ANACORTES COMMUNITY FOREST LANDS

Forest Monitoring Program

Annual Report 2023

Photo by Lynn Wohlers

An ongoing study by
Transition Fidalgo and the City of Anacortes

Transition Fidalgo

Transition Off Fossil Fuels!

CITY OF ANACORTES

Introduction

by Eric Shen

Our forests are critical to all of us on so many levels. Forest ecosystems clean the air, filter water supplies, control floods and erosion, sustain biodiversity, and provide opportunities for recreation, education, and cultural enrichment. Perhaps the most important service is the ability to remove CO_2 from the atmosphere, which has become critical in the fight to maintain a survivable future. Removal of CO_2 through photosynthesis is one of a very few proven methods known to perform this beneficial service without creating negative side effects.

Understanding the health of our forests and causes of stress is the first step in establishing a plan to maintain the health and vigor of the ecosystems that make up a forest.

In 2019, Transition Fidalgo, in partnership with the City of Anacortes, initiated a monitoring program to evaluate the current health of the forest ecosystem and to establish long term surveys of these ecosystems. There has always been a desire to conduct such a monitoring program. The observed stress from the hot temperatures and long drought period in 2015 and 2016 provided the impetus for Transition Fidalgo to launch the ACFL Forest Monitoring Program.

The monitoring program has three primary goals, which guide our seven projects in how surveys are conducted and what questions need to be answered:

- *Conduct a long-term monitoring program that provides an overall assessment of the health of ACFL terrestrial and aquatic systems over time.*
- *Provide an opportunity for community members to develop a deeper understanding of the forest covering Fidalgo Island through hands-on participation in the monitoring program.*
- *Provide City managers and advising boards with data to make decisions about the use and management of the ACFL.*

Since our first annual report, issued last year, much has been accomplished. And we are starting to see some early results. Our 2022 annual report (https://www.transitionfidalgo.org/wp-content/uploads/2022/06/ACFL-ffs-annual-report-2022.pdf) explained how each of the projects were conducting their surveys and where the surveys were located.

This year's annual report will focus on what has been observed and talk about results where there is enough information to form an opinion. Our volunteers, called Fidalgo Forest Stewards, are working to link their observations with information gathered from sister projects, such as the weather/climate project and the soil moisture project, to start to understand what stressors are affecting the forest ecosystems. The project reports that follow will summarize their thoughts and findings and what the connections between projects have shown.

A big boost to this program has been provided by the Friends of the Forest through staff support of our volunteers. A survey led by Ellie Kravets provided insight to the program management team about what types of activities would interest our volunteers. As a result, there have been several articles featured in our Forest Stewards newsletters that discuss forest ecology, weather trends, soil moisture, etc. In April, a great presentation on forest ecology by Roger Fuller talked about the relationships between forest species, both large and small, plant and animal. An information hike in May of this year highlighted what has been learned from our forest monitoring surveys to date.

Transition Fidalgo gives all our Forest Stewards a big **thank you** for your years of dedicated work in conducting these surveys. Some of you have been going out to do your observations monthly and even as frequently as a couple times a week. It is your diligence that has produced the observations and early conclusions we see in this annual report.

Dynamics and Health Project

Project Lead: Dave Peterson

Overview

This project quantifies the long-term forest dynamics, health, and vigor of selected locations in the ACFL. Some forest areas of the ACFL have experienced significant stress, dieback, and tree mortality, a phenomenon observed in much of western Washington since 2015, presumably associated with recent dry summers. Stress symptoms in the ACFL may indicate the early stages of altered forest structure associated with extreme drought and perhaps a long-term response to climatic variability and change.

Data on forest composition and structure are collected at two locations:

Six plots adjacent to Trail 201 (near Whistle Lake), where recent tree mortality and dieback have been observed. Dominant tree species are Douglas-fir, western hemlock and red alder.

Six plots adjacent to Trail 304 (east of Heart Lake), where forest health appears to be good and recent mortality and dieback are not apparent. Dominant tree species are Douglas-fir, western hemlock, grand fir, red alder, and big leaf maple.

Progress report

We made some adjustments in 2022 to maintain consistency and minimize errors. After reviewing the 2019 and 2021 data, we realized that these two samples included different numbers of trees. Sample plots are laid out with a compass and measuring tape in the field, such that the slightly different location from year to year means that different trees are included near the perimeter of the plot. We wanted to correct this inconsistency, ensuring that the same trees are sampled in all future years.

This was resolved by making a map of every tree within each permanent sample plot adjacent to Whistle Lake trails 201 and 304. Volunteers involved in tree mapping ensured accurate locations of the trees with respect to the center and perimeter of each plot. We now have a standard list of trees along with maps to guide data collection in future years. We did not collect some of the usual forest monitoring data (e.g., crown density) this year, but anticipate a "normal" data collection process in 2023.

Our 2022 Volunteers:

Kari Bishay
Bill Buchanan
Mary Campbell
Elizabeth Drozda-Freeman
Adam Erie
Sam Hardesty
Connie Harris
Jack Hartt
Sharon Howard
Taft Perry
Steve Purcer
Jim Redding
Sarah Roberts
Nancy White

Data collected in 2022 — Whistle Lake trail 201

	Trees per hectare	Percent live	Mean diameter (cm) Total	Live	Dead
Douglas-fir	358	87	43.7	47.2	20.2
Western redcedar	350	71	9.9	21.5	16.7
Western hemlock	75	78	14.0	16.5	6.4

Data collected in 2022 — Trail 304

	Trees per hectare	Percent live	Mean diameter (cm) Total	Live	Dead
Western redcedar	283	100	9.5	9.5	—
Big leaf maple	246	95	31.0	29.7	46.5
Douglas-fir	112	96	55.1	57.0	6.0
Grand fir	83	95	15.5	14.7	5.8
Western hemlock	75	67	23.6	21.9	26.5

Note: A few red alders and mountain ash are present but not included in the table.

Western Redcedar Mortality Project

Project Leads: Eric Shen and Jon Ranney

Following the extended drought event in 2015 and 2016, forest management staff and hikers in our community discovered numerous dead or dying western redcedar trees in many parts of the ACFL. Throughout western Washington, from the Olympic Peninsula to the Cascades, there have been reports and studies that show there are areas where western redcedars are dying and/or in poor health.

The survey of western redcedar in the ACFL began in 2019 with the monitoring of the health of trees along selected trails within the forest. The initial concern was to determine if the die-offs noted regionally were also progressing as quickly in the ACFL. Hence, the trail surveys started out on a quarterly basis to capture fast moving changes. Over time, the frequency of these surveys has decreased to an annual basis, as it has become apparent that the health of the ACFL western redcedar population appears to be stable.

Our yardsticks for assessing tree health are changes in the color and density of the foliage on an annual basis. The color and density numbers range from 0 for a dead section of the tree to 3 for a tree with healthy foliage. The chart below shows the average characteristics of all trees on Trail 313 for each survey year. Other trails show a similar pattern.

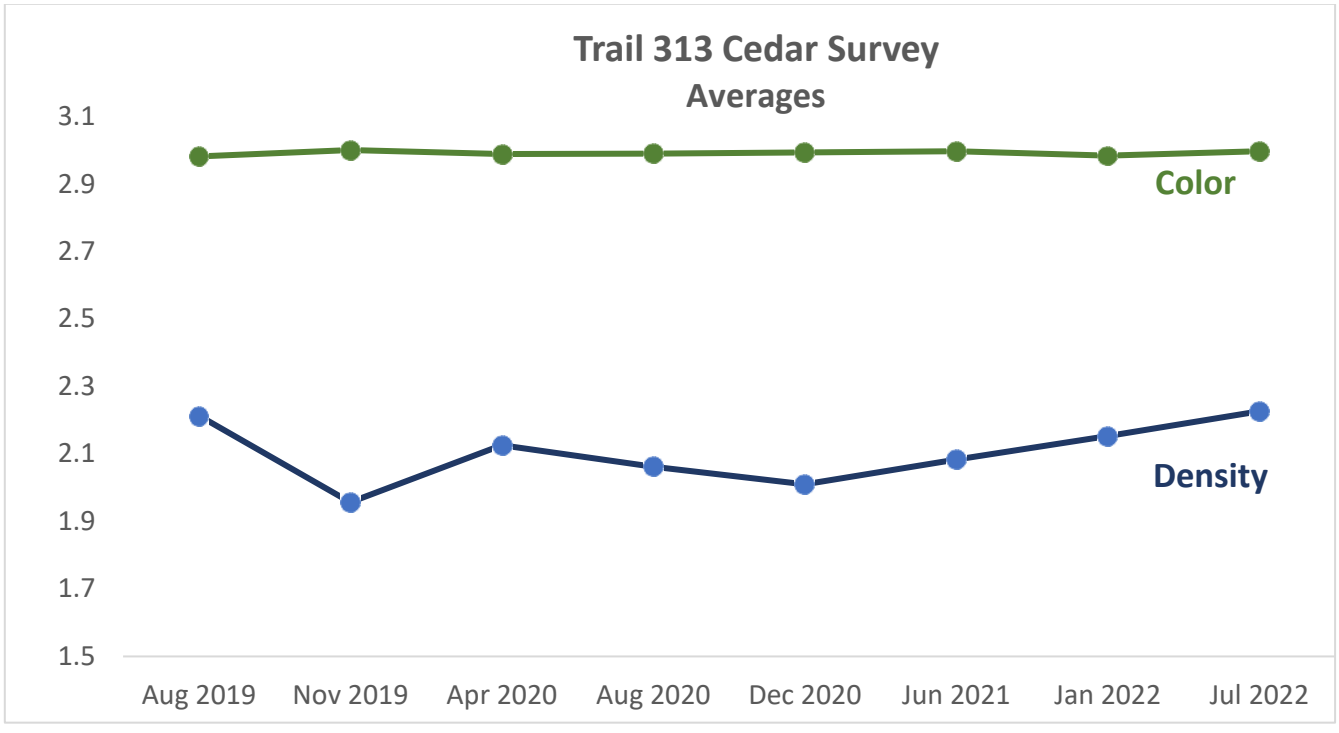
If the regional trends and the trends in the ACFL continue, the health of the western redcedars living on Fidalgo Island will be an anomaly. Very probably, the uniquely temperate weather on the island has buffered the extremes of temperature, if not the drought. Jon Ranney, the project lead for weather and climate, presents a weather analysis on page 5, pointing out reasons that might account for the die off observations following the 2015-2016 drought and why that trend may not be continuing.

These early observations result from numerous surveys conducted on 10 trails located in the ACFL by over 20 volunteers over the course of four years.

Our 2022 Cedar Monitoring Volunteers:

Taft Perry, Dan Miner, Ruth Bachrach, Shirley Hoh, Sarah Roberts, Elizabeth Drozda, Kath Goldhartt. Lynn Wohlers, Jack Hartt, Laurie Sherman, Becky Vavrosky, Jan Hersey, Patricia Rothman, Robbie Hutton, Evelyn Adams, Rosann Wuebbels, Eric Shen, and Jon Ranney.

A big thank you to all of them for their dedication and commitment.



Climate Trends and Western Redcedar Die-off

By Jon Ranney

Western redcedars have died in significant number in various locations around the Pacific Northwest, including in the ACFL, in recent years. Knowledgeable observers have suggested that the deaths can be attributed to warmer weather and lower rainfall. Summer heat and low rainfall during the months of April through June are cited as key factors.

To help quantify the relationship between extreme weather and cedar die-off, a "stress Index" can be constructed using historical weather data. One simple formulation for a stress index is the average of a summer heat index and a spring drought index. The two component indexes can be represented by percentile values from relevant data for years during a given historical time frame.

To illustrate this concept for Fidalgo Island, distributions for summer temperature and spring rainfall from 1900 through 2022 are used. The heat index values are calculated by ranking the average daily high temperatures for June through August from lowest to highest (1 to 123) and calculating the percentiles for those ranks. The drought index values are the percentiles from highest to lowest (123 to 1) for the ranked total rainfall amounts for April through June.

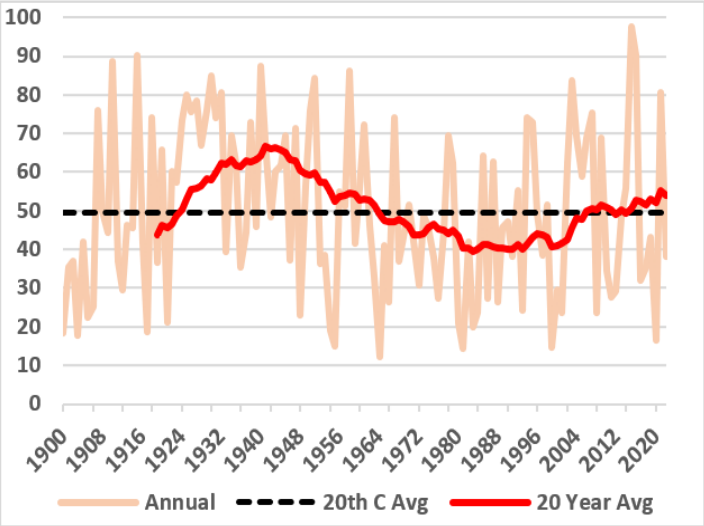
Stress index values for the years 1900 through 2022 are graphed below. The table shows the top ten years.

The years 2015 and 2016 rank at the top of the stress index list. Those summers were the two warmest, and spring rains during both years were among the 20 driest. There is no remotely comparable consecutive two-year period in the entire history. Cedar deaths were noted in the ACFL and elsewhere in the Puget Sound region around this time.

Through the coming years, the cedar surveys should help to validate and refine the formulation of the stress index. It may eventually be possible to determine the relative importance of drought and heat and to establish thresholds at which tree deaths are likely to occur.

If the trend toward increasing spring rain continues as expected, the effect of warmer summers may be mitigated to some degree. On the other hand, as summer temperatures increase, it is likely we will see more cedar deaths when warm summers coincide with the dry springs that will inevitably occur.

Stress Index



Stress Index – Top Ten, 1900 – 2022

	Jun -Aug Avg High	Heat Index	Apr-Jun Rainfall	Drought Index	Stress Index
2015	77.6	99.2	2.5	95.9	97.6
2016	75.0	95.9	3.3	84.6	90.2
1915	76.5	98.4	3.4	82.1	90.2
1910	73.5	89.4	3.0	87.8	88.6
1940	72.8	84.6	2.9	90.2	87.4
1958	75.2	96.7	3.6	75.6	86.2
1930	72.2	76.4	2.8	93.5	85.0
1951	72.2	75.6	2.8	92.7	84.1
2003	73.6	90.2	3.6	77.2	83.7
2021	72.2	74.8	3.3	86.2	80.5

Fire Effects and Forest Dynamics

Project Leads: Jon Ranney and Eric Shen

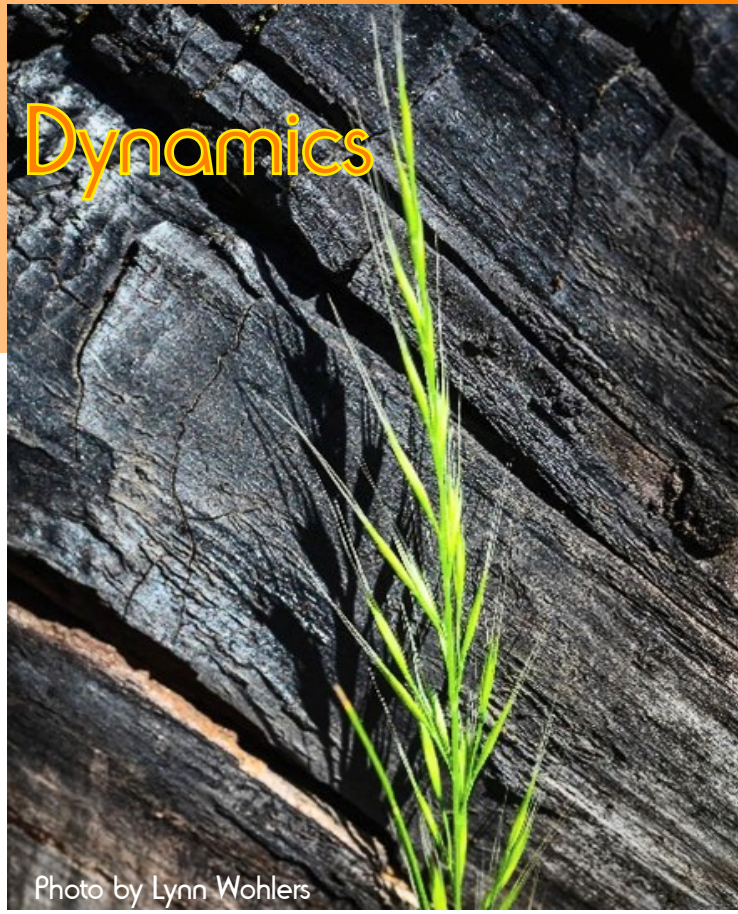


Photo by Lynn Wohlers

Each year a team of photographers go to designated locations in the Little Cranberry Lake Burn Area to take photos at each of the major compass points to document the progress of the post-fire recovery. These annual photos taken in the years since the fire capture the overall recovery process. The pictures below were taken from a photo point located on Trail 103. A photo taken immediately after the fire in 2016 is approximately in the same location designated as Photo Site 7. The photo series illustrates the progression of the recovery along the upper trail on the east side of Little Cranberry Lake.

2016

2019

2022

In the spring of 2023, a more detailed survey of each of the 8 photo sites was conducted to identify the plant species present and create a health baseline for the surviving trees.

Two additional sites were selected (approximately 100 meters beyond the burn area along the same trails) for similar surveys to provide a comparison of the species present pre-burn and post-burn.

The results were surprising. A total of 58 different plant species were found at the 8 sites that resided in the burn area. In contrast, at the 2 sites outside the burn area only 13 different species were found. At one location in the unburned area, only 4 species were found. This particular location was almost completely dominated by salal. The fewest number of species found at a burn site location was 11. Clearly, the 2016 fire created an opportunity for new species to repopulate the area cleared by fire. In light of these results, additional survey sites in the unburned area are being considered for some future monitoring event to determine whether the two selected sites are typical of other locations in unburned locations.

Our 2022 Volunteers:

Jon Ranney, Paul Sherman, Robin King, Tom King, Tom Strawman, Terry Slotemaker, Ellie Kravets, and Eric Shen

Everyone put in a great effort this year.
Thank you.

Plant Phenology

Project Leads: Taft Perry, Ruth Bachrach

Phenology is the scientific study of periodic biological phenomena in relation to climatic conditions. For the Transition Fidalgo Phenology Study, there are teams of volunteers who observe spring and autumn events for particular plants located in the ACFL. One team studies salmonberry, ocean spray, and oso berry. Another team studies western hemlock, Douglas-fir and red alder. The third team studies big leaf maples.

We record from when the first leaves and flowers open their buds until the last leaves fall. This is the fourth year of data collection, with a goal to develop a large enough data set over time that some future climate or biology researcher can use this data to determine the effects of climate change on these plants in our setting. We highlight Big Leaf Maples for this report.

One of the most challenging things we had to contend with was finding maples that met our selection criteria. Those criteria required that the plants to be studied had to be close enough to each other to allow volunteers to go to one parking lot/trailhead to make observations. Further, the plants had to have low enough branches to be photographed to document the various periodic events we were tracking.

Above: Martha Hall photographing bud break

Thank you to our phenology volunteers :
Shirley Hoh, Jan Hersey, Rob Adler, Dan Miner, Peter Heffelfinger, Martha Hall and Sarah Roberts

Even a casual user of the ACFL will notice that there are lots of maples in the forest. But the low branch requirement made it difficult to find trees that would work. Mature maples are majestic and plentiful in the ACFL, but rarely have low branches. As they mature, the low branches fall off. But eventually two maples were located off the A Avenue ACFL entrance (aka the old dump) that met the criteria.

In spring 2023, two new team members were added to the maple team: Martha Hall and Sarah Roberts. This led us to realize that it was almost impossible for a person working alone to hold the branch down while taking the picture. What to do? Many options were considered, and eventually we settled on a specially constructed tool to serve as a branch weight.

A Funny Thing Happened on the Way to the Survey

The maple observations started in fall of 2020. The observations were carried out during the observation time frame by a team of two people (Dan Miner and Taft Perry).

In the fall of 2022, they went to check the maples and SURPRISE! Three of the six maple branches were no longer on the trees. The sharp cuts near the trunk made it clear someone had used a lopper or pruner to remove them even though they were off the trail.

Eventually we learned that one of the city employees who maintains the ACFL had been doing some pruning to allow a large truck in and had gotten overly enthusiastic. So the Friends of the Forest put together a tour of all the plants being studied, which was attended by observers, the lead city ACFL worker, and Transition Fidalgo project leads, so all would be aware of the plant locations.

Soil Moisture

Project Lead: Eric Shen

The soil moisture project began in the summer of 2019 with the installation of data logging stations located on trails 201 and 304 near the forest study locations. Soil moisture is key to the health of the forest ecosystems. A detailed understanding of how the soil moisture varies over the course of the year and from year to year will provide insights into how prolonged periods of dry soil conditions impact plant health.

Recent studies have shown that prolonged wet soil conditions extending into the late spring have a larger beneficial impact on the health of trees than the duration of the length of the drought period in the summer and early fall. The reason for this was explained by Dave Peterson, Forest Monitoring Lead Scientist, in an article published earlier this year in a newsletter to the Forest Stewards:

Volunteer Ellie Kravets Retrieving Soil Moisture Data

"Trees generally have plenty of water available in the spring and early summer, during their period of maximum photosynthesis and cell growth. This is when leaves, branches, and the trunk are actively growing. By late summer, when the soil has dried out, growth slows down to nearly zero. Trees are well adapted to this seasonal pattern, including the dry soil in late summer.

"However, trees can become stressed when the drought period comes early. Dry soils between May and July can reduce growth considerably. By late summer, soil moisture may be so low that some trees can have difficulty transporting water up to the crown via the xylem, in some cases causing leaf yellowing and mortality. Light rainfall in summer may alleviate stress only a little because much of the water will not reach the root systems. Multiple drought years over a short period of time can be particularly stressful, making trees susceptible to insects and pathogens."

In 2022, the ACFL experienced a wet spring that kept the soil moisture high out to the beginning of June for the top 11 inches of soil and to the middle of July at a soil depth of 30".

It is notable that the cedar monitoring surveys conducted in 2022 showed an increase in the overall health of the trees (improvement in the foliage density and color) across all the trails with four years of continuous survey data. This is a single-year observation; monitoring in future years will hopefully confirm the correlation between wet soil conditions extending into the late spring and observations of healthier trees.

Bird Surveys

Project Lead: Jack Hartt

Volunteers with binoculars around their necks have been hiking trails around Heart Lake and the Little Cranberry/Big Beaver pond areas since 2021 for Transition Fidalgo.

Their goal: identify what species of birds can be found there each month, and how many of each species.

Every month, Robbie Hutton, Evelyn Adams, and Neil O'Hara have faithfully walked a section of these areas, taking two or three hours each time to look and listen among the forests and waterways. Kath Goldhartt and I have subbed a couple of times when needed.

We save our observations for Transition Fidalgo's records, and share our findings with E-bird, an international website for recording bird sightings.

Over the coming years we will be able to determine if any changes are occurring in our bird populations. As you know, birds are "canaries in the coal mine" in many ways. Changes to the habitat, brought on by a multitude of potential impacts, are often first seen in increasing or diminishing numbers of certain bird species, or in changes of when they first appear or leave for other places.

It is obviously too early to draw any conclusions yet; it will take more time to see any trends.

But so far, we have observed a total of 88 species living in these parts of the ACFL. Our record for one day is 31 species, 134 total birds, in March of this year. Our lowest number is 9 species, 34 total birds seen in – you probably guessed it – January of this year.

Above: Evelyn Adams checks the Heart Lake shoreline for birds. Photo by Jack Hartt

Below: A Wood Duck couple on Big Beaver Pond. Photo by Neil A. O'Hara

Weather and Climatology

Project Lead: Jon Ranney

Hydrologic Year 2022 Summary

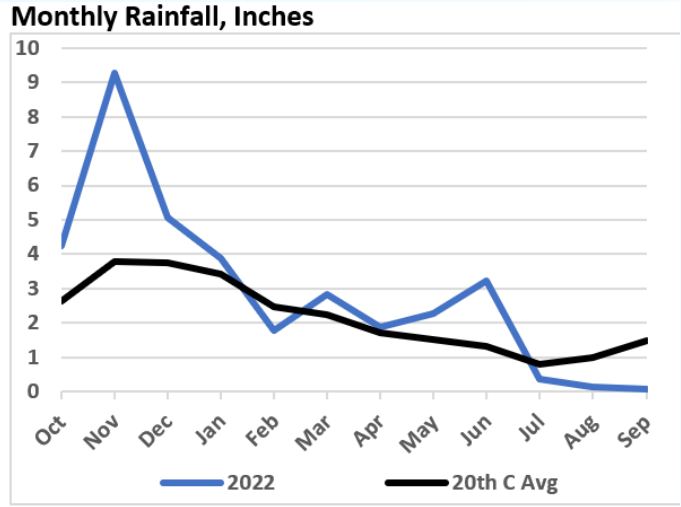
Hydrologic year 2022, from October 2021 through September 2022, was an unusually wet year. Total rainfall of about 35 inches was the third highest of any year since 1900. Almost all the rain came during the nine-month period October through June, easily the wettest such period over the last 123 years. This was followed by the driest July through September, when only a little over a half inch of rain fell.

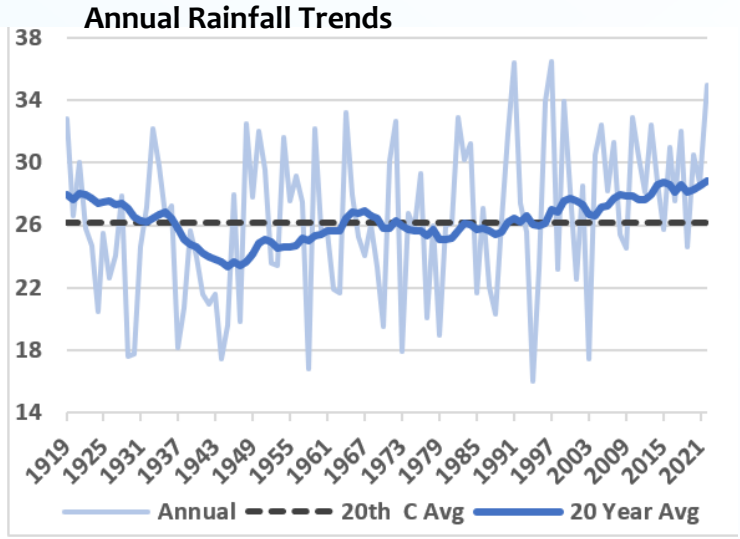
Average temperatures throughout most of the year were very close to the long-term averages. However, average daily highs were mostly lower than the long-term averages, while daily lows were higher than average.

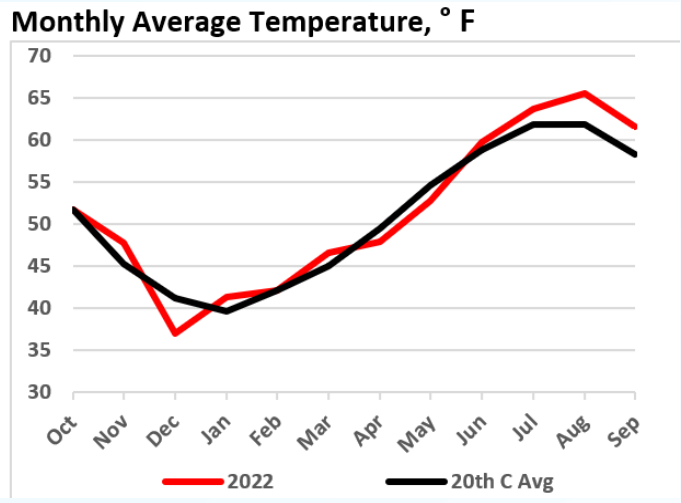
The graphs below compare 2022 monthly rainfall and average temperatures with 20th century averages.

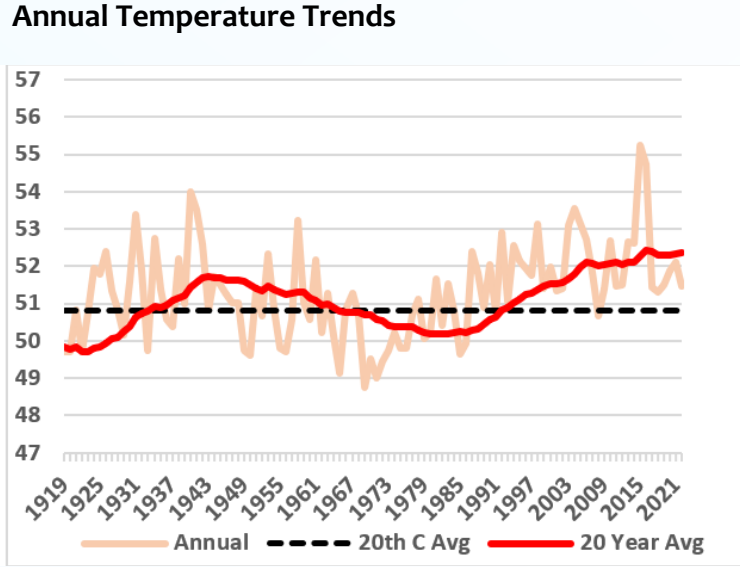
Climate Trends

Annual variability in temperatures and rainfall can make it difficult to discern the long- term climate trends. One simple way to represent the trends is by looking at moving averages. Rainfall and temperature trends are illustrated in this manner in the graphs below.









Summary

By Eric Shen

As the ACFL Forest Monitoring Program continues in its fifth year, early observations are starting to emerge. It is clear that the western redcedar population is not in the rapid decline as we experienced following the 2015/2016 drought years. In fact, surveys across several projects are showing the forest ecosystems appear stable, even improving in 2022 with good soil moisture extending into late spring/early summer.

The fire at Little Cranberry Lake in 2016 has created opportunities for new plant species to lead the recovery. Each of the surveyed locations showed a significantly higher diversity when compared to the unburned parts of the forest. The percentage of vegetation cover has progressively increased based on the photo point surveys taken since 2019. The vast difference is noted when photo series are compared with the photos taken immediately after the fire.

The weather patterns influencing the ACFL and soil moisture data are starting to be tied to survey data from the other projects that make up the ACFL Forest Monitoring Program. As the monitoring continues, integration of data across the seven ongoing projects will start to show trends and improve our understanding of which factors are important to the health of the forest ecosystems.

New projects are in development that will allow the observations from the current projects to be extrapolated to the entire ACFL. It will be important to have that baseline of ecosystem health as the impacts of climate change continue to advance.

The ACFL Forest Monitoring Program is an all-volunteer, citizen science effort. The information in this annual report would not be possible without the hundreds of volunteer hours that have been contributed over the past four and a half years of this program. A big thank you to all of our volunteers for their dedication to going out in all types of weather conditions to gather this data.

As a citizen science program, there is a continual need for new volunteers. If you are interested, or know of others who may be interested, please drop us a line at: info@transitionfidalgo.org. We would love to have your help.

Our 2022/2023 Volunteers

You are the people who make all of this happen.

Thank you!

Evelyn Adams
Rob Adler
Bill Bachman
Ruth Bachrach
Christine Bergman
Kari Bishay
Bill Buchanan
Mary Campbell
Dave Crockett
Elizabeth Drozda-Freeman
Adam Erie
Kath Goldhartt
Martha Hall
Sam Hardesty
Connie Harris
Jack Hartt
Peter Heffelfinger
Jan Hersey
Shirley Hoh
Sharon Howard
Robbie Hutton
Steve Johnson
Robin King
Tom King
Ellie Kravets
Dan Miner
Neil O'Hara
Taft Perry
Dave Peterson
Steve Purcer
Jon Ranney
Jim Redding
Sarah Roberts
Patricia Rothman
Eric Shen
Laurie Sherman
Paul Sherman
Terry Slotemaker
Tom Strawman
Tamala Taylor
Becky Vavrosky
Lynn Wohlers
Chris Wood
Rosann Wuebbels