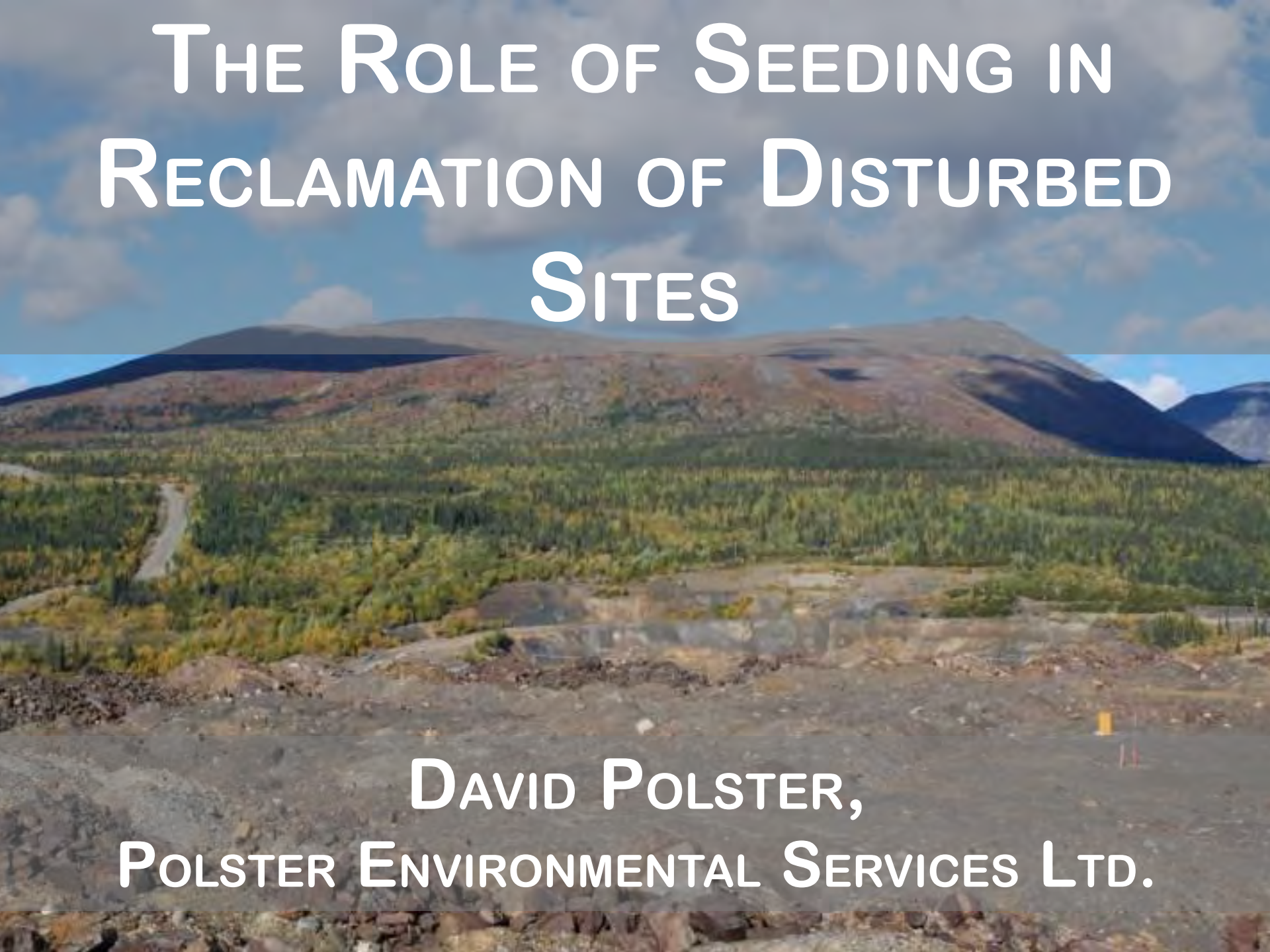


THE ROLE OF SEEDING IN RECLAMATION OF DISTURBED SITES

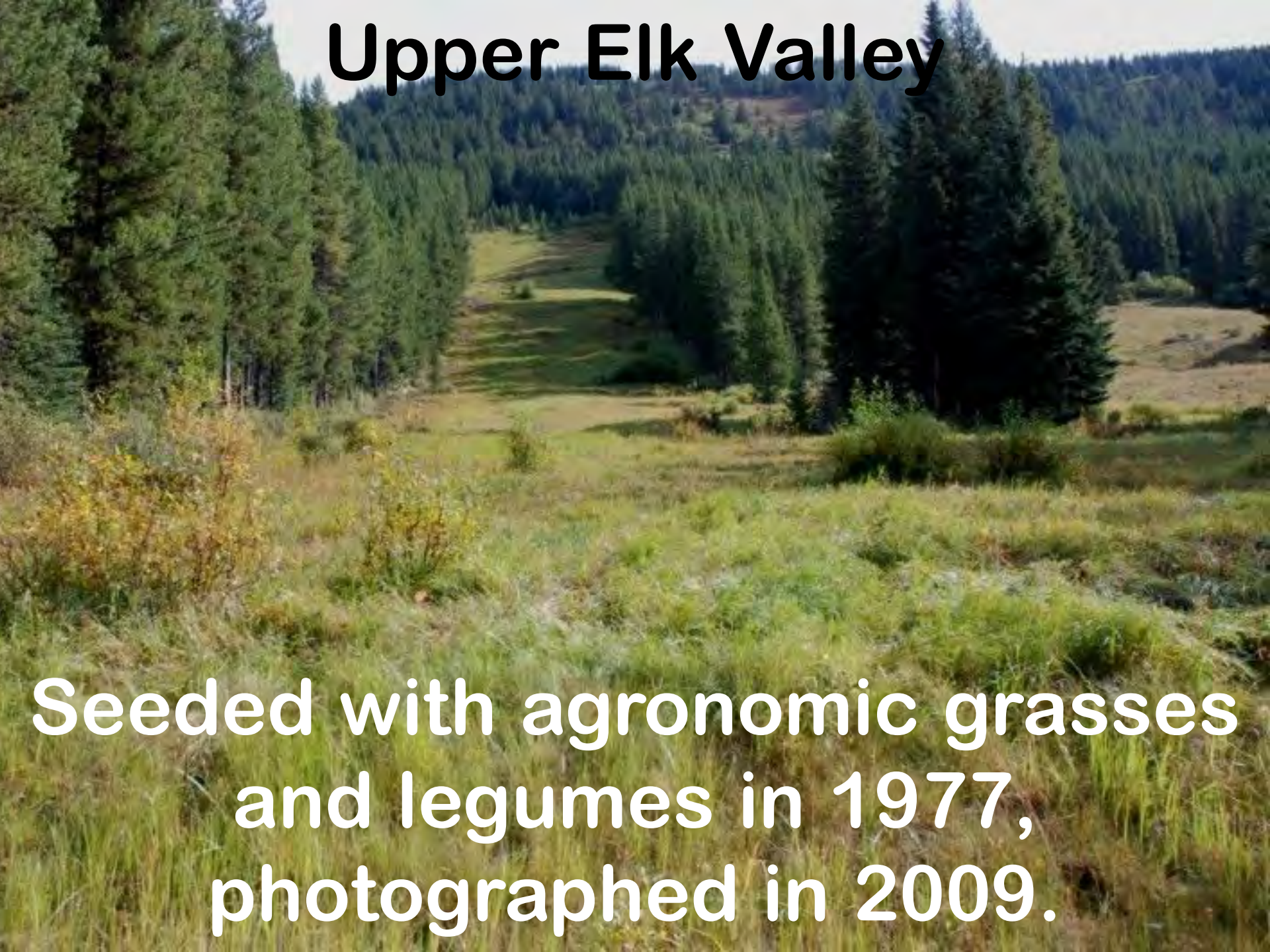


DAVID POLSTER,
POLSTER ENVIRONMENTAL SERVICES LTD.



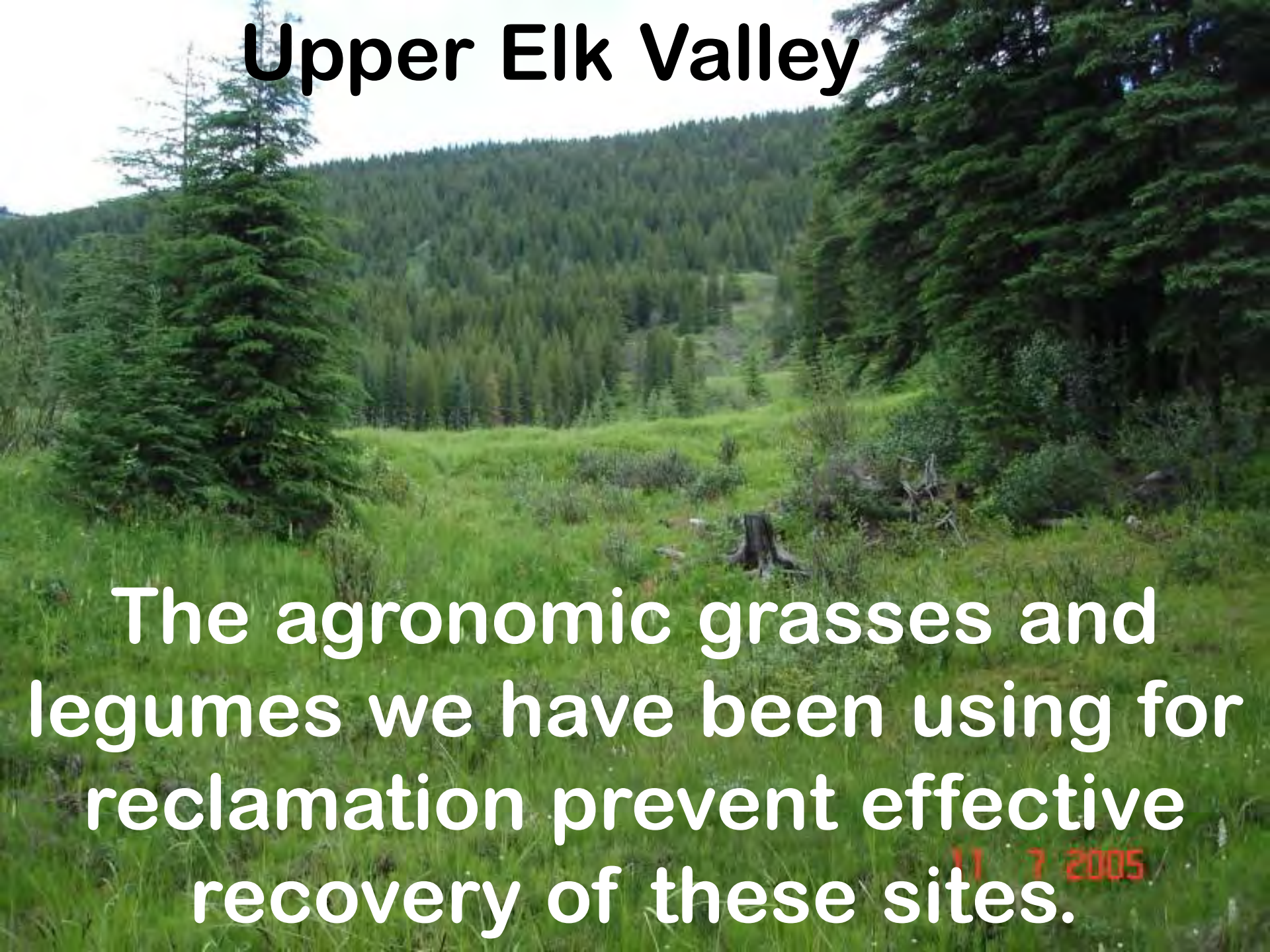
**Helicopter
seeding
exploration
trench in the
Upper Elk
Valley in the
fall of 1977**

Upper Elk Valley



Seeded with agronomic grasses
and legumes in 1977,
photographed in 2009.

Upper Elk Valley



The agronomic grasses and legumes we have been using for reclamation prevent effective recovery of these sites.

11 7 2005



Ecologically based strategies seek to re-establish natural successional trajectories on lands used for mining.

2 9 2005

Over 500,000 Red Alder trees
planted at the Island Copper
Mine





12 years old

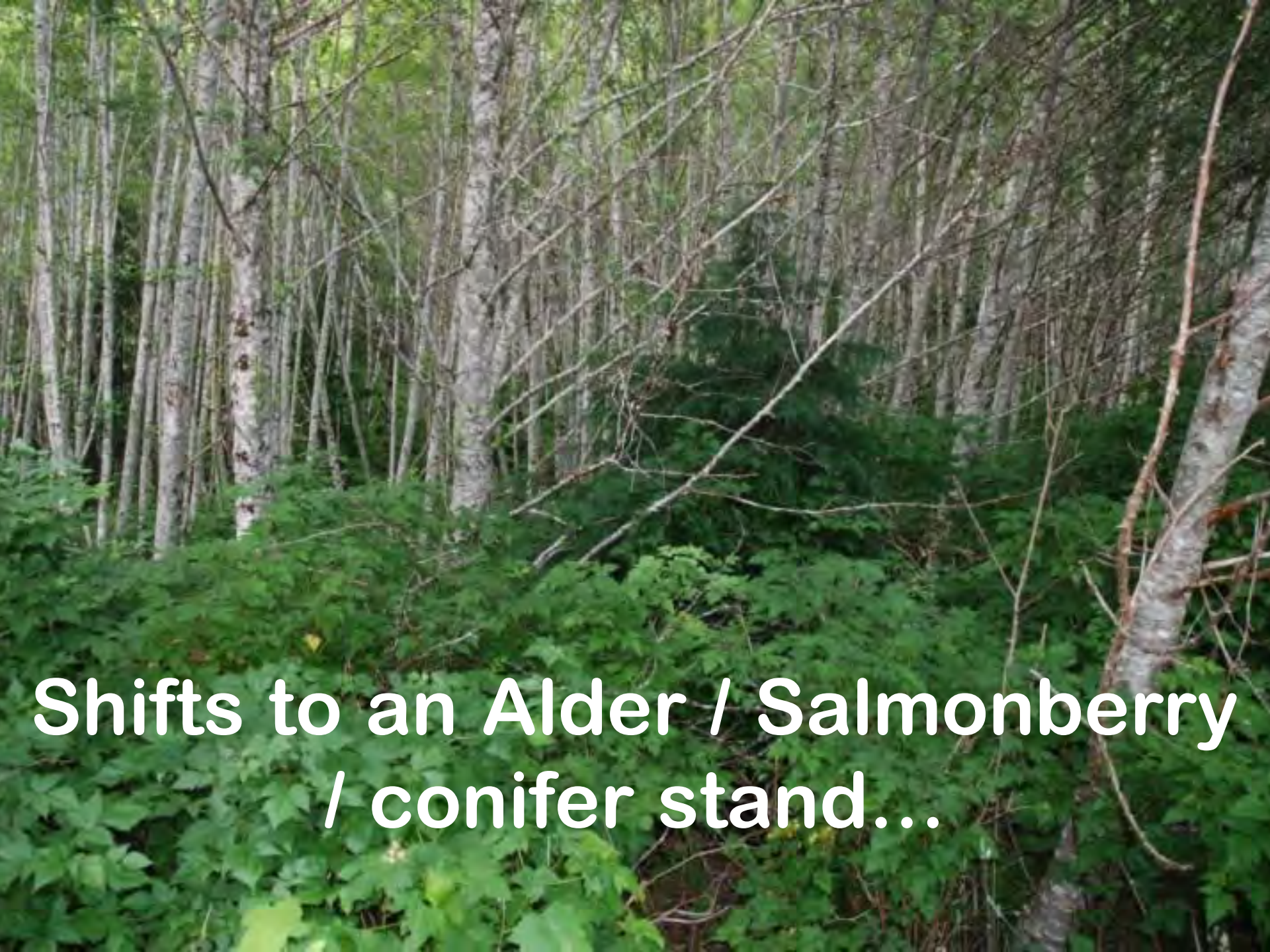
Establishment of pioneering species such as alder on waste rock dumps results in excellent vegetation growth.

2 8 2007

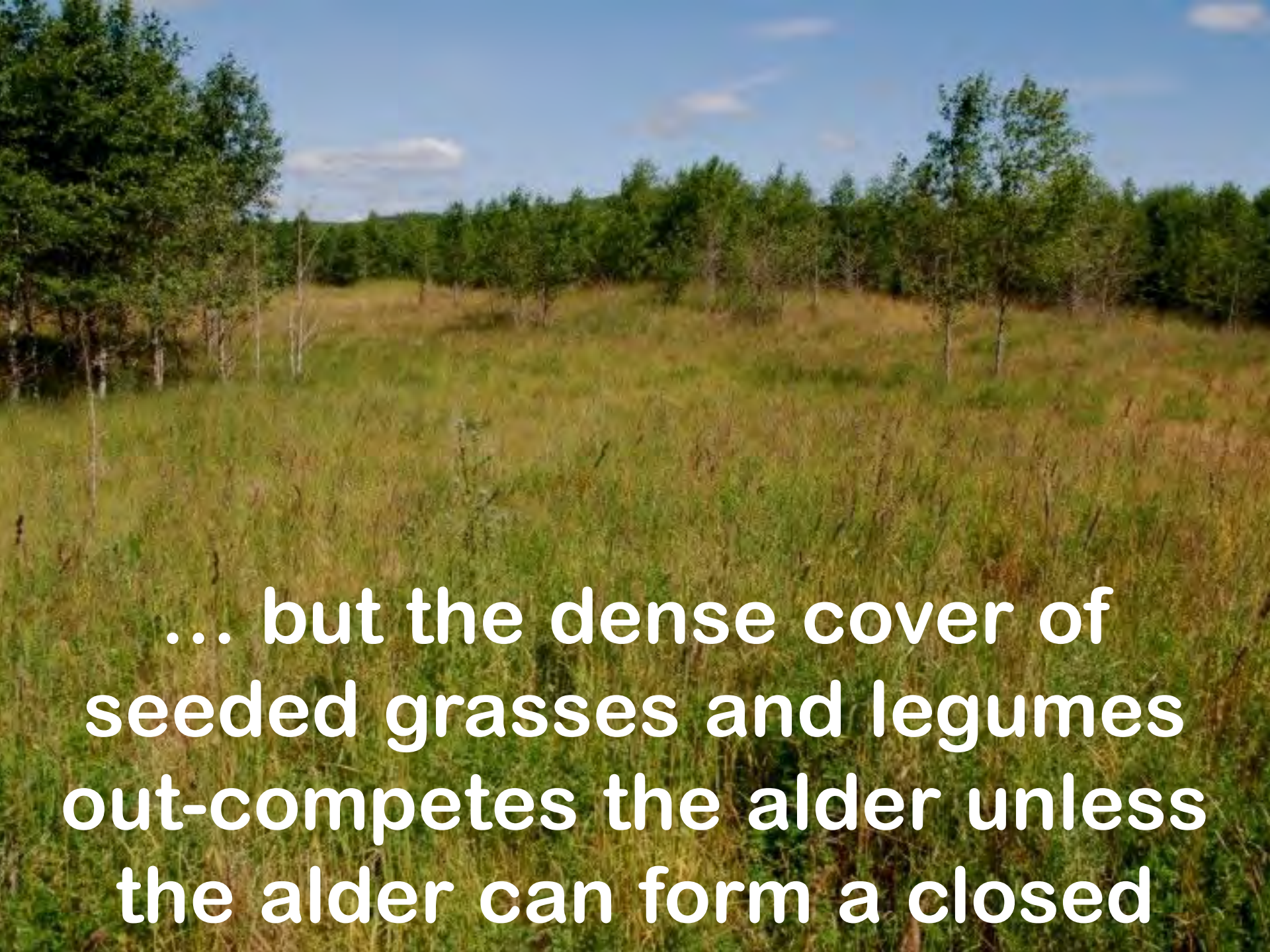


25 years old

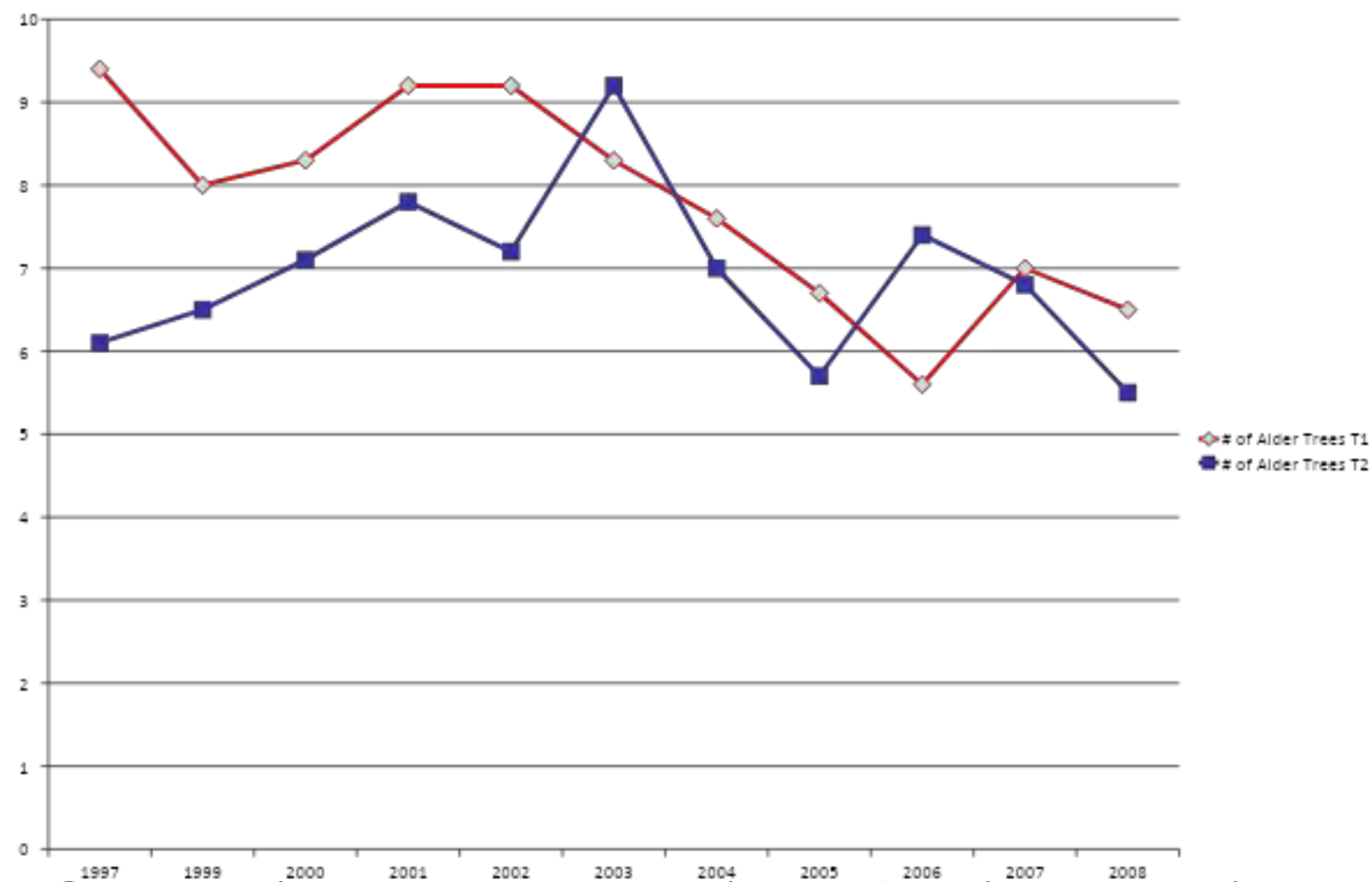
2 9 2005

A photograph of a forest. The background is filled with numerous thin, light-colored tree trunks, likely birches, standing vertically. In the foreground, there is a dense, lush green undergrowth of various plants and shrubs. The text is overlaid on the lower portion of the image.

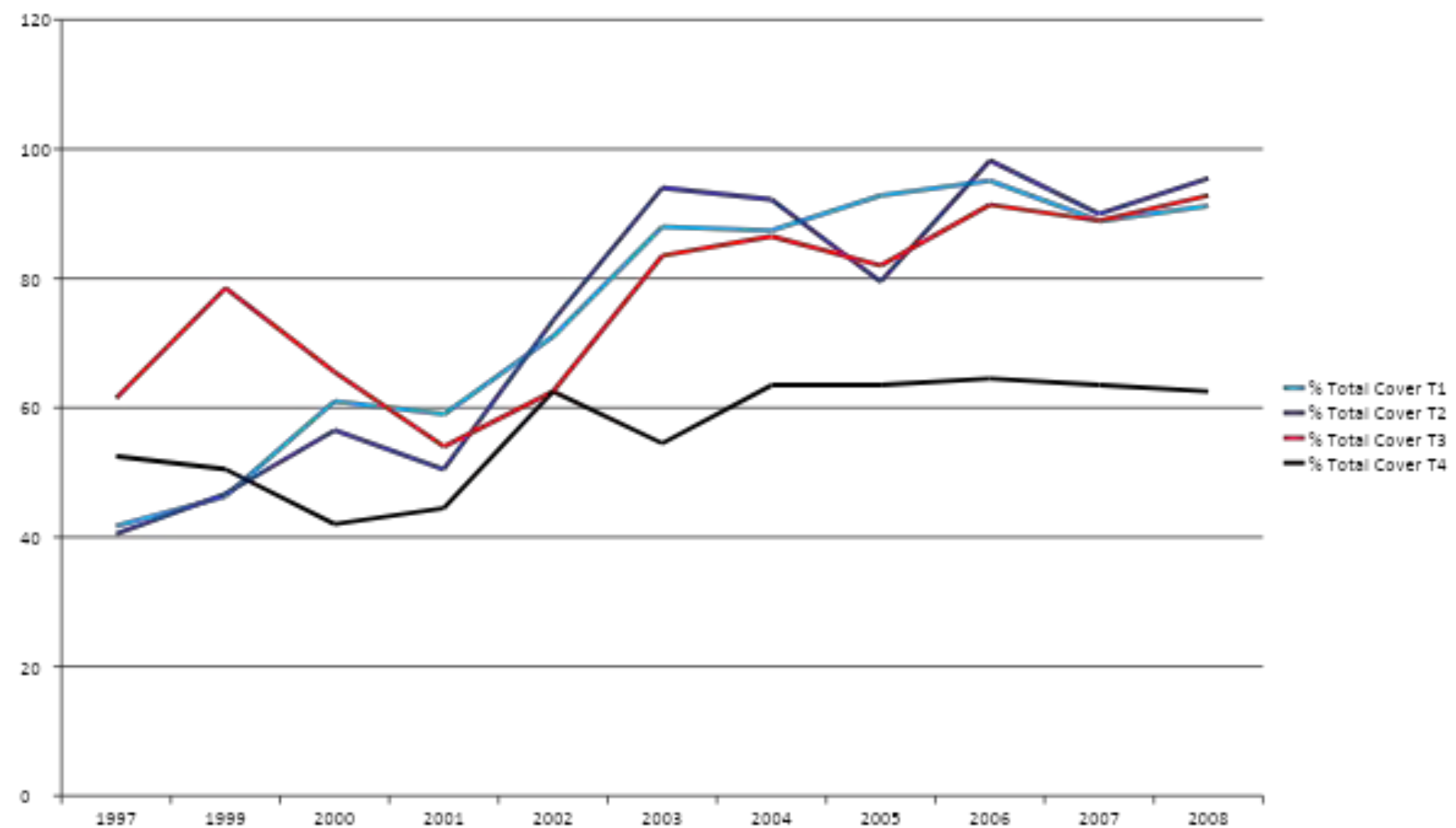
Shifts to an Alder / Salmonberry
/ conifer stand...



... but the dense cover of
seeded grasses and legumes
out-competes the alder unless
the alder can form a closed



So we have seen a drop in the number of alder trees over the years...



...even as the total cover has gone up.

A photograph showing a steep, eroded hillside. In the foreground, a large, light-colored concrete retaining wall stands vertically. To the left of the wall, a yellow excavator is working on the slope. Further up the hill, a red crane or derrick is visible. The background is filled with a dense forest of tall evergreen trees. The sky is blue with some light clouds.

Seeding slopes for erosion control

Fall 1985

Excellent cover of seeded species...

August 27, 1992

'92 8 27



...almost too good (preventing woody species establishment). July 9, 2005

9 7 2005

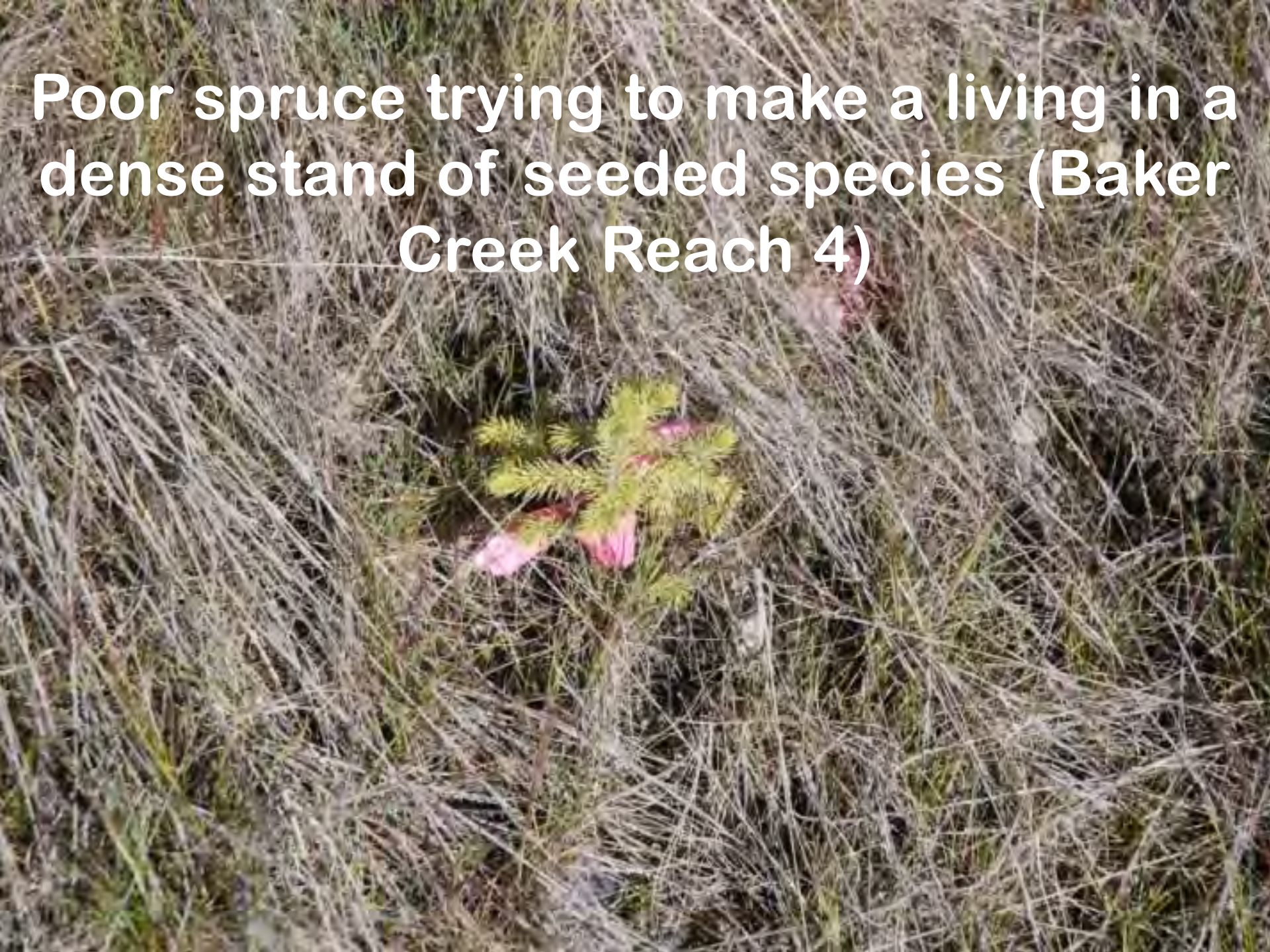


Slow encroachment - August 1, 2009

Dense stand of seeded grasses and legumes at Giant Mine Site (Baker Creek Reach 4)



Poor spruce trying to make a living in a
dense stand of seeded species (Baker
Creek Reach 4)



30 year old NWT well site

A photograph of a grassy field, likely a well site, with a dense line of trees in the background under a cloudy sky. The foreground is filled with various types of grass and small shrubs, some of which are identified as Creeping Red Fescue.

Creeping Red Fescue

Another 30 year old NWT well site



Creeping Red Fescue

Freshly seeded NWT well site



Not some cheap afterthought by a
guy with a hand seeder...



11 years of forest recovery right
next to seeded well site...



Seeded Selwyn exploration site, the only place I found invasive species



Faro freshwater reservoir area seeded and staked



21 7 2007

Yesterday...



Faro Grum sulphide cell cover project, seeded



Faro Grum sulphide cell cover project



Seismic Site

A photograph of a grassy field with a forest in the background. The foreground is filled with tall, dry, yellowish-brown grass. In the background, there is a dense forest of tall, thin trees, likely birches, with green foliage. The sky is blue with some white clouds.

Seeded agronomic grasses and legumes create successional stagnation conditions.

Wildlife collisions are a major problem...

Vehicles Stop Wildlife DEAD in their tracks ...

There are 4 to 8 large animal-vehicle collisions every hour in Canada.

Past wildlife-vehicle accident records demonstrate that in a typical year in B.C. it is estimated that:

- 3 people are killed
- 2,477 motorbikes are injured
- 4,200 animals are considered as victims
- 15,000 wildlife deaths go unreported

The Wildlife Factor

Behaviour

- Some animals may jump suddenly onto the road.
- Some animals travel in groups. If one animal strikes the road, others may follow.
- All animals are unpredictable – even if one sees you, it still may jump in front of your vehicle.

Time of Day About 40% of collisions occur between 7:00 pm and midnight.

Time of Year

- Spring** Early vegetation green-up – most roads attract animals.
- Summer** Drought, food supply and forest fires all affect animal movement.
- Fall** Feeding, mating season – many animals are up the road.
- Winter** Road salt attracts animals.

Hints for The Highway

- When driving** Actively watch for wildlife and drive defensively. Watch out between dusk and dawn, when light levels are low and animals are active.
- Use Your Vehicle** Clean and maintainable headlights. Use high beams and scan the road ahead. Wear your seatbelt at all times.
- Do Not Drink or Drive** Do not take any drugs or alcohol. Consider using your brakes, not your wheels.

Obey wildlife warning signs. Do not disregard them. Just because you see no animals does not mean there are no animals. Wildlife use areas.

This Sign Means Watch for Wildlife Use Caution

Want To Help Save Our Wildlife

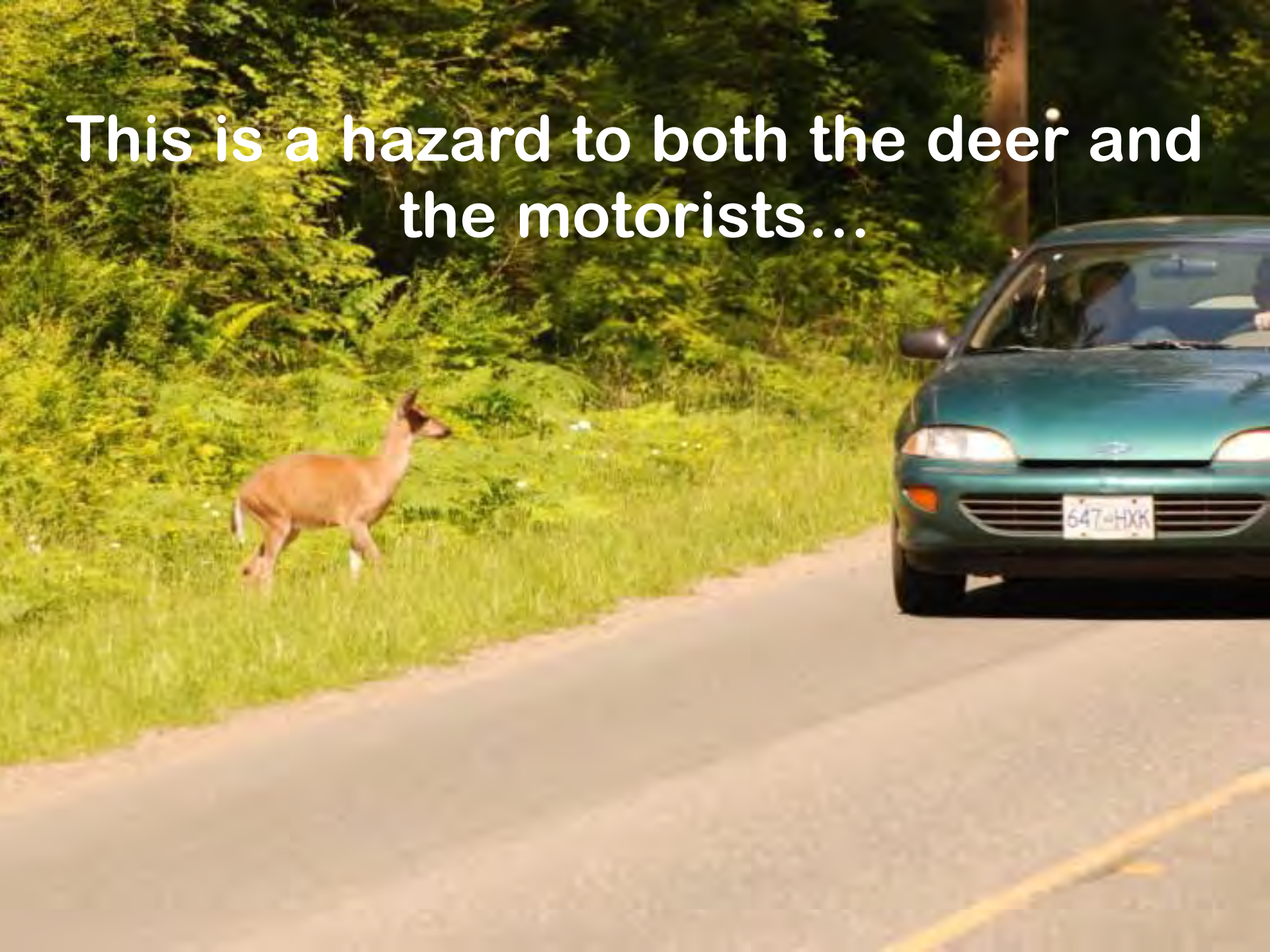
Don't feed wildlife. Use proper disposal and recycling methods. Wildlife attractants are not allowed in residential areas. Do not feed wildlife. Do not feed wildlife. Do not feed wildlife.

...but we do everything we can to provide enticing food for wildlife near the road.

Fresh grass in the spring brings the deer to the roadside...



This is a hazard to both the deer and the motorists...



Eventually bad things happen...





This is a restoration
issue...

A photograph of a multi-lane highway with a grassy shoulder in the foreground. Several vehicles, including cars and large trucks, are visible on the road. The background shows a hilly landscape under a clear sky. A large, white, bold text overlay is centered on the image.

Planting tasty forage
crops along highways
attracts animals with fatal
results – mostly for the
animals but sometimes
humans

Use of natural successional processes to inform vegetation management – a Yukon example...



Cleared roadside – initial successional
stage

8 9 2005



Cleared roadside – pioneering
invaders... lot's of moose food!

5 9 2005



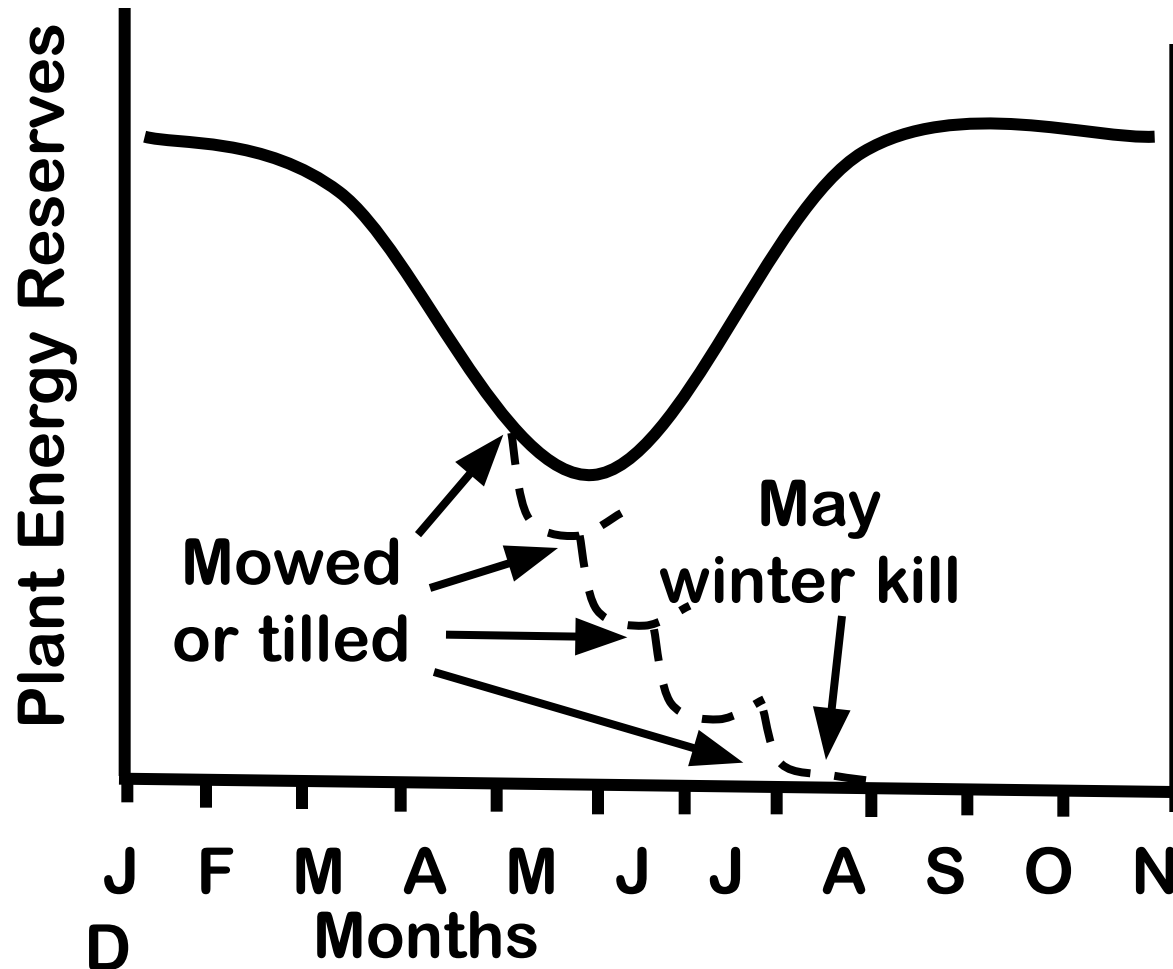
Blocks sightlines, hides signs...

8 9 2005

What do we do when we have brush problems?

Send in the brush cutters...

8-9-2005



Cutting when root reserves are high will result in increased growth

A photograph of a forest clearing. In the background, a dense stand of trees with yellow and orange autumn foliage rises. The foreground is a cleared area with dark, rich soil, scattered fallen logs, and some low-lying vegetation. The text is overlaid in white, bold font.

Cutting causes re-growth of the cut species – suckering of pioneering plants.

Cleared roadside – grows to dense thicket... good cover for moose...



Cleared roadside 2005 – clearing
repeated

8 9 2005

A gravel road curves through a landscape of cleared land. On the right side of the road, there are several large piles of brush, branches, and debris. In the background, a dense line of trees with yellow and orange autumn foliage stands against a blue sky with light clouds. The overall scene depicts a roadside clearing project.

Cleared roadside 2005

8 9 2005



Cleared roadside 2006 – so what do we have?

16 9 2006

A photograph showing a dirt road that curves through a landscape. The foreground is filled with low-lying, scrubby vegetation in shades of green and brown. To the left, a line of tall, thin trees stands. In the background, rolling hills and mountains are visible under a pale sky. The overall scene suggests a remote, natural environment.

Pioneering vegetation – let's take a closer look...

15 9 2006

A photograph showing a dense cluster of young aspen saplings. The trees have thin, dark brown trunks and are covered in green leaves, some of which are beginning to turn yellow, indicating autumn. The ground is covered with fallen leaves and some low-lying vegetation. In the background, a concrete wall or fence is visible.

Rapidly growing aspen

16 9 2006



Rapidly growing balsam poplar



A variety of rapidly growing pioneers...

18 9 2006

A photograph showing a wide, cleared roadside area with a dirt road. The ground is brown and uneven, with some roots exposed. In the background, there is a dense forest of thin, light-colored trees, possibly birches, under a cloudy sky. The text "Cleared roadside – look to forest to get off this early successional treadmill..." is overlaid in white at the bottom.

Cleared roadside – look to forest to get off this early successional treadmill...

8 9 2005



Open aspen forest – limited cover for a
moose and no forage..8 9 2005



Kinnikinnick (*Arctostaphylos uva-ursi*) -
ideal understory

8 9 2005

Details...

8 9 2005



Selective removal of understory stems
to speed opening up of forest.

8 9 2005



Selective removal of understory trees,
pruning spruce boughs...

8 9 2005

A photograph of a forest with many tall, thin trees with white bark, likely aspens or birches. In the center of the forest, there is a single, smaller evergreen tree, which is a spruce. The ground is covered with dry leaves and low-lying vegetation. The sky is visible through the canopy of trees.

What about the spruce?

8 9 2005

A photograph of a dense forest of tall, thin evergreen trees, likely spruce or fir, with a gravel path in the foreground. The trees are closely packed, and the ground is covered in brown, dry-looking vegetation and fallen branches. The sky is visible through the canopy, showing a clear blue color.

Late successional stage but dense...

8 9 2005



Prune branches, remove young ~~red~~ trees.

Lichens and mosses...



8 9 2005



Prune branches...

8. 9. 2005



With branches pruned, no need to touch
this site for decades..8 9 2005

Understanding vegetation successional
patterns allows cost effective
management



A photograph of a wooded area with a dirt path. On the left side of the path, there is a white rectangular sign supported by two wooden posts. The path leads into a dense forest of green trees. The foreground is covered with low-lying green vegetation and some bare soil.

Some simple solutions to
sight lines

8 6 2007

Just getting started, 12:02 PM



Sight lines restricted



Sight lines opened, 1:03 PM



10 8 2007

Just getting started, 2:12 PM



10 8 2007



Sight lines opened, 2:30 PM

10 8 2007

Pruning branches opens the sightlines
without opening the site to early
successional species.



27 7 2005

A photograph showing a paved road on the left side, leading towards a dense forest of tall evergreen trees. The foreground is filled with lush green vegetation, including ferns and grasses. In the distance, a small white building is visible through the trees. The sky is clear and blue.

Used on forestry intersections

27 7 2005

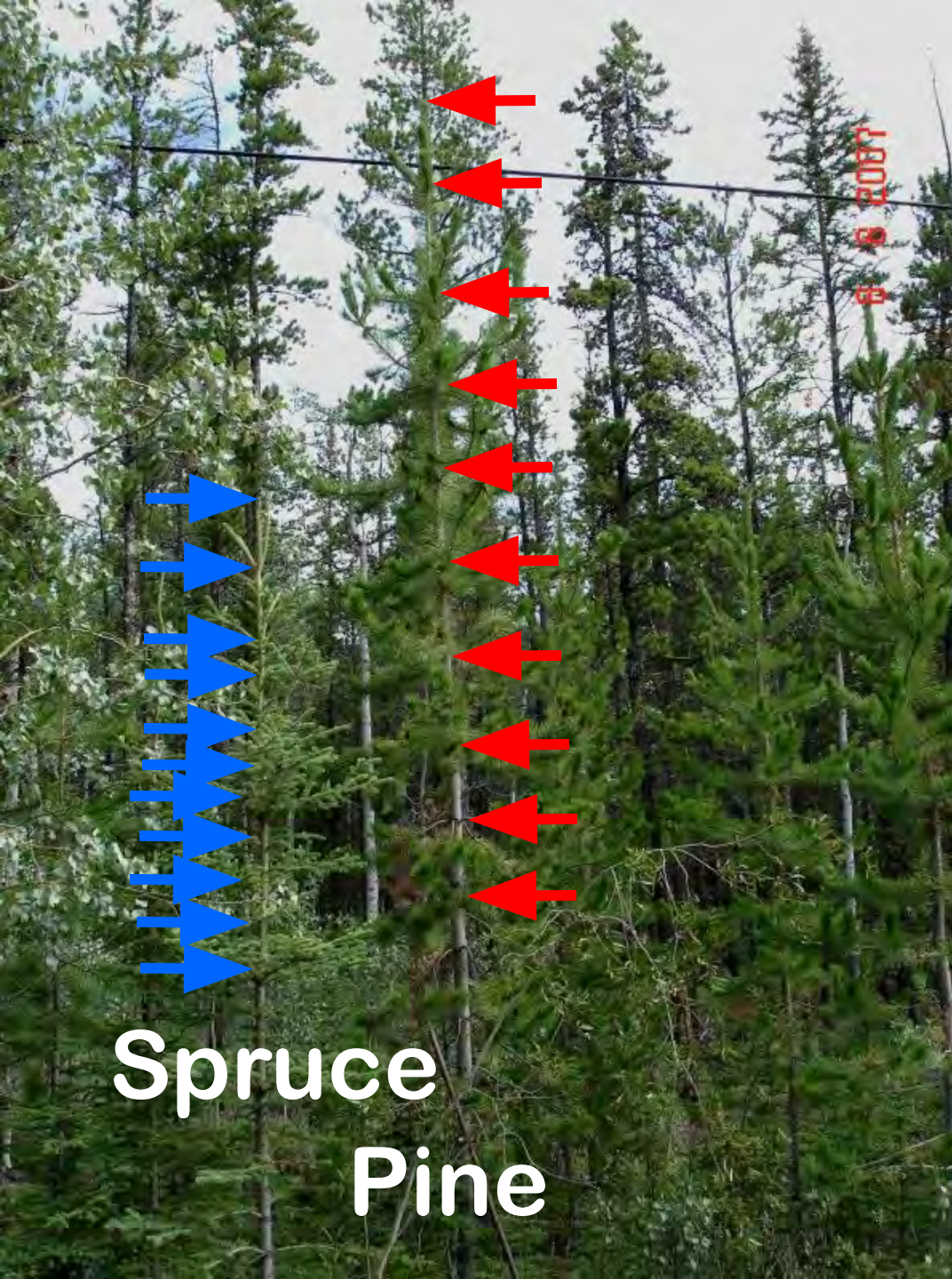
Cutting pioneering woody species
under power lines results in rapid
re-growth of these species

25 7 2007



Treatments under
power lines

8 8 2007



**Select
species with
slower
growth rates**

**Spruce
Pine**

Dense early seral vegetation
blocks sightlines



A bit of selective pruning...





...and we can go from here...

25 9 2007



...to here (September, 2007).

25 9 2007



May 21, 2008



May 15, 2009

A photograph of a road scene. In the foreground, a paved road with a white line runs horizontally. Behind the road is a grassy area with many thin, vertical tree trunks. A dark-colored car is parked or driving on a road behind the trees. In the background, there are more trees and a utility pole with power lines. The sky is overcast.

June 18, 2011



May 10, 2013



**BC Hydro removed
the Heber River Dam and was faced
with the need to restore the disturbed
sites**

There was a 3 km penstock that was also removed.



So we made project sites rough and loose and covered them with woody debris...



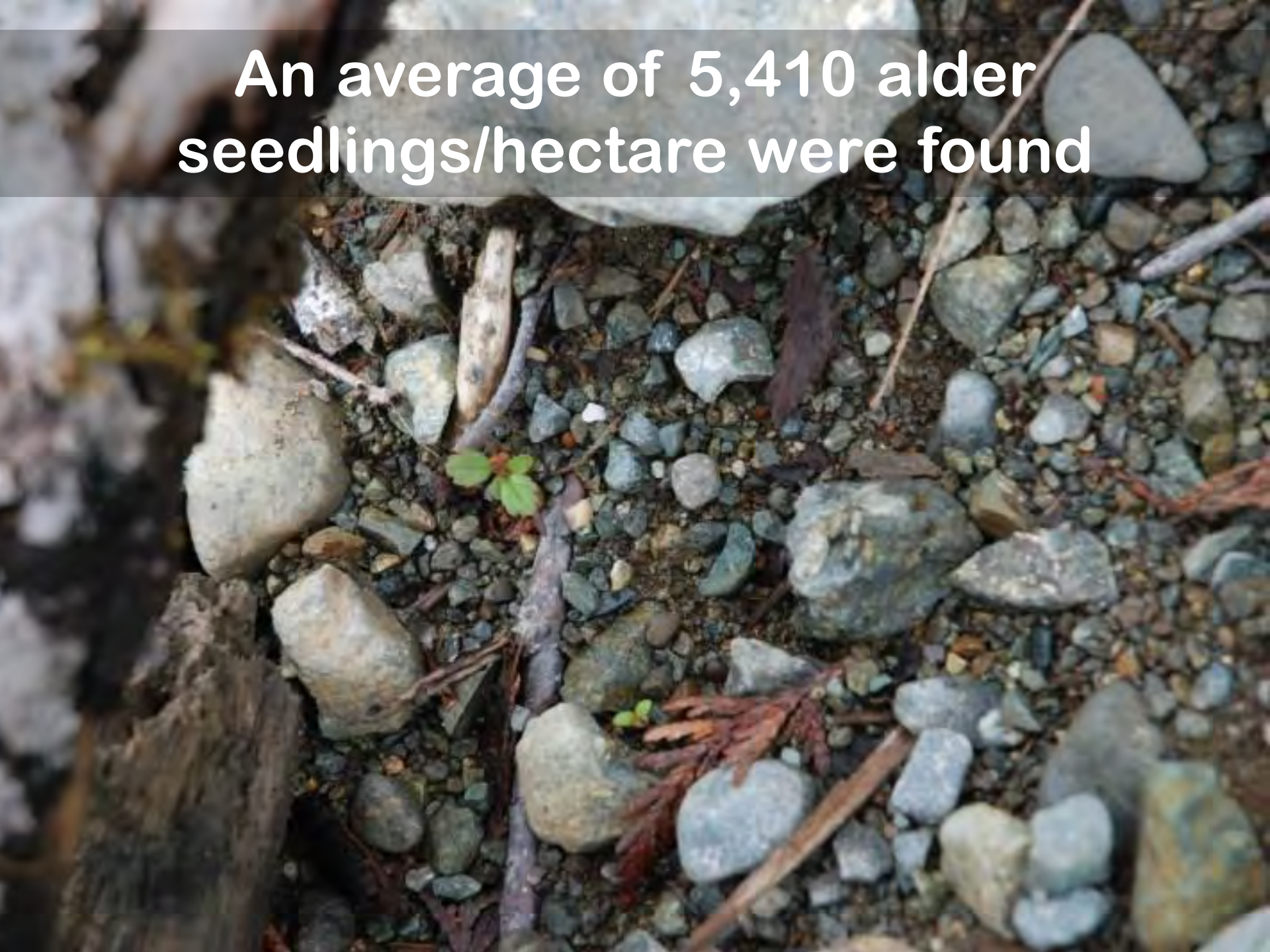
By November 13th, 2012 the project sites were ready for winter.



**Monitoring transects were established
at 5 project locations, July 16, 2013**



An average of 5,410 alder seedlings/hectare were found



Including between the rocks of the
rip-rap



A photograph of a forest path. The path is composed of dirt and small stones, showing signs of erosion and compaction. The surrounding area is filled with dense green foliage and trees. The text "Mount Tuam Road Restoration" is overlaid in large white letters at the top.

Mount Tuam Road Restoration

Compaction and
erosion issues

Unauthorized access





Making sites rough and loose



Rough and loose road

October 17, 2011

A photograph of a forest floor. The ground is covered in a dense carpet of new seedlings, appearing as a mix of green and brown. A path or clearing leads through the undergrowth towards the background. The background is filled with tall, green trees and foliage. The text "Carpet of new seedlings" is overlaid in white at the top.

Carpet of new seedlings

June 28, 2012

A close-up photograph of a young Douglas-fir seedling growing in a forest. The seedling has several thin, green, needle-like leaves. It is surrounded by dark brown soil, small rocks, and some dried leaves. Other small green plants are visible in the background.

Douglas-fir seedling

March 23, 2013

A photograph of a low-growing plant with bright green, deeply lobed leaves, identified as Oceanspray. The plant is growing in a sandy, rocky environment with some dry leaves and twigs scattered around. The background is a mix of light brown sand and small, greyish rocks.

Oceanspray

August 13, 2013

Red Alder

A young Red Alder seedling is the central focus of the image. It has three distinct, ovate leaves with serrated margins and a prominent midrib. The seedling is growing from a patch of brown, moist soil. Surrounding the seedling is a dense carpet of green grass and some dry, brown plant matter. The lighting is bright, suggesting a sunny day.

August 13, 2013



Pioneering plants are
ready to work for us

Faro Mine