

RMD-26-01: Proposed pest risk management for red pine scale

Preface

As described by the International Plant Protection Convention (IPPC), Pest Risk Analysis (PRA) includes three stages: initiation, pest risk assessment and pest risk management. Initiating the PRA process involves identifying pests and pathways of concern and defining the PRA area. Pest risk assessment provides the scientific basis for the overall management of risk. Pest risk management involves identifying potential measures to reduce pest risk. It also involves evaluating those measures and selecting the most appropriate ones. The goal is to reduce the identified pest risk to an acceptable level.

This Risk Management Document (RMD) includes a summary of the findings of a pest risk assessment and records the pest risk management process for the identified issue. It is consistent with the principles, terminology and guidelines provided in the IPPC standards for pest risk analysis which may be found at the [IPPC website](#).

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1. Executive summary

Matsucoccus matsumurae Kuwana, commonly known as red pine scale or pine bast scale, is a pest that feeds on the phloem tissue of various *Pinus* species. It is native to Japan and was introduced in China, South Korea, Europe and the United States (Anderson et al. 1976; Choi et al. 2019; Gertsson 2001; McClure 1983; Van Driesche et al. undated) and is now invasive in those countries. As of June 2026, it had not been detected in Canada. In the United States (U.S.), red pine scale was first discovered in the 1940s and is a significant pest of red pine (*Pinus resinosa*). It kills red pines of all ages within a few years of infestation and is also known to kill some cultivated exotic pine species used as ornamentals.

The recent northward spread of red pine scale in the U.S., suggests that climatic conditions may be increasingly favourable for establishment in northern areas. A PRA undertaken by the CFIA determined that red pine scale would be able to survive and establish itself in Canada if introduced. The impacts could be devastating, because many of the areas that are climatically suitable for the pest also have natural stands of red pine and exotic ornamental pine tree species.

There are four *Pinus* species known to be hosts that are present in Canada: *P. resinosa* (the only host that is native to Canada), *P. densiflora*, *P. tabuliformis* and *P. thunbergii*. The import of host species of pine plants for planting and pine products, such as timber and logs, from infested areas represents high risk pathways for the introduction of the pest into Canada. Existing regulations already address the plants-for-planting pathway for other pests. However, Canada currently has no requirements to mitigate the risk associated with pine logs with bark that originate from infested areas of the continental U.S.

This RMD provides options with regards to the regulation of red pine scale in Canada. The removal and destruction of bark from logs of hosts species of pine imported from infested areas are suggested measures to prevent the introduction of red pine scale into Canada.

Red pine scale is proposed for addition to the List of Pests Regulated by Canada. Another proposed measure is the inclusion of additional declarations on Phytosanitary Certificates issued by the U.S. for the export of host pine species to Canada. These measures are expected to reduce the risk of the pest being introduced into Canada. Alternatively, importers would also have the option to participate in a compliance program for importing host species of pine forest products with bark (such as logs) from infested areas of the continental U.S.

2. Purpose

The purpose of this RMD is to communicate pest risk management considerations to stakeholders. It also seeks to obtain their feedback regarding the CFIA's proposal for the regulation of red pine scale in Canada.

3. Scope

This RMD examines the phytosanitary risks associated with the introduction of red pine scale into Canada and outlines potential risk management options.

Information on current import requirements for specific plants or plant products may be obtained from the CFIA [Automated Import Reference System](#) (AIRS).

4. Definitions, abbreviations and acronyms

Definitions of terms used in this document but not defined in this section can be found in the [Plant Protection Act](#), the [Plant Protection Regulations](#), the Canadian Food Inspection Agency's (CFIA) [Plant Health Glossary of Terms](#), the North American Plant Protection Organization's (NAPPO) [Regional Standard for Phytosanitary Measures no 5: NAPPO Glossary of Phytosanitary Terms \(PDF\)](#), and/or the [International Standard for Phytosanitary Measures no 5: Glossary of phytosanitary terms](#).

5. Background

Red pine scale was assessed in 1989 and based on climatic conditions, the recommendation at the time was to not regulate the species. However, due to recent effects of climate change and the increasing number of states infested by this pest in the U.S., there was a need to reassess the risks associated with the pest. Canada imports pine logs with bark from infested U.S. states. Therefore, it was particularly important to determine whether red pine scale can become a pest of economical and ecological significance in Canada.

A recent (February 2022) pest categorization determined that red pine scale has the potential to meet the definition of a quarantine pest in Canada. As a result, a new pest risk assessment was undertaken for this

pest and completed in July 2022.

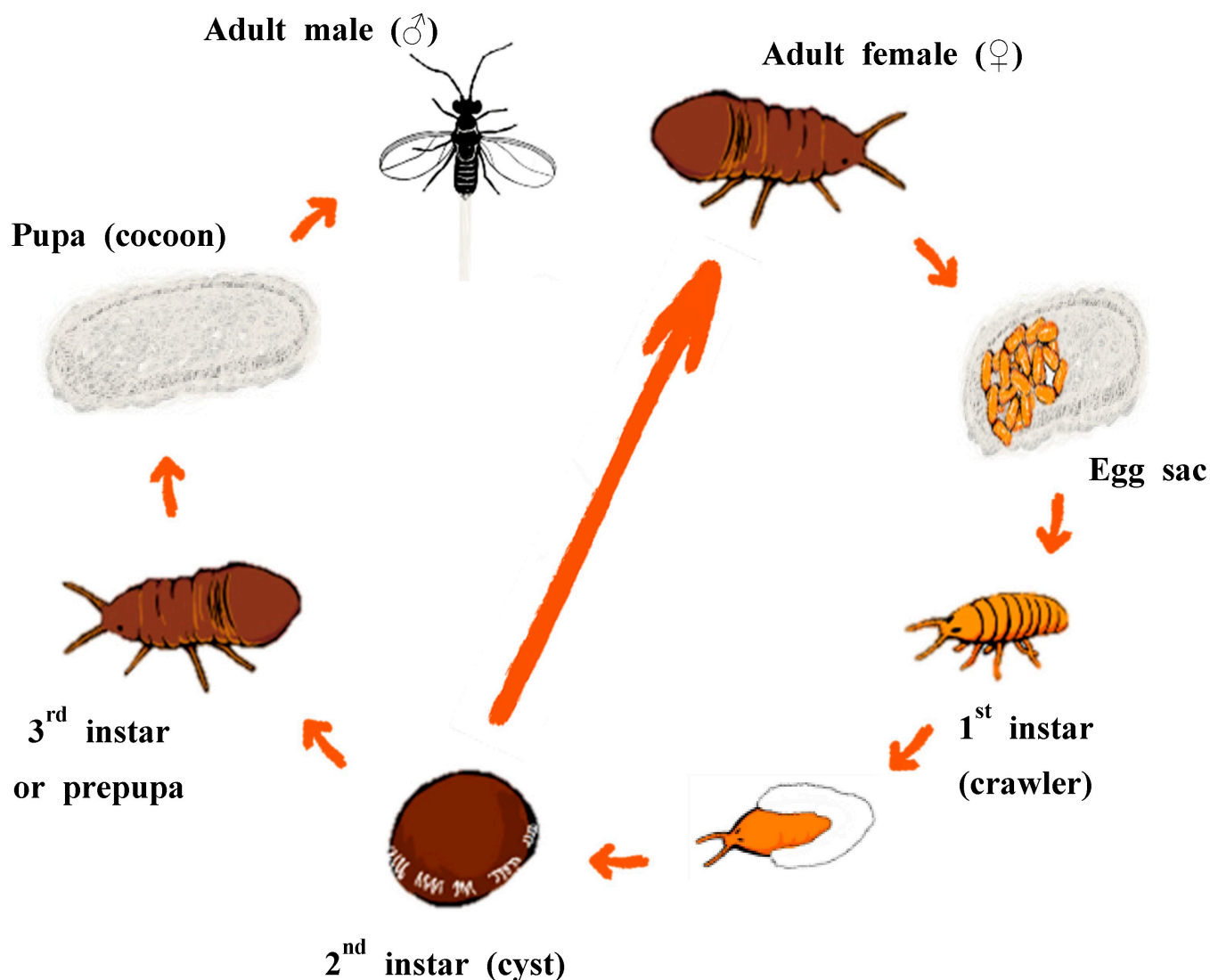
Red pine scale is currently not a regulated pest in Canada. Additionally, it is not listed as a regulated pest in the U.S. Regulated Plant Pest Table (United States Department of Agriculture - Animal and Plant Health Inspection Service (USDA-APHIS 2020)). It is also not listed in the European and Mediterranean Plant Protection Organization (EPPO) A1 and A2 Lists of pests recommended for regulation as quarantine pests (EPPO 2022).

6. Pest Risk Assessment summary

6.1 Pest biology and host suitability

The life cycle of red pine scale passes from the egg stage through three larval instars to the adult stage. Eggs of red pine scale are laid on branch axils and when larvae hatch, the nymphs move beneath bark scales to feed on the phloem of the host tree. Feeding damage can eventually kill the tree or make it vulnerable to attack by pathogens (Gaige and Glogower 2016). First instars are crawlers and are the only form in which both sexes may disperse. The second instar is the feeding and overwintering stage of the pest and is sometimes called the "cyst". Females and males are sexually dimorphic at the second instar stage. At maturity, female second instars become adults. Meanwhile male second instars continue to become third instars (also known as pre-pupae), then cocooned pupae, before metamorphosing into winged adults (see figure 1) (Choi et al. 2019; Foldi 2004).

Figure 1: Life cycle of Matsucoccus (Source: Choi et al. 2019; Creative Commons)



► Figure 1 – Text version

Pinus resinosa, commonly known as red pine or Norway pine, belongs to the subgenus *Pinus*, section *Pinus* subsect. *Pinus* (syn.: subgenus *Pinus*, section *Pinus* subsection *Sylvestris*) (Gernandt et al. 2005; Price et al. in Richardson 1998). *Pinus* species considered in this subsection each contains three resin acids. These three resin acids are absent from pines of other groups and those other groups are all known to be resistant to attack from red pine scale (Ge 1981), cited from (McClure 1985). McClure (1985) indicated that these three chemical compounds are a basis for host suitability and that bark texture provides protected sites for red pine scale.

The *Pinus* species listed in table 1 are known to be hosts of red pine scale and are present in Canada. All known hosts are from subgenus *Pinus*, section *Pinus* subsection *Pinus* (Gernandt et al. 2005).

Table 1: Species known to be hosts of red pine scale and that are present in Canada

Scientific name (United States Department of Agriculture's Agricultural Research Service (USDA-ARS) 2022)	Distribution in Canada (Brouillet et al. 2010+; CFIA 2014)
<i>Pinus densiflora</i> Siebold and Zucc.	Present only in cultivation
<i>Pinus resinosa</i> Aiton	Native to eastern Canada (Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island and Quebec)
<i>Pinus tabuliformis</i> Carrière (Syn: <i>Pinus tabuliformis</i> Carr.)	Present only in cultivation
<i>Pinus thunbergii</i> Parl. (Syn: <i>Pinus thunbergiana</i> Franco)	Present only in cultivation. Popular for bonsais

6.2 Distribution

Red pine scale is native to Japan. It was introduced and is now invasive in: China, South Korea, Europe and the U.S. (Anderson et al. 1976; Choi et al. 2019; Gertsson 2001; McClure 1983; Van Driesche et al. undated).

Red pine scale has been established in the U.S. since the 1940s and has been spreading northward since its discovery. The pest is currently known to occur in multiple U.S. states in the northern portion of its range

(García Morales et al. 2016; Plumb 1950; The University of Vermont (undated; Wheeler et al. 2015, [USDA Forest Service distribution map \(PDF\)](#))).

6.3 Pathways

The main pathways for introduction of red pine scale include host pine plants for planting, logs with bark and branches, hitchhiking on vehicles and other conveyances and the movement of humans and machinery through infested areas (Anderson et al. 1976; Duda 1961; Kanoti 2014).

All life stages of the pest can be carried on nursery stocks, timber, bonsai and host species of pine products that are transported out of infested areas (Anderson et al. 1976).

Plants for planting and pine products such as logs with bark represent the riskiest pathways for the introduction of the pest. Plants for planting are partially protected by existing regulations. However, there is currently no strategy in place to mitigate the risk associated with pine logs with bark originating from infested areas of the U.S.

In the U.S., when an infestation of red pine scale is detected in a red pine forest, the usual response is a salvage operation, which involves harvesting as many trees as possible to obtain timber before they become non-merchantable (Gaige and Glogower 2016). Salvage operations are often carried out during the winter and studies have shown that first stage larvae of red pine scale could survive to adulthood by hiding in the bark of cut logs until the following spring (Anderson et al. 1976; Duda 1961). Thus, the import of red pine logs with bark is considered a high-risk pathway compared to all other products. Debarking logs or other treatment to destroy overwintering larvae is required to prevent the red pine scale from surviving on logs (Duda 1961).

6.4 Potential for establishment and spread in Canada: Climatic and ecological conditions

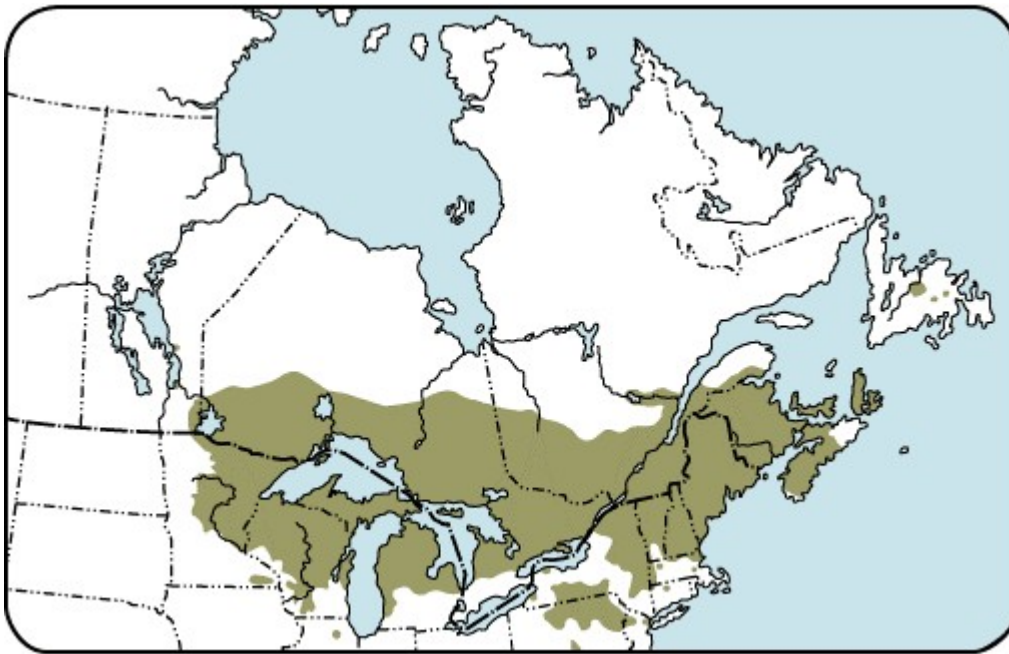
In North America, the pest is currently reported from several U.S. states in the northern portion of its distribution. In China, high overwintering mortality north of 41°30' N latitude has been a barrier to its spread northward in that country. The absence of suitable hosts south of 40° N latitude in the U.S. has limited southern spread of the pest (McClure 1983). The recent northward spread of red pine scale suggests that climatic conditions may be increasingly favourable for establishment in northern areas. Climate modelling indicates that some of the states where this pest is currently established, like Vermont and Maine, have climatic conditions similar to many areas in southern Canada.

The PRA indicates that red pine scale will be able to survive and establish in some parts of Canada if introduced. In addition, many areas that are climatically suitable for the pest also have natural stands of red pine and ornamental pine species known to be hosts of red pine scale (see table 1).

In Canada, red pine is distributed from southern Manitoba eastward to Newfoundland (figure 2; Anderson et al. 1976; Brouillet et al. 2010). *Pinus densiflora*, *Pinus tabulaeformis* and *Pinus thunbergiana* are native to Asia but are planted as ornamentals in Canada (Anderson et al. 1976).

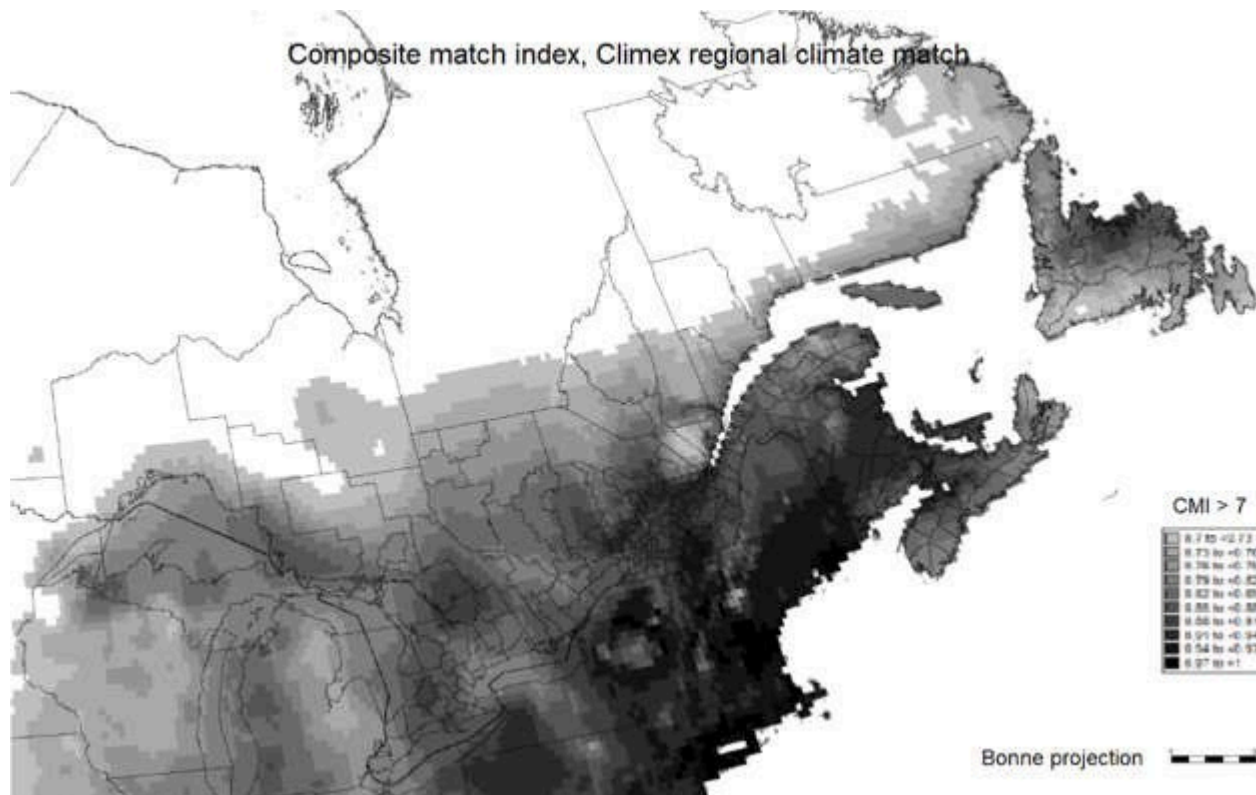
The CLIMEX (software) regional climate match modelling indicates that the potential range of red pine scale due to climate change overlaps with the range of red pine in eastern Canada (figure 3). This suggests that large portions of the Canadian range of red pine appear climatically suitable for establishment. The potential range of the pest in western Canada is likely limited to British Columbia, where red pine may be found as an ornamental tree.

Figure 2. Distribution of red pine in Northeastern America (Source: Natural Resources Canada 2015)



► Figure 2 – Text version

Composite match index, Climex regional climate match



► Figure 3 – Text version

6.5 Potential economic and environmental consequences

Red pine scale kills host trees of all age classes within a few years of infestation. Its main host red pine (*Pinus resinosa*) represents a very important tree species, both ecologically and economically.

Potential economic consequences

Pinus species are part of Canada's softwood lumber industry. Softwood lumber is used in construction, repair and remodeling, furniture manufacturing and for a number of other products. Canada's softwood lumber industry was valued at \$10 billion in 2020 (Government of Canada 2022; Moore 2002).

Red pine is important for forestry purposes because it grows rapidly and is resistant to wind (Espace pour la vie 2022). It is an important source of wood products and is used for lumber pulp and firewood (Espace pour la vie 2022; Scott 2008). Its resin is used to make turpentine (Fern 2022).

The direct economic consequences of introduction of red pine scale will hinge on the volume of red pine in Canada. Estimates from the National Forest Inventory (NFI) database indicate that the gross volume of red pine in Eastern Canada is approximately 64 million cubic metres and represents less than 2% of conifer volume in the region.

Red pine is a relatively valuable commercial timber species. In Ontario, crown charges for harvesting of red pine range from \$5 to \$15 per cubic metre depending on year, month and

final use. A simple way to value the red pine timber stock is to multiply the volume in cubic metres by a price per cubic metre. Using \$10 as a price and estimates from the NFI database, we could speculate that red pine is generating a value of approximately \$641 million. However, this simplistic method assumes that all volume is available for harvest, which is not the case. Also, these figures are highly likely to be underestimated. Of note, is that Quebec's provincial data on red pine inventory is greater

than Quebec's NFI inventory number, even though it is a smaller land area. Using volumes from the Quebec provincial data produces an estimate of \$128.2 million in Quebec, compared to \$56 million using the NFI data.

This raises the concern that the NFI inventory data may underrepresent red pine in the other provinces. This may be particularly true in Ontario, which is known to have red pine plantations in the southern region of the province (southern reaches of the boreal plains and within the mixed wood plains).

The net value of the stocks will depend on the amount of merchantable red pine harvested over time, standing value of red pine harvested and the discount rate. With that consideration in mind and the caveats regarding the inventory discussed previously, the relative value of red pine is relatively low in eastern Canada from a timber perspective.

Potential ecological consequences

Red pine is an important species in forest ecosystems. It is often the dominant tree species on sandy or gravelly soils, soils of low fertility and too poor for other pine species. Red pine is also extremely cold tolerant and wind resistant. Old growth red pine forest is essential for maintaining biodiversity at stand and landscape scales. The largest remaining old-growth red pine forest in the world is in the Wolf Lake Forest Reserve, Ontario (Anand and al 2013). Few tree species grow in environmental conditions in which the red pine thrives. Thus it would be very hard to replace this species in its natural habitat if it is decimated. Red pine seeds are a valuable food source for wildlife such as birds and small mammals. White-tailed deer browse red pine needles, primarily in winter. In addition, red pine stands provide important shelter for various bird species and other wildlife (Scott 2008). About 80% of forest-dwelling wildlife species found in central Ontario use forests associated with red pine or white pine (Naylor 1994).

It is estimated that red pine scale infestation more than doubles the natural mortality rate of red pine (Fei et al. 2019). Salvaging/harvesting damaged red pine trees owing to attack by this scale insect would have significant negative environmental impact on affected habitats with respect to the loss of ecosystem function (see previous section). Red pine scale can cause significant damage to tree stands. Red pine is particularly susceptible to this pest. Red pine also has important economic and ecological value. Taken together, these factors indicate that the potential impacts of red pine scale are significant.

7. Risk management considerations

This section includes a list of factors that are important to consider when assessing options for managing the risks associated with the introduction of red pine scale: the highest risk pathways are the movement of host species of plants for planting and logs with bark

The introduction of red pine scale to Canada would most likely occur through the importation of wood products and nursery stock of *Pinus resinosa*, *P. densiflora*, *P. tabulaeformis* and *P. thunbergii*.

The risks associated with host plants for planting are already mitigated by existing regulations. These include: the CFIA policy directive "D-08-04: Plant Protection Import Requirements for "Plants and Plant Parts for Planting" and other relevant directives. All *Pinus* spp. from overseas are prohibited entry without a pest risk assessment, due to the risk of importing Scleroderris canker (*Gremmeniella abietina*, European race). The risk of entry to Canada is therefore limited at the current time to plants and plant products such as logs entering from the U.S.

A CFIA Permit to Import is required for the importation of propagative material for all *Pinus* spp. from the U.S. The shipment must be accompanied by a phytosanitary certificate issued by the national plant protection organization of the U.S. This along with an additional

declaration that "the material certified was produced outside of the scleroderris canker regulated area", as well as the same for the spongy moth (*Lymantria dispar*) if it is moving to a regulated area. To be issued a phytosanitary certificate, the plants must be inspected and found free of other insects.

Important factors to consider:

- there is currently no strategy in place to mitigate the risk associated with red pine logs with bark originating from infested areas of the U.S.
- red pine scale kills host trees of all age classes within a few years of infestation
- red pine scale will be able to survive and establish in some parts of Canada if introduced
- many areas of Canada that are climatically suitable for the pest also have natural stands of red pine, as well as ornamental pine species known to be hosts of red pine scale

8. Pest risk management options

Option 1: status quo (that is no change to the regulatory status of red pine scale)

Red pine scale is currently not listed as a regulated pest in the U.S. Regulated Plant Pest Table (USDA-APHIS 2020). It is also not listed in the EPPO A1 and A2 Lists of pests recommended for regulation as quarantine pests (EPPO 2022). Thus, making no changes to the regulatory status of red pine scale in Canada would be consistent with the approach taken by the U.S. It would also imply less stringent requirements for importing hosts species of pine forest products with bark (such as logs) from the U.S. Industry would continue to be able to trade without restrictions or additional phytosanitary requirements.

However, this is not the preferred option because of the damage the pest may cause on red pine stands. The known suitability of red pine as a host for the pest and the ecological importance of this native species in Canada are important factors to take into consideration.

Option 2: compliance program required for host species of pine forest products coming from infested areas of the continental U.S.

Import requirements for host species of pine logs with bark

Red pine scale is proposed for addition to the List of Pests Regulated by Canada. A compliance program is also proposed for importing pine forest products with bark, such as logs, from infested areas of the continental U.S. These products must be from host pine species. Together, these measures are expected to reduce the risk of the pest being introduced into Canada. The compliance program would involve the removal and destruction of bark. This mitigation strategy would greatly reduce the risk of introducing red pine scale into Canada.

A permit to import would be required

Before a permit would be issued, a facility wishing to be recognized as an approved processing facility would need to develop a CFIA-approved Preventative Control Plan (PCP). This plan would address storage, bark removal and bark disposal requirements, as outlined under option 2.

Conditions included in a compliance program would require that:

- the receiving facility provides evidence that a PCP is in place at the facility and that the PCP is documented
- all regulated material sourced from regulated areas of the continental U.S., be transported directly to the receiving facility with no unnecessary stops and must be accompanied by shipping documents that clearly identify destination of the shipment

- all regulated material be processed or treated at the processing facility

All logs imported from areas infested with red pine scale would be required to have bark removed and be processed in a timely manner. All regulated material residue including bark and other waste would need to be disposed of or processed in a manner that is timely and approved by the CFIA.

- the receiving facility maintains accurate records of imported regulated material for 2 years from the date of receipt and records must be provided to a CFIA inspector upon request
- all regulated material sourced from regulated areas of the continental U.S., be segregated and easily identified (for example with paint, flags, area markers, etc.) from those sourced from non-regulated areas

The regulated material must be held in a secure area isolated from host trees.

- the approved receiving facility be audited by the CFIA for program compliance

From an industry perspective, the compliance program would be more practical for frequent importers than phytosanitary certification (option 3). The program would be administered by the CFIA, thus reducing the administrative burden on the industry. However, for infrequent importers, entering a compliance program may be inefficient as it involves developing and implementing a PCP for a small number of shipments of pine forest products per year.

Option 3: phytosanitary certification required for host species of pine forest products coming from infested areas of the U.S.

Red pine scale is proposed for addition to the List of Pests Regulated by Canada. Another proposed measure is to require additional declarations on phytosanitary certificates issued by the U.S. These declarations would apply to pine forest products with bark, such as logs, that are exported to Canada. Together, these measures are expected to reduce the risk of the pest being introduced into Canada.

The required additional declaration or treatment statement for host pine species (*Pinus resinosa*, *P. densiflora*, *P. tabuliformis* and *P. thunbergii*) would be as described in the following section.

The phytosanitary certificate must contain the additional declaration or treatment statement for red pine scale (*Matsucoccus matsumurae* Kuwana) as described in this section.

For all material belonging to the genus *Pinus*, the exact species name(s) must be stated on the phytosanitary certificate. If the phytosanitary certificate lists a regulated *Pinus* species (*P. resinosa*, *P. densiflora*, *P. tabuliformis* or *P. thunbergii*), one of the following requirements must be met:

1. Treatment: each piece of wood was heat treated to achieve a minimum core temperature of 56°C throughout the profile of the wood, including the core, for a minimum of 30 minutes or has been fumigated with methyl bromide as specified in appendix 1 of D-02-12.

The treatment details must be outlined in the appropriate section of the phytosanitary certificate.

or

2. The following declaration "The material described herein was produced/harvested in a county where red pine scale (*Matsucoccus matsumurae* Kuwana) is not known to occur, based on official surveys".

From an industry perspective, this option would not be practical for frequent importers, as it would require a phytosanitary certificate for every shipment. In addition, each shipment would need to be inspected by the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS) at the loading site or facility to verify that the forest products are free of red pine scale.

Option 4: (CFIA's recommended option): phytosanitary certification or compliance program required for red pine forest products coming from infested areas of the continental U.S.

This option combines options 2 and 3. This option allows the importation of logs with bark from states infested with red pine scale, provided they are accompanied by a phytosanitary certificate attesting to freedom from the pest (based on treatment or pest-free area status) or are produced under a CFIA-approved compliance program.

Logs being imported from states known to be infested with red pine scale would be permitted, provided that the importer fulfills one of the following criteria:

1. shipment accompanied by a phytosanitary certificate which fulfills one of the requirements detailed in option 3

or

2. obtain a permit to import

before a permit can be issued, a facility seeking recognition as an approved processing facility must develop a CFIA-approved PCP that addresses storage, bark removal and bark disposal requirements, as outlined under option 2.

This is CFIA's preferred option. It significantly lowers the risk of introducing red pine scale to Canada through the logs with bark pathway, while giving industry two viable options for trade to continue.

9. Stakeholder communications

The CFIA is soliciting comments from government and industry stakeholders before making a decision on regulating this pest.

10. References

- Anderson, J. F., Ford, R. P., Kegg, J. D. and Risley, J. H. 1976. The red pine scale in North America. [Online]. [2022].
- Anand, M., Leithead, M., Silva, L. C. R, Wagner, C., Ashiq, M. W, Cecile, J., A. Das, A., and Bulger, C. The scientific value of the largest remaining old-growth red pine forests in North America. *Biodiversity and Conservation* (2013) 22:1847–1861.
- Brouillet, L., Coursol, F., Meades, S. J., Favreau, M., Anions, M., Bélisle, P. and Desmet, P. 2010+. VASCAN, the database of vascular plants of Canada. [Online]. [2022].
- Choi, J., Cha, D., Kim, D. and Lee, S. 2019. Review of Japanese pine bast scale, *Matsucoccus matsumurae* (Kuwana) (Coccothrips: Matsucoccidae), occurring on Japanese black pine (*Pinus thunbergii* Parl.) and Japanese red pine (*P. densiflora* Siebold & Zucc.) from Korea. *Forests* 10(8):14.
- Duda, E. J. 1961. Some aspects of the biology and ecology of the red pine scale, *Matsucoccus resinosae* B&G (Homoptera: Margarodidae) Ph.D. thesis, University of Massachusetts, Amherst, Amherst, Massachusetts. 170 pp.
- EPPO. 2022. EPPO Lists of pests recommended for regulation as quarantine pests, version (2021-09).
- Fei, S., Morin, R. S., Oswalt, C. M. and Liebhold, A. M. 2019. Biomass losses resulting from insect and disease invasions in U.S. forests. *116*(35):17371-17376.

- Foldi, I. 2004. The Matsucoccidae in the Mediterranean basin with a world list of species (Hemiptera: Sternorrhyncha: Coccoidea).
- Gaige, M. and Glogower, Y. 2016. Great Mountain Forest - A Field Book (PDF). [Online]. Available: [2022].
- García Morales, M., Denno, B. D., Miller, D. R., Miller, G. L., Ben-Dov, Y. and Hardy, N. B. 2016. Matsucoccus matsumurae (Kuwana, 1905) (Matsucoccidae: Matsucoccus). [Online]. [2022].
- Ge, Z. 1981. A study on the resistance of several pine species to the bast scale (*Matsucoccus matsumurae* Kuwana). Report of the Chinese Academy of Forestry 4:400-405.
- Gernandt, D., Geada López, G., García, S. and Liston, A. 2005. Phylogeny and classification of *Pinus*. Taxon 54:29.
- Gertsson, C. 2001. An annotated checklist of the scale insects (Homoptera: Coccoidea) of Sweden. Entomologisk Tidskrift 122(3):123-130.
- Government of Canada. 2022. Canada's softwood lumber industry. [Online]. [2022].
- Horton, K. W. and Bedell, G. H. D. 1960. White and Red Pine: Ecology, Silvi-culture, and Management.
- Department of Northern Affairs and National Resources, Forestry Branch.
Kanoti, A. 2014. Pest alert - Red pine scale (*Matsucoccus matsumurae*) detected in Hancock County, ME (PDF). [Online]. [2022].
- Knowles, K. 1995. Woody ornamentals for the Prairies. 2 ed. University of Alberta, Edmonton. 210 pp.
- McClure, M. S. 1983. Temperature and host availability affect the distribution of *Matsucoccus matsumurae* (Kuwana) (Homoptera:

Margarodidae) in Asia and North America. *Annals of the Entomological Society of America* 76(4):761-765.

- Moore, L. M. 2002. Red pine: Plant fact Sheet. [Online].
- Natural Resources Canada, *Pinus resinosa* fact sheet. [Online]
- Naylor, B. J. 1994. Managing wildlife habitat in red pine and white pine forests of central Ontario. *The Forestry Chronicle* 70(4):411-419.
- Plumb, G. H. 1950. A new and serious insect pest of red pine. Connecticut Agricultural Experiment Station Special Circular, New Haven, Connecticut.
- Richardson, D. M. 1998. Ecology and biogeography of *Pinus*. Cambridge University Press, Cambridge, UK.
- Scott, H. A. 2008. *Pinus resinosa* in: Fire effects information system. [Online]. [2022].
- The University of Vermont. undated. Red Pine Scale, *Matsucoccus matsumurae*. [Online]. [2022].
- USDA-APHIS. 2020. U.S. regulated plant pest list. [Online]. [2022]
- USDA-ARS. 2022. Germplasm Resources Information Network - (GRIN). [Online Database]. [Online]. [2022].
- Van Driesche, R. G., LaForest, J., Bargerion, C., Reardon, R. and Herlihy, M. undated. Pine bast scale, *Matsucoccus matsumurae* (Kuwana). (Hemiptera: Matsucoccidae). [Online]. [2022].
- Wheeler, J., Seirup, C., Short, M., Miller, K. and Connery, J. H. 2015. Unpublished report, Acadia National Park, National Park Service. [July 11, 2022].

Appendix 1: Amendment record (consultation only)

Amendment number/Document version	Amended by	Date amended	Purpose of amendment
1	Section, name	-	Highlights only; refer to amended section for clarity if necessary
2	-	-	-
3	-	-	-

Date modified:
2026-08-24