The Success of Tree Seeds

Nº. 84

JUNIOR

Science/Math

LESSON SUMMARY

Students will learn to estimate the potential seed crop from a coniferous tree species in a specific area.

Ontario Wood

FORESTS ONTARIO

Focus on Forests

Focus on Forests is a program of Forests Ontario.

Activity Information

Grade Level:	Junior
Estimated duration:	2 class periods (one for outside and one for inside)
Materials:	Bags to collect cones, cutting board, knife (or hand pruner), copies of Activity Sheet
Setting:	Outside and inside
Key Vocabulary:	Seed forecasting and collecting, cone, conifers
Season:	August to November

Teacher Background

Ontario's large, diverse landscape has four main forest regions and more than 100 native woody plants, including trees, shrubs and vines. Distinguished by bogs and fens, sparse slow growing forest and tundra, the **Hudson Bay Lowlands** is the northernmost forest region in Ontario. The most common trees found in this region are tamarack, black spruce, white spruce, dwarf birch and willow.

With an area of 50 million hectares, the **Boreal Forest** is the largest forest region in Ontario and Canada. It is dominated by conifers and a few deciduous species. The most common trees are black spruce, white spruce, jack pine, tamarack, trembling aspen and birch.

The **Great Lakes-St. Lawrence** forest is the second largest forest region in Ontario, covering approximately 20 million hectares. It has a mix of deciduous and conifer species. The most common trees are white spruce, white pine, white cedar, red pine, hemlock, tamarack, maple, beech, ash, birch, basswood, poplar and red oak.

Totaling almost 3 million hectares, the **Carolinian Forest** is the southernmost region in Ontario, dominated by agriculture and urban areas. It is also a diverse forest of many deciduous species such as oak, hickory, tulip tree, ash, maple, black walnut, butternut, magnolia, black gum, sassafras and red bud.

Ontario's forest diversity starts with the genetic diversity of many species that are adapted to many conditions. It is essential to maintain and restore our many tree and shrub species, along with all their local populations and the unique individuals within these populations. Biodiversity provides for ecological stability, evolutionary capacity and economic potential. The different tree species provide habitat for different animals and together, they assure the health of the ecosystem. Also, they adapt themselves in different ways to the local conditions. Therefore, it is important to keep the variety to have as many adapted trees as possible.

Seed can potentially be produced on any plant. Most conifers and some broadleaf species have flowers that contain only male or female parts and occur separately but on the same plant. These species are called **monoecious** (meaning "one house"). Male and female flowers can also occur separately on separate plants. These species are called **dioecious** (meaning "two houses") and seed will only be produced on female trees. Another variation is **polygamo-dioecious**, meaning the plant has some bisexual or perfect flowers but most flowers will be either female or male.

The basic structure of woody plant flowers has resulted in the classification of two major groups of flowering plants: **angiosperms** (flowering plants) and **gymnosperms** (cone-bearing plants). It is important to understand that seed is contained in a fruit or cone. After pollination, gymnosperm female flowers become cones. Angiosperm flowers become many different types of fruit. Both cones and fruit protect the developing seed, provide nutrition, and help disperse the seed.

Cones are the female "flowers" of coniferous trees. Maples, elms, chestnuts, and other deciduous trees have true flowers that produce seeds inside a type of fruit. Conifers, on the other hand, produce their seeds inside cones. The hard brown scales of the cones close over the developing seeds to protect them from inclement weather and from predation. When the seeds are ripe, the scales shrink slightly and open up, releasing the light, winged seeds to the wind.

In Ontario, planting trees (artificial regeneration) is an important part of the forest regeneration strategy. Collecting seeds, tracking those that germinate and compiling information about seed availability, location, type and quantity is an important component in Ontario's tree planting strategy. **Seed forecasting** and **seed collecting** are crucial steps in establishing healthy diverse forests. The seed collector's role in collecting high quality seed is important as the effects of climate change become more pronounced. The seeds collected at maturity, and from many locally adapted and healthy trees, will be able to withstand any stresses because they will be better adapted to the different environmental conditions.

In the earliest stages of forecasting, estimating the amount of flowering and developing seed crop after pollination is essential to determine whether to return to a site to continue monitoring or to collect the crop. The **cut test** provides an estimate of the cone crop. Early cut tests will indicate the number of damaged and developing seed. Later cut tests show embryo development to help estimate maturity and collection timing. The examination of a sample of seeds also indicates the incidence of damage by pests or diseases. As an example of a cut test, refer to Image 1.

Image 1 – Examples of half cut seed test* (the red lines indicate good seeds)

Colorado Spruce, Blue Spruce

Austrian Pine, European Black Pine

Scots Pine

Photos form *A Seed Manual for Ontario* (MNR 1996)

Teaching Note:

Students will estimate the potential seed crop from a coniferous tree species in a specific area.

Advance Preparation:

Find a good area with 5 or more trees of the same coniferous species. Make sure you make your outdoor visit at the right time of the year. For most coniferous species, the collection period is from August to October. To know the exact forecasting and collecting periods of conifers species, refer to Table 1 – Conifers quick sheet.

Activity

Outdoors:

1. Briefly discuss the four forest regions of Ontario and the most common trees found in each region. Then, discuss the importance of seed collecting in forest regeneration.
2. Take your class on a seed hunt in a nearby park or forest, making sure that the park is public, or if it is private land that you gain permission prior to collecting seed.
3. Locate an area where there are more than 5 conifers of the same species (e.g. 5 white pine trees). Divide the group according to the number of trees in the delimited area.
4. Ask each team to estimate the number of cones in their coniferous tree. You can use Table 2 – Guide to estimating crop volumes on single trees for help.
5. Ask each team to collect 10 cones from their tree. They must sample from the part they are able to collect from (they must not climb in the tree), sample from all sides of the tree and avoid old cones that have previously shed their seeds. The cones could be found on the ground if they appear to be in good condition (cones free from insect damage, deformity and disease).

Indoors:

Print one **Activity Sheet** for each team to prepare for this part of the activity.

6. Before cutting the cones, estimate the number of seeds per cone.
7. With a knife and a cutting board, the teacher should **carefully** cut the cones in half along the axis (the students could do it with a hand pruner). Set one half aside for a few minutes so the cut surface darkens and makes the seeds easier to count.
8. Count the number of filled seeds from only **one of the half sections cut**. Look for the seeds that have the "coconut meat" color. Underdeveloped seeds which often occur at the top and base of cones should not be counted. To determine the total number of seeds per cone, multiply by four. You can refer to Image 1 – Examples of half cut seed test, to have good examples of what the seeds should look like.
9. Using the Activity Sheet, estimate the total amount of seeds that each tree could produce and determine the collectability of your trees using Table 3 – Cone yields. Should you: Walk away, Do more cut tests, Collect or have you hit the jackpot?
10. Compare the results from each team and then compile the results to estimate the total amount of seeds the area could produce.

Final Note: Trees might not produce seeds every year. Because of poor weather conditions (E.g. excessive rain, frost) trees could skip a year. If you don't have cones to analyze or if there's no seed in any of them, you can use the example at the end of the lesson to do the activity in class.

Resources:

Food and Agriculture Organization of the United Nations (1985). A guide to forest seed handling. In Food and Agriculture Organization of the United Nations. Forestry Department. http://www.fao.org/docrep/006/ad232e/AD232E00.htm#TOC

Ontario Government (2014). Forest Regions. In Ontario Government. Environment and energy. https://www.ontario.ca/environment-and-energy/forest-regions

Ontario Tree Seed Plant (2014). Seeds of Ontario Trees & Shrubs: Field Manual for Crop Forecasting and Collecting. Ontario, Ontario Ministry of Natural Resources, 275p.**

**This manual is available for purchase from Forests Ontario. If you are interested in obtaining a copy, please call 1-877-646-1193

ACTIVITY SHEET

Team #: _____

Name: _____

_____

_____

_____

_____

Date: _____

Location: _____

City: _____

Postal Code: _____

Estimated number of cones per tree: _____

Estimated number of seeds per cone: _____

Species Name	Cone #	# Seeds/ ½ Section	Total # of seeds (# Seeds/ ½ Section x 4)	Calculations:
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
		Total:		
			Average number of seeds per cone (Total seeds / number of cones):	
			Number of cones per tree:	
			Total number of seeds in the tree (Average number of seeds per cone x number of cones per tree):	
			Individual Tree's Assessment	WALK AWAY DO MORE CUT TESTS COLLECT YOU'VE HIT THE JACKPOT

Table 1 – Conifers Quick Sheet

Flowering | Forecasting | Critical times to forecast | Collection

Species (Colour by Maturity Group)	Pg	Periodicity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Balsam Fir *(Abies balsamea)*	50	2 - 4 years												
Common Juniper *(Juniperus communis)*	52	Irregular												
Red Cedar *(Juniperus virginiana)*	68	2 - 3 years												
*European Larch *(Larix decidua)*	70	3 - 10 years												
Tamarack *(Larix decidua)*	54	3 - 6 years												
*Norway Spruce *(Picea abies)*	56	3 - 5 years												
White Spruce *(Picea glauca)*	58	2 - 3 years												
Black Spruce *(Picea mariana)*	72	2 - 8 years												
*Colorado Blue Spruce *(Picea punguns)*	60	1 - 3 years												
Red Spruce *(Picea rubens)*	74	3 - 8 years												
Jack Pine *(Pinus banksiana)*	76	1 - 3 years												
*Mugo Pine *(Pinus mugo)*	78	Annual												
*Austrian Pine *(Pinus nigra)*	80	2 - 5 years												
Red Pine *(Pinus resinosa)*	82	3 - 7 years												
Pitch Pine *(Pinus rigida)*	62	4 - 9 years												
Eastern White Pine *(Pinus strobus)*	64	1 - 7 years												
*Scots Pine *(Pinus sylvestris)*	84	1 - 3 years												
Eastern White Cedar *(Thuja occidentalis)*	66	3 - 5 years												
Eastern Hemlock *(Tsuga canadensis)*	86	2 - 3 years												

Source: Seeds of Ontario Trees & Shrubs: Field Manual for Crop Forecasting and Collecting, 2014.

Table 2 – Guide to estimating crop volumes on single trees (100 liters = 1 hectolitre (hl))

1 lb. coffee tin	Approximately 1 L
A hard hat	Approximately 2 L
2 gallon plastic pail	Approximately 9 L
1 bushel basket	Approximately 36 L
1 burlap bag	Approximately 100 L (=1hl)

Table 3 – Cone Yields (average number of seeds per cone)

SPECIES	Walk away	Do more cut tests	Collect	You've hit the jackpot
Balsam Fir	< 32	32-40	40-48	48 +
European Larch	< 12	12-16	16-24	24 +
Tamarack	< 4	4-6	6	6 +
Norway Spruce	< 40	40-48	48-64	64 +
White Spruce	< 32	32-40	40-56	56 +
Black Spruce	< 16	16-24	24	24 +
Colorado blue spruce	< 30	30-40	40	40 +
Red Spruce	< 32	32-40	40-48	48 +
Mugo Pine	< 12	12-16	16-20	20 +
Austrian Pine	< 16	16-24	24	24 +
Red Pine	< 12	12-16	16-32	32 +
Pitch Pine	< 16	16-24	24	24 +
Eastern White Pine	< 24	24-32	32-48	48 +
Scots Pine	< 16	16-20	20	20 +
Eastern White Cedar	< 5	5-7	7	7 +
Eastern Hemlock	< 12	12-16	16-24	24 +

ACTIVITY SHEET (Example)

Team #: 1

Name: John Smith
April Showers
Rosey Thorn

Date: June 1, 2015

Location: Coldwater

City: ON

Postal Code: L9J

Estimated number of cones per tree: 450

Estimated number of seeds per cone: 25

Species Name	Cone #	# Seeds/ ½ Section	Total # of seeds (# Seeds/ ½ Section x 4)	Calculations:
White Spruce	1	10	10 x 4 = 40	40+28+40+56+44 +32+48+44+24+56 = 412
	2	7	7 x 4 = 28	
	3	10	10 x 4 = 40	
	4	14	14 x 4 = 56	
	5	11	11 x 4 = 44	
	6	8	8 x 4 = 32	
	7	12	12 x 4 = 48	
	8	11	11 x 4 = 44	
	9	6	6 x 4 = 24	
	10	14	14 x 4 = 56	
		Total:	412	
			Average number of seeds per cone (Total seeds / number of cones):	412 / 10 = 41.2 = 41
			Number of cones per tree:	450
			Total number of seeds in the tree (Average number of seeds per cone x number of cones per tree):	450 x 41 = 18,450
			Individual Tree's Assessment	WALK AWAY DO MORE CUT TESTS COLLECT YOU'VE HIT THE JACKPOT