



Miistakis
Institute

Post-Kenow Wildfire Workshop

Summary Report

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Document prepared for Waterton Lakes
National Park

January 2018

Post-Kenow Wildfire Workshop: Summary Report

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Disclaimer

It is important to recognize that this document and its contents represent the observations and initial conclusions of the Miistakis Institute based on their participation in the Post-Kenow Wildfire Workshop, and does not profess to contain any detailed analysis or conclusive recommendations. The summary notes of the presentations represent the best effort of the Miistakis Institute, but come with no warranties or guarantees of accuracy. It is recommended that anyone using this information verify it first.

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Introduction

The summer of 2017 was especially dry in southwestern Alberta, leading to a heightened fire risk in the area. On August 30th, a lightning strike in the Akamina area of southeastern BC ignited a wildfire. The fire made its way north and east, eventually crossing into Waterton Lakes National Park (WLNP) on Sept 11th. It then raced through the forested valleys overnight, into the Park's grasslands, and moving out into lands adjacent to the park in the Municipal District of Pincher Creek. When it was done, the fire had burned approximately 50% of the Park's vegetated area, and of that over 75% burned at 'extreme severity.'

While it is known that the Kenow Wildfire had an unprecedented impact on the Park's ecology, exactly what that impact is, and what it implies for future monitoring, research and management is challenging to assess. As a result, WLNP Resource Conservation personnel convened a workshop in Waterton Park on January 10th and 11th, 2018 with the following purpose:

In partnership with post-wildfire ecology and management experts, Parks Canada will compile knowledge to guide research, monitoring and management in Waterton Lakes National Park following the Kenow Wildfire of September, 2017.



The intended outcomes of this workshop were:

1. *Identify ecological effects expected in the short- and long-term and how these may affect/direct active management within WLNP.*
2. *Define research and monitoring priorities a) to inform park management and b) for greater research purposes. Identify possible researchers/leads.*
3. *Identify key mitigations for reduction of long-term, adverse impacts.*
4. *Compile lessons learned from collective experience in post-fire management.*

Experts in various areas of post-wildfire ecology from across western North America were asked to participate, working side-by-side with WLNP staff to better understand the ecological implications of the Kenow Wildfire and the necessary next steps for the Park.

This document is a summary of that workshop. It includes information on the process of developing the workshop, summaries of the information presented at the workshop, and summaries of the discussions that took place. It also includes observations from the Miistakis Institute as to the themes that appeared to be cutting across the entire workshop.

Workshop development

Workshop Initiation

The workshop was initiated by personnel from Waterton Lakes National Park's Resource Conservation department. These are the people who are charged with monitoring, researching, and/or managing the Park from an ecological perspective. A cross-department team identified that a workshop represented an ideal venue for the necessary cross-disciplinary conversation that was needed. They worked out a series of needs for the workshop, refining these into a purpose and associated objectives (as listed above).

The workshop planning team then identified a series of possible participants who had the necessary background knowledge in various aspects post-fire ecology, and could provide that wisdom in a form that would draw from their other experiences, but be applicable to WLNP and the Kenow Wildfire. Select participants were asked to present on their areas of expertise.

Interest in the workshop was very high, and despite very short notice, the two-day length, and the need to travel to Waterton in winter, there was a very robust response. Unfortunately, in order to keep the workshop manageable and productive, several interested people had to be turned away.

The WLNP team approached the Miistakis Institute to provide support in designing and facilitating a workshop to serve these needs.

Workshop Structure

The WLNP team worked with the Miistakis Institute to design a suitable workshop structure. The ultimate design emerged from a philosophy that there would be essentially two groups in the room: 1) WLNP personnel who need information to monitor and manage a post-fire park; and 2) experts and knowledgeable people with information that WLNP



personnel could need. The goal then was to ensure the information would come from the information *providers* in a manner usable for the information *users*.

The workshop was then designed to serve four needs:

Information provision – ‘Context’ presentations by WLNP personnel and ‘Content’ presentations by invited experts; background information that all workshop participants would use in the subsequent exercises

Refinement of information – ‘Fishbowl’ sessions following every ‘Content’ presentation; ensuring information that is genuinely applicable to WLNP is drawn from each presentation

Conversion of information to actions – breakout sessions used to move from ‘received information’ to ‘applicable direction’; specifically regarding Monitoring, Research, Management, and Partnerships

Prioritization of actions – drawing on the assembled expertise to help identify and suggest which actions should perhaps get priority

Workshop Format

The workshop itself took place over two days and had the following sections;

Context presentations

The 'Context' presentations were intended to provide just that – context around the Park, its ecology, its management regime, and the Kenow Wildfire itself. The presentations/presenters were:

- Welcome – Ifan Thomas, Field Unit Superintendent
- Park Management Context – Dennis Madsen, Resource Conservation Manager
- Park Ecology Context – Barb Johnston, Wildlife/Aquatics Ecologist
- Overview of the Kenow Fire – Scott Murphy, Fire Management Officer

Expert presentations

The 'Content' presentations were aimed at specific areas of post-fire ecology: hydrology, forests, grasslands, and wildlife. Each speaker was given the same set of questions to answer in some way during their presentation (see sidebar). The presentations/presenters were:

- Post-fire Hydrology - Uldis Silins, Professor of Forest Hydrology, University of Alberta
- Post-fire Grassland Ecology - Barry Adams, Range Ecology Consultant
- Post-fire Forest Ecology – David Hibbs, Professor Emeritus – Oregon State University, Earthwatch Institute
- Post-fire Wildlife Ecology – Evelyn Merrill, Professor, Department of Biological Sciences, University of Alberta

After each presentation a 'Fishbowl' questioning format was used, where the speaker was quizzed by a designated note-taker on each of the speaker questions to ensure that information was captured. The floor was then opened to all participants to ask questions of the speakers or add to the gathered 'speaker question' information.

Discussions

The workshop discussion had two components, the first being a short 'extra discussion' space at the start of Day 2, and the second (and primary) one being the breakout sessions.

The group decided to use the 'Extra Discussion' space simply to continue or expand on conversations that had come up during Day 1.

The Breakout sessions were designed to be directed conversations on specific topics. A series of topics were chosen in advance based on issues for which WLNP personnel wanted specific information. That list was then put to the group to determine if modifications were needed based on the discussion thus far.

The original list presented was:

- Aquatics
- Invasive plants
- Wildlife (regional)
- Forests
- Grasslands
- Prescribed burning

After discussion, the list was modified to be:

- Aquatics and Hydrology
- ~~Invasive plants~~ [*agreed that this topic should be discussed in each group*]
- Wildlife (regional)
- Forests

Speaker Questions:

- What are the *short-term ecological effects* of note?
- What are the *long-term ecological effects* of note?
- What are the *management implications*?
- What are the *key mitigations* needed for negative, long-term ecological effects?
- What are the *lessons learned* applicable to WLNP?
- Who are the *key people* in this area WLNP should contact?

- Grasslands
- ~~Prescribed burning~~ Fire management (including prescribed burning)
- [*agreed that Landscape Ecology should be discussed in each group*]

The questions to be discussed in each group were:

- What should we be *watching* for? (Monitoring)
- What should we be *asking?* (Research)
- What should we be *doing* about it? (Management)
- *Who* should help us? (Partnerships)

Although there were five (5) Breakout topics, there were only three (3) Breakout discussion sessions. Participants were given the opportunity to choose the three topics that they would contribute to.

All breakout session feedback was gathered on flipchart pages posted on the wall. Staff from WLNP played the role of scribe in each case.



Prioritization Exercise

The workshop concluded with a modest prioritization exercise. This exercise was based on the following assumptions:

- All suggested actions have some degree of importance, but not all of them can be accomplished;

- The ultimate decision of what does or does not happen is in the hands of WLNP personnel; thus these are only suggestions; and
- The group would be comparing 'apples and oranges' as some suggested actions would be general and some specific, but the intent was to get a collective picture of how the group recommended proceeding.

The flip chart pages were collected in one room, and each workshop participant was given 12 dots. Each person placed their dots adjacent to the actions they thought should be a priority. 'Priority' was defined as;

- Is of greater importance than other actions; and/or
- Should be pursued more quickly than other actions.

Presentation Summaries

Context Presentations

Welcome

(Ifan Thomas, Field Unit Superintendent)

- Kenow Fire - Unprecedented for Waterton and for Parks Canada (speed, intensity and response)
- Pleased with Parks Canada's ability to respond - ability to marshal resources with speed in a high visitation year
- Post fire recovery will also be unprecedented - WLNP will act as a laboratory
- WLNP welcomes insight from outside
- In addition to ecological impacts of the Kenow Wildfire, Parks Canada also needs to also attend to recreational and visitor needs



- Also need to be able to communicate significance of park to those who do not visit – visitor experience – this needs to be considered throughout the dialogue

Park Management Context

(Dennis Madsen, Resource Conservation Manager, WLNP)

- Park history (1895) – effort by local ranchers to protect: 505 km²
- First International Peace Park in the world
- Part of Waterton Biosphere Reserve
- Many areas popular with visitors are also areas which burned, so will have impacts on park visitation
- Ecological integrity and visitor experience focus (communication to visitors about the park is important)
- High demand in Waterton from park visitors (record year in 2017 due to Canada 150 free park entrance) – 578,000 visitors in 2017
- Ecological Integrity is primary consideration; that means “Parts, Processes and in Perpetuity”
- Ecological Priorities
 - Invasive species (single biggest issue)
 - Species at Risk
 - Natural Processes (i.e., wildfire)
 - Habitat Connectivity
 - Human-wildlife coexistence/conflict
- Rebuilding – the current state of the park will have impacts on the rebuilding efforts – i.e., removal of some danger trees
- Conversely, need to minimize impacts of rebuilding infrastructure on ecological integrity – i.e., the design of new/rebuilt campgrounds will need to consider regrowth from fire (i.e., berry bushes)



Park ecology

(Barb Johnston, Wildlife/Aquatics Ecologist, WLNP)

- WLNP in the Crown of the Continent – nexus of prairie and mountains – where the mountains meet the prairie – happens in an abrupt fashion, results in high biodiversity
- Coldest summers, snowy winters, high rain, high winds common
- 45 different vegetation classes
- Rich and diverse plant species - 1100 vascular plants, over 200 lichens, over half of the rare plants in Alberta are found in WLNP, 104 provincially rare species
- Forests: aspen woodland, Douglas-fir and lodgepole pine, limber pine, black cottonwood, sub-alpine fir and lodgepole pine, white bark pine
 - Forest challenges – previously were lack of fire and disease – beetle; threat of drought at high elevation; blister rust with five-needle pines
- Grassland – WLNP only Canadian national park that protects this type of grassland (foothills rough fescue).
 - Biggest challenges: non-native species (10% of vascular plants identified in the park are non-native species); aspen and shrub encroachment; grazing impacts of large herd of elk
- Aquatic systems – Crown of the Continent is the nexus of three major drainage systems. Waterton River, Belly River, headwaters. Fed by high gradient streams, very cold, high in oxygen and low in nutrients (oligotrophic).
 - Upper Waterton Lake – deepest in Canadian Rockies
 - Biggest challenges are climate change (increasing temperatures), and aquatic invasive are a major concern (non-native trout stocking occurred until 1970s). Zebra/quagga mussels are a nearby threat, whirling disease occurs in near-by water bodies (confirmed in Waterton and Belly drainages downstream of WLNP).



- Wildlife – Nearly full contingent of native species (except extirpated bison and northern leopard frog). Many species at risk (SAR action plan recently finalized for WLNP and Bar U Ranch National Historic Site)
 - Challenges include impacts from fire on SAR (Endangered half-moon hairstreak butterfly occurs on Blakiston alluvial fan, five-needle pines, olive-sided flycatcher)
- Ecological monitoring program long-term (baseline data for pre- and post-fire), occupancy for songbirds, amphibians and stream fish, five needle pine monitoring
- Restoration projects: five needle pines (planting seedlings resistant to blister rust), foothills grasslands (revegetation of disturbed sites, reducing agronomic invasives, reduction of encroachment of aspen and shrubs).

Questions

- Please comment on how WLNP views invasive species.
 - Historically focus on restoring native species and removing species that are invasive (not historically here), processes (some are natural and native and others are not) if native we do not intervene.
- Neighbouring jurisdiction conflict – are there concerns about fire management/pine beetle and conservation activities that are at odds with neighbouring jurisdictions?
 - Due to location (east no forests/timber) we do not have conflicts around how we treat pine beetle
 - We are dry, windy and small – prescribed burning is controlled
 - Crown Managers Partnership, develop good working relationships with other agencies around common issues
- We have a good working relationship with the province, neighbouring ranchers, US cooperation with Glacier National Park.
- Jurisdictionally Alberta has spent \$2 million to battle pine beetle (seen as a pest)
- Do you have First Nations involvement and are they engaged in research in Park and use of TEK?
 - Work on a number of fronts: visitor center education and outreach around history and interpretation, collection of native plants and uses, important agreements being developed, ceremony planned for spring around Kenow Wildfire
- Collaboration occurring with First Nations in Alberta
- BC Parks collaborations?

- Worked with them from fire perspective (closed back-country camp grounds jointly during drought conditions)
- Limited capacity to address all fire challenges
- Are there still discussions to add Akamina Prov. Park to WLNP?
 - No on-going discussion – in the hands of BC government
 - Trail head to Akamina-Kishenena Provincial Park has been one of the most popular in WLNP

Next Steps – Post Workshop

(Kim Pearson, Conservation and Restoration Project Manager, WLNP)

- Workshop results will help guide program work and research over the next decade
- Provided with a summary report post workshop (will be shared in some capacity)
- Workshop findings will be amalgamated with existing work plans and prioritization to develop more formal plans for monitoring and research (will be shared in some capacity)
- Some additional individual conversations will be needed
- Field tours in Spring 2018
- Will share ecological information with other sections within WLNP – External Relations, Visitor Experience, etc.

Comments:

- Management response will need to be nimble (lots of contingency plans)
- Much of five needle pine habitat in WLNP has been affected by Kenow Wildfire so need to re-evaluate that program
- Opportunities to integrate post-fire ecological information into post-fire infrastructure work (i.e. Crandell Campground will be re-developed with consideration of wildlife conflict issues)
- Interpretation to public (fire in western Canada) through programming will be a big opportunity and is important

Overview of the Kenow Wildfire

(Scott Murphy, Fire Management Officer, WLNP)

- Waterton Fire Environment –
 - Steep environmental gradients (45% coniferous, equal parts deciduous and grasslands, 5% water bodies)

- Fuels and vegetation managed by parts and processes (disease (pine beetle, blister rust), wind, fire)
- Entomologist forest and disease survey of park – isolated pockets of mountain pine beetle, tent caterpillar (east side).
- Drought and insects are starting to have significant impacts (fire controlled for some of the insects)
- WLNP defined by severe weather – wind, precipitation (750–1500 ml/year)
- Fire season can be both long and short - grasslands are relatively snow free due to Chinooks (long fire season), up against the divide not snow free until June then have lots of precipitation in July so really only July and Aug as fire season
- Fire Management Regime
 - Positive and negative impacts
 - Fire Management Zoning – intensive – full suppression (high density of values at risk, potential for spread outside of park), intermediate (default is suppression), extensive (allow fire to play its ecological role)
 - Managing for Positive Impacts – Prescribed fire
 - Vimy Basin Prescribed Fire 2014 – to restore whitebark pine – create openings in forest with fire, plant whitebark pine cones, continuous monitoring of seedlings – very labour intensive
 - Sofa Mountain Prescribed Fire 2016 – used heli torch, resulted in larger fire, aimed at whitebark pine restoration
 - Eskerine Prescribed Fire 2006, 2014, 2017 – over last 100 years have had 30% loss of grasslands to shrub encroachment – burned in the winter to prevent spread
 - Waterton has burned grasslands multiple times – interval is 7-8 years between fires



- Waterton Fire History/Regime
 - Mountain Legacy Project: historic photos of Parks provides evidence of history of fires
 - Repeat photography lends to thinking that fire condition may be the 'normal' condition
 - Age class maps classification for all of WLNP – suggesting many historical fires. Stand replacing fires is dominant fire regime over last three centuries
 - Modern fires – Waterton Lakes Fire 2015 10 hectares – caused by lightning strike. 1998 Sofa Mtn fire 1521 hectares – moved a short distance outside park into private lands. Boundary Creek Fire 1935 895 hectares, on both sides of border.
 - Kenow Wildfire – very little fire refugia compared to historical WLNP fires.
 - 2017 Fire Season – WLNP entered Extreme Hazard in mid-July and stayed there until Kenow Wildfire entered the park (Sept 11). Third driest season on record.
- Kenow Wildfire
 - June precipitation was 50% of normal in 2017
 - Fire ban was initiated July 15 and stayed for rest of season. Aug 9 restrictions were implemented in backcountry (no off trail use)
 - Aug 30 lightning strike in Akamina – 6 hectares – grows continuously as BC was dealing with other higher risk fires (15 strikes from Aug 30 event) so not actively managing this one
 - Sept 2/3 fire grows significantly – results in one spot fire in WLNP .5 hectare. Remains like this for a few days. Evacuation alert in WLNP on Sept 5. WLNP concentrated efforts on Kootenay Pass. Started implementing plan to protect townsite.
 - Sept 5, 6, 7 – largely smoked in, limited action taken
 - Sept 7 South Kootenay Pass burned out by Parks Canada to keep fire from entering the park in that area
 - Sept 8 – burnout tied in to Kishinena Creek – evacuation order (following an unfavourable weather forecast), still no fire in WLNP other than small spot fires at Sage Pass
 - Sept 9 fire starts to move down valley and jumps 5 km on Sept 10
 - Sept 11 fire has spotted into WLNP in Tamarack Basin (50 hectares) – Parks Canada tried to hold it and slow it down. Forecast for good burn conditions for Sept 11 and 12.
 - Sept 11 5 pm fire quickly moves into WLNP via Akamina Valley, by 10 pm has moved into the MD of Pincher Creek

- Plans for fire evacuation had been made in WLNP many years prior
- Sept 12 winds died down and fire was contained
- Kenow wildfire burn severity map
 - Not patchy (not much refugia [areas not burned] compared to past events)
- High to Extreme burn severity may be a function of high fuel loads and fire condition (intensity high)
- Only three spot fires in Waterton Townsite (winds were favourable) as embers were blown northward by south wind. Prince of Wales Hotel had a lot of ember showers.

Questions

- Debate into investment of efforts to reduce fuels – this was demonstrated in WLNP – the fuel break around the Waterton Townsite played a significant role in keeping fire from affecting the town. This fuel reduction was key to preventing infrastructure losses in Waterton Townsite. Also implemented many lessons from other towns (Fort MacMurray) in preparing the town (removing fuels, sprinklers, blowing leaves etc.)
- What is the interval between controlled burns? grasslands (range 3-8 years between)
- Fire polygon stand origin map – much smaller than this one
- Do you have a fire map that includes Flathead Valley and Glacier National Park?
 - We have this but did not include a slide
- What were the wind levels on the day of the fire?
 - At the top of divide 70-100 knots
 - 25-45 knots out near boundary
- Were there projections that the fire could move this quickly down the valley?
 - Not unexpected, but happened at night so challenging to know where the head of the fire was.
- High severity fires – is this similar to Verdant Creek Fire?
 - Yes, dry conditions resulted in high severity
- Several of the fires in BC that were high severity like this fire?
 - Compounded by Mountain Pine Beetle dead trees (Fuel load)
- 1980's MPB activity, affecting fuels in this fire
 - Not 100% mortality from Mountain Pine Beetle, but lots of trees came down
 - Not sure about

- Measured by Lori Daniels - Fuel spread from Mountain Pine Beetle killed fuel was 11 times higher than Canadian Fuel said it would be
- Lori summarizes Boulder Creek Fire impacts on wildlife – survival of fish and amphibians occurred– despite high severity
- Ecological concerns from slide show
 - Seed bank – soil erosion from wind after fire
 - Bull trout – spawning habitat
 - Lack of refugia for recovery

Expert Presentations

Post-fire Hydrology

(Uldis Silins, Professor of Forest Hydrology, University of Alberta)

Presentation

- What happened to the water? Based on observations from the 2003 Lost Creek Fire primarily. Work also focused on 2012 Mile River, 2016 Horse River, 2014 Spreading Creek, 2017 Elephant Hill and provincial scale risk analysis.
- Lost Creek Fire –
 - 30 km north of Kenow Wildfire – also a severe fire.
 - August fire and snow came quickly after.
 - Snow melt in 2004 at Lost Creek area will be similar to what WLNP will see.
 - Kenow Wildlife extreme severity seems more extensively spread than Lost Creek
 - AEP invested in looking at impacts of fire/ scope and impact on water, how long do impacts last – Southern Rockies Watershed Project
 - Not a lot was known about these severe fires at the time the project began



- 9 instrumented watersheds that have been monitored – 3 reference, 3 burned, 2 burned and salvaged, 1 harvest and prescribed burn.
Network of 43 climate/hydrometric monitoring sites
- Drinking water was used as the water value
- Salvage logging occurred by Government of Alberta in the study area
- Research interest in broader catchment scale impacts
- Headwater hydrology
 - Water quality (drinking water value)
 - Aquatic ecology
- Resistance (how far can you push a system until it responds?) and resilience
- May be large initial impacts but then recovery quickly or sometime impacts may appear later on.
- Other important context:
 - Snowmelt-dominated landscape
 - Highest precipitation (snow melt runs the show)
 - High water yields
 - Surface flows are ground water dominated (rather than rainfall systems)
- What are the **ecological effects** of fire on hydrology?
 - Interception Loss: Snow gets caught in canopy and evaporated into the sky before falls onto the ground. **Interception loss will occur after a fire, therefore deeper snow packs occur**; decade of data: 64% increase in peak snowpack depth (40-200% increase in snowpack). Increase is bigger in low snow years
 - **Higher snow pack water equivalent**: 130 -140 ml extra
 - Interception loss: 133 mm of extra snow water and in summer 146 mm of extra rainfall – 280 mm increase expected.
 - Changes in streamflow: Hydro-climatic comparison between burn and non-burn areas indicates onset of **snow melt happens earlier and slightly more water per area unit area discharge in burn areas**: 1037 mm/yr burned to 731 mm/yr non-burn.
 - Timing of flow will change (**snowmelt happens earlier**) more so than gross amount of flow. From mid-July onward no change or slight reduction in amount of water.
 - There is an **upward shift in flow regime** after fires.
 - Stormflows: we did not see catastrophic flows from Lost Creek fire. Precipitation events did not impact pre and post fire in northern areas. Area more hydrologically resistant from a flow perspective than

originally thought. Not sure if this is totally applicable to Kenow due to extreme severity and size of the fire.

- **Delayed debris flows**: Originally did not see debris flows or dams, but we are seeing more and more over time.
- What are the **ecological effects** on water quality?
 - **Water Temperature: no change (primary hydrological influence is ground water)**
 - **Mercury: elevated in burned streams** – not sure of longevity of this issue
 - Some bio-accumulation in fish tissue (methyl mercury found but not high enough levels to avoid consumption) – not evident down stream
 - **Metals: Lead and aluminum trace amounts**
 - Sediment and turbidity
 - **High sediment production** over initial seven years
 - Increased sediment production that lasted over 11 years (strong incremental effect of salvage logging lead to increased sedimentation)
 - Nitrogen
 - **Large effects of fire on stream nitrogen**: rapid recovery from an ecosystem perspective (5-6 years). **Seasonal pulsing of nitrates** with a low point at the peak of the growing season. Burned systems pulsing is higher in amplitude whereby it dropped below seasonal norms at low point compared to unburned areas.
 - Nitrogen is the limiting nutrition for vegetation
 - High recruitment rate on salvaged logging areas as disturbance helped cones (drive nitrogen)
 - **Recruitment rate is low in non-salvaged burns**
 - **Phosphorus: increase strongly associated with sediment** (important for aquatics). No clean sign of recovery in 10 years at Lost Creek.
 - Continual exchange between phosphorus and sediment drive ecological communities, after burn almost double amount of phosphorus (resulting in **changes in plant production**, for example we see **streams choked with algae**).
 - In addition **macro-invertebrate abundance and diversity was higher**, as **ingress of more true flies**. There were **still clean**

- No catastrophic debris flows (high) in Lost Creek - more common in dry landscapes with non-sedimentary rock (California), but secondary events (high precip) over time can lead to increased debris in streams
- Increased sediment production over 11 years, different than other places as we have limestone deposits and sedimentary material that creates fine sediments, but will continue to erode for a long period of time.
- Who are the **key people** in this area that WLNP should contact?
 - David Schindler – Erin Kelly – water quality – National Academy of Science
 - Bull trout: Moab Lake Consumption advisory

Discussion

- Short Term
 - Nitrogen increase would be considered short term
 - Not difference in water temp as it is ground water controlled
 - Mercury – some but not level of concern for human consumption
 - Lead/aluminum – just trace amounts
 - No pH impacts
- Long term
 - Peak snow pack increased – less interception. Peak snow pack is impacted by elevation – higher elevation in WLNP could be more severe impacts
 - Timing of flow – peak is several weeks earlier
 - **Storm flows** – did not see difference between burned/unburned with flows during summer rainfall season but did see moderate increase in runoff from burn in April/early May – **biggest impact is rain on snow.** Wetness before the rainfall events makes a big difference – that is why



don't see a big difference in summer but see it in spring when there is still snow on the ground.

- Sediment production – longer in salvage areas
- Is there a need for a wind consideration for WLNP as well. Snow pack happens at tree line – **tree line has now been removed.**
- Will have **geochemical hotspots from ash compilations**
- Do we need to monitor nitrogen in the soil?
- What do we have for **seed viability?**
- Increase in groundwater discharge? In buffalo paddock have large potholes – what will impact be on small waterbodies? There is precedent that suggests **increased snow pack may see increase ground water discharge.** Increase snow packs, less evapotranspiration results in shallow subsurface, should result in more ground water discharge
- **Early on saw increase in run off on hydrophobic soils** but haven't seen a huge increase in runoff overall. **Ash can be hydrophylic** (absorbs like a gel) so next spring be cautious walking through burned areas!
- Can have lower surface flows in July /Aug

Post-fire Grassland Ecology

(Barry Adams, Range Ecology Consultant)

Presentation

- Fire and grazing were historically influential in maintaining mesic grasslands and the development of Chernozemic soils
- Mountain Legacy project well demonstrates the changes to our landscape – primarily encroaching shrubs and trees in grasslands
- Fescue grasslands are a product of bison and fire
- Prescribed burns to reduce willow – Chain Lakes 1985
- Grassland response to fire
 - The **greatest value of fire will be to maintain grassland landscapes**
 - **Fall burning can be more detrimental than spring because of potential for loss of organic soil**
 - Use Range Health Indicators – Range Health Assessments – 5 indicators – results in an index (healthy, healthy with problems, unhealthy)

- Litter - Presence of litter/mulch is important. Conserves soil water and increases productivity
- What are the **ecological effects** of fire on grassland ecology?
 - Relative to unburned area, **production declined** by 40%
 - **Forb production increased**
 - **Species richness increases**
 - **Increase in exposed soil and decline in litter**
 - **Increases in seed head production**
 - **Productivity is reduced depending on site and climate for 2-5 years**
 - **Species richness increases on healthy late seral communities**
 - **Vegetation ground cover decreases - esp moss/lichen layer**
 - **Forage quality from individual plants increases**
 - **Invasive agronomics may increase**
 - **Reduced presence of organic mulch and rangeland soil water** (litter conserves soil water and increases production)
 - Severity – fire impacts where the litter completely burned and was significant penetration of the thatch layer – but recovered
 - **Noxious weed, if present, may establish or spread**
 - Grasslands that have high litter and carryover are more susceptible to negative fire effects and will take longer to recover
 - Climate and site factors will influence recovery following burning
 - Rainfall can impact recovery (**higher rainfall improves recovery**)
 - Greater nitrogen levels down stream
- What are the **management implications/Monitoring?**
 - **Grasslands that have high litter and carryover are more susceptible to negative fire effects and will take longer to recover**
 - **Fall burning can be more detrimental than spring because of potential for loss of organic soil**
 - WLNP has the **potential for drought oriented invasives** – need to watch for this
 - Will there be consideration for ungulate grazing in WLNP considering one of the key mitigations for Granum Fire was keeping cattle off for 2-3 years? **Elk impact on aspen regrowth on grassland is minimal.** WLNP should compare areas of high herbivory to others.
 - Will need **establishment of no go zones to protect recovering grasslands** – infrastructure re-build will have to be considered in this

- **Early seed harvesting**

- WLNP has a good stock of seeds and so does Glacier NP – **will be key for severely affected areas**. Will need to prioritize sites for seeding. 100kg of seed does not go very far.

- Have a larger weed problem – need to focus on that

- **Use first year to make your plan**

- Be aware of drought cycles – how this affects monitoring plans
 - Work backwards from range assessments to inform practice



- What are the **key mitigations** needed for negative, long-term ecological effects?

- Monitor local sites to establish severity
 - Need complete rest of burned grasslands
 - Progressive restocking – grazing was reintroduced very slowly (2-3 years) – was there any consideration for wild species?
 - Does Parks needs to consider more frequent burning of grasslands to prevent build up of litter/fuel levels?

- What are the **lessons learned** applicable to WLNP?

- Importance of long term monitoring – need to identify most severe sites
 - Case Study – Granum Fire 1997, highest rate of spread fire in Canada
 - Government and universities offered assistance to assess impacts of fire
 - Provided guidelines to ranching community to assess fire severity based on the relative degree of disturbance to the surface organic layers
 - Only 3% impacted to the severe level, tended to occur in areas where secondary grazing was occurring – lots of fuel.
 - Monitoring: ground cover, forage production, and forage quality
 - WLNP may have range sites more affected – more erosion
 - Hardships of communities to recover from fire need to be recognized

- Need for individual, community and municipal/provincial fire control planning
- Rangelands are well adapted to fire impacts
- Harvested seeds could have good genetics
- Opportunity in WLNP to study the prescribed burn areas in comparison to burned areas
- Who are the **key people** in this area that WLNP should contact?
 - Key resource - Range Health Indicators – Range Health Assessments
 - Cordy Tymstra – Wildfire Science Coordinator - Alberta Agriculture
 - Susan Bayley – U of A
 - David Green - McGill
 - Walter Willms – Agriculture Canada (Lethbridge Research Station)

Discussion

- What has shrub regrowth been following the Granum Fire? A need for fire/bison interaction on woody plants.
- Was the fall regrowth that was observed in WLNP normal? Yes.

Post-fire Forest Ecology

(David Hibbs, Professor Emeritus – Oregon State University, Earthwatch Institute)

Presentation

- Change is change, it has no positive or negative ecological value.
- They (flora and fauna) have been through this before. We haven't but they have.
- They have been through this before and apparently did just fine without us.
- What are the **ecological effects** of note?
 - Community composition
 - **Establishment depends on:**
 - **Propagule availability**
 - **Weather is important especially for small seeded plants**
 - **Munchers (insects, rodents, ungulates) - will be looking for food and could impact regeneration**
 - Mycorrhizal fungi – not much is known. Obligates may begin to disappear. Facultative use decaying matter.

- Long time window is important – this will continue to happen over 30 years
- **Woody Shrubs: play a critical role of reservoirs of mycorrhizal fungi**



- Sources of regeneration
 - **Seeds – stored** (in the soil (by rodents) or canopy) **or dispersed.** Dispersed seeds depends on survivors – survivors become critical seed sources – need to determine this
 - **WLNP will not have much canopy seed dispersal however may have long distance seed dispersal – good potential for this in WLNP**
 - **Sprouts – both from root collar and roots. Good chance aspen will regenerate well** – will need to monitor what munchers do with it.
- Climate Change
 - **Climate is different now from what it was when the burned forest established**
 - Climate 50 years from now will be different from today
 - **Fire is an opportunity for species and communities to resort on a landscape to better match current conditions**

- Fire and Riparian Areas
 - **Riparian areas recover quickly, moisture promotes regrowth, recovery of stability and shade**
 - Can expect resorting of vegetation composition in riparian
 - **Trees that come down into the streams can take up to 100 years to break down – will get a pulse of wood into the streams.** Ultimately, a 170 year impact as need to replace the trees that come down over the next many years
- Erosion
 - **Logs and stones play an important role in stabilizing slopes**
 - **Grass seedlings can smother other seeds**
 - Sterile straw can be used to stabilize as well
- Aspen will play a significant role – will provide shade/protection for more heat sensitive species that will then be able to take hold
- What are the **management implications?**
 - Management response requires imagination and seeks to build flexibility of response
 - Where and what are the seed sources?
 - How damaged are the re-sprouters?
 - **In nearby, recent high severity fires how have WLNP species behaved?**
 - **What are the muncher (small to big) populations doing?**
 - Explore available techniques (felling, salvage) – need to consider the implications of salvage – exacerbating impacts of fire -
 - If WLNP intentionally retains dead trees are their human safety liabilities?
 - **Consider refugia planting**, consider location/aspect etc.
 - **Need to have a network of monitoring plots** – use existing monitoring plots so you can have before and after comparisons – include understory plant composition and fuel structures
 - Coarse woody debris – causes blockages at bridges etc.
 - When considering tree regrowth need to consider climate change. ‘Climate velocity’ will impact what areas are most suitable for species. Need to have a broad spectrum of seed sources for replanting
 - Focus on successional processes. Need to understand the understory and elevational gradient throughout the park.
 - Small pieces of refugia

- Forest resilience and heterogeneity - need to keep this in mind. Historical range of variation. This severe event may allow to 'skip a step'
 - Is massive conversion from conifer forest desired? What are we restoring for? What is the goal?
 - Townsite and people management are the key issue – what trails are maintained/restored will be impacted by people accessing them.
Townsite is a major potential source of invasives.
 - Vegetation Management Plan
 - Revisit BMP for infrastructure rebuild
- What are the **key mitigations** needed for negative, long-term ecological effects?
 - Could placement of logs/stones improve slope stability?
 - Grass seedlings can smother other seeds
 - Retention of dead trees in riparian
- What are the **lessons learned** applicable to WLNP?
 - **Patience is required for seedlings. Successful establishment period is up to 20 years.**
 - **Very important to go out to see sprouts next spring**
 - Salvage logging can trample seedlings
 - Species that were in place may not be the best
 - Seeding may pull herbivores (i.e., draw them to newly-seeded areas) – this may be unwanted
- Who are the **key people** in this area WLNP should contact?
 - Lori Daniels - information on retention of dead trees
 - Meg Krawchuck (Oregon State University) – fire refugia

Discussion

- Is there existing information that WLNP should be accessing?
 - Some of the old still existing forest patches (cores and cookie opportunities) should be used.
- Should we be keeping woody debris remnants in areas for habitat? Fuel? Will need to be felling trees for human safety – what should we do with debris?
 - Will be getting heaps of woody debris from falling trees in lots of places regardless. This will be site specific. Banff National Park has

debris removal guidelines. Are erosion concerns, small mammal concerns.

Post-fire Wildlife Ecology

(Evelyn Merrill, Professor, Department of Biological Sciences, University of Alberta)

Presentation

- Case studies from Mount St Helens, Yellowstone Fires and Ya Ha Tinda burns – personal view of aftermath of large scale disturbances
- A common theme is initial destruction, usually very dramatic
- There is usually a strong public response – immediate concerns for safety, health risks and destruction of natural resources. A perception that there is a destruction of nature. From a scientific/resource manager perspective it is the uncertainty of the aftermath
- **The certainty is that ecosystems are resilient BUT the landscape will change.** Need to keep the long-term ecological perspective but cope with short-term effects
- **Need to balance the public's reality and ecological reality**
- The uncertainty is that past studies only provide testable predictions but are not reality. The past vs future – **need to consider realities of today (i.e. climate change), are we restoring or adapting?**
- Also uncertain - What support are you going to get – political, financial, public? **Need to identify key people from other events. Ask them what would you do differently? What did you learn?**
- Case studies - Mt St Helens
 - Earthquake triggered a landslide (24 km) – released hot gases that travelled north that killed everything above ground – very severe disturbance
 - Ash travelled 20 km – up to a metre deep, many metres deep at high elevation.
 - Many blowdown zones, further distances away had single blowdown zones
 - There was an edge to the destruction zone
 - Two key things – 1) what are the remnant populations (same for WLNP)? At the small scale there were remnant lupine on Mt St Helens – when these died they provided nutrients for other seeds that blew in. Back sides of tree stumps allowed growth.
 - Surviving populations of wildlife (species that were underground at Mt St Helens survived and if they were associated with water).

Amphibians (frogs) survived due to their association with water. **WLNP will have survivors.**

- **First invaders were the arthropods** – even before plants, were reproducing 2 years after eruption. **Also mammals were first invaders which were related to the early seedlings (rodents) which also brings birds that feed on them.**
- **First large mammals were elk** - how they moved back in – may move in slowly and find patches of remnant habitat
- **Elk herd boosted after / during veg recovery but as canopy fills in there is less forage** (dynamic of timing)
- Case Study Ya Ha Tinda (Banff National Park)
 - Unburned areas – elk selected them less. Areas of high and low risk that were burned. Used high risk (predators) areas less. Predators may alter selection of burned habitat.
 - Burns are not the major driver of elk survival (cows)
 - How this translates to population changes? **First two years pop growth declined and elk densities were reduced but then increased.** Long term effects were complicated by wolves



- What are the **ecological effects** of note?
 - Fire impacts on wildlife
 - **Direct effects – animals killed** – proportion of population affected depends on fire size, severity/pattern and timing. Depends on animal mobility (flying ability and large body size)
 - **Habitat quality changes** – nest sites, food, cover

- Wildlife use of burns – selection/occupancy/densities
 - Animal performance – diet, body condition, survival/reproduction
 - Population level – long term studies, modeling (do not have good information on this – requires long term monitoring)
- Patch level changes
 - Within 2-5 years will have vegetation recovery
 - Litter removal
 - **Shifts in the foraging grasses** - this is important in summer ranges. **Compositional changes will be very important**
 - **Shrub responses will be delayed**
 - **Will have short term N-nutrient pulses that are variable**
 - Need to consider how patches fit into the overall landscape – landscape pattern is important
- Landscape heterogeneity
 - Need to look at the landscape at multiple scales
 - **Animals moving to access different areas for different resources will be important**
- **Wildlife will avoid the park this winter due to lack of forage that results in new use of unburned or agricultural areas** – new use areas?
- **High use of unburned, burned (bark) and sprouts of aspen (other shrubs) on and near winter range in the winter**
- **High overwinter mortality due to drought (the pre-fire conditions are very important in how animals respond) and loss of winter forage with carcasses feed carnivores in winter and spring**
- **Poor juvenile growth and recruitment in 2018/19**
- **More variable migration** due to early green up in burned area from early snow loss and earlier growth at low elevations
- Longer term – **increased use of Park in summer consistent with vegetation recovery** except around wolf packs – **improved summer range – increased reproduction**
- Don't be surprised by the **heterogeneity - just the difference between north and south facing slopes will be substantial.** Do not close your mind to the small scale heterogeneity
- Ungulate forage selection patterns changed with burn/predator dynamics
- Salvage logging can have negative impacts on wildlife

- What are the **management implications**?
 - Post Management – do we want to complicate the landscape with other treatments (salvage treatments)? There are no intentions to salvage log in WLNP.
 - Research Integration and Advancement –
 - need to make predictions – determine how you will test your predictions.
 - **Monitor wildlife recovery with a camera network system – use past locations**
 - **Unique opportunity – what is the effect of past management when fires are so severe – WLNP can study past prescribed burns area and compare to newly burned areas.** Does it make sense to continue to prescribed burning when these large events come through with higher severity?
 - Facilitate long-term research – MSH pulse concept – WLNP should facilitate long term research, support researchers
 - Educate public on research results via publicizing efforts, citizen science efforts, a glossy publication
 - Connecting with BC, AB Parks, Blood Tribe, private land owners – need to monitor these movements – may differ due to different patterns of severity.
 - **There are some patches in WLNP that are still intact – will they be able to sustain wildlife?**
 - **There may be an impact in wildlife movement due to the changes in numbers of hikers due to hiking closures**
 - Are some of the patches created by the fire aligning with large landscape objectives? (looking at patches in WLNP, Glacier and BC)?
 - Need to **connect with researchers in adjacent areas to monitor wildlife movements/dispersal**
 - Importance of severity classification – methods are good at determining severity in forests, but not in grasslands. Don't draw too many conclusions from severity maps for grasslands – suggestion to revisit range health assessments

- What are the **key mitigations** needed for negative, long-term ecological effects?
 -

- What are the **lessons learned** applicable to WLNP?
 - Mount St. Helens, uncertainty of the aftermath

- Vegetation recovery – survivors (remnant populations)
 - Wildlife – factors that induced survival (below ground species likely survived, associated with water (survival))
 - How they moved back in may vary: slowly or move into remnant patches or may move in and then back out.
 - Past studies provide testable predictions not reality
 - Formulate expectations as predictions to be tested
 - Monitor wildlife recovery with camera network (BACI)
 - Unique opportunity: what is the effect of the past management with a fire so severe
- Who are the **key people** in this area WLNP should contact?
 - People doing research adjacent and close to the park to monitor movement of wildlife
 - Engagement with industry – opportunities for industry to support research?
 - Other large landscape researchers – boreal forest etc. (Ellen MacDonald U of A, Adam Ford UBC Okanagan)
 - Andrea Morehouse – large carnivore movement
 - Charlie McLellan, Bruce McLellan
 - Waterton Biosphere Reserve Association
 - Adjacent First Nations
 - Private Landowners
 - Landscapes in Motion – fire history, fire severity, spatial patterns
 - Meta-analysis on salvage treatments – biggest impact is on wildlife
 - Soil Scientists – Ron McNeil
 - Brad Hawk – Sofa Fire – tree falling models

Discussion

- Edge effects of Mt St Helens – this is a bit different in WLNP – entire valleys are decimated – how will this impact wildlife returning? Response – MT St Helens had one large circular edge, not unlike the large edge of the WLNP fire. WLNP has narrow drainages – movement patterns of wildlife returning will depend on remnant veg.
- Long term nature of this process – some things will become more important over time
- Expectations – need to form these as testable hypotheses. Lots of people collect data but this data sits as they do not know how to use this data. Need to formulate questions before data is collected

- How much did reintroduction of wolves influence recovery in Yellowstone? Wolves changed selection pattern – elk used burned areas less when wolves around. Do not use the small burns – these are very predictable, wolves know to go there.
- Want to recognize WLNP efforts in informing the public



Discussion Summaries

Breakout Groups

Topic Choice

Participants were invited to review the proposed breakout group topics and modify them based on the information from the presentations.

- Prescribed fire could be changed to **fire management** more broadly
- Invasives could be included in both Forests and Grasslands, however invasives are more of a direct management consideration. Invasives must be included as part of the Forest, Grasslands discussions
- Should we consider Landscape Ecology to address the landscape more broadly? This should be included as part of each breakout session
- Does aquatics include hydrology? Yes
- Also want to consider the 'How to' aspect – need to consider this as part of the questions.

(NB: numbers in brackets before bullets indicate the number of 'dots' each received in the end-of-day prioritization exercise)



Breakout Session 1 – Grasslands

Monitoring: What should we be watching for?

- Invasive species – what is the required frequency?
- [1] High risk points and linear features – where mineral soil is exposed and road sides where ash has accumulated and potentially where invasives are
- Should be doing health assessments
- Monitor hot spots (high risk) and distance of effect
- [1] Use existing source information
- Habitat selection by elk – use and effects
- Continue monitoring aspen encroachment
- May need to add/augment existing veg plots/protocols – opportunities to augment in the post fire landscape
- [2] Map the refugia
- [3] Monitoring plant communities over time/succession
- Soil mapping
- [3] Early detection/rapid response to new influx of invasives
- [1] Monitoring of newly emerging species from seed bank and from elsewhere
- [1] Monitor human use and impacts in unburned areas
- [2] Monitor rare plants/community response to fire – new distribution (are whole populations wiped out)
- Monitor prescribed fire areas for response to ensure test hypotheses
- Effect of the severity on fescue grasslands – fine scale
- Temperature, moisture, humidity – climate effects on species that colonize



Research: What should we be asking?

- Need to foremost decide which research will ultimately result in assisting better decision making.

- Prior to fire, invasives was the highest priority program with respect to grasslands – we need to prioritize the research that will assist this
- What is our source of invasives? Existing models demonstrate where seed sites are, have disturbance maps.
- Need to determine elk impacts - their role as weed vectors
- [3] Fire-herbivory interactions – to determine impact of prescribed burning – including ungulates and ground squirrels – look at influence on heterogeneity
- [2] What is primary succession of disturbed sites – succession patterns
- [2] How is the grassland/forest/shrub interface changing? How is the landscape composition changing?
- [2] What is the extension of new (drones) remote sensing applications in grasslands? Other methods are needed for severity assessments
- [4] What are the impacts of climate change on grasslands – what should we be expecting – need to use models to determine grasslands, shrub/forest interface in light of climate change
- [2] What are the alpine community impacts?
- [1] Fungal/microbial communities in soils
- What should the landscape heterogeneity of grasslands be
- Research on various restoration activities/methods
- Effect of fire severity on shrub encroachment - interactions with herbivory
- [1] Effect of exposed soil on grasslands recovery and non-native vegetation
- Effect of ash on recovery of grassland
- Effect of previous non-native vegetation containment/management and fire on the extent/spread of non-native vegetation – interactions with season/burning etc. Share info with others re success/challenges

Management: What should we be doing about it?

- Consider changing climate – moisture stress – grasslands may be replacing forests
- [6] Invasive species mitigation – need to move away from site actions (pulling weeds) and look at more landscape effects
- [1] Prescribed fire – as it relates to fire-herbivory interactions. Too much litter will change the moisture regime and facilitate invasives. To maintain integrity, productivity and heterogeneity
- [1] Public and Parks Canada contractors – cleaning in/out
- [1] Re-evaluate guidelines/BMP for minimal disturbance for construction activities
- [4] Detailed soils mapping

- Assess existing NNV species relative to risk of invasiveness versus fire
- Rapid response of new/existing invasives
- Collection of seed from remnants
- Collection of early succession forbs
- [3] Additional workshop solely on infrastructure/construction mitigation and key issues – including Project Managers, Res Con, Contractors and ILUP
- Control access to sensitive sites
- Opportunity to convert – grasslands and maintenance
- Closure from horses
- [2] Permanent restoration/reclamation positions to oversee projects
- Balance human use in burned/unburned
- Review of all veg mgmt. plans
- Detailed soil sampling/testing for all projects
- Mitigate use of unburned areas
- Armouring/enhancing trails for increased use
- Access quotas?
- [1] Limited access to restoration sites/creative fencing etc.
- [1] Managing herbivore habitat use (fire/fencing etc.) – displacement concerns on private lands

Partnerships: Who should be helping?

- Brent Smith - Medicine Hat Community College – imagery for double sampling method
- Cam Carlyle – U of A – Carbon, Range Ecology
- JC Cahill – U of A Bioscience
- Craig Demaere - Provincial Rangeland Specialist (Foothills/Montane)
- Other Parks – especially those dealing with grass/fire (GNP, BNP)
- Ron McNeill - Consultant
- SWACWMA
- Foothills Restoration Forum
- Society for Range Management
- Waterton Biosphere Reserve Association

Breakout Session 2 – Forests

Monitoring: What should we be watching for?

- [1] ID high risk zones
 - People/public safety
 - Endangered species –rare communities
- [4] Monitoring – refugia and other areas/variables
 - Stratified by elevation, aspect, moisture, topographic, moisture classes
 - Native, invasives and noxious weeds
 - Species, cover, tree size
- [4] Early detection of invasives (bromes, knapweed, hawkweed)
- Weather/meteorological stations, stream hydrology flow
- Don't forget to establish control points
- [2] Slope stability/erosion
- [1] Soil Hydrophobicity
- Measurement of the new age class structure or quantity
- [1] Fine scale climate refugia – high density of data loggers to identify micro climates
- Ensure comprehensive soils baseline



Research: What should we be asking?

- [2]How severe (veg/organics/soil) and where – informs where plots go
- [5] Successional pathways – informs what species establish (short and long term)
- [4] Where are fire refugia?
- What is the role of aspen on the landscape?

- [2] What is the whitebark pine recovery? Surviving seed trees? Natural regeneration?
- What slopes are high risk for erosion/tree fall/debris flow and dams (links to hydrology)
- [1] What are the linkages to TEK?
- What is the Seed bank viability?
- What are the communities? What are the driving forces on the landscape that are driving what communities are and where they are?
- [1] What is the establishment of novel communities?
- [1] Paleo-ecology of lake areas to establish change/time

Management: What should we be doing about it?

- Need to determine what overall objective is – what we are managing for? Is it multiple age classes (heterogeneity), reduced fire intensity? Landscape scale need to be considered here – in the Crown of the Continent this is a relatively small scale to be all the same age class so perhaps this is not as big of a consideration
- [3] Do no harm (EA, BMP work, clean, go – staff and contractors)
- Mitigate high risk areas (limit access?)
- [5] Early detection – rapid response
- [1] Don't forget the non-burned areas
- Implement preventions – play, clean, go
 - [1] Horses – ban them the first year or develop mitigations
 - Create species priority lists
- [1] 5 needle pines – how do we structure the establishment program to account for climate change?
- Construction – have restoration plans develop at the same time as construction plans
- [1] Minimal disturbance – Best Management Practices
- [1] Hazard trees – safety versus habitat. Be strategic in removal when needed. Use felled trees as erosion control etc.
- [3] Use closures for safety instead of removal of danger trees etc.
- [2] Reapply prescribed burning
- Protection for surviving aspen stands?
- [1] Need to consider rare/endangered plants – species on the edge of their range are important considering climate change

Partnerships: Who should be helping?

- Glacier NP

- Castle PP
- Crown Managers Forum
- AB Forest Initiative
- ABMI
- Blood and Piikani
- BC Parks
- Zack Holden – climate refugia – microclimate modeling
- U of A – Andreas Hamann
- Diana Stralberg – climate refugia

Breakout Session: Fire Management

Monitoring: What should we be watching for?

- [6] Does recovery look different in older/newer wildfires as well as in previous prescribed fires?
- [6] Veg succession/fuel succession – grasslands, litter/biomass, forests, downed wood and canopy layers
- [3] The effect of this fire on shrub/aspens encroachment
- Post-fire impacts to wildlife habitat
- [1] Fuel trajectory (as a factor of burn severity)
- [3] Effectiveness of fuel treatment work – communicate, document
- [1] BACI on prescribed fires (veg, fuels, temp, ROS, intensity / severity)



Research: What should we be asking?

- Where does this fire fit in the terms of historical range of variability (fire size/severity, fire weather)?

- [1] What kind of fire do we need more/less of in the future? Changes to mgmt. regime/zoning
- [3] What kind of fire do we need inside the Kenow Fire moving forward – heterogeneity?
- [1] What is the climate change impact in the short/long term – fuels/trajectory for forests and grasslands
- [2] How do we manage fire in the remnant forest? Change zoning? Allow some fire?
- How intense/severe are prescribed fires?
- [2] Where is the fire refugia and why? Value as seed source? Habitat?
- [3] Effects of past fire policies on Kenow fire behaviours and landscape patterns
- [3] TEK – where, when, how, why was fire traditionally used

Management: What should we be doing about it?

- [2] Nothing – watching
- [5] Take advantage of this event to maintain fescue grasslands – keep burning on the eskerine/red rock/Y-Camp
- [[5] Make facilities/infrastructure more resilient/Fire Smart – existing and as we rebuild
- Use/opportunities for prescribed fire to manage habitat and wildlife corridors
- [1] Review Park Fire Mgmt Plan
- Patch burning to manipulate herbivory (elk) and manage detrimental accumulations of grassland litter
- [1] Create and maintain landscape fuel breaks
- [1] Evaluate fire refugia for value as seed source and habitat to guide subsequent fire management (eg. Suppression)
- [2] Public communication ‘pulses’ as the landscape responds. Share changes/surprises/lessons

Partnerships: Who should be helping?

- Jed, Bob Gray, Susan Prichard – re0burn project (JFS)
- Fire Community – CIFFC, Can Partnerships, CFS, FPI, US, other Parks
- [1] Blood and Piikani traditional fire keepers. Amy Christianson CFS Edmonton
- Weather – Mike Flannigan
- Fire Regime – Landscapes in Motion (FRI Research)
- MP Rougeau and Chris Stockdale

Breakout Session: Aquatic/Hydrology

Monitoring: What should we be watching for?

- (6) Instabilities occurring stream bank and stream bed
 - StormWatch for debris from precept events
- (1) Snowpack (Akamina Ab Station)
- (2) Weather to prepare for large events, such as snowmelt and precip. (forecast)
- (3) Streamflow, water level and temperature (Cameron and Blakiston)
- Critical locations where problem may occur
- (2) Chemistry measurements from perspective of water quality measurements (nitrogen, phosphorus, metals)
- (2) Aquatic species impacts:
 - Bull trout
 - community composition
 - distribution of native vs. non-native
 - electro-fishing might not be the right method due to sedimentation
- Invertebrates (abundance and community structure)
- (2) Amphibians, who is there (pond/wetland monitoring), occupancy and abundance?
- Amphibian water quality monitoring as a surrogate for health?



- Bolander's Quillwort (SAR)
- Impacts (+ and -) of large woody debris
- Plant community (periphyte) change
- Erosion

Research: What should we be asking?

- (1) Sediment- intrusion into spawning beds
- How does the fire change the distribution of non-native fish
- Bioaccumulation mercury in amphibians and fish (waterbodies that do not have outflow)
- (1) Watershed scale impacts
- Watershed repellency of the soils (short lived 1-2 years)
- Amphibian and Fish disease (post fire response)

Management: What should we be doing about it?

- Use information from past events that can identify potential hotspots (such as 2013 flood events, past plugged culverts, bridges)
- (1) Weather stations: Need to know a large weather event is happening: need to ensure they are working
- (2) Response plan developed for addressing high water event
 - Equipment ready and in place to address issues
 - Triggers to manage woody debris
- Inform where people can drink water in the Park (need to some water quality measurements) –carbon and filters
- Create spawning habitat? (Bull trout)
- Mercury in fish (human consumption)
- (3) AIS prevention under changing management pressures

Partnerships: Who should be helping?

- Monica Emelko, Drinking Water Engineer, University of Waterloo, part of Lost Creek Fire research team
- Clint Muhlfeld, Fisheries expert
- L. DeBano: summary review paper
- Amanda Martins (U of A)
- Kirsten Muller, phycologist (Algae)
- Mike Stone, sediment
- Cheryl Bradley, rare aquatic plants
- Blake Hossack, USGS, MT, amphibians

Breakout Session: Wildlife (Regional)

Monitoring: What should we be watching for?

- (3) Species at risk (are they there), night hawks, olive sided flycatchers, common nighthawk, all frogs and bats, bumblebees)
- (5) General monitoring program for species distributions (and abundance): direct mortality vs. re-colonization
- Sheep and goat: aerial surveys (what portion of range has been burned)
- Monitoring for forage sources (berries, and others) expected region and timing
- (4) Forage production on rangeland
 - See bison range assessment in management



Research: What should we be asking?

- One of the main questions is did the fire change distribution, abundance, movements (migration), life history traits)
- (1) Bats: Roost surveys: like for the fire effects on roosting sites and fire severity
- (5) Songbirds and other monitoring programs: extend monitoring to cover gradients of disturbance (don't forgot to keep the non-burned sites)
- Habitat: integrate availability and regeneration
- Species shift distribution (camera monitoring project)
- Snag and coarse woody debris
- Wildlife disease

- (1) Telemetry on wide-ranging carnivore (bears and ungulates)
- Using RSF models to ground truth ungulates winter range (sheep)
- (1) Raptors, increase due to small mammals
- (1) Monitor change in invertebrates (pest causing species, pollinators, bird/bat focal)

Management: What should we be doing about it?

- (1) Corridor use: will landscape use change
- Human wildlife conflict concerns (elk, bear, sheep, deer moving into the town site)
- (4) Management of human use in refugia
- (3) Conflict in Ranchlands (communications)
 - Modification of hunt (AEP)
- Look at Shell elk telemetry data to identify corridors (pre-fire seasonal migration)
- Re-mapped ungulate winter range
- (4) Infrastructure planning:
 - Trail planning around town site
 - Crandell CG wildlife mitigation
 - Corridors and berry management
- Berry production may be low in year 1 (review lit. for info on region)
- Reassess bison paddock for range

Partnerships: Who should be helping?

- Dr. Core Lawson, Dr. Robert Barclay (U of A)
- Erin Bayne, U of A (acoustic)
- Dr. Scott Neilson, U of A, Bears
- Dr. Adam Ford, UBC, Okanagan Campus, landscape scale wildlife movement, trophic cascade
- Alberta Parks (Wonnita Andrus, Megan Evans)
- Dale Paton, elk and sheep movement
- Dr. Kathrine Ruckstal, U of C, sheep work (behaviour)
- Charlie McLellan
- Tannas Environmental, grassland forage for Elk
- Davis Hamer
- John Spence, Carabid beetles, spiders, ants
- Roger CSF
- Ralph Carter, U of C, pollinators
- Mary Reid, U of C, Bark Beetle

- Nadir Erbilgin, U of A (Bark Beetle)
- Dr. Tony Clevenger, wolverine

Additional Discussions

Day 1 Recap and Debrief (Day 2)

(a recap of Day 1 took place at the beginning of Day 2, and miscellaneous comments were gathered)

- There has been less talk on fire severity – need to match field observation with spectral signature
- What to do with public expectations
- How to translate info from Day 1 to best practices/guidelines for infrastructure development – need to integrate the ecological with the infrastructure – these conversations need to be taking place now. This works well when we focus on objectives – what is the end result we want? This is not the focus of this workshop and there are many others that need to be part of this dialogue but this is the very beginning of the dialogue and these conversations will continue to happen. This could be a topic for the breakout sessions

Extra Discussion Space (Day 2)

(the agenda for Day 2 had an ‘Extra Discussion’ space intended to accommodate another ‘Fishbowl’ session, additional presentation, further discussion on a specific element, or other; in the end the participants chose to add comments to a number of topics)

- Break out group consideration – want to have a discussion about Composite Burn Index (CBI) – need to make assumptions using this – want to discuss strengths/limitations of CBI.
- How do we stratify sites based on severity if we don’t necessarily know the severity?
- White bark pine – importance of genetic diversity (resilience to blister rust)
- Does WLNP know anything about seroteny of cones – this impacts wildlife use
- Is Park open to other agencies/public assisting with photography studies? Glacier has a post fire study (mostly vegetation) that is run by staff
- WLNP will be revisiting select Mountain Legacy sites and retaking photos
- Fish eye canopy photos – these can be digitized for veg analysis
- Role of soil science – this has come up in several discussions – may want to find a collaborator in this field.

- What is the time scale/rate for snags to start coming down? Lodgepole – 6-7 years is when lots will come down, some stay for decades. Lots will come down the first year and then it will stabilize for a while. Chinook, wind and moisture and aspect will impact this greatly. Should talk to land managers in Kootenay NP (burned in 2003) and other comparable fires

Dinner Sticky Notes

(during dinner at the end of Day 1, large sticky note pads were passed around to each table, and participants asked to capture things they thought were not captured during the day)

Table A

- Group therapy – (CISM) Critical Incident Stress Management needed again
- Lots of monitoring has been proposed – how are we going to implement?
 - Where is the \$ going to come from
 - What is the access
 - What does year 1 look like?
- More clarity is needed for planning
- We need to focus on year 1 and make a plan
- Why don't we have a process like the USNP Service BAER plan (a post fire assessment planning process is needed in Parks Canada)

Table B

- What needs doing first (this summer)
- If these kinds of fires will increase, what can this tell us for other parks / the future?
- Continue monitoring existing plots
- Invasives and herbicides for example
- Close parks / trails for period of time
- Is there a group doing planning of campgrounds holistically

Table C

- Rate of snag fall over time?
- Look at invasive veg data to identify areas of concern and gather info regarding risk associated with various species with respect to fire / disturbance
- What happened to the ticks? Butterflies?

Culvert Trap

(aka 'Parking Lot'; a flip chart page was posted to capture ideas here and release them somewhere more appropriate later)

- Shows Fire Smart Value
 - Could be noteworthy FireSmart case study (example of severity of fire and the role of the fuel break / sprinklers in protecting the town)
- What to do with public expectations
- Infrastructure concerns



Moving Forward

Prioritization Exercise

(after participants were led through a 'dotmocracy' exercise where each had 12 dots to identify the priority actions, the top three under each breakout topic were identified and discussed)



FIRE MANAGEMENT

- Monitoring - does recovery look different in older/newer wild fires as well as previous prescribed fires
- Vegetation succession/fuel succession

WILDLIFE

- General monitoring program over time for species distribution and abundance
- Songbirds – monitoring

GRASSLAND

- Invasive species mitigation
- Detailed soil mapping
- Model grassland/shrub interface in face of climate change

AQUATICS / HYDROLOGY

- AIS prevention under changing management pressures
- Stream flow, wrt level and temperature monitoring
- Monitor instability in stream bank/bed

FOREST

- Short term, long term plant succession across fire severity
- Where are fire refugia?
- Early detection invasives and new and unexpected

Discussion

- Surprised wildlife priorities are generic and not that specific to fire
- Will be interesting to go through and determine which items ranked second, third etc. Some elements will be lumped with those identified as priorities also
- Research design wrt fire severity will be really important (stratified), also choosing sites that already have baseline data – this will help address multiple objectives
- Ones that were discussed but weren't priorities – access/closures (human use mgmt.), scale (WLNP wrt the Crown, greater ecosystem)
- See a limitation to the dot exercise – many good points overlooked. The results are a reflection of who is in the room
- Keep in mind what you are trying to do overall – progression of monitoring – will take a long time, tracking succession will be important. Importance of long-term monitoring. Don't bite off more than you can chew wrt research/monitoring as want to be able to invest in long term monitoring
- Engaging with TEK and First Nations ASAP is very important



Summary of Emergent Themes

Themes from the Presentations

Several themes emerged in the presentations that cut across ecological themes, management issues, and lessons learned. The following is a summary of themes which the Miistakis Institute identified as arising during both the introductory 'context' presentations, as well as the 'expert' presentations.

They are presented in *no particular order of importance*, but were captured here to roughly correspond with their emergence at the workshop.

This fire was unusual

- Fire is normal; repetition and mix of severity is normal
- The speed, intensity were unprecedented
- Normal patchiness and refugia were not there
- Severity has analogues but the extent of extreme severity may be unusual
- Severity on the grasslands and severity on forested lands are not the same thing
- Yet there are analogues to this fire and these will be important sources of information
 - Portions of Lost Creek, BC's unusual 2017 fire season

Park will come back but will be different

- The Park will change in unanticipated ways
- Charting new territory, so first period will be one of simply understanding what you now have
- Climate change has changed the background narrative; changed the conditions, fire behaviour
- Tree line is gone in many areas
- Resilience does not equal sameness

Impacts will be variable over the next several years

- Use the first year to make your plan
- Focus on successional processes
- Impact of large future events may be greater than annual events

- E.g., Debris flow issues may show up a decade from now based on significant rain on snow events at that time
- Some wildlife populations will grow over the first years
- Fish and amphibian species may survive better than expected; but spawning habitat may be affected
- Lack of refugia will impact colonization behaviour
- The number of wet years in the next little while vs dry years will have big impact
- This is a long window (30 years)
- Potential for high overwinter mortality in first year

Surrounding context is critical

- This is the case both ecologically and for cooperative management
- Superintendent set this tone from the beginning saying outside help is needed
- Size of park and placement in Crown means it sits within a larger system
- Adjacent jurisdictions need to be involved as impacted and knowledgeable entities
- Adjacent ranchers and First Nations are critical stakeholders in any next steps
- Research and management needs to occur at the scale of the region as well as the Park
- Need to consider heterogeneity at the landscape scale

Monitoring / research program will need deft design / re-design

- Caution needs to be taken choosing reference sites
- Pre-burn data will be invaluable, but new data will not necessarily be directly comparable
- Need to monitor to establish severity
- Species at risk monitoring will require revisit
- Research push will come so be ready; may need to manage expectations
- Aspect, solar incidence, drainage orientation are now more important considerations
- Research needs to consider broader catchment
- Need to compare burned vs. unburned areas vs. prescribed burn areas
- Monitoring in early years may look very different from monitoring in later years
- Monitoring needs to be planned over time / succession

Need to monitor/manage for seed and soils

- Seed banking, and seed establishment will be critical
- Existing seed stocks will be important, and harvested seeds might be stronger genetically
- Soil loss will change systems
- Burning needs to consider loss of organic soil
- Increased sediment production, potential for increased erosion over multiple years
- Erosion will need to be monitored

Restoration, adaptation

- Will the goal be to restore or to adapt to a new system state
- Need to ask if recent restoration goals still valid
- Restoration research and management will need to clearly identify the restoration goal
- Fire is an opportunity for species and communities to re-sort on a landscape to better match current conditions
- Need to consider refugia planting
- Need to consider climate velocity
- Seedling re-establishment is a 20 year process
- Seeding may pull herbivores

There are key vegetation considerations to watch

- Aspen may play key role, regenerating in unexpected patterns, providing shade for heat-sensitive species
- Shrub growth will have positive (reservoirs of mycorrhizal fungi) and negative (grassland encroachment) aspects to consider
- Woody debris will help halt erosion, promote regeneration, cause blockages, and represent safety hazards
- Riparian areas will regenerate first, and play key role, though you can expect a re-sorting of riparian vegetation
- Canopy loss, and canopy re-establishment will drive plant and wildlife recolonization
- Salvage logging will likely have negative ecological impacts
- Invasive plant species are a key consideration, especially invasive agronomics in the grasslands, noxious weeds, and the potential for drought oriented invasives
- Herbivory impacts on new vegetation (grasses, shrubs) will need to be watched

There are key hydrological considerations to watch

- Changes in snowpack, interception, streamflow, soil moisture
- Changes in sediment, temperature change, chemical changes, water quality
- Groundwater should be monitored

Current management priorities will need to be re-assessed

- Five-needle pine work will need to be re-evaluated
- Much of the direction / success will hinge on available funding
- Species at risk needs re-consideration in terms of habitat alterations
- Funding and political acceptability will affect options/decisions

Fire management may need a reset

- There is an opportunity to evaluate prescribed burn program
- Fire Management Zoning may need to be revisited
- May want to burn for different goals than in the past
- Dry conditions linked to high severity; dry condition scenarios likely to be more frequent in the future
- Effects of Mountain Pine Beetle combined with fire may be more significant than previously thought
- Impacts on organic soil in grasslands need to be considered
- Need to ensure different measures in grasslands vs forests re health, severity, impacts

Ecological considerations will need to inform infrastructure replacement

- Infrastructure may need to be considered differently
- Regrowth of vegetation (such as berry bushes) needs to be considered around new infrastructure (such as campgrounds)

Visitor use and experience expectations will have to be adjusted

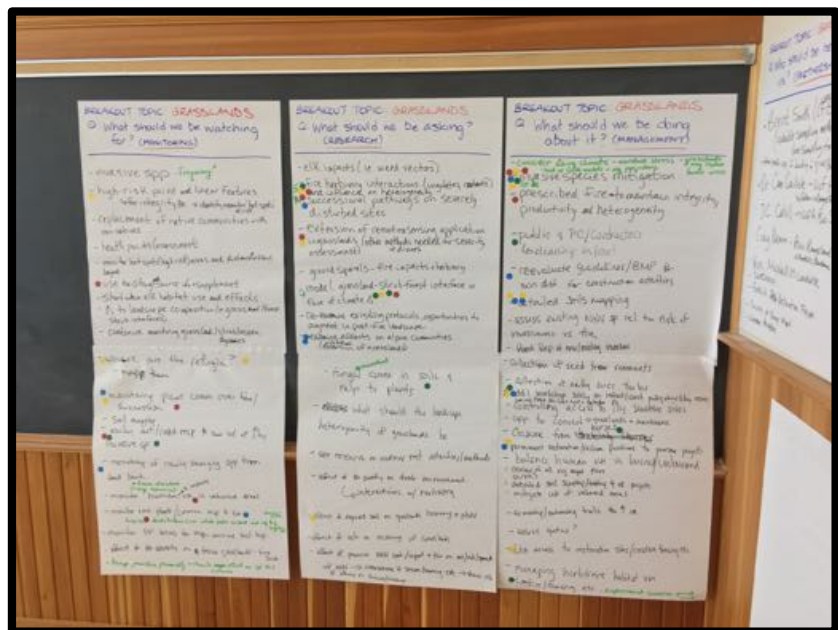
- Visitation was high in areas that burned
- Visitation may or may not decrease
- Area closures will be needed, access managed, especially in fragile areas; applies in both grasslands and forested areas
- Visitor safety an issue in burned areas, but tree removal needs to be approached in a manner which is cognizant of ecological impact
- Increased avalanche risk in some areas

Next steps

- Regular monitoring events can be valuable (i.e., the 'Pulse' concept)
- Need to combine new program initiatives with existing plans and research programs
- There are lots of people in academia, other parks, within WLNP, surrounding area who can assist in monitoring, research, and management

Opportunities have been created

- Opportunities for re-visioning of (e.g.) campgrounds
- Unique research opportunities for Parks Canada
- If one accepts that future wildfires will be exceptionally severe, Kenow provides a unique case study
- Burned areas should be set in context of historical and recent fire behaviour
- Coordinating visitor use with adjacent public lands
- Ask what you want to differently, what do you want to learn
- Case study for FireSmart
- Unique communication opportunities for fire interpretation
- Long term data monitoring can start with this 're-set'



Communication going forward will be critical

- Despite all the effort put in by Parks Canada thus far this will need to be a priority; especially re: the nature of fire
- Initial destruction brings strong public response; need to balance that with ecological reality
- Need to be able to communicate significance of park in new context

Themes from the Breakout Sessions

As noted above, each of the Breakout Group discussions was directed to answer four questions that corresponded to the workshop goals and purpose. In many cases, of course, the suggested actions from one discussion were mirrored in another.

The following is an effort by the Miistakis Institute to summarize (gather and group) the various suggestions/feedback from across the Breakout topics into a single list for each question.

Again, there is no particular order of importance, though an effort was made to group items from the more general comments/suggestions to the more specific.

Monitoring: What should we be watching for?

System Monitoring

- System change
 - Newly emerging species;
 - Colonizing species;
 - Measurement of the new age class structure or quantity;
 - Veg succession/fuel succession;
 - Grasslands - litter/biomass;
 - Forests - downed wood and canopy layers;
 - Aquatic plant community (periphyte) change
- High risk (hot spot) points/zones
 - Linear features; Exposed mineral soil;
 - Road side ash/particulate accumulations
- Refugia
 - Mapping of remaining refugia;
 - Fine scale climate refugia
- Hydrology
 - Streamflow, water level, and temperature;
 - Instabilities (stream bank and stream bed);
 - Debris occurrence/impacts from precipitation events;
 - Water quality chemistry (nitrogen, phosphorus, metals)
- Soil
 - Soil mapping;

- Ensure comprehensive soils baseline;
- Hydrophobicity
- Weather, climate, precipitation
 - Temperature, moisture, humidity;
 - Identify micro climates;
 - Snowpack
- Human use impacts in burned areas

Flora / Fauna

- Invasive plant species
 - New influxes;
 - Early detection (bromes, knapweed, hawkweed);
 - Noxious weeds
- Rare species, communities
 - Rare plant response, distribution;
 - Bolander's quillwort;
 - Occurrence of nighthawks, olive sided flycatchers, frogs, bats, bumblebees
- Forests
 - Species complement;
 - Cover;
 - Tree size;
 - Aspen encroachment
- Wildlife
 - Post-fire habitat impacts;
 - Species distributions and abundance;
 - Direct mortality vs. re-colonization;
 - Impacts on sheep and goat range;
 - Expected region / timing for forage sources (berries, and others);
 - Bison range assessment (forage production on rangeland);
 - Elk habitat selection in grasslands;
 - Songbirds;
 - Berry production
- Aquatic species
 - Bull Trout impacts;
 - Aquatic community composition;
 - Distribution of native vs. non-native;
 - Invertebrates (abundance, community structure);
 - Amphibian occurrence (pond/wetland), occupancy and abundance

Fire Behaviour / Management

- Prescribed fire areas
 - Response;
 - Correlation to hypotheses
- Fire severity
 - On fescue grasslands
- Fire behaviour
 - Fuel trajectory (as a factor of burn severity)
 - Effectiveness of fuel treatment work

Monitoring methods

- Do we have the right veg plots;
- Stratified by elevation, aspect, moisture, topography;
- BACI on prescribed fires (veg, fuels, temp, ROS, intensity/severity);
- Electro-fishing might not be the right method due to sedimentation;
- How can new remote sensing technology (drones) be used?
- Extend monitoring to cover gradients of disturbance (including non-burned sites)

Research: What should we be asking?

Management Research

- Which research assists decision making?
- What are the available restoration activities/methods?

System

- What slopes are high risk for erosion/tree fall/debris flow and dams?
- What is the establishment of novel communities?
- Where are the fire refugia and why?
- What is the paleo-ecology of lake areas to establish change/time?
- How is the grassland/forest/shrub interface changing?
- What are the impacts on alpine communities?
- What are the fungal/microbial communities in soils?
- What is the seed bank viability?

Invasives, Non-Native Species

- What research will assist management of grassland invasives?

- What is the source of invasives?
- What is the effect of fire on the extent/spread/management of non-native vegetation?

Forests, Trees

- What is the role of Aspen on the landscape?
- What is the effect on white bark pine recovery?
- What/where are the forest communities now, and what is driving that?
- What are the effects of snags and coarse woody debris?

Grasslands

- What are the impact of elk on grasslands?
- What is primary succession of disturbed sites?
- What was the fire severity in the grasslands?
- What are the impacts of climate change on grasslands?
- What should the landscape heterogeneity of grasslands be?
- What is the effect of fire severity on shrub encroachment in the grasslands?
- What is the effect of exposed soil on grasslands recovery and non-native vegetation?
- What is the effect of ash on recovery of grasslands?

Aquatics, Hydrology

- What is the sediment intrusion into spawning beds?
- How does the fire change the distribution of non-native fish?
- What is the bioaccumulation of mercury in amphibians and fish (waterbodies that do not have outflow)
- What are the watershed scale impacts?
- What is the short-term watershed repellency of the soils?
- What is the post-fire amphibian and fish disease response?

Wildlife

- What are the fire-herbivory interactions?
- Did the fire change distribution, abundance, movements, life history traits of wildlife?
- What was the effect of the fire on bats?
- What is the shift distribution of wildlife species?
- What wildlife diseases have arisen?
- Have raptor numbers increased due to small mammals?
- Can Shell elk telemetry data identify corridors (pre-fire seasonal migration)

Fire Behaviour, Management

- How was fire severity distributed across the landscape?
- Does recovery look different in older/newer wildfires as well as in previous prescribed fires?
- Where does this fire fit in the terms of historical range of variability (fire size/severity, fire weather)?
- What kind of fire do we need more/less of in the future?
- What kind of fire do we need inside the Kenow Fire moving forward – heterogeneity?
- What will be the climate change impact in the short/long term on fire behaviour?
- How do we manage fire in the remnant forest?
- How intense/severe should prescribed fires be?
- What were the effects of past fire policies on Kenow fire behaviour and pattern?
- Where, when, how, and why was fire traditionally used?

Research Methods

- Need to use models to determine grasslands, shrub/forest interface in light of climate change
- Use telemetry on wide-ranging carnivore (bears and ungulates)
- Using RSF models to ground truth ungulates winter range (sheep)
- What are the linkages to Traditional Ecological Knowledge (TEK)?

Management: What should we be doing about it?

System Management

- Manage for a changing climate
 - Grasslands may be replacing forests
- Use early detection / rapid response approach
- Do no harm (E/A, BMP work, clean, go – staff and contractors)
- Use minimal disturbance and Best Management Practices approaches
- Maintain weather stations, and ensure they are working

Invasive Species

- Move away from site actions for invasive species (pulling weeds) and look at more landscape effects

- Assess existing non-native species relative to risk of invasiveness versus fire
- Ensure rapid response to new/existing invasives

Fire Management

- Employ prescribed fire with relation to fire-herbivory interactions.
- Reapply prescribed burning
- Spend time doing 'nothing' – watching to understand
- Review Park Fire Management Plan
- Create and maintain landscape fuel breaks
- Evaluate fire refugia for value as seed source and habitat to guide subsequent fire management (e.g., suppression)
- Consider a post fire assessment planning process like US NPS' BAER Plan

Infrastructure Replacement / Development

- Re-evaluate guidelines/BMP for minimal disturbance for construction activities
- Convene workshop solely on infrastructure/construction mitigation and key issues
- Conduct detailed soil sampling/testing for all projects
- Have restoration plans developed at the same time as construction plans
- Make existing/new facilities/infrastructure more resilient/Fire Smart
- Review infrastructure planning for trail around town site, Crandall campground wildlife mitigation

Vegetation Management

- Collect seed from remnants
- Collect early succession forbs
- Review all vegetation management plans
- Consider protection for surviving aspen stands
- Patch burn to manipulate herbivory (elk) and manage detrimental accumulations of grassland litter
- Reassess bison paddock for range

Forest Management

- Determine what you are managing for
 - multiple age classes (heterogeneity), reduced fire intensity?
- Consider age class objectives in scale of Crown of the Continent
- Structure 5 needle pine program to account for climate change
- Balance safety with habitat when dealing with hazard trees

- Keep burning on the eskerine / Red Rock/ Y-Camp to maintain fescue grasslands

Visitor / Human Use Management

- Control access to sensitive sites, known refugia
- Use closures for safety instead of removal of danger trees etc.
- Implement closures for horses, consider first year ban
- Seek to balance human use in burned/unburned areas
- Armour/enhance trails for increased use
- Consider access quotas
- Conduct public communication 'pulses' as the landscape responds to share changes/surprises/lessons
- Communicate as to where people can drink water in the Park
- Assess human - wildlife conflict concerns (elk, bear, sheep, deer)
- Manage potential wildlife conflict in ranchlands through communications

Wildlife Management

- Manage herbivore habitat use (fire/fencing etc.)
- Address concerns regarding displacement of wildlife to private lands
- Create species priority lists
- Use/opportunities for prescribed fire to manage habitat and wildlife corridors
- Explore modification of hunt with Alberta Environment and Parks
- Re-map ungulate winter range

Restoration

- Create permanent restoration/reclamation positions to oversee projects
- Limit access to restoration sites

Species at Risk

- Need to consider rare/endangered plants as species on the edge of their range are important considering climate change

Hydrology / Aquatic Management

- Use information from past events that can identify potential hotspots (such as 2013 flood events, past plugged culverts, bridges)
- Create response plan for addressing high water event
- Consider creating spawning habitat for Bull trout

Appendices

Appendix 1: Workshop Agenda



Waterton Lakes National Park



Canada

Post-Kenow Wildfire Ecological Research, Monitoring and Management Workshop

January 10-11, 2018, Waterton Lakes National Park, Alberta

Workshop Purpose:

In partnership with post-wildfire ecology and management experts, Parks Canada will compile knowledge to guide research, monitoring and management in Waterton Lakes National Park (WLNP) following the Kenow Wildfire of September, 2017.

Workshop Outcomes:

- 1) Identify ecological effects expected in the short- and long-term and how these may affect/direct active management within WLNP.
- 2) Define research and monitoring priorities a) to inform park management and b) for greater research purposes. Identify possible researchers/leads.
- 3) Identify key mitigations for reduction of long-term, adverse impacts.
- 4) Compile lessons learned from collective experience in post-fire management.

Workshop Agenda:

Day 1

8:30 - 9:15	Welcome and Introductions <ul style="list-style-type: none">• Introductions, overview of the workshop
9:15 - 10:00	Context – Waterton Lakes National Park overview <ul style="list-style-type: none">• Welcome – Ifan Thomas, Field Unit Superintendent• Park management – Dennis Madsen• Park ecology – Barb Johnson
10:00 - 10:30	Break
10:30 - 12:00	Kenow Fire – Overview of the Kenow Fire <ul style="list-style-type: none">• Scott Murphy, WLNP• Field Trip (weather permitting)
12:00 – 1:00	Lunch – Provided by Parks Canada
1:00 - 2:00	Post-fire Hydrology - Presentation <ul style="list-style-type: none">• Uldis Silins
2:00 - 2:30	Post-fire Hydrology – Discussion
2:30 - 3:00	Post-fire Grassland Ecology - Presentation <ul style="list-style-type: none">• Barry Adams



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|-------------|--|
| 3:00 - 3:30 | Post-fire Grassland Ecology – Discussion |
| 3:30 - 4:00 | <i>Break</i> |
| 4:00 - 4:30 | Post-fire Forest Ecology - Presentation <ul style="list-style-type: none">• David Hibbs |
| 4:30 - 5:00 | Post-fire Forest Ecology – Discussion |
| 5:30 | <i>Dinner – Group reservation at Twin Butte Store</i> |
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Day 2

- | | |
|---------------|--|
| 8:30 - 9:00 | Recap and Debrief <ul style="list-style-type: none">• Review of Day 1 |
| 9:00 - 9:30 | Post-fire Wildlife Ecology - Presentation <ul style="list-style-type: none">• Evelyn Merrill, University of Alberta |
| 9:30 - 10:00 | Post-fire Wildlife Ecology – Discussion |
| 10:00 - 10:30 | Breakout Group – Topic Choice |
| 10:30 - 11:00 | <i>Break</i> |
| 10:30 - 11:15 | Breakout Session 1 – Participant-chosen topics |
| 11:15 - 12:00 | Breakout Session 2 – Participant-chosen topics |
| 12:00 – 1:00 | <i>Lunch – Provided by Parks Canada</i> |
| 1:00- 1:45 | Breakout Session 3 – Participant-chosen topics |
| 1:45 - 2:15 | <i>Break</i> |
| 2:15 - 3:15 | Moving Forward – Discussion - Next steps for WLNP |
| 3:15 | <i>Adjourn</i> |

Appendix 2: Participant List

Barry Adams

Rangeland Ecology Consultant

Mark Burke

Public Works and Government
Services Canada

Diandra Bruised Head

Kainai Nation

Jen Carpenter

Waterton Lakes National Park

Adam Collingwood

Waterton Lakes National Park

Kelly Cooley

CoolPro Solutions Environmental
Consulting

Lori Daniels

University of British Columbia

Danah Duke

Miistakis Institute

Kansie Fox

Kainai Nation

Guy Greenaway

Miistakis Institute

David Hibbs

Earthwatch Institute

Chris Hopkinson

University of Lethbridge

Barb Johnston

Waterton Lakes National Park

Dawn LaFleur

Glacier National Park, MT

Tracy Lee

Miistakis Institute

Dennis Madsen

Waterton Lakes National Park

Evelyn Merrill

University of Alberta

Scott Murphy

Waterton Lakes National Park

Marilyn Neville

Rangeland Ecology and Restoration
Consultant

Marc-Andre Parisien

Canadian Forest Service

Jane Park

Parks Canada Agency

Kim Pearson

Waterton Lakes National Park

Dan Perrakis

Natural Resources Canada

Dale Redford

Waterton Lakes National Park

Don Sears
Waterton Lakes National Park

Dave Soleim
Glacier National Park, MT

Uldis Silins
University of Alberta

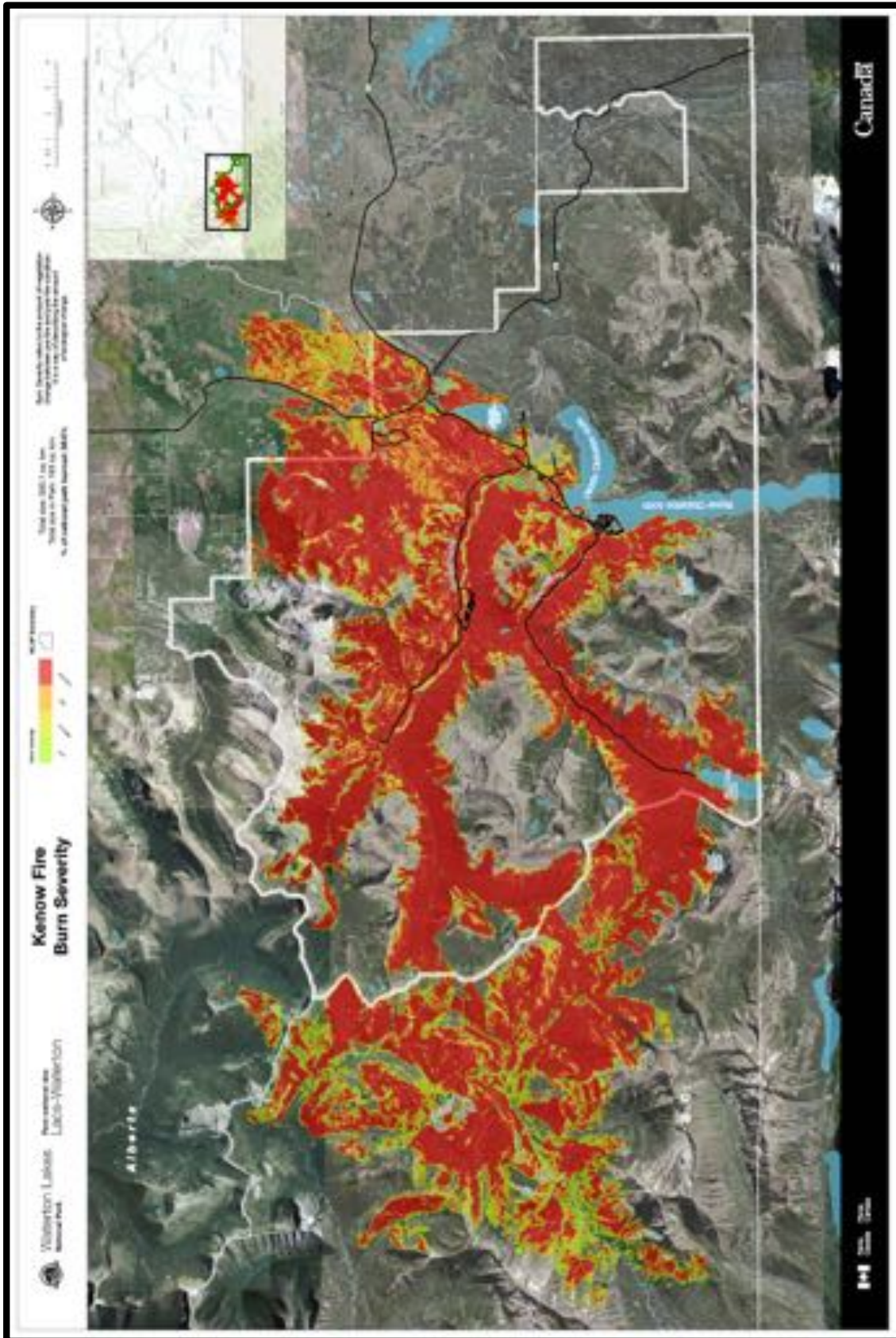
Ifan Thomas
Waterton Lakes National Park

Robert Sissons
Waterton Lakes National Park

Chris Williams
University of Alberta



Appendix 3: Kenow Wildfire Burn Severity Map



Appendix 4: Workshop Outline Provided to Invitees

**Post-Kenow Wildfire
Ecological Research, Monitoring and Management Workshop
January 10-11, 2018
Waterton Lakes National Park, Alberta**

Purpose: In partnership with post-wildfire ecology and management experts, Parks Canada will compile knowledge to guide research, monitoring and management in Waterton Lakes National Park (WLNP) following the Kenow Wildfire of September, 2017.

Outcomes:

- 1) Identify ecological effects expected in the short- and long-term and how these may affect/direct active management within WLNP.
- 2) Define research and monitoring priorities a) to inform park management and b) for greater research purposes. Identify possible researchers/leads.
- 3) Identify key mitigations for reduction of long-term, adverse impacts.
- 4) Compile lessons learned from collective experience in post-fire management.

Kenow Wildfire Facts:

Total size: 35,010 ha
Total size within WLNP: 19,302 ha
WLNP area burned: 38.6%
WLNP vegetated area burned: approximately 50%

WLNP fire area burned at:

- extreme severity: 75.4%
- high severity: 12.6%
- medium severity: 6.4%
- low severity: 5.6%



Appendix 5: Workshop Evaluation Summary

In total, thirteen (13) evaluations were completed, with the average rating of the workshop 4.77 out of 5.

1. Overall, how would you rate this workshop? (1 – Poor; 5 – Excellent)

Average: 4.77

Comments:

- Bit short on overall discussion time
- Great diversity, [] and focused [] competent and disciplined facilitation focus on outcomes
- Good mix of people with a wide variety of background and experience
- Well planned and great job sticking to the objectives
- Fantastic

2. Do you feel that we met our objectives for this workshop? (1 – Poorly; 5 – Very Well)

Average: 4.50

Comments:

- I felt that more discussion on links to mgmt impacts would have been good
- Ultimately will depend on feedback from PC
- Yes, thank you :)
- Time will tell once we've viewed the completed notes
- Overall absolutely - just much to think about

3. In your opinion, is Waterton Lakes National Park well-positioned to pursue the ecological monitoring and research necessary to support post-fire management of the Park. (1 – Disagree; 5 – Agree)

Average: 4.08

Comments:

- Involve partners and universities; Leverage funds --> Fed Govt
- Well positioned to begin developing plans.
- Yes, but timing is critical --> we need to start this spring
- Going into this with strong research and monitoring []
- This is entirely dependent on funding
- Depends on funding
- Desire is there but resources lacking

- Theory yes - funding maybe?
- Depends on resources given them; Excellent approach to figuring what to do

4. Were the presentations useful in terms of informing the discussions of options and alternatives? (1 – Disagree; 5 – Agree)

Average: 4.83

Comments:

- Some were better than others - some generated more discussion while others (Uldis) provided good empirical evidence / data
- While the style and content differed the presentations seemed to adequately stimulate the required discussion
- Yes
- Great! All very thoughtfully put together
- Excellent

5. Were the breakout exercises useful in terms of identifying and prioritizing options and alternatives? (1 – Disagree; 5 – Agree)

Average: 4.46

Comments:

- Within the constraints of the logistics and the will
- Don't really know. I'm not a Park person but park concerns, priorities will play a big role in ultimate choices
- Maybe a bit long, but quite useful
- Perhaps too many but prioritization approach should refine
- Lots of additional info detail came out and more time for discussion / debate
- Would have preferred facilitators hosting each topic
- Too much expanded / not focused question/issues

6. What aspects of the workshop did you particularly like?

Comments:

- Post Presentation group dialogue
- Interaction, discussion, efficient use of time
- Good [], right amount of info
- Interaction with experts at breaks and meals and breakouts
- Fire chronology, diversity of speakers
- Presentations were relevant and interesting; break out sessions; chance for general discussions

- Interactive discussions with multiple subject-matter experts brought out more detailed info; All participants remained really engaged --> great moderating
- Presentations were excellent
- Organization, content, ALL GOOD
- Breakout and discussion --> introduction talks
- Free flow of information; Good background info; Good group size

7. What aspects of the workshop did you particularly dislike?

Comments:

- Nothing
- Breakouts a bit long
- --
- None
- N/A
- Post talk session --> the fishbowl

8. How would you rate the facilitation for this workshop? (1 – Poor; 5 – Excellent)

Average: 4.77

Comments:

- Guy brought great energy and guidance to the group
- Once the heat was turned up
- Again, disciplined and focused
- Very good. Well planned and executed
- See my answer to Q5
- Nice job! Great "start"!

9. Other comments or feedback:

- Good discussion; The workshop will influence the wildfire recovery efforts.
- Thanks for the invite
- Well done!
- Food was excellent
- Thank you for the chance to provide input! Would appreciate receiving copies of the presentations and proceedings.