Pine Needle Cast

Yukon Forest Health — Forest insect and disease

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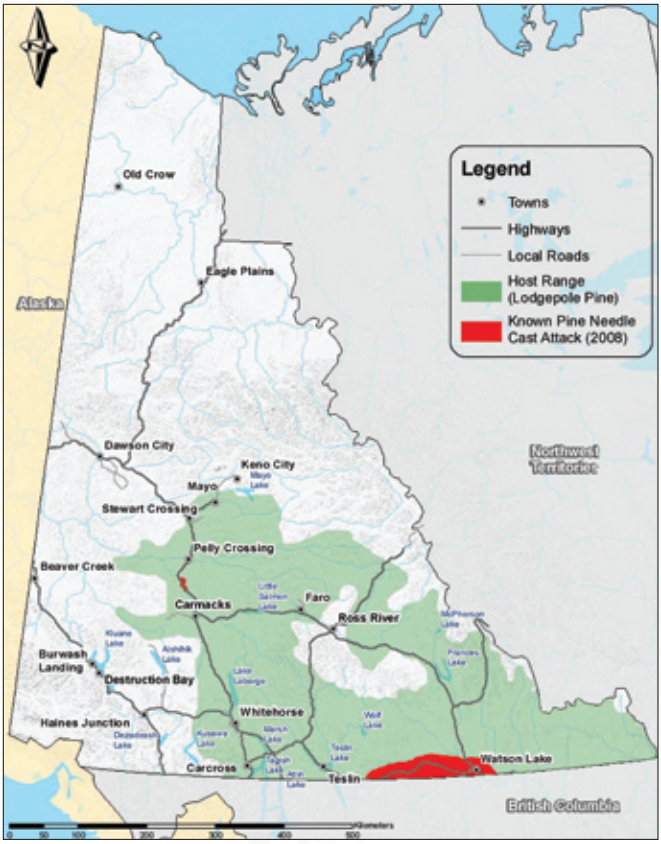
Yukon
Energy, Mines and Resources
Forest Management Branch

Introduction

Pine needle cast (*Lophodermella concolor*) is a fungal disease of two-needle pines. In Yukon, it occurs throughout the range of the host species, lodgepole pine (*Pinus contorta*). The disease is prevalent in the southeast and is increasingly common in central Yukon. In 2008, severe infections were found in young pine that regenerated following the Minto Fire. This was the northernmost incidence of the disease yet found in Yukon. Crown dieback, branch kill, defoliation and tree mortality (rarely) occur as a result of infection. Pine needle cast can infect all age classes of pine. Outbreaks of pine needle cast tend to be more severe following successive wet summers when conditions have been optimal for spore production, dispersal and infection.

Host Range for Pine Needle Cast



(Source data: Yukon Government Forest Inventory Data [2008] and U.S. Geological Survey [1999] Digital representation of "Atlas of United States Trees" by Elbert L. Little, Jr. (http://esp.cr.usgs.gov/data/little/)
Disclaimer: The data set for historic incidence is likely incomplete and only extends from 1994–2008. Endemic or outbreak populations may have occurred or may currently exist in non-mapped locations within the host range.

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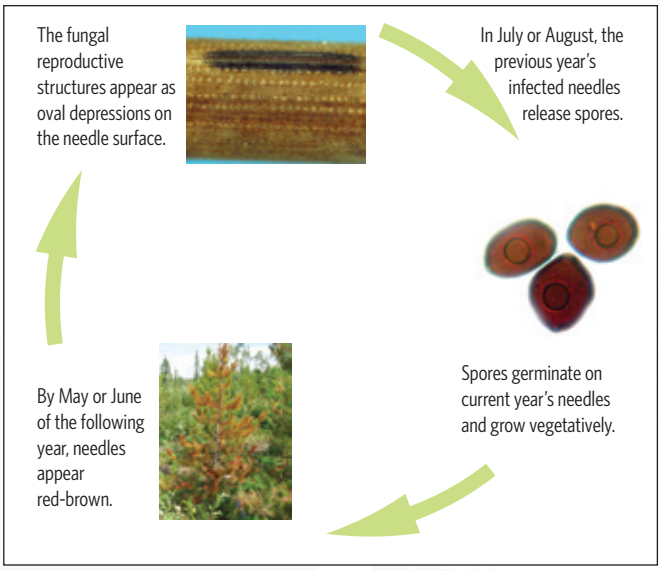
Disease Cycle



The disease cycle of the pine needle cast is completed in a single year:

1. In July or August, when relative humidity is high, the previous year's infected needles release spores. The air-borne spores are spread by rain splash and infect new host material (current year emerging needles). As a result, infections tend to be more severe when rain events coincide with spore release.
2. The spores germinate on the current year's needles and begin vegetative growth.
3. In May and June of the following year the mycelia have digested the contents of most of the needles and the needles will appear red-brown **(photo 3)**.
4. Later in the summer the needles turn a straw colour **(photo 2)**. The fungal reproductive structures (hysterothecia) are similarly coloured (concolrous) and appear as oval depressions in the surface of the needles.
5. The following summer, needles are cast by the infected tree and spores are released to renew the disease cycle.

Needle casts only infect the new foliage, which distinguishes them from blights.

Host Species Attacked and Damage

Tree species attacked in Yukon: Lodgepole pine is highly susceptible and the sole host species in Yukon. Trees of all ages are susceptible, but younger trees are more prone to mortality because the new foliage makes up a much larger proportion of the entire crown.

Late in the first year of infection, needle discolouration progresses from green to red and then to straw-coloured. These needles may appear in bunches at the branch tips. During successive years of severe infection, only the current year's foliage remains on the tree resulting in "lion's tailing" **(photo 1)**. When pine needle cast outbreaks are this severe, the entire stand is likely to exhibit the symptom **(photo 4)**.

The damage associated with pine needle cast includes reduced height and radial growth increment, and loss of overall tree vigour. Repeated severe infections can cause some mortality.

Definitive identification of *L. concolor* is only possible if samples are cultured in a laboratory. However, if the host tree has straw-coloured needles with concolourous, oval-shaped fruiting bodies, the most likely disease is *L. concolor.*

Photo number:

1. **Lions tailing.** Citation: Bob Erickson, Natural Resources Canada, Canadian Forest Service.
2. **Lions tailing and straw coloured needles.** Citation: Rod Garbutt, Canadian Forest Service.
3. **Needle damage (red).** Citation: Rod Garbutt, Canadian Forest Service.
4. **Lion's tailing.** Citation: Rod Garbutt, Canadian Forest Service.
5. **Fruiting bodies of H. pinicola.** Citation: Rod Garbutt, Canadian Forest Service.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Similar damage

Abiotic disturbance agents such as winter-kill, drought, roadside dieback and air pollution can cause similar foliage discolouration and needle drop. The absence of oval shaped depressions on the needle surface would distinguish these other forms of damage from that of pine needle cast.

In 1994, two similar needle diseases (blights) were observed in Yukon — *Phaeoseptoria contortae* and *Leptomelanconium cinereum*. Both blights cause similar tree and stand level symptoms to pine needle cast except that they infect needles of all ages (current and past year's growth). *L. cinereum* fruiting bodies are not concolourous and appear as spore masses on the needle surface. A secondary infection by *Hendersonia pinicola* is often seen in association with *L. concolor* and can be recognised by distinct black fruiting bodies **(photo 5)** in contrast to the concolorus fruiting bodies of *L. concolor.* Dothistroma needle blight (*Dothistroma pini*) has caused severe and widespread damage to pine plantations in the Cranberry and Nass River Valleys in British Columbia, and has recently been found as far north as the Hwy. 37 crossing of the Dease River. It is expected to reach Yukon as early as 2010. Being a blight, however, it attacks needles of all ages, so infections can easily be distinguished from those caused by *L. concolor.*

Risk Assessment

The following tables summarize the likelihood of occurrence and magnitude of impact of an outbreak at the stand level. These tables are a coarse guide for estimating the risk of an outbreak when populations are at endemic levels.

Likelihood of Occurrence

Stand Infection Hazard:	**High → Low**	
Current July/August relative humidity[1]	High	Low
Previous year's summer climate[2]	Wet	Dry

Notes:

1. There is a coincidental relationship between relative humidity and higher incidence of pine needle cast.
2. Years of successive wet summers would increase the likelihood of pine needle cast incidence. In years of dry weather, the pine needle cast is less successful in infesting new host material. Conversely, in wetter summers the pine needle cast is able to spread and infect new trees over a greater area.

Magnitude of Consequence

The magnitude of consequence is a subjective assessment of the potential consequences of an outbreak. This list is not exhaustive and is intended to stimulate thought on potential impacts to consider over time.

Value	Impact							
	-							+
Traditional Use[1]				■				
Comment:	No impact anticipated							
Visual Quality[2]				■				
Comment:	Discoloured needle period (-)							
Timber Productivity[3]				■				
Comment:	Young pine mortality (-)							
Wildfire Hazard[4]								
Comment:	No impact anticipated							
Public Safety[5]								
Comment:	No impact anticipated							
Hydrology[6]								
Comment:	No impact anticipated							
Time Scale (years)	20+	15	10	0-5	0-5	10	15	20+
Comment:	Impact refers to a predicted, substantial positive (+) or negative (-) impact on a value for an estimated time period							

Notes:

1. In this context, traditional use values considered are hunting, trapping and understory shrub/plant use. Pine needles are used as a material for basket weaving, thus a negative impact is anticipated.
2. Visual quality is negatively impacted in the year following infection until infected needles are shed.
3. Severe infection can result in mortality, more often in young pines due to their smaller crowns. Productivity in young plantations could be negatively impacted by reduced growth and/or mortality during the duration of the outbreak.
4. Given that pine needle cast only affects the current year's foliage and therefore generates very little fine fuel input, no impact is anticipated.
5. Given that pine needle cast outbreaks rarely cause mortality, no impact is anticipated.
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Implications of Climate Change

General Circulation Model (GCM) results in the 2007 Intergovernmental Panel on Climate Change (IPCC) report indicate that warming in northern Canada is likely to be greatest in winter (up to 10°C) and warmer by 3–5°C in summer. Mean annual precipitation is also predicted to increase (particularly in fall and winter). More rainfall is expected on windward slopes of the mountains in the west, therefore the rain shadow effect of the St. Elias Mountains may mean that southern Yukon does not experience increased rainfall. High temperatures will increase levels of evaporation and transpiration, and ultimately lower soil moisture levels. Therefore, even if summer rainfall is maintained at current average levels, higher temperatures would result in limited soil water availability and cause moisture stress in trees. Currently, climate scenarios suggest that Yukon will experience a warmer climate that will be wetter or drier in the future depending on the region.

Temperature and precipitation are likely to be the dominant drivers of change in pathogen abundance and tree responses as it influences pathogen development, dispersal, survival, distribution and abundance.

If the current trend of wetter/warmer summers continues, the incidence and severity of pine needle cast may increase. As with other pathogens, moisture is a critical factor for spore development, dispersal and infection. Increased precipitation during the summer months would mean more successful dispersal and infection of new host material. The opposite would be true if a warmer, drier trend continues because spore dispersal and germination would be less successful.

Management Options

Monitoring

Pine needle cast activity can be viewed from both aerial and ground surveys. Due to the limited extent of current disease levels, this disturbance agent is best monitored with annual ground surveys. The best time of year for monitoring is May or June when the foliage is in its red phase and the fruiting bodies are most conspicuous. For information about aerial surveys refer to BC aerial survey standards (MoF, 2000). For strategic planning information, refer to the Forest Management Branch risk-based monitoring strategy (Ott, 2009).

Direct Control

Other than sanitation of infected branches/needles or removal of host tree species through sanitation logging, there are few direct means for control of pine needle cast outbreaks in natural stands. In nurseries and on high value trees, fungicides have been successfully used to control or prevent fungal infections but their use should be limited as fungi can develop resistance.

Harvesting Considerations

Harvesting of lodgepole pine may occur either as a by-product of private/industrial land clearing or if a commercial forestry operation is undertaken. Spore transport on the logging equipment may contribute to the spread of the disease. Sanitation logging can be used as a potential control mechanism if the occurrence of pine needle cast is isolated. If implementing sanitation logging for pine needle cast control, then harvesting activities should occur in the late fall, winter or early spring (before spore release) and as much of the debris as possible should be destroyed on site during or shortly after harvest, to remove inoculum.

Silvicultural Considerations

Silvicultural considerations are relevant if a stand is being managed for commercial forestry or if an area is being replanted. Consider managing for increased stand biodiversity by utilizing a range of preferred and acceptable species for planting.

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