WPEF student research grant awarded for 2017

A call for proposals for the annual WPEF student research grant was released in the Spring/Summer issue of Nutcracker Notes, and online. The proposals were reviewed by board members Bryan Donner and Cyndi Smith, and Nutcracker Notes *editor Bob Keane.* ***KIAH ALLEN****, a MSc student in the Department of Forestry at University of British Columbia, was chosen as the grant recipient for 2017. Her supervisor is Dr. Richard Hamelin. Following is a description of Kiah's project:*

Determine the level of hybridization and introgression of the hybrid pine stem rust *Cronartium x flexili* and to assess its level of fitness

Background and necessity of research

White pine blister rust, caused by *Cronartium ribicola*, was introduced from Europe and Asia in the 19th century and is responsible for one of the most devastating forest disease outbreaks worldwide. This pathogen attacks the stems and branches of five-needle (white) pines and alternates on currants and gooseberries (*Ribes* spp.). Comandra blister rust, caused by *C. comandra*, is a native rust that attacks two-needle pines (e.g., lodgepole and jack pines) and alternates on bastard toadflax (*Comandra* spp.). The recent discovery of *Cronartium x flexili*, a hybrid between these two rusts, was surprising because they do not share hosts. These two rusts are considered among the most destructive rust pathogens in Canadian forests (Woods et al. 2000 Loo 2009). However, the impact of their hybridization is yet unknown. Hybrid pathogens are known to jump hosts in unpredictable ways and can be subjected to episodic selection and speciation (Brasier et al. 2003). The hybrid rust has been found on the *C. ribicola* hosts limber pine (*Pinus flexilis*) and whitebark pine (*P. albicaulis*), but it is unknown if it also occurs on lodgepole pine (*P. contorta*) (Joly et al. 2006) or any of the known alternate (telial) hosts. The characteristics of the hybrid rust including occurrence, distribution, survivability, viability and host range are currently unknown (Joly et al. 2006).

Objective

My research objective is to determine the level of hybridization and introgression of the hybrid pine stem rust *Cronartium x flexili* and to assess its level of fitness. To address these aims I will test the hypothesis that *Cronartium x flexili* has an expanded host range compared to its parental species. I will sample and identify hybrid rusts using DNA SNPs profiles and perform inoculations of the hybrid rust spores on the hosts of the respective parent rusts.

Methods

Aeciospores will be collected from white pines, whitebark pines and lodgepole pines from sites where the presence of the hybrid rust is already known to occur, predominantly in British Columbia (Clason et al. 2014), but also the Rocky Mountains of Alberta (Waterton Lakes National Park, Kananaskis Country, Porcupine Hills) (Joly et al. 2006). The expected dates of data collection are from March through September 2017. The samples will be divided in two subsets to perform: 1) analysis of hybridization rate, direction and pattern; and 2) assessment of viability and host range. Half of the samples will be treated for DNA extraction and SNP genotyping using genotyping-by-sequencing. The data will be used to calculate the rate of hybridization on the two pine hosts and determine if the hybridization is one-way or bi-directional. The second subsample will be used for inoculations and spore germination tests. The germination tests will serve to examine the viability of the hybrid spores. The spore morphology

will be analyzed microscopically to identify intermediate spore types of the hybrids as well as parental species (Joly et al. 2006). Spore germination efficiency will be measured and compared for pure parental species and the hybrids. In order to evaluate the fitness of the hybrid rust, I will measure infection efficiency and spore production, using aeciospores of both pure parental species and of *C. x flexilis* on all known telial hosts of the parental rusts. If aeciospores are viable and infectious onto the telial hosts, an inoculation of telia and basidiospores onto the respective aecial hosts (whitebark pine and lodgepole pine seedlings) will be conducted. The relative fitness of the parental rusts onto their hosts will be compared to the hybrid rust to evaluate its fitness. Expected date of writing completion is December 2018.

Impact and expected outcomes

The severity of the combined effects of *C. ribicola*, mountain pine beetle and climate change have caused whitebark pine to be listed as endangered under the federal *Species at Risk Act* (*SARA*) (Clason et al. 2014). Findings from this study will determine the if the hybrid rust *C. x flexilis* is viable and has a modified host range or epidemiological behavior. Improving our understanding of hybridization between a native and non-native tree rust, such as *C. x flexilis* will help to address disease outbreaks in terms of conservation and to inform forest stewards of better disease management strategies.

References

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