

Task CP1: Impacts of successional trajectories on abundance and composition of fuels through succession

- Johnstone, Mack, Rupp

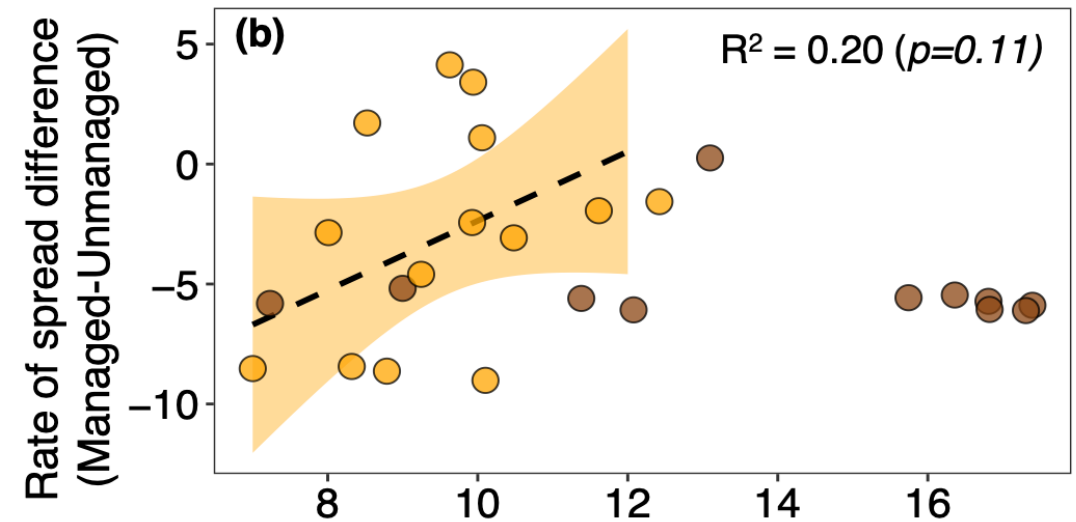
Summary of findings:

- Re-surveys of fuel management sites (Mack lab)
 - Thaw depth and spruce seedling recruitment in fuel treatments increases over time
 - Weak effects on potential fire rate of spread (ROS)
 - Potential ROS increased in shearbladed BS woodlands because lichen fuels were replaced with grass
- Initial trajectories of post-fire recovery and fuel characteristics in black spruce systems
 - Updating successional trajectories workbook (Johnstone/Hollingsworth)
- Synthesis of fire self-regulation in boreal forests
 - Project with AK Fire Management community (Johnstone)
- LandCarbon project using ALFRESCO/TEM

Thinned



Shearbladed



Successional trajectories and impacts on fuels

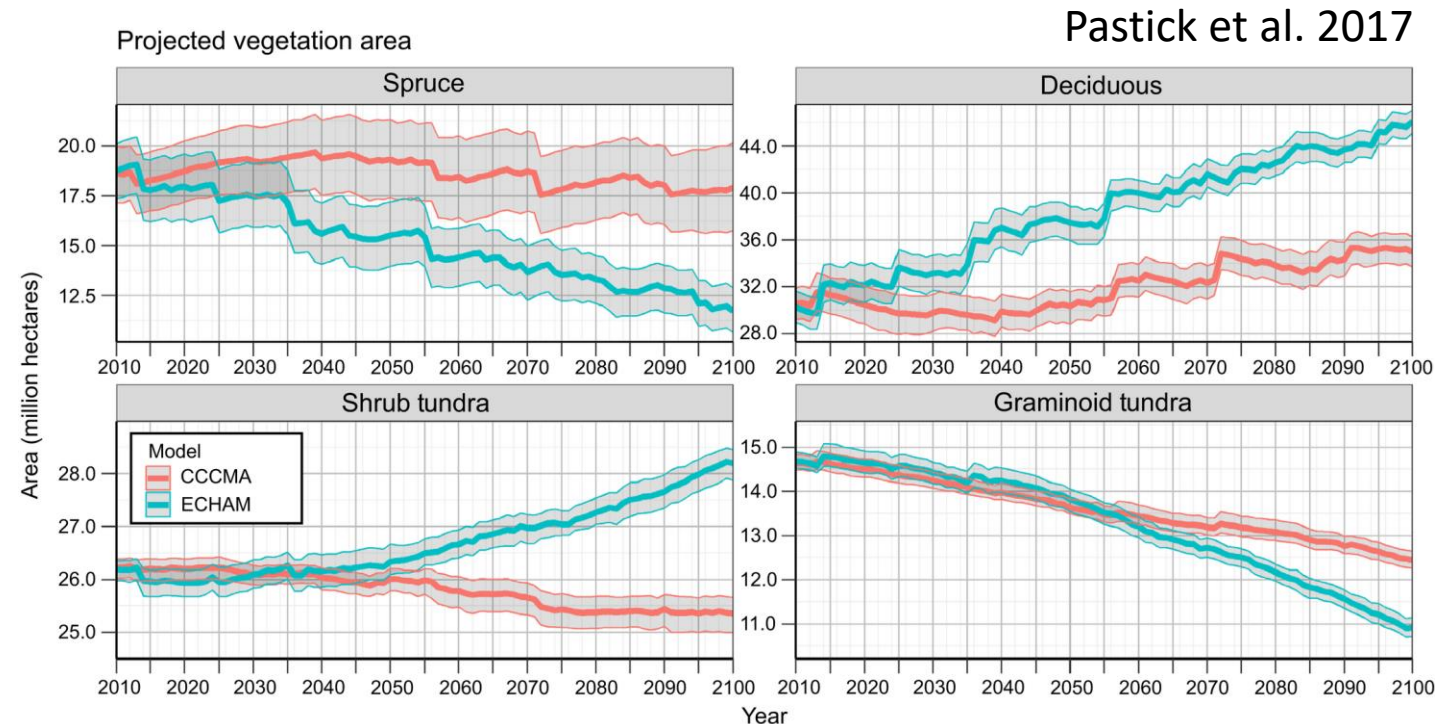
Future directions

- What are your plans moving forward?
 - Fire self-regulation synthesis to be completed in 2019 and presented at Nov. meeting of Assoc. for Fire Ecology (special session on Fire & Management in AK)
 - Successional trajectories workbook revisions, working on fuels characterization with graduate student
 - Plans to re-publish as USFS technical report (accessible to managers)
 - AKFSC Fact sheet for managers on long-term effects of fuel treatments
 - Modelling work: not yet sure what is likely to be most useful
 - Currently using Alaska Fuels Guide and CanFire model to provide basic estimates of rates of spread
 - Potential to explore some fire interactions with iLand
- What is limiting your efforts?
 - Big issues: need for money, personnel, time to support expanding modelling efforts
 - Unsuccessful NASA ABoVE proposal
 - Looking for other funding venues – notable restriction of funding for JFSP in recent years, limited options
 - NNA proposal in review

Successional trajectories and impacts on fuels

Cross-scale interactions

- Understanding dynamics of fire self-regulation are critical for fire management and prediction because of effects on landscape fire behavior
- Changing efficacy of fuel treatments over time will influence future behavior of fire breaks and management costs
- Landscape scale changes in forest composition may affect fire behavior but there is substantial uncertainty



Successional trajectories and impacts on fuels

Publications and datasets

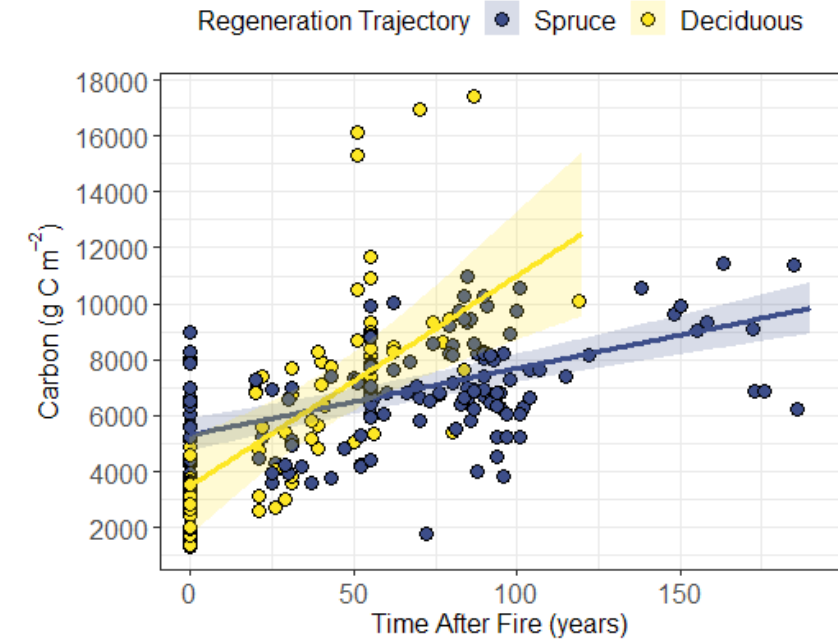
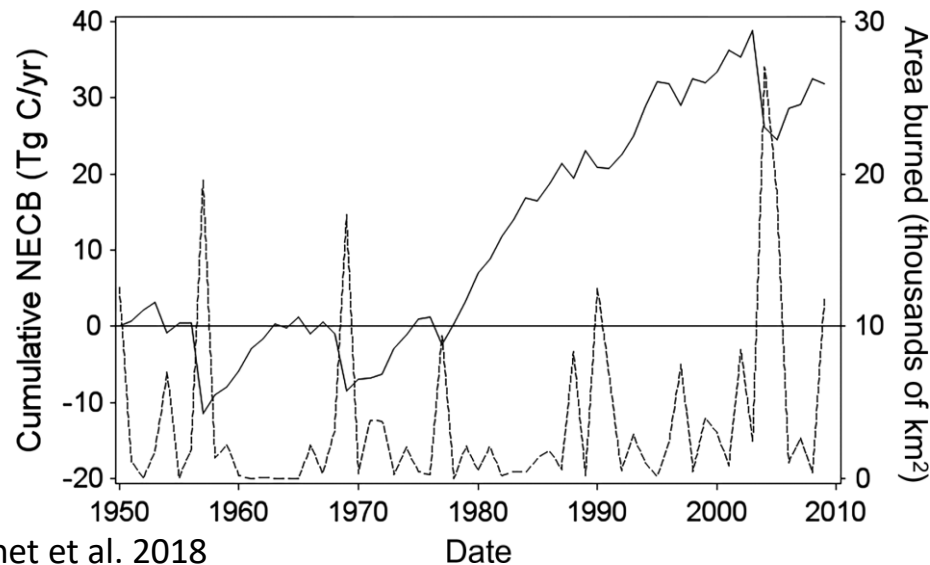
- Published and planned papers
 - Boyd MB, Celis G, Johnstone JF, Schuur EAG, Walker XJ, and Mack MC. Long term effects of fuel reduction treatments on ecosystem structure and permafrost stability in boreal forest black spruce stands. *in prep*
 - Jean, M., H.D.A. Alexander, M.C. Mack, J.F. Johnstone. 2017. Patterns of bryophyte succession in a 160-year chronosequence in deciduous and coniferous forests of boreal Alaska. *Canadian Journal of Forest Research* 47. pp. 1021-1032. doi: 10.1139/cjfr-2017-0013
 - Melvin, A.M., G. Celis, J.F. Johnstone, A.D. McGuire, H. Genet, E.A.G. Schuur, T.S. Rupp, M.C. Mack. 2018. Fuel-reduction management alters plant composition, carbon and nitrogen pools, and soil thaw in Alaskan boreal forest. *Ecological Applications* 28. pp. 149-161. doi: 10.1002/eap.1636
 - Pastick, N. J., P. Duffy, H. Genet, T. S. Rupp, B. K. Wylie, K. D. Johnson, M. T. Jorgenson, N. Bliss, A. D. McGuire, E. E. Jafarov, and J. F. Knight. 2017. Historical and projected trends in landscape drivers affecting carbon dynamics in Alaska. *Ecological Applications* 27:1383–1402.
 - Wehmas, M.I. 2018. Temporal and Spatial Variation in Flammability of Broadleaf Forest in Boreal Alaska. M.S. Thesis. University of Alaska Fairbanks; Fairbanks, AK. 49 p.

Task CP2: Landscape consequences of changing fire on patterns of carbon storage

Johnstone, Mack, Rupp

A brief summary of findings:

- High severity burning shifts stand dominance from spruce to deciduous increases
- Shift results in a 5 Kg m^{-2} increase in net ecosystem carbon storage ($t_{100}-t_0$)
- Plant-soil-microbial feedbacks shift N from low C:N soil to high C:N wood
- Need to understand fate and turnover time of deciduous carbon pools



- Land Carbon integrated modelling project (ALFRESCO + DOS-TEM)
 - Climate change is expected to drive increased area burned
 - CO_2 & climate stimulate C storage but also increase fire
 - Fire in the boreal interior is an important constraint on increasing NECB in Alaska

Landscape consequences of changing fire on C storage

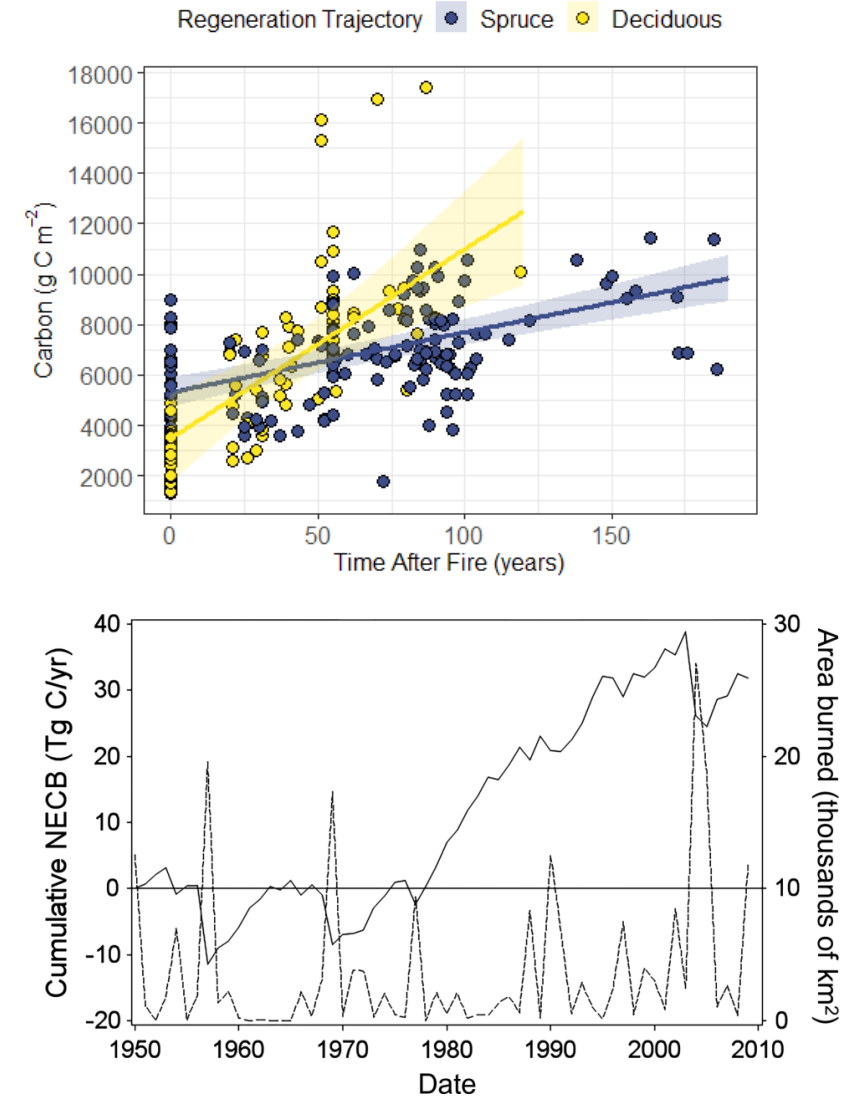
Future directions

- What are your plans moving forward?
 - Proposed initial spreadsheet model – not sure if we will be doing this...
 - Possible future work with iLand (collaboration with Winslow Hansen)
 - Field work to understand fate of carbon in older mixed and deciduous stands
 - Fuel modeling and remote sensing to understand how tree species composition impacts flammability, fire spread, and fire severity
- What is limiting your efforts?
 - External funding to support new modelling and remote sensing work
 - Unsuccessful NASA ABoVE proposal
 - NNA proposal under review

Landscape consequences of changing fire on C storage

Cross-scale interactions

- Fire plays a critical role for landscape C dynamics:
 - Dominant spatial disturbance (thus responsible for much of the disturbance-induced C losses)
 - Fire characteristics affect both the magnitude of C loss, and rate of C recovery
- Net effect on the landscape depends on both losses and recovery
- Land Carbon modeling suggests fire effects may prevent interior AK from being a carbon sink with warming and CO₂ fertilization
- Fate of burned stands is a critical area where we need more research and modeling



Landscape consequences of changing fire on C storage

Publications and datasets

- Published and planned papers

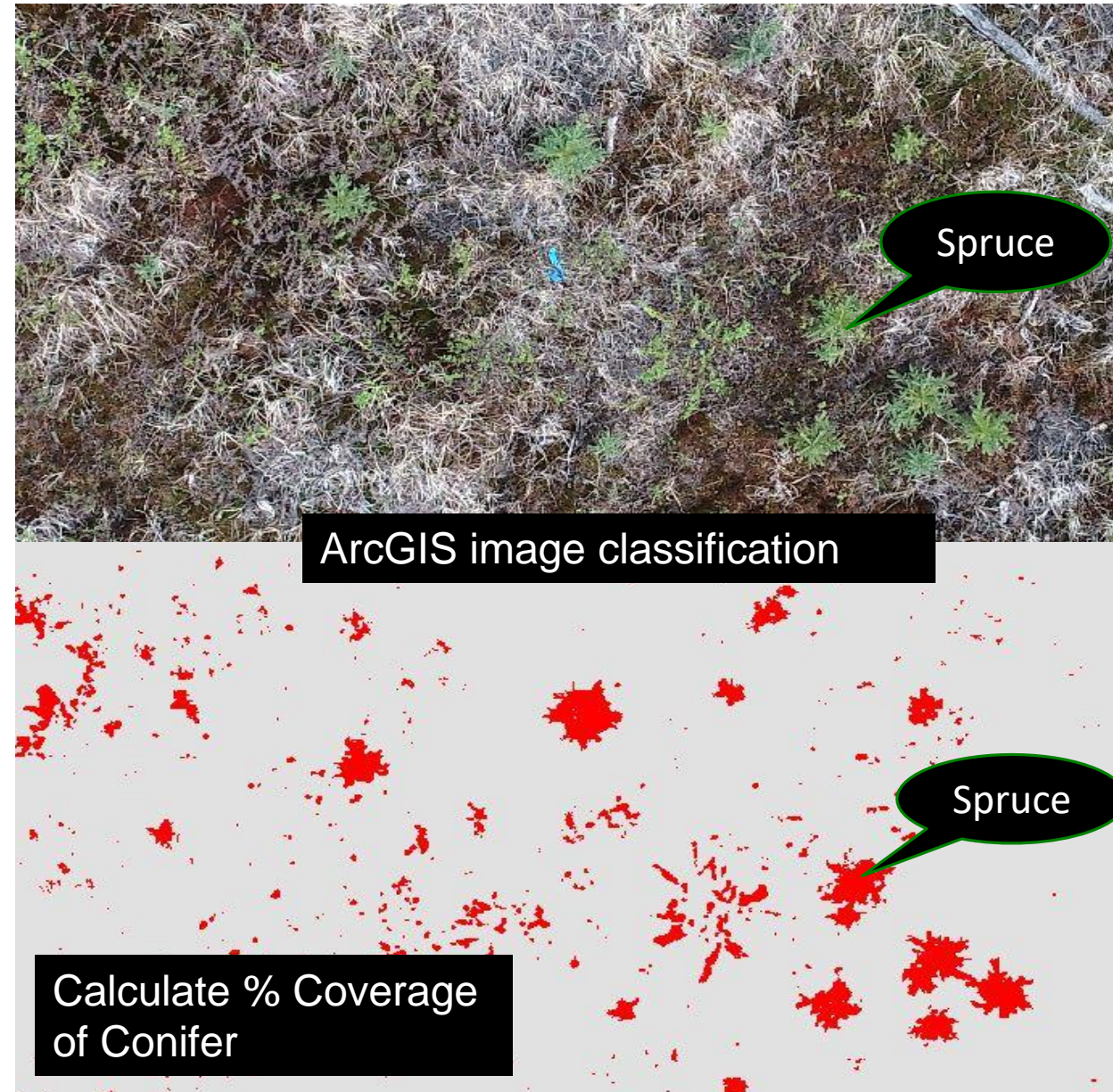
- Mack et al., in prep
- Chen, G., D. J. Hayes, and A. David McGuire. 2017. Contributions of wildland fire to terrestrial ecosystem carbon dynamics in North America from 1990 to 2012: Fire-Caused Net Ecosystem Carbon Flux. *Global Biogeochemical Cycles* 31:878–900.
- Genet, H., Y. He, Z. Lyu, A. D. McGuire, Q. Zhuang, J. Clein, D. D'Amore, A. Bennett, A. Breen, F. Biles, E. S. Euskirchen, K. Johnson, T. Kurkowski, S. Kushch Schroder, N. Pastick, T. S. Rupp, B. Wylie, Y. Zhang, X. Zhou, and Z. Zhu. 2018. The role of driving factors in historical and projected carbon dynamics of upland ecosystems in Alaska. *Ecological Applications* 28:5–27.
- Houle, G., E.S. Kane, E.S. Kasischke, C.M. Gibson, M.R. Turetsky. 2018. Recovery of Carbon Pools a Decade Following Wildfire in Black Spruce Forests of Interior Alaska: Effects of Soil Texture and Landscape Position. *Canadian Journal of Forest Research* 48: 1-10. doi: 10.1139/cjfr-2017-0236
- McGuire, A. D., H. Genet, Z. Lyu, N. Pastick, S. Stackpoole, R. Birdsey, D. D'Amore, Y. He, T. S. Rupp, R. Striegl, B. K. Wylie, X. Zhou, Q. Zhuang, and Z. Zhu. 2018. Assessing historical and projected carbon balance of Alaska: A synthesis of results and policy/management implications. *Ecological Applications* 28:1396–1412.
- Melvin, A.M., J. Murry, B. Boehlert, J.A. Martinich, L. Rennels, T.S. Rupp. 2017. Estimating wildfire response costs in Alaska's changing climate. *Climate Change* 141. pp. 783-795. doi: 10.1007/s10584-017-1923-2
- Walker, X.J., B.M. Rogers, J.L. Baltzer, S.G. Cumming, N.J. Day, S.J. Goetz, J.F. Johnstone, E.A.G. Schuur, M.R. Turetsky, M.C. Mack. 2018. Cross-scale controls on carbon emissions from boreal forest megafires. *Global Change Biology* 24: 4251-4265. doi: 10.1111/gcb.14287

CP3: Quantify vegetation composition and change within the fire break and timber/biofuel harvest areas, and assess use by both moose and hunters

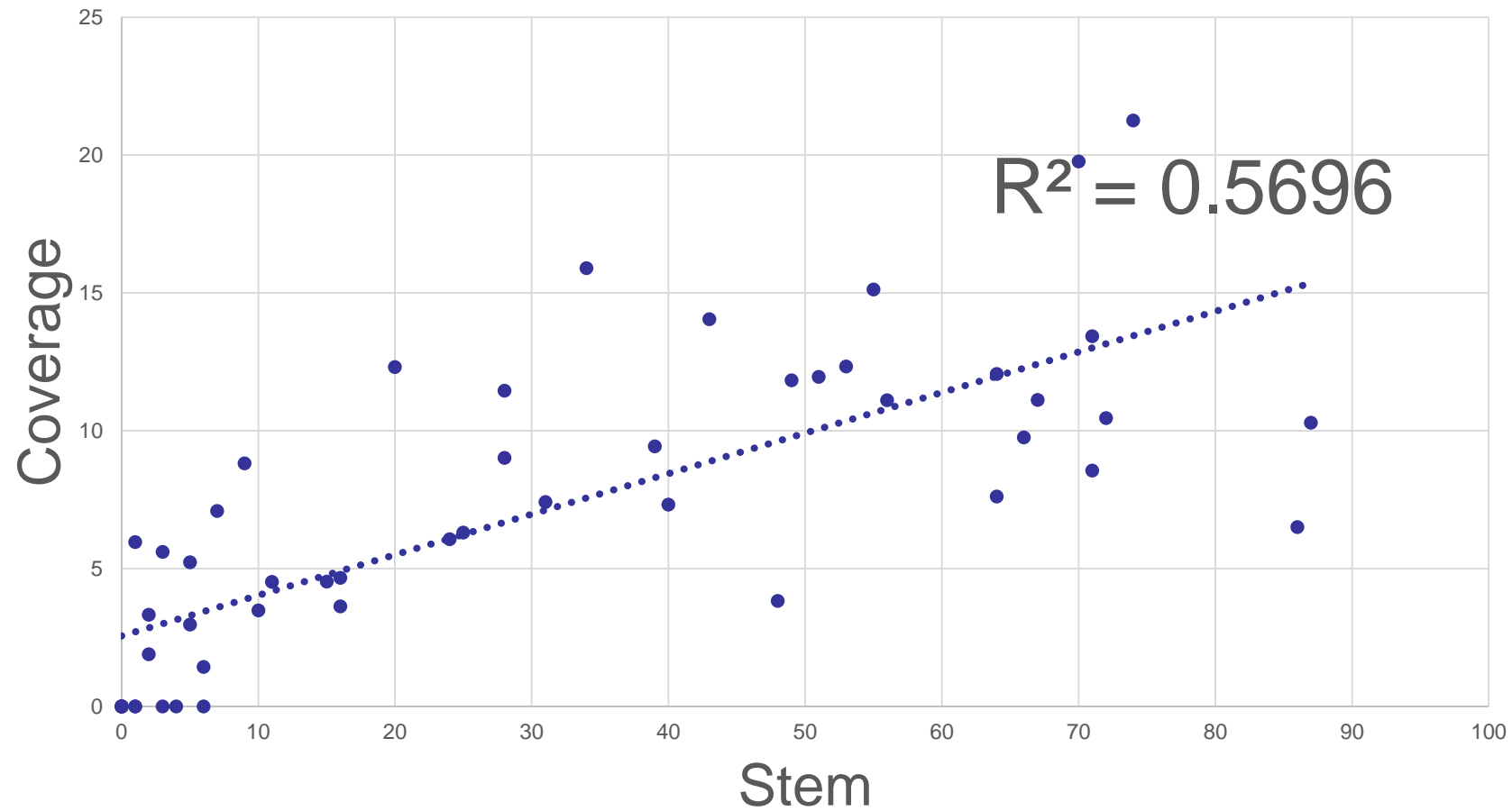


METHOD COMPARISON

- DOF – Stem density counts
- ADFG – Primary and secondary species using ground images
- UAF – Drone-based image classification



Correlations	Stem count	Ground_primary
Aerial coverage	.755**	.433**



FUTURE DIRECTIONS & LIMITATIONS



Bear Baiting Practices and Patterns in Interior Alaska



Cross-scale interactions and opportunities?

- Application of our rapid assessment technique to
 - Natural burns
 - Logged stands
 - Biomass

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Fuel-reduction management alters plant composition, carbon and nitrogen pools, and soil thaw in Alaskan boreal forest

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EDWARD A. G. SCHUUR,³ T. SCOTT RUPP,⁷ AND MICHELLE C. MACK³

Publication: Paragi T, TJ Brinkman, G Quigley, D Hansen. A rapid assessment tool for evaluating fuels regeneration in wildfire breaks. Forest Science. *In prep*

Presentation: Alaska Fire Science Workshop (March 2019, Fairbanks)

Task CP4: Design and implement a landscape-level experiment to test management scenarios affecting forage availability, moose distribution, habitat use, and hunter behavior (Ruess, Brinkman, Kielland).

