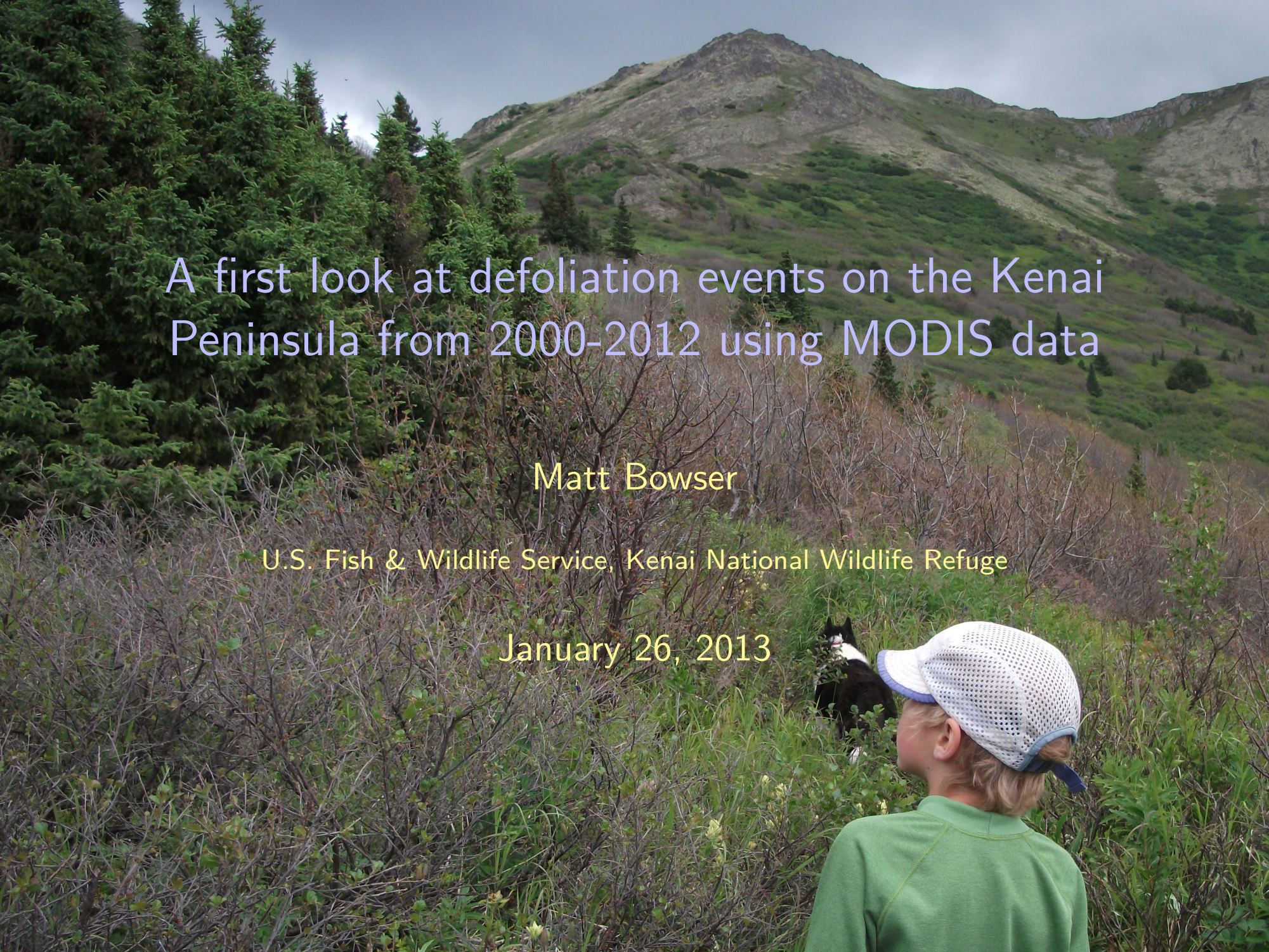


A first look at defoliation events on the Kenai Peninsula from 2000-2012 using MODIS data

Matt Bowser

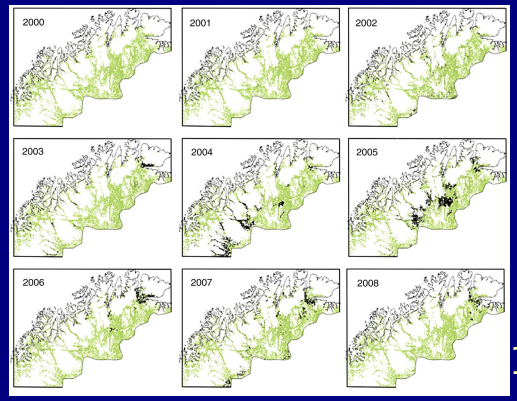
U.S. Fish & Wildlife Service, Kenai National Wildlife Refuge

January 26, 2013

Contents

Justification

Provide continuous maps of defoliation events (the big picture).



[1]

[1] from Jepsen et al. 2009

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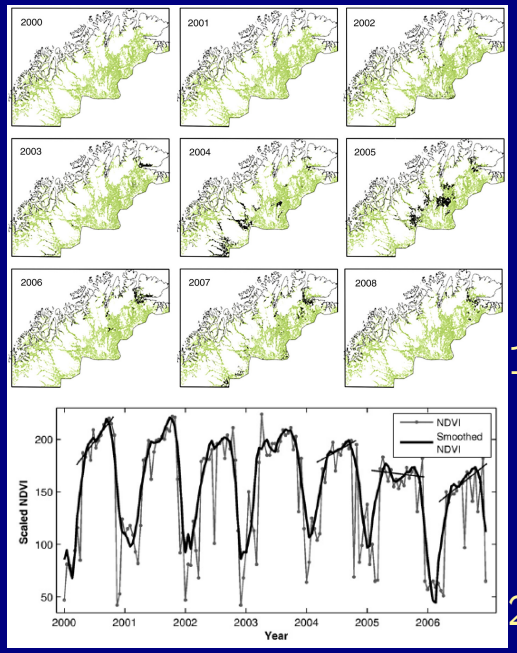
[3] http://www.adirondackwildlife.org/moose_091712_a.jpg

Justification

Provide continuous maps of defoliation events (the big picture).

Can investigate cyclicity / seasonality of defoliation events.



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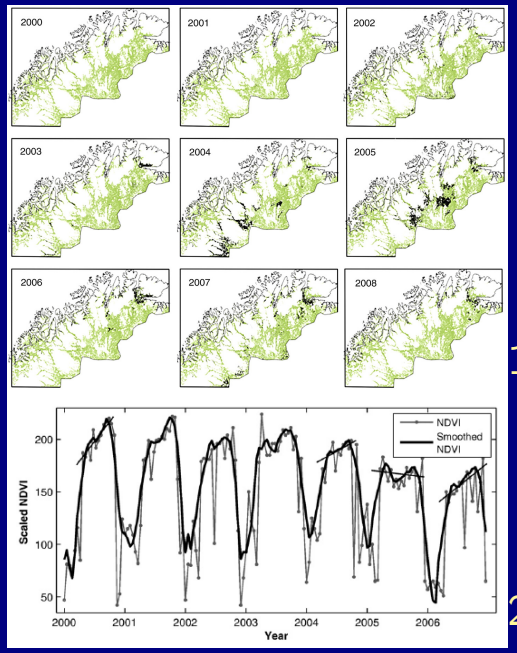

1

2

Can investigate cyclicity / seasonality of defoliation events.

3

Multi-species interactions / management.

---

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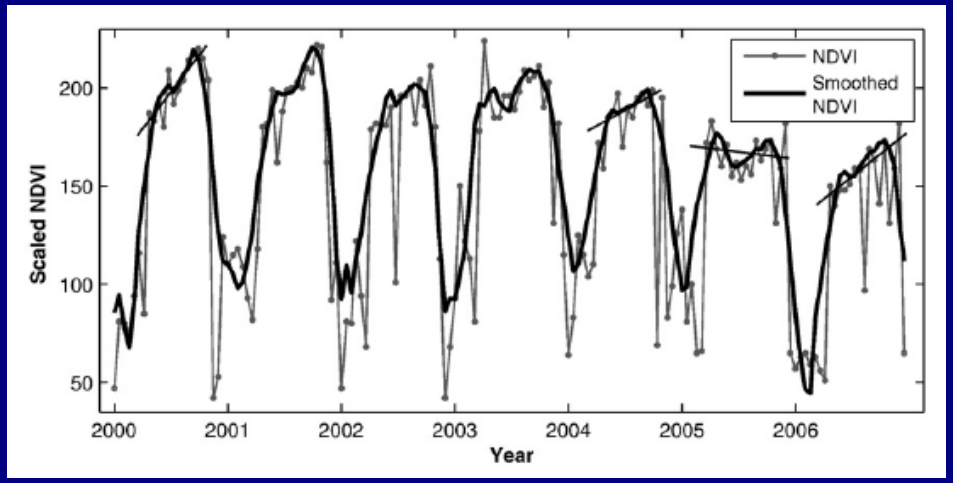
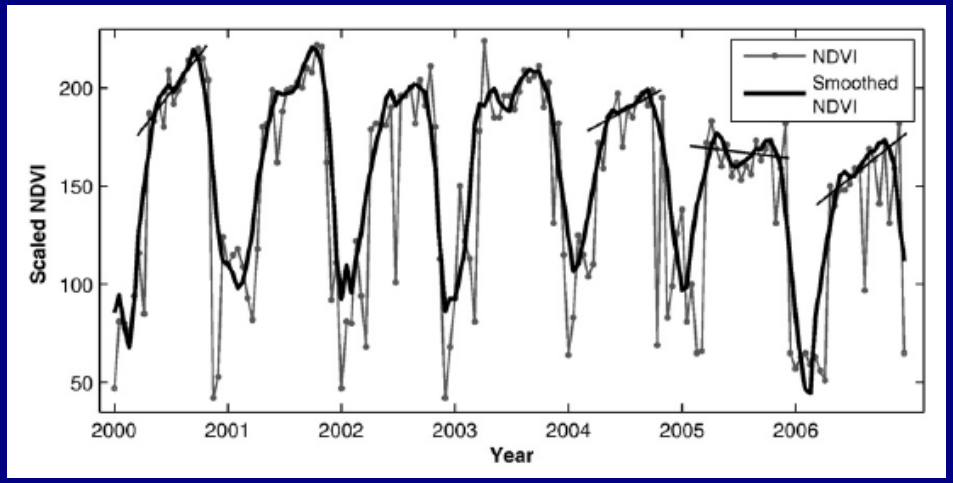
Types of approaches



- Within-season curves
- Multi-season comparisons
- Computer learning / classification methods

Types of approaches



- Within-season curves
- Multi-season comparisons
- Computer learning / classification methods

For monitoring, keep it simple!

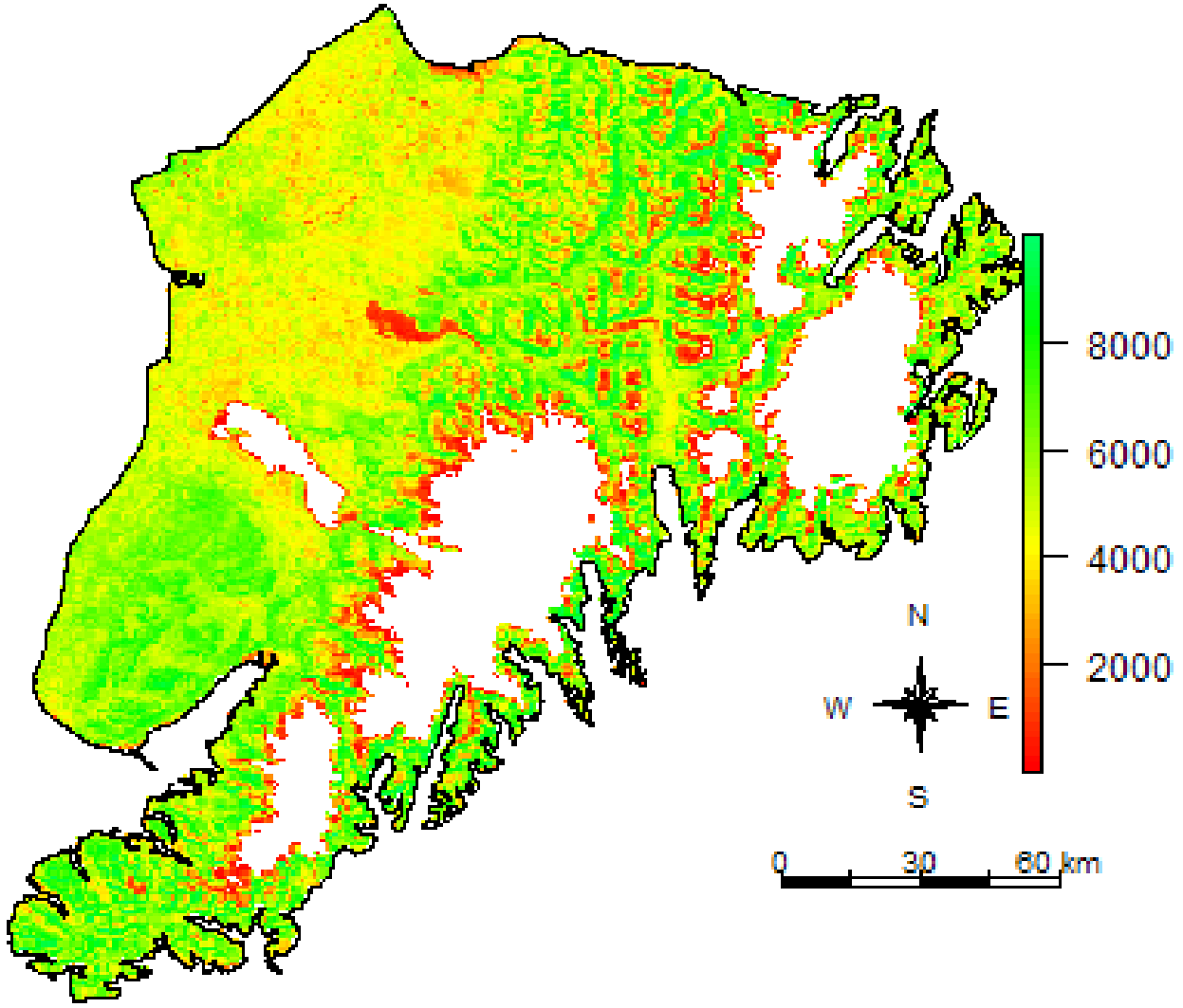
MODIS MOD13Q1 product, Enhanced Vegetation Index (EVI)

- Spatial extent: worldwide on land
- Spatial resolution: 250m
- Temporal extent: from 2000 forward
- Temporal resolution: 16 days
- Cost: free

Reference Raster

- Select the four time periods from June 26 - August 29.
- Select only pixels with good data quality.
- Reference value is the 3^{rd} highest value for a pixel over the 13 years considered.

Vegetation Index Reference Raster



Detecting defoliation

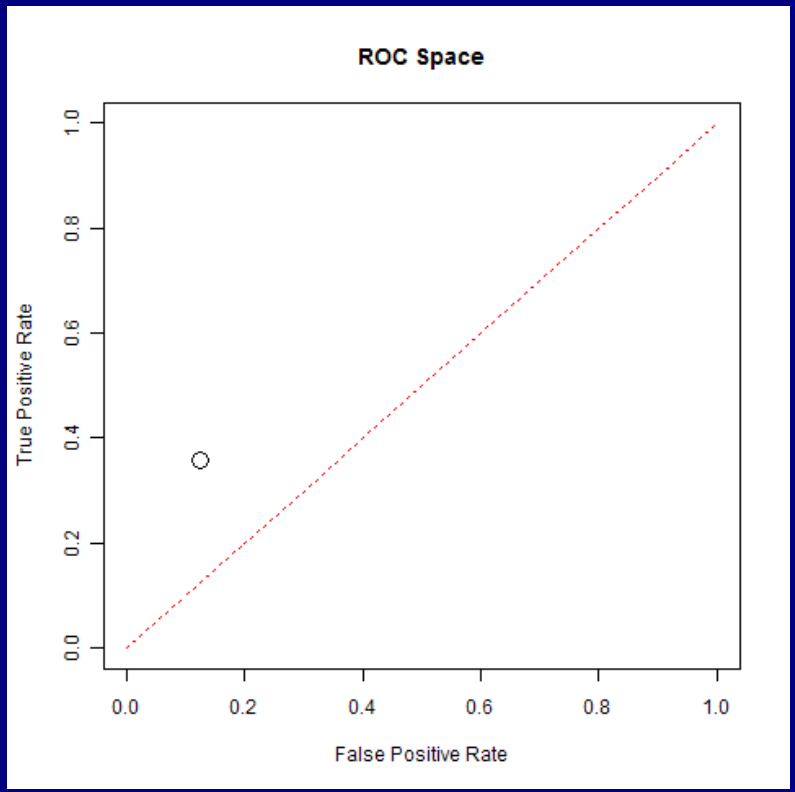
For each year, select pixels where

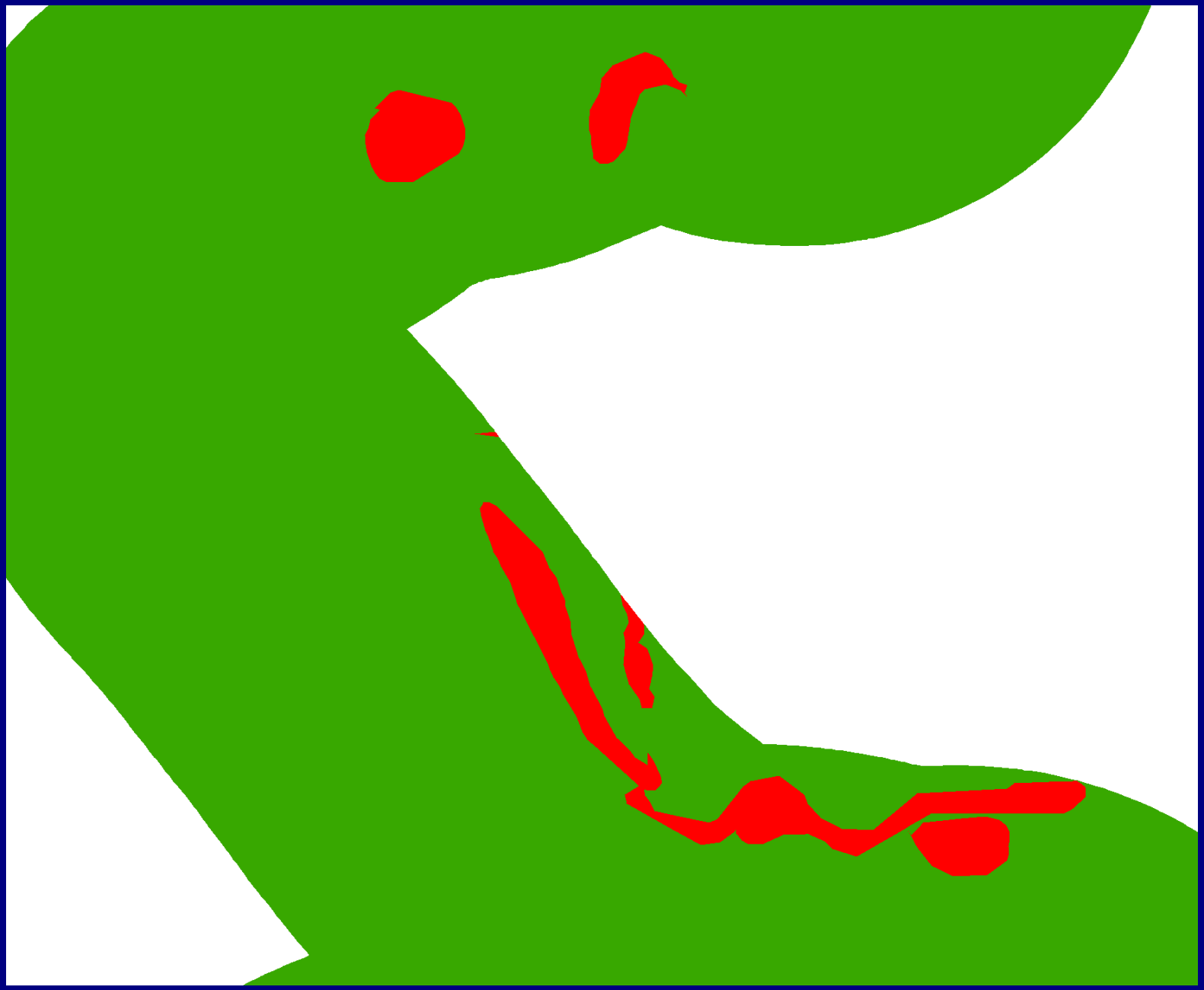
- the pixel did not burn in this or the preceeding three years,
- the pixel is < 40 % ice or water,
- the pixel's reference EVI value > 0.4, and
- EVI decreased by $> 20\%$ from the reference raster for at least 3 out of 4 16-day time periods.

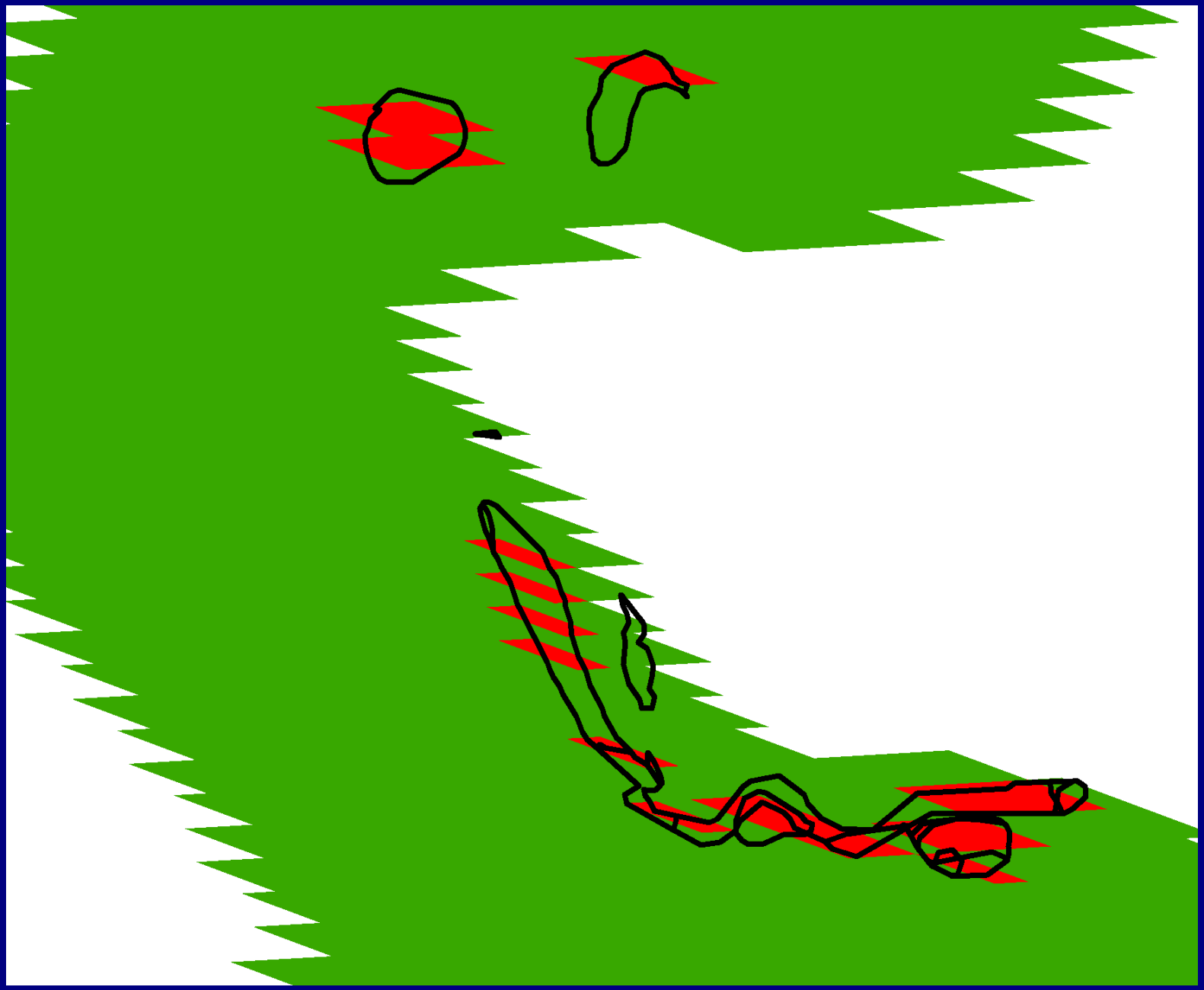
Accuracy

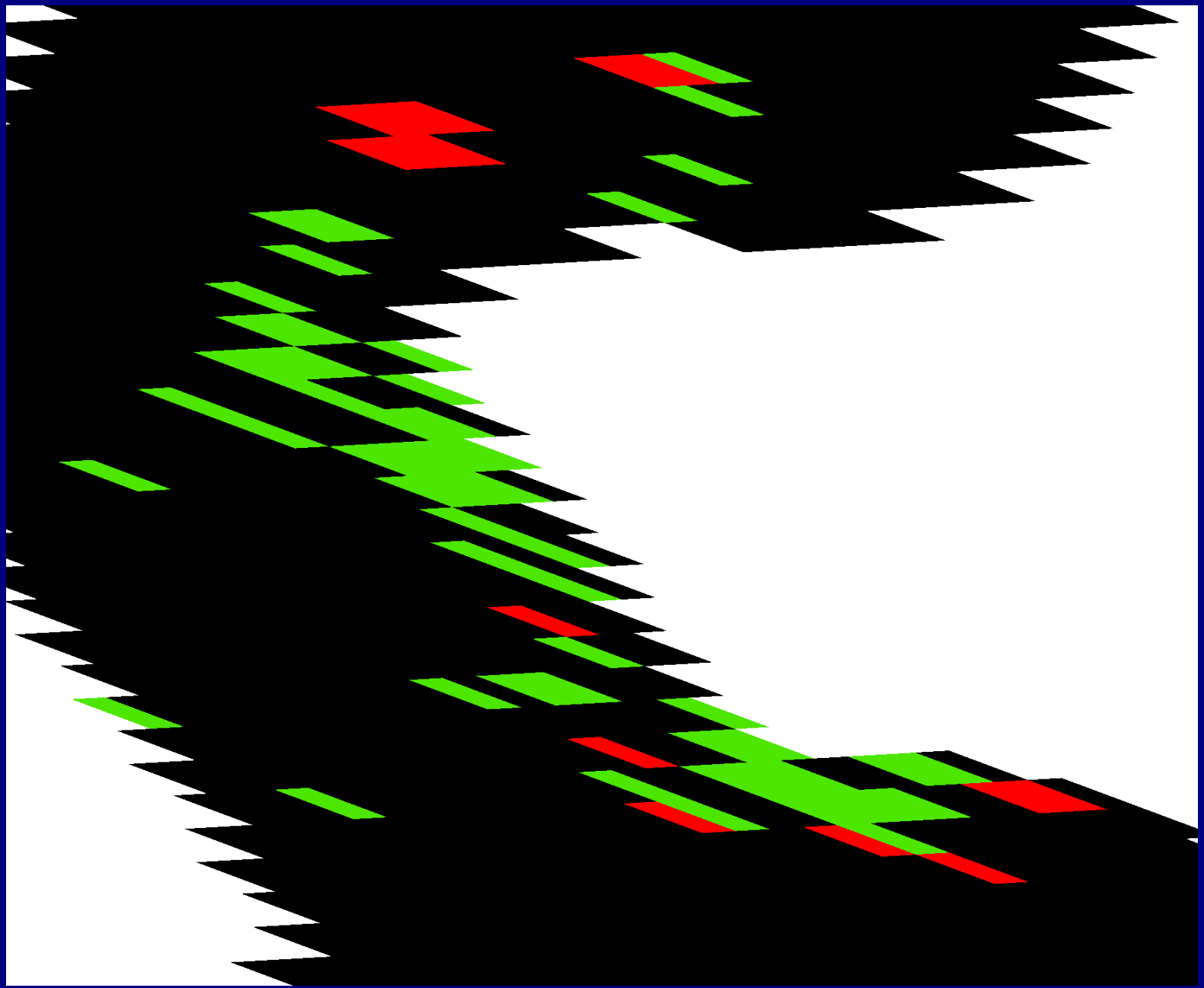
2012 defolation from MODIS compared to rasterized 2012 aerial detection data (only high damage classes).

- 12% false positives (errors of commission)
- 0.5% false negatives (errors of omission)
- 87% agreement

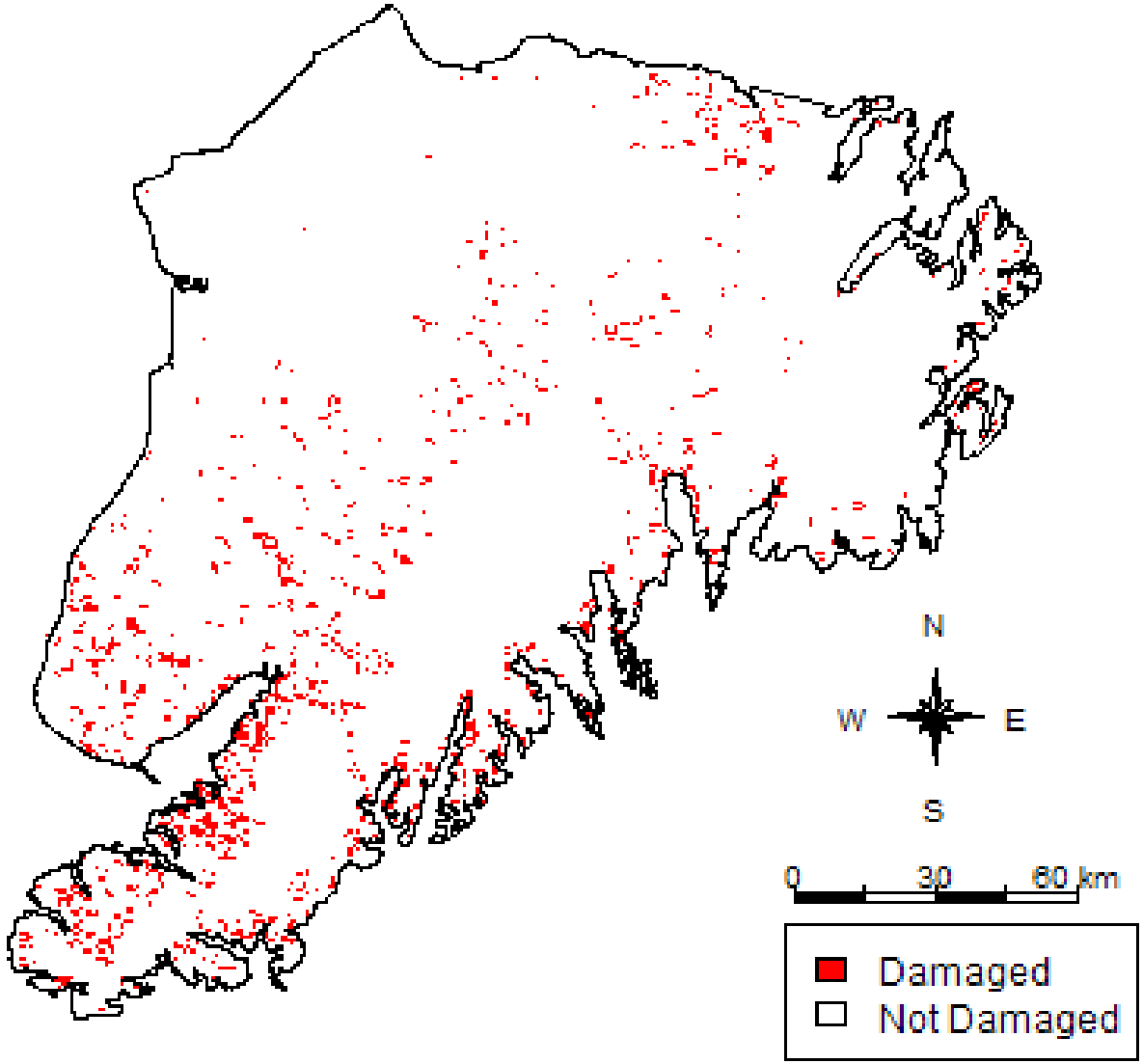




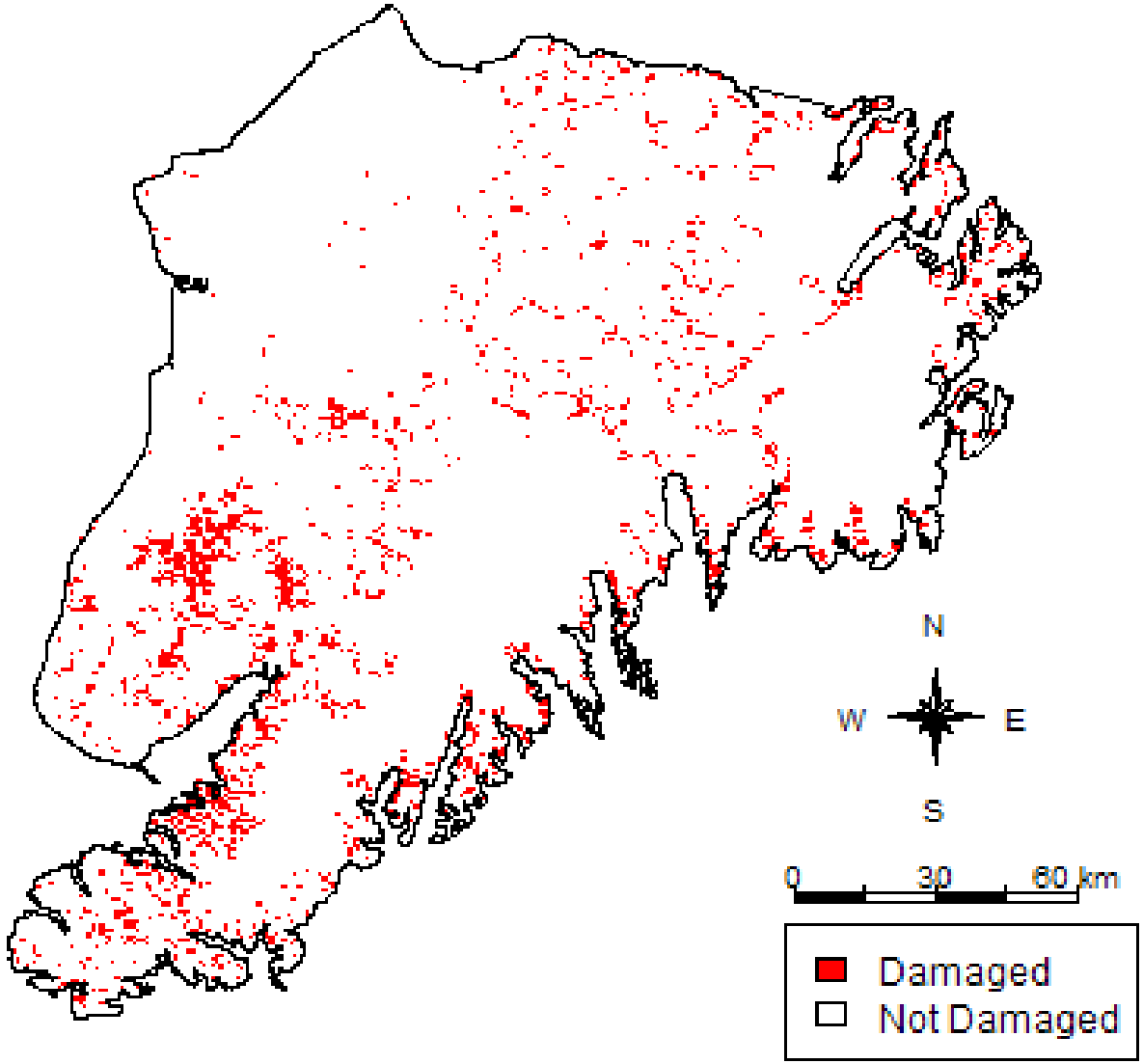




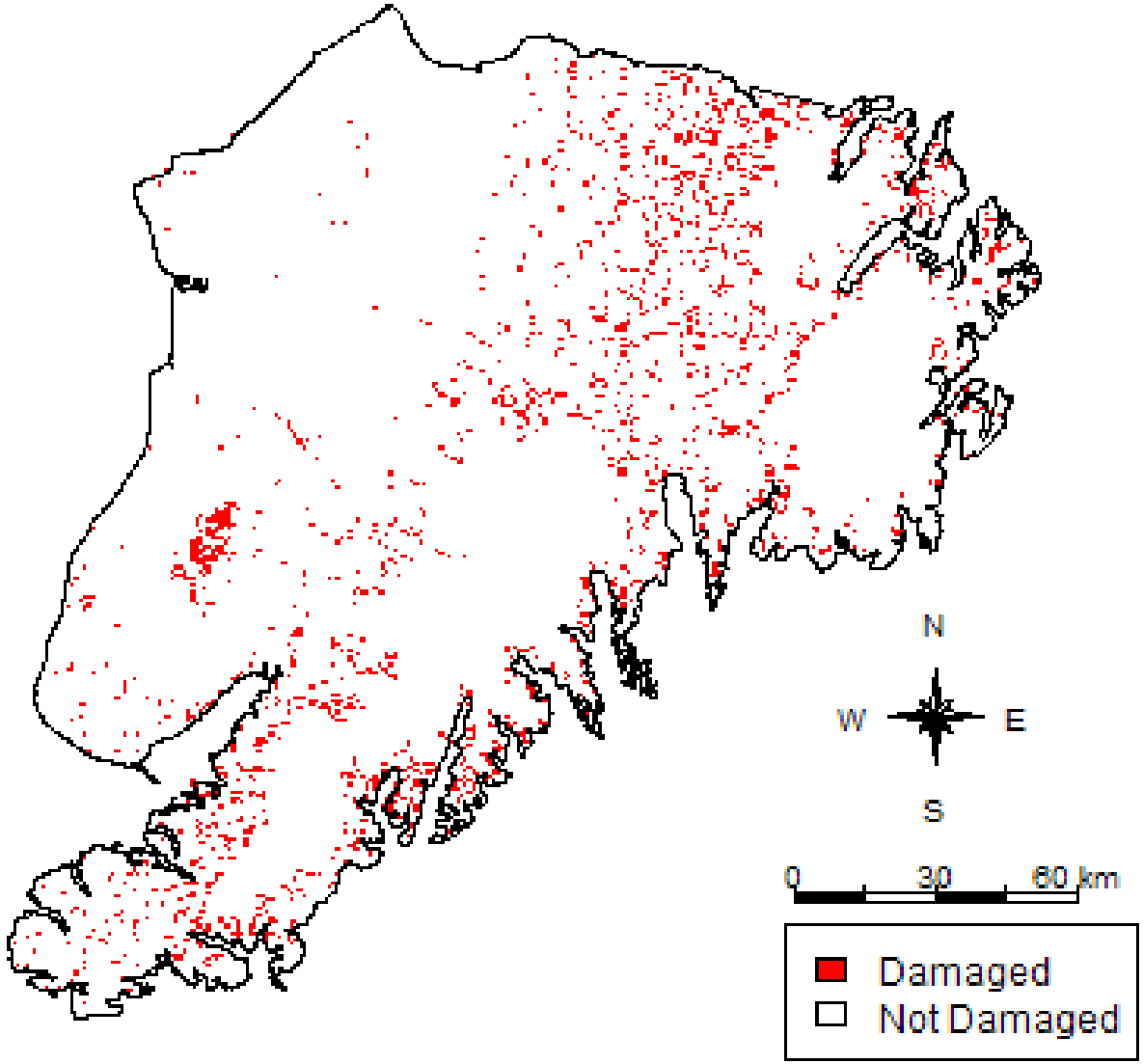
Defoliation 2000



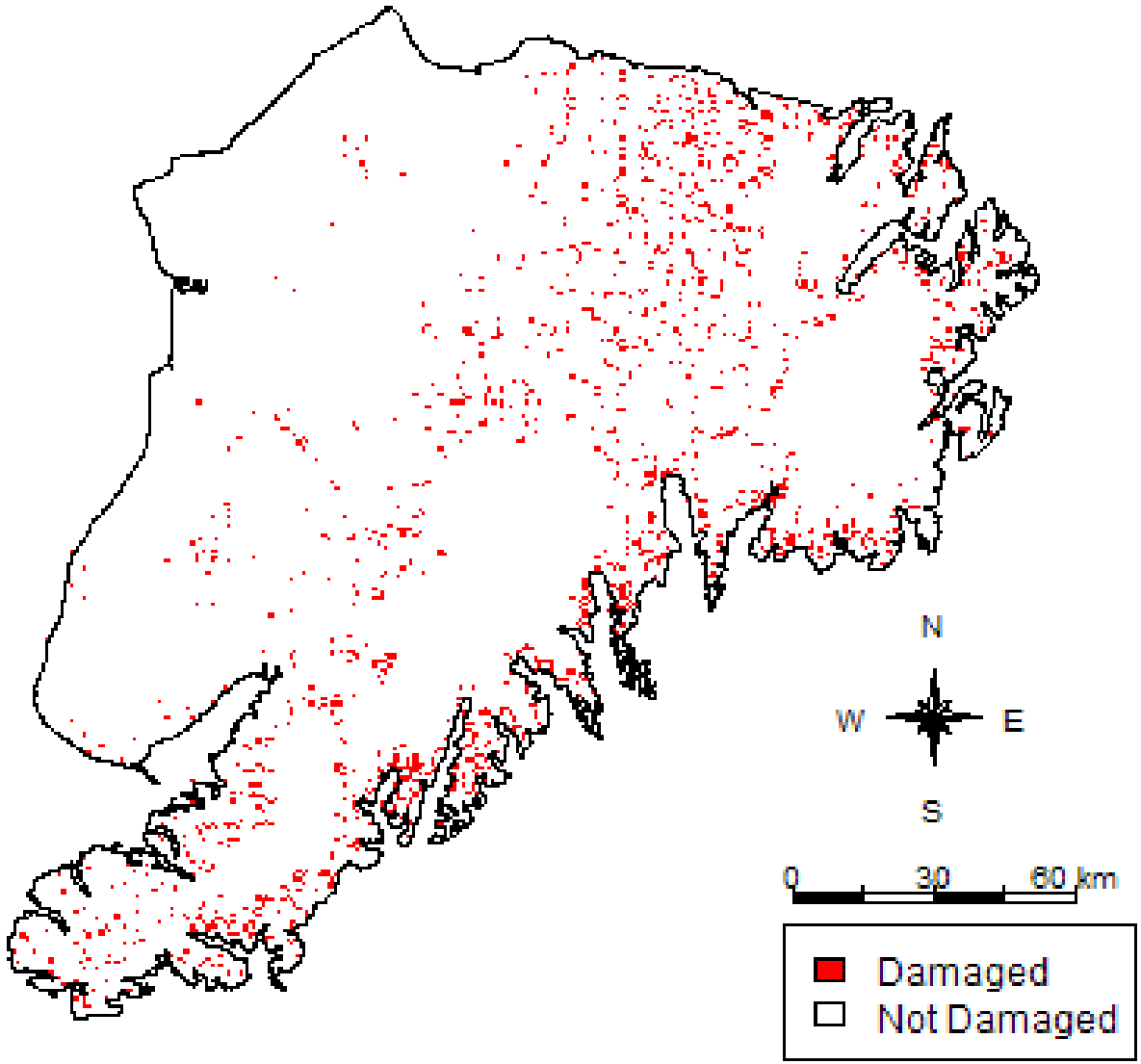
Defoliation 2001



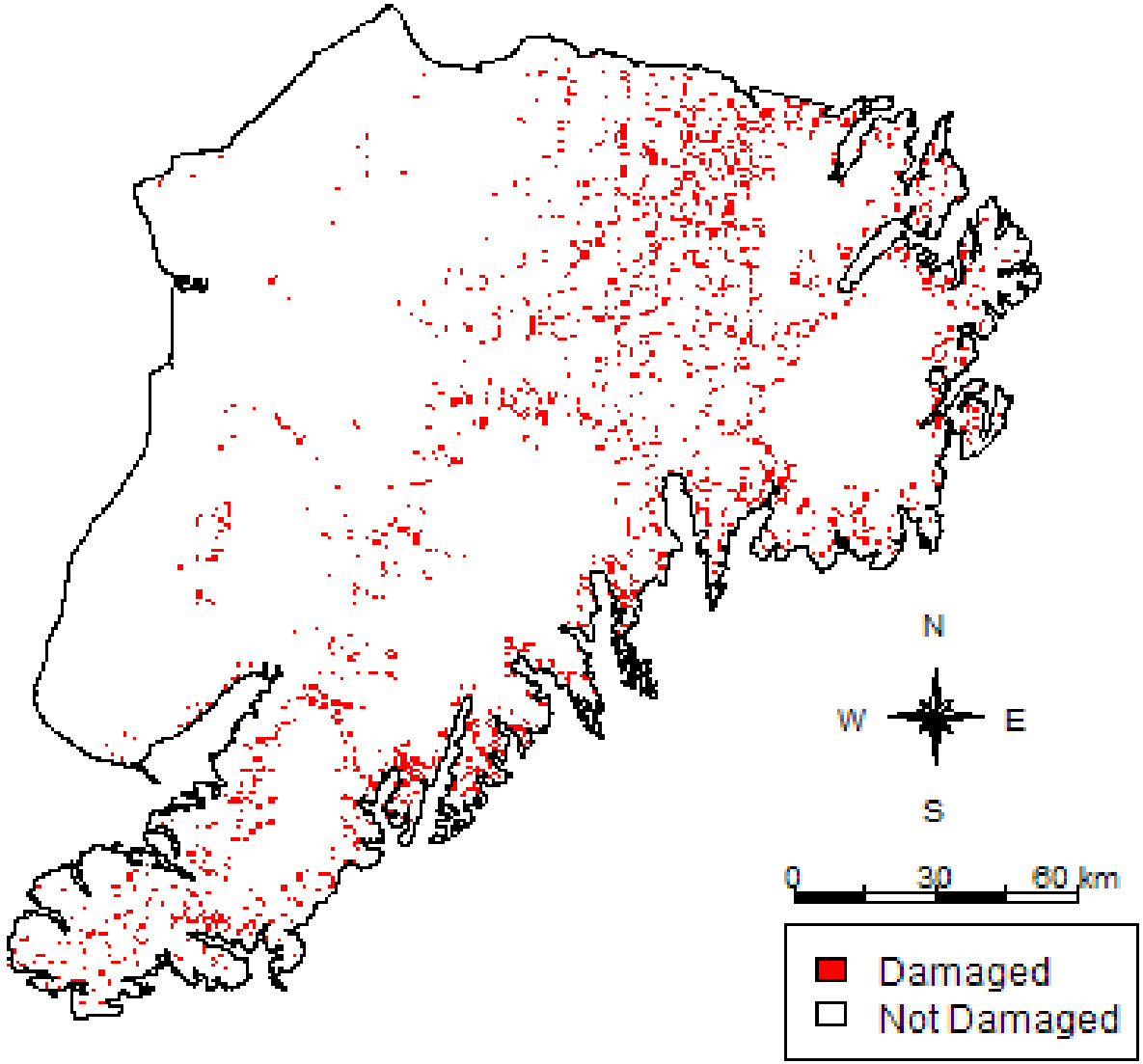
Defoliation 2002



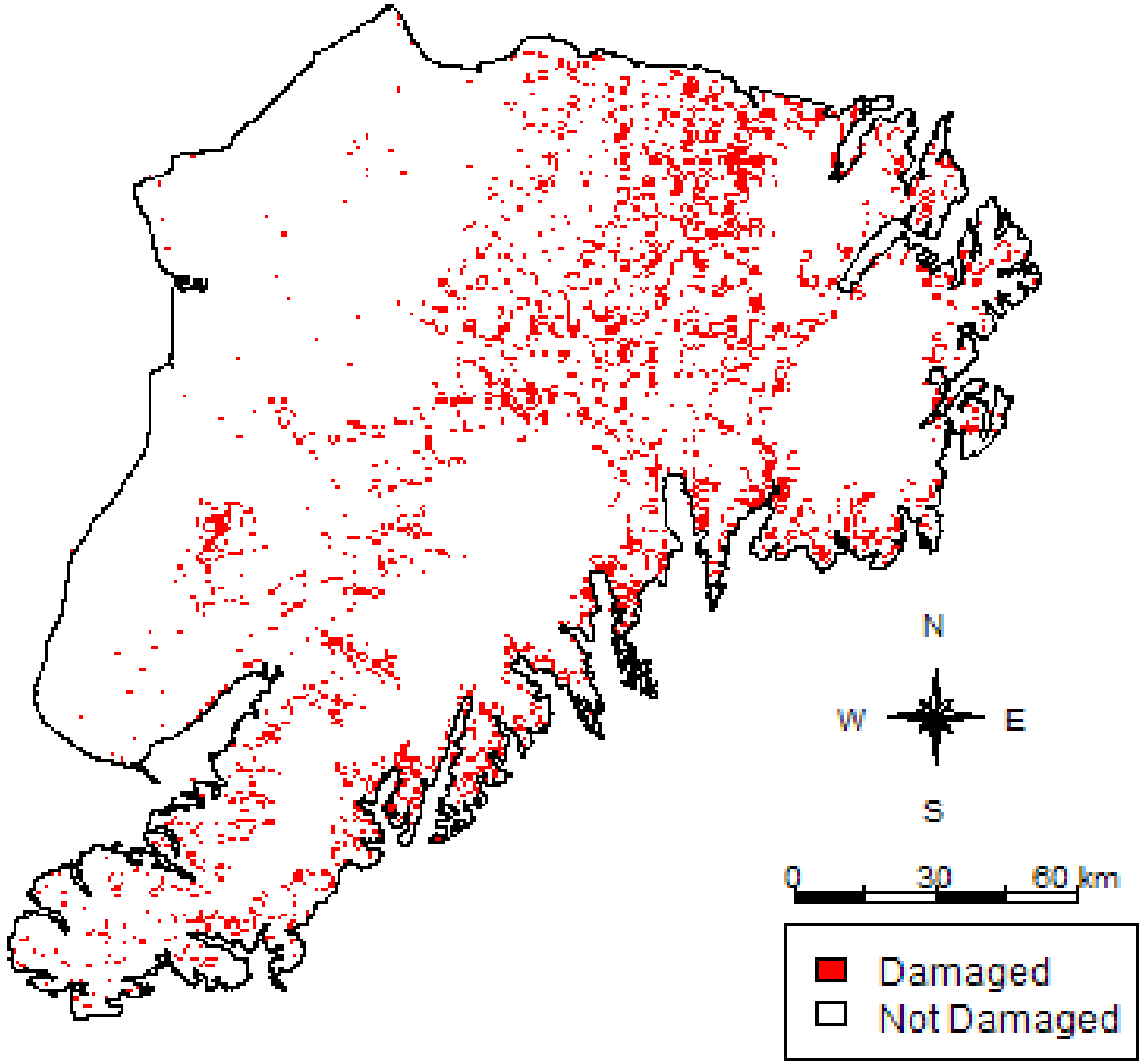
Defoliation 2003



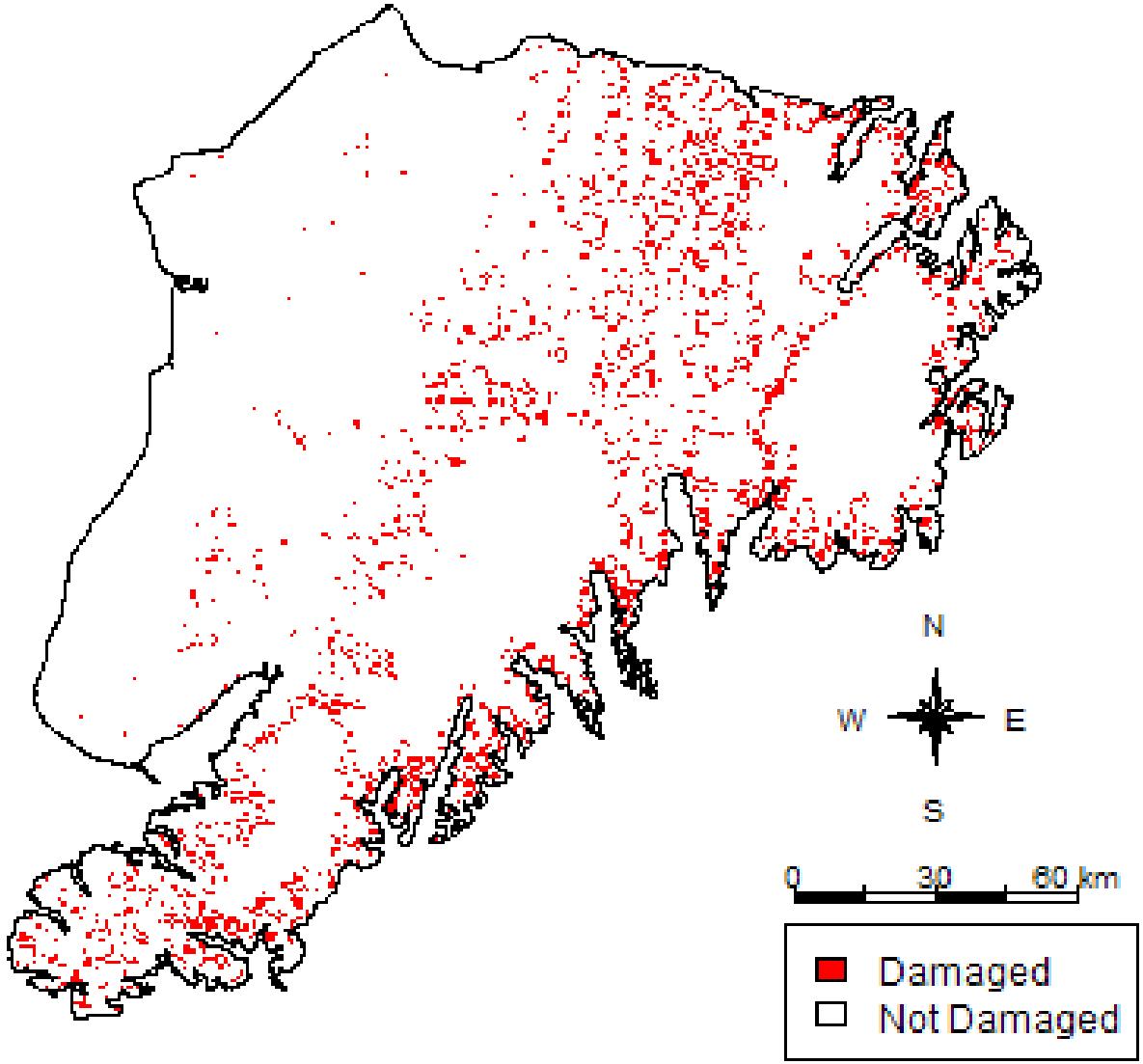
Defoliation 2004



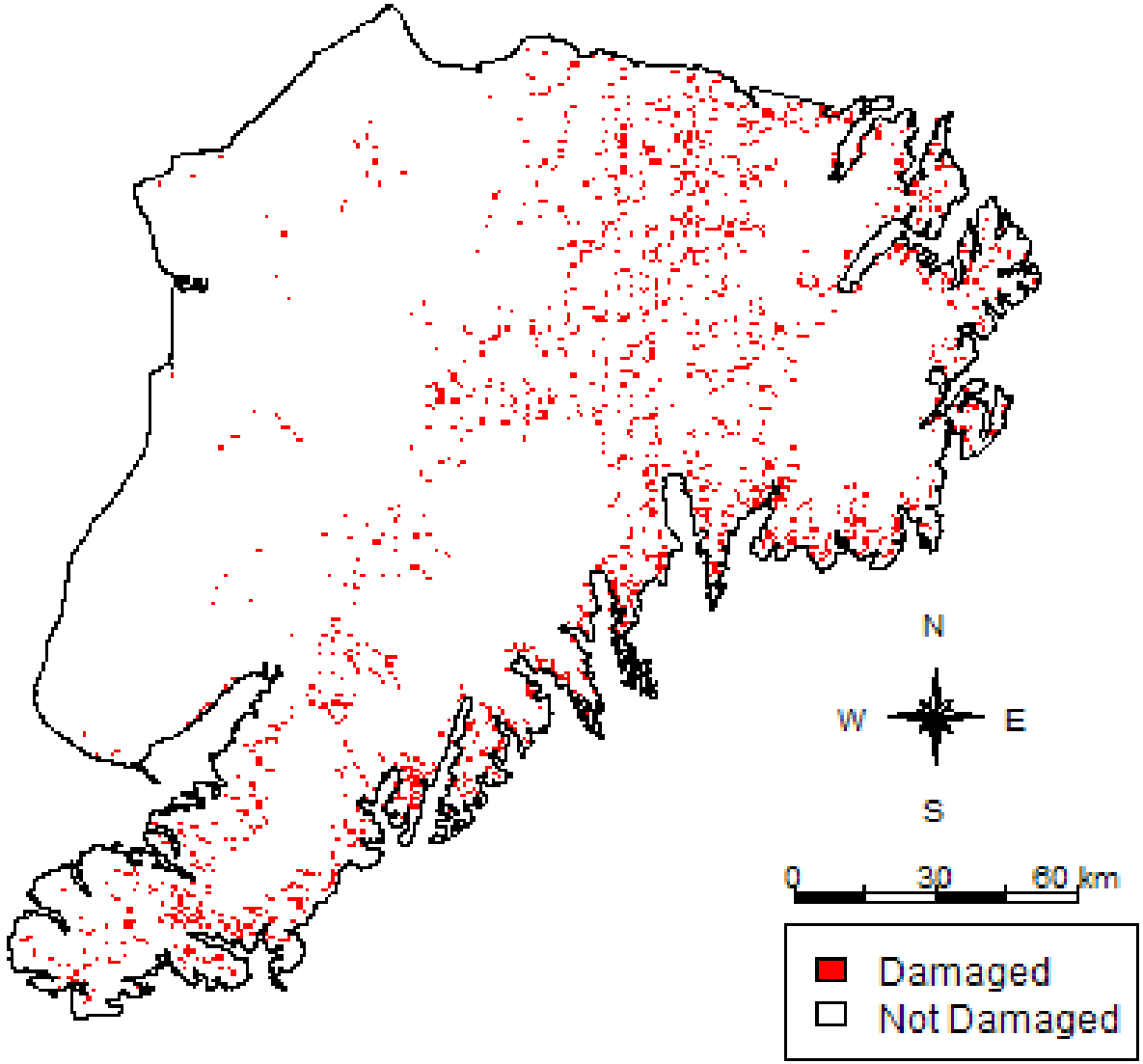
Defoliation 2005



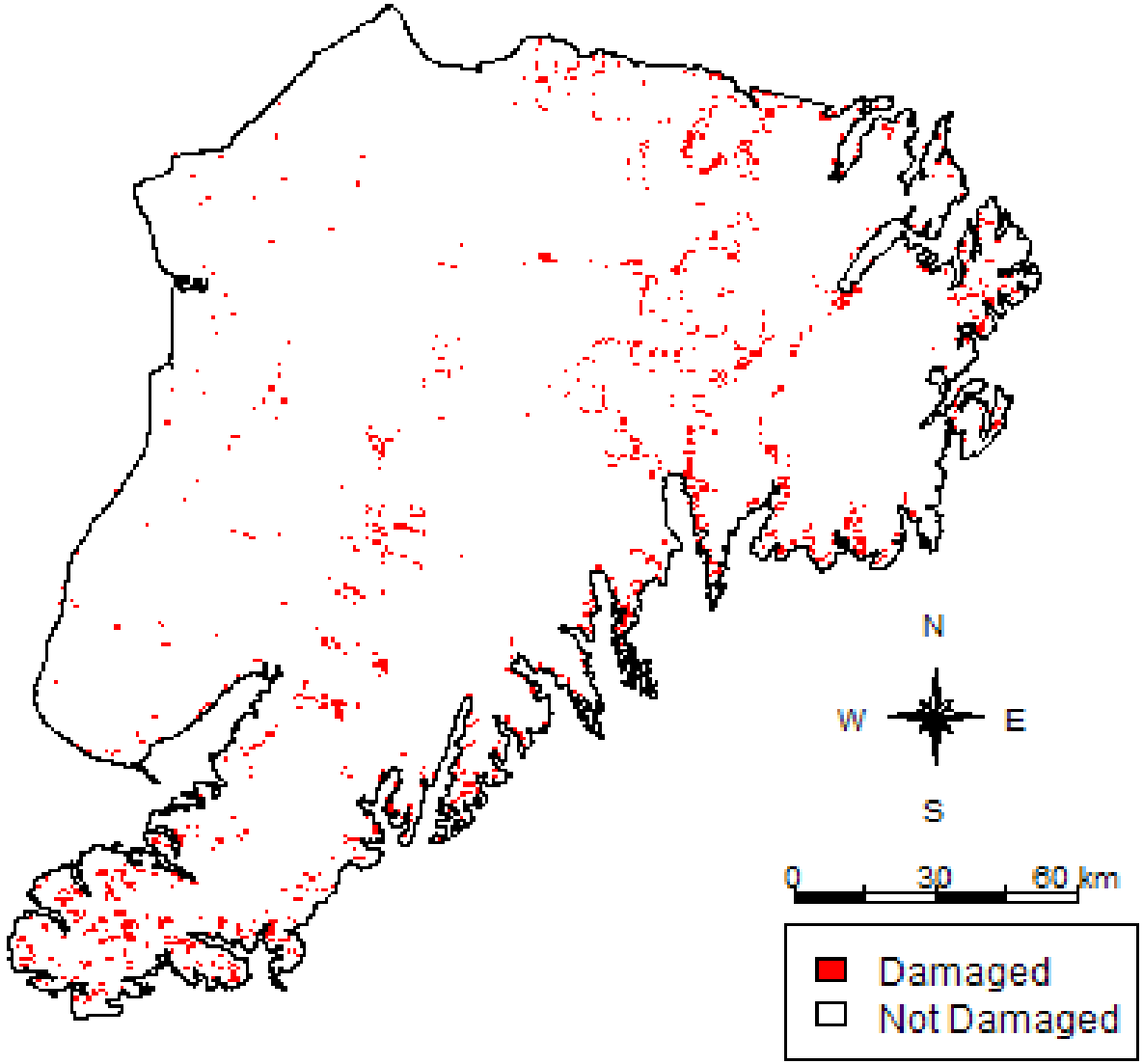
Defoliation 2006



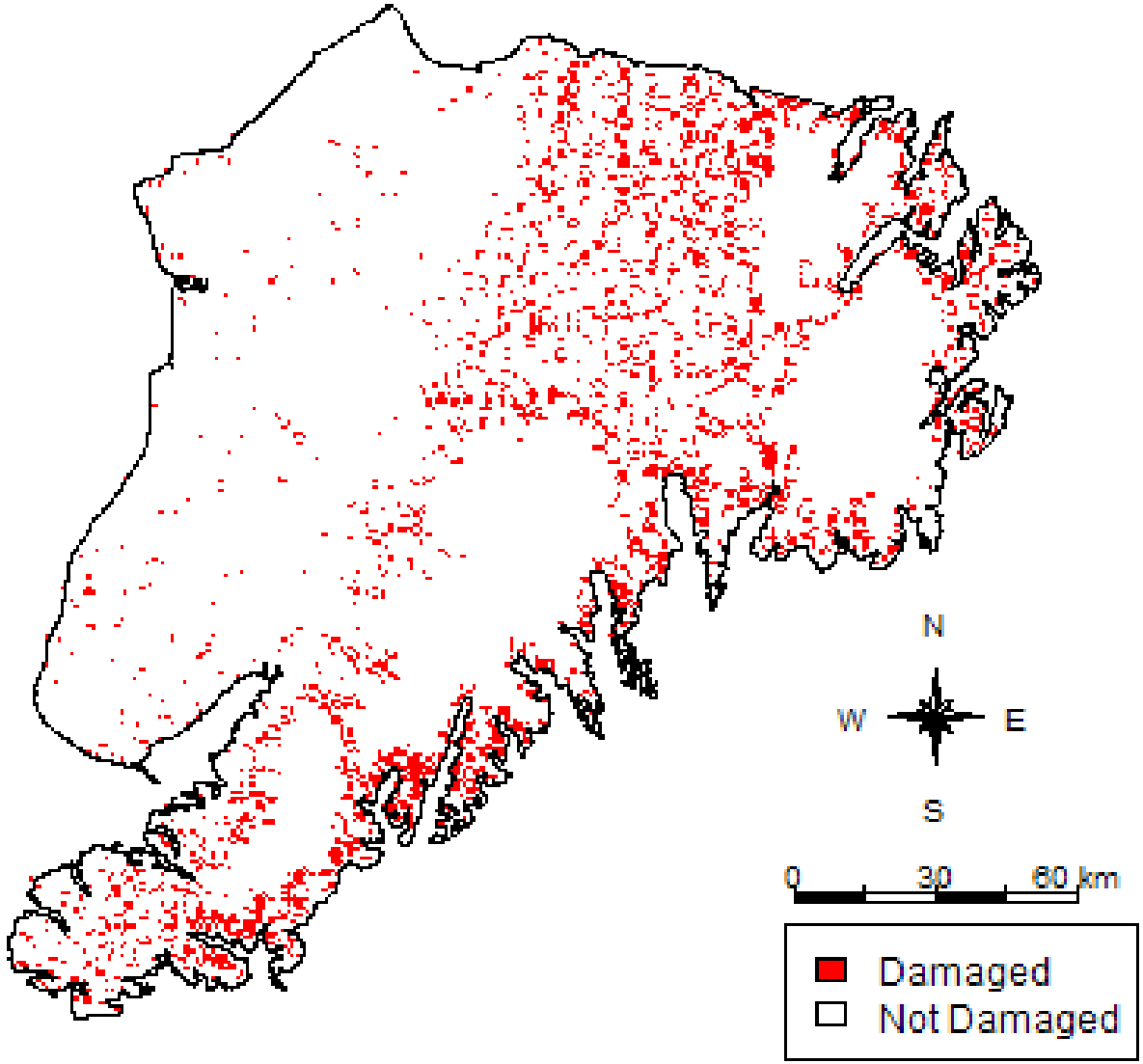
Defoliation 2007



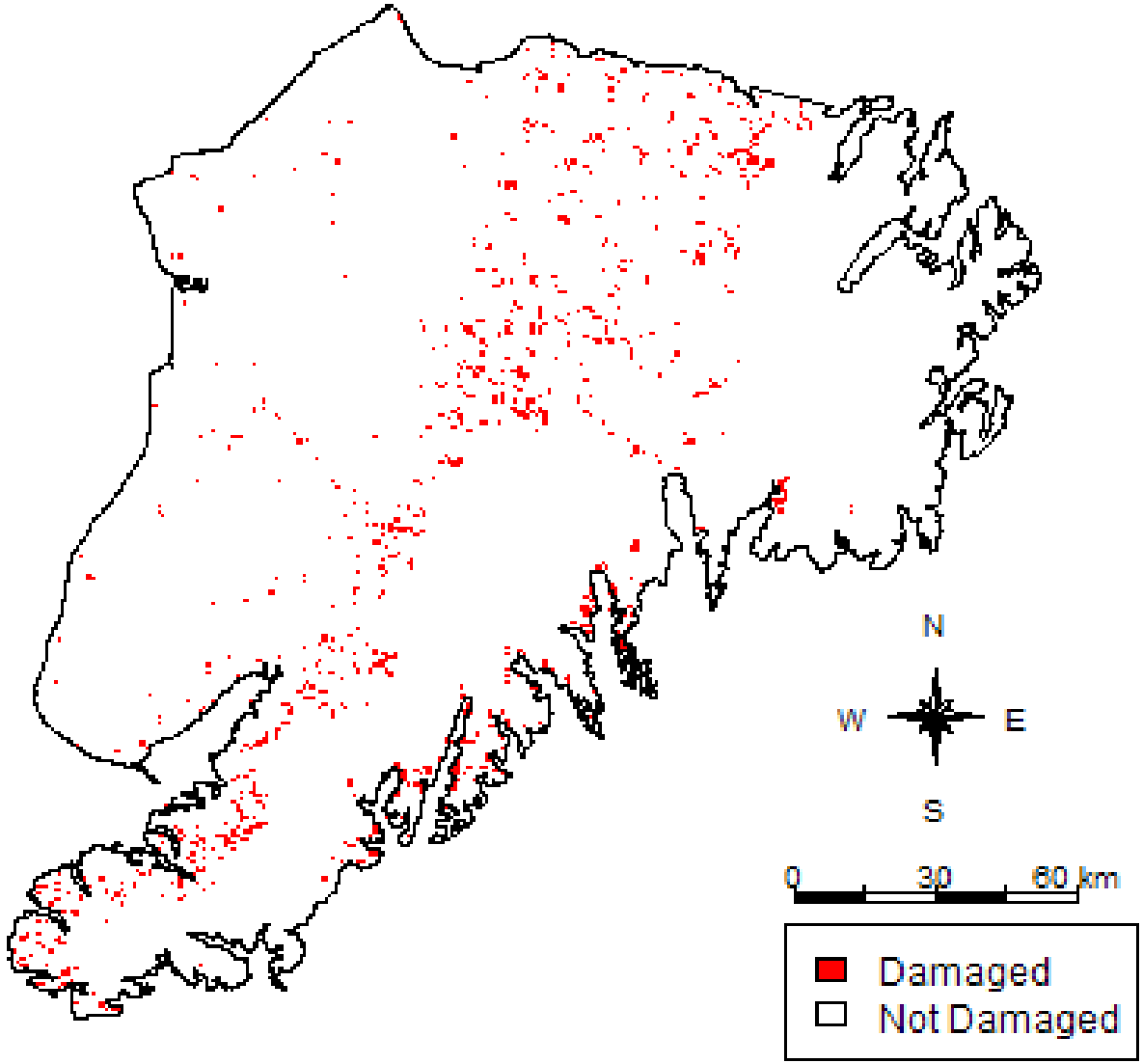
Defoliation 2008



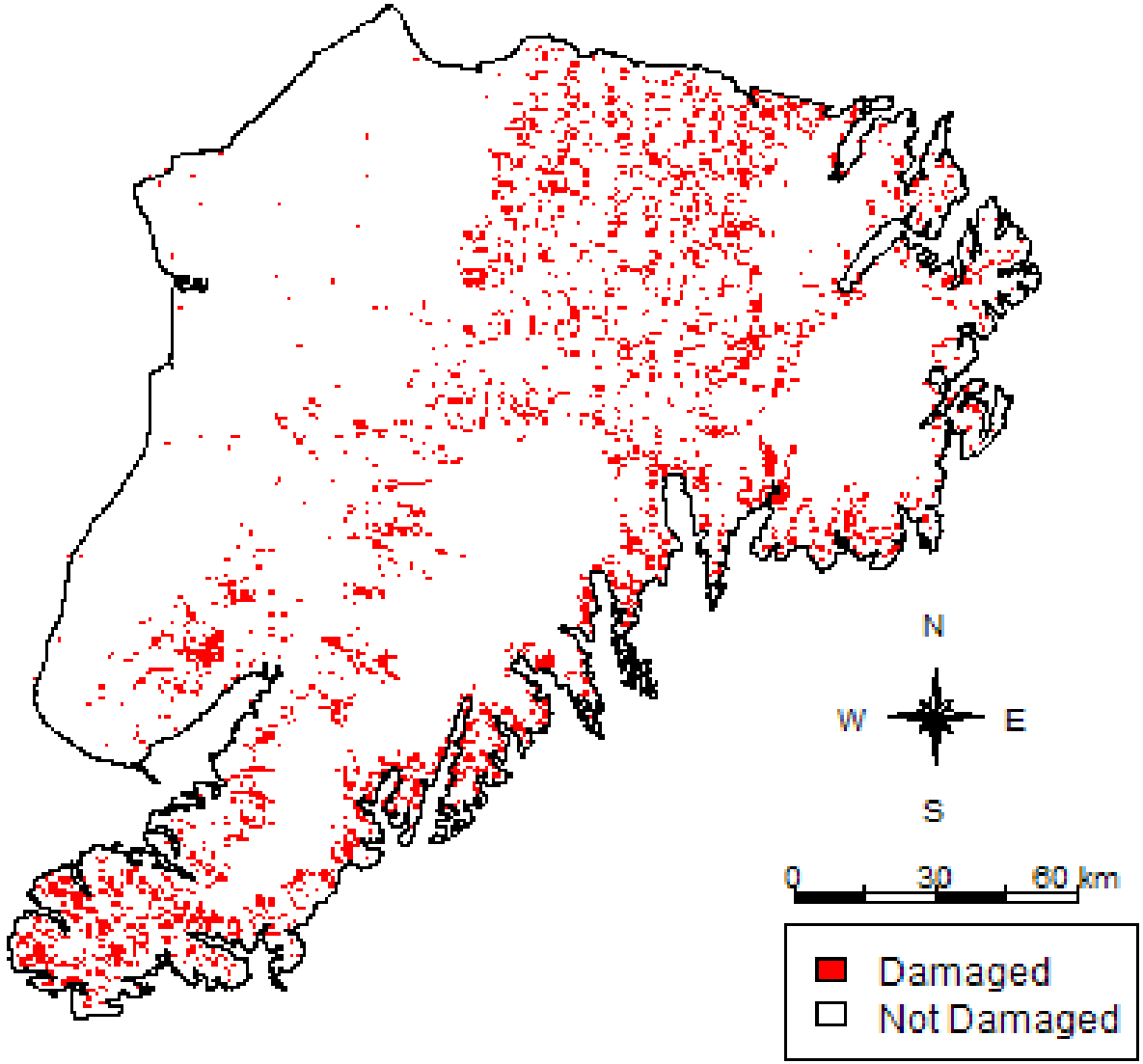
Defoliation 2009



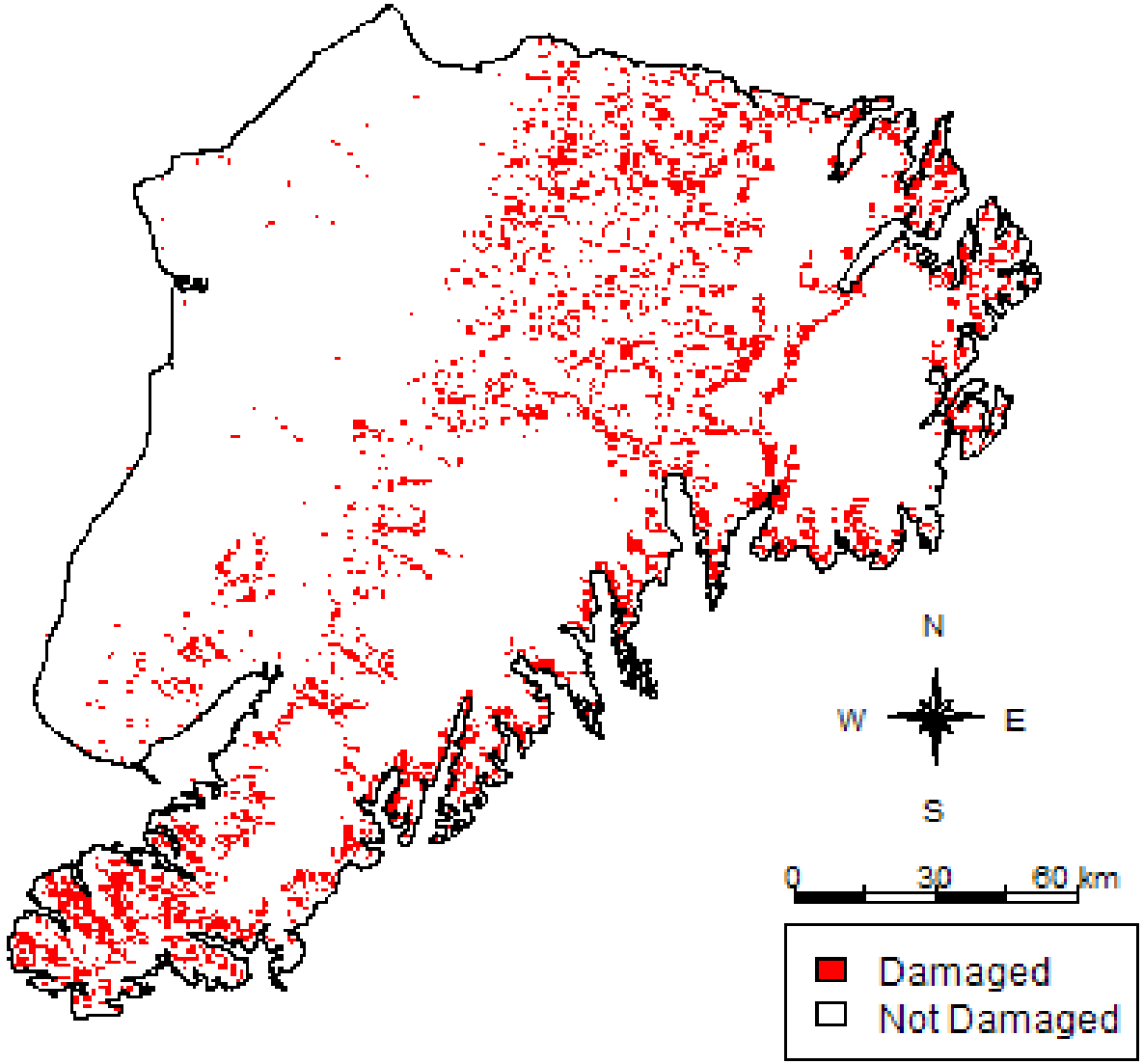
Defoliation 2010

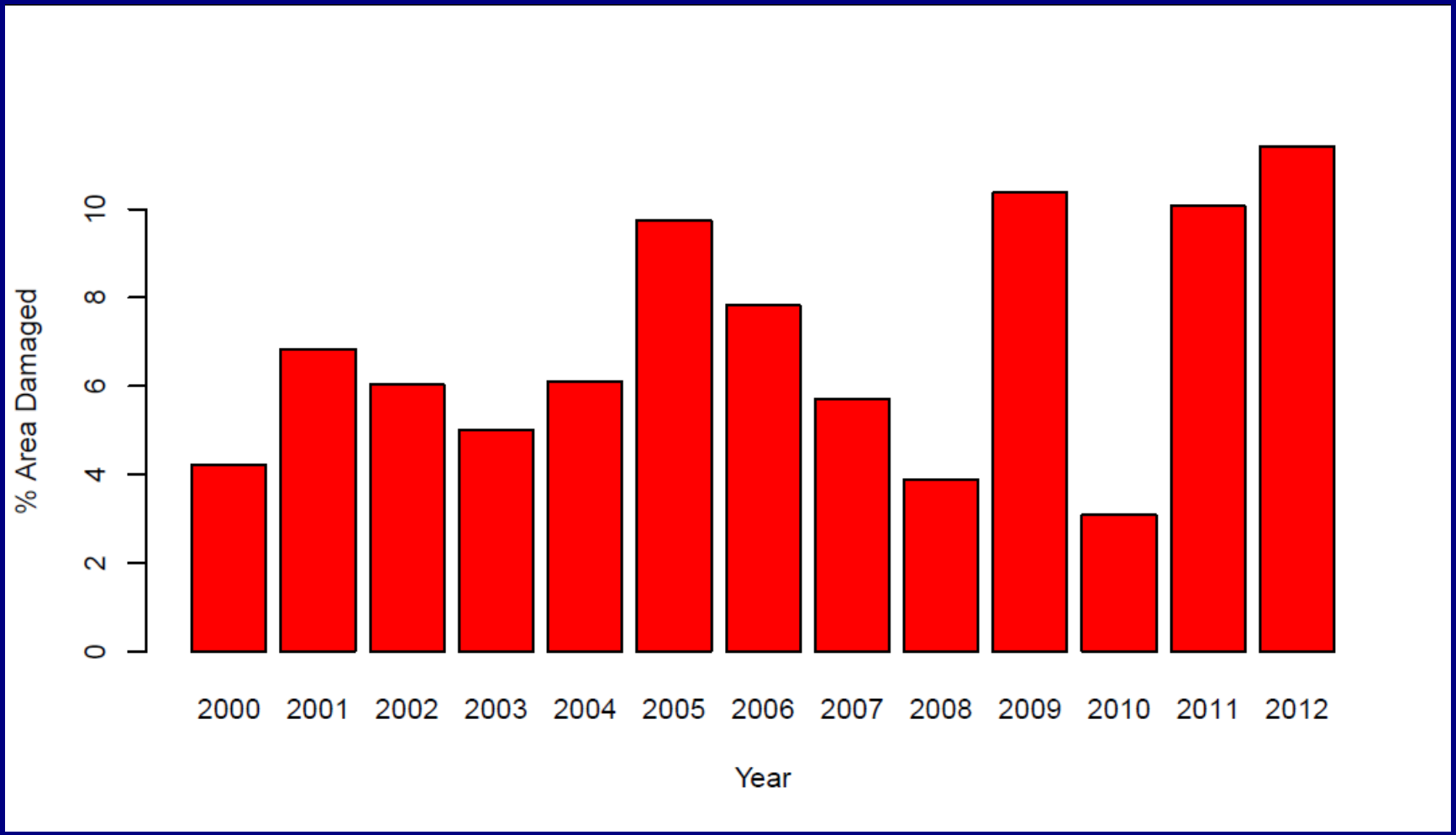


Defoliation 2011



Defoliation 2012




% Area Damaged
0
2
4
6
8
10
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Year

Disadvantages

- Causes of reduced productivity unknown.
- Time delay.
- Resolution - misses small areas of damage.
- Noise.
- My methods missed late season defoliators.

Advantages

- Complete coverage over spatial extent.
- No observer bias.
- Consistent over space and time (same pixels and time periods monitored every year).
- Cheap.
- Repeatable.

Conclusions

- Routine, annual mapping of statewide defoliation derived from MODIS could greatly extend aerial survey data spatially.
- Aerial survey methods are still required to determine plant species affected and agent of damage.
- Within-season analysis of MODIS vegetation index data could inform aerial surveys.
- MODIS VI data would lend itself well to detailed studies postitioned to align with pixels.