

**SOFEW**  
**Defining Forest Sustainability within Regional Wood  
Basin Analysis**

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## Historical Development of Concept/Definition of Sustainability

Naval Live Oaks Preserve 1829

Shipbuilding= PRODUCTION/USE/YIELD

Land Revision Act of 1891 – Creation of National Forests

Concern over watershed of San Gabriel Mountains = PLACE (i.e. Space)

Multiple Use - Sustained Yield Act of 1960/NFMA 1976/RPA

“perpetuity of a high-level annual or regular periodic output”=TIME

Brundtland Commission – Our Common Future 1987

Sustainable DEVELOPMENT – Modern Definition= Multi Variable Function

Montreal Process 1994 - Criteria & Indicators= METRICS

Annual harvest of wood products by volume & as a % of net growth or sustained yield

Forest Certification - FSC 1993 /SFI 1994/Tree Farm = ASSESSMENT TOOLS

## Simple Definition

“Sustainability is the capacity to endure” – Wikipedia

*Have we endured?*

Clawson – Forests in the Long Sweep of American History - Four Observations and Metrics

1. Timberland ACRES - reduced@60% , then stabilized
2. Stand timber INVENTORY – increased
3. Net Timber GROWTH (net Mortality) - increased
4. Timber HARVEST (REMOVALS) – increased

SO HOW IS THIS SO – *Less acres & growth but more inventory and removals?*

“Many people realize that timber harvest cannot exceed net timber growth indefinitely, for this would deplete inventory, ultimately to the vanishing point. But fewer people seem to realize that net growth cannot exceed harvest for very long, since inventory accumulation proceeds to the level where no further net growth takes place.” Clawson



## *Use of Growth/Removal Ratios*

**G/R Ratio - Function of Periodic or Annual Growth divided by Removals**

**Growth - Biologic Conditions - i.e.. age, site, cultural treatments**

**Removals - Economic & Social Conditions – i.e. price, objective, policy**

**So is G/R ratios an appropriate use for “predicting” sustainability**

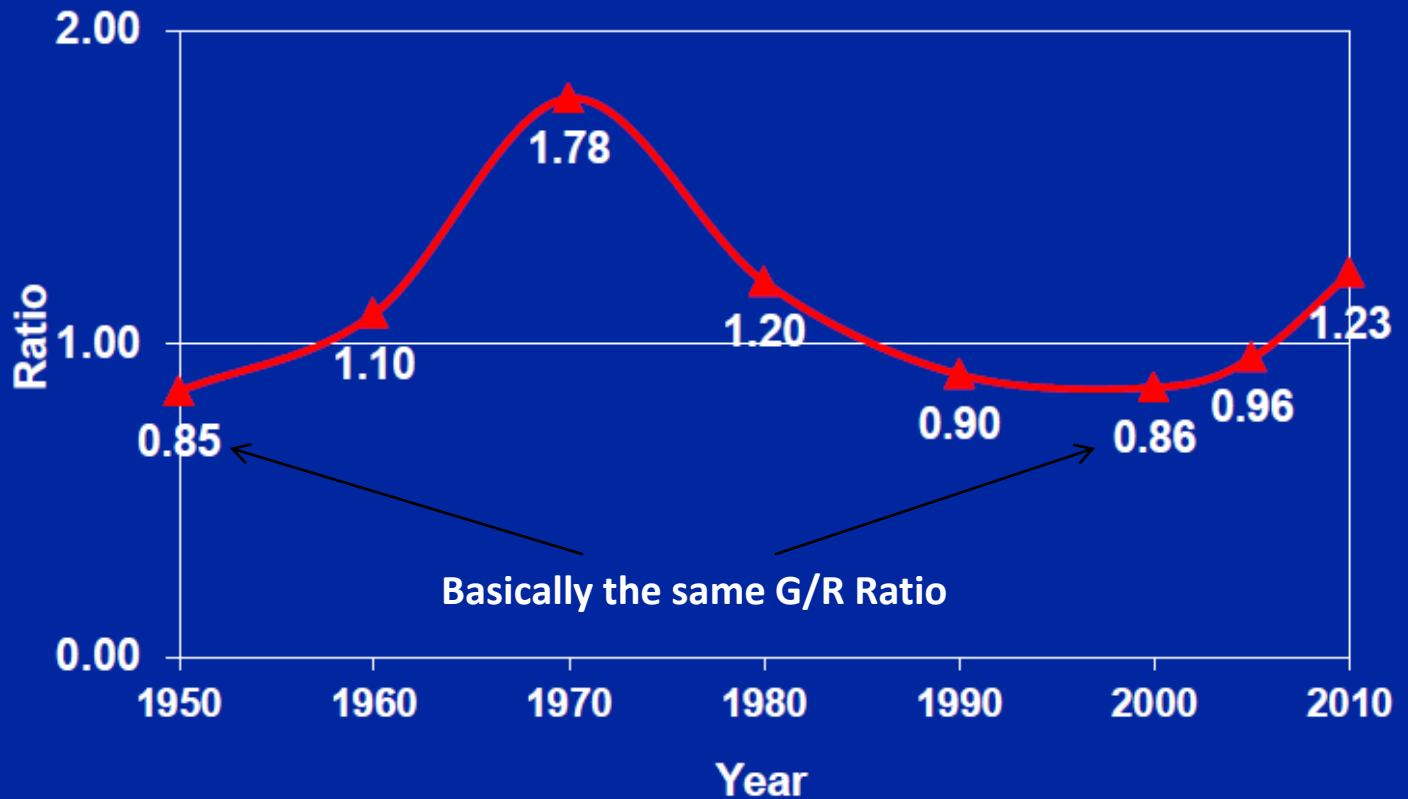
**Two Recent Studies Suggest perhaps but more analysis (as always) needed**

**Ray Sheffield – SOFAC 2012**

**Natasha James - NCSU Masters Thesis 2013**

## Softwood Growth/Removal Ratio Trends

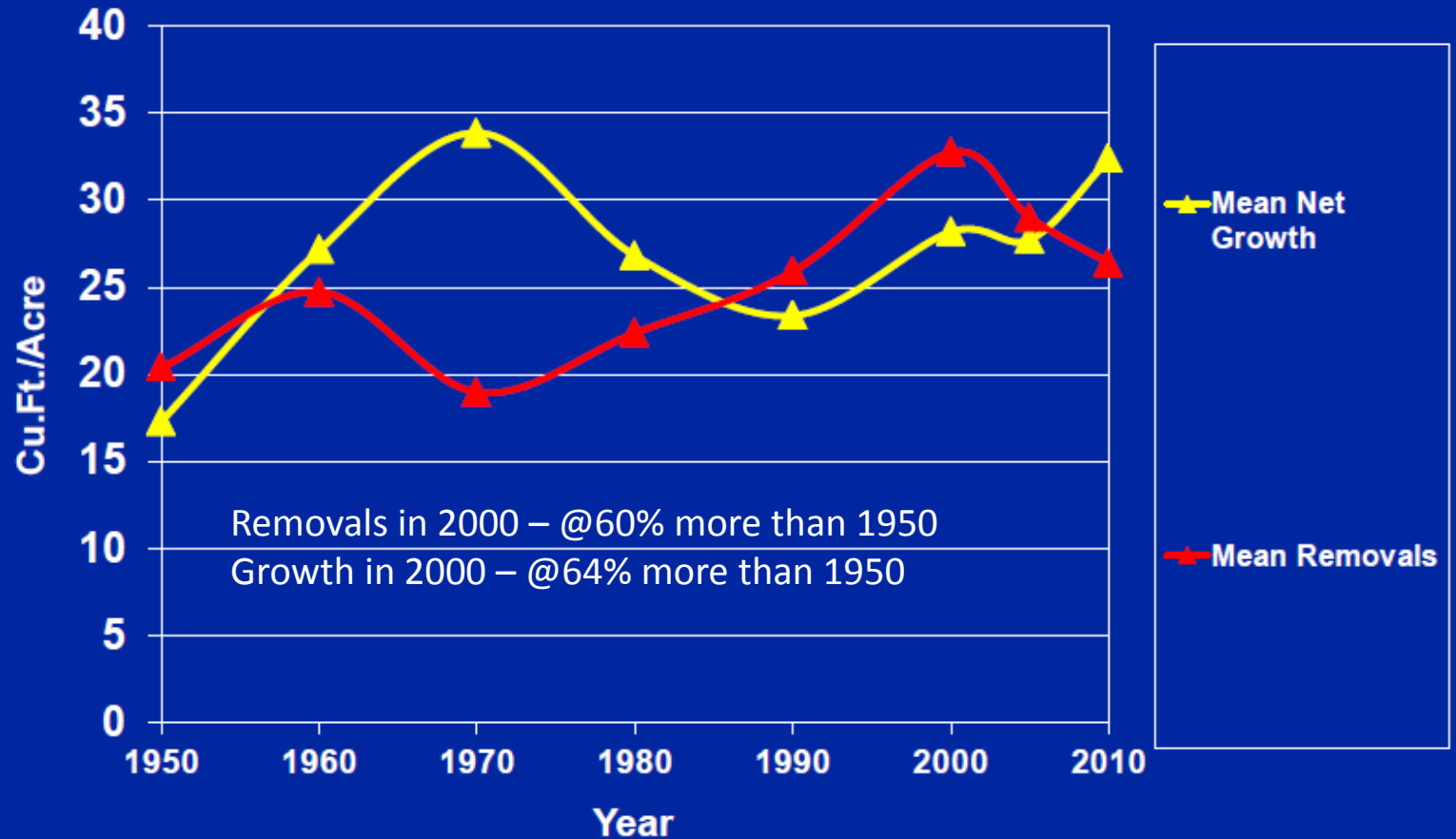
Areas where  $G/R < 1$  in 1950 (9 survey units)



Source - Sheffield SOFAC 2013

## Softwood Growth and Removal Trends

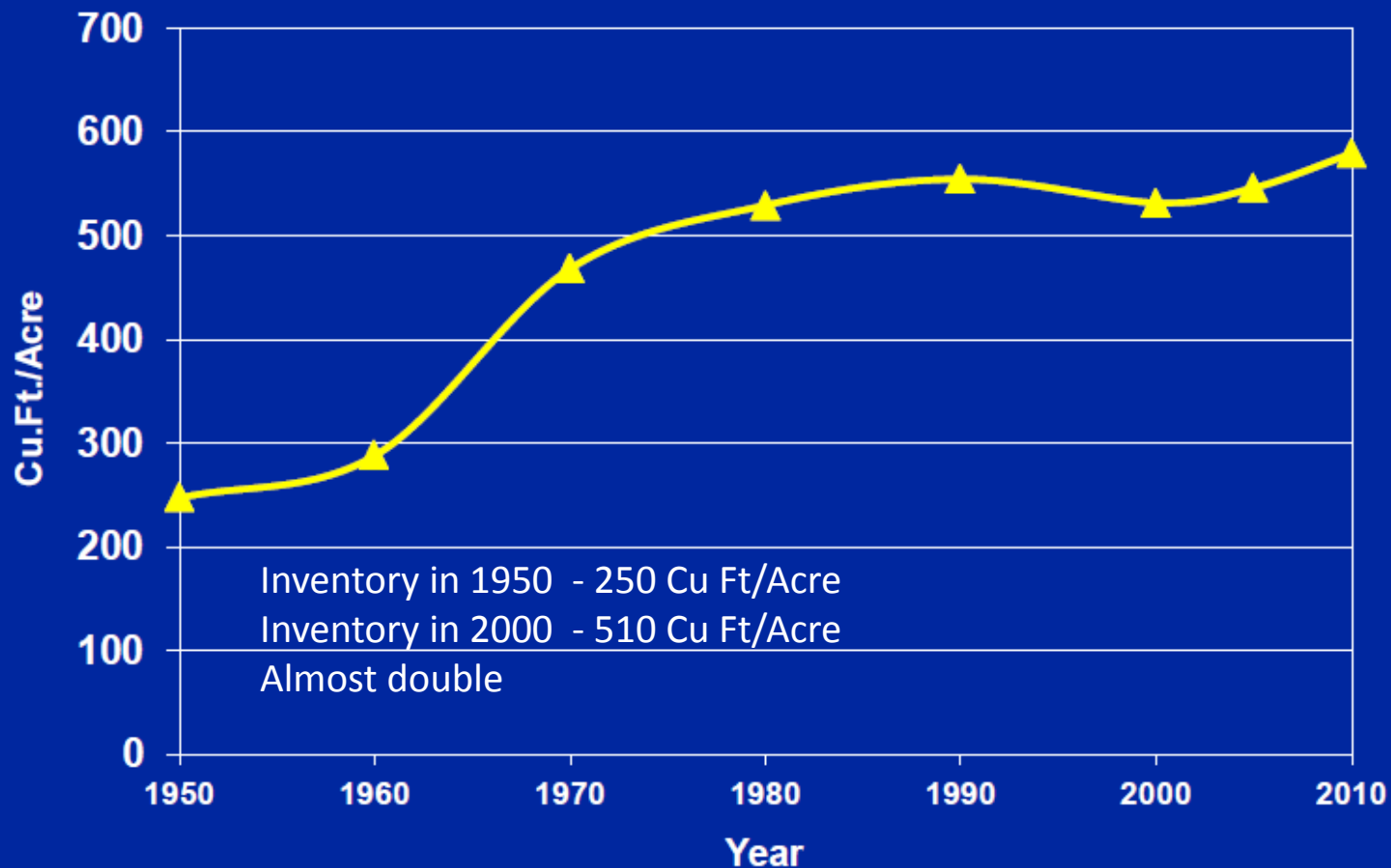
Areas where  $G/R < 1$  in 1950 (9 survey units)



Source - Sheffield SOFAC 2013

## Softwood Inventory Trends

Areas where  $G/R < 1$  in 1950 (9 survey units)

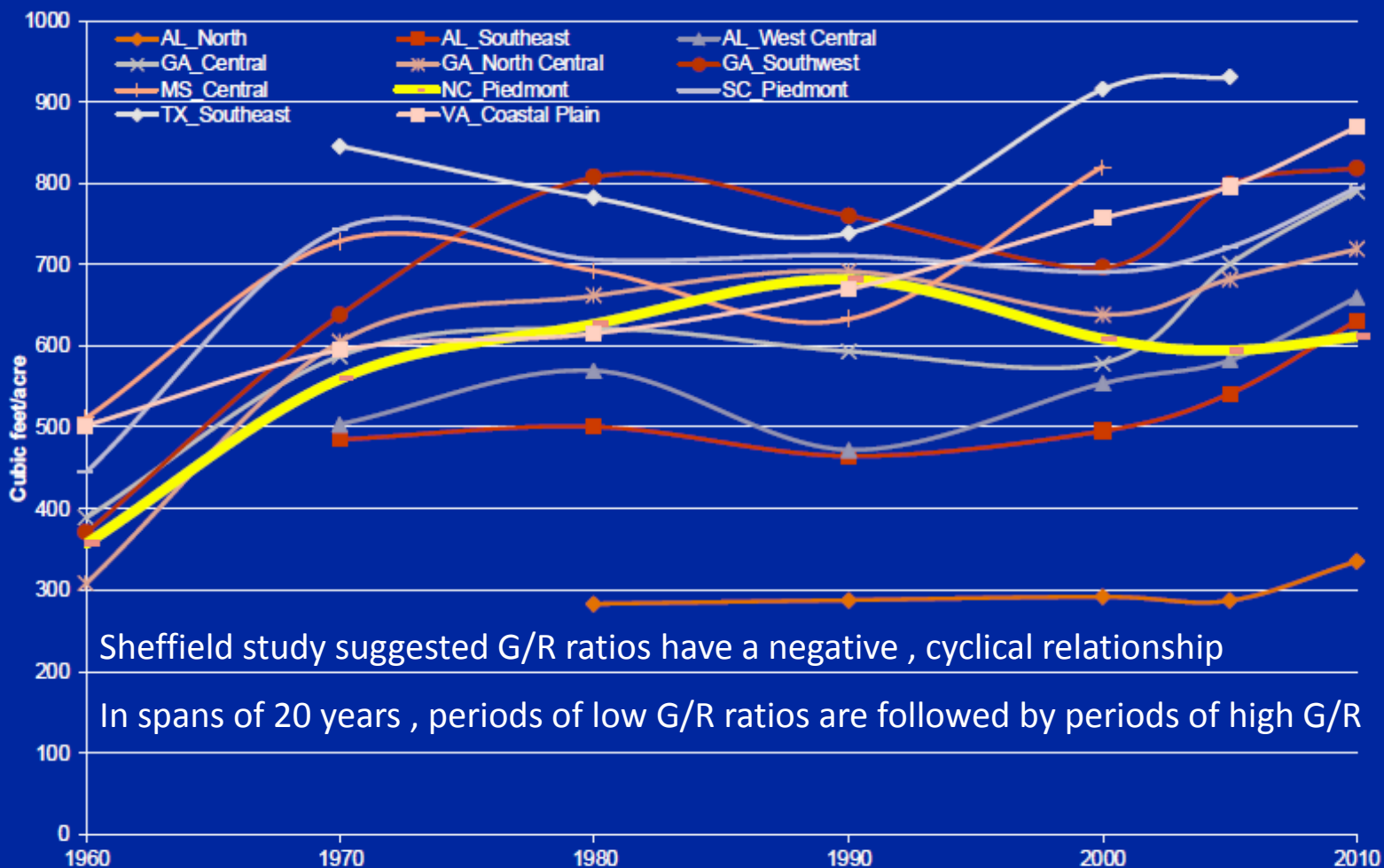


Source - Sheffield SOFAC 2013



## Softwood Inventory Trends

11 Survey Units Where G/R < 1 in Multiple Consecutive Periods



Sheffield study suggested G/R ratios have a negative, cyclical relationship

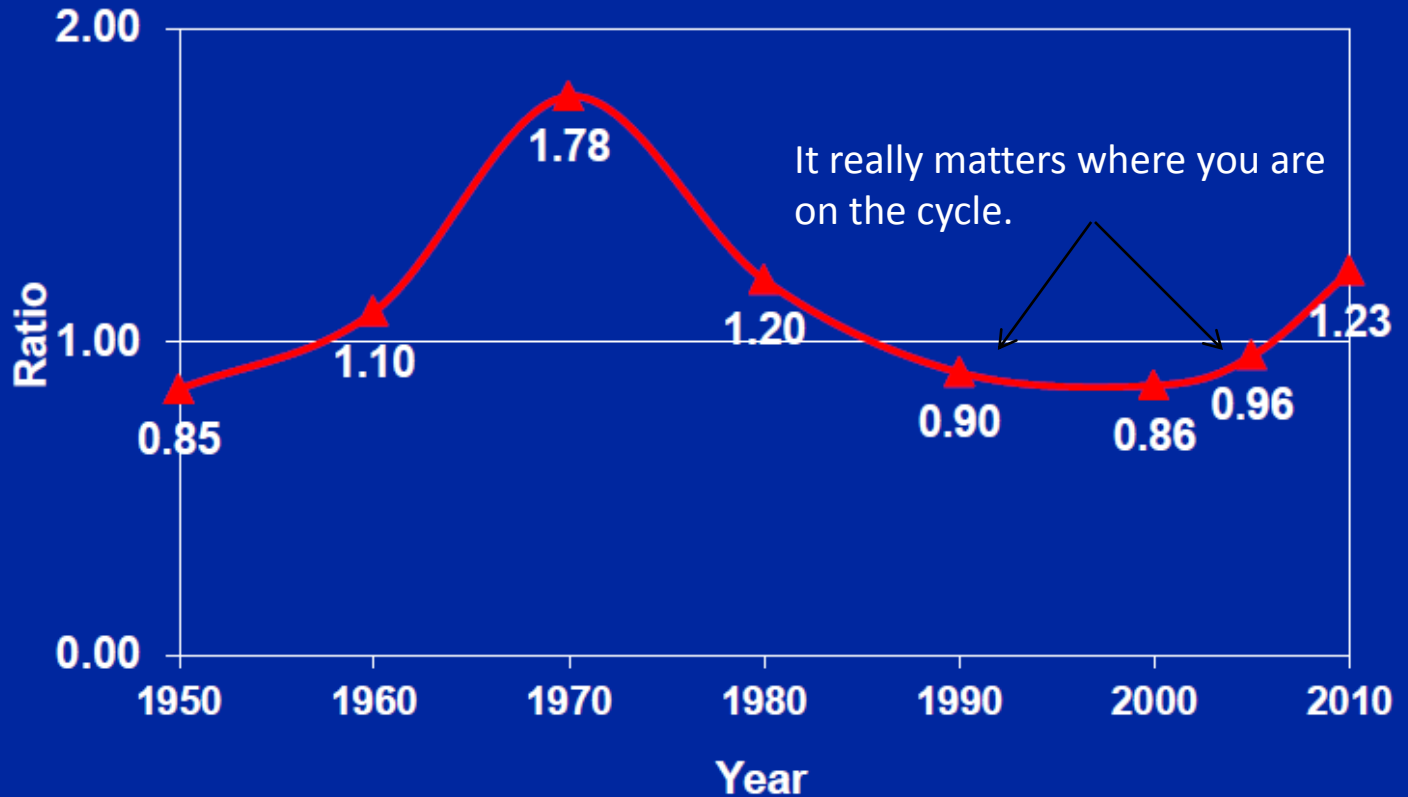
In spans of 20 years, periods of low G/R ratios are followed by periods of high G/R

Source - Sheffield SOFAC 2013



## Softwood Growth/Removal Ratio Trends

Areas where  $G/R < 1$  in 1950 (9 survey units)



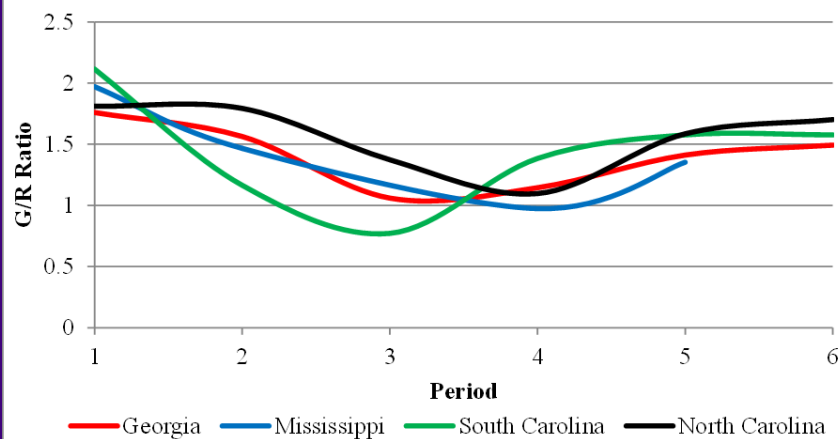
Source - Sheffield SOFAC 2013

## James Thesis - Forecasting Sustainability; Growth to Removals Ratio Dynamics

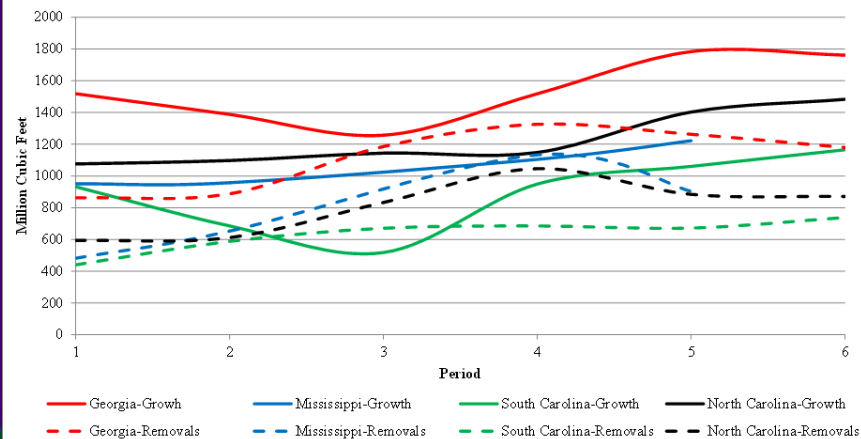
Time and Space – appears cyclical over time and has positive relationship over one period and a negative relationship with the G/R ratio two periods ago

Relationship of Components over time – Growth appears to have an upward trend, while removals tend to oscillate. Hypothesis that net removals are the driver of change

Growth to Removals Ratio for Selected States



Growth and Removals of Selected States

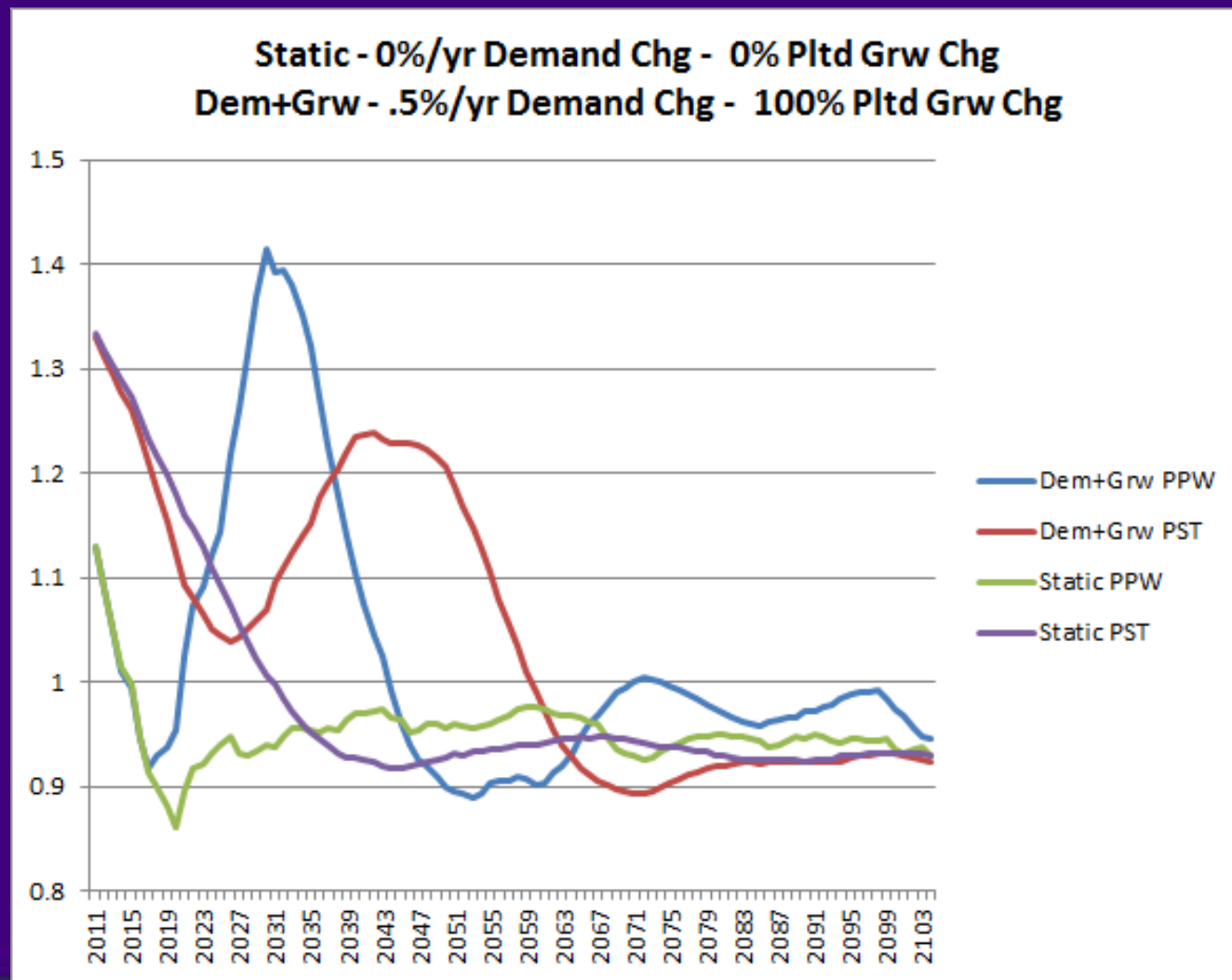


**James Thesis - Forecasting Sustainability; Growth to Removals  
Ratio Dynamics**

**Statistical Analysis – Preliminary Results**

- 1) Correlation and OLS Analyses
  - 1) Suggest G/R ratio has a positive relationship with itself over time.
  - 2) R Squares are relatively low
- 2) Fixed Effects Analysis – Components of Time/Space
  - 1) Over Time
    - 1) Short Run - positive relationship
    - 2) Long Run - negative relationship
  - 2) Over Space
    - 1) Positive relationship
    - 2) R Squares relatively higher for space than time
  - 3) Corrections for Inconsistencies in Estimates
    - 1) Only relationship over time in short run confirmed
    - 2) Also the empirical results are not robust enough to draw a strong conclusion about the decomposition of the components of G/R

## 100 Year SRTS Run - With No Demand Change – Lower Inventories



## What does this mean for using G/R ratios for Sustainability?

G/R – Short run 10 year (positive) vs Long Run Uses 20 Years (negative)

But are there other components of Growth and Removal to investigate

- Beginning Inventory Characteristics

- Age class distributions

- Specie/Management Classes

- Site Productivity

- Cultural Treatments

Appropriate and Varying Scales – ie, stand, forest, basin, nation, world

- More work needed to aggregate cross sectional data

- Influence of wood basin size and location more important?

Finally influence of Market (\$) and Policy in G/R Ratios and Components

- Economic Definition of Scarcity

- Stumpages prices, interest rates, land values

- Positive and negative forest policies, legislation