

# Estimating Regeneration of Burned Forest Areas

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**2018 Inland Northwest Growth and Yield Co-op Winter Technical Meeting**

# Objectives

- **Illuminate the state of wildfire and regeneration in the West**
- **Highlight the need for a precise and cost-effective method to estimate regeneration of burned areas**
- **Address the shortcomings of existing methods**
- **Outline important considerations for the development of potential new approaches**



West Fork Teton Trailhead  
Choteau, MT  
Mile 0 of 18





Bowl Creek Drainage, July 2017  
Bob Marshall Wilderness  
Headwaters of Middle Fork Flathead River  
Persistent effects of the Ahorn Fire, 2007

# A Million Acres Scorched by Montana Wildfires

Posted by Dana Rogge, FSA Public Affairs Specialist in [Forestry, Conservation](#)  
Oct 03, 2017



Fires blaze from the Blacktail Fire, located in the Blacktail Creek area, east of Loco Mountain in the Crazy Mountains, in Montana. The Blacktail Fire engulfed a little over 5,000 acres, with over 1 million acres impacted across Montana through various wildfires.

<https://www.usda.gov/media/blog/2017/10/03/million-acres-scorched-montana-wildfires>

### LETTER

## Evidence for declining forest resilience to wildfires under climate change

Camille S. Stevens-Rumann,<sup>1,2\*</sup>  
Kerry B. Kemp,<sup>3</sup> Philip E. Higuera,<sup>4</sup>  
Brian J. Harvey,<sup>5</sup>  
Monica T. Rother,<sup>6,7</sup>

Daniel C. Donato,<sup>5,8</sup>  
Penelope Morgan<sup>1</sup> and  
Thomas T. Veblen<sup>6</sup>

*“In the US Rocky Mountains, we documented a significant trend of reduced post-fire tree regeneration...Our findings are consistent with the expectation of reduced resilience of forest ecosystems to the combined impacts of climate warming and wildfire activity. Our results suggest that predicted shifts from forest to non-forested vegetation may be underway, expedited by fire disturbances.”*

## 4. FOREST AND RANGELAND RENEWABLE RESOURCES PLANNING ACT OF 1974

[As Amended Through Public Law 106–580, Dec. 31, 2000]

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AN ACT To provide for the Forest Service, Department of Agriculture, to protect, develop, and enhance the productivity and other values of certain of the Nation's lands and resources, and for other purposes.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That [16 U.S.C. 1600 note] this Act may be cited as the "Forest and Rangeland Renewable Resources Planning Act of 1974".*

(4) the new knowledge derived from coordinated public and private research programs will promote a sound technical and ecological base for effective management, use, and protection of the Nation's renewable resources;

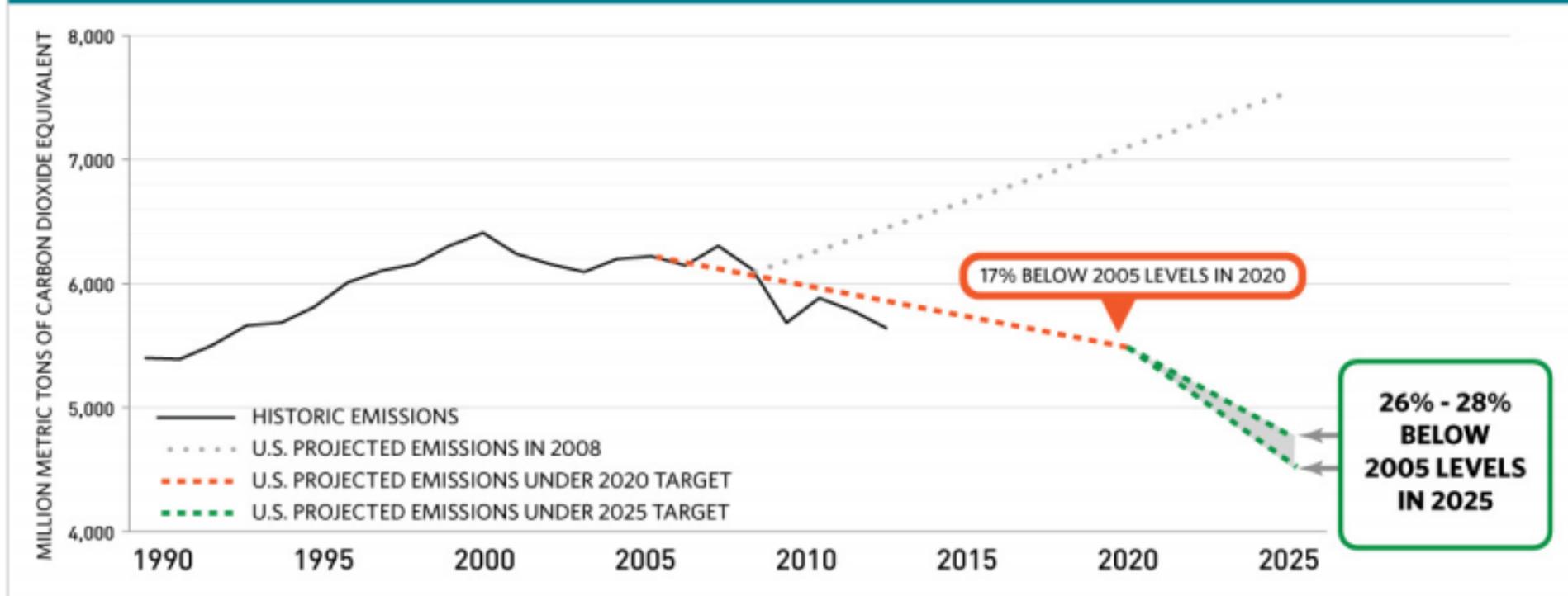
Sec. 4

FOREST & RANGELAND RENEWABLE RESOURCES

4-6

(2) Notwithstanding the provisions of section 9 of this Act, the Secretary shall annually for eight years following the enactment of this subsection, transmit to the Congress in the manner provided in this subsection an estimate of the sums necessary to be appropriated, in addition to the funds available from other sources, to replant and otherwise treat an acreage equal to the acreage to be cut over that year, plus a sufficient portion of the backlog of lands found to be in need of treatment...

## U.S. EMISSIONS UNDER 2020 AND 2025 TARGETS



## Potential for Additional Carbon Sequestration through Regeneration of Nonstocked Forest Land in the United States

V. Alaric Sample

- 8 million ha of forestland are currently defined as non-stocked from natural/human disturbances
- Regeneration on these lands could result in additional sequestration of 48.9 million metric tons of CO<sub>2</sub> equivalent (CO<sub>2</sub>e) annually.
- On NFS lands,  $\geq 50\%$  of the total potential carbon sequestration from regenerating non-stocked lands could be achieved by reforesting just the top 30% of these lands in moderate-to-high site productivity classes.
- On private lands, more than 70% of the total potential carbon benefit can be achieved by regenerating the most productive 30%.
- *Non-contentious*



St. Joe

St. Joe River

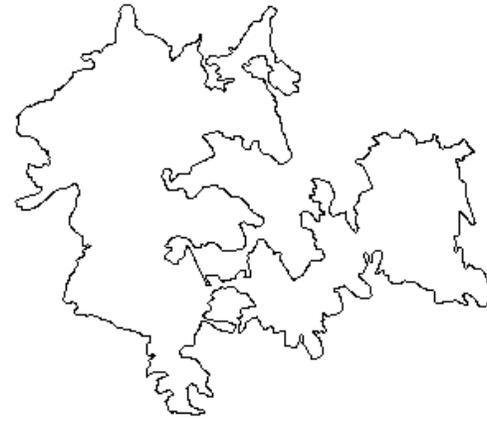
Calder

Erimo

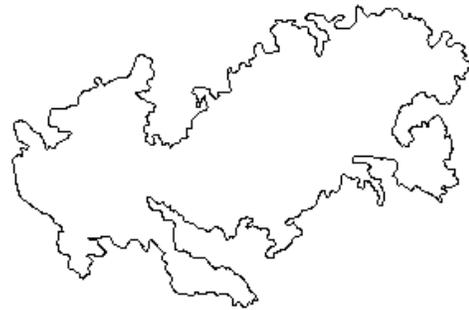
Pocono

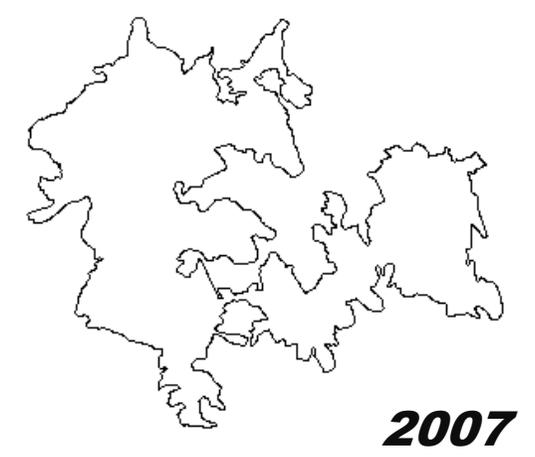
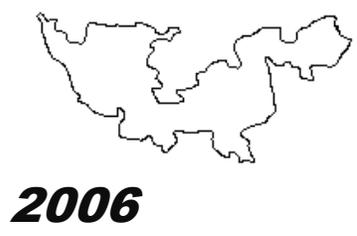
# Existing Methods

- **FIA-based direct estimation**
- **Other modeling approaches**



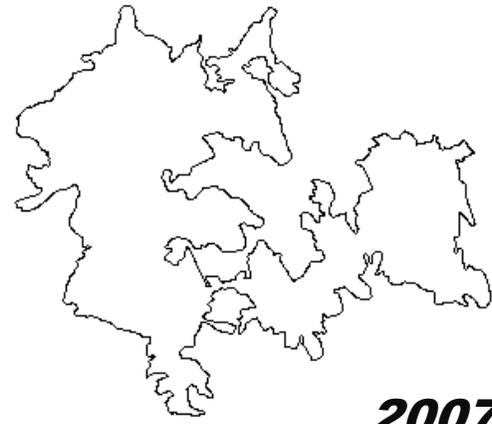
## Domains and direct estimation







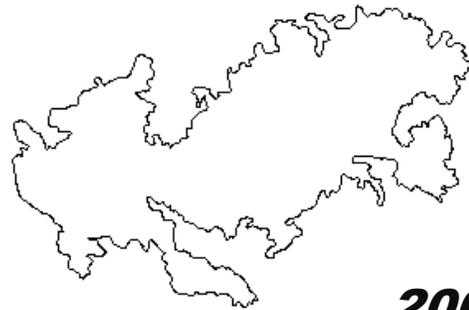
**2006**



**2007**

**R2**

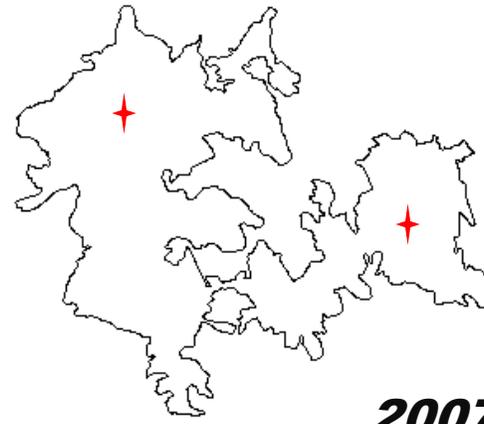
**R1**



**2007**



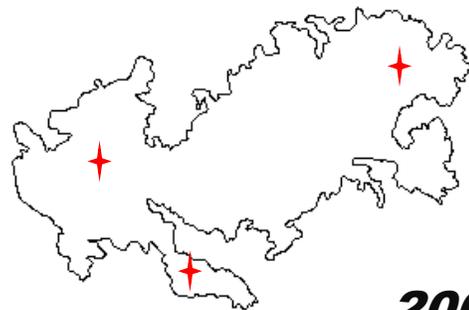
**2006**



**2007**

**R2**

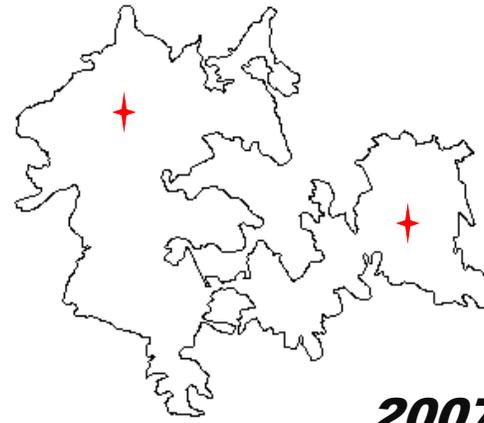
**R1**



**2007**



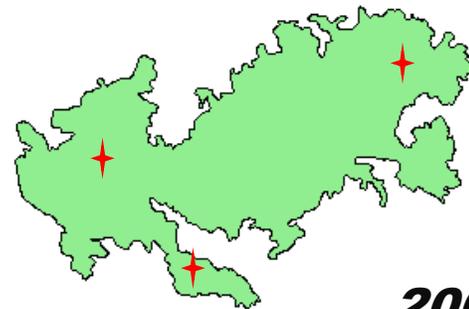
**2006**



**2007**

**R2**

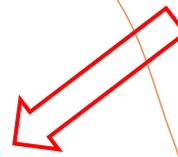
**R1**



**2007**

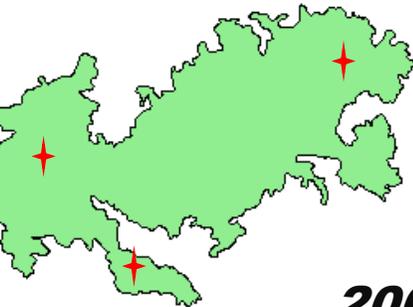
**D**

• **Direct estimation**

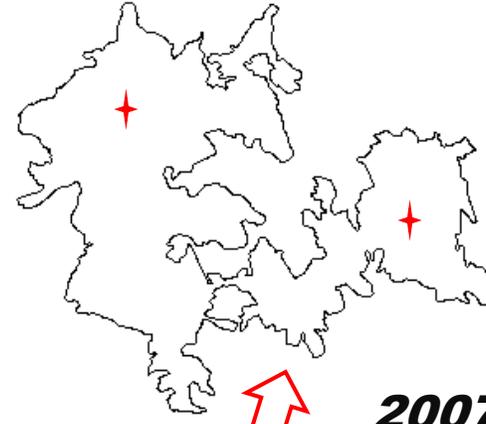


**R1**

**2006**



**2007**



**2007**



**D**

- Direct estimation
- Indirect, or small area estimation

**R2**







# FIA-based estimates

- (Somewhat) publicly-available, remeasured on a 10 year cycle
- High variability/low precision as a result of inadequately few plots in any given domain of interest.
- **The previous table transposed; years are now plot years for plots falling in 2009 fires**
- **Each year's plots are completely distinct sets of plots**

| Year | Seedlings/ha | MoE   | FIA plots |
|------|--------------|-------|-----------|
| 2010 | 796          | 968   | 9         |
| 2011 | 254          | 379   | 9         |
| 2012 | 1911         | 1594  | 14        |
| 2013 | 657          | 745   | 11        |
| 2014 | 2121         | 2313  | 6         |
| 2015 | 8365         | 11962 | 9         |

# Existing Methods

- **FIA-based direct estimation**
- **Other modeling approaches**



Contents lists available at [ScienceDirect](#)

## Forest Ecology and Management

journal homepage: [www.elsevier.com/locate/foreco](http://www.elsevier.com/locate/foreco)

### Development and assessment of regeneration imputation models for National Forests of Oregon and Washington

Karin Kralicek<sup>a</sup>, Andrew J. Sánchez Meador<sup>b,\*</sup>, Leah C. Rathbun<sup>c</sup>

- Nearest-neighbor imputation based on FIA data
- Individual models developed for each of 58 plant association groups
- Based upon the attributes (BA, SDI, canopy cover) of an existing stand
- Primarily intended to estimate sub-canopy regeneration of existing stands
- Did not incorporate climatic, multispectral, or other remotely-sensed sources of auxiliary information

*Few other methods evaluated*

# Important considerations

**1) For what domain types and extents will direct estimation work?**

- **Regeneration is highly variable in time in space**
- **If the domain is large and constrained to uniform conditions, direct estimators may be adequate.**
- **Similarly, as more time since disturbance elapses, precision of direct estimators should improve.**

**We expect the spatio-temporal measurement interval of FIA will prove too limiting.**

# Important considerations

## 2) For what domain types and extents can indirect estimators outperform direct estimators?

- Indirect estimators leverage both FIA data and auxiliary information from years and geographic areas beyond  $y$ , the year of interest
- Questions remain:
  - How far in time and space can we reach?
  - How different can conditions in the expanded domain be?
  - What forms of auxiliary information might we use?
  - What types of indirect estimators will minimize bias and maximize precision?

# Important considerations

**3) How should we design sampling strategies to collect additional data and auxiliary information?**

- **Variability in forest cover types and burn severity**
- **Predicative utility of alternative forms of remotely sensed data, e.g. UAV imagery**
- **The dynamic nature of the population: new areas burn and previously burned areas regenerate every year.**

# Important considerations

## Data Needs

- **Landsat, NAIP, NDEP in Google Earth Engine**
- **FIA plot tables available online, but we require decrypted plot locations**
- **Collaboration with GTAC for TCC datasets and ecological models**
- **Hi-res climate info**
- **Potential for additional field campaigns to collect ground- and UAV-based data.**
- **Exploration of small area estimation techniques.**



**Questions? Comments?**

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