Old growth ponderosa pine in British Columbia: a rare resource

Old growth stand of ponderosa pine near Naramata

A submission to the Old Growth Strategic Review Panel

from

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Summary

British Columbia's ponderosa pine forests are at the northern edge of their range in Western North America. While they were highly valued for timber at one time, they are now more valued for ecosystem services and the habitat they provide for a wide range of species, some of which are at risk of loss. Old growth stands, as with other forest types are especially valuable.

These forests have been subjected to many disturbances in the past and the stands we see today bear the marks of fires of varying intensities, bark beetle attacks and logging. Most recently, the ponderosa pine forests in the northern part of the species' range were devastated by the mountain pine beetle epidemic . In the Thompson valley, for example, almost all stands lost all of the stems larger than 3m in height and will not recover their former condition for at least 50 years. This change has already been shown to have affected bird species that key on large live ponderosa pine stems for foraging and winter food. Further impacts on ecosystem components are expected.

As a result of the disturbance history, both old and recent, old growth ponderosa pine stands in the province are rare. A very few stands have been afforded protection within Ecological Reserves, Protected Areas and Parks and a survey of the ponderosa pine forest area is required to determine if opportunities exist for adding to the current network of reserves.

Disturbance events are expected to continue within the existing reserves. However, the characteristics of these events are likely to be altered by changing climatic conditions and increasing population. Managers should expect surprises in the type, scale and intensity of disturbances, and management activities within reserves should be planned and implemented with caution.

Introduction

The objective of this submission is to provide background information on old growth ponderosa pine stands in British Columbia for the Old Growth Strategic Review. Ponderosa pine is not normally a species included in the conversation about old growth forests in the province but this report will attempt to redress the omission. It is based on work carried out by the Ponderosa Pine research group centred at Thompson Rivers University since 2007 (see Vyse et al. 2009).

The submission provides basic information on the distribution and ecology of ponderosa pine before providing information that will be useful in assessing the ecological significance of old growth ponderosa pine. It asks three questions:

- Should there be concern about the protection of old growth ponderosa pine ecosystems?
- What are the threats?
- What strategies could be employed to counter the threats?

Distribution and ecology of Ponderosa pine in British Columbia

Ponderosa pine is at the northern edge of its range in the province and occupies a narrow strip along the sides of the Fraser, Thompson, Okanagan, Kettle and Kootenay rivers in the southern Interior (Figures 1 and 2). The majority of stands of ponderosa pine are found in the Ponderosa Pine zone (Meidinger and Pojar 1990). This Zone is the driest of the forested zones in British Columbia, and in summer it is also one of the warmest. In July, mean temperatures range from 17 to 22° C. The low precipitation of 250–450 mm per year is a result of the strong rain-shadow cast over this area by the Coast and Purcell Mountains. Descriptions of stands in the Ponderosa pine zone often refer to large well-spaced stems with a grassy understory but such conditions are relatively rare. Stands can range from very open to dense crown cover over short distances and often contain a substantial component of Douglas-fir.

Ponderosa pine is also found in three other biogeoclimatic zones. Scattered open stands of pure pine are found in the drier, warmer Bunchgrass Zone, often on talus slopes, interspersed with grasslands. In the wetter cooler Interior Douglas-fir zone ponderosa pine is mixed with Douglas-fir but at low proportions. In the still wetter Interior Cedar-Hemlock zone it is found only on dry sites and as a minor species.

Ponderosa pine forests occupy an area of about 600,000 hectares in the province, but the area of stands dominated by the species is probably less than half of this total based on data for the more extensive western portion of the stands in the province.

The Ponderosa Pine Zone is an important environment for many kinds of wildlife because of the variety of habitats and the location of the zone between the Great Basin to the south and the boreal forests to the north. Ponderosa pine forests provide habitat for species such as Clark's Nutcracker, White-breasted Nuthatch, Pygmy Nuthatch and Yellow-pine Chipmunk that feed on the large pine seeds. Older stands with larger stems provide nesting and roosting cavities for bird and animal species. Fallen stems provide substrate for specialised lichens. In winter, ungulates such as Rocky Mountain Elk, Mule Deer, and White-tailed Deer eat the shrubs that grow under the open-canopied older forests. Denser younger stands of Douglas-fir and ponderosa pine provide winter cover for ungulates and abundant seeds and insects for a variety of birds and small mammals such as the Little Brown Myotis, California Myotis, Red squirrel, Northwestern Chipmunk, and Long-tailed Vole (Ministry of Forests 1996).

Should there be concern about the future for old growth ponderosa pine?

Extensive disturbance in the past.

The ponderosa pine forests in British Columbia have been heavily exploited throughout their range for at least a century. Along with the coastal Douglas-fir Zone and Bunch Grass Zone, they represent the most disturbed and endangered ecosystems in the province (Austin et al. 2008). The forests provided first nations peoples with food, shelter, and fuel for millennia but this low level of use was interrupted in the latter part of the 19th Century. Following European settlement, the forests were first grazed and then cut to provide timber for railway building, housing, and containers for agricultural exports. Early commentators on forest conservation concluded that the high levels of pine lumber production could not continue. Whitford and Craig (1918) reported that heavy harvesting had already occurred in yellow pine forests in most of the interior, noting "greater inroads on this type than any other". Two decades later Mulholland (1937), in his survey of forest conditions in the Province, noted the extensive and likely excessive harvesting of yellow pine, and concluded that this forest type "has been too heavily cut and cannot continue to supply the demand" (see Fig.3 a,b,c). Only a few areas in relatively inaccessible areas appear to have escaped the saw. After 1950, timber harvesting shifted from the pine forests to higher elevation forest types but there have been occasional increases in logging in response to demand for logs from Washington State.

Bark beetles also played a major role in changing the stands. Attacks were noted throughout the 1920s and 1930s in the Okanagan and Merritt areas. Mulholland (1937, p. 62) noted that "bark beetles have destroyed most of the yellow

pine occurring in pure stands in the Province" (see Fig. 3d). Fires and bark beetle attacks through the 1930s and 40s further diminished the forests and again as a result of the most recent pine beetle attack from 2005-2009.

Cattle and horse grazing, often at intense levels, has been widespread since the 1850s and continues to the present.

Much of the lower elevation ponderosa pine forest was transferred to private ownership by 1900 and clearing for agriculture and housing took place as the population in the province increased and settlements in the interior valleys expanded (Whitford and Craig 1918). This trend has continued up to the present day particularly in the Okanagan valley where subdivisions and vineyards continue to encroach on the former range of ponderosa pine forests.

What is the Conservation status?

The provincial conservation status of the Ponderosa Pine Zone and associated ponderosa pine forests has been assessed by Biodiversity BC (Austin et al. 2008). The zone as a whole is considered to be intermediate between imperilled and vulnerable and is assessed as having a moderate to high risk of extinction. It is one of four zones in the province with this rating or higher (the others are bunchgrass, CDF and IDF). Contributing to this rating is the relatively small area of the zone and the threats from urbanization, agriculture and climate change. The rating is mitigated by the fact that that British Columbia has less than a fifth (11-19%) of the area occupied by ponderosa pine forests in Western North America. However, it should be noted that the province has a much higher proportion of the northern ponderosa pine type. Another concern is the fact that almost all of the zone has been modified by disturbance.

The conservation concern at the species level is also high because the zone supports 10 species of global conservation concern and 114 of provincial concern. In addition, 27 of 29 ecological communities described are also of provincial conservation concern. However, many of these species and communities are not directly associated with ponderosa pine forests but with grasslands, rocky ground, and wetlands. The provincial species at risk tables list 15 ponderosa pine communities that are considered to be at risk.

Recognising the conservation concern over many years, the province has protected a number of ponderosa pine stands across the range of the species. A partial list of ecological reserves, parks and protected areas is shown in Table 1. Ecological reserves have the highest conservation status and there are 12 with some amount of ponderosa pine forest. The largest reserve is 884 ha. and seven are smaller than 100 ha. Only four reserves are located in the lower elevation ponderosa forest types.

Old ponderosa pine forests are much more vulnerable than younger forests. The State of the Forest report (Ministry of Forests 2006) estimates that 37% of the ponderosa pine forest type is over 140 years but only 3% is over 250 years old (Table 2). However the values shown are for the smaller area of Ponderosa Pine Zone and not for the total area of ponderosa pine dominated forest. In addition the area estimates do not reflect recent disturbances. This small proportion suggests that "old growth" ponderosa pine forest are very rare, and this observation is supported by recent surveys in the Okanagan, Nicola and Thompson drainages.

Further support for this conclusion can be found in the western part of the species range. A review of the Provincial Protected areas found that there are very few examples of old growth stands under protection. Examples of old growth can be found at Trout Creek (ER 7) and Whipsaw Creek (ER 27), and there is a small patch of big trees in Kalamalka Lake Park, but none of these examples could be considered stands. The South Okanagan Grasslands Protected Area contains a small patch of old growth at the upper elevation limit of the species and there are scattered old trees among much younger trees in White Lake Grasslands Protected Area. Patches of old trees at the Chasm Ecological Reserve (ER 65) were killed in the recent mountain pine beetle epidemic and other patches in the Arrowstone Protected area were damaged by the recent Elephant Hill fire. The example shown in Fig. 3 is within a South Okanagan Regional District Park that was established to protect historical artifacts associated with the Kettle Valley Railway. The diameter of the protected stems is very much smaller than those shown in the photo from 1910.

What are the threats to the ponderosa pine ecosystem in British Columbia?

The threatened status of ponderosa pine forests has been and is likely to be further exacerbated by a number of human-caused and natural disturbances and the few remaining stands of old growth are particularly vulnerable.

Bark beetles.

The biggest future threat to ponderosa pine stands is the mountain pine beetle (*Dendroctonus ponderosae* Hopk.*)*. The well-reported beetle epidemic in lodgepole pine (*Pinus contorta var. latifolia*) stands throughout the interior of the province has also had a major impact on ponderosa pine stands, especially in the Thompson valley. Attacks on a large scale began in 2005, and they expanded rapidly in 2006. In many stands almost all of the large trees were killed. In subsequent years the epidemic has spread further south into the lower Thompson, North Okanagan, Nicola and Princeton areas but the affected area has not expanded since 2009. Figure 4 shows the general location of attacked ponderosa pine in the southern interior by the summer of 2008 and Fig. 5 illustrates the damage level in northern stands.

Other bark beetle species also pose a threat especially to the remaining patches of old growth. In the south Okanagan continuous mortality caused by attacks by western pine beetle (*Dendroctonus brevicomis*) has been observed over the last dozen years. Red turpentine beetle (*Dendroctonus valens*) and engraver beetles (*Ips sp.*) are also threats.

Large high severity fires

Extensive fires have caused serious damage to ponderosa pine forests in the past and continue to threaten the future of these forests. Several recent fires, among them the Okanagan Mountain fire, the Garnet fire (near Penticton), the Greenstone fire (near Kamloops) and the Elephant Hill fire (near Ashcroft) have burned substantial portions of ponderosa pine forests. Peaks in fire activity correspond with peaks in drought and interactions between fire activity, beetle mortality and climate change can be expected.

Urban encroachment

There has been rapid population growth in valleys of the dry Interior adjacent to ponderosa pine forests. A substantial but unknown proportion of the original area of forest has already been lost. Continuing losses of forest on private land can be expected.

Climate change

Climate changed throughout the province over the thirty years from 1970-2000. Over much of the ponderosa pine zone, winter temperatures were warmer and precipitation increased. Projections of future climate suggest that these trends will continue. Mean annual temperatures will increase by at least 2.5 degrees. Winter precipitation is expected to increase but summer precipitation will decrease (Spittlehouse 2008). The climate of the ponderosa pine forests is expected to shift to that of the adjacent lower elevation Bunchgrass Zone (Hamman and Wang 2006). The effect of these changes on ponderosa pine ecosystems is not known, but it is expected that summer drought stress will intensify. Fire occurrence and intensity may increase, and the activity of damaging bark beetles may also increase. Regeneration of ponderosa pine after disturbance may become more difficult, mostly as a result of drought during the establishment phase. Overall it is expected that the ability of ponderosa pine ecosystems to recover from human and natural disturbances, like those of many other ecosystems in the province, will diminish.

Consequences of changes in the ponderosa pine forests

The consequences of historical and current disturbances in ponderosa pine forests have been studied by a number of authors (e.g. Ministry of Environment Lands and Parks 1998; Austin et al. 2008), but only in a cursory way, and at a regional level. Several detailed studies of individual "species at risk" have also been completed (see Ministry of Environment, Lands and Parks 1997, Bryan and Sarell 2006,).

One recent study has assessed the impact of the mountain pine beetle epidemic on a range of ponderosa pine forest ecosystem components including forest structure, disturbance history, ground vegetation, birds, soils and invertebrates (Klenner and Arsenault 2009; Vyse et al. 2009). The effect of the high rates of mortality on plant and animal communities in ponderosa pine stands in the Thompson and Nicola drainages is not simple to predict. While the visible changes are large, and some rapid changes can be expected, other responses may take many years to become evident. One way of examining the possible changes is to assess the effect of high mortality on habitat features known to be important for a wide range of species over time. Key features include large live trees, large declining trees or snags, large downed wood, abundant understory and within stand heterogeneity of well-developed tree canopies and canopy gaps. Table 3 shows the result of such an assessment for pure (>70%) stands of ponderosa pine. Species relying on downed wood and abundant understory are likely to be positively affected for a considerable period of time. Other species relying on large dead trees will benefit in the short term but will lose resources as snags fall to the ground. Half of the large dead stems are expected to fall to the ground within the next 5 to 10 years. Species negatively affected include those relying on large live trees, for example for food, and those relying on live trees to provide snow interception and winter cover. Consequently, the loss of old growth ponderosa pine is of high conservation concern, as it is for other forest species in the province.

Reducing the threats to old growth ponderosa pine forests

The common and prevailing view of the state of ponderosa pine forests is that they are in an unnatural condition as a result of fire suppression. Recent large fire events and pest outbreaks in the western United States and British Columbia have been attributed to widespread unnatural conditions in dry forest ecosystems and arguments have been made that they are outside their historic range of natural variability. To restore the dry forests and ponderosa pine forests to a more natural condition, an Ecosystem Restoration Program has been developed by the Ministry of Forests and Range (Neal and Anderson 2009) and similar efforts are underway in the United States. The vision of the program is to restore forest and grassland ecosystems to an ecologically appropriate condition and to create a resilient landscape that supports the economic, social, and cultural interests of British Columbians.

The natural disturbance regime of ponderosa pine forests, and dry forests in general (dry forests incorporate both ponderosa pine forests and lower elevation Douglas-fir forests), has been the subject of considerable discussion and some controversy. Although the fire-maintained ecosystem paradigm appears to hold in ponderosa pine forests of the Pacific Southwest (Allen et al. 2002) it has been challenged in other parts of the species range (e.g. in the Black Hills by Baker and Ehle (2001), and in Colorado by Veblen et al. (2001)). For British Columbia, Arsenault et al. (2005) and Klenner et al. (2008) suggest that the fire-maintained paradigm neglects the role of more severe fires and a variety of disturbance agents other than fire that have shaped the stands we view today. In the case of local ponderosa pine forests, logging and clearing was extensive beginning around 1850 and continued to the 1950s. Bark beetles have been very significant disturbance agents and grazing continues to the present.

The controversy over disturbance regime is not simply an academic debate. The government ecosystem restoration program is founded on the idea that a certain type of stand structure is best for ponderosa pine forests and the range of species that are dependent on the forest. Rejection of this premise means that the program goals should be re-examined in terms of landscape level and site level goals.

Threats to ponderosa pine forests should be reviewed at a strategic level considering all of the planned actions on the landscape and the potential impact of natural disturbances. In the absence of such an approach there is a danger that activities such as prescribed fire and mechanical treatments to thin the forest could combine with the effects of salvage logging and forest cover changes on private land to work against the restoration goals. The forecast changes in climate further increase the danger of unintended consequences.

Conclusions

The ponderosa pine forest types of the southern Interior are of high conservation interest and have been severely damaged by a series of disturbances and loss of forest land over the 150 years. As a result, sustaining the valuable features of these forest ecosystems is a challenge and it is expected that the threats will grow worse with climate change. A number of programs are taking place on crown lands that may further imperil the future of these ecosystems in unintended ways. Mountain pine beetle salvage logging, associated bio-fuel logging, and ecosystem restoration projects should only take place in the context of landscape level plans that set clear conservation goals for the ponderosa pine forest type.

The few remaining old growth stands of ponderosa pine are especially threatened, largely because of their rarity and the consequences of further loss are likely to be high. Efforts should be made to identify areas of old growth ponderosa pine, especially in the eastern part of the species range, and the area under protection expanded. On

existing protected areas, managers should expect surprises in both type scale and intensity of disturbances and plan activities with caution.

Acknowledgements

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Figure 1. Distribution of ponderosa pine in North America. The zones denote the general location of varieties of the species.

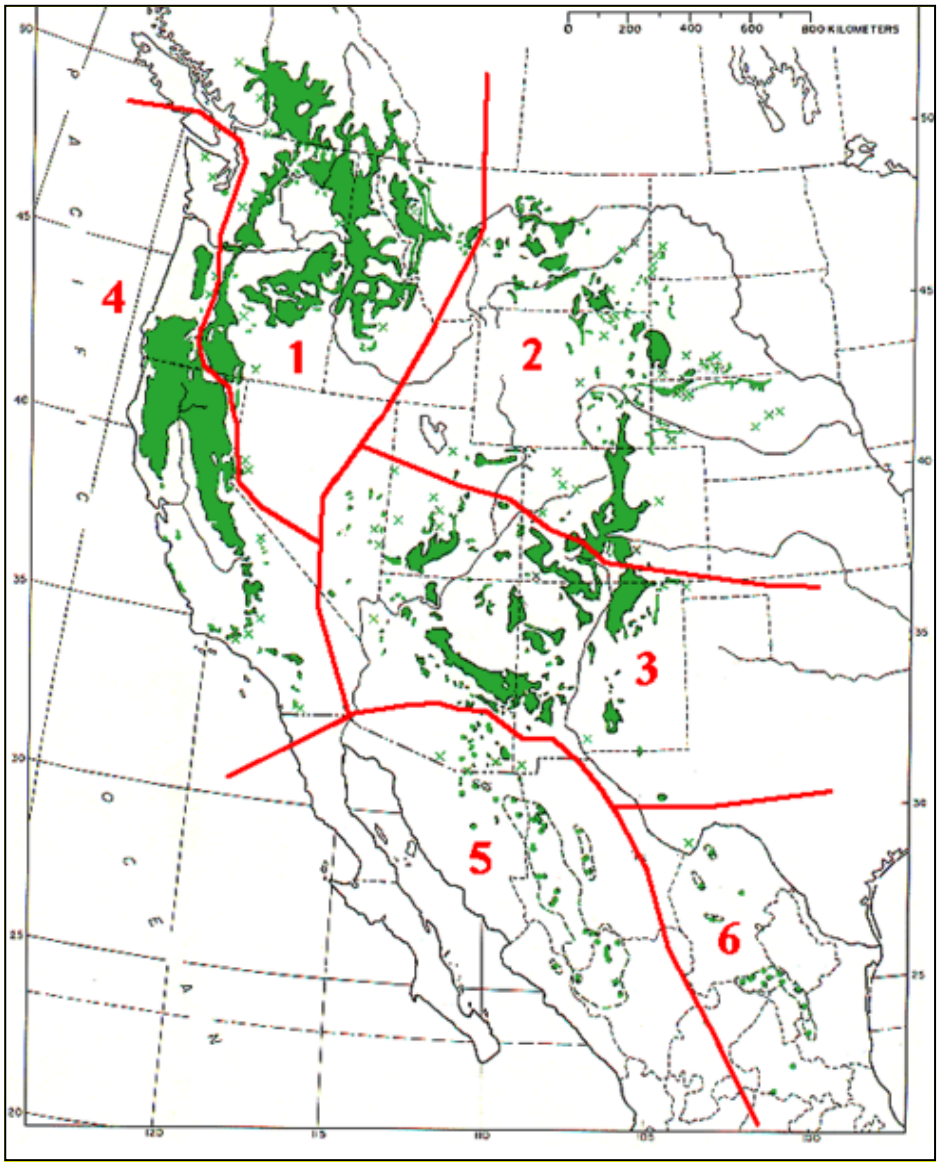


Figure 2. Distribution of ponderosa pine in south central British Columbia .
C= Cascades Forest District; K= Kamloops Forest District; O= Okanagan Forest District

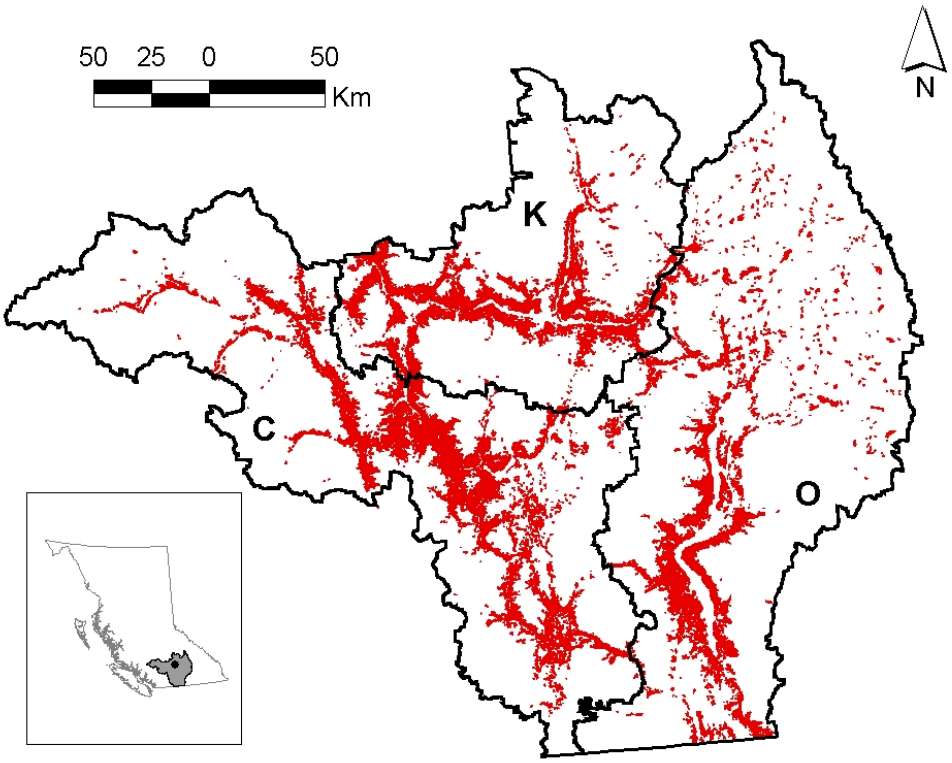


Figure 3. Early logging and beetle attacks in ponderosa pine forests

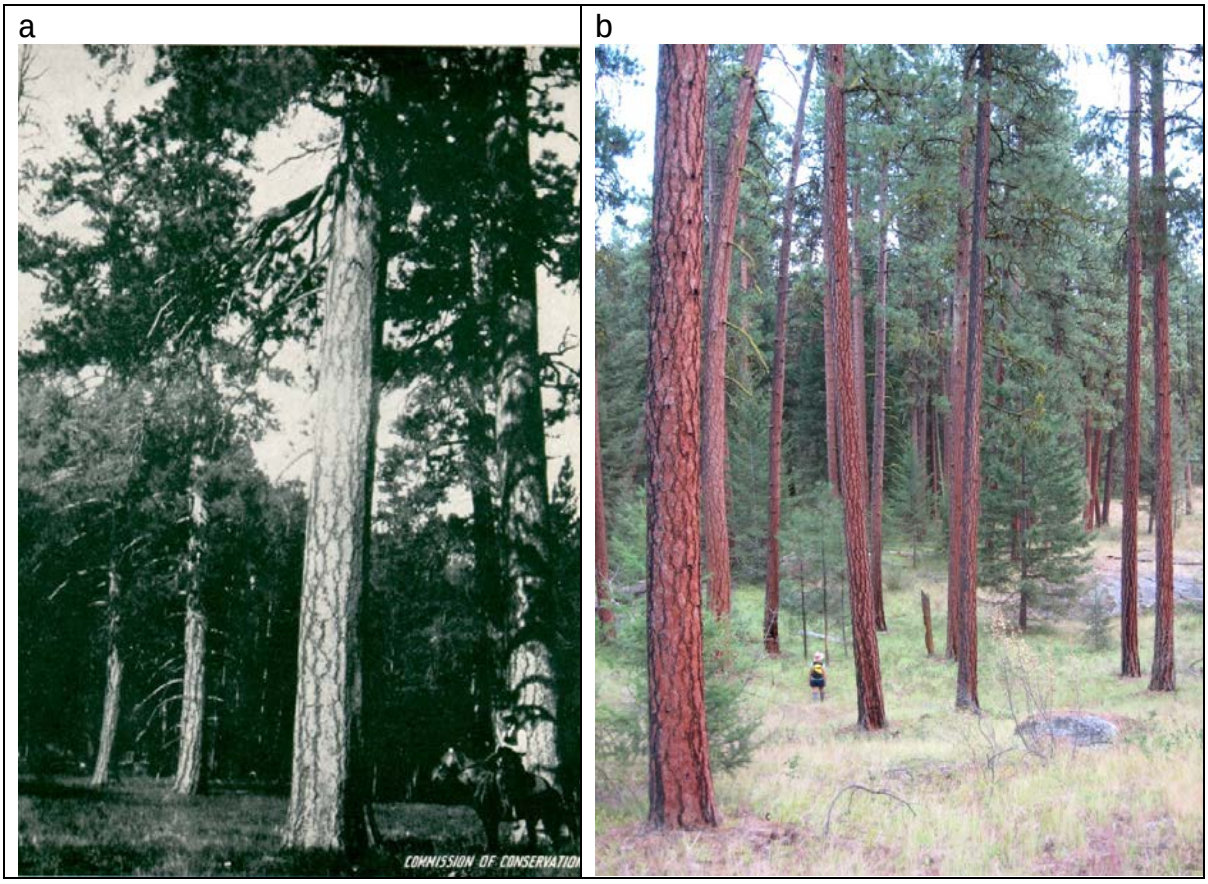
a. early logging near Summerland B.C. showing stumps and residual stems

b. log chute in ponderosa pine forest near Monte Lake; logged area with residuals in background

c. early logging truck showing the size of ponderosa pine stems that were selected for cutting

d. 1930s bark beetle attack in ponderosa pine stands near Merritt showing large snags and understory of ponderosa pine.

Figure 4. Old growth ponderosa pine forest types in 1915 and 2009



a. Photo from Whitford and Craig 1919 b. Rock Ovens Park, near Naramata, B.C.

Figure 5. Distribution of recent mountain pine beetle mortality in ponderosa pine stands

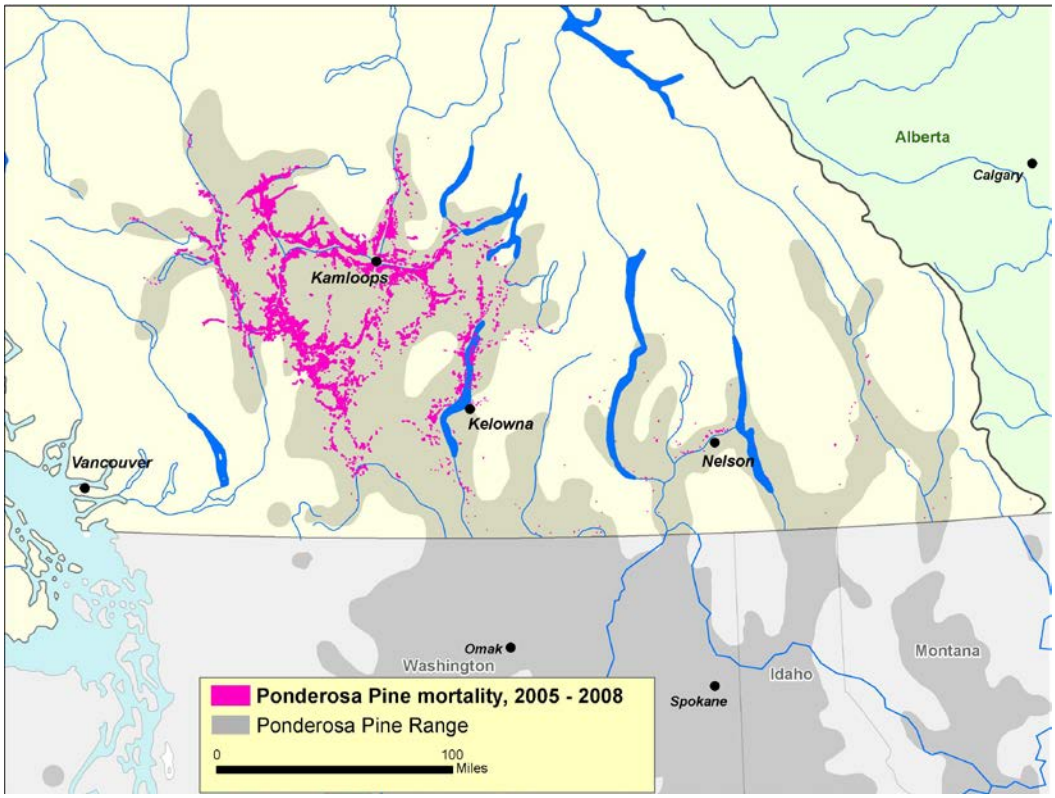


Figure 6. Impact of mountain pine beetle on ponderosa pine stands in the Thompson drainage near Kamloops.

Table 1. Ecological Reserves, Parks and Protected Areas with stands of ponderosa pine or ponderosa pine mixed with Douglas-fir and assessment of recent MPB impact

Name	Status	Location	Size ha.	BEC zone	MPB impact	Notes
Anarchist	PA	Near Osoyoos	467	PP, IDF	light	
Arrowstone	Park	Near Cache Creek	6203	BG, PP, IDF	severe	burned 2016
Bear Creek	Park	Near Kelowna	178	PP	unknown	
Bromley Rock	Park	Near Princeton	149	PP	unknown	
Campbell-Brown	ER77	Near Oyama	107	PP, IDF	moderate	
Chasm	Park	Near Clinton	3067	IDF	severe	
Chasm	ER65	Near Clinton	197	IDF	severe	
Columbia Lake	ER20	Near Canal Flats	32	IDF	unknown	scattered Py
Cougar Canyon	ER108	Near Oyama	107	PP, IDF	moderate	
Edge Hills	Park	Near Clinton	11850	IDF	unknown	
Ellison	Park	Near Vernon		IDF		
Fintry	Park	Near Vernon	361	IDF	unknown	
Kalamalka	Park	Near Vernon	4209	IDF	moderate	
Kentucky/Alleyn	Park	Near Merritt	144	IDF	unknown	
L. du Bois Grasslands	PA	Near Kamloops	15000	BG, PP, IDF	severe	
Mahoney	ER130	Near OK Falls	29	PP; lake	light	Py forest
McQueen	ER110	Near Kamloops	35	IDF	severe	
Monck	Park	Near Merritt	92	PP	severe	
Monte L.	Park	Near Kamloops	8	IDF	unknown	
Myra Bellevue	Park	Near Kelowna	7852	IDF	unknown	
Okanagan L.	Park	Near Penticton	98	PP	light	
Okanagan Mtn	Park	Near Penticton	11038	PP, IDF	light	burned
Ross Lake	ER22	Near Hope	61	IDF	unknown	
Six Mile Hill	PA	Near Kamloops	151	IDF	severe	
Skagit Valley	Park	Near Hope	27948	IDF?	unknown	
Skihist	ER92	Near Lytton	36	PP	moderate	Py forest
Soap Lake	ER3	Near Spences Bridge	884	IDF	moderate	Scattered Py
South OK. Grasslands	PA	Near Penticton	9364	BG, PP, IDF	light	
Stein Valley	Park	Near Lytton	107191	IDF	unknown	
Stemwinder	Park	Near Keremeos	4	IDF	unknown	
Syringa	Park	Near Castlegar	4417	IDF	unknown	
Tranquille	ER29	Near Kamloops	234	PP	severe	Py forest
Trout Lake	ER7	Near Summerland	75	PP, IDF	light	
Vaseux Lake	Park	Near OK Falls	12	BG, PP	light	
Vaseux	PA	Near OK Falls	2015	BG, PP, IDF	light	
Wardner	Park	Near Cranbrook	4	PP	unknown	
White Lake grasslands	PA	Near OK Falls	3741	BG, PP	light	
Whipsaw	ER27	Near Princeton	32	IDF	light	Py/Fdi forest
Windermere L.	Park	Near Invermere	205	IDF	unknown	

Table 2. Area and proportion of old forests in selected ecological zones (from the State of the Forest report (Ministry of Forests 2006)

	CDF	CWH	PP	IDF	ICH
		million ha.			
Non-forest	0.129	2.223	0.152	0.897	0.840
Younger forests, 1–140 years	0.110	3.225	0.119	2.496	2.764
Older forests, 141–250 years	0.004	1.247	0.066	0.864	0.936
Older forests, 251+ years	0.003	4.017	0.006	0.119	0.708
Total forests	0.117	8.489	0.191	3.479	4.408
Total area	0.246	10.712	0.342	4.376	5.248
		%			
Younger forests, 1–140 years	94	38	63	72	63
Older forests, 141–250 years	3	15	34	25	21
Older forests, 251+ years	3	47	3	3	16

Table 3. Summary of predicted changes in key ponderosa pine habitat features and associated wildlife resulting from mortality of overstory trees in pure stands of ponderosa pine.

Habitat feature	Years since beetle attack						Examples of species associated with habitat feature
	Pure stands			Mixed stands			
	1-5 yrs	6-20 yrs	21-50 yrs	1-5 yrs	6-20 yrs	21-50 yrs	
Large live trees	--	--	-	-	-	=	Clark's nutcracker, Pygmy nuthatch
Large declining trees or recent snag - foraging	+ +	-	--	+	-	=	Hairy woodpecker, Pileated woodpecker' avian communities
Large snag - nesting	+ +	=	--	+ +	=	=	Primary cavity nesters; secondary cavity nesters
Large downed wood	+	+ +	+	=	+	+	Small mammals; carabid beetles
Abundant understory	+ +	+ +	+	+	=	=	Understory vegetation; microtine rodents; ungulates - summer
Snow interception and mosaic of forage thermal and security cover	--	--	-	+	+	=	Ungulates - winter