with compliments,
Don Gayton.

# TROUT CREEK ECOLOGICAL RESERVE
# FIRE HISTORY PROJECT

**A Report for**

**Okanagan-Shuswap Ecological Restoration Committee**

**By**

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**FORREX**

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## Introduction

The 75 hectare Trout Creek Ecological Reserve (#7) was created to "conserve representative semi-arid vegetation dominated by ponderosa pine, bunchgrass and Douglas-fir in the southern Interior of BC" (Ministry of Environment, 2010). It is located approximately 6km southeast of the community of Summerland, and ranges from 540 meters to 850 meters, and is totally within the PPXh1 subzone[1]. It is bounded on the east by the Summerland Golf Course, on the south and west by the deep ravine of Trout Creek, and on the north by Penticton Indian Band (PIB) land. PIB land is also just to the west and south of the Trout Creek Ecological Reserve (TCER); Trout Creek forms the border.

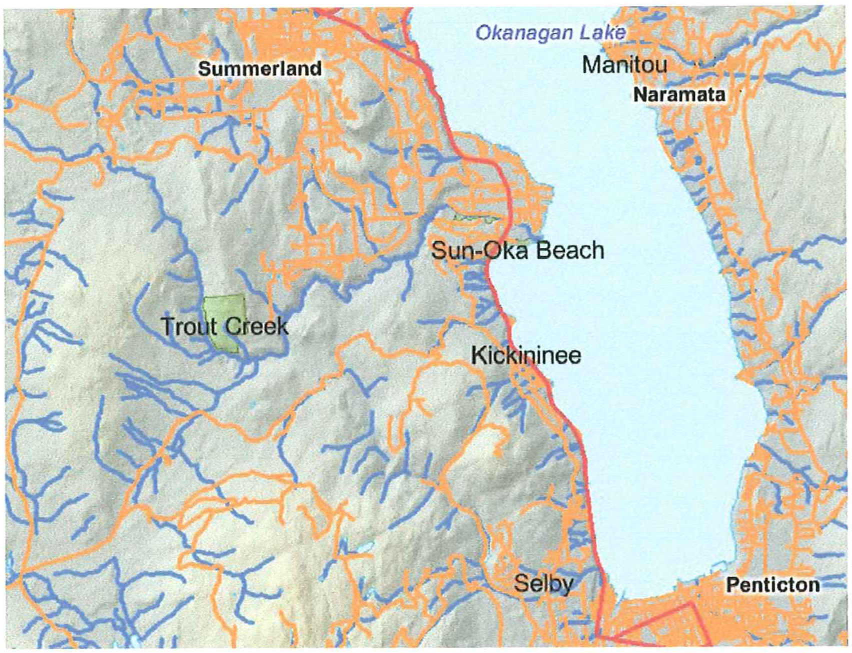



Fig. 1. This map shows the location of the TCER (colored in green).

The TCER was among the first 29 ecological reserves created in British Columbia, which were designated in May, 1971. The purpose of the ER program is as follows:

> *"Ecological reserves are established for the maintenance of biological diversity. They assist in developing and promoting an environmental consciousness and provide outdoor laboratories and classrooms for studies concerned with the natural environment. Ecological reserves are benchmarks against which environmental changes can be measured. As many ecological processes are as yet poorly understood, today's scientists cannot predict some of the questions that will require research in unaltered ecosystems. Ecological reserves keep our options open for the future. A system of ecological reserves is a "genetic data bank" which may hold the key to new discoveries."*
>
> *--BC Ministry of Environment, 2010*

[1] The BC Parks website lists the Trout Creek ER as being in the Interior Douglas-fir.

## Purpose of the Project

This paper is partly in fulfillment of contract ORWHFS/DOS/ER10_007, between the Okanagan Region Wildlife Heritage Fund Society, and FORREX, Forum for Research and Extension in Natural Resources, and done on behalf of the Okanagan-Shuswap Ecological Restoration Committee. The contract calls for the documentation of the fire history and fire return interval for a typical South Okanagan ponderosa pine/bunchgrass area, by analyzing fire-scarred trees, using established dendrochronological procedures. As fire is an integral component of the ponderosa pine/bunchgrass community type, the results of this analysis can provide baseline data and management direction for the ER, as per the boxed statement above.

There are 4.4 million hectares of land in British Columbia that are considered to be fire-maintained ecosystems. Less than 5 percent of this type are to be found in parks or protected areas (Shaeffer et al 2003), so individual parcels such as the TCER are of greater importance than their physical size attests.

This paper also represents a small contribution to the limited stock of documented knowledge about the TCER, to be laid alongside previous contributions by Larmour (1975), Sirk and Bayliss (1977), Alcock (2006) and the observations made by ER volunteer wardens Enid Maynard and Laurie Rockwell.

## Topography and Soils

The ER represents the southern terminus of Mount Conkle, an elongated, north-south ridge that parallels Trout Creek. Most of the ER's exposure is to the south and southwest and, aside from a few narrow benches and ridge-tops, the terrain is quite steep. The lacustrine soils of the lowest slope positions are cut with gullies. The bare, white walls of the deeply incised Trout Creek Canyon are quite imposing. From the lowest bench to the bottom of the Canyon is a nearly vertical 120 meter drop. There are only one or two very precipitous game trails that connect the benchlands to the bottom of the Canyon. The area above the benchlands is a combination of unstable talus slopes, vegetated ridgetops and gullies, and bare or sparsely vegetated lava rock outcroppings.

The soils of the level and slightly sloping benchlands are sandy loams, grading into stonier loamy sands on the steeper slopes. pH of the surface soil is alkaline, at 6.5, and organic matter levels range from 2.5 to 4.5 percent. The soils of both topographical positions are classed as Brunisols (Larmour, 1975).

Fig. 2. Looking SW down onto typical benchland Ponderosa pine/bluebunch wheatgrass community in the Trout Creek ER. A portion of the Trout Creek Canyon is visible in the upper part of the photo; the land beyond the Canyon belongs to the Penticton Indian Band. Note the preponderance of younger age-class trees on the bench.

**History**

The area covered by the ER was originally surveyed as a separate lot by the Municipality of Summerland. However, it was either never alienated, or else alienated for a time but then returned to the Municipality. There is a small network of abandoned forestry haul roads on the Reserve. The author suspects the roads date from the horse logging era, as they are too narrow for modern vehicles. A fence was built around the entire Reserve in 1977. Prior to the fencing, the area was subject to uncontrolled livestock grazing as well as off-road vehicle use. The adjacent Summerland Golf Course, the construction of the perimeter fence and the inaccessibility of much of the ER's terrain have combined to eliminate most of the typical human disturbances for the past few decades. A 1977 report describes a number of dirt bike and dune buggy trails on the ER (Sirk and Bayliss, 1977); none of those are apparent at this writing, and the old haul roads are just barely visible.

First Nations undoubtedly used the area of the ER, for hunting and the gathering of food and medicinal plants. However use was likely sporadic, given the difficulty of access and the lack of nearby water. There is no record of archaeological sites in the area, but no archaeological assessment has been done.

**Vegetation**

The predominant vegetation type is a semi-open ponderosa pine forest, with sun-loving shrubs, grasses and herbs underneath, and occasional Douglas-firs in mesic sites. There are a few small pockets of open grassland. The ridges and steep slopes support a mix of mosses, lichens and diminutive grasses and herbs. Larmour (1975) defined four vegetation types on the ER, and she listed them in declining order of area occupied:

1. *Pinus ponderosa/pseudoregneria spicata* (ponderosa pine/bluebunch wheatgrass)

   Found on the benchlands, at 620-720m elevation; average 10% slope; occupies 80-90% of the ER

2. *Pinus ponderosa/Pseudotsuga menziesii/Amelanchier alnifolia* (ponderosa pine/Douglas-fir/Saskatoon)

   Found at higher elevations and below the talus slopes, 700-740m elevation, average 32% slope

3. *Selaginella wallacei* (Wallace's selaginella moss)

   Found on ridgetops and exposed rock outcrops, 825m, average 24% slope

4. *Pinus ponderosa/Pseudotsuga menziesii/Calamagrostis rubescens* (ponderosa pine/Douglas-fir/Pinegrass

   Found in swales and on north aspects

Other significant species found in the ponderosa pine/bluebunch wheatgrass community are: gray rabbitbrush (*Chrysothamnus nauseosus*) Idaho fescue (*Festuca idahoensis*) and prickly pear cactus (*Opuntia polyacantha*). A recent invasive plant assessment identified small patches of Dalmatian toadflax (*Linaria genistifolia*) diffuse knapweed (*Centaurea diffusa*) and sulfur cinquefoil (*potentilla recta*) (Alcock, 2006).

**Forest Trees**

Numerous stumps throughout the ER testify to an early logging operation. The harvesting was quite extensive and trees of all sizes—including many down to as little as 20cm diameter—were taken. Trees that had been previously fire-scarred were also taken. The author has been unable to find any information on when the logging occurred. However, given the advanced deterioration of the stumps, and the evidence of old horse logging trails, the logging probably occurred prior to the 1940's.

A 2009 Vegetation Resources Inventory of the ER identified three larger polygons with the following characteristics (Ministry of Forests and Range, 2010):

| **Polygon #** | **59798750** | **58278454** | **57328419** |
|---|---|---|---|
| **BEC** | PPxh1 | PPxh1 | PPxh1 |
| **Area, ha** | 18.7 | 16.3 | 16.9 |
| **Site Index** | 8.5 | 8.5 | 6.5 |
| **Leading Species** | Ponderosa pine | Ponderosa pine | Ponderosa pine |
| **Crown Closure %** | 15 | 20 | 20 |
| **Basal Area M2/ha** | 5.1 | 15.0 | 3.2 |
| **VRI Live Stems/ha** | 197 | 244 | 258 |
| **Projected age, years** | 142 | 162 | 122 |

Larmour (1975) measured tree, transgressive and sapling density in 18 10x10 meter plots within the *Pinus ponderosa/Pseudoregneria spicata* community. Average values were:

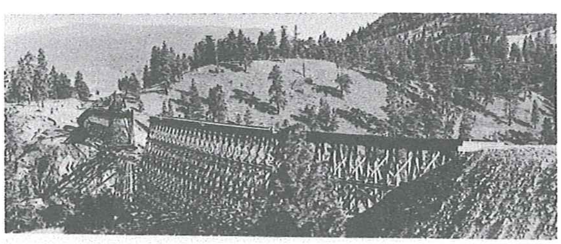
- Seedlings/transgressives/saplings: 460 stems/ha
- Live trees: 45
- Total: 505 stems/ha

Larmour further observes that "sapling and transgressive densities are higher than that of the trees, which may indicate that the tree density will increase." Sirk and Bayliss (1977) also note "trees have grown (more trees) since time of airphoto, noticed at west side of mountain (first ridge)."

Another source of forest information can be obtained by locating and retaking old photographs and airphotos.

Fig. 3. The Kettle Valley Railway trestle

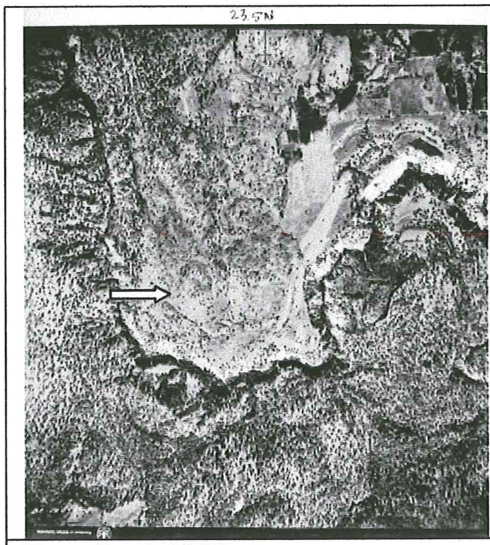
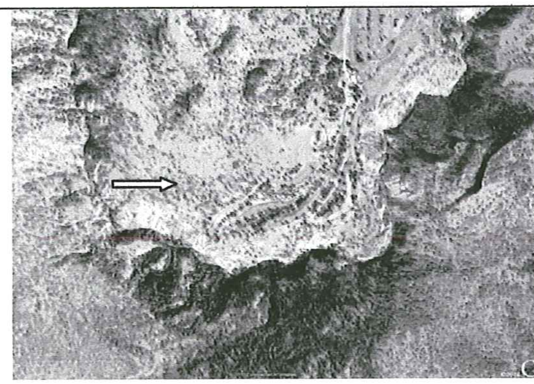
**KVR TROUT CREEK, 1914**



**KVR TROUT CREEK, 2006**

This photo pair is looking south across the Trout Creek Canyon, approximately 5km east of the Ecological Reserve. The hillside, which is a sandy, north-facing slope, has experienced substantial tree ingress in the 90 year period.

Fig. 4. Aerial photopairs of the TCER

|  |  |
| --- | --- |
| Trout Creek 1938 | Trout Creek 2010 |

In this photopair, ingrowth is particularly obvious on the north-facing slopes along the south side of Trout Creek. Ingrowth on the dry, south-facing benchlands of the ER is less obvious, but is occurring nonetheless. The arrows indicate an original pocket of bunchgrass grassland which has now become an open forest.

**Fire Maintained Ecosystems**

The ponderosa pine/bluebunch wheatgrass plant community which dominates the Trout Creek ER falls within the suite of biogeoclimatic subzones (BG, PP and dry IDF) that are known as "fire-maintained ecosystems" (Blackwell et al 2003; BC Ministry of Forests, 1995). In other words, frequent, low-intensity fires were an integral part of the functioning of these ecosystems, maintaining a dynamic balance between trees, shrubs and herbaceous vegetation. The fire regime consisted of a lightning-caused component, as well as fires purposely lit by First Nations. The frequent fire regime performed a number of useful functions:

- Thinning of tree regeneration, resulting in large, widely-spaced and essentially fireproof veteran trees
- Maintaining sufficient sunlight, moisture and nutrients for diverse herbaceous understory plant communities
- Providing herbaceous forage for wild ungulates
- Recycling of nutrients sequestered in coarse woody debris and litter
- Reducing fuel loads, thereby reducing the risk of severe wildfires which reduce biodiversity and trigger soil loss through post-fire erosion events
- Reducing the incidence of forest pest attacks by maintaining an overstory of healthy, widely spaced trees
- Maintaining a positive soil water balance in drought-prone soils by reducing water lost through tree transpiration and sublimation

The frequent fire regimes experienced by the BG, PP and dry IDF ecosystems began to be disrupted in the 1890's, as livestock consumed fine fuels, and First Nations traditional land management practices were curtailed and then banned altogether. Fire suppression then came into full force in the 1940's, with the advent of modern firefighting techniques.

**Biodiversity and Endangered Species**

There is a very close correlation between low elevation interior grasslands and overall biodiversity, as well as the concentration of species at risk. More than 30 percent of BC's species at risk depend on grasslands for some part of their life cycle (BC Grasslands Conservation Council, 2010).

Stevens (1995) ranked BC's 14 Biogeoclimatic subzones by total wildlife (amphibian, reptile, avian and mammal) biodiversity; the PP and BG ranked 4$^{th}$ and 6$^{th}$, respectively. However, they rank second and third (behind Coastal Douglas-fir) in terms of concentration (species per hectare) of wildlife. This is due to the very small areal extent of these two subzones, and the high degree of land conversion they have experienced (Austin et al, 2008).

Scudder (2004) mapped overall species biodiversity and endangered species concentrations, and found that both measures coincided in three locations in British Columbia; southeastern Vancouver Island/Gulf Islands, the Lower Mainland, and the South Okanagan.

Krannitz and Rohner (1999), working in the South Okanagan, found a positive correlation between total avian biodiversity and increasing ponderosa pine tree density, but the increases were among the Forest and Ubiquitous bird guilds; the number from the Open (grassland) bird guild declined. They concluded that "slight increases in ponderosa pine density at a site resulted in negative conservation consequences for grassland birds; not only did they habitat become less suitable for them, but also birds that normally preyed on their nests and young increased in abundance."

Warden Laurie Rockwell is an accomplished birder, and has documented sightings of a large variety of birds on the TCER. Sirk and Bayliss (1977) also list birds they observed there.

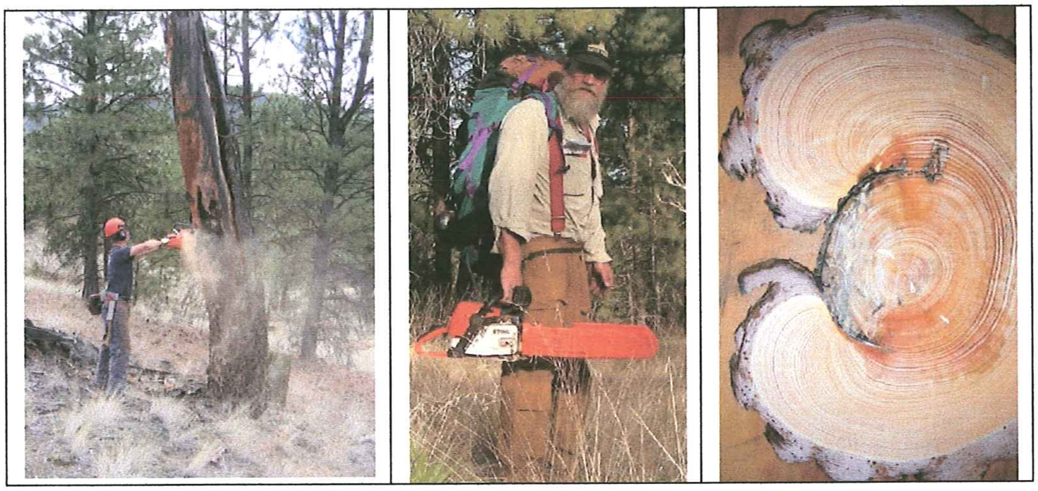
**Fire Histories**

There is a small but growing body of knowledge about pre- and post-suppression fire occurrences based on fire-scarred ("cat-faced") trees. Schellhaas et al (2003) performed an extensive fire history analysis in a Douglas-fir/Ponderosa pine area near the Eastern Washington community of Winthrop, about 60km southwest of the Nighthawk border crossing. Using the period 1660 to 1889 as the period of reliability, they found an average fire interval of 16.1 years, with the shortest interval registering at 9 years and the longest at 43 years. Because of their extensive sampling effort, they were able to determine an average fire size, which was approximately 600 hectares. However they did identify several "regional" fires that were much larger in size. After 1889, there were only two recorded fires.

Morrison and Gray (2005) analyzed fire-scarred trees in an IDFdk1 site at Pothole Creek, southeast of Merritt. For the period of reliability 1632-1967, the average fire return interval was 9.8 years, with a minimum return of one year and a maximum of 47 years.

Blackwell et al (2003) summarized historical (i.e., pre-European settlement) natural fire return interval (HNFR) documentation in British Columbia BG and PP sites, and reported a range of 3 to 28 year HNFR.

Fig. 5. (left) Faller Terry Schmidt cutting a fire-scarred snag on the TCER; (center) author packing out cookies; (right) a typical finished cookie, showing one fire scar.



Turner and Krannitz (2001) analyzed forest cover (stems/ha) on airphotos from 1938 and 1985 in representative burned and unburned BG and PP sites in the Okanagan Valley, from Osoyoos to Penticton. Unburned sites gained 6 stems/ha from 1938 to 1985, whereas burned sites lost 8 stems/ha over the same time period. From this they concluded that "fire suppression in the southern interior of BC his therefore likely linked to establishment of Ponderosa pine and Douglas-fir in grassland and savannah habitats of the south Okanagan and Lower Similkameen valleys."

Gyug and Martens (2002) did a similar airphoto analysis (1947 and 1996) in the Lower Similkameen area. Two of their conclusions were:

- The invasion of previously semi-open forests at all elevations by conifers and the conversion of these sites to closed forests
- The encroachment of conifers into open grasslands and other open habitats

No direct references to fire on the Trout Creek Ecological Reserve could be located, aside from the following comments in Sirk and Bayliss (1977): "west slope burnt," "most of reserve has been logged and burnt"

**Fire History Study—Methods**

The entire ER was first surveyed on foot, and all fire-scarred trees and stumps were given a unique identification number and their locations recorded using a Garmin etrex Legend GPS unit. Selected trees and stumps were then cut with a chainsaw, and duplicate cross-sections ("cookies") of 3-8cm thickness were taken from each. Tree selection was based on the condition of the fire scars, safety issues, and a broad geographical and aspect representation of the entire Reserve. Partway into the project it was observed that many of the single-scarred, sampled trees were scarred by the same 1933 fire, so additional single-scarred trees bearing that fire signature were not taken.

The cookies were then air-dried for 10 days, and then clamped and glued down onto 3/8" plywood backing boards using PL400 construction glue. Affixing the cookies to backing boards facilitates the sanding process, and also prevents warpage and splitting. All samples were permanently labeled with their GPS waypoint identifying number.

Fig. 6. Location of firescarred live trees, snags and stumps on (and immediately adjacent to) the Trout Creek Ecological Reserve. Reserve boundary is shown by the thin green line.

The mounted cookies were then sanded, first with 80 grit, and then progressing through 120, 220, 320 and finally to 400 grit, to achieve maximum visibility of the tree rings and fire scars. Dating procedures were as per Stokes and Smiley (1968). Rings were counted using 3x and 10x hand lenses, and in some instances a 40x dissecting scope was required.

**Fire History Study—Results**

Fig.7 Distribution of fire scar dates from live trees on the Trout Creek Ecological Reserve.

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1755 | 1790 | 1816 | 1845 | 1851 | 1856 | 1857 | 1858 | 1932 | 1933 | 1934 | 1935 | 1938 | 1939 | 1942 | 1950 | 1978 |
| | | | | 1851 | | | | 1932 | 1933 | 1934 | | | | | | |
| | | | | | | | | | 1933 | 1934 | | | | | | |
| | | | | | | | | | 1933 | | | | | | | |
| | | | | | | | | | 1933 | | | | | | | |
| | | | | | | | | | 1933 | | | | | | | |
| | | | | | | | | | 1933 | | | | | | | |

A total of 27 scars were identified, from 18 live trees (see Appendix). Both ponderosa pine and Douglas-fir were represented. The table above shows the number and date range of all the individual fire scars. Dates immediately adjacent to each other are assumed to be the same fire, with years varying slightly because of the inherent inaccuracies in tree ring dating. Extremely dry years can produce a nearly invisible ring, and cool, wet summers occasionally produce a band of latewood that can be misinterpreted as an annual growth ring. Wood deterioration resulting from diseases, insects and weathering can also produce inaccuracies. Thus I am assuming the fires dated 1932, 1934 and 1935 actually occurred in 1933. Similarly, the fires dated 1856, 1857 and 1858 I am assuming to have occurred in 1851.

The 1933 fire was obviously a regional or subregional conflagration, since a large number of trees recorded it, from different locations and aspects on the ER. This date corresponds to a very dry climatic period in much of Western North America, which could have created the conditions for a large fire. This fire may also have been a purposeful or accidental byproduct of the early logging.

In dry forest dendrochronology work the number of available live trees with scars dating to before 1900 drops off dramatically, due to tree death from insects or disease, severe wildfire, blowdowns and historical logging. However, the lack of more contemporary (1933 and forward) fire scars may represent an actual decrease in the incidence of fire and subsequent fire scarring. Further sampling would help to answer this question.

Fig. 8. Fire return intervals

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1755 | | 1790 | | 1816 | | 1845 | | 1851 | | 1933 | | 1938 | | 1942 | | 1950 | | 1978 | | | |
| | *35* | | *26* | | *29* | | *6* | | *82* | | *6* | | *4* | | *8* | | *38* | | | = | *26 year fire return interval* |

The numbers in italics represent the number of years between fires; the minimum return interval is 4 years, the maximum is 82, and the mean is 26 years.

Five fire-scarred cookies from stumps and snags were collected as well, in hopes of adding to the database using the "cross-dating" procedures outlined in Stokes and Smiley. An unscarred, climate-sensitive "recorder tree" is crucial to the cross-dating process. Unfortunately the author could not locate an adequate recorder tree.

Fig.9. Intervals between fires on the undated snags and stumps.

| Tree Waypoint Number | Years from Tree death To latest fire | Years between Latest fire To 1st previous fire | Years from 1st previous Fire to 2nd Previous fire | Years from 2nd Previous fire to 3rd Previous fire |
|---|---|---|---|---|
| 6 | 67 | 61 | | |
| 32 | 43 | 89 | 37 | 25 |
| 36 | 47 | 75 | 62 | |
| 60 | 27 | 64 | | |
| 77 | 85 | | | |

It is tempting to take the intervals between fires from these undated snags and stumps and roll it in with the live tree interval data, but until these cookies can actually be actually dated, this table remains as simply raw data.

Beyond the fire return interval, the other important metric is fire size. This can only be determined by extensive, grid-based sampling.

**Conclusions**

The 26-year fire interval is considerably longer than others reported in the literature for similar BG and PP ecosystems. There are a number of possible reasons for this, but the most likely is insufficient sampling. Another possibility is because of its relative inaccessibility, the area was infrequently burned by the Sy'ilx Nation peoples. A third possibility is that the extensive logging event removed many fire-scarred trees from the potential sampling pool.

If one assumes a degree of dating inaccuracy, the fire dated 1978 may have been the one that Sirk and Bayliss referred to in their 1977 paper. However they gave no indication of how old the fire evidence was. Indeed, a dry forest can retain the evidence of a burn for quite some time.

**Management Implications**

If we take the information derived from this brief study—a 26 year fire return interval and 1978 as the date of the last fire—as a crude baseline for management purposes, then the ER has missed one and one quarter fire cycles. Due to modern fire suppression, this is fairly typical of the dry interior forests of BC (Blackwell et al, 2003).

Fig. 10. TCER Lower benchlands

The above photo tells an eloquent story. In the foreground are three high seral, sun-loving species, Idaho fescue (*Festuca idahoensis*), bluebunch wheatgrass (*Pseudoregneria spicata*) and Arrowleaf balsamoroot (*Balsamorhiza sagittata*). In the absence of grazing or fire, a thick mat of grass litter has developed. To the left of the middle ground are two trees in early maturity, with large accumulations of duff around their bases. To the right of the middle ground and in the background are saplings and pole-sized regeneration—ingrowth and encroachment trees. Left to its own devices, this ecosystem will shift from an open savannah grassland to an unthrifty closed pine forest, and the current herbaceous understory will die out and be replaced with sparse, shade tolerant species such as pinegrass (*Calamagrostis rubescens*) and Oregon grape (*Mahonia aquifolium*). This site will also become a candidate for a severe wildfire, which will eliminate the mature, veteran and wildlife trees, and set the ecological clock back to a very early seral stage.

The Trout Creek Ecological Reserve seems an excellent candidate for fire-maintained ecosystem restoration, for the following reasons:

- We now have a crude idea of the area's fire history and return intervals
- The location and general topography of the ER lends itself to a safe burn, with several natural fire barriers already in place
- The ER has the logistical advantage of being close by, making it a good candidate for prescribed burn training, operational monitoring and research
- There is an existing repository of monitoring data and observations
- The herbaceous understory is in quite good condition, with few invasive species present
- The forest ingrowth and encroachment is still in the incipient stage; fuel loading is not high, and a good percentage of the regeneration is still at the stage where it is easily killed by a ground-oriented prescribed burn

This initial fire history can be added to—and re-analyzed—in the future. The existing samples are all permanently labeled and will be stored long term. A second phase of the fire history study could also access adjacent lands, to help fill chronological and geographical gaps.

**Acknowledgments**

Every landscape contains many stories, and it has been my privilege to transcribe this one. My thanks go to Bernie Kaplun (MOFR Vernon), chair of the Okanagan-Shuswap Ecological Restoration Committee, and Chris Hollstedt, CEO, FORREX, for making this project possible.

## APPENDIX: INDIVIDUAL LIVE TREE DATA

| Tree Waypoint Number | Species | Rings from 2010 to latest fire (Year) | Rings from 2010 to 2nd fire (Year) | Rings from 2010 to 3rd fire (Year) | Rings from 2010 to 4th fire (Year) |
|---|---|---|---|---|---|
| 8 | Fd | 76 (1934) | 153 (1857) | | |
| 11 | Py | 68 (1942) | 255 (1755) | | |
| 16 | Fd | 78 (1932) | 154 (1856) | | |
| 29 | Fd | 77 (1933) | | | |
| 30 | Py | 77 (1933) | | | |
| 35 | Py | 75 (1935) | 159 (1851) | 194 (1816) | |
| 39 | Fd | 77 (1933) | | | |
| 46 | Fd | 77 (1933) | | | |
| 47 | Fd | 32 (1978) | 76 (1934) | | |
| 51 | Py | 152 (1858) | | | |
| 52 | Py | 76 (1934) | | | |
| 57 | Py | 77 (1933) | | | |
| 59 | Py | 77 (1933) | | | |
| 61 | Py | 77 (1933) | 165 (1845) | | |
| 67 | Py | 71 (1939) | | | |
| 70 | Py | 72 (1938) | | | |
| 73 | Fd | 78 (1932) | | | |
| 75 | Fd | 60 (1950) | 80 (1930) | 159 (1851) | 220 (1790) |

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