

# A Metapopulation Approach to Examining the Effect of Restorations on Population Viability in the Indiana Dunes

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# *Cirsium pitcheri*

- Pitcher's Thistle
  - U.S. threatened species
  - Endemic to Great Lakes shoreline
  - Restricted to dunes and blowouts
  - Requires 60% open sand cover
  - Monocarpic perennial herb
  - 3-10 year life span
  - Mixed mating system



# Metapopulation Dynamics

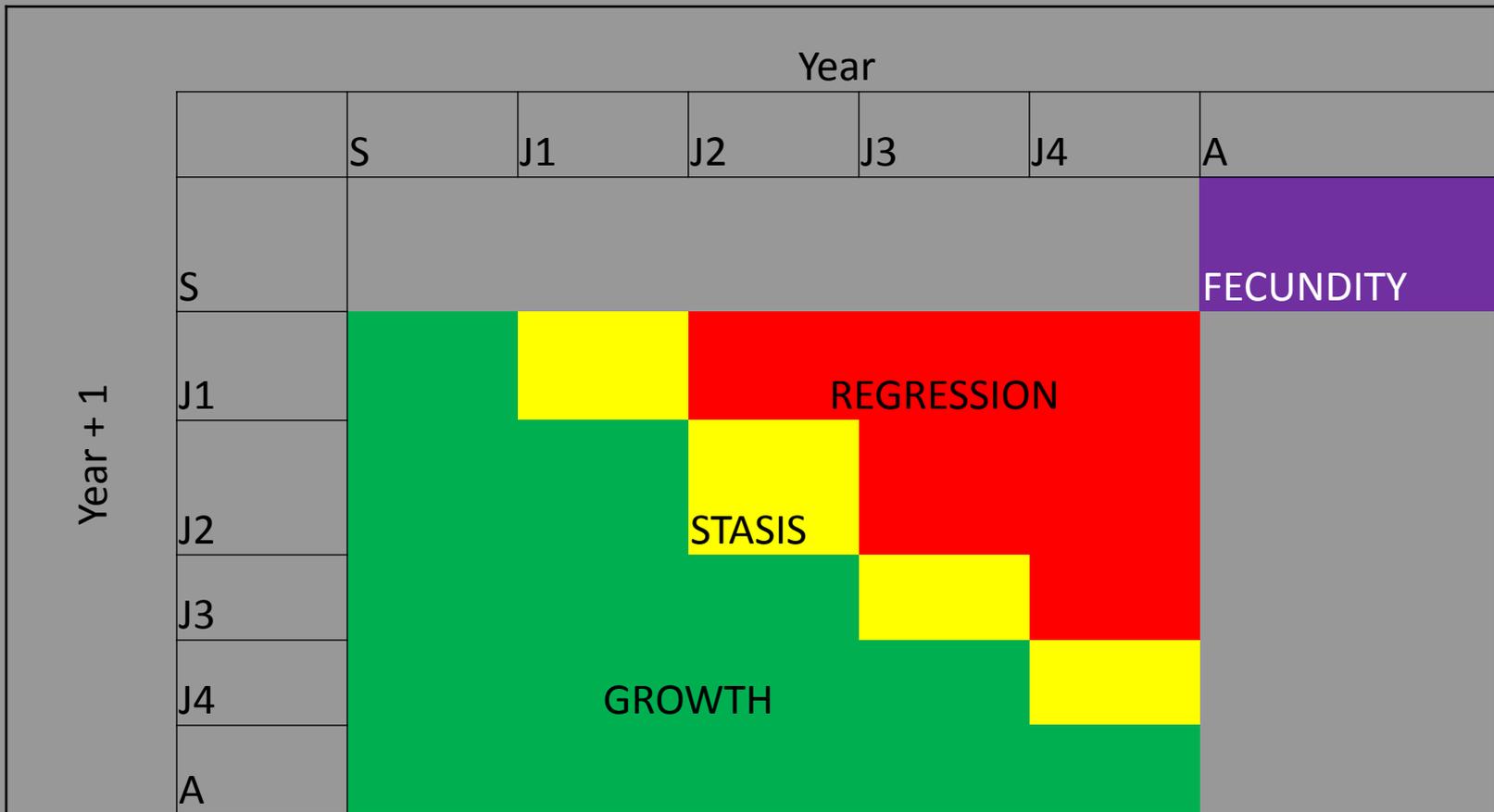
- Collection of separate but potentially interacting populations separated by discrete gaps in habitats
- Characteristics of plant metapopulations
  - Connected by gene flow
  - Size, growth and fates influenced by space and time
- Habitat fragmentation is a threat to metapopulation viability
  - Small population sizes
  - Restricted exchange of pollen and seeds

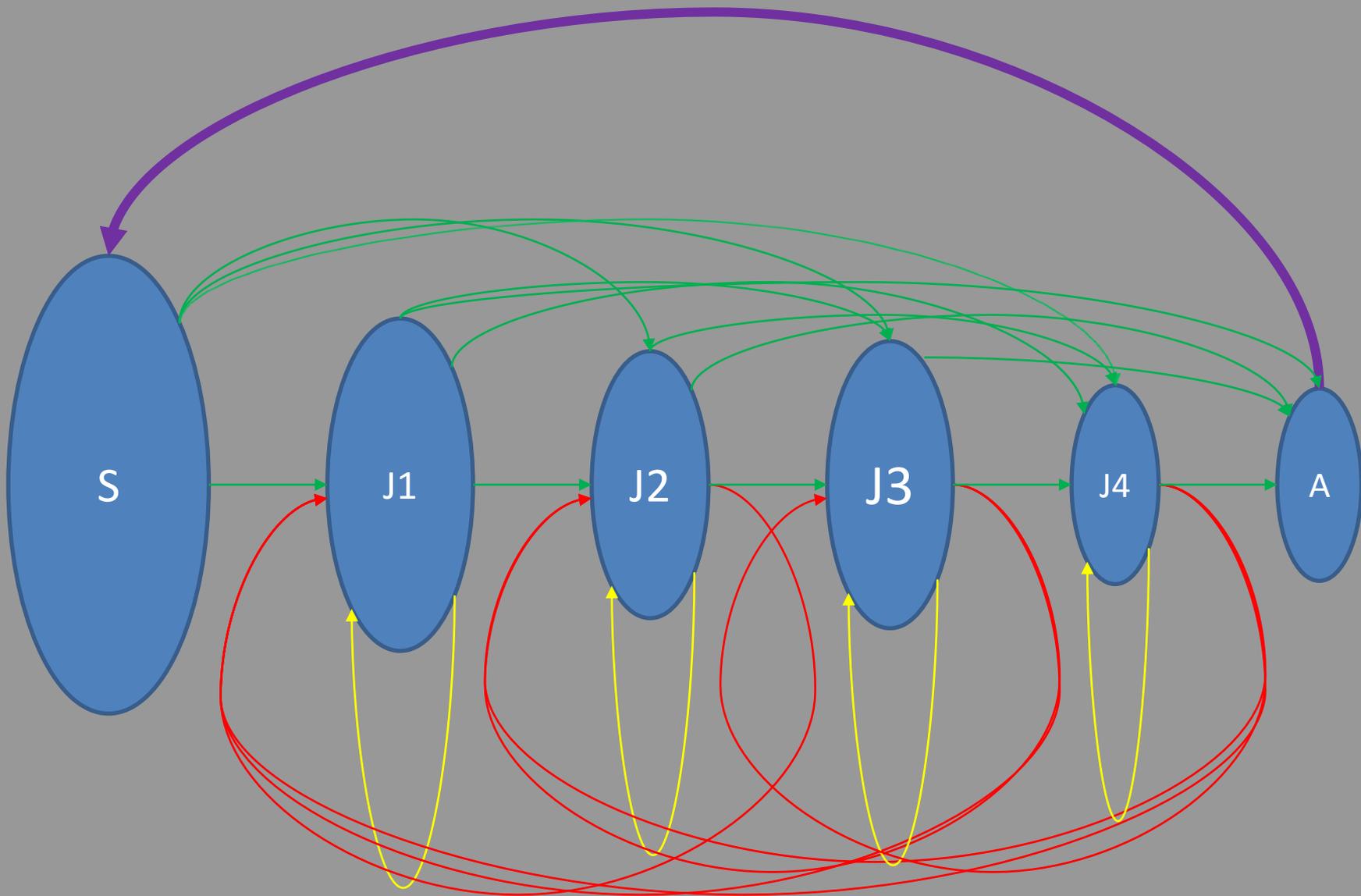
Does the Addition of New Populations  
increase Metapopulation Viability?

Is there a difference in the vital rates of  
the populations?

# Indiana Dunes National Lakeshore

- Demographic Monitoring
- Native Populations
  - 1988-2012
    - West Beach
    - State Park Big Blowout
    - Miller High
- Reintroduction
  - 1994-2012
    - Ogden Dunes East
    - Ogden Dunes West
- Create Matrices
  - 87 total
- Population Viability Analysis
  - Probability of Extinction
- Life Table Response Experiment
  - Contribution of source to Metapopulation





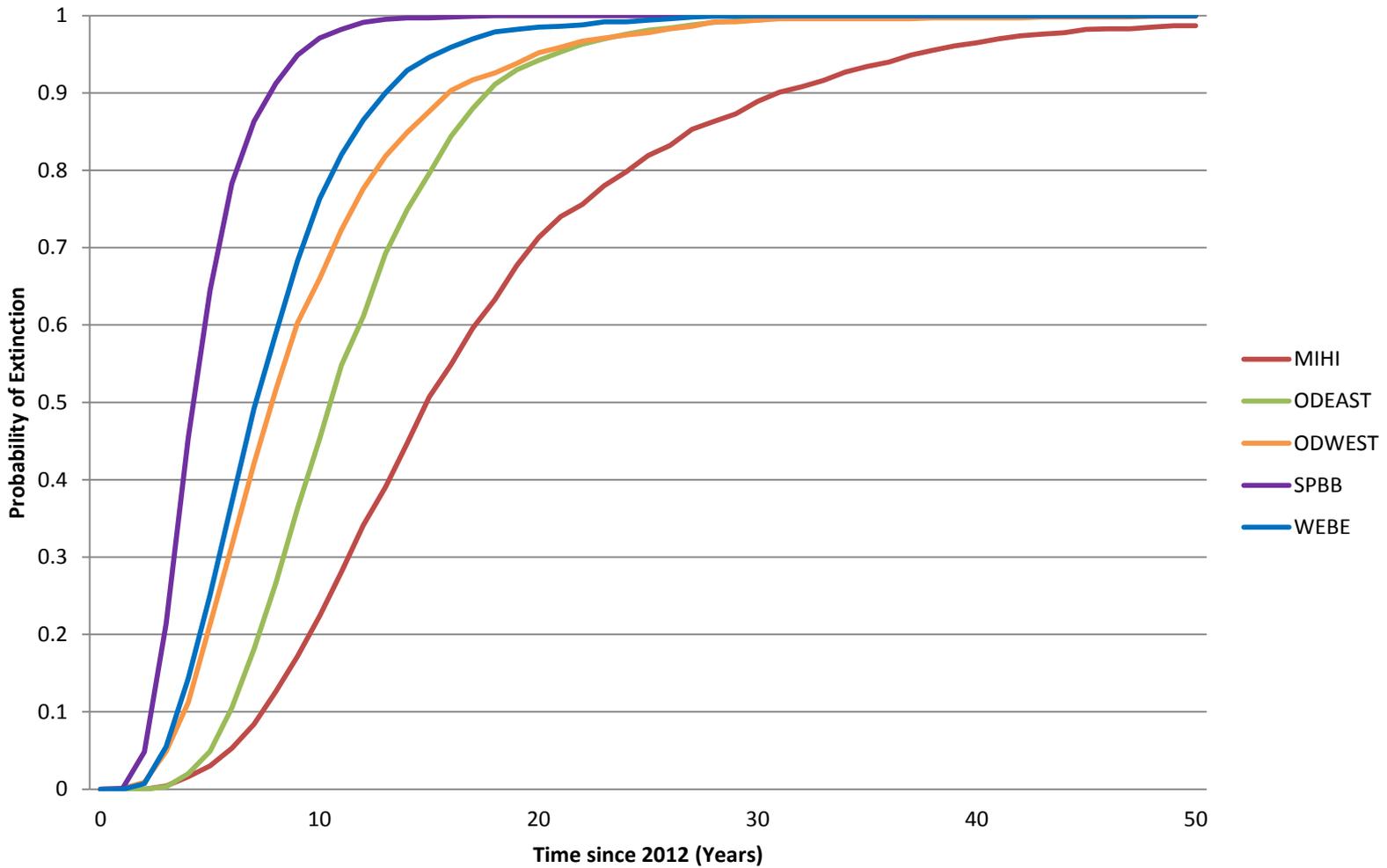


Figure 5. Probability of Extinction since 2012 for 5 subpopulations of Indiana Dunes National Lakeshore Metapopulation. Median Time to Extinction lies at 50% probability.

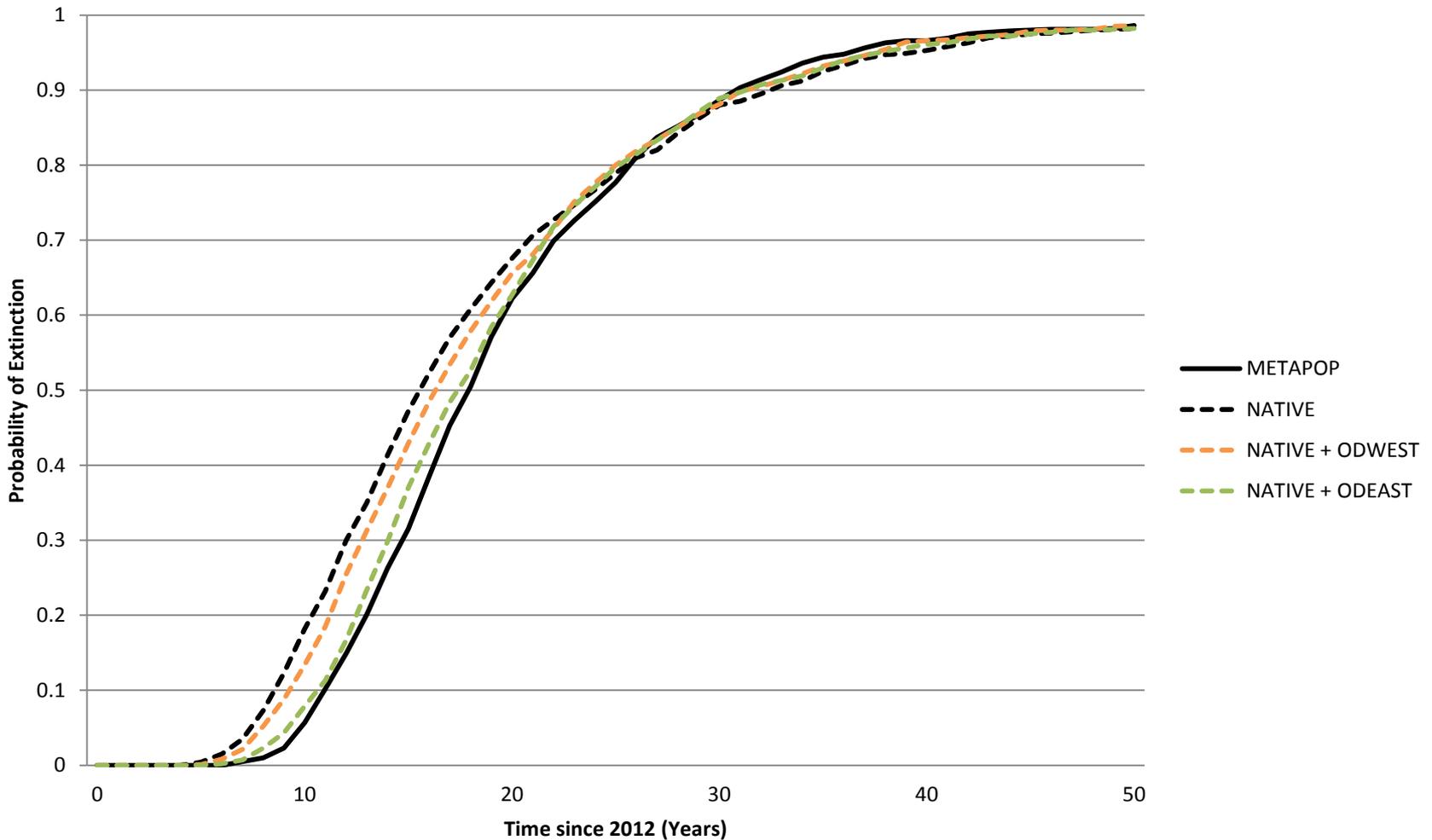


Figure 6. Probability of Extinction comparison of population Native (without reintroductions), Native + ODWEST , Native + ODEAST and Metapopulation( both native and reintroductions)

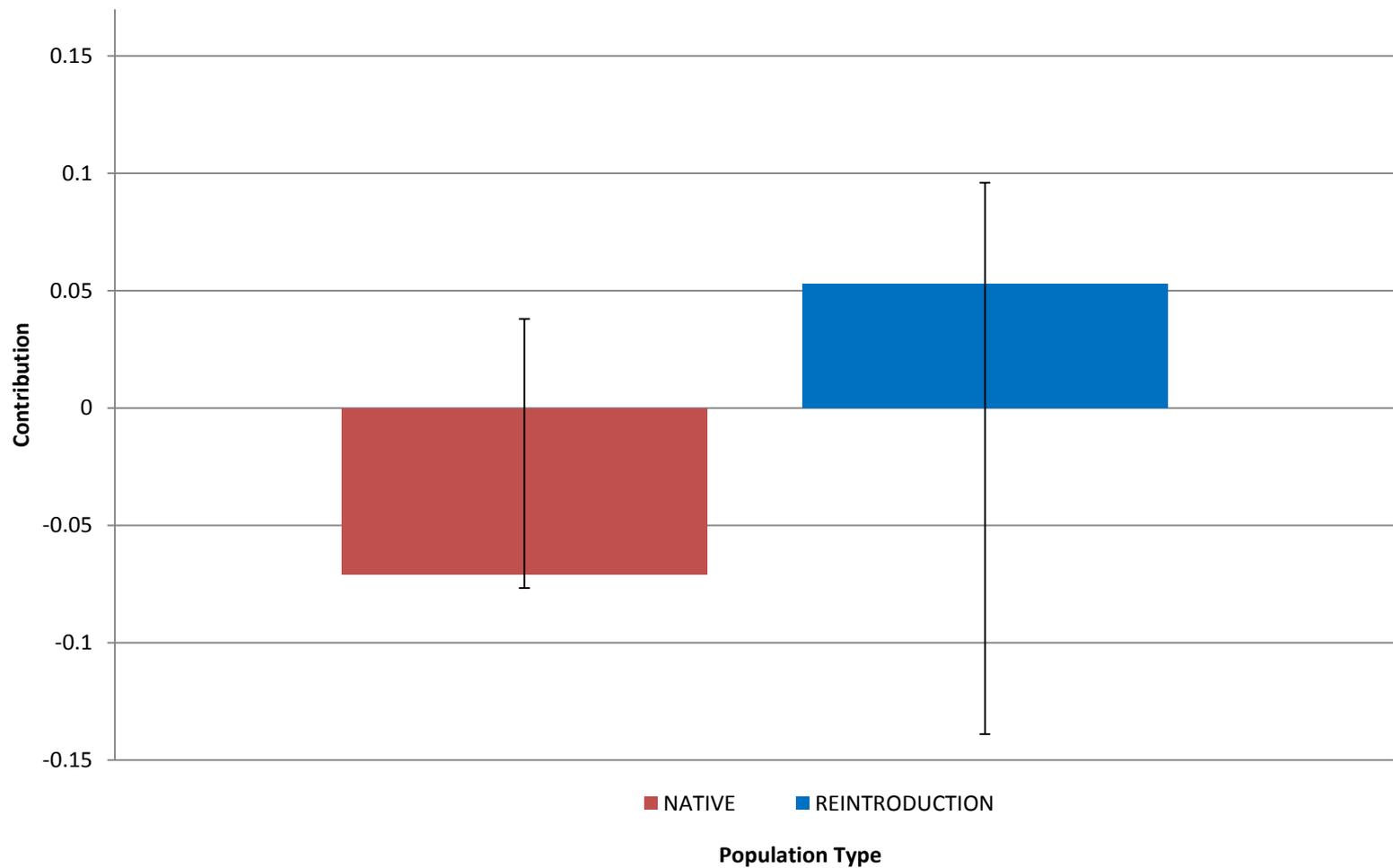


Figure 7. LTRE contributions of each population types' effect on Indiana Dunes Metapopulation growth rate ( $\lambda$ ) with 95% CI. Native  $p=0.07$  & Reintroduction  $p=0.22$

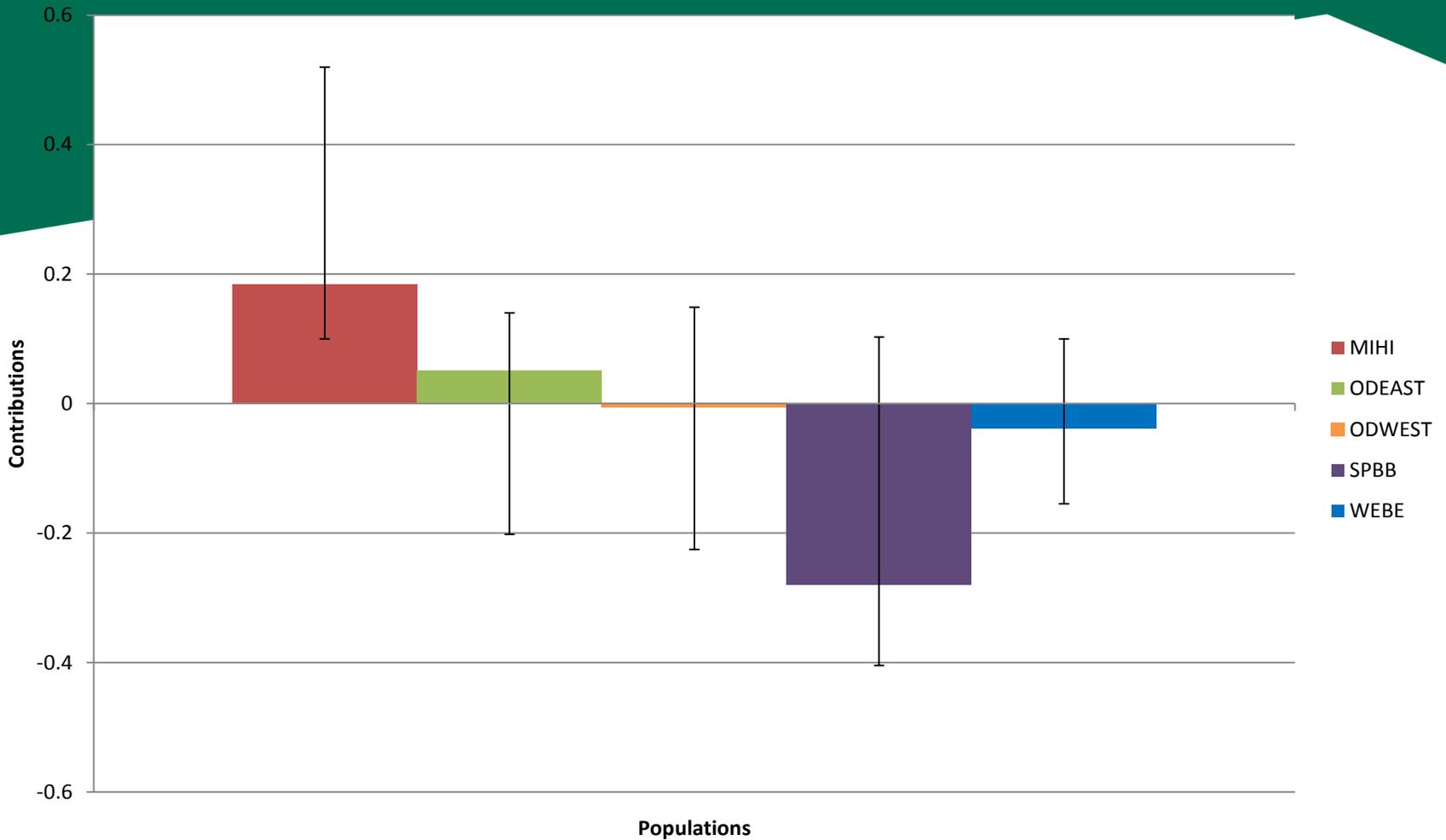


Figure 8. LTRE contribution of each sub populations effect on Indiana Dunes Metapopulation growth rate ( $\lambda$ ) with 95% CI.

MIHI  $p=0.0$ , ODEAST  $p=0.316$ , ODWEST  $p=0.081$ , SPBB  $p=0.0$

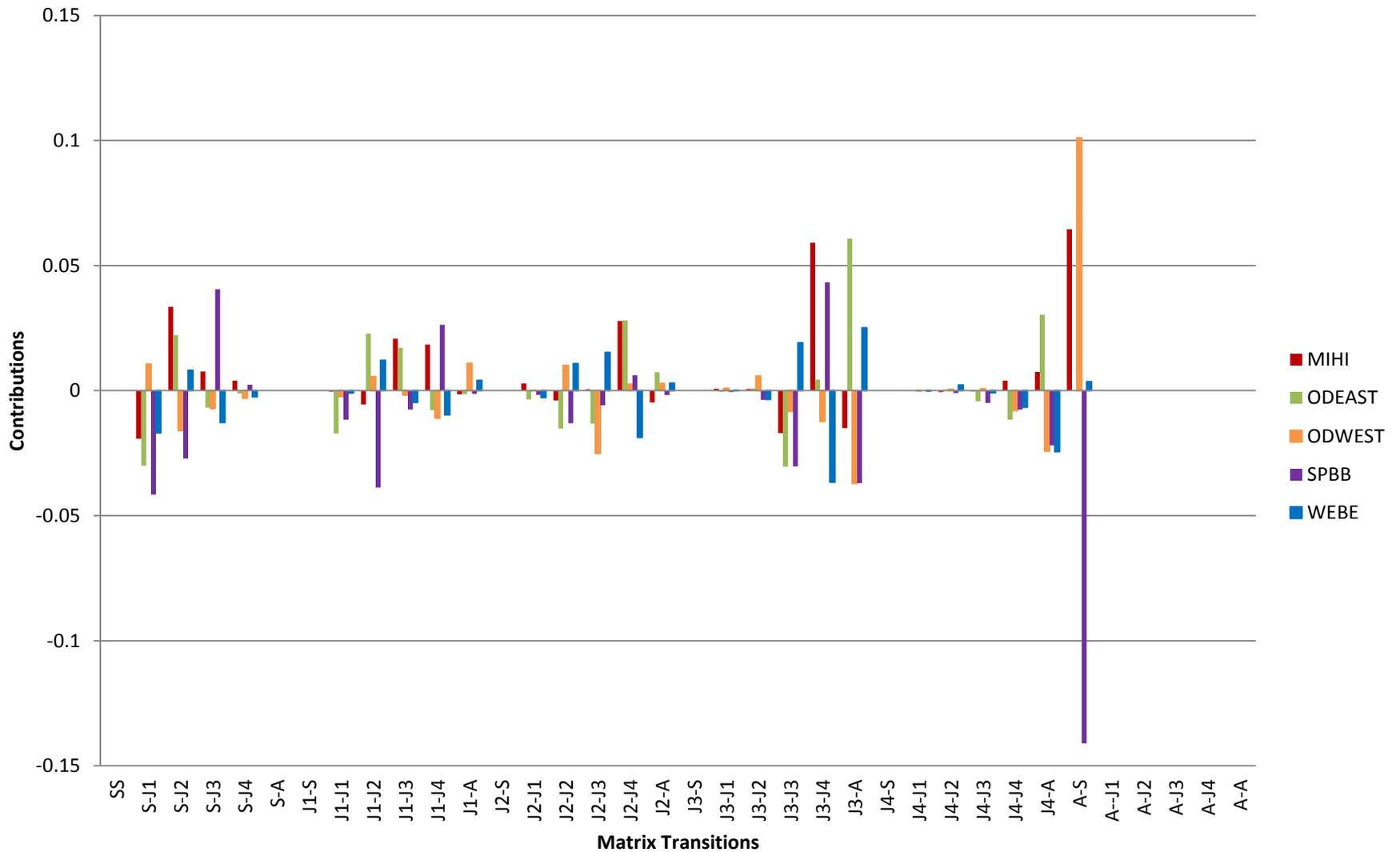


Figure 10. LTR decomposition of vital rates of each of 5 sub populations effect on the Indiana Dunes Metapopulation growth rate ( $\lambda$ ).

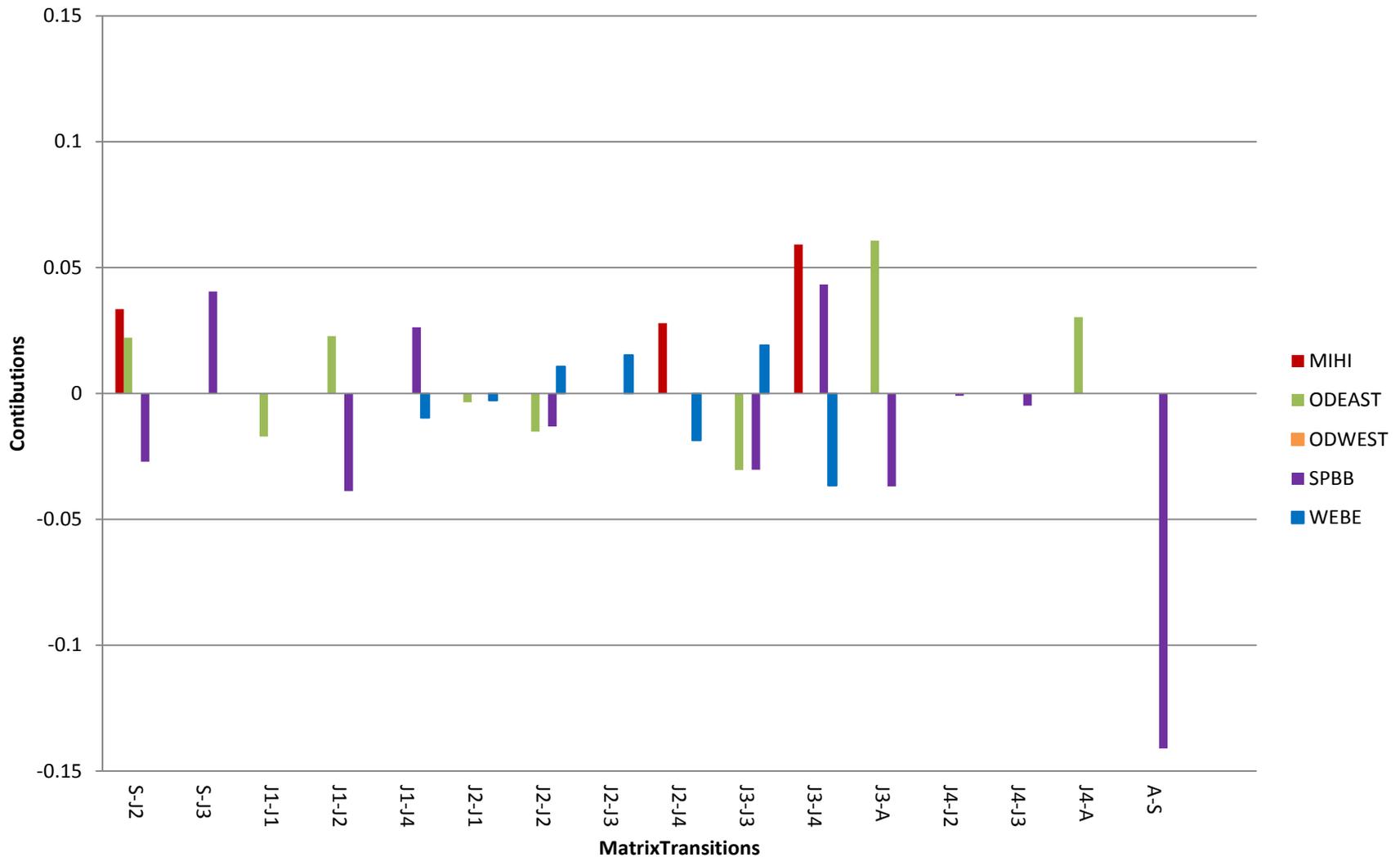


Figure 11. LTRE decomposition of contribution of vital rate with significant effect ( $p < 0.05$ ) of each of the five sub populations on the Indiana Dunes Metapopulation growth rate( $\lambda$ ).

# Take Home Message

- Additional populations improve the Metapopulation
- No significant difference between Native and Reintroduced populations
- Big Blowout
  - Low Fecundity (A-S)
- Miller High & Ogden Dunes East
  - Growing