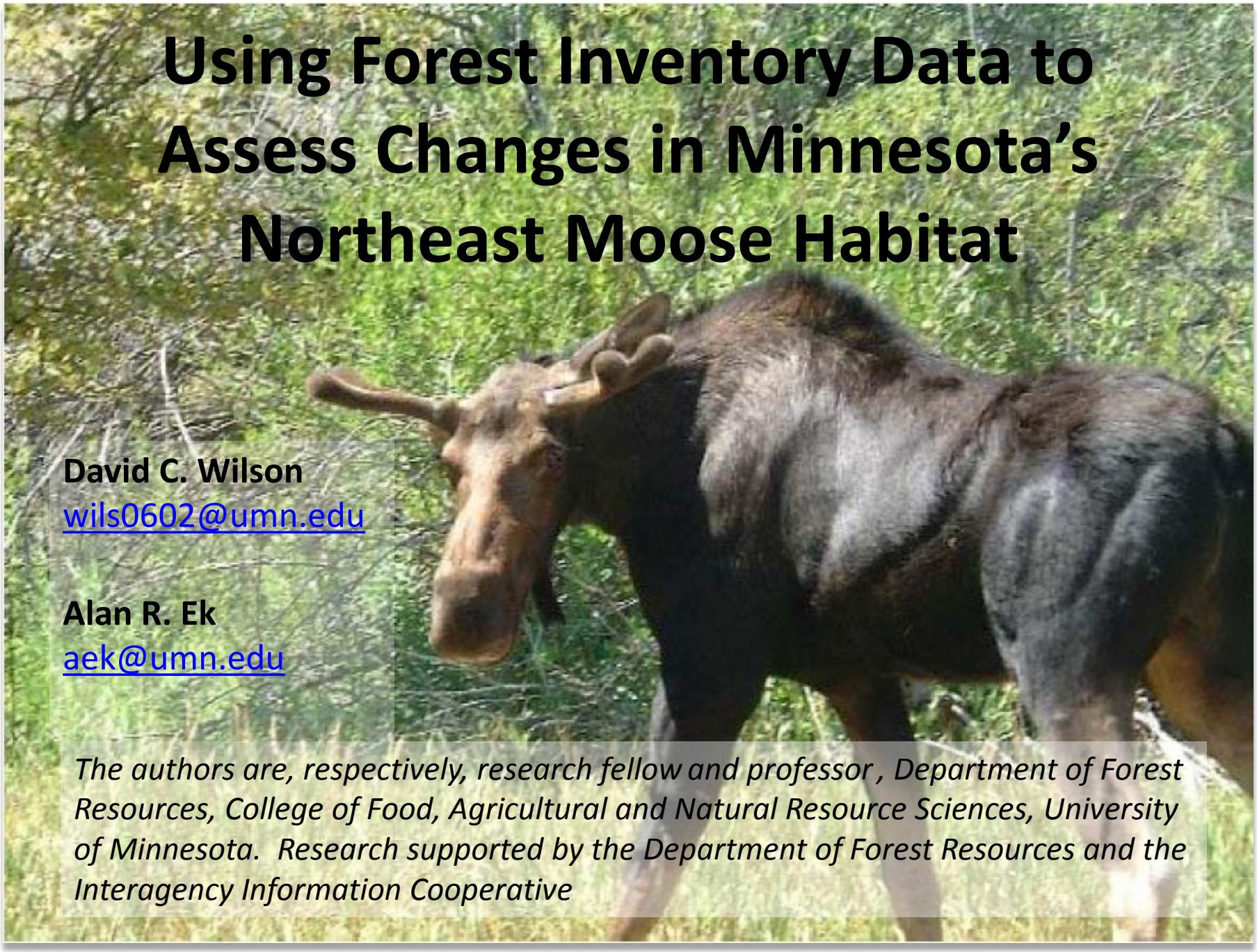
Using Forest Inventory Data to Assess Changes in Minnesota's Northeast Moose Habitat



David C. Wilson
wils0602@umn.edu

Alan R. Ek
aek@umn.edu

The authors are, respectively, research fellow and professor , Department of Forest Resources, College of Food, Agricultural and Natural Resource Sciences, University of Minnesota. *Research supported by the Department of Forest Resources and the Interagency Information Cooperative*

Moose Habitat in Minnesota

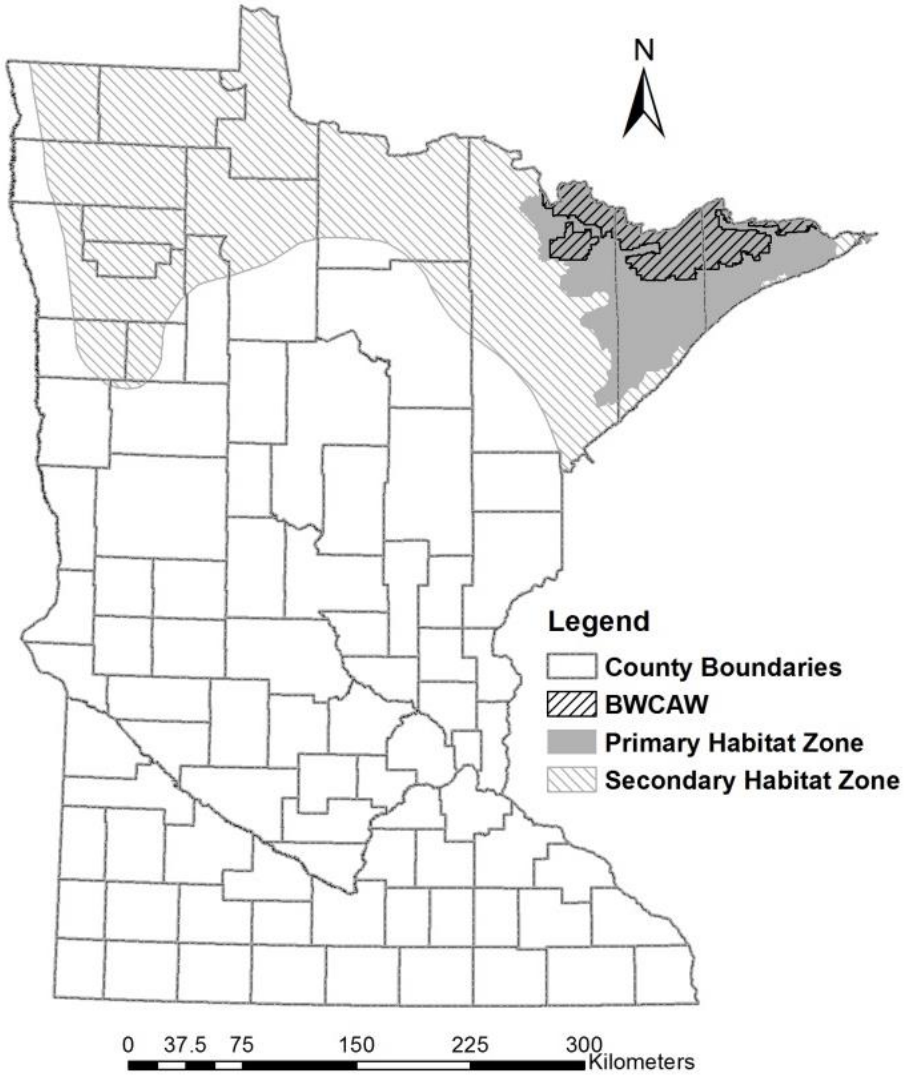
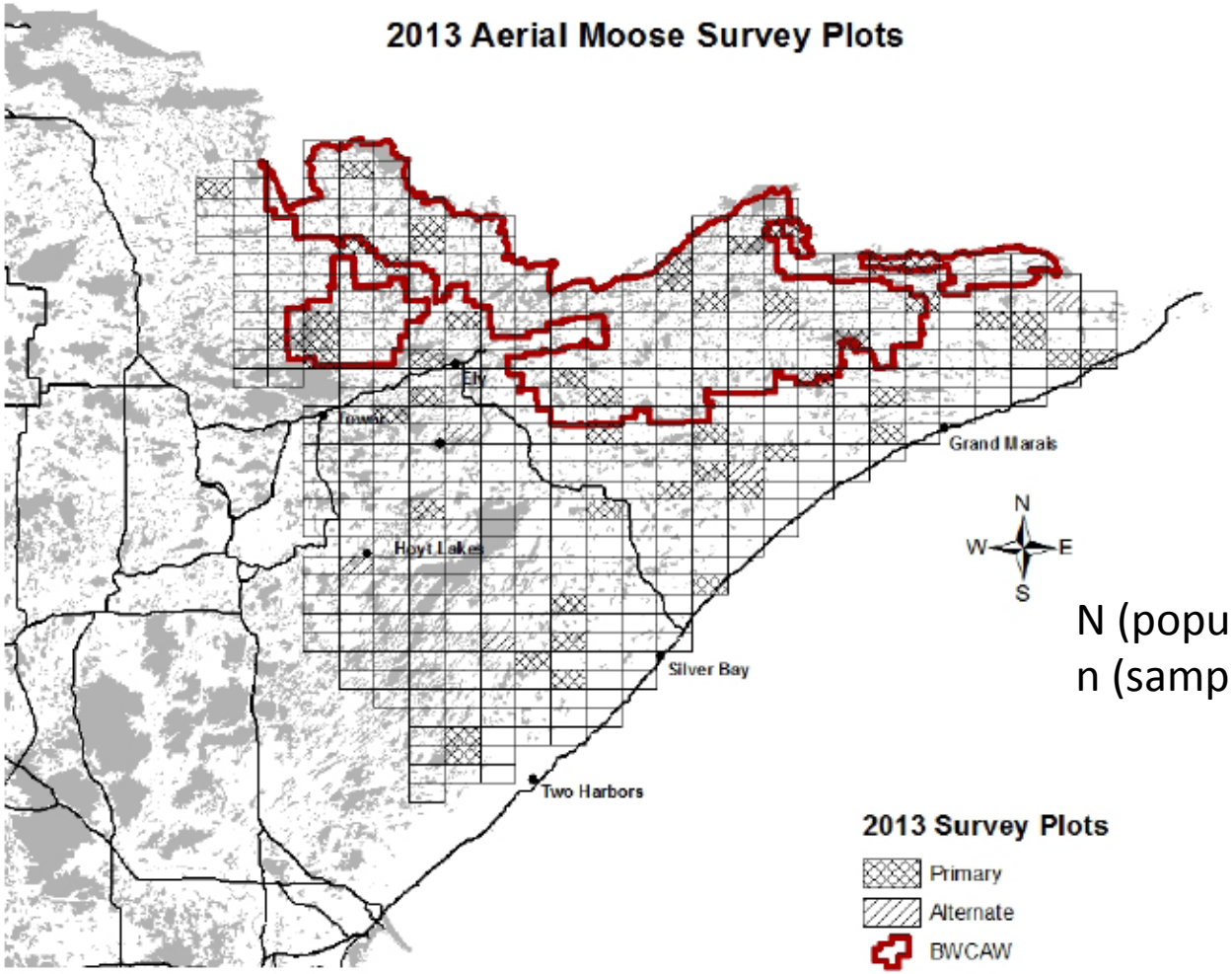


Figure 1: Moose Habitat Zones in Northern Minnesota. Primary habitat zone data (circa 2010) courtesy of Minnesota DNR Data Deli. Secondary habitat zone adapted from Moose Advisory Committee (2009).

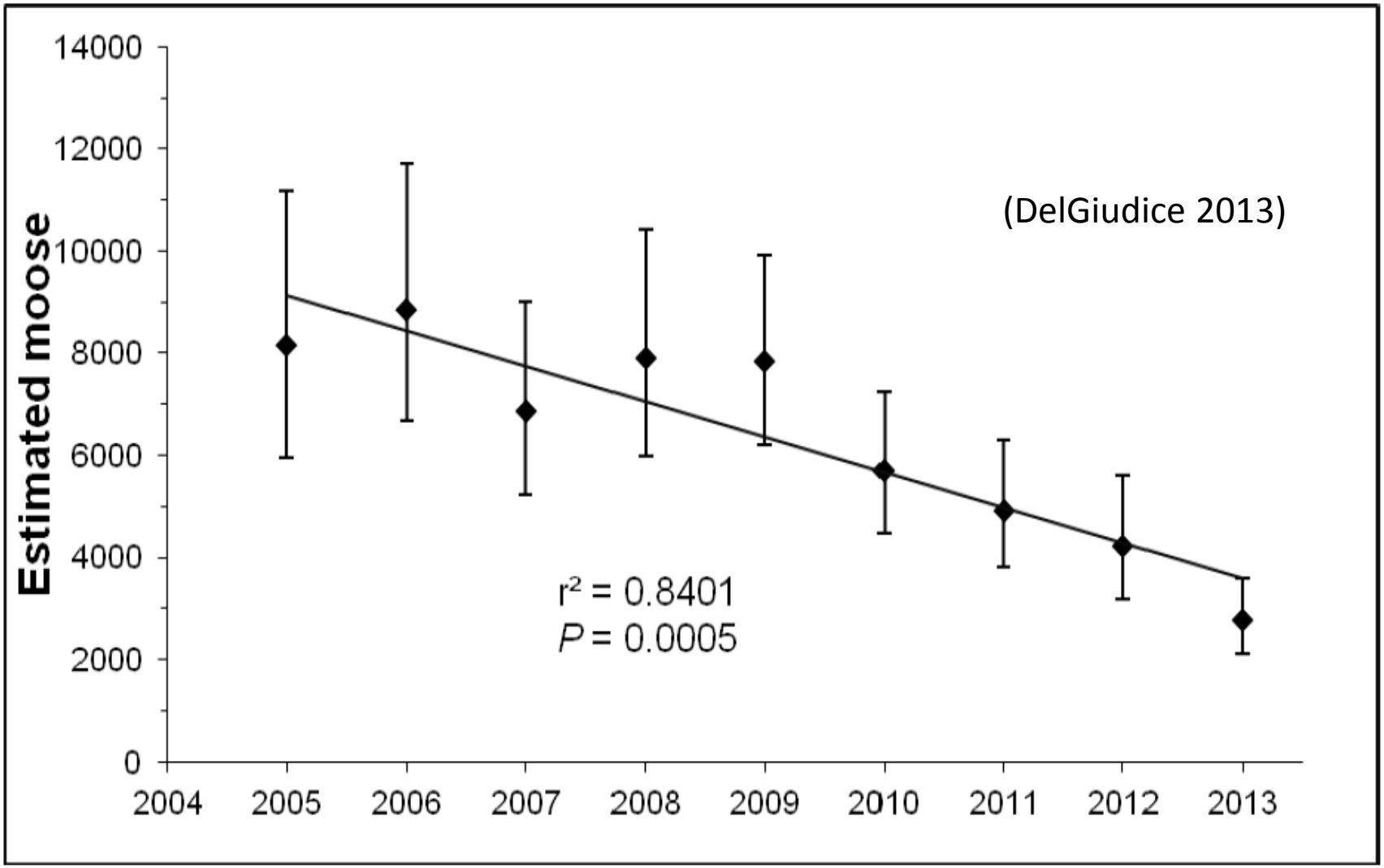
Moose Population Study - MNDNR



N (population)=452 Plots
n (sample)=54 Plots

Figure 2. Northeast moose survey area and sample plots (cross hatching) flown in the 2013 aerial moose survey (DelGiudice 2013).

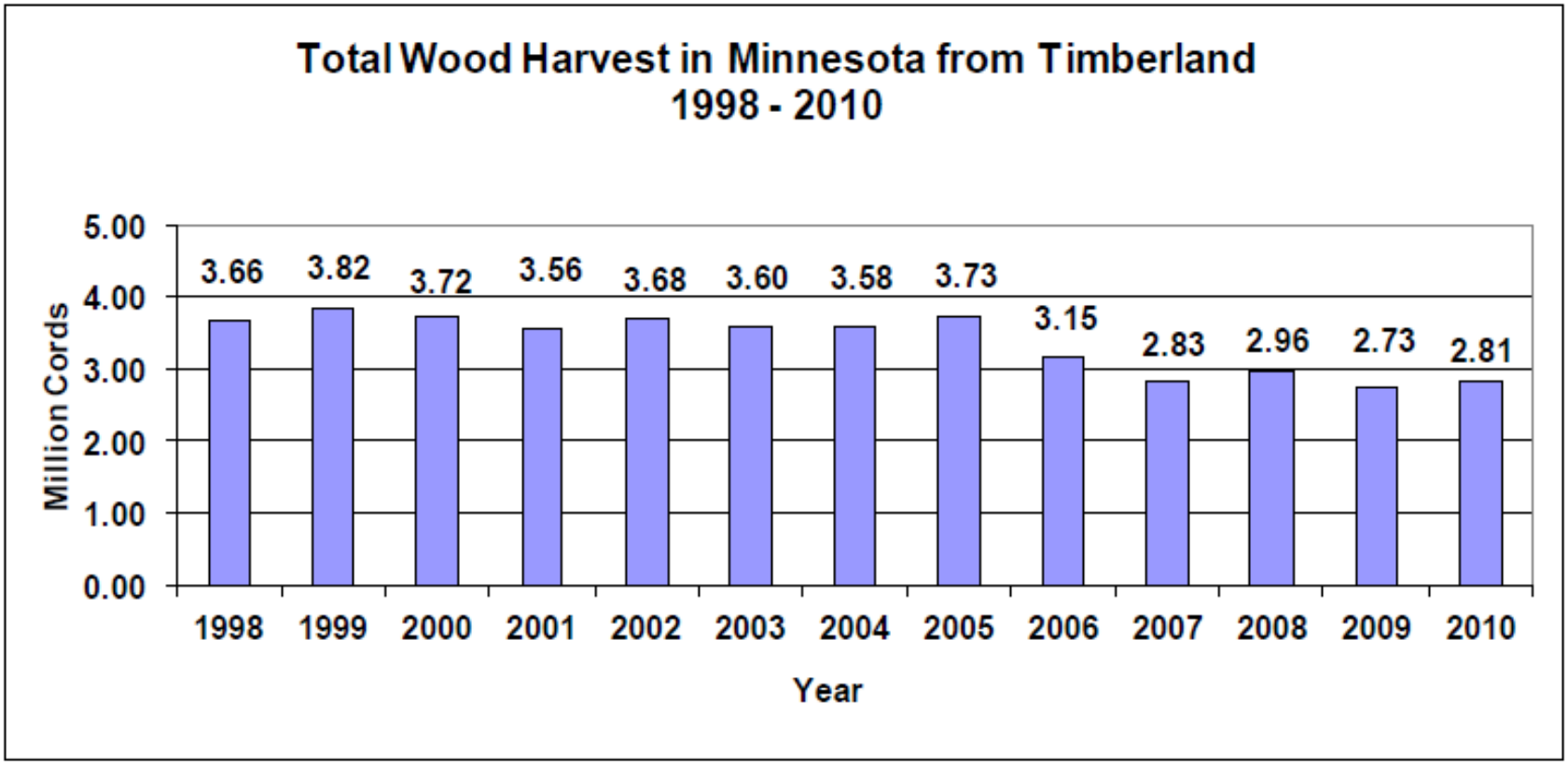
Moose Population Trend



What is causing the decline?

- Low levels of adult survival and calf recruitment
  - Disease?
  - Parasites?
  - Predation/Hunting?
  - Climate change?
  - Habitat change?

Statewide Harvesting Trend



Data Source: Pulpwood (USFS, Northern Research Station), sawtimber and fuelwood (MN DNR surveys).

Taken From: *Minnesota's Forest Resources 2012*

Volume of timber harvest from Superior National Forest

Federal Fiscal Year	Volume Harvested (MBF)
FY 00	66,633
FY 01	71,408
FY 02	56,509
FY 03	46,507
FY 04	55,147
FY 05	48,590
FY 06	32,445
FY 07	27,930
FY 08	32,330
FY 09	50,163
FY 10	49,851
FY 11	40,152
FY 12	50,907

Note: 1 cord = 500 Bd ft

SNF harvest data courtesy of Tim O'Hara, Minnesota Forest Industries, Duluth, MN

Forest Inventory and Analysis Program

- Inventories began in 1930s, and include estimates for 1977 and 1990, in addition to annually updated 5-year estimates starting with the 1999-2003 FIA cycle.

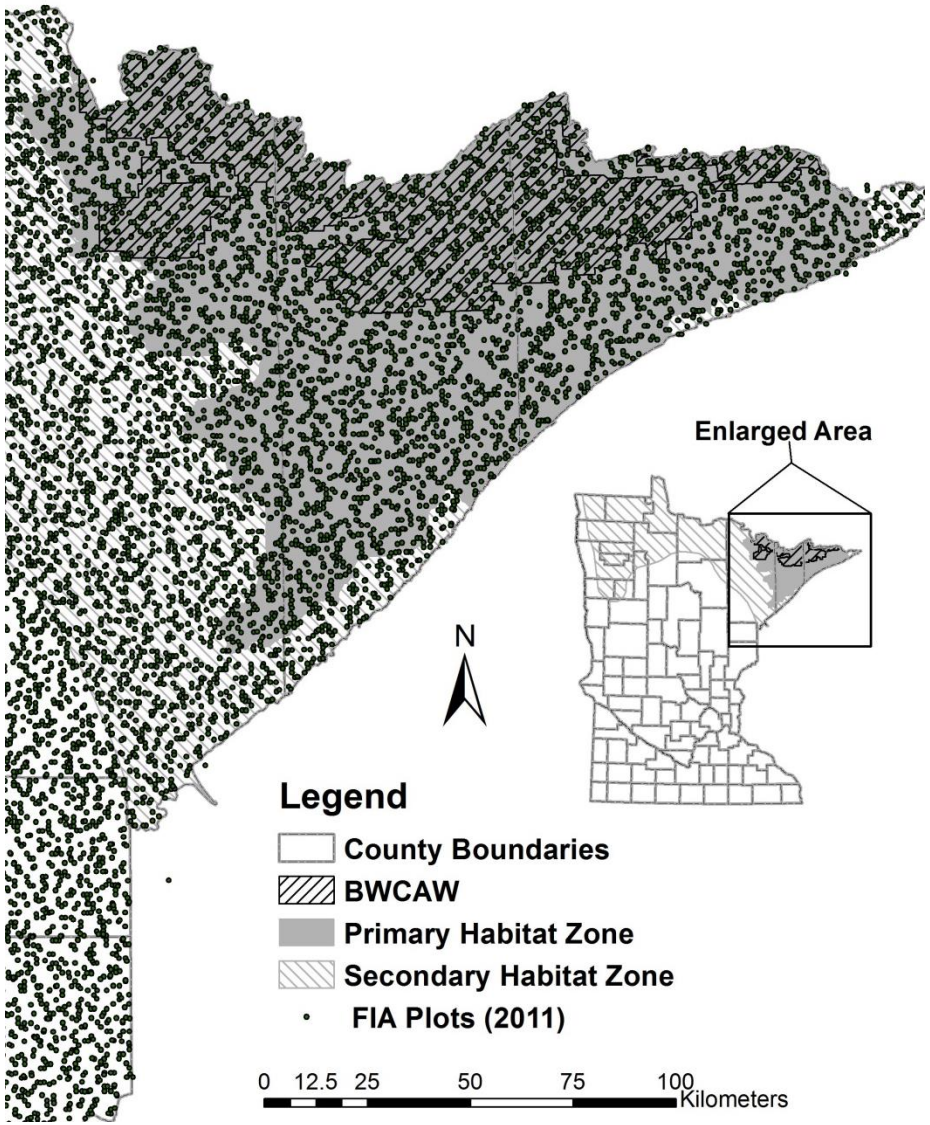
- Data used to project forest conditions 10 to 50 years or more into the future.

- Serves as key data for policy development and investment analysis…for economic development, forest management, and resource protection, etc.

- Used to evaluate status and trends in:
  - forest area, species, size, and health of trees;
  - total tree growth, mortality, and removals by harvest;
  - wood production and utilization rates;
  - forest land ownership.

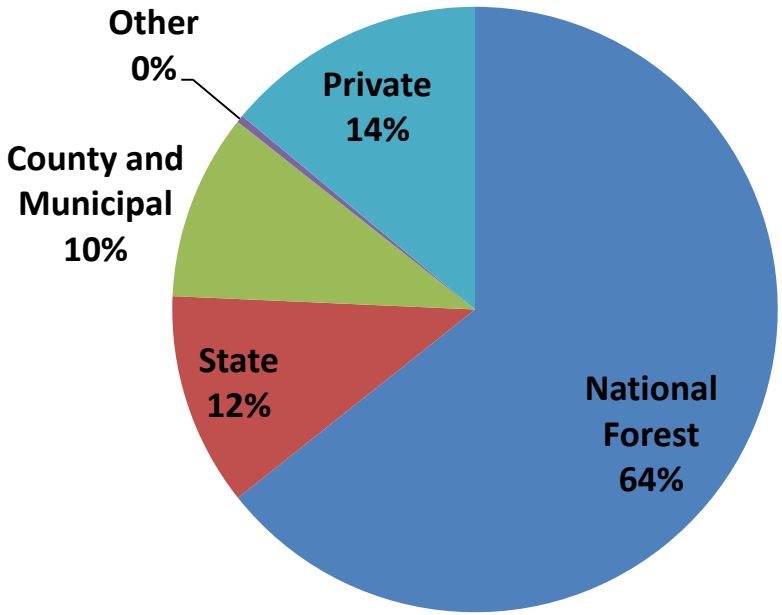
FIA in Northern Minnesota

- 1,258 permanent sample plots within the primary moose habitat zone.
  - Includes 4 subplots covering 0.0415 acres per subplot
- 1/5th of plots measured each year
- In 2011, 224 plots fell on non-forested conditions:
  - Non-forested land (92),
  - Open water (132),
  - Not sampled(37)



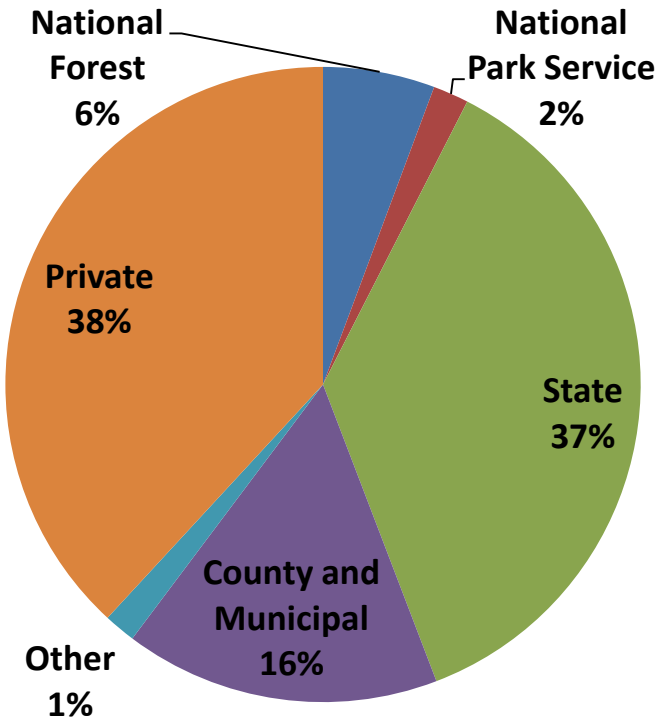
Forestland Ownership

Primary Moose Habitat Zone



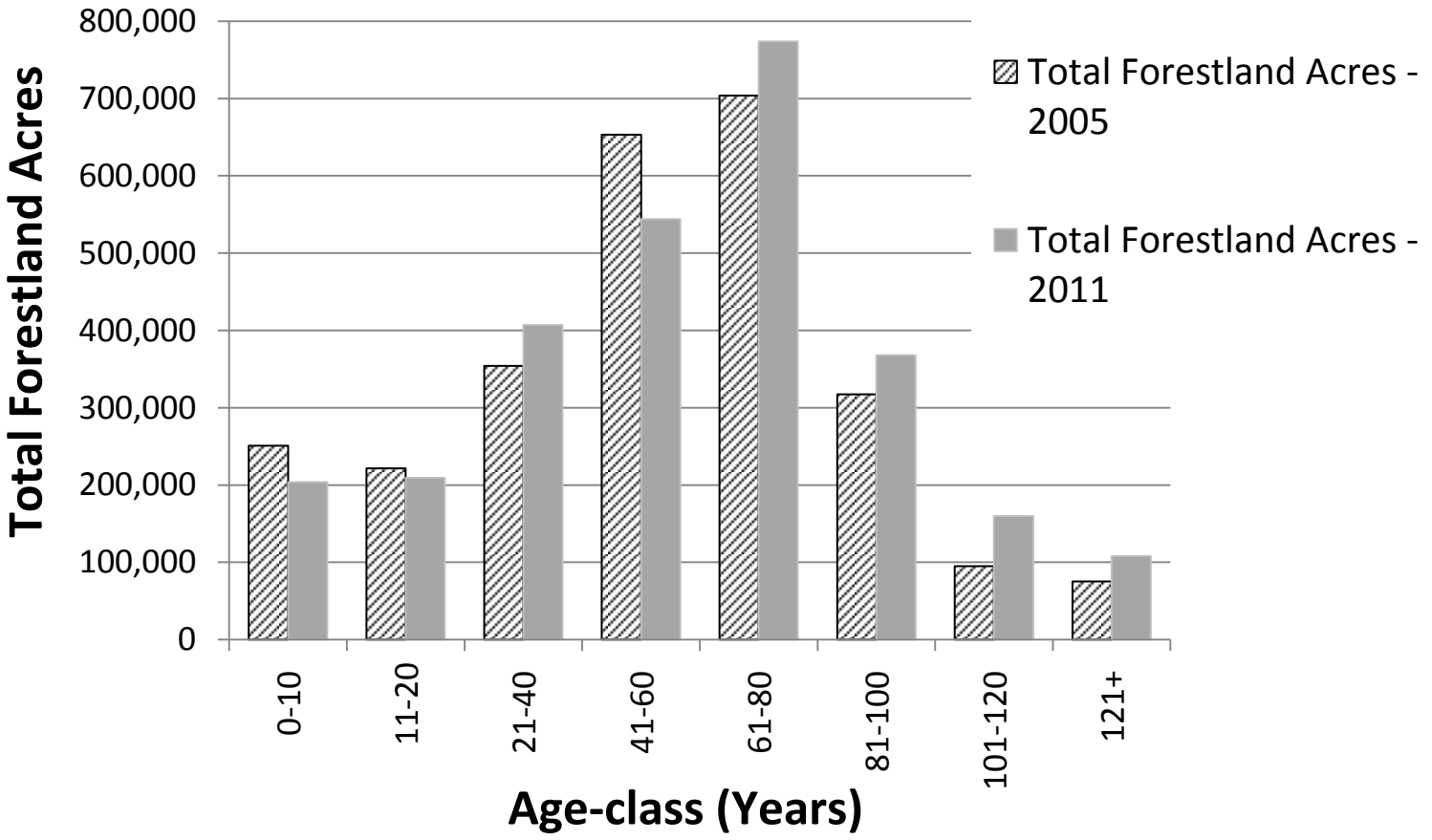
Forestland Acres = 2,773,798
84.7% Forested

Secondary Moose Habitat Zone



Forestland Acres = 5,554,128
46.6% Forested

Forest Age distribution within the primary moose habitat zone (2005 vs. 2011)



Comparing Moose Population and Forest Inventory Data

Table 1: Moose population estimates and corresponding FIA estimates of forestland in the 0-10 year age-class, acres disturbed by harvest, wind, weather, fire, flood (includes beaver damage), human, and unknown causes, and acres of open water.

Moose survey year	Moose population estimate	Acres 0 to 10-year old forestland	Acres 0 to 10-year aspen-birch-willow	Harvested acres	Acres harvested and/or disturbed	Open water
2003	---	227,632	129,527	91,503	352,299	394,589
2004	---	236,889	136,712	89,629	343,311	405,490
2005	8,160	250,817	140,855	91,651	303,238	427,147
2006	8,840	241,238	126,853	89,405	236,019	393,319
2007	6,860	236,149	113,228	81,747	180,647	389,109
2008	7,890	241,834	117,737	67,467	126,584	386,185
2009	7,840	209,084	101,818	58,966	123,015	351,370
2010	5,700	206,087	106,983	71,346	194,748	349,247
2011	4,900	203,766	107,976	71,468	236,007	348,271
2012	4,230	---	---	---	---	---
2013	2,760	---	---	---	---	---

Comparing Moose Population and Forest Inventory Data

- Estimates of changes in potential feeding habitat area do not coincide precisely with the steep decline in the moose population.
- A period of time (lag) would be needed for the moose population to respond to changes in its habitat.
  - Moose depend on body mass gained, and hence food availability, from the preceding summer to survive the winter.

More explanation regarding assumed lag response times

- We assumed a 1 year expected response time to changes in area of young forestland and aquatic feeding habitat recorded by FIA.
  - For example, to determine the effect of forest conditions from 2005 on the moose population with an assumed response time of 1 year, we compare FIA data from 2005 with moose population data from 2006.
- For changes in harvested and disturbed forestland area, we assumed a longer response time.
  - For example, the time required for disturbed areas to develop into young forest and serve as a food source for moose will vary depending on forest type and type of disturbance.
  - We assume that aspen will produce abundant suckers 1 or 2 years following harvest/disturbance (Bates et al. 1991). We further assumed an additional year for these suckers to become small saplings, and the technical passing of another year between the FIA field season and the January moose survey.
  - Hence, for comparisons of the moose population with FIA estimates of area disturbed and/or harvested, we assumed an overall response time of 4 years.

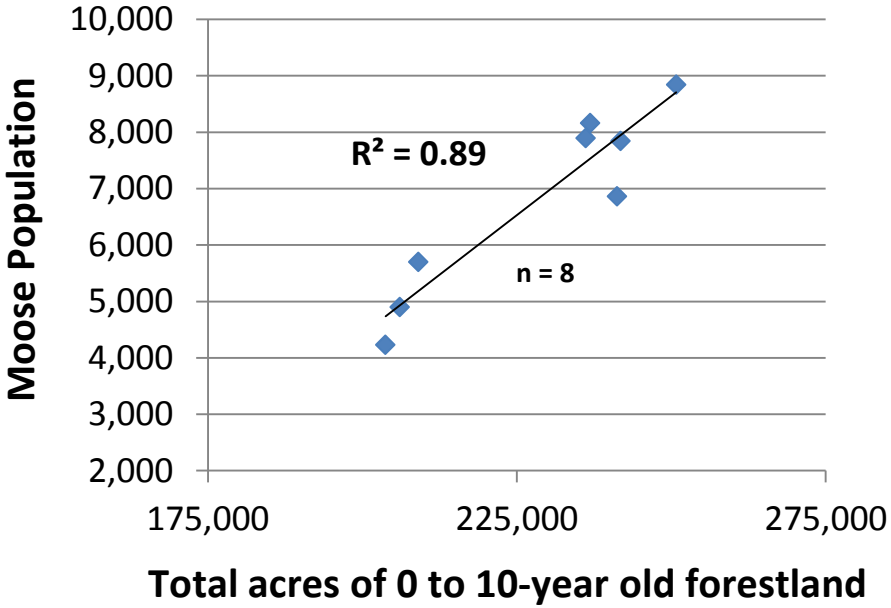
Correlation Matrix r-values

Variable	Moose population estimate	0 to 10-year forestland (acres)	0 to 10-year aspen-birch-willow	Harvested + disturbed acres	Open water (acres)	SNF harvested volume (MBF)
Moose population	1.0000	0.9425	0.7787	0.9321	0.9344	0.8829
0 - 10-year forestland	0.9425	1.0000	0.7925	0.9252	0.9341	0.8598
0 - 10-year aspen-birch-willow	0.7787	0.7925	1.0000	0.7109	0.9324	0.8548
Harvested + disturbed acres	0.9321	0.9252	0.7109	1.0000	0.9359	0.8131
Open water (acres)	0.9344	0.9341	0.9324	0.9359	1.0000	0.9042
SNF harvested volume	0.8829	0.8598	0.8548	0.8131	0.9042	1.0000

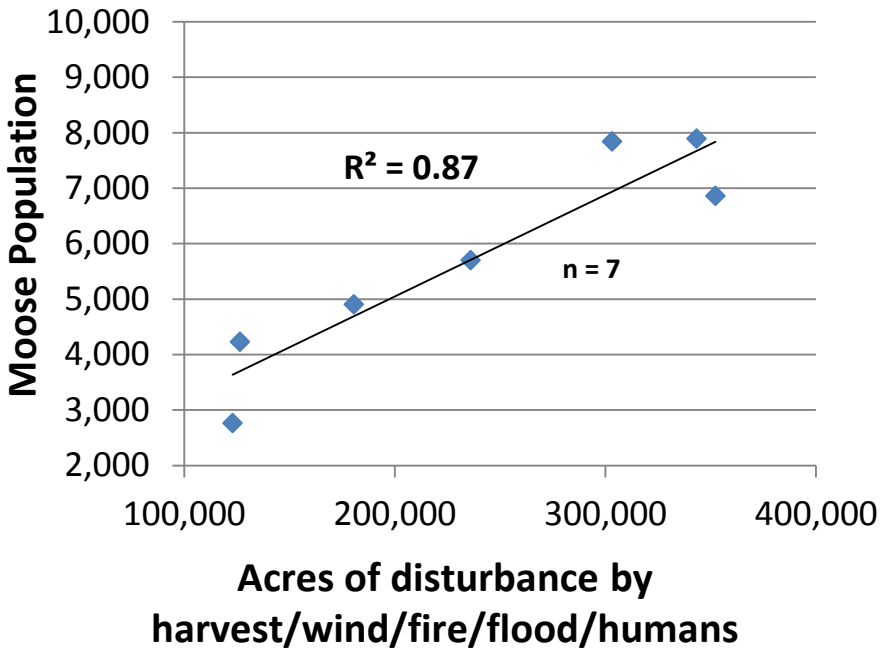
Correlation analysis verifies the existence of a shared relationship.

Regression Analysis

Moose numbers vs. Acres of young forestland



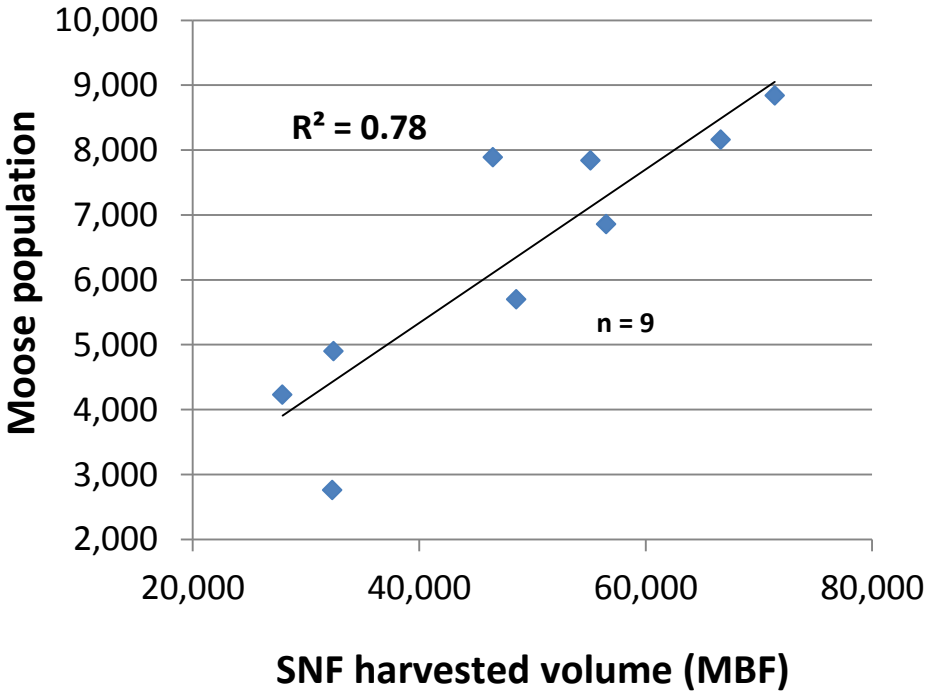
Moose numbers vs. Disturbed Acres



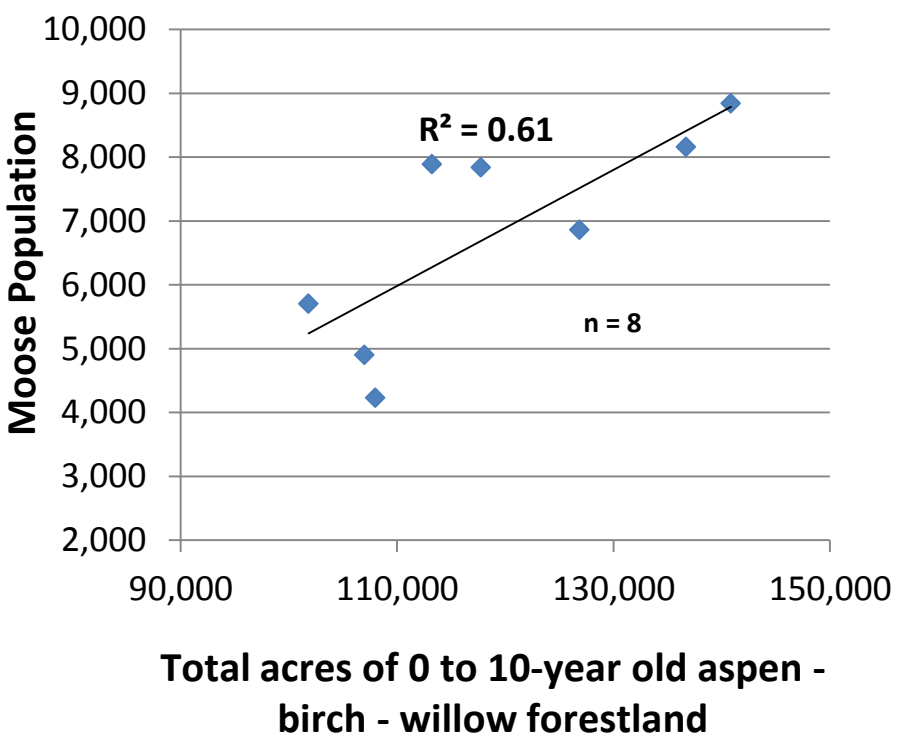
- Regression analysis quantifies the shared relationship between moose numbers and habitat variables.
  - Does not address causality

Regression Analysis

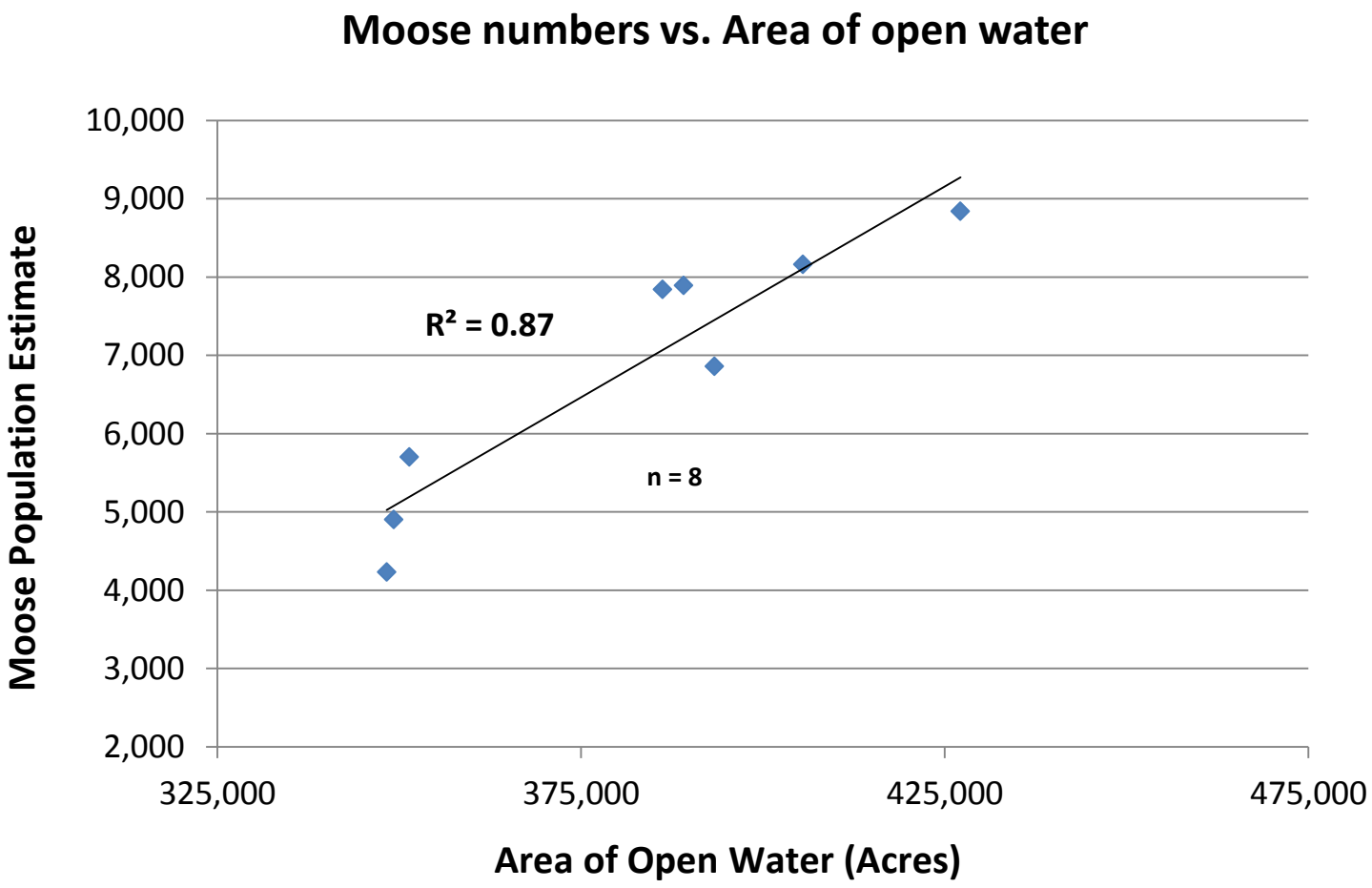
Moose numbers vs. Volume harvested from SNF



Moose numbers vs. Acres of young aspen – birch – willow



Regression Analysis



Conclusions/Discussion

- This analysis suggests that habitat limitations may be playing a role in the observed moose population decline…directly or indirectly.
- Given the substantial loss in total area of summer feeding habitat, it is possible that Minnesota's Moose population is experiencing pressure due to food resource limitations.

Suggestions/Questions?

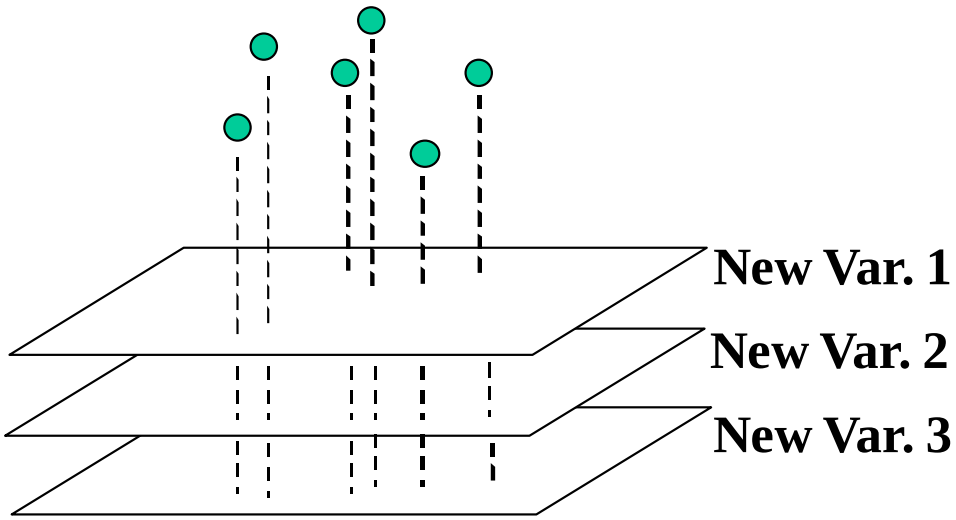
- Re-examine the historical response of moose populations to forest age and age class distributions and associated disturbance… such as fires, harvesting, and loss of wetlands and other aquatic habitat.
- Examine the potential of additional disturbance on the landscape to benefit the moose population.
- Further examination of how moose use recently burned, harvested, or otherwise disturbed areas may help to establish the nature of the relationships indicated here.

References

- Bates, P.C., C.R. Blinn and A.A. Alm. 1991. Regenerating Quaking Aspen: Management Recommendations. University of Minnesota - Extension. Publication #: WW-05637-GO. URL: http://www.extension.umn.edu/distribution/naturalresources/dd5637.html
- DelGiudice, G.D. 2013. 2013 Aerial Moose Survey Final Results. Forest Wildlife Populations and Research Group, Minnesota Department of Natural Resources. 6p. URL: http://files.dnr.state.mn.us/recreation/hunting/moose/moose_survey_2013.pdf
- Franzmann, A.W., C.C. Schwartz, and R.E. McCabe. 2007. Ecology and Management of the North American Moose. 2nd edition. University Press of Colorado. 733p.
- Kilgore, M.A. and A.R. Ek. 2013. Minnesota Forest Age Class Distribution, 2011. Minnesota Forestry Research Notes. No. 295. Department of Forest Resources, University of Minnesota, St. Paul, Minnesota. 3p.
- Lenarz, M.S., R.G. Wright, M.W. Schrage, and A.J. Edwards. 2011. Compositional analysis of moose habitat in northeastern Minnesota. Alces Vol. 47: 135-149.
- Miles, P.D. 2009. EVALIDatorReports: Reporting beyond the FIADB. In: McWilliams, W, G. Moisen, and R. Czaplewski, comps. Forest Inventory and Analysis (FIA) Symposium 2008; October 21-23, 2008; Park City, UT. Proc. RMRS-P-56CD. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 24 p. URL: http://www.fs.fed.us/rm/pubs/rmrs_p056/rmrs_p056_04_miles.pdf.
- Miles, P.D. 2011. EVALIDatorPC (Version 5.01.02) [Software]. Newtown Square, PA: USDA Forest Service, Northern Research Station. URL: http://apps.fs.fed.us/fiadb-downloads/datamart.html
- Minnesota Department of Natural Resources. 2011. Minnesota Moose Research and Management Plan, Minnesota Department of Natural Resources. St. Paul, MN. 51p. URL: http://files.dnr.state.mn.us/fish_wildlife/wildlife/moose/management/mooseplan-final.pdf
- Moose Advisory Committee. 2009. Report to the Minnesota Department of Natural Resources (DNR) by the Moose Advisory Committee. St. Paul, MN. 45p. URL: http://files.dnr.state.mn.us/fish_wildlife/wildlife/moose/mac/macreport.pdf
- O'Connell, B.M., E.B. LaPoint, J. A. Turner, T. Ridley, D. Boyer, A.M. Wilson, K.L. Waddell, B.L. Conkling. 2012. The Forest Inventory and Analysis Database: Database Description and Users Manual Version 5.1.5 for Phase 2. USDA Forest Service. 359p. plus append. See: http://www.fia.fs.fed.us/library/field-guides-methods-proc/
- Peek, J.M., D.L. Urich and R.J. Mackie. 1976. Moose Habitat Selection and Relationships to Forest Management in Northeastern Minnesota. Wildlife Monographs, No. 48, pp. 3-65

Steps in using FIA Data in Analysis

1. Import the X,Y coordinates from the FIA PLOT table to a GIS.
2. Attach spatially explicit attribute data to each plot.
3. Bring the modified PLOT table back into the FIA – Access data base, and update the COND table for each plot.
4. Use FIA–EVALIDator interface to make estimates for area of interest.



Plt_CN	Var 1	Var 2	Var 3
1	39	101	187
2	224	59	239
3	190	128	227
4	186	105	179
5	33	29	242
6	240	47	121
7	194	110	193
...			

(Lister, Miles 2009)