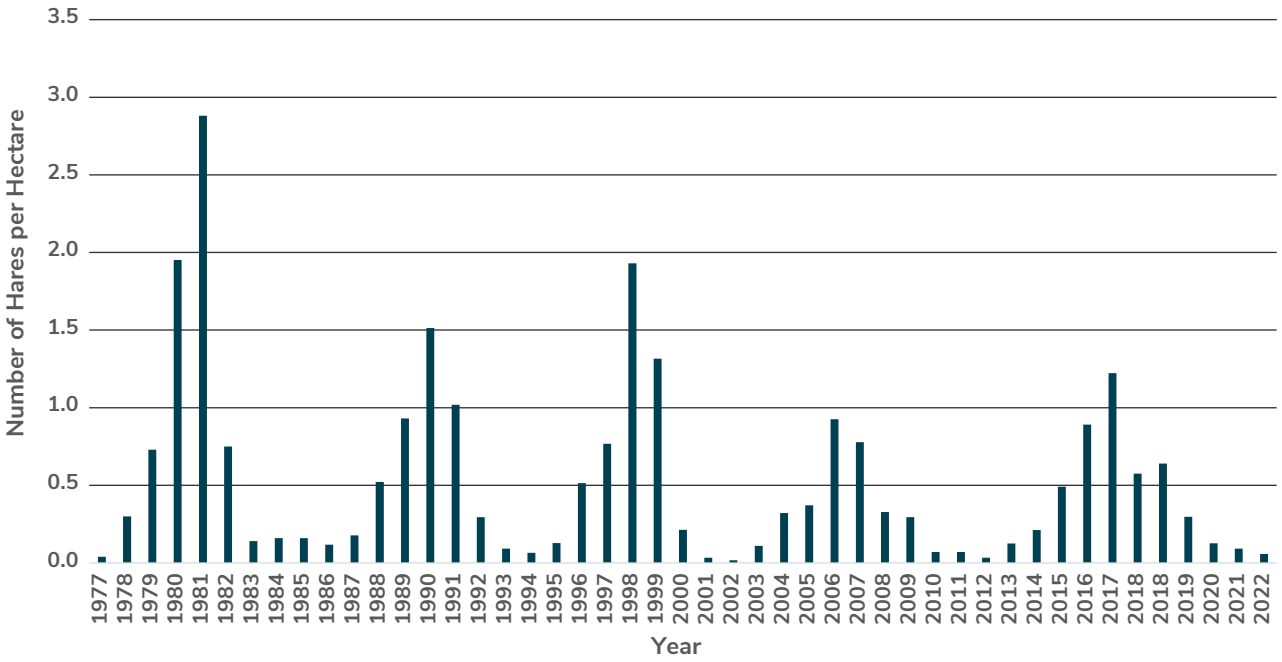

Figure 2: Spring densities of Snowshoe Hares at Kluane Lake.

Taking action

Because Snowshoe Hare are a keystone species in boreal food webs, monitoring their numbers is important as it provides a continuous record of changes in their abundance over time. Long term data on their abundance can provide information on the fluctuations in abundance of their primary predators. Moreover, long-term monitoring efforts can inform how this keystone species is being affected by climate change and, consequently, how it may affect boreal ecosystems.

The Community Ecological Monitoring Program (CEMP) monitors Snowshoe Hare density at sites in different regions of the Yukon, including near Haines Junction, Whitehorse, Mayo, Faro and Watson Lake. CEMP is carried out by a partnership of Government of Yukon biologists and those from several Canadian universities (led by Dr. Charles Krebs).

CEMP also monitors other components of the boreal food web, including berries, mushrooms, spruce cones, small mammals (mice and voles) and hare predators. Lynx abundance is monitored through winter track counts. Lynx numbers have been in decline since 2018, as their fate is inextricably linked to that of the hare population. In the absence of hare, movements of lynx increase as they search for food.

A report on these trends is produced annually.

Data quality

The strengths of the CEMP program are that the data collection protocols are both simple and standardized, so that they are repeatable over years and locations. While simple, protocols for estimating the density of Snowshoe Hare in the Yukon have been rigorously tested and peer reviewed. In the Kluane region, CEMP estimates the density of Snowshoe Hares by live-trapping, marking and releasing individuals. These data extend from 1973 to the present, representing one of the longest continuous time series of wildlife monitoring data in the world.

Data from the other CEMP sites in the Yukon are available from 2005 onwards. At these sites, hare are not live trapped; rather, fecal pellets are counted yearly and used to mathematically derive an estimate of hare density. Standardized data from both live trapping and pellet counts done by CEMP allow for comparisons in the density of hare across the Yukon, and with those in the Northwest Territories, Alaska and elsewhere.

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24. Winter Tick surveillance

Significance

Winter Ticks *(Dermacentor albipictus)* have been shown in other regions of Canada to have severe health impacts on some wildlife species, particularly Moose. These ticks can also be found on other wildlife (deer, Elk, bison, wild sheep and caribou) and domestic animals. In domestic animals, the ticks are of little health consequence.

Winter Ticks attach to an animal and feed on blood. The ticks may be groomed off. If there are small numbers of ticks, and grooming is prompt and effective, there is no impact on the animal's health. This is usually the case with domestic animals.

If there are large numbers of ticks on an animal, and they are not removed by grooming, the result can be illness and even death of the animal. High numbers of ticks feeding on an individual animal result in the worst consequences. Because Moose have difficulty removing the ticks, Moose are the species that tend to suffer the most severe consequences. Consequences of Winter Ticks include blood loss, hair loss and distraction from eating. Eventually, animals with heavy tick burdens can die due to starvation and inability to maintain body temperature.

Winter Ticks are not passed from animal to animal, but an increased number of ticks in the environment can lead to more individual animals affected and higher numbers of ticks on one animal. Studying the distribution and occurrence of Winter Ticks in the Yukon provides ongoing assessment of the impact this parasite has on wildlife of the Yukon.

What is happening

The Animal Health Unit has been examining hides from Moose, deer, Elk and caribou since 2011.

From 2017 to 2020 the Government of Yukon's Animal Health Unit partnered with a graduate student from the University of Toronto, which increased surveillance of this parasite in the Yukon. This work used a combination of field work and mathematical modeling to examine geographical distribution and survival of Winter Ticks in the environment (E.S. Chenery et al. 2020).

The Animal Health Unit continues to monitor hide submissions for the presence of Winter Ticks. Mandatory submission of hide from Elk and deer, and voluntary submission from Moose and caribou, are examined in the Department of Environment laboratory in Whitehorse. This work provides data on the geographical presence of winter tick (see Figure 1), the presence of the tick in different species (see Table 1) and the Winter Tick burden on individual animal pelts.

Hides examined by Game Management Zone – 2011 to 2021

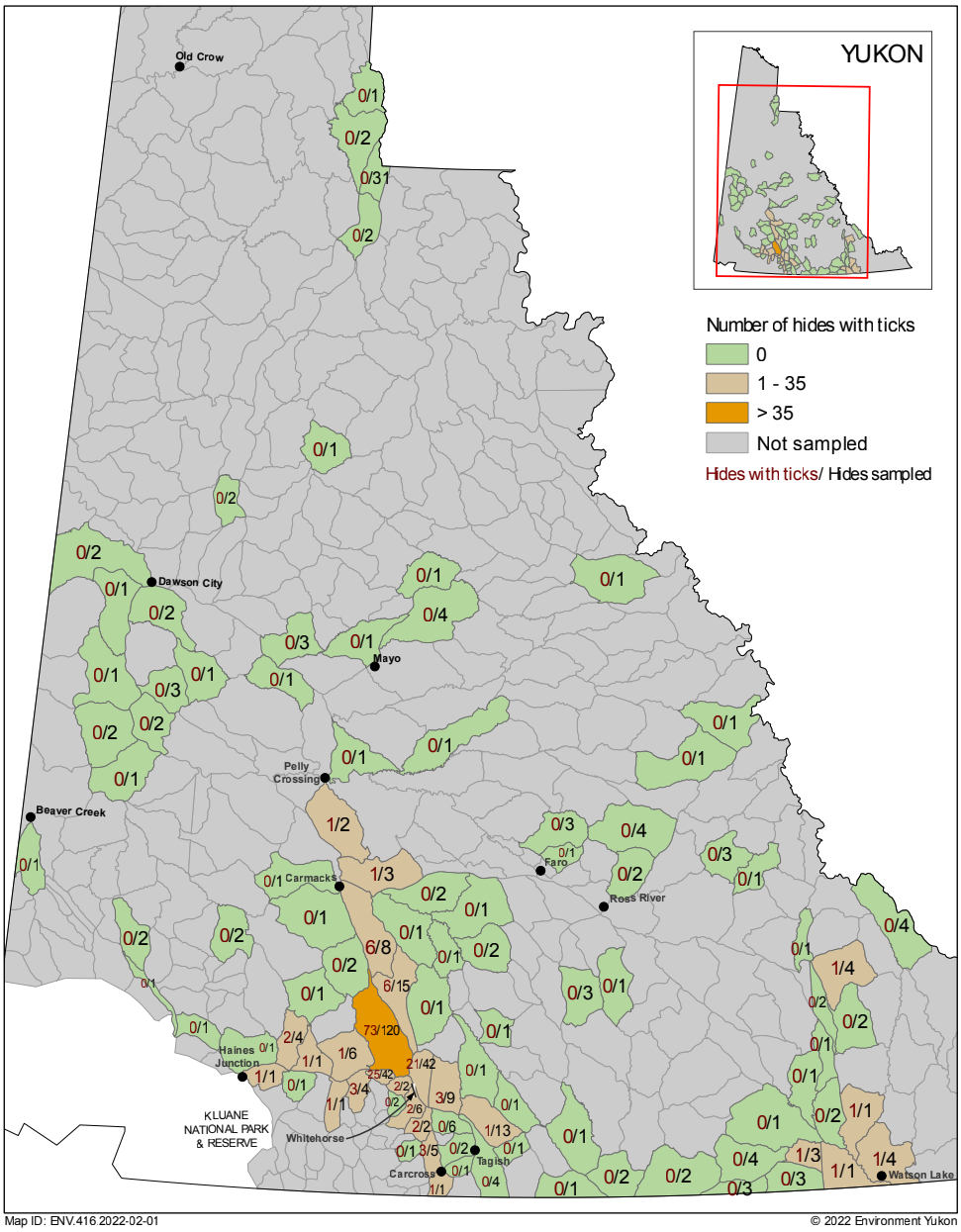

Figure 1: The known distribution of winter ticks based on hides examined to date (collected between 2011 and 2021).

Table 1: Cervid hides examined for Winter Ticks between 2011 and 2021.

Species	Number of hides sampled	Per cent hides found with (actual numbers)
Mule Deer	125	54% (68)
Moose	120	4.1% (5)
Elk	139	63% (87)
Caribou	75	1.3% (1)

Winter ticks are established on Elk and Mule Deer in the Yukon, and less so on the Moose submissions that have been examined.

Hides of from 100 Game Management Subzones have been examined and 25 of those subzones have had a cervid hide with Winter Ticks. To date, the small number of hides originating north of Pelly Crossing have not had Winter Tick detections.

Consistent with findings in other jurisdictions, the heaviest tick burden detected in the Yukon was on a Moose.

Taking action

The Animal Health Unit continues to examine cervid hides for Winter Ticks. Elk and deer hides are mandatory harvest submissions; caribou and Moose hides are submitted voluntarily.

In order to better understand Winter Tick in the Yukon, submission of cervid hides from all areas of the territory is encouraged.

References

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25. Sustainability of Lake Trout fisheries

Significance

Lake Trout (*Salvelinus namaycush*) are a top predator and a highly valued freshwater species for Yukon recreational and subsistence fisheries. Monitoring Lake Trout population levels, health and changes to habitat provides valuable information that reflects the state of our freshwater lakes. This is in part due to requirements of the Lake Trout's life cycle and unique ecology, including:

- its need for cold, well oxygenated and clean habitat;
- availability of prey fish; and its slow growth rate; and
- long lifespan as a species.

These aspects and requirements make Lake Trout a valuable species to monitor overall lake health, ecosystem health and the effects of climate change on freshwater populations. As such, this species is monitored throughout the Yukon to detect changes over time, maintain sustainable recreational levels and enable sustainable fisheries for future Yukoners.

What is happening

- Lake Trout population assessments are conducted on targeted lakes across the Yukon on a yearly basis. In addition to these population assessments, the Department of Environment monitors recreational harvest pressure across the Yukon to help determine sustainable harvest limits.
- In 2021, the Department of Environment conducted Lake Trout population assessments on Snafu Lake, Tarfu Lake, Little Atlin Lake and Fish Lake. The data collected will help address the recovering Lake Trout populations within Snafu Lake and Tarfu Lake, as well as the small-bodied Lake Trout population within Fish Lake. In 2021 the department monitored recreational harvest pressure at the Twin Lakes, Dezadeash Lake and the Kathleen River system
- In addition to these sampling events, the Government of Yukon updated and published the ***Lake Trout Monitoring Program: 2020 Program Update***, encompassing assessment results from 2010 thorough 2020 (Sinclair et. al. 2021).
- Current data in this report suggests that the majority of the recreational Lake Trout harvest was sustainable across the Yukon, maintaining high quality angling opportunities. Lakes with stocks at risk are managed through size, catch and possession regulations.

Taking action

- The Government of Yukon is developing a 10-year strategic monitoring plan to assess Lake Trout populations and build on long-term trends. Part of this plan includes:
  - monitoring populations in recovery, populations of concern, sustainability of small-bodied Lake Trout; and
  - addressing impacts of climate change.
- The Government of Yukon is actively working on Lake Trout recovery plans for known depleted stocks in Pine Lake, Snafu Lake, Tarfu Lake, Twin Lakes and Frenchman Lake.

Data quality

Lake Trout population estimates in individual lakes are derived from conducting Summer Profundal Index Netting over the course of several days. These methods have been used by the Lake Trout Monitoring Program since 2010. These estimates are combined with recreational harvest pressure monitoring, through conducting angler interviews, to determine sustainable yields.

Incorporating traditional knowledge

The Government of Yukon works with First Nations governments when monitoring Lake Trout populations, to further understand changes over time when compared to traditional patterns.

Profile: Southern Lakes Lake Trout movement

The Government of Yukon conducted a multi-year Lake Trout movement study throughout the Southern Lakes system to determine seasonal movement patterns throughout this large system. In addition to assessing movement patterns, genetic analysis was conducted to determine genetic variation throughout this system.

From 2013 through 2020, over 30 million data points were collected from a series of 19 receivers located in Bennett Lake, Windy Arm, Tagish Lake and Marsh Lake. This data is currently undergoing analysis to assist in determining:

- movement and home range patterns of distinct genetic groups;
- seasonal spawning migration patterns;
- movement patterns associated with local and traditional knowledge of Lake Trout and prey species;
- seasonal (overwintering) movement; and
- habitat preference.

Over the course of the next year, this data will be finalized to help us further understand the Yukon's largest lake system and how Lake Trout use this series of interconnected lakes.

References

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Government of Yukon staff conducting a lake trout population assessment on Little Atlin Lake.
Photo: Cameron Sinclair.

26. Number of spawning Chinook Salmon

Significance

Yukon Chinook Salmon:

- are among the longest running migrating salmon in the world;
- are an important resource for many species;
- release marine-derived nutrients from their ocean feeding ground to freshwater and terrestrial ecosystems when they die; and
- are an integral component of First Nations history, diet and culture.

Annual Chinook Salmon returns vary considerably due to a number of factors including:

- juvenile survival through incubation, emergence and outmigration to the Bering Sea;
- survival and growth in marine feeding grounds to adult stages;
- predation;
- disease;
- environmental variables including water level, temperature, and climatic events such as the Pacific Decadal Oscillation and El Niño; and
- marine and in-river harvest.

The international Yukon River Salmon Agreement has formally been in place since 2002 to help rebuild and conserve Canadian-origin salmon stocks and to define harvest allocations to Canadian and US fisheries. The Yukon River Panel established an interim goal for spawning escapement (the number of fish that return to their spawning grounds). The goal is for 42,500 to 55,000 Chinook Salmon to return to the Canadian portion of the Yukon River to spawn annually. Each year, Fisheries and Oceans Canada monitors if this target has been achieved, mainly through a border assessment project located in Eagle, Alaska that is operated in partnership with the Alaska Department of Fish and Game.

What is happening

- In 2021, the spawning escapement goal for Yukon River Chinook Salmon was not met, with an estimate of just over 31,000 fish reaching their spawning grounds in the Yukon (Figure 1).
- This is the third time the spawning escapement goal was not achieved since 2013.

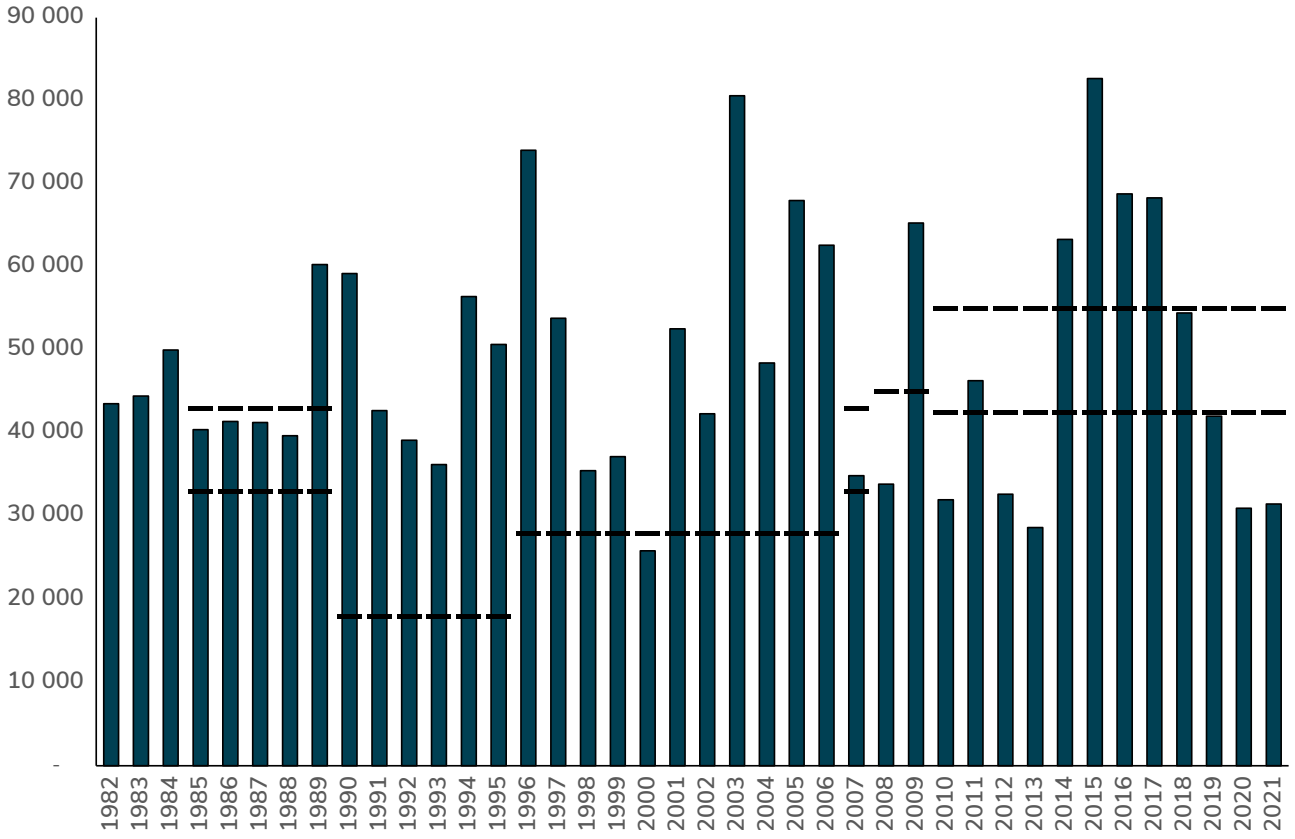

Figure 1: Number of Chinook salmon spawning in the Canadian portion of the Yukon River, excluding the Porcupine River drainage. Bars represent yearly spawning escapement estimates and lines represent spawning escapement goal ranges.

Taking action

Estimates of the total number of salmon that return to their spawning grounds in the Yukon are based on:

- sonar passage estimates based in Eagle, Alaska; and
- harvest estimates from fisheries upstream of the sonar in both Alaska and the Yukon.

In addition, a number of assessment projects in the upper Yukon River watershed are used to monitor the number of adult salmon returning to specific spawning tributaries. These projects also monitor the ratio of females to males, and the size and age composition of adult salmon returning to spawn.

References

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27. Trumpeter Swan population monitoring

No new data was available this year. Refer to the ***Yukon state of the environment report 2020*** for the latest reporting information.

28. Monitoring breeding waterfowl

No new data was available this year. Refer to the ***Yukon state of the environment report 2020*** for the latest reporting information.

29. Monitoring wild sheep and goat health

Significance

- The bacteria *Mycoplasma ovipneumoniae* (*M. ovi*) is a concern in the Yukon, as it has been implicated in causing fatal outbreaks of pneumonia in wild sheep and mountain goats in other parts of North America.
- In 2015, the Government of Yukon began testing Yukon wildlife for *M. ovi*, sampling thinhorn sheep. This sampling effort is ongoing (Figure 1).
- In 2018, Alaska reported *M. ovi* had been detected in Alaska ungulates (hoofed herbivores). In response, the Yukon's surveillance was expanded to include other wild ungulates.

What is happening

- Since 2015, over 1,000 wild ungulates have been tested (Figure 2).
- Samples are sent to the Animal Health Centre laboratory in British Columbia and Prairie Diagnostic Services laboratory in Saskatchewan. They use the same test for *M. ovi* so results are comparable.
- Between 2015 and 2020, all tests were negative for *M. ovi* except for one caribou from the Forty Mile herd near the Alaska border.
  - This caribou was captured approximately 50 kilometres east of the Alaska border in 2018.
    - **Explanation:** Approximately 10 per cent of the Forty Mile herd samples tested by Alaska have been positive for *M. ovi*, therefore this was not an unexpected finding. To date, no pneumonia outbreaks in wildlife have been associated with the positive samples in Alaska.
- **In 2021:**
  - 263 individual animals were tested, the majority being thinhorn sheep (114) and caribou (91).
  - Of the 91 caribou samples tested in 2021, four samples from the Porcupine caribou herd tested positive for a Mycoplasma bacteria, but confirmatory genetic sequencing determined that the Mycoplasma detected was not *M. ovi*.
    - **Explanation:** Mycoplasma bacterial strains can adapt to specific host species and not cause disease in that species, so it is not surprising to find a distinct strain of Mycoplasma in healthy caribou.

The 114 thinhorn sheep and 58 other ungulates tested in 2021 were negative.

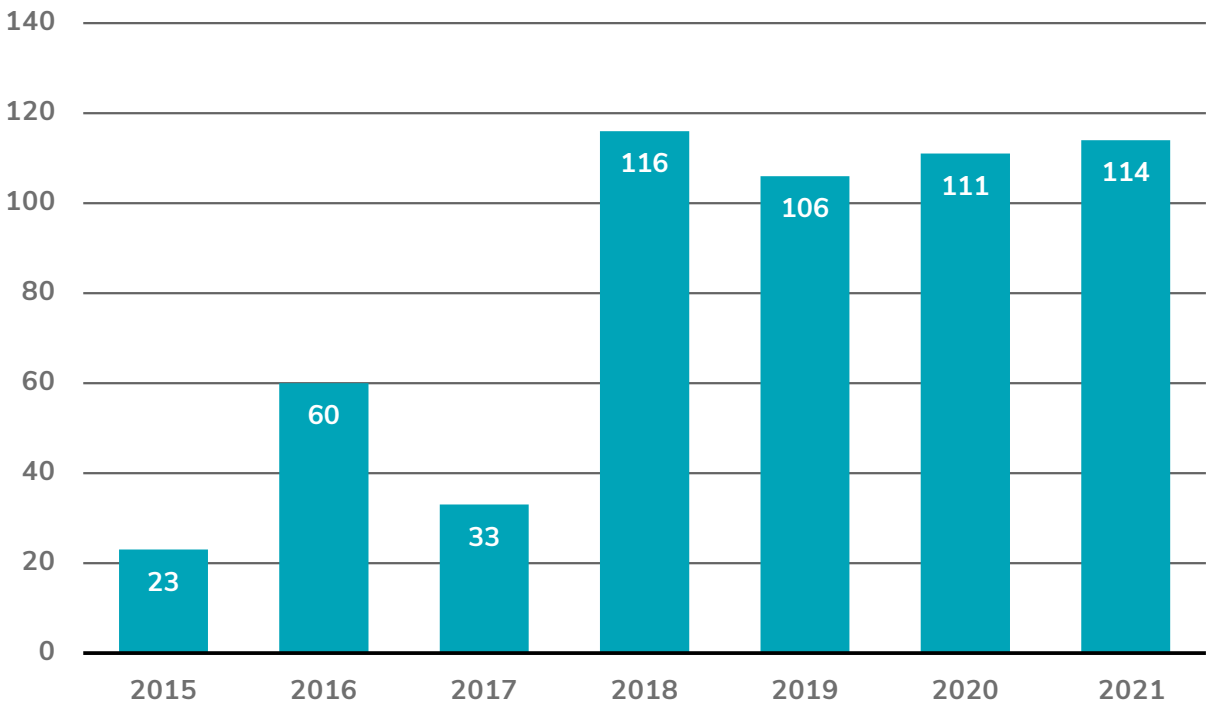

Figure 1: The number of individual thinhorn sheep tested in the Yukon per year since 2015.

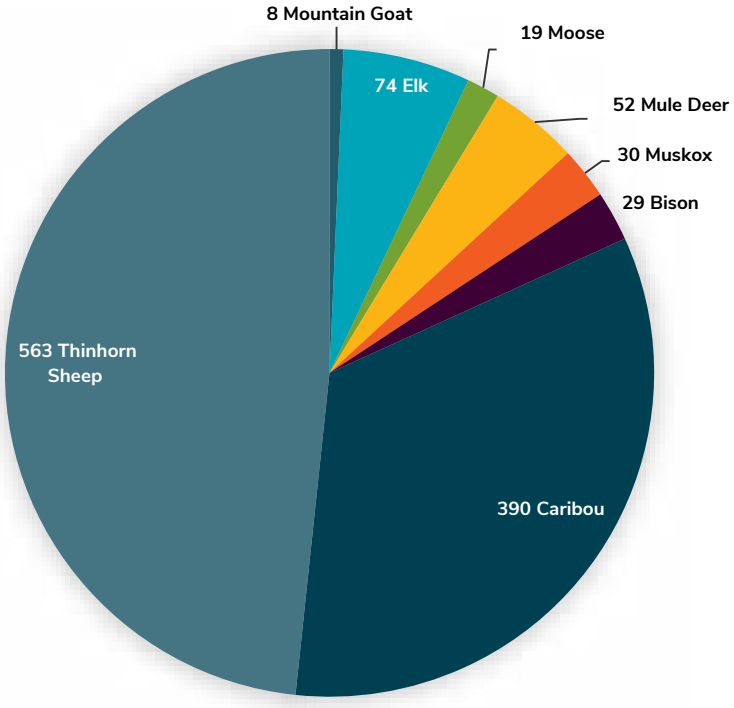

Figure 2: The number of individual free-ranging animals tested by the Government of Yukon's Animal Health Unit for *Mycoplasma ovipneumoniae* between 2015 and 2021.
Note: thinhorn sheep testing began in 2015. Testing of other species began in 2018.

Taking action

- Surveillance of *M. ovi* in wildlife is ongoing. Nasal samples are collected by thinhorn sheep hunters in the field, laboratory technicians during compulsory and voluntary submissions from the regulated hunt, and from wildlife found dead. When possible, biologists and veterinarians collect nasal swab samples in the field during collaring of wild ungulates.
- Sample kits for thinhorn sheep and mountain goat hunters are available from Department of Environment offices. We plan to collect two swabs per animal in the future to enable further investigation of any Mycoplasma found in wildlife that are not *Mycoplasma ovipneumoniae*.
- By monitoring wildlife for the specific respiratory pathogens of concern, the Government of Yukon's Animal Health Unit will be better informed and positioned to mitigate occurrences.

Related

M. ovi can be carried by domestic sheep and goats. A control order under the Yukon's ***Animal Health Act*** is in effect to reduce the chance of transmission from these domestic animals to wildlife. The order requires sheep and goat owners to only keep animals that test negative for *M. ovi* and comply with fencing requirements. Import permits are required for any movement of sheep and goats into the territory.

Taking a nasal swab of a wild sheep.


Yukon