Climate Change
and
Insects and Pathogens

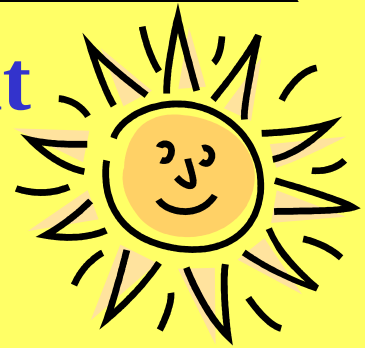
Karen Ripley, Forest Health Program Manager
Washington Department of Natural Resources

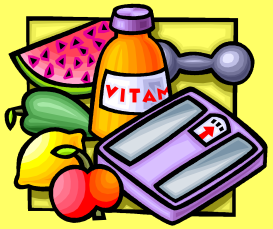
Host

Pathogen

Disease
or Damage

Environment





Mountain Pine Beetle

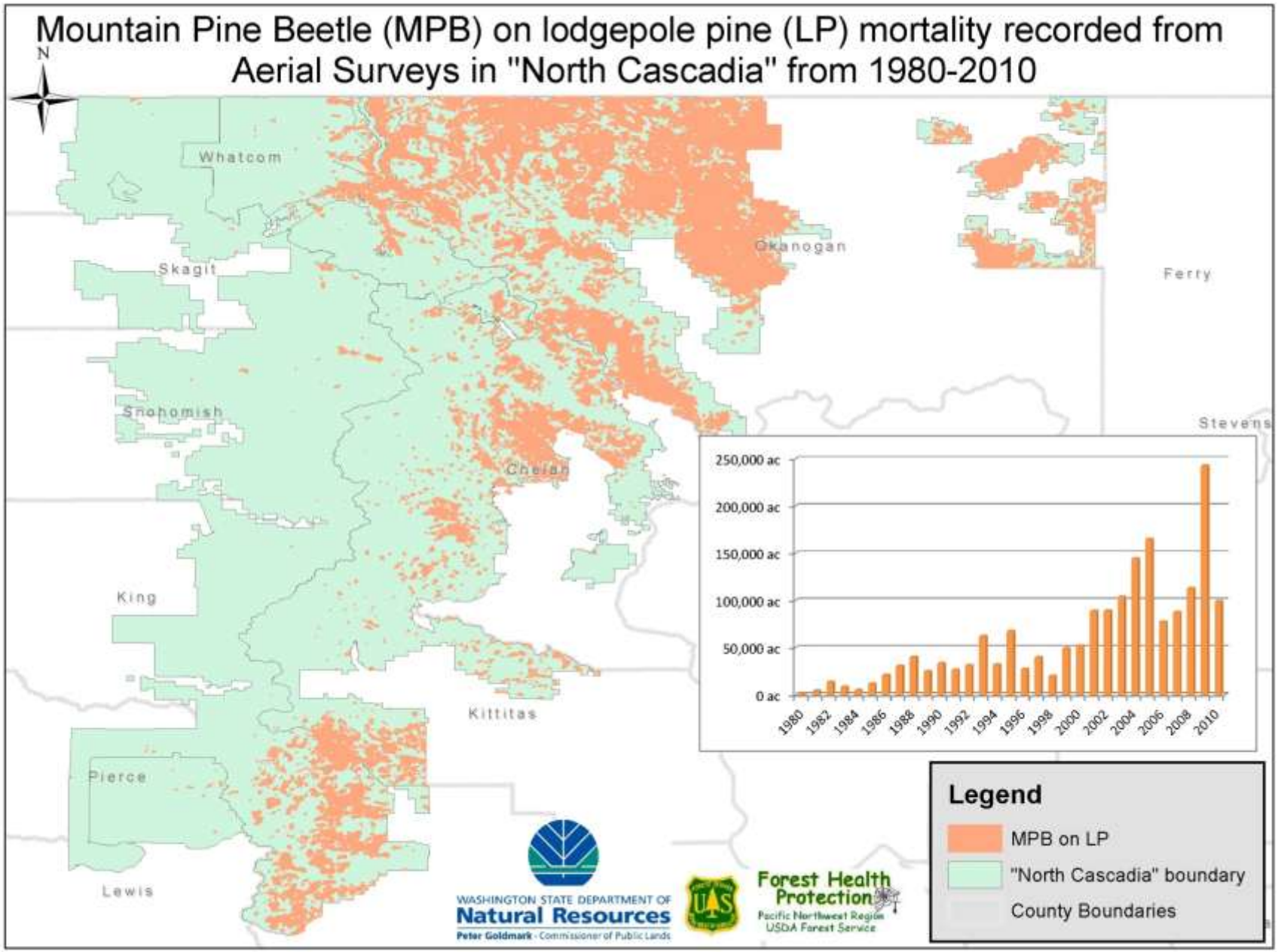
- Prefers mature hosts

- hot, dry summer creates host stress

- killed at less than 30°F below zero for 5 days

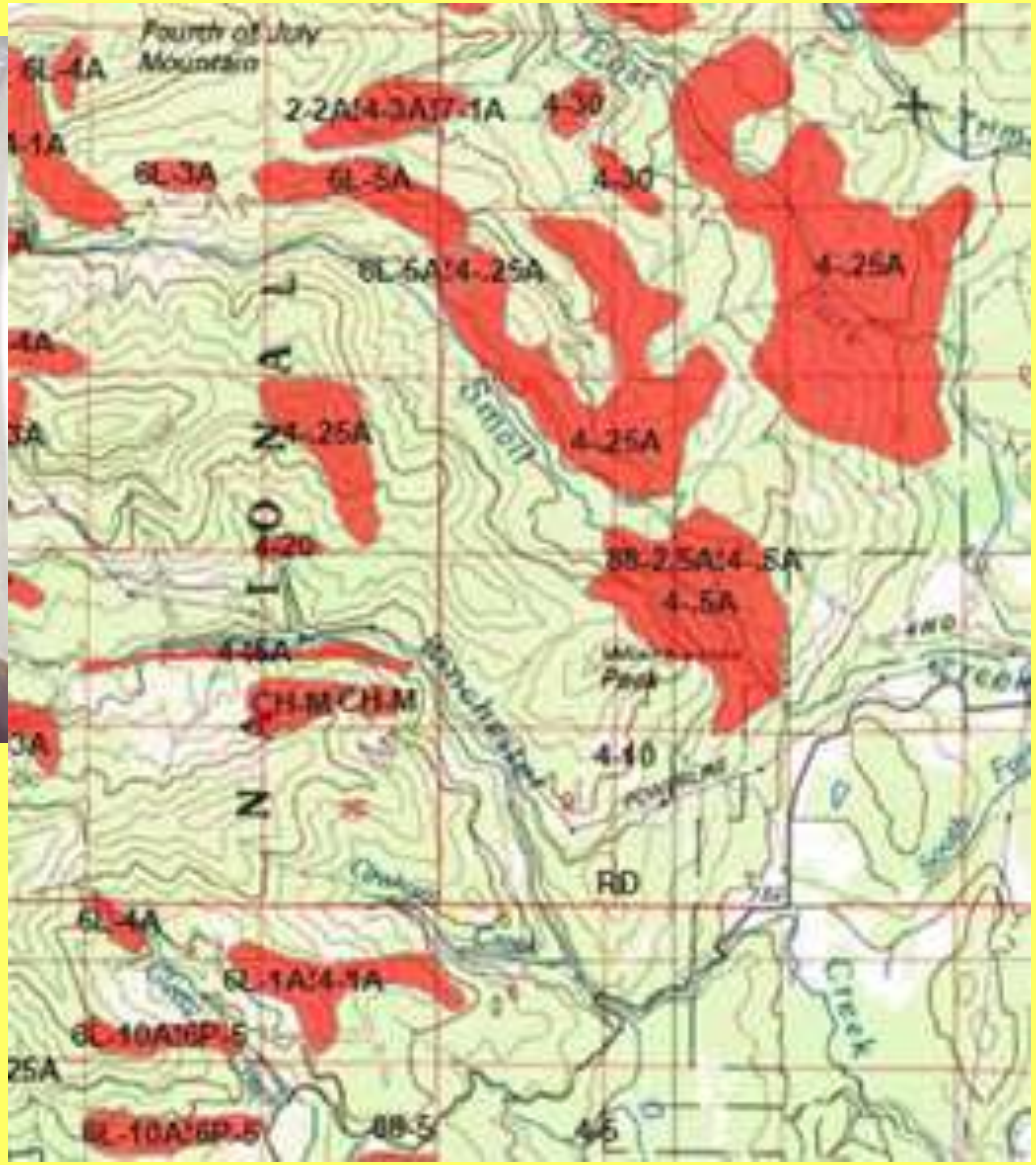
- heat accumulation that synchronizes 1 yr life cycle

Mountain Pine Beetle (MPB) on lodgepole pine (LP) mortality recorded from Aerial Surveys in "North Cascadia" from 1980-2010

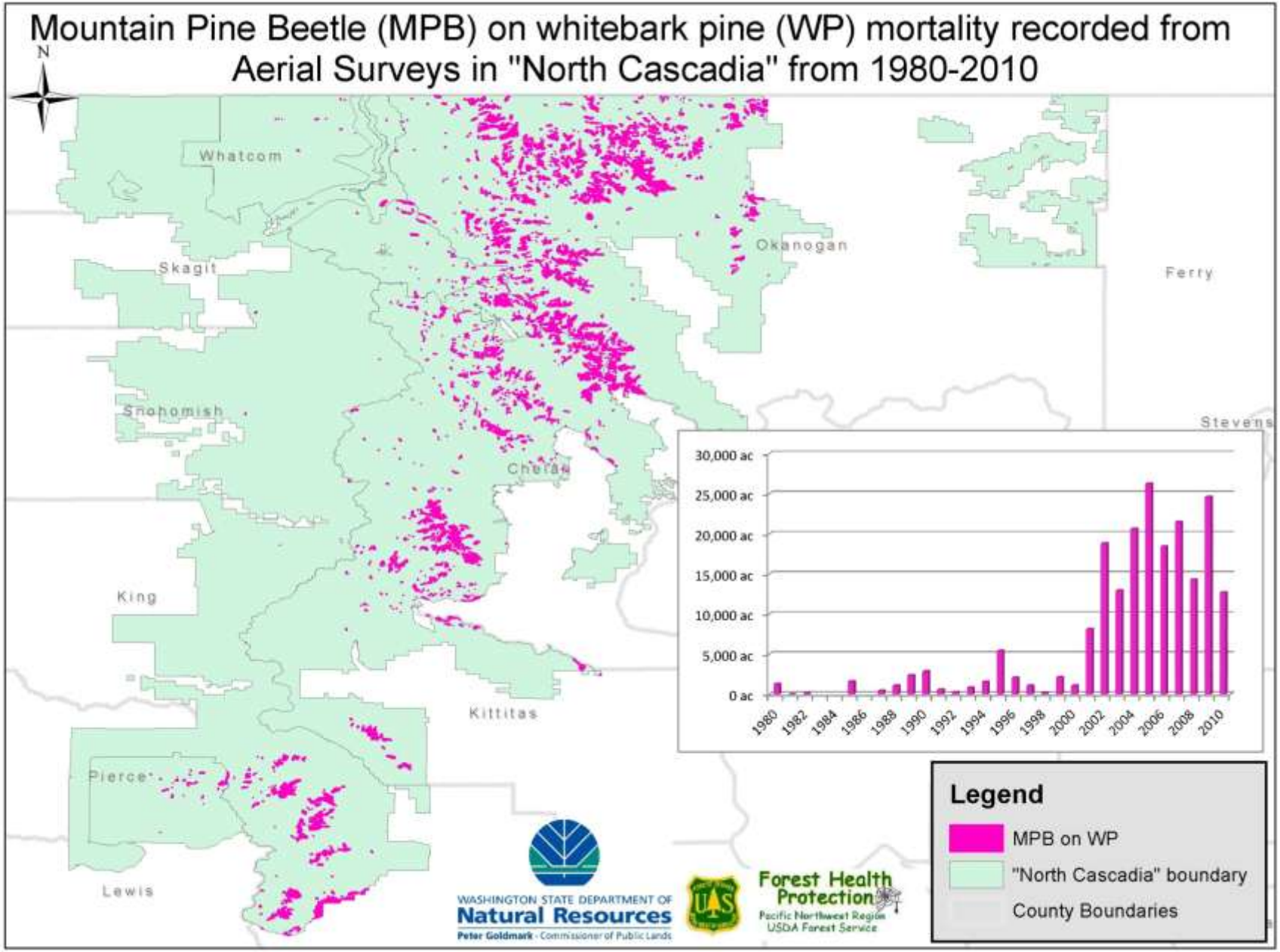


Annual “Aerial Survey”

Aerial observer:
Jeff Moore



Survey Map


Mountain Pine Beetle (MPB) on whitebark pine (WP) mortality recorded from Aerial Surveys in "North Cascadia" from 1980-2010
N
Whatcom
Skagit
Okanogan
Ferry
Snohomish
Chelan
Stevens
King
Kittitas
Pierce
Lewis
30,000 ac
25,000 ac
20,000 ac
15,000 ac
10,000 ac
5,000 ac
0 ac
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Legend
MPB on WP
"North Cascadia" boundary
County Boundaries
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USDA Forest Service
0
15
30
60 Miles

Pine Bark Beetle Avoidance

- **Develop a mosiac of lodgepole pine stands**
- **Thin overcrowded stands**
- **Remove the weakest trees**
- **Avoid injuring trees**

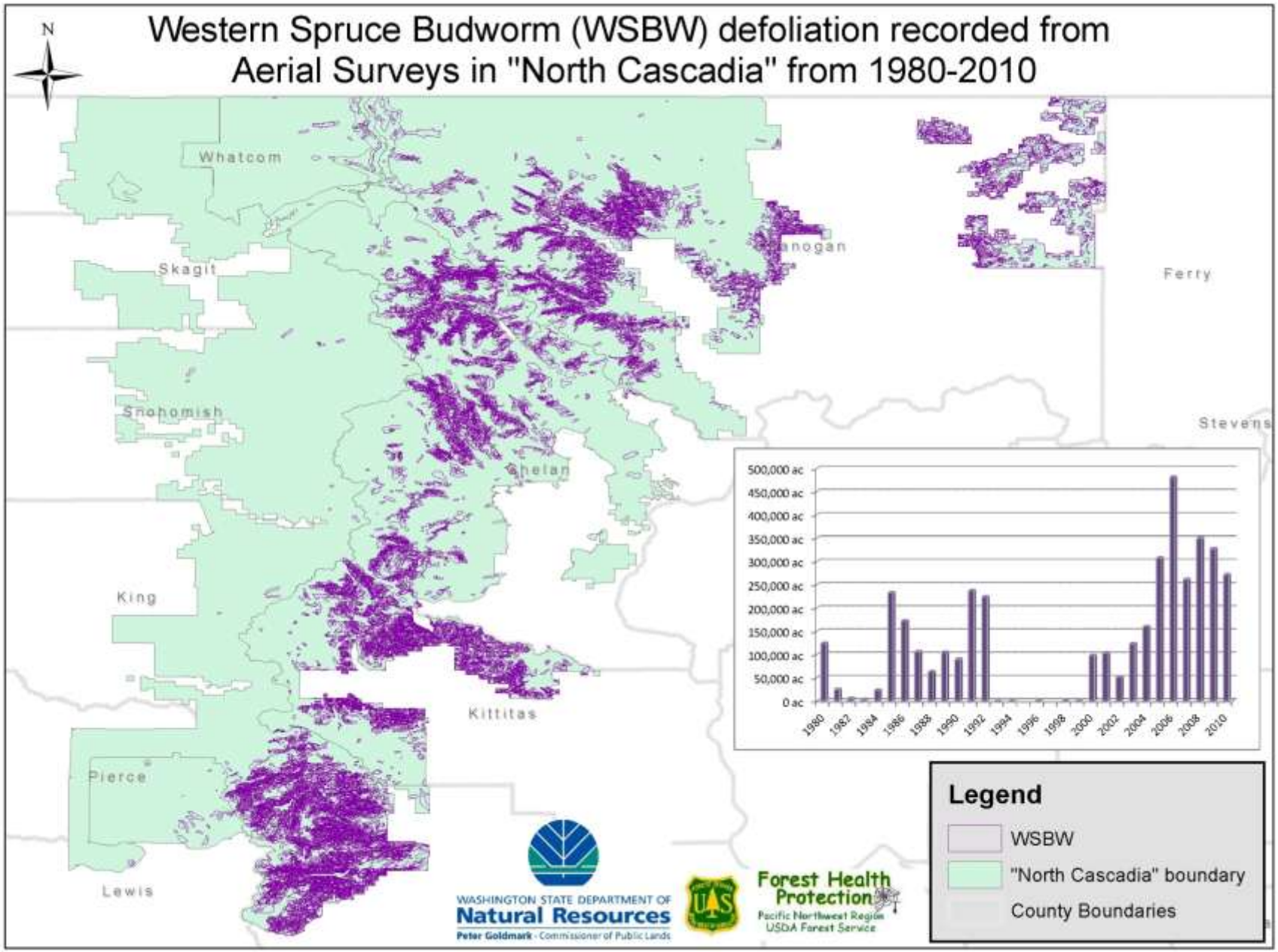
- **Preventive pesticides, innovative pheromone manipulation, selective breeding (whitebark pine) may be options**

Other Aerial Survey Results

(Cascadia, 31 years, acres):

Western Spruce Budworm	3.95 mil. acres
Mountain pine beetle (lodgepole)	1.7 mil. acres
Fir Engraver /Western Balsam Bark Beetle	753,000
Mountain pine beetle (western white)	431,000
Western black-headed budworm	280,000
Spruce Beetle	260,000
Balsam woolly adelgid	229,000
Douglas-fir beetle	213,000
Mountain pine beetle (whitebark)	204,000

Western Spruce Budworm (WSBW) defoliation recorded from Aerial Surveys in "North Cascadia" from 1980-2010



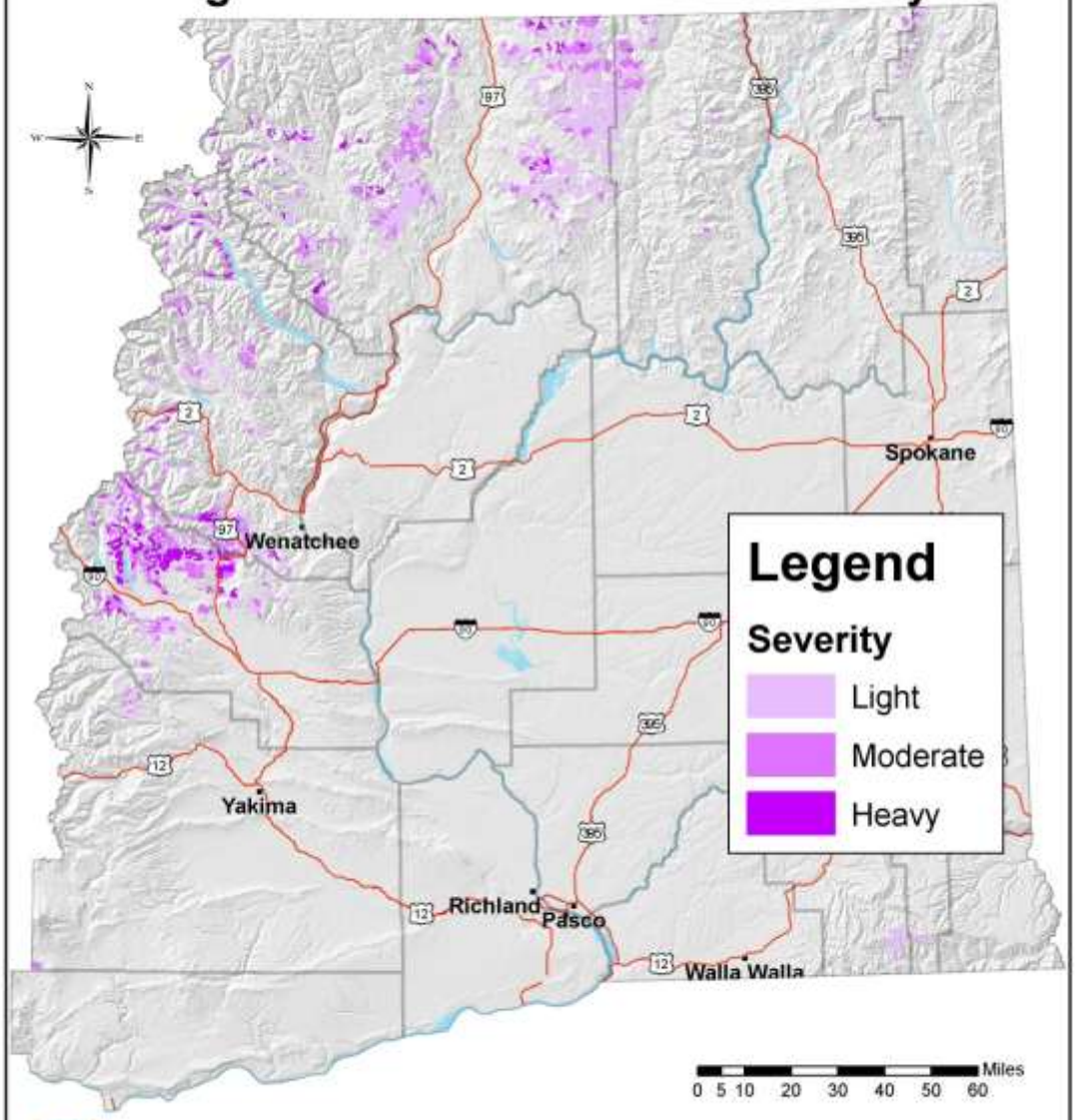
Western Spruce Budworm

Choristoneura occidentalis

- **Hosts: Douglas-fir and grand fir**
- **Eats just the new foliage each year**
- **Becomes serious after many years of activity**
- **Spring phenology (timing) is important**

DRAFT 09/26/2011

Western Spruce Budworm Activity in Eastern Washington Based on 2011 Aerial Survey Data



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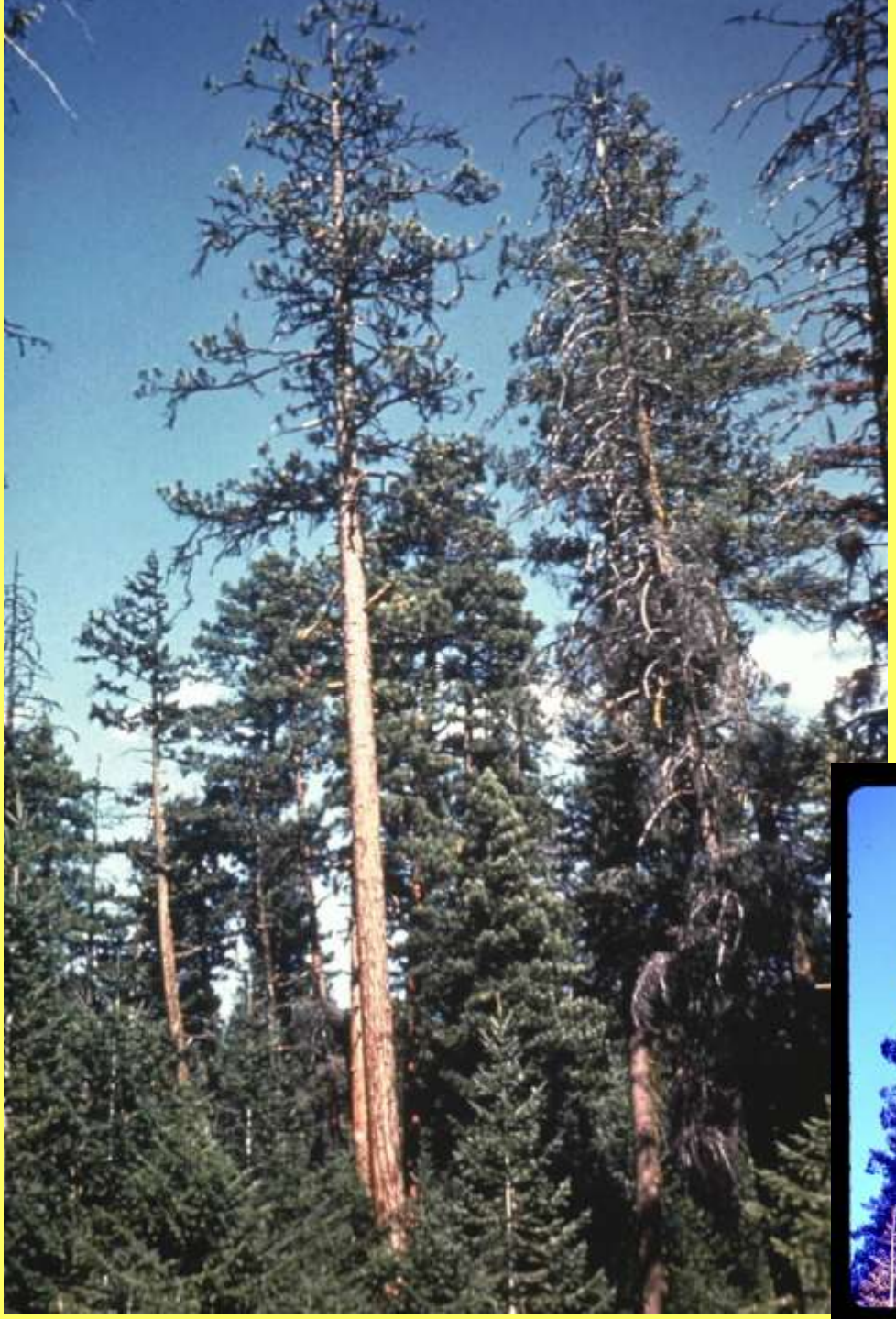


Forest Changes:

- Structure
- Species Composition
- Tree Density
- Tree Vigor

Mimic the structure natural fire would have produced:

more pine,

less fir,

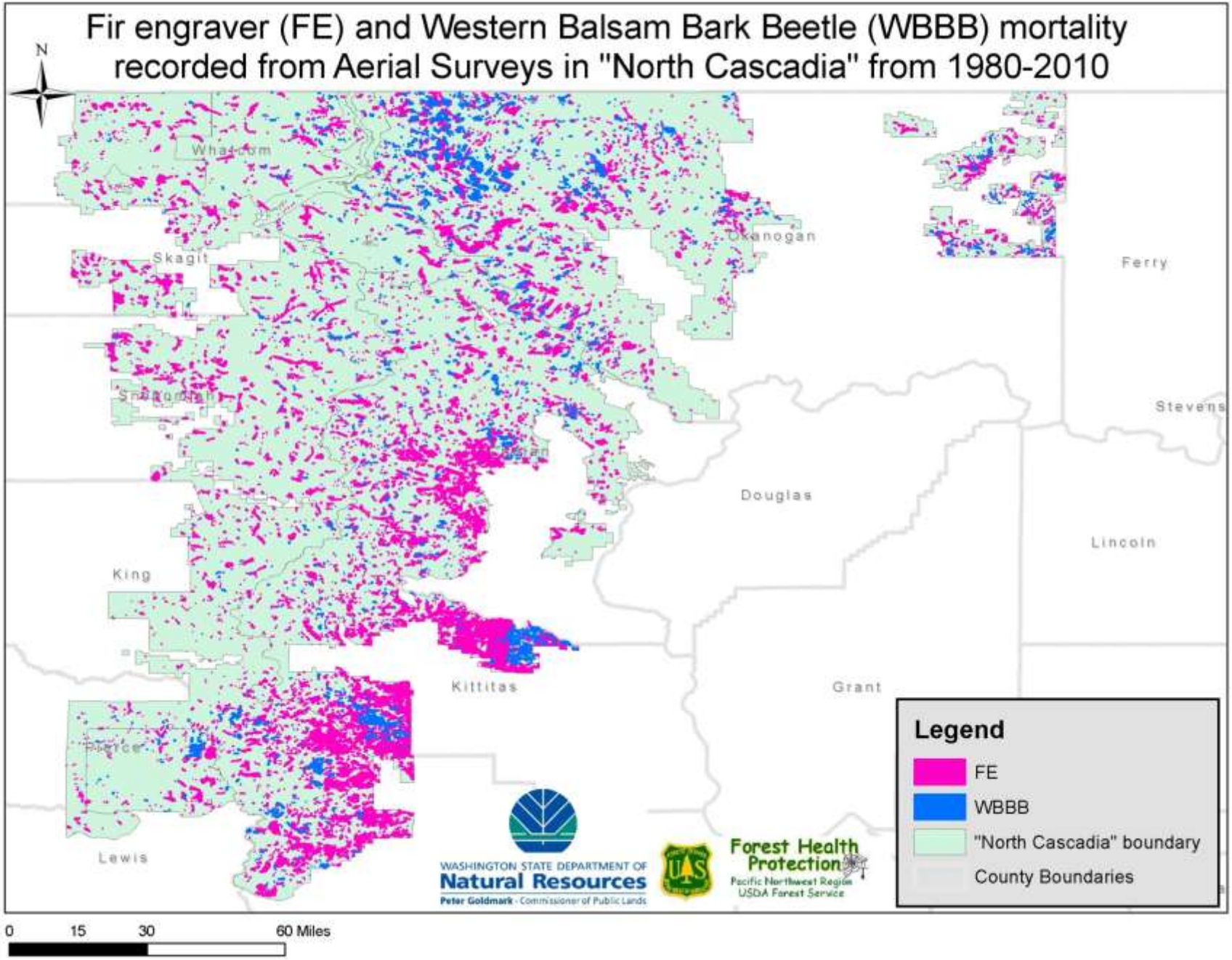
fewer layers

Abies

- Bark Beetles

- Balsam woolly adelgid

- Defoliators


Fir engraver (FE) and Western Balsam Bark Beetle (WBBB) mortality recorded from Aerial Surveys in "North Cascadia" from 1980-2010
N
Whatcom
Skagit
Okanogan
Ferry
Stevens
Douglas
Lincoln
King
Kittitas
Grant
Pierce
Lewis
Legend
FE
WBBB
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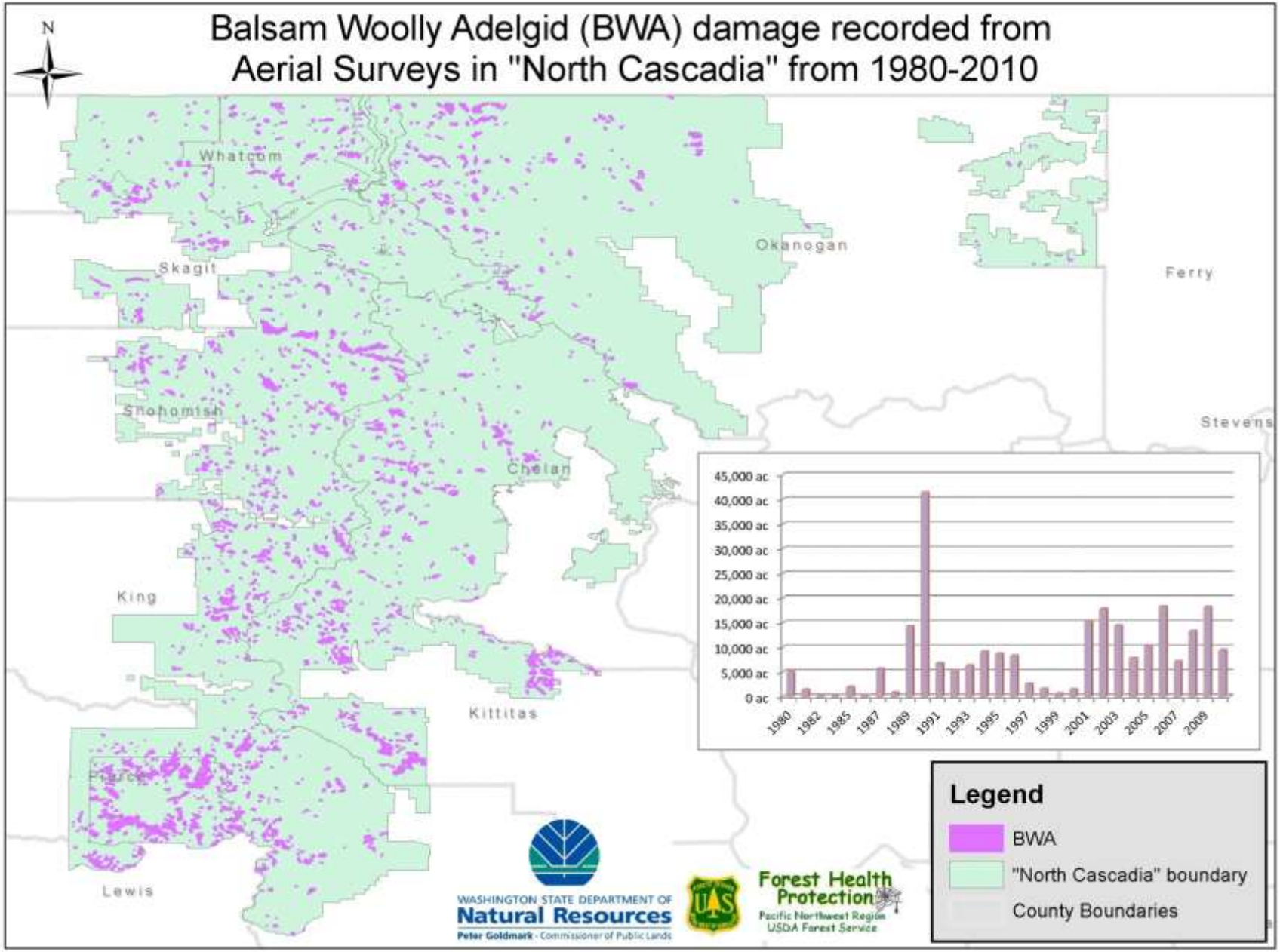
0
15
30
60 Miles

Balsam Woolly Adelgid

- **Exotic, Aphid-like insect**
- **Hosts: True Firs "*Abies*"**
- **Twig Infection:**
  - **"Wool" covered insects**
  - **Foliage loss**
  - **Gouting**

Symptoms/Signs:

- **Stem Infection:**
  - **“Wool” covered insects**
  - **Crown decline**
  - **Tree mortality rapid or delayed**


Balsam Woolly Adelgid (BWA) damage recorded from
Aerial Surveys in "North Cascadia" from 1980-2010
N
Whatcom
Skagit
Okanogan
Ferry
Stevens
Snohomish
Chelan
King
Kittitas
Lewis
45,000 ac
40,000 ac
35,000 ac
30,000 ac
25,000 ac
20,000 ac
15,000 ac
10,000 ac
5,000 ac
0 ac
1980
1982
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Legend
BWA
"North Cascadia" boundary
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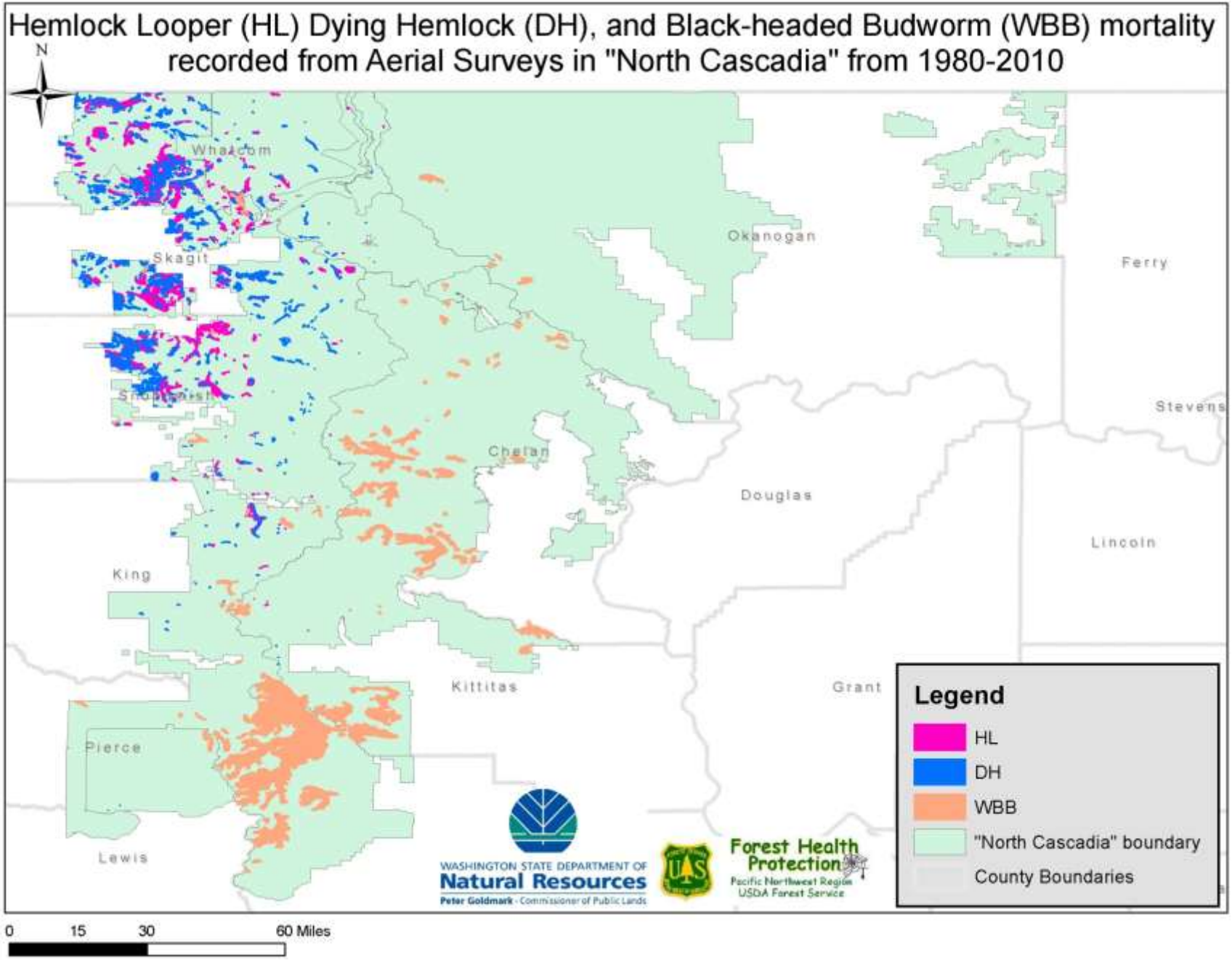
0
15
30
60 Miles

Western hemlock looper

Western black-headed budworm


Hemlock Looper (HL) Dying Hemlock (DH), and Black-headed Budworm (WBB) mortality recorded from Aerial Surveys in "North Cascadia" from 1980-2010
N
Whatcom
Skagit
Okanogan
Ferry
Stevens
Chelan
Douglas
Lincoln
King
Kittitas
Grant
Pierce
Lewis
Legend
HL
DH
WBB
"North Cascadia" boundary
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0
15
30
60 Miles

Heat or drought stress:

Alaska Yellow Cedar

Phleosinus bark beetles
- secondary; "hasten the death" or infest injured trees and tree parts
- Drought weakened western juniper 1920's - 30's.
- *Phleosinus sequoiae* is "more aggressive" than other species

Cool, damp spring

Foliage diseases:

- Swiss needle cast disease (DF)
- Larch needle casts

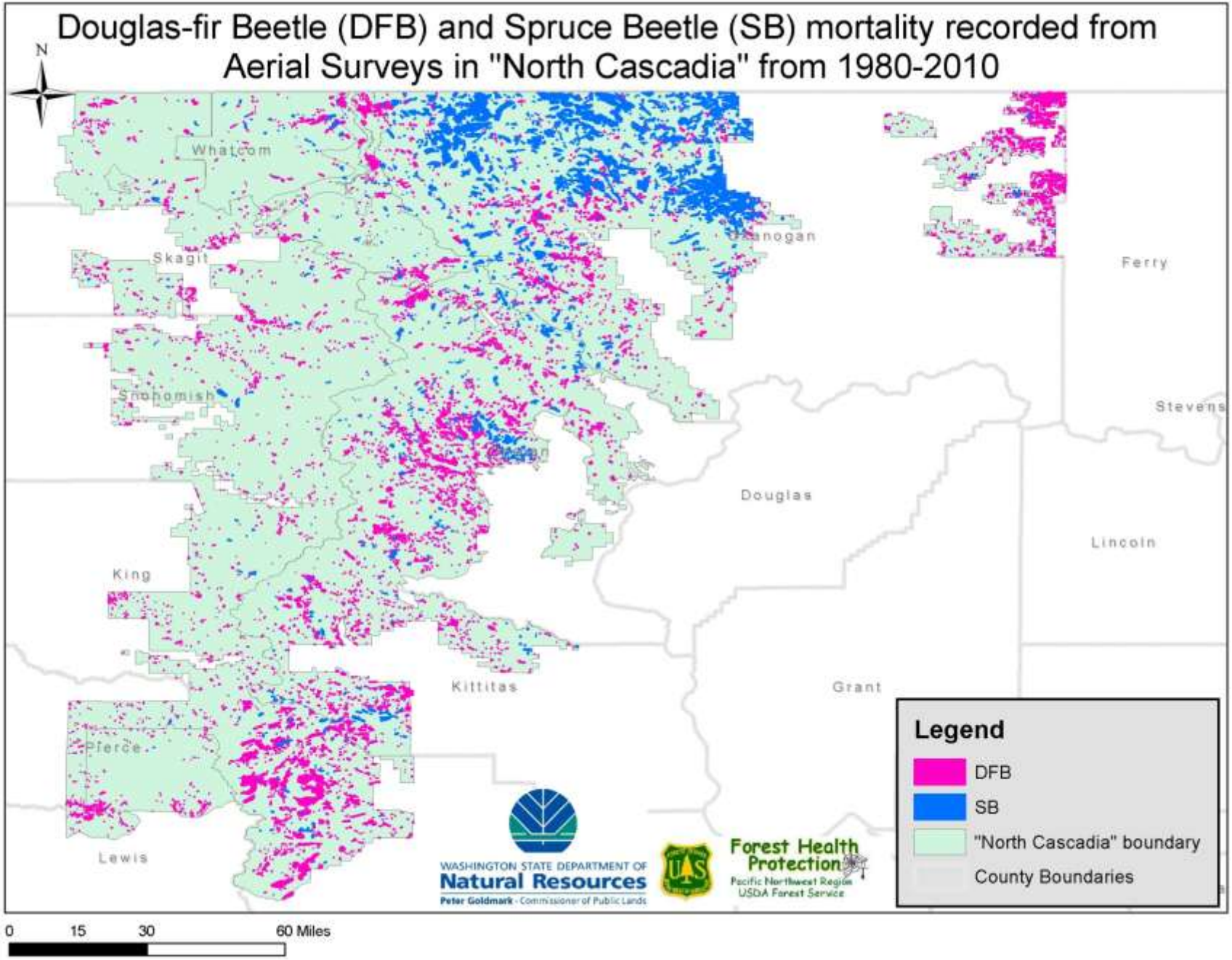
Adverse Weather

Blow down:

Douglas-fir beetle, Spruce beetle

Wind throw

Population increase triggered by blowdown. Outbreaks are extended if hosts are stressed. Spruce beetle can shift from 2 to 1-year life cycle.


Douglas-fir Beetle (DFB) and Spruce Beetle (SB) mortality recorded from Aerial Surveys in "North Cascadia" from 1980-2010
N
Whatcom
Skagit
Snohomish
King
Pierce
Lewis
Kittitas
Douglas
Grant
Lincoln
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Heat and Drought:

Red Alder

- Western Tent Caterpillar: more damage on wettest sites during drought period

- Alder bark beetles: defoliated or stressed trees

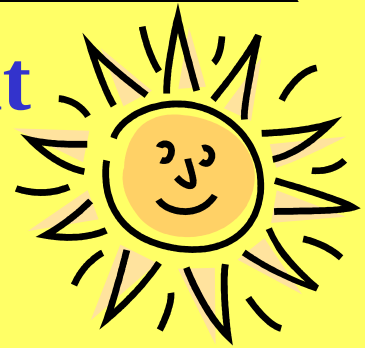
- Exotic sawflies:

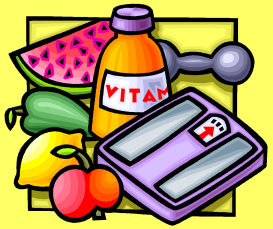
Host

Pathogen

Disease
or Damage

Environment





Conclusions:

- **Vigorous trees are good. Increase vigor!**
- **Reduce overcrowding**
- **Favor drought tolerant species**
- **Avoid wounding residual trees and roots**
- **Plan (and plant) for variable condition**
- **Thinning creates growing space for natural migrations**