TITLE: Alder (*Alnus tenuifolia*) Mortality Agent Complex Effects on Riparian Zone Habitat

LOCATION: South-central Alaska

DURATION: Year 1 of 2-year project **FUNDING SOURCE:** Base

PROJECT LEADER: Dr. James Kruse, Entomologist, USDA Forest Service, State & Private Forestry, Forest Health Protection, Fairbanks, Alaska.

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PROJECT OBJECTIVES: This project will serve to investigate alder dieback in riparian areas in south-central Alaska previously identified via aerial survey; (1) identify the extent to which non-native sawflies contribute directly to alder dieback; (2) identify the extent to which alder canker contributes directly to alder dieback; (3) identify the extent to which non-native sawflies and canker may synergize to cause alder dieback; (4) attempt to identify whether non-native sawflies may serve as infection court facilitators or otherwise predispose alder to pathogens. Ultimately, this work will help determine whether there is a correlation between alder sawflies and alder pathogens, and help determine the necessity for chemical or biological control of non-native sawflies to protect riparian alder forests and salmon spawning streams.

JUSTIFICATION: Large scale mortality of alder in riparian areas creates the potential for deep-seated changes in these ecosystems. There are multiple impacts that can be directly related to the loss of alder as the dominant species in early and mid-successional riparian areas, including but not limited to: decreased aesthetic value, fundamental and irreversible changes in long-term nutrient cycling and forest productivity, reduced allochthanous inputs to rivers and streams, and a shift in prey abundance and quality in salmonid breeding areas. South-central Alaska is the most heavily populated area of the state, and receives a large tourist influx each summer. Large scale defoliation and mortality of riparian alders will likely reduce the desirability of Alaskan rivers as recreation destinations. Alder is also a symbiotic nitrogen-fixer, allowing it to thrive in low nutrient soil. The long-term productivity of Alaskan riparian forests is directly related to the large amounts of nitrogen fixed and deposited in the soil during the alder dominated stages of succession. In addition, because the streams and rivers of south-central Alaska are a critical resource for salmon reproduction, the Cook Inlet and Prince William Sound fisheries are, in part, dependent on the breeding habitat found in these waters. Finally little is known about how fast the non-native sawfly *Monsoma pulveratum* will spread, how readily it will acclimate to other habitats in Alaska and along the Pacific Northwest coast, or alder canker distribution in Alaska.

This proposed project addresses the following selection criteria:

1) Linkage to Forest Health Monitoring (FHM) survey and plot data—this project was identified by utilizing FHM Detection Monitoring data;
2) Significance of geographic scale—non-native sawflies and alder canker threaten the state-wide distribution of thin-leaf alder in Alaska;
3) Biological impact—information gathered from this project will aid in the determination of the need for biological control of non-native sawflies in Alaska. Defoliation and mortality of riparian

alders may have a cascading effect in associated terrestrial and aquatic ecosystems;

4) Feasibility of the project—this project can be successfully completed;
5) This project addresses five of the Evaluation Monitoring priority issues, including:
   - Climate Change – at least one of the suspected mortality agents was likely introduced from eastern Canada or Europe through an Arctic Ocean shipping lane that will receive increasing amounts of traffic as the arctic continues to warm.
   - Validating or filling data gaps in insect & disease risk model – This project will provide information that will help complete alder risk models.
   - Tree mortality – This project will identify the causes of the deviation in alder mortality from expected levels.
   - Poor crown conditions – This project will investigate the contributing factors to alder defoliation in south-central Alaska.
   - Soil conditions – Alder's nitrogen-fixing symbiosis making it key component of riparian ecosystems, and changes in alder health and productivity will have significant affects on soil chemistry in these areas. Complete defoliation of large areas, as seen in the Aerial Detection Surveys, will also lead to increased erosion, and reduced forest floor depth.
   - Fragmentation – the removal of foliage and mortality of one of the primary components of these riparian forests will lead to increased fragmentation.

DESCRIPTION:

a. Background: Three defoliating sawfly species feed on thin-leaf alder in riparian areas throughout southcentral and interior Alaska. The circumpolar striped alder sawfly *Hemichroa crocea* and two non-native European species, wooly alder sawfly *Eriocampa ovata* and European green alder sawfly *Monsoma pulveratum* are the major sources of alder defoliation in Alaska. The green alder sawfly is the newest detection of a non-native sawfly in Alaska representing a new U.S. record, and a new potential threat to the integrity of riparian ecosystems and salmon spawning streams in western North America. Significant defoliation by both exotic sawflies has been recorded in the Palmer Hay Flats, Kenai Peninsula (Cooper Landing, Quartz Creek), and the Little Susitna River. The mode of introduction is hypothesized to be direct shipping from Europe or eastern Canada to Anchorage. More than 125 ships per year travel to Anchorage via Arctic Ocean shipping routes and will only increase with increased access and use of the Arctic Ocean in a warming climate.

Roadside surveys have detected widespread canker disease at over 100 locations across south-central and interior Alaska with mortality reaching nearly 30% at some sites. The only remote surveys were conducted in Katmai National Park within which approximately 60% of alder are dead at one site. Aerial surveys for canker damage in Alaska have not been conducted. Two *Phytophthora* species may be associated with canker in Alaska. One of these is unnamed and new to science, while the other (*P. alni* subsp. *uniformis*) is involved in alder disease in nearly a dozen European countries. The 2007 discovery of *P. alni uniformis* in Alaska was the first time that this pathogen had been confirmed in North America. While mortality has not yet been detected in Alaska, the two species may have existed benignly beneath alder or been introduced from Europe, where *Phytophthora* species devastate alder.

The majority of Alaskan forests comprise remote wilderness and have not been surveyed for alder diseases. The distribution and impacts of alder diseases in remote locations is unknown and represents a critical gap in our knowledge and understanding of the effects and potential

interactions of sawflies and disease on the health of riparian alder. Little is known about how these organisms interact in regards to alder productivity and survival. In addition, even less is known regarding the ability of *Phythophthora* spp. to cause disease in thin-leaf alder.

b. Methods: Canker incidence and damage assessments will be conducted in conjunction with Forest Health Monitoring surveys and plots to map the occurrence and severity of canker mortality and sawfly damage along streams in remote areas. Six sites along the Eagle River drainage, the Little Susitna River, and the Quartz Creek drainage will be selected in early and mid-succession alder stands. Sites will be selected in areas with known evidence of sawfly and *V. melanodiscus* activity, and that are suspected of containing *Phythophthora spp*. Alder genets infected and uninfected by *V. melanodiscus* will be protected from sawflies by handpicking and tanglefoot traps or allowed to be defoliated by sawflies. These four treatments will be tracked into the next season to observe whether they are more susceptible to further canker formation. In addition, we will bait and trap *Phythophthora* spp. at each of these locations from roots and soil using thin-leaf alder twigs, and attempt to correlate presence/absence with basic site characteristics and mortality records.

c. Products: FHM meeting poster, first year and final reports, potential alder dieback complex FIDL, potential peer-reviewed scientific publications, potential recommendations for sawfly control.

d. Schedule of Activities: 2010, 1) aerial surveys to determine the extent and severity of alder canker, 2) field verification the presence of both sawflies and canker within aerially identified alder dieback areas. 3) Plot establishment, identification of clean alder genets and protecting with tanglefoot traps and handpicking, identification of sawfly and alder infested genets, flagging for re-visit. 4) Revisit plots to characterize the extent of defoliation, canker severity, and soil sampling. Anticipated results will include: (1) Map of alder damage from aerial survey supplemented with ground verification within six study areas, and (2) Preliminary correlation analyses of patterns of defoliation and mortality agent occurrence. Progress for 2010 will be reported at the annual Forest Health Monitoring Working Group meeting in January 2011. In 2011, plots will be remeasured for sawfly recurrence and canker severity, data processing, and report writing. Results will include: (1) Updated results including second year of study describing potential of pattern of defoliation and disease in riparian areas, and (2) Laboratory results of *Phytophthora* presence and identification.

YEAR 1 COSTS (year 2 costs are expected to be similar to year 1) :

	Item	**Requested FHM EM Funding**	**Other-Source Funding**	**Source**
Administration	Salary		$15,000	Base FHP
	Overhead		$ 900	Base FHP
	Travel	$8,000	$ 2,000	Base FHP
Procurements	Contracting	$10,000	$8,000	
	Equipment			
	Supplies	$2,000		
Total		$22,000	$25,900	