# *COPING WITH DISTURBANCE AND CHANGE: IDENTIFYING THE COSTS ASSOCIATED WITH INVASIVE PLANTS IN THE SOUTHEAST*

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**Joint Meeting of SE-EPPC and SE-SERI**
**Chattanooga, Tennessee**
**May 11, 2010**

***An invasive species is "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health."*** **- Executive Order 13112**

**Cogon grass**

Source: VA Cooperative Extension

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***"Invasive species are those that are not native to the ecosystem under consideration and that cause or are likely to cause economic or environmental harm or harm to human, animal, or plant health. NISC 2006***

# INVASIVE SPECIES EFFECTS

- **SECOND MOST COMMONLY CITED FACTOR IN EXTINCTION THREATS**

- **SIGNIFICANT THREAT TO A NUMBER OF ECOSYSTEM SERVICES**
  - ***Provisioning Services***
  - ***Regulating Services***
  - ***Cultural Services***

- **SUBSTANTIAL ECONOMIC EFFECTS**
  - ***Damages***
  - ***Control Efforts***
  - ***Ecosystem Functioning/Services***
  - ***Non-Use Values***

# INVASIVE SPECIES FROM AN ECONOMIC PERSPECTIVE

- SOME PREVIOUS ESTIMATES OF ECONOMIC VALUES
- BASIC ECONOMIC CONCEPTS FOR INVASIVE SPECIES
- DESIGNING A COMPREHENSIVE ESTIMATE OF INVASIVE IMPACTS
- CLIMATE CHANGE EFFECTS
- POLICY ALTERNATIVES

# U.S. ECONOMIC IMPACT ESTIMATES

- OFFICE OF TECHNOLOGY ASSESSMENT (1993) $97 BILLION
  79 SPECIES
  85 YEAR PERIOD
- PIMENTEL ET AL. (2000) $137 BILLION
- PIMENTEL ET AL. (2004) $143 BILLION

## Estimated Annual Costs Associated With Invasive Species
*(millions of dollars)*

| Category | Nonindigenous Species | Losses & damages | Control Costs | Total |
|---|---|---|---|---|
| PLANTS | 25,000 | | | |
| Purple loosestrife | | – | – | 45 |
| Aquatic weeds | | 10 | 100 | 110 |
| Mealeuca tree | | NA | 3–6 | 3–6 |
| Crop weeds | | 24,000 | 3,000 | 27,000 |
| Weeds in pastures | | 1,000 | 5,000 | 6.000 |
| Weeds in lawns, gardens, golf courses | | NA | 1,500 | 1,500 |

Source: Pimental et al. 2004

# INVASIVE SPECIES FROM AN ECONOMIC PERSPECTIVE

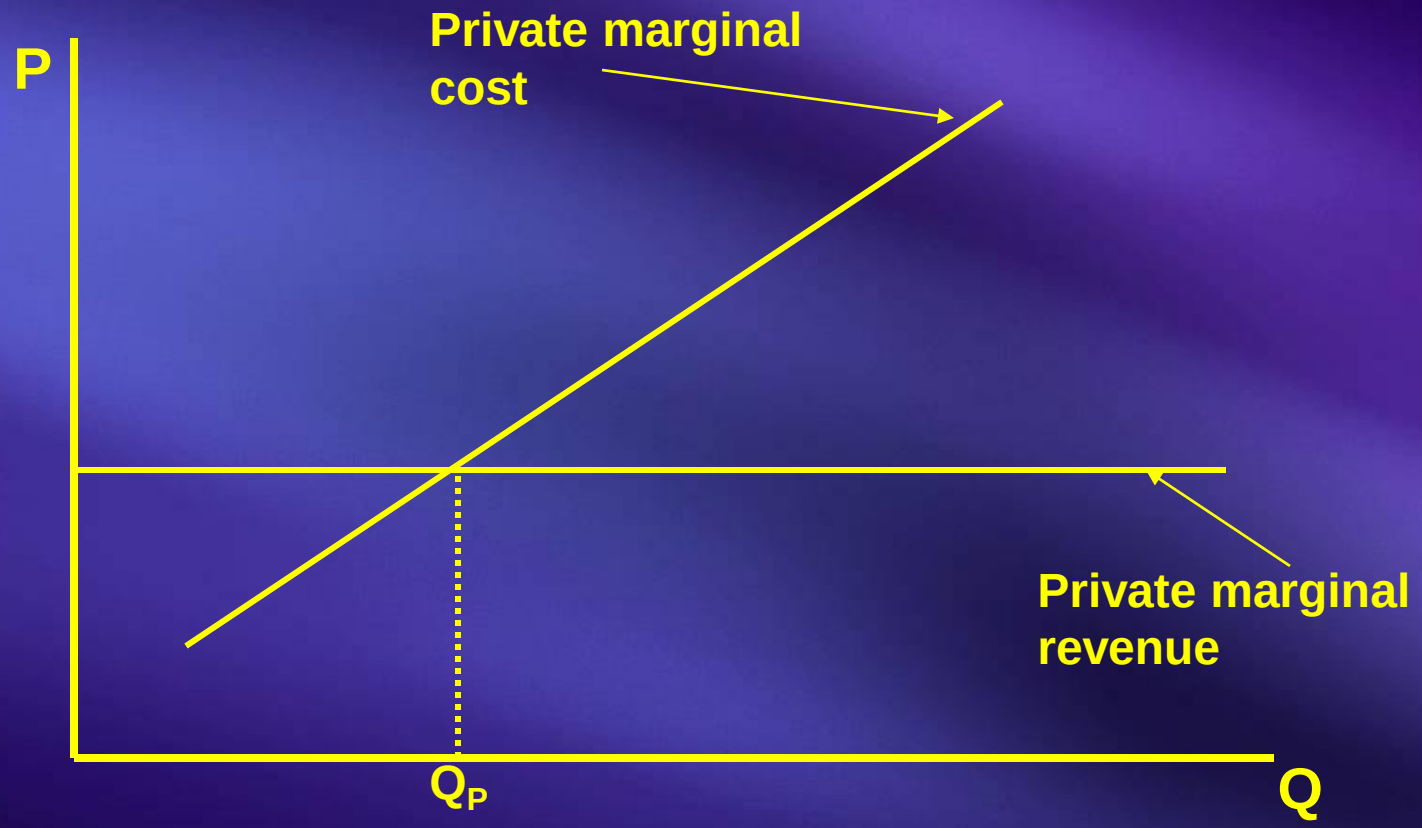
**PUBLIC GOODS -** *[goods] which all enjoy in common in the sense that each individual's consumption of such a good leads to no subtractions from any other individual's consumption of that good...* – Samuelson (1954)

**NON-EXCLUDABLE**

**NON-RIVAL**

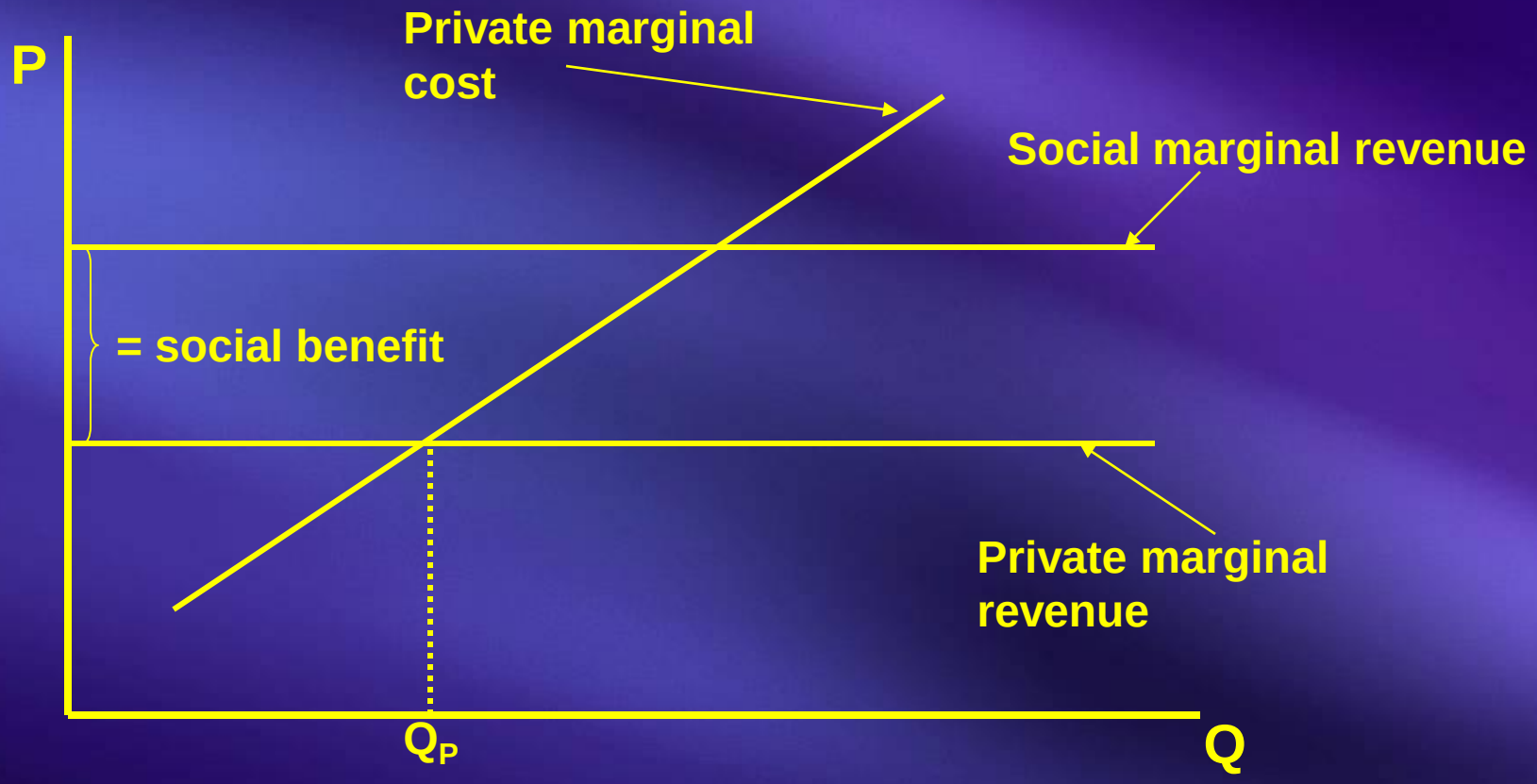
# INVASIVE SPECIES FROM AN ECONOMIC PERSPECTIVE

## SUB-OPTIMAL LEVEL OF PUBLIC GOOD IS LIKELY



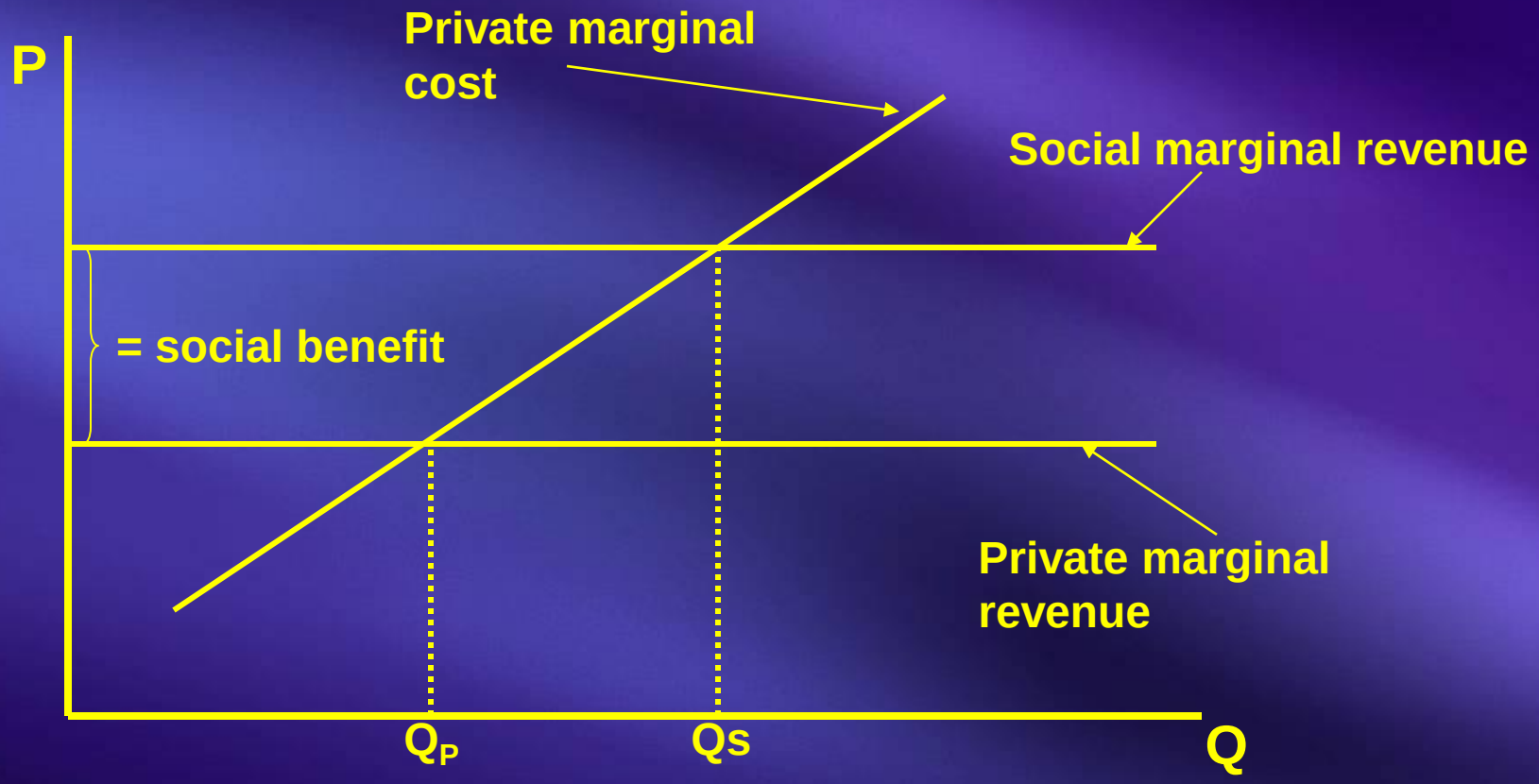
# INVASIVE SPECIES FROM AN ECONOMIC PERSPECTIVE

## $Q_P$ DOES NOT REFLECT TOTAL VALUE OF CONTROL TO SOCIETY



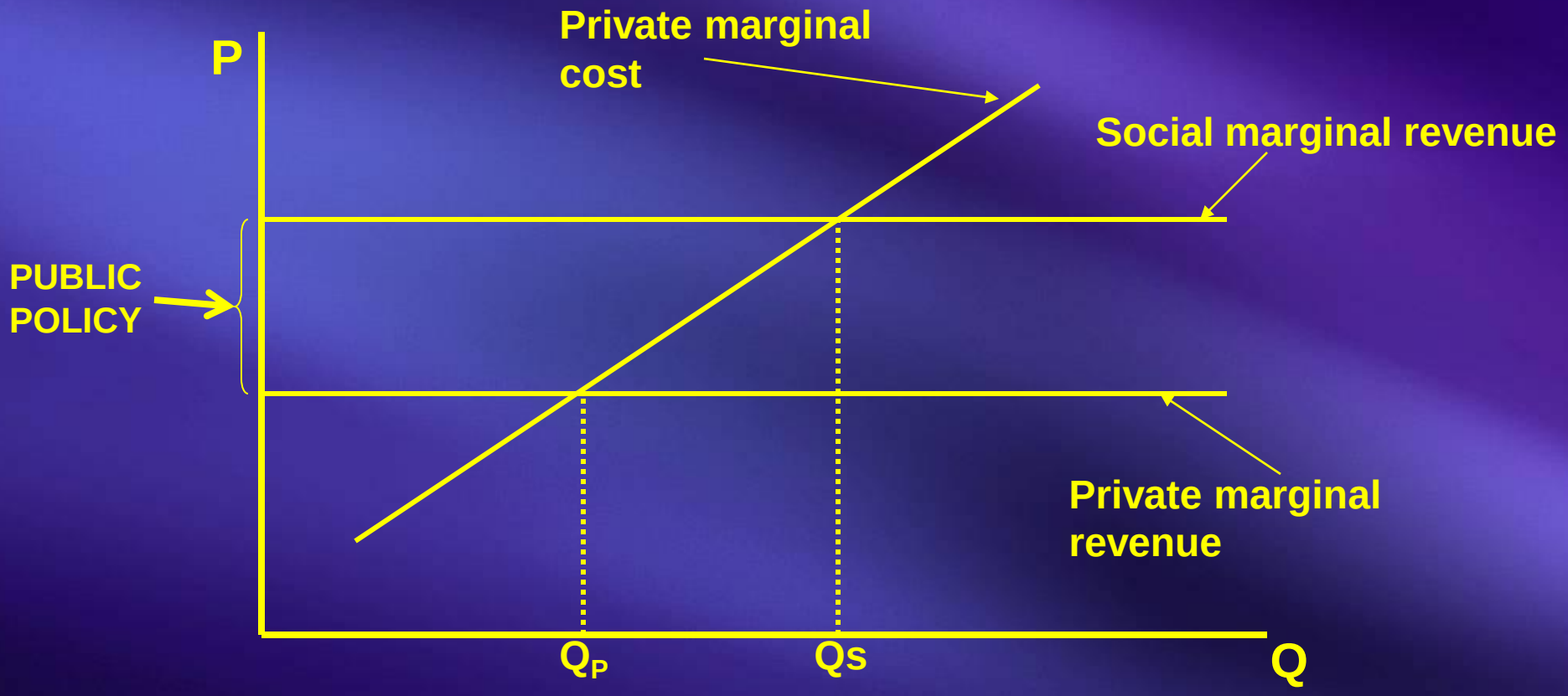
# INVASIVE SPECIES FROM AN ECONOMIC PERSPECTIVE

## THE ADDITION OF SOCIAL BENEFITS INCREASES THE DESIRED LEVEL TP $Q_S$



# INVASIVE SPECIES FROM AN ECONOMIC PERSPECTIVE

## PUBLIC POLICY CAN 'INTERNALIZE' SOCIALLY OPTIMAL SOLUTION



# INVASIVE SPECIES FROM AN ECONOMIC PERSPECTIVE

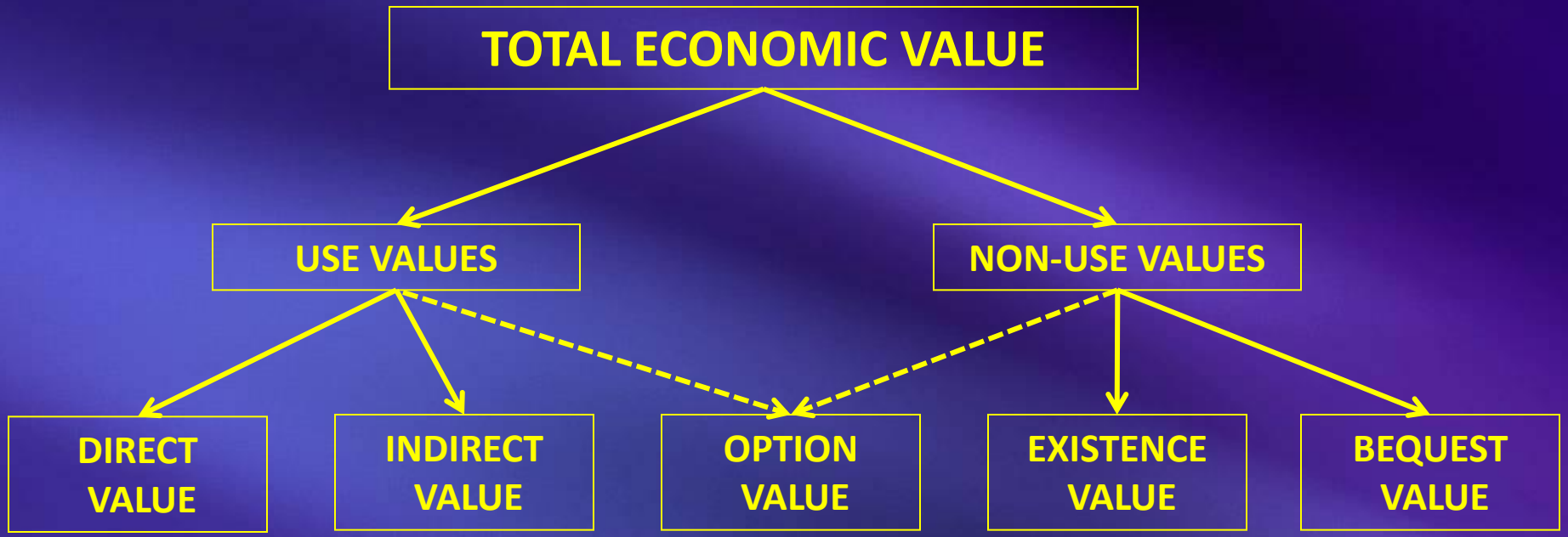
**CONTROLLING INVASIVE SPECIES ALSO IS CONSIDERED:**

***WEAKEST-LINK PUBLIC GOOD***

***EFFECTIVENESS IS ONLY AS STRONG AS CONTROL EFFORT BY 'WEAKEST 'LANDOWNER/COUNTRY***

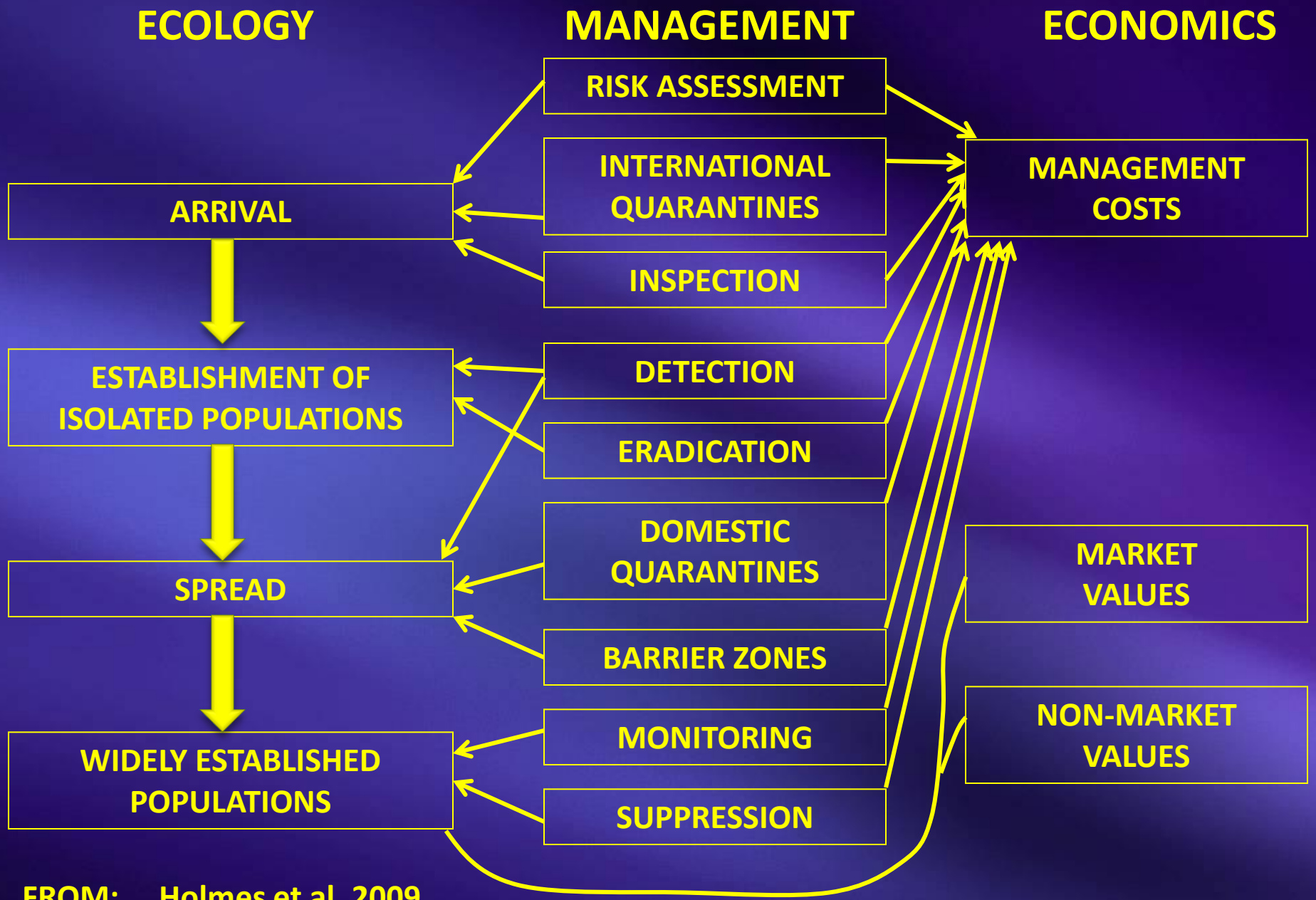
- ***IF INVASIVE THREAT IS SIGNIFICANT, WEAKEST-LINK EFFECT IS REDUCED***
- ***IF WEAKEST-LINK NATURE IS RECOGNIZED, FREE-RIDER EFFECT IS REDUCED***

# TOTAL ECONOMIC VALUE




FROM: Born et al., 2005 (adapted from Pearce and Turner 1990)

# RELATIONSHIPS BETWEEN INVASION, RESPONSES, & IMPACTS




FROM: Holmes et al. 2009

# RECOMMENDATIONS FOR ECONOMIC ANALYSIS OF INVASIVE SPECIES

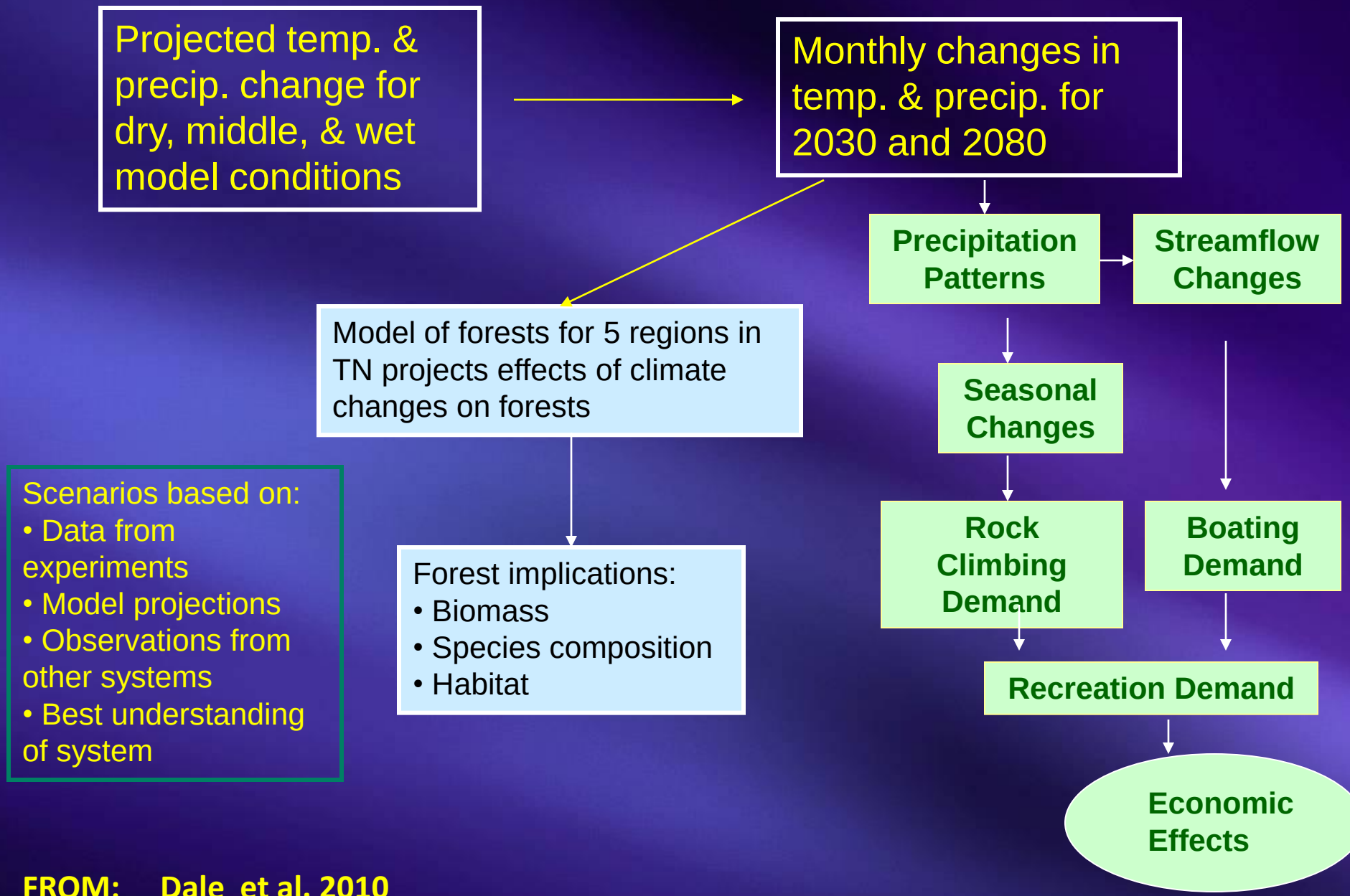
- PUBLIC GOODS NATURE MUST BE INCORPORATED INTO ANALYSIS
  - ENSURE OPTIMAL LEVEL OF PREVENTION/CONTROL
  - DETERMINE BEST POLICY OPTIONS
- WEAKEST-LINK ASPECT WILL BE CRITICAL IN DEVELOPING POLICIES TO ADDRESS INVASIVE SPECIES
  - NO IMPACT ON ECONOMIC ASSESSMENTS
  - VITAL IN DETERMINING EFFECTIVE OPTIONS
- IMPORTANT TO CONSIDER ALL ASPECTS OF ECONOMIC EFFECTS
  - TOTAL ECONOMIC VALUE
  - *EX-ANTE* AS WELL AS *EX-POST*
- SHOULD ENCOMPASS ALL PHASES/MANAGEMENT OF 'INVASION'

# POTENTIAL CLIMATE CHANGE EFFECTS

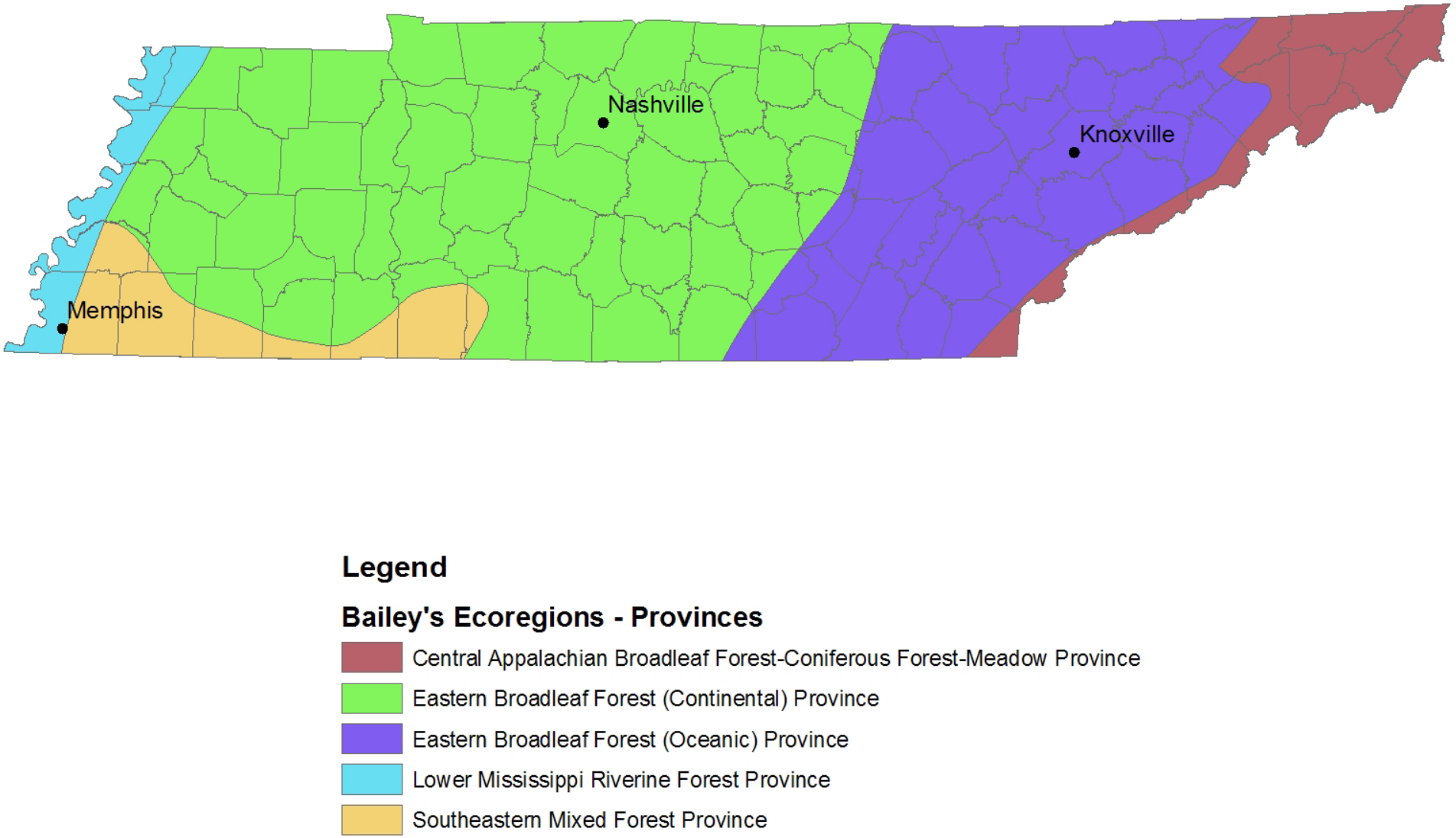
REVIEW OF RECENT STUDY ON TENNESSEE FORESTS

IMPLICATIONS FOR INVASIVES

# Components of Simulation

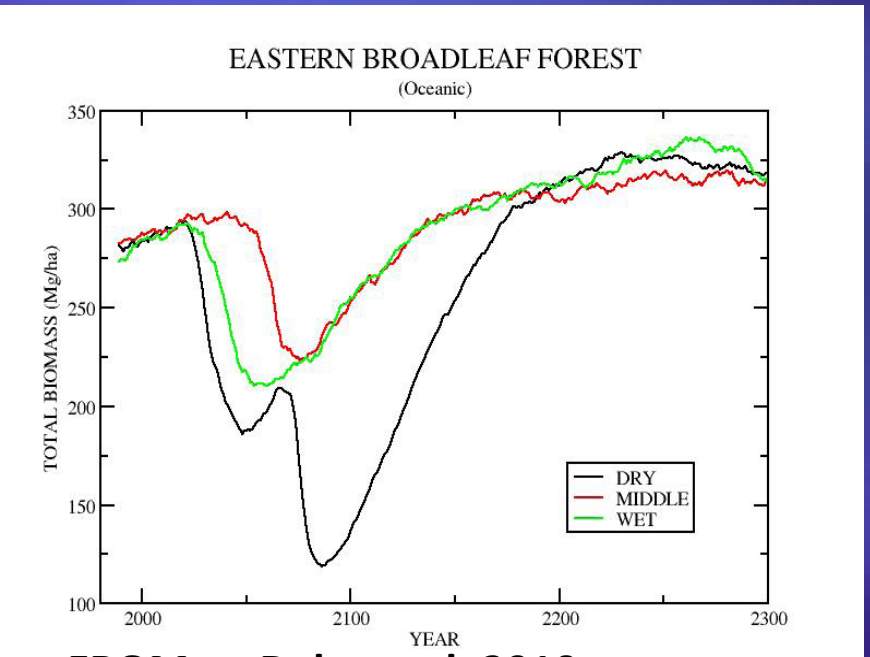



**FROM: Dale et al. 2010**

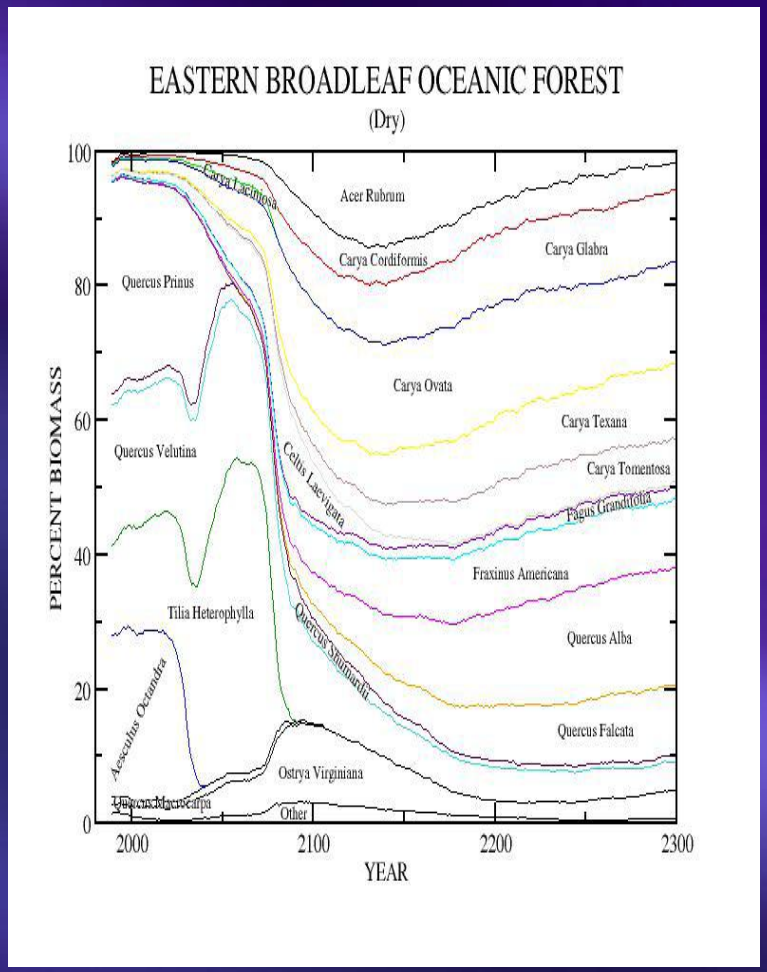



**FROM: Dale et al. 2010**

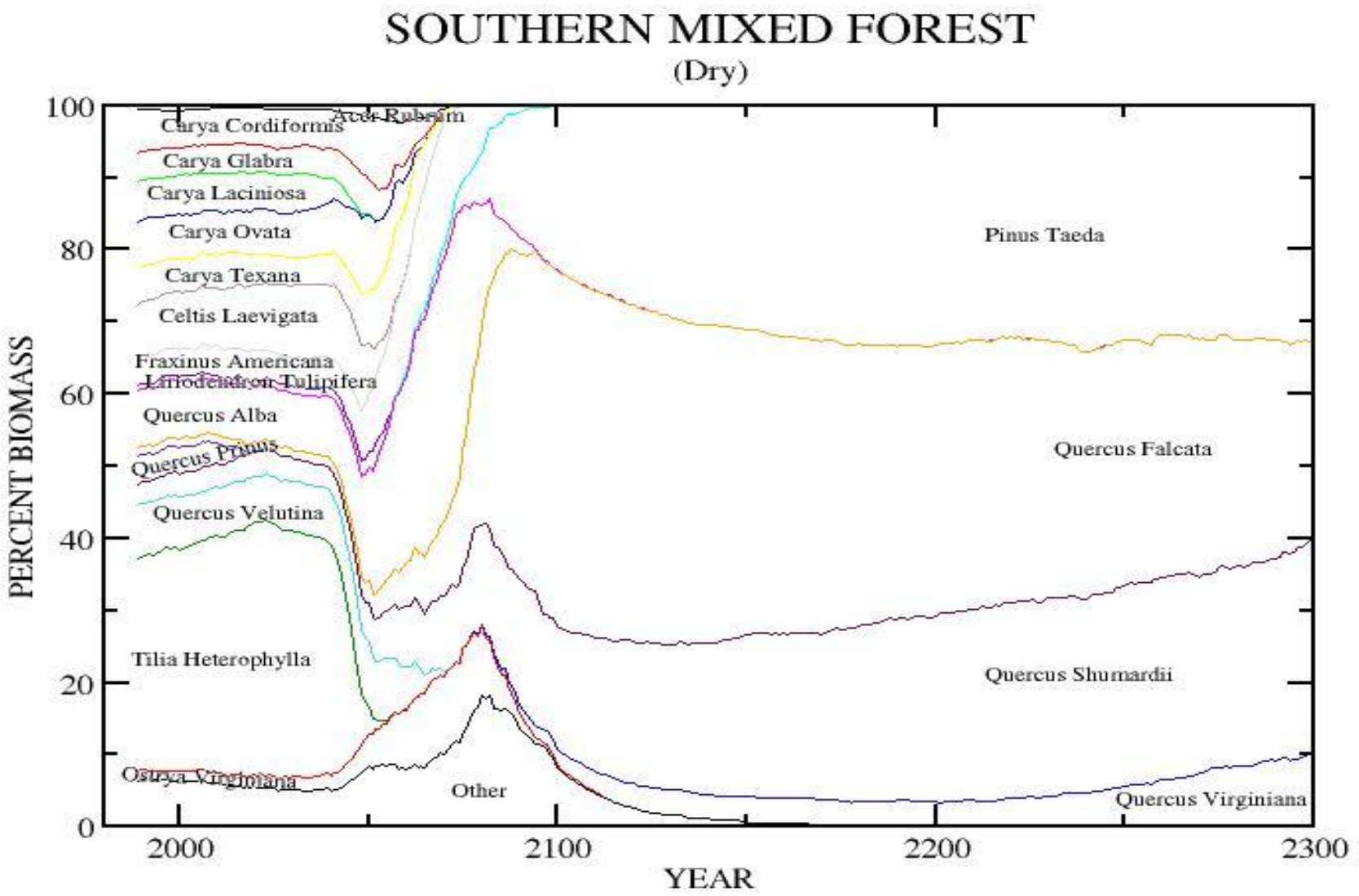
- Climate Changes
  - Temperatures projected to increase in all ecological provinces in all months for 2030 and 2080
  - Precipitation patterns are more complex and within existing variability
- Vegetation Change
  - Species composition
  - Biomass decline and recovery




**FROM: Dale et al. 2010**



# POTENTIAL CLIMATE CHANGE EFFECTS

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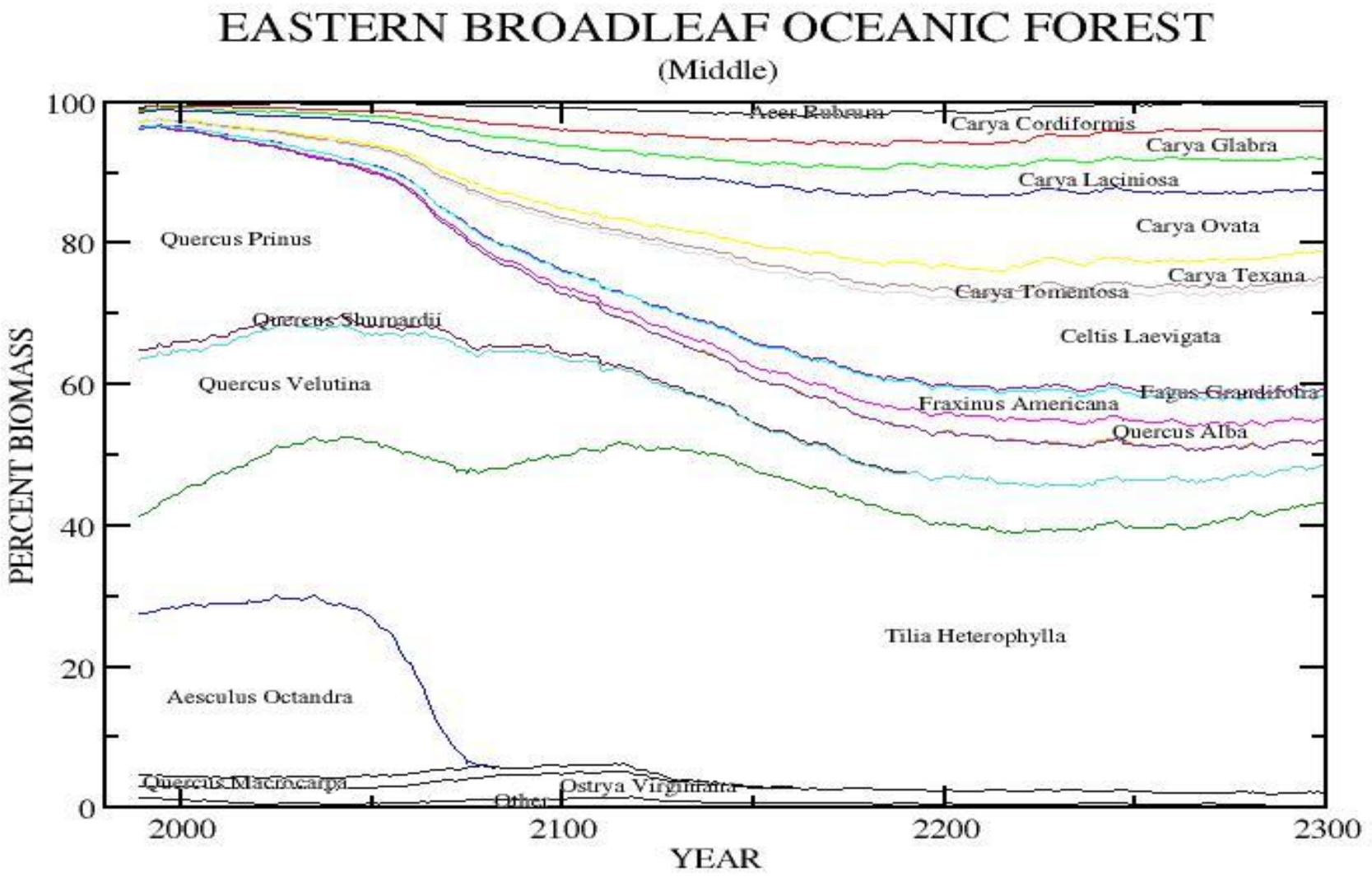


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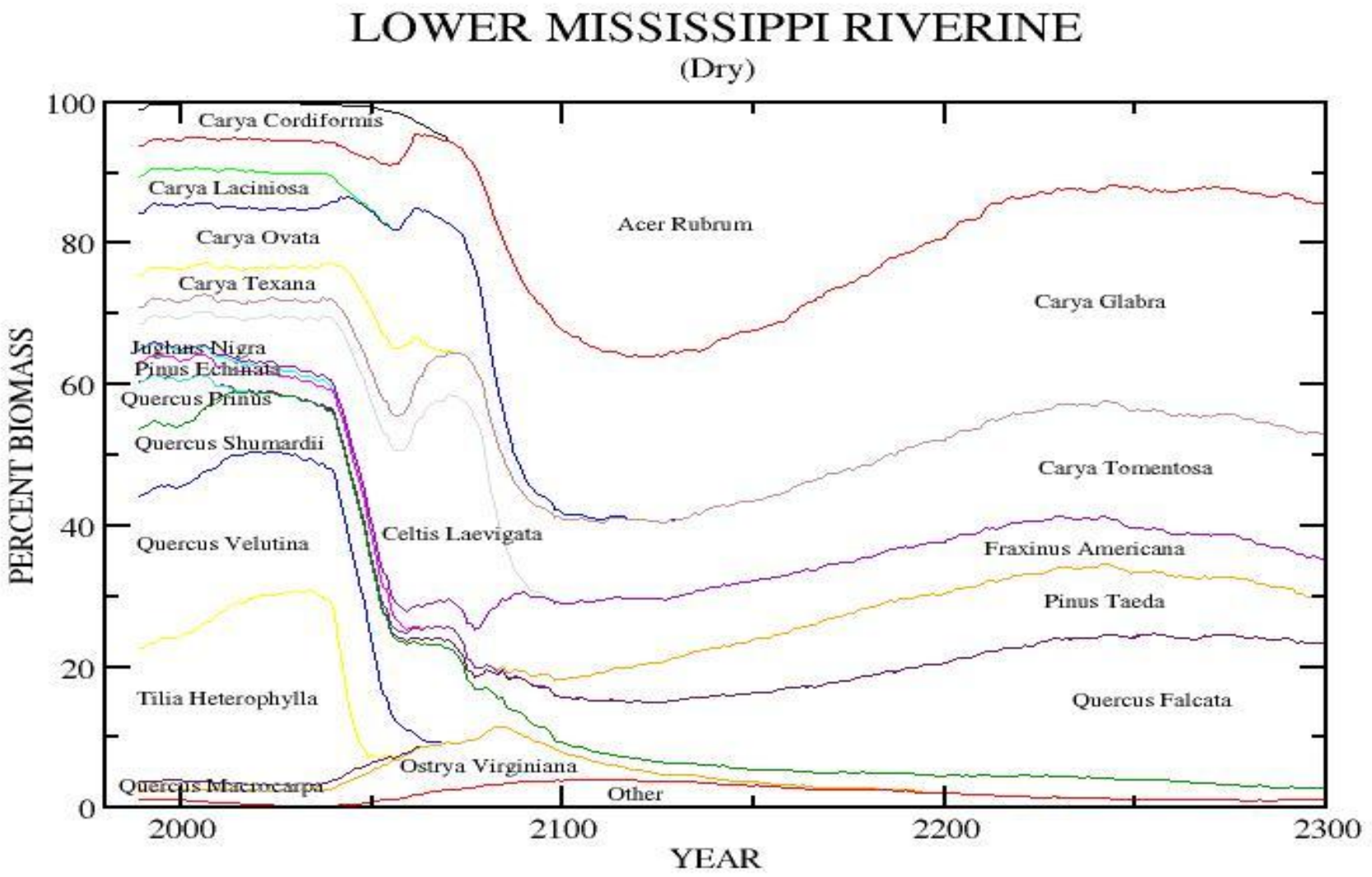
# POTENTIAL CLIMATE CHANGE EFFECTS




**FROM: Dale et al. 2010**

# IMPLICATIONS FOR INVASIVES

- **INVASIVE SPECIES NOT INCLUDED IN MODEL**
  **LIKELY TO BE MORE PREVALENT DUE TO ADAPTATIONS**

- **CHANGES IN SPECIES COMPOSITION LIKELY TO ENHANCE CHANGE**

- **INCREASED WARMING IN ALL MONTHS**

- **ECONOMIC ASSESSMENTS**

  1. **TOTAL ECONOMIC VALUE IS ESSENTIAL**
  2. **NON-USE VALUES WILL BECOME MORE CRITICAL**
  3. **MORE *EX-ANTE* ANALYSES NEEDED**

# POLICY OPTIONS

- ✓PRIMARY GOAL - PROVIDE INCENTIVES FOR PREVENTION AND CONTROL

- ✓BETTER UNDERSTANDING OF
  - IMPLICATIONS OF WEAKEST-LINK PUBLIC GOOD
  - COST-EFFECTIVENESS OF PREVENTIVE MEASURES

MUST ENCOMPASS ALL COMPONENTS OF ECONOMIC VALUE/COST

# POLICY OPTIONS

## INCENTIVES (*OR DISINCENTIVES*)

- BEST MEANS OF ADDRESSING PUBLIC GOODS NATURE
- FOCUSES CHANGE ON SOURCE OF PROBLEM
- MAY BE POLITICALLY DIFFICULT

## INTERNATIONAL TRADE/GOVERNANCE

- FOCUS ON BOTH PREVENTION AND CONTROL
- TARIFF STRUCTURE (Margolis et al. 2005)
- TRADEABLE RISK PERMIT (Horan and Lupi 2005)

## DETECTION

- MAY BE MOST COST-EFFECTIVE ALTERNATIVE
- EARLY DETECTION MINIMIZES COSTS/MAXIMIZES OPTIONS

## DON'T FORGET EDUCATION!

- REDUCES PROBLEMS OF PUBLIC GOODS SOMEWHAT
- HAS PROVEN EFFECTIVE FOR MONITORING AND CONTROL

# CONCLUSIONS

## FROM PERRINGS ET AL. 2002

***First, the science of biological invasions should embrace the fact that invasions are a human problem, with human causes and consequences.***

***Second, as a problem with its roots in human decisions and risk perception, …….. Requires the development of incentives to the people whose behavior is the proximate cause of the problem.***

***Third, the fact that the control of many biological invasions is a weakest-link international public good, suggests the need for a coordinated international response to the problem.***