Yukon Forest Health Report

2003

Yukon
Energy, Mines and Resources
Forest Management

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BY Rod Garbutt

Executive Summary

The annual survey of forest pests in the Yukon was conducted in July 2003. **Attacks from the spruce bark beetle, *Dendroctonus rufipennis,* in southwest Yukon resulted in white spruce mortality on 41 641 ha, down from last year's 69 400 ha.** The most intensive activity is south of Mush Lake in Kluane National Park, and south of Dezadeash Lake as far as the B.C. border. Significant this year were expansions of infestations to the north along Talbot Arm on Kluane Lake and to the east from Dezadeash Lake toward Kusawa Lake. Current attack levels remained high, indicating that the infestation will continue undiminished in 2004.

Another objective this year was an intensive survey to determine the incidence of the root disease, *Inonotus tomentosus,* and the relationship, if any, between the root disease and the spruce bark beetle. In the Shakwak Trench in southwest Yukon, 815 white spruce trees were sampled in the permanent forest health assessment plots. Of these, 350 (43.3%) had at least one root that exhibited a pink stain, characteristic of the early stage of the disease. **There was almost no sign (<1% of trees) of the advanced stage of the disease in any of the plots and there was no significant difference between the incidence of stain in healthy and spruce beetle-killed trees.**

A similar though much less intensive root disease survey was done in stands adjacent to plantations in the LaBiche River area in the southeastern corner of the Territory. Incidence of stain (88%) was more than twice that of the Shakwak, but again the advanced stage of the disease was found in only 1% of the trees.

The two-year cycle spruce budworm, *Choristoneaura biennis*, appears poised to cause significant damage on white spruce between Beaver Creek in the north and the Alsek River corridor in the south. Significant bud feeding by the immature larvae was seen this summer. Next June when the larvae feed to maturity, the damage will be far greater. Though *C. biennis* has often been found in small numbers in the past on Yukon white spruce, this is the first recorded instance of a high population resulting in visible damage. Only trace levels of eastern spruce budworm, *Choristoneura fumiferana*, damage were seen in areas of chronic activity south of Watson Lake and in the LaBiche.

Other significant insect activity included the continued severe defoliation of alpine willows south of Dezadeash Lake by the Bruce spanworm, *Operopthera bruceata*, and the continued severe attack of aspen throughout the southern portion of the territory by the aspen serpentine leafminer *Phyllocnistis populiella*. The spanworm population appeared to have collapsed this summer, but the severe leafminer damage is expected to continue next year.

Introduction

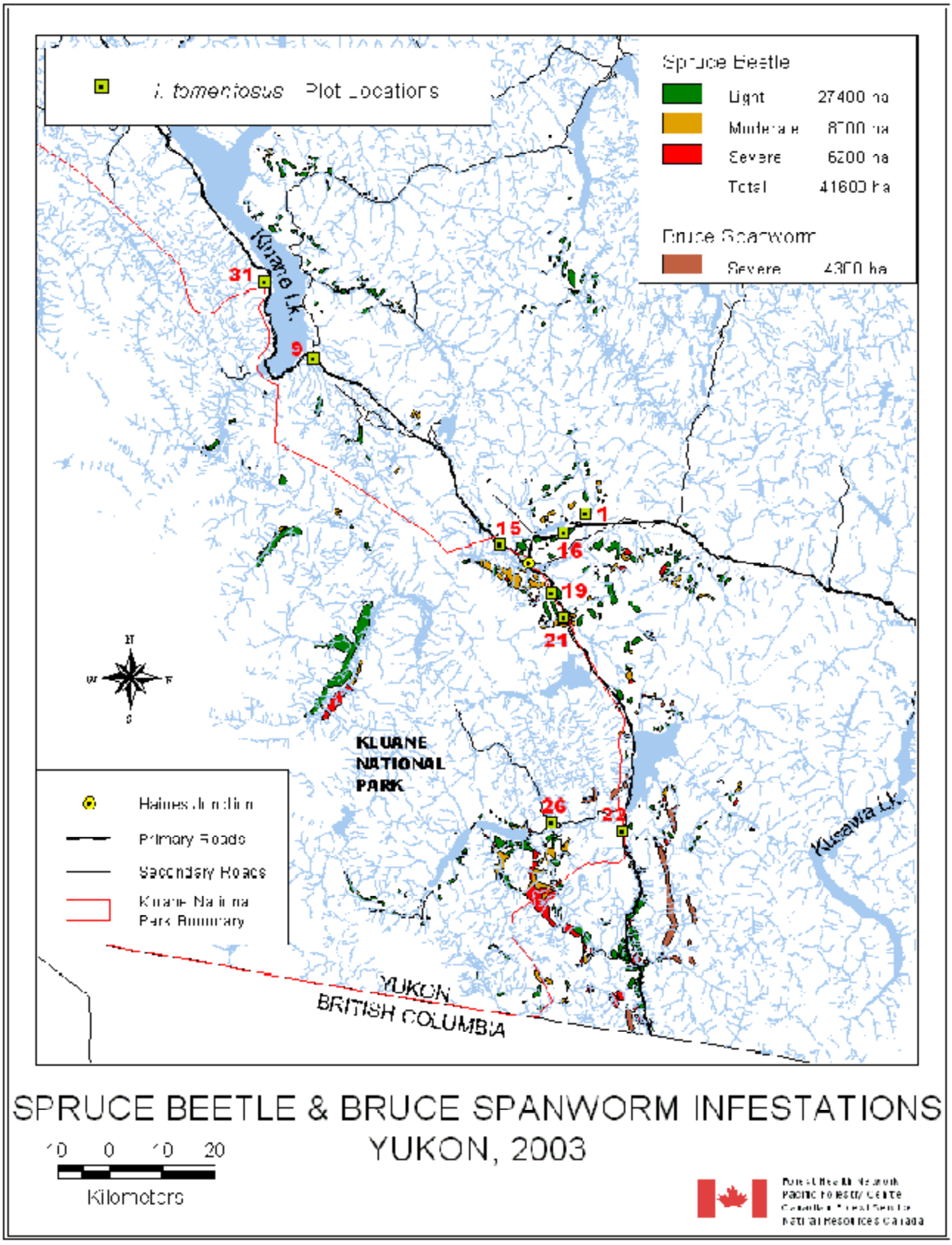
The annual Canadian Forest Service survey of Yukon forests was conducted between June 27th and July 30th 2003. The purpose of the annual survey is to identify and assess forest damage and damaging agents, including insects, diseases and climatic stress. Most of our field time this year was devoted to the ongoing analysis of a large epidemic of the spruce bark beetle, *Dendroctonus rufipennis* in the Shakwak Trench and Kluane National Park. The infestation has caused the death of over 300,000 ha of mature white spruce since it began in the early 1990s. This year, in addition to the annual assessment of the infestation, surveyors focused on the incidence of tomentosus root disease, *Inonotus tomentosus;* the primary root disease of northern white spruce. In 1995 an American root rot specialist, talking at a public meeting in Whitehorse, implicated tomentosus root disease as the primary cause of the spruce beetle infestation. Since then, the question as to the true role of the disease as a primary agent of stress has remained unanswered. Sections of multiple roots from over 800 trees in 9 stands from Kluane Lake to Klukshu were examined in an attempt to answer this question. The same methodology was applied to scattered stands of white spruce in the LaBiche region, in the extreme southeast of the Territory.

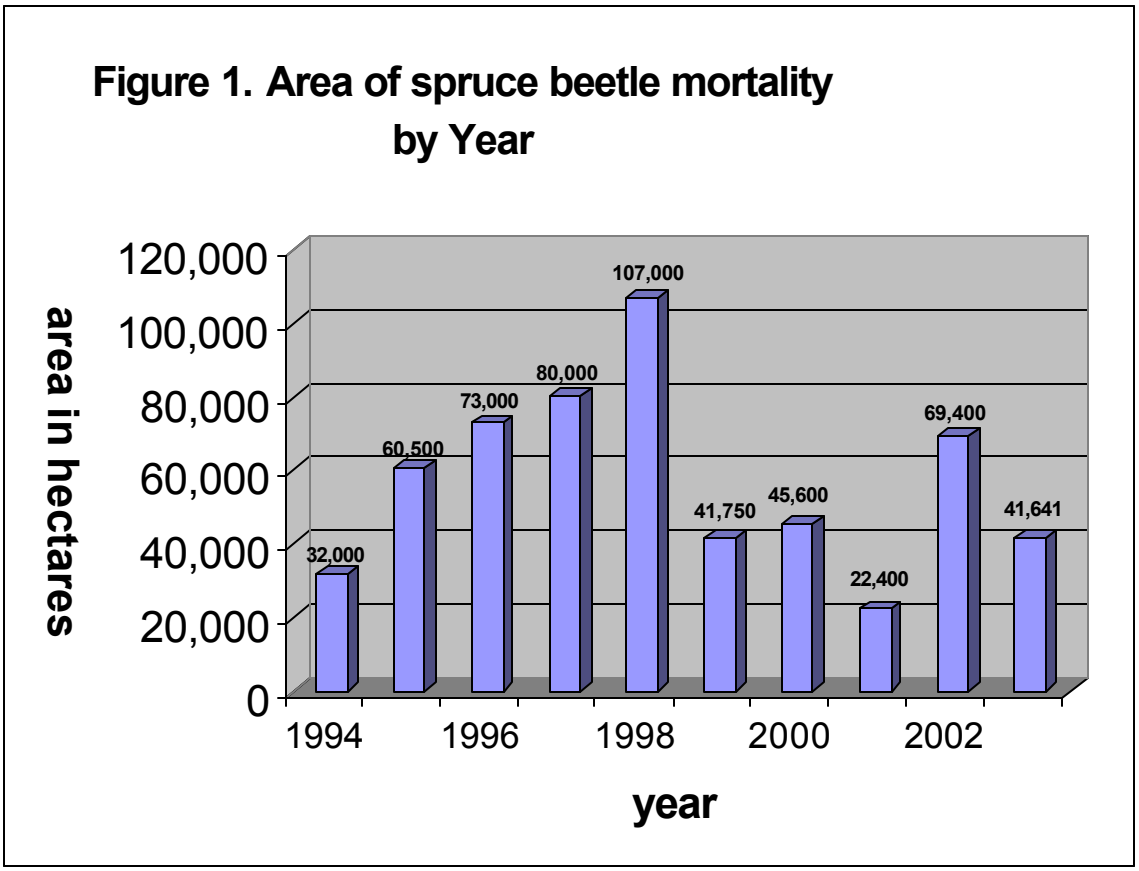
In addition to spruce beetle, other insect populations, most of which were seen also in 2002, continued to infest trees and shrubs, particularly in the southwest. Among these were the two-year cycle spruce budworm, *Choristoneura biennis,* and the eastern spruce budworm, *Choristoneura fumiferana,* in white spruce, the Bruce spanworm, *Operopthera bruceata,* in alpine willow, and the aspen serpentine leafminer, *Phyllocnistis populiella*, in trembling aspen.

Spruce beetle, *Dendroctonus rufipennis*

The area of recent white spruce mortality declined to **41 600** ha (27 400 ha of light[1] , 8000 ha of moderate and 6200 ha of severe) from the more than 69 000 ha mapped in 2002. The mortality mapped (Map 1) this year resulted from spruce beetle attacks in June, 2002. Though the general pattern of infestation was similar to last year, there were significant changes in the local extent and severity of mapped polygons. Similar to last year the most intense activity was mapped southeast of Mush Lake on the southwest side of the valley formed by Fraser Creek, from Klukshu south to the B.C border and along the upper Tatshenshini and lower Takhanne rivers.

[1] Light: 10% or less of stand killed the previous year; moderate: 10 – 30% of stand killed the previous year; severe: 30%+ of stand killed the previous year.


I. tomentosus Plot Locations
Spruce Beetle
Light 27400 ha
Moderate 8700 ha
Severe 6200 ha
Total 41600 ha
Bruce Spanworm
Severe 4300 ha
Kluane L.
31
9
1
15
16
19
21
26
22
KLUANE
NATIONAL
PARK
Kusawa L.
Haines Junction
Primary Roads
Secondary Roads
Kluane National
Park Boundary
YUKON
BRITISH COLUMBIA
SPRUCE BEETLE & BRUCE SPANWORM INFESTATIONS
YUKON, 2003
0 0 20
Kilometers



In the late 1980s and through the1990s, consistently warmer spring temperatures imposed drought stress on white spruce stands throughout the Shakwak Trench and the Alsek River drainage within Kluane National Park, and predisposed the trees to attack from the spruce beetle. The infestation was first seen and mapped in 1994 when it was already 32 000 ha in size. The area of annual mortality increased steadily through 1998 when 88 000 ha was mapped, and then steadily declined to 22 000 in 2001 (Figure 1). The drought was finally broken in 2000 and 2001 with cooler temperatures and higher than average rainfall during the growing season.

Following two successive cool wet years, the already declining population of spruce beetle was expected to collapse as the trees re-hydrated and regained their capacity to produce resins and successfully repel beetle attacks. Indeed, in 2001 pitch-outs (attacks repelled by the tree) were seen for the first time since the mid 1990s. The recent increase in tree mortality, however, suggests that the re-hydrated trees that were successfully attacked, provided a better environment for developing beetle broods, and thereby enhancing brood production and survival. The broods were so successful that, in 2002, the area of recent mortality tripled to 69 000 ha. In 2003 the area of mortality dropped back to 41 600 ha. The 27 600 ha reduction between 2002 and 2003 cannot, however, by itself, be taken as a measure of the infestation. Mapped area represents population distribution, but the size of the population is represented by mapped severity. Small remnant populations continued to kill scattered remaining mature trees in both the Alsek

River Valley and the Shakwak Trench in stands that the infestation swept through as many as six or seven years ago. Many of these stands, especially those from Haines Junction south to Dezadeash Lake, were mapped as light attack in 2002. Red trees were again present in these stands this year, but were few and scattered, and therefore not recorded as polygons on aerial survey maps. This accounts for much of the decline in mapped area. While the infested area declined, the average intensity of the mapped polygons increased. A much higher proportion of this year's mortality was mapped as moderate or severe.

Figure 2: Spruce bark beetle infested tree.

The Spruce Bark Beetle Scene in 2003

The annual aerial survey was conducted in late July using a Cessna 205 fixed wing aircraft. The purpose of the survey was to map the extent and severity of beetle attacks within the stands of white spruce, and to map any other symptomatic damage visible from the air.

Starting in the north, a number of small polygons containing light mortality were again mapped in the West Aishihik River Valley in the vicinity of Bear Lake. There was no significant increase in either the size or intensity of infestations. From here the aerial survey proceeded north into the Nisling River as far as Dwarf Birch Creek. No spruce beetle activity was seen in this drainage. West of here a significant expansion of beetle activity occurred up the Talbot Arm of Kluane Lake. Numerous polygons of light mortality were mapped along Raft Creek, and on both sides of the Arm south to Gladstone Creek. These polygons represented over 1000 ha of new activity and will be closely monitored as the beetle population could continue to migrate north into stands in Talbot Creek and beyond to the Nisling River.

Farther south mostly light mortality with some localized areas of moderate were again mapped along Gladstone Creek and above the east shore of Kluane Lake. In the Cultus Creek drainage mortality was more widespread but the intensity of attacks had diminished significantly. Scattered patches of light mortality re-emerged in stands near Sulfur Lake, upper Silver Creek and Telluride Creek in stands first attacked in the mid 1990s.

Within Kluane National Park, from north to south, small patches of light were mapped for the first time in the Slims River drainage, near the mouth of Canada Creek, and along Vulcan Creek. In the Kaskawush drainage small light patches were mapped across from the toe of the Kaskawulsh Glacier, near the mouth of Lost Cache Creek, and near the mouth of the Jarvis River. Across the Valley large light patches were seen in Disappointment Creek and in the Dusty River, over an area similar to last year. Farther south in the Alsek drainage, scattered reds still occurred within the sea of grey, from the Kaskawulsh River, south, almost to the Lowell Glacier and to the east to Kathleen Lake. Tree mortality was too light to map. Similar to last year, the largest and most severe patches of mortality were seen on three sides of Mush Lake, with concentrations above the north lakeshore, to the south on both sides of Mush Creek, and to the east near lower Sickle Creek and the upper Fraser Creek Basin. The largest most intensive infestations, totalling nearly 3000 ha of severe mortality and 1000 ha of moderate, occurred southwest of Fraser Creek, from Esker Creek continuously to the southeast into the Kane Creek drainage, and from there to the Tatshenshini River. Farther down the Tatshenshini small moderate patches were seen along Squaw and Silver creeks, and up the Bridge River to beyond Onion Lake. Small patches of mostly light mortality were mapped south and west of Bates Lake; a significant reduction from the large patches of light and moderate mapped in 2002.

In the Shakwak Trench near Haines Junction both light and moderate patches were mapped north and south of Paint Mountain along both sides of Marshall Creek and between Pine Lake and the town. Similar to last year large patches of moderate and some severe mortality, totalling over 1000 ha, occurred in stands on the north and east slopes of the Auriol Range immediately south and west of town. Also similar to 2002, numerous active infestations of varying intensity were scattered along the lower slopes of the Dezadeash Range from Granite Creek clockwise as far east as Van Bibber Creek.

The most significant reduction in mortality was in the Kathleen River and Quill Creek areas. Though remaining populations still caused light to moderate mortality the mapped area was reduced by approximately 70%. Numerous small infestations were scattered on the north and west side of Dezadeash Lake at levels similar to last year but the potential remains for continued movement to the northeast down the Dezadeash River Valley. For the first time patches of light and moderate mortality were mapped on the east side of the Lake south of the Kluhini River. This trend continued to the south and east where new small patches of recent mortality were mapped from the south end of Dezadeash Lake east into the headwaters of Frederick Creek and north to beyond Frederick Lake. This means that, for the first time active beetle populations are poised on the edge of the Kusawa Lake drainage.

From Klukshu south to the B.C. border the infested area was similar to 2002, though it had intensified. Numerous patches of severe were mapped near the confluence of the Takhanne and Tatshenshini rivers, and across the Valley to the southwest on either side of Pirate Creek.

Overall, the aerial survey indicated that, in 2003, a large healthy population of beetles was continuing to kill remaining trees within previously infested stands, while, at the same time, continuing to move into new areas of host opportunity. The most important of these new areas were on the east side and northeast end of Dezadeash Lake, and along the Talbot Arm of Kluane Lake. Both of these areas represent significant future spread potential.

The Future

One of the objectives of the 2003 forest health survey was to determine if there was a relationship between the spruce bark beetle and root disease, *Inonotus tomentosu*. The occurrence of root disease and spruce bark beetle attack status of 815 trees was recorded within 9 of the 27 Forest Health assessment plots (Table 1). In these stands, current attack levels of the spruce bark beetle were four times (12% vs 3%) higher than in 2002. This was almost the same ratio as was determined from 12 plots in 2002. Though the increased spruce bark beetle activity was not reflected in overall area mapped this year, the continued intensification **is** seen in the tripling of the areas of "severe" infestation (Map 1).

With the exception of Dezadeash Lake, Mush Road and Congdon Creek the Forest Health plots were located in areas of prolonged infestation, with no current intense beetle activity. The three excepted stands contained few grey trees, indicating a recent invasion by beetles. The Dezadeash Plot, with 15% current attack and 4% red (2002 attack), is on the northern flank of the intense activity south of Klukshu. The Mush Road Plot is located only about five kilometers east of the edge of the most intense current beetle activity anywhere. Both the Mush Road and Dezadeash plots are located in stands that were heavily damaged by an outbreak of spruce beetle in the1940s. The patches of

Table 1. White spruce tree condition within *Inonotus tomentosus* plots

			Tree Condition					
Plot	Location	No. trees	Healthy %	Current [1] %	Red [1] %	Grey [1] %	Partial/ pitch-out [1] %	Dead % other causes
1	Marshall Cr.	128	23	38	0	20	0	19
9	Silver Cr.	75	77	1	7	12	3	0
15	Pine Lake	70	42	14	1	24	7	10
16	Macintosh south	125	66	5	0	25	2	3
19	7.5 km -S- of H.J.	81	49	10	0	15	2	23
21	Quill Cr	92	39	14	7	22	8	10
22	Dezadeash Lk	96	39	15	4	6	18	19
26	Mush Road	69	58	7	6	10	4	14
31	Congdon Cr.	79	53	6	2	1	2	4
	average	**91**	**53**	**12**	**3**	**15**	**5**	**11**

[1] Current: killed by spruce beetle in 2003
Red: killed by spruce beetle in 2002
Grey: killed by spruce beetle prior to 2002
Partial/pitch-out: attacked by spruce beetle but not killed

spruce here are interspersed with larger aspen stands which were less attractive to the beetle. Increment cores from these stands were sent to Alaskan ecologist Dr. Ed Berg who has studied the chronology of prior outbreaks in the Yukon and Alaska. His analysis found that the trees currently under attack were released from the understory following the earlier infestation. The entire study can be viewed at: http://alaska.fws.gov/nwr0/kenai/biology/index.html

White spruce stands on the southwest side of Kluane Lake have, since the mid 1990s, have received beetles blown in by strong southerly winds from remote infestations. Throughout this time tree mortality was limited to the shoreline campsite area at Congdon Creek and it remains the only spot where the beetle populations have survived on the west side of the Lake. Though small populations have briefly taken hold in the campsite and killed many of the mature spruce, brood survival has been poor, probably due to the dryness of the site.

The 38% current attack in the Marshall Creek plot was surprising because the most intense beetle activity occurred in that area more than five years ago. This resurgence however, is consistent with the general resurgence of spruce beetle populations in the last few years.

Recent climatic conditions again favour beetle survival and development. Given a continuation of these conditions and escalating fresh attacks mortality is expected to continue at a similar or higher intensity within selected areas of the infested perimeter, coupled with a slow outward expansion. The areas of greatest concern for expansion have changed somewhat this year to focus on the northward movement of beetles along Talbot Arm and the movement eastward from Dezadeash Lake toward Kusawa Lake. Areas of previous focus, including the West Aishihik Valley and the Dezadeash River Valley east of Haines Junction, will continue to be closely monitored as well.

Tomentosus Root Disease, *Inonotus tomentosus*

Shakwak Trench

Surveys of the 27 forest health plots established between 2000 and 2003 have provided baseline data on many aspects of stand structure and vegetation associations. Missing, however, was information on the influence of root disease on stand health and composition. The role that root disease played in the predisposition of spruce trees to attack by spruce beetle was first made prominent in a talk given in Whitehorse in 1995 by retired Idaho mycologist and root disease specialist Dr. Art Partridge. He declared the spruce beetle epidemic to be essentially a root rot problem. In all of the years of Forest Insect and Disease (FIDS) surveys throughout the Yukon and subsequent work in spruce beetle infested stands, *I. tomentosus* had frequently been found in association with individual windfallen trees, but there had been no evidence of an epidemic of the proportions suggested. A study was done in 2001 to examine the relationship between spruce beetle and tomentosus root disease in north-central British Columbia (Lewis J.K. and Lindgren B. S, 2002). The results indicated that tomentosus had a role in maintaining

endemic (low) populations of spruce beetle, but at epidemic (high) levels no relationship could be found. Nevertheless, the role, if any, that root disease played in pre-disposing the white spruce to beetle attack in the southwest Yukon remained unknown. Determining this incidence of *I. tomentosus* in these beetle-affected stands is a first step in understanding beetle/root disease dynamics in the Yukon, and determining the potential impact of root disease on spruce regeneration.

To aid in identifying the disease and developing the methodology Teresa White of Cedrus Consulting, Smithers, B.C. was contracted for the first day of the survey. Ms White has extensive experience planning and executing *I. tomentosus* surveys both in B.C. and the Yukon. She completed the prior tomentosus root disease survey in the area in 1999. Ms White was contracted by DIAND to do a stump-top survey in a recent clear-cut at Marshall Creek. The results at that time indicated a 2.2% incidence of advanced decay in the fresh stumps.

The 2003 root disease study plots were established adjacent to 9 of the 27 Forest Health Assessment (FHA) plots (Map 1). Selected plots included the driest (Plot 31: Congdon Creek and Plot 9: Silver City) at the north end of the study area, and the wettest (Plot 22: Dezadeash Lake and Plot 26: Mush Road) at the south end. The other five plots represented a gradient of moisture regimes. At each of the nine plots, three circular sub-plots were established as root disease study plots. To avoid disturbance to the FHA plots, the root disease sub-plots were offset 25 meters from the FHA plot transects. Plot diameters were adjusted to include an average of 90 trees per plot.

In all, 2851 roots were sectioned on 815 trees (an average of 3.52 roots/tree). Cross-sections of roots were examined for the presence of a pink stain or advanced white-pitted rot; characteristic of the incipient and advanced stages of the disease respectively. Until the presence of *I. tomentosus* in the stained samples has been confirmed by laboratory culture, they are classed as "the suspected incipient stage" of the disease. Root sections that exhibited the pink stain were collected and removed to the Pacific Forestry Centre. Fungi that are being cultured from the stained root samples will be analyzed using a DNA-specific probe developed at the Laurentian Forestry Centre in St. Foy, Quebec (Germain. et. al. 2002). The probe recognizes DNA that is unique to *I. tomentosus*.

Field examination determined that 350 (43.3%) of the trees had at least one root that was either stained or decayed, though only 7 (0.9%) trees had advanced decay in one or more roots. In an additional 46.8% of the roots there was no visible stain in any of the examined roots. All sampled roots in the remaining 9% of the trees were decayed by a disease other than *I. tomentosus*. Most of this decay was in the form of a brown crumbly rot, probably the common slash destroying fungus *Fomitopsis pinicola* (though no fruiting bodies were seen). All of these trees had been dead for a number of years; killed by spruce beetle or other undetermined agents.

Although conclusions regarding the incidence of *I. tomentosus* would be pre-mature prior to the results of culture, it is possible at this stage to conclude two things about the

disease in the western Yukon. First, regardless of the prevalence of the incipient stage (stain) of the disease, the advanced (rot) stage is rare (0.9% of trees) in these stands. Second, and following from the first, of the over 220 plot trees that had been dead for more than two years (killed by spruce beetle or by other means), only four had the advanced rot characteristic of *I. tomentosus*. The roots of more than 10 times that number had been decayed by other fungi. This suggests that, unlike some of the other important root diseases like *Armillaria ostoyae* or *Phellinus weirii*, *I. tomentosus* is quickly overtaken by more aggressive secondary fungi following the death of the tree. The importance of this will be realized in the future as stand dominance passes from the dead overstory to the succeeding understory spruce. If the disease cannot survive in the roots as a saprophyte it cannot infect the young trees as they grow and make root contact with the dead trees.

It is possible at this time to make only tentative conclusions about the impact of the suspected incipient stage of the disease. The incidence of stain (41.5%) in healthy (unattacked) trees was not significantly different ($X^2_{.05}$)[1] from the average incidence of stain (47.8%) in the spruce beetle-killed trees (Table 2). We can conclude therefore that the stress placed on the trees from the suspected incipient stage of the root disease is below the threshold that would render them significantly more attractive to attack by the spruce beetle. We do not know, however, what influence the stress induced by the ongoing drought may have had in pre-disposing the white spruce to infection by *I. tomentosus*. The incidence of infection may be significantly higher now than it was 15 or 20 years ago.

Figure 2: Example of pink stain in white spruce roots.

[2] $X^2_{.05}$ = 2.58 well below the 3.84 required for significance

LaBiche River

I had an opportunity to conduct a similar though less extensive assessment of the incidence of *I. tomentosus* during a three-day visit to the LaBiche River area in the extreme southeast of the Territory in late July. While YTG silviculturists Deb Wortley and Don White assessed the condition of plantations they had established during the 1990s, I sampled the roots of selected typical mature white spruce near the perimeter of the clearcuts for the presence of characteristic stain/rot. Nine sites were sampled. A total of 98 roots were sectioned on 33 trees. Stain was found on at least one root on 29 (88%) of the trees. Advanced decay, symptomatic of *I. tomentosus,* was found on only one of the 98 roots.

The incidence of stain in roots of the LaBiche spruce was more than twice that found in the Shakwak (88% vs 42.4%), and was reminiscent of stands around Prince George B.C. (from probes done in the mid 1980s). However, the incidence of advanced decay was again very low (1%), almost identical to the Shakwak.

The LaBiche area is far wetter than the Shakwak Trench. Within the Shakwak the incidence of stain was higher in the wetter south around Dezadeash (69%) than in the dry north near Kluane Lake (20%). There appears, therefore, to be a direct relationship between soil moisture and the incidence of stain.

Table 2. Incidence of root staining related to spruce beetle activity in the southwest Yukon

			Spruce Beetle Attack Categories								Dead	
	Healthy		Current[1]		Red[1]		Grey[1]		Partial[1]		Other Causes	
Plot #	# trees	# stain	# trees	# stain	# trees	# stain	# trees	# stain	# trees	# stain	# trees	# stain
1	29	12	49	28	0	0	26	8	0	0	24	7
9	59	11	1	0	5	0	9	2	4	0	0	0
15	83	15	6	4	0	0	31	9	3	1	4	0
16	25	12	10	5	1	0	17	11	5	2	7	2
19	40	29	8	2	0	0	12	7	2	1	19	8
21	36	11	13	4	7	3	20	7	7	10	9	0
22	37	34	14	11	4	2	6	1	19	16	18	2
26	40	31	5	4	4	4	15	5	3	3	11	8
31	65	17	5	1	2	0	1	0	2	0	3	0
totals	414	172	111	59	23	9	137	50	45	33	95	27
% stain[2]		41.5%		53.1%		39.1%		36.5%		73.3%		28%
			average percent stain for attacked trees: 47.8%									
								53.3%[3]				81%[3]

[1] Current: killed by spruce beetle in 2003
Red: killed by spruce beetle in 2002
Grey: killed by spruce beetle prior to 2002
Partial: attacked by spruce beetle but not killed

[2] includes seven trees (0.9%) with advanced decay symptomatic of *I. tomentosus*

[3] including advanced rot (not *I. tomentosus*)

Two-year cycle spruce budworm, *Choristoneura biennis*

In July 2002 a significant number of budworm moths were seen in the Kaskawulsh River Valley, and farther north at Congdon Creek on the west side of Kluane Lake. These moths were in the process of laying eggs on the spruce needles. The eggs hatched in August and shortly thereafter the small second (of six larval instar growth stages) larvae spun a silken hibernacula where they spent the winter. The larvae emerged in the spring of 2003 bored into the swelling spruce buds and commenced feeding. This was the first of the two years required for this budworm to reach maturity, and the larvae remained small, feeding exclusively on the buds and newly flushed spruce needles. In July bud damage was evident on all spruce from the U.S. border at Beaver Creek to the south end of Kluane Lake. From Beaver Creek south to Koidern roughly 20% of buds were damaged by larval feeding but from Pine Valley to the south end of Kluane Lake between 60% and 80% of buds were damaged. Only scattered low instances of bud damage were seen along the Alcan Highway between Kluane Lake and Haines Junction. The Kaskawulsh River Valley was not visited this year, but budworm moths were seen here in 2002. Similar levels of damage likely occurred here and in the Slims River Valley that links the two areas.

In August the larvae, now in their fourth instar, once again spun over-wintering hibernacula. In 2004 the larvae will emerge once again and commence feeding on the current growth. In their final two instars, before they pupate in mid to late June, the larvae will feed voraciously. If the population is close to 2003 levels the current needles will be quickly consumed, and the larvae will then to feed on older needles.

The damage in July 2002 indicates a significant outbreak over a very large area. If the resultant damage is severe enough to cause a visible colour change in the crowns, it will be mapped from the air in late July 2004.

Though the infestation is important for its damage potential more significantly it is the first time a large population of *C. biennis* has ever been detected in the Yukon; yet another effect of a climate that has become more favorable to the survival and proliferation of a former severely restricted insect.

Eastern spruce budworm, *Choristoneura fumiferana*

The eastern spruce budworm is a chronic defoliator of white spruce in the Liard River corridor near Watson Lake, and in the LaBiche River area adjacent to the B.C./ Northwest Territories border. This year, in both areas, defoliation was significantly reduced. Only trace to very light defoliation was seen in the Watson Lake area and along tributaries to the Liard River at the Contact Creek and Irons Creek crossings. Damage that was seen for the first time last year along Highway 37 in the Blue River corridor, just south of the B.C./Yukon border, did not recur. During helicopter overflights of the LaBiche/Liard in the extreme southeast of the Territory only patchy light defoliation was seen on the lower southern slopes of Mt. Martin. Elsewhere only trace levels were visible.

In the LaBiche area the chronic variable levels of defoliation have taken their toll on the white spruce. Throughout the area, dead standing trees attest to the long-term effects of repeated defoliation events. An equal number of trees retain tufts of foliage and will likely join the ranks of the snags following one or two more years of significant defoliation. A scan of 300 mature and semi-mature white spruce on the horizon around the camp at Devon Energy's Kotaneelee gas plant, revealed 50 trees dead, 55 trees with top kill and approximately 100 with tufted foliage. Though the affects here were more severe than almost anywhere, possibly due to periodic off-gassing from the plant, the symptoms in the top killed and tufted trees were consistent with the symptoms of chronic budworm damage seen elsewhere.

Western balsam bark beetle, disease complex, *Dryocoetes confusus*, *Ceratocystis dryocoetidis*

This beetle and its associated sap-stain fungus, attacks and kills mature and semi-mature alpine fir. In the last 20 years the beetle's range has extended steadily northward through Dease Lake and across the 60th parallel into the Yukon, and it is now causing mortality to the full northern limit of the host range. In the last approximately seven years it has killed many alpine fir in the LaBiche River area, and along the Windy Arm of Tagish Lake, south of Carcross. This year during helicopter flights in the LaBiche, damage on the slopes of Mt. Martin appeared similar to that seen four years ago. The foliage of approximately 1% of the trees was the characteristic brick-red colour typical of trees killed the previous year by the beetle.

Balsam bark beetle populations rarely get large enough to cause rapid landscape level damage. The beetle generally kills single or small groups of trees, with damage appearing from the air as scattered red spots on the landscape. Though the damage occurs over a protracted period, the results are ultimately the same: the loss of the alpine fir component from the mature overstory. In the Yukon, alpine fir is generally mixed in varying proportions with white spruce. The alpine fir component increases with elevation, and it is in the high elevation stands that the damage is most apparent.

This insect is widespread and common throughout the range of trembling aspen in western North America. In the Yukon populations have been epidemic in the Mayo-McQuesten area since the early 1990s, infesting up to 100% of the leaves on all trees. In the past four years populations have increased dramatically in the Dawson City area and in the Shakwak Valley causing similar levels of damage. Infestations of lesser intensity have also occurred throughout the remainder of the southern Yukon.

Figure 3: Aspen serpentine leafminer

The adults are non-descript tiny moths that are noticeable only when they appear in great numbers in mid-May. Eggs are laid singly on the edges of the newly-flushed aspen leaves. When the eggs hatch the larvae commence to mine the interior of the leaf following a serpentine passage until they mature. At this stage, all that is left is the silvery translucent top and bottom epidermis. In areas of intense feeding entire stands take on this silver appearance.

The insect capable of causing growth loss and will occasionally kill trees (Furniss, R.L. and Carolyn, V.M., 1977). In the areas of long-term infestation in Yukon, however, the trees appear to have, as yet, suffered little damage.

Bruce spanworm, *Operopthera bruceata*

Severe defoliation in the alpine willows south of Dezadeash Lake was first reported last year. In the early spring of 2003, Deb Wortley and Don White of (then) DIAND Forest Resources, sent soil and litter samples containing pupae. The pupae were identified as Bruce spanworm. The Bruce spanworm is a common defoliator of willow and aspen in the north, but damage of this magnitude has not before been reported north of 60. The area of severe defoliation mapped from the air within the Yukon this year was 4390 ha (Map 1), in 11 separate infestations south of Dezadeash Lake; only about half of the area reported last year. The main body of the infestation and most of the damage had shifted south into B.C., extending to the headwaters of the Tatshenshini River. With B.C. included, the actual infested area was greater than last year.

Though the feeding often resulted in the complete stripping of the willow thickets, little (<10%) mortality was observed among the individual shrubs, and the willows will probably quickly regain their vigour following the collapse of the insect population. This

collapse appeared to have already occurred prior to July 14 when Kluane National Park Ecologist David Henry and I probed four of the damaged sites adjacent to the Haines Road. A few pre-pupal larvae were found on the foliage, but no pupae were seen in the leaf litter. It is normal for these infestations to subside after two years. The parasitised pupae found earlier likely represented the mechanism of the collapse.

Ambermarked birch leafminer, *Profenusa thomsoni*

In the mid 1980s this introduced leafminer was found for the first time in British Columbia on native white birch in the City of Prince George. Since that time it has expanded its range in two ways; naturally outward from infestation centers through the flight of adult moths, and artificially through the movement of infested ornamentals. The second means has resulted in the leafminer now being found in almost every urban area where ornamental birch has been planted. Whitehorse is no exception. A survey for the incidence of *P. thomsoni* and a related introduced species *Fenusa dohrnii* that attacks alder spp. was conducted throughout the Territory in September 2003, by Dr. David Langor from the CFS's Northern Forestry Centre in Edmonton. Dr. Langor found *P. thomsoni* was "abundant throughout most of Whitehorse and common in the southwestern part of Dawson City" (unpublished report). There was a minor incidence in Watson Lake but otherwise the insect was absent elsewhere in the Territory. In Whitehorse, where native birch is absent, all infestations were on ornamentals. Native white birch is common, however, in Dawson City and Watson Lake. No *F. dohrnii* was found anywhere in the Yukon.

P. thomsoni was introduced to North America from Europe and is therefore not subject to control from the natural enemies of its native environment. Because of this, infestations in North America tend to be chronic and populations fluctuate in response to environmental conditions rather than pressure from parasites, predators and disease. Chronically infested trees suffer, no doubt, a loss of growth potential, and some dieback may occur with time, but mortality is uncommon.

Mountain pine beetle, *Dendroctonus ponderosae*

Mountain pine beetles are killing lodgepole pine in central B.C. at a rate unprecedented in recorded history. At the same time, because of a moderating climate, the beetle's range has been steadily moving northward. One of the main avenues of expansion is the Rocky Mountain Trench. In northern B.C. the trench includes Williston Lake, the Findlay River and the Kechika River, ultimately entering the Yukon via the Liard River Valley. This year for the first time a series of mountain pine beetle baits were set out at numerous locations along the Alcan Highway to detect local populations in stands of mature pine. Two baits we**re set out in stands between Liard River and Watson Lake and a third at Upper Liard. Four more were hung along Hwy 37 from the Yukon border south to Cassiar. No** mountain pine beetles were attracted to the baited trees**. This year's results will serve as a baseline for future trap studies at the same sites.**

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