Portfolio Effects and Benefits of Invasive Species Control

Travis Warziniack, PhD
Fort Collins, Colorado
twwarziniack@fs.fed.us

Rocky Mountain Research Station

and the team from NOAA CSCOR Grant No. NA09NOS4780192 “Forecasting spread and bioeconomic impacts of aquatic invasive species from multiple pathways to improve management and policy in the Great Lakes,” including:

- **Jenny Johnson**, Colorado State U.
- **David Finnoff**, U of Wyoming
- **Matt Barnes**, Texas Tech
- **Hongyan Zhang**, U. of Michigan
- **Ed Rutherford**, NOAA
- **Lindsey Chatterton**, The Nature Conservancy
- **Marion Whitman**, U.of Nevada Reno
- **David Lodge**, U. of Notre Dame.



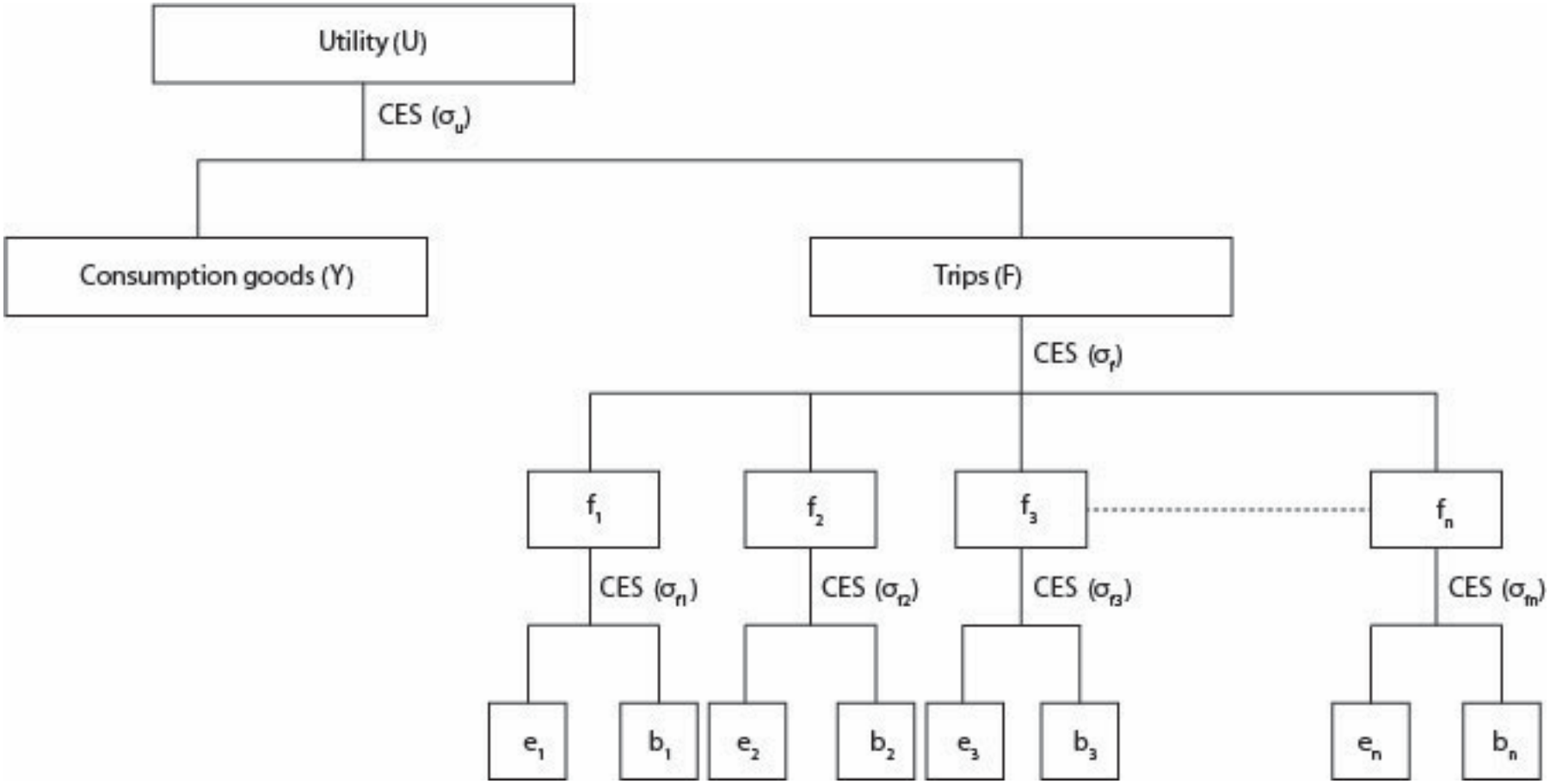

Economists as Accountants vs. Interdisciplinary Research

- **Zebra, quagga mussel: $150M/yr in Great Lakes**
- **All ship-borne in GL: $100-800M/yr on US side**
- **Sea lamprey: $20M/yr**
- **Emerald Ash Borer: $13B/10yr for US tree removal**
- **Gypsy Moth: $14M/yr in slow the spread in US**
- **Giant Cane (*Arundo donax*): $25K/acre control, CA**
- **Sudden Oak Death: $270M/10yr CA tree removal**
- **West Nile Virus: human, horse, wildlife mortality**
- **Crop, Livestock diseases: quarantine, trade loss**
- **All species: US $120B/yr; Canada $35B/yr**

Damages are a result of:

- Behavioral responses
- Some risk is endogenous
- We can prevent
- We can control
- We can adapt

Economic Methods: General Equilibrium Model of Ecosystem Services (GEMES) & Equilibrium Amenity Models



Spread of Zebra & Quagga Mussels

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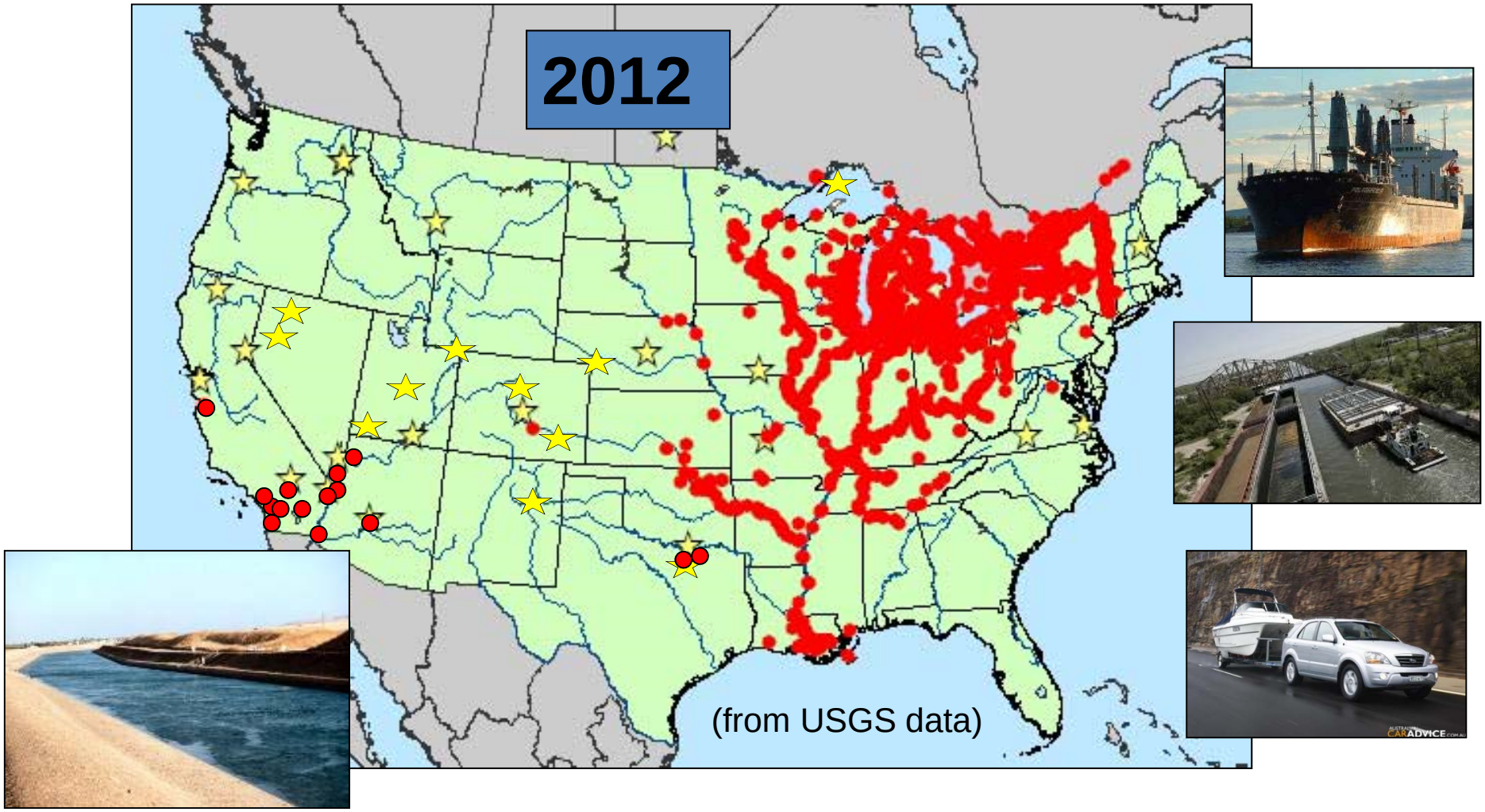
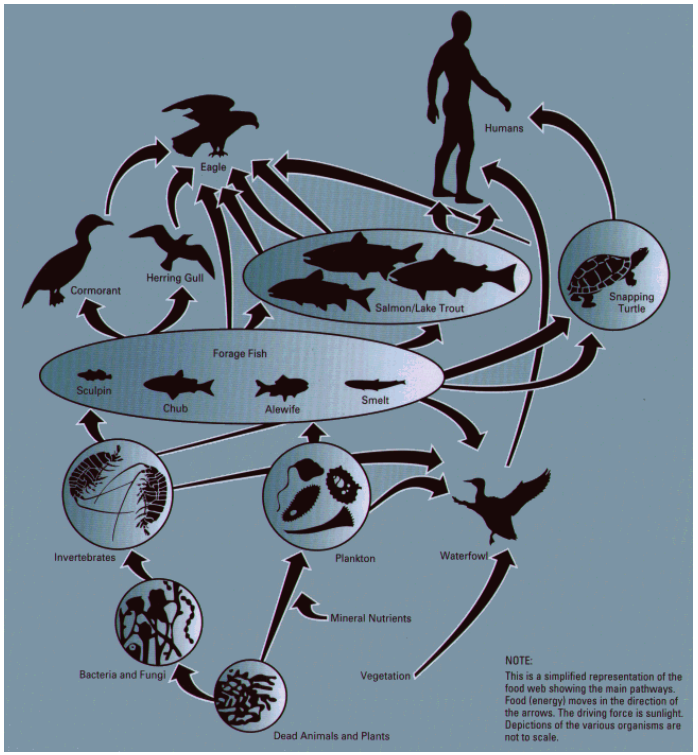
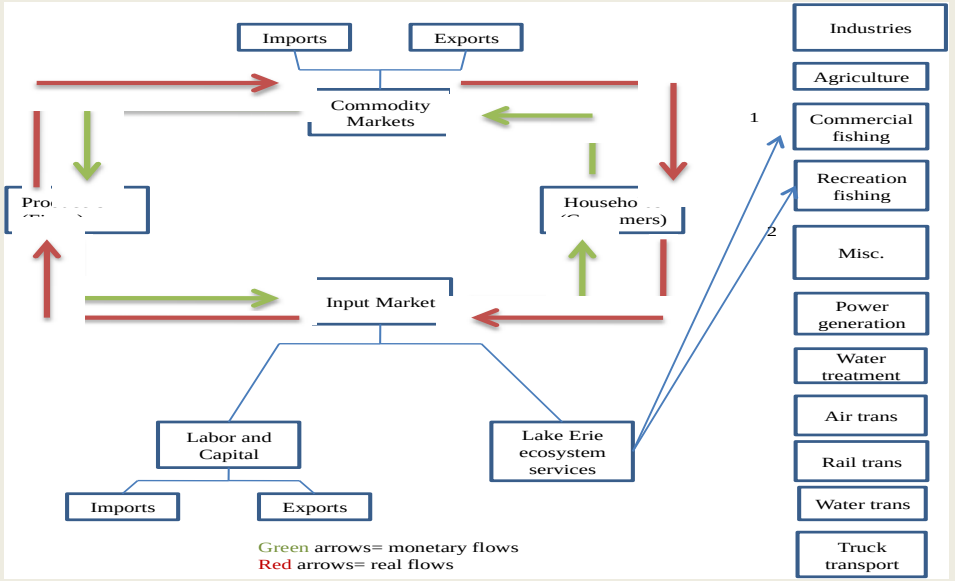
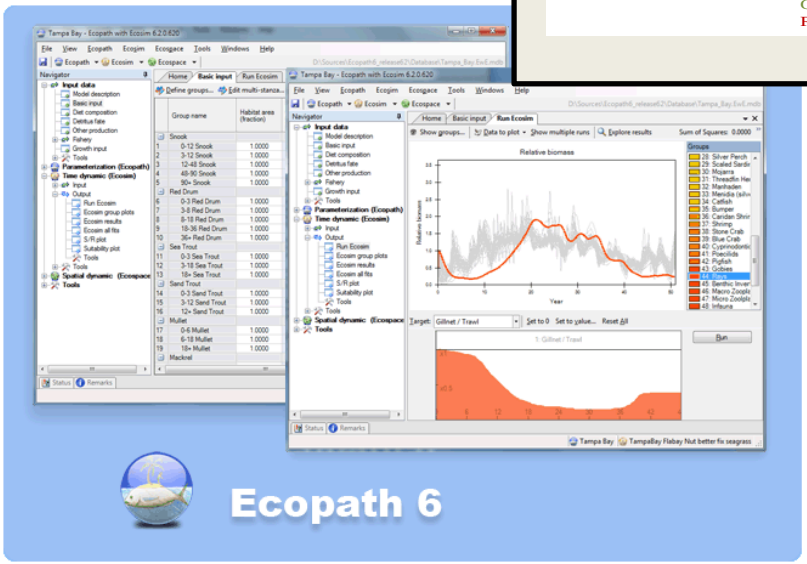


Case studies: Control of zebra and quagga mussels in Lake Erie and Lake Michigan

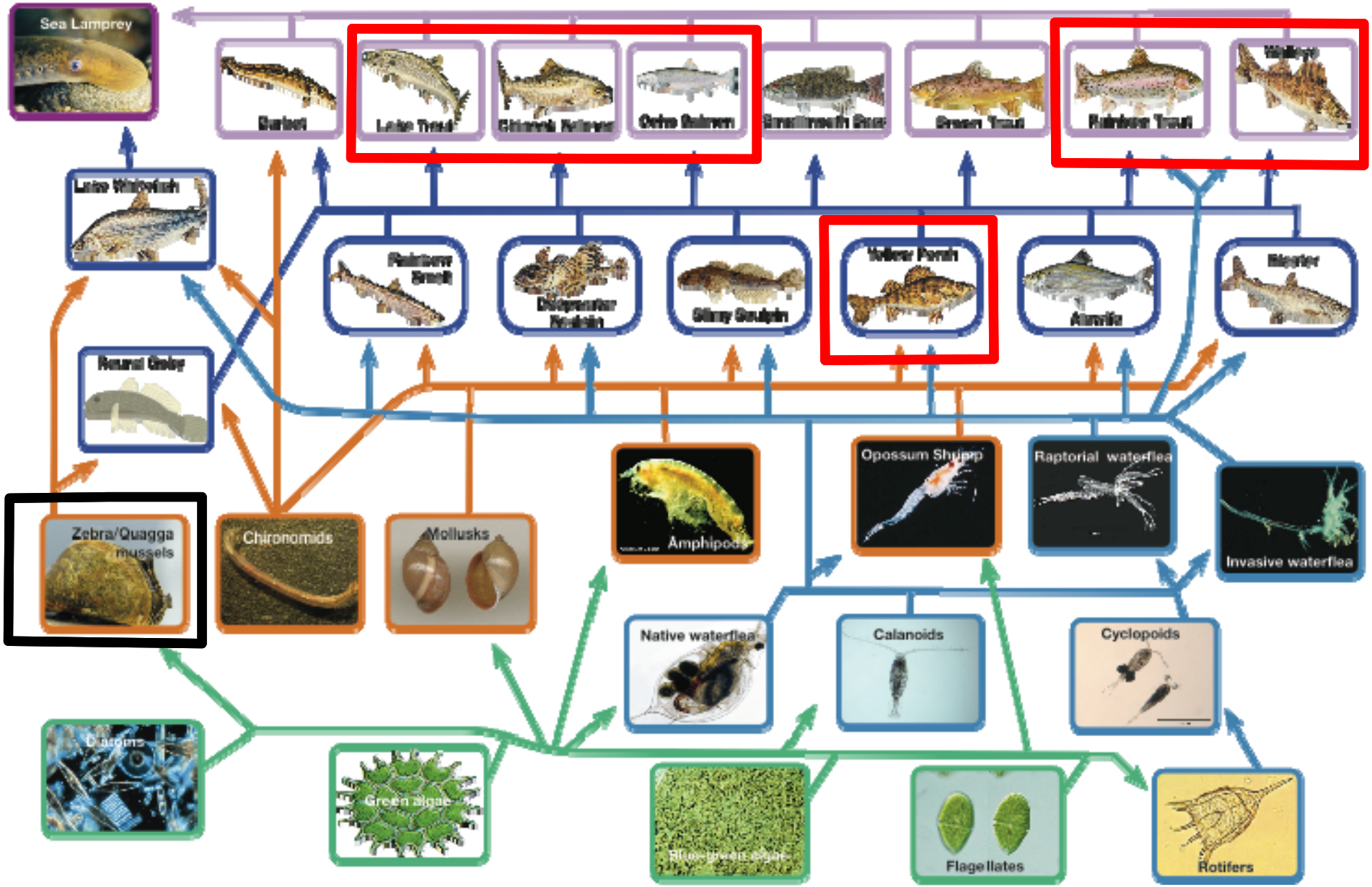


General Equilibrium Model of Ecosystem Service (GEMES)

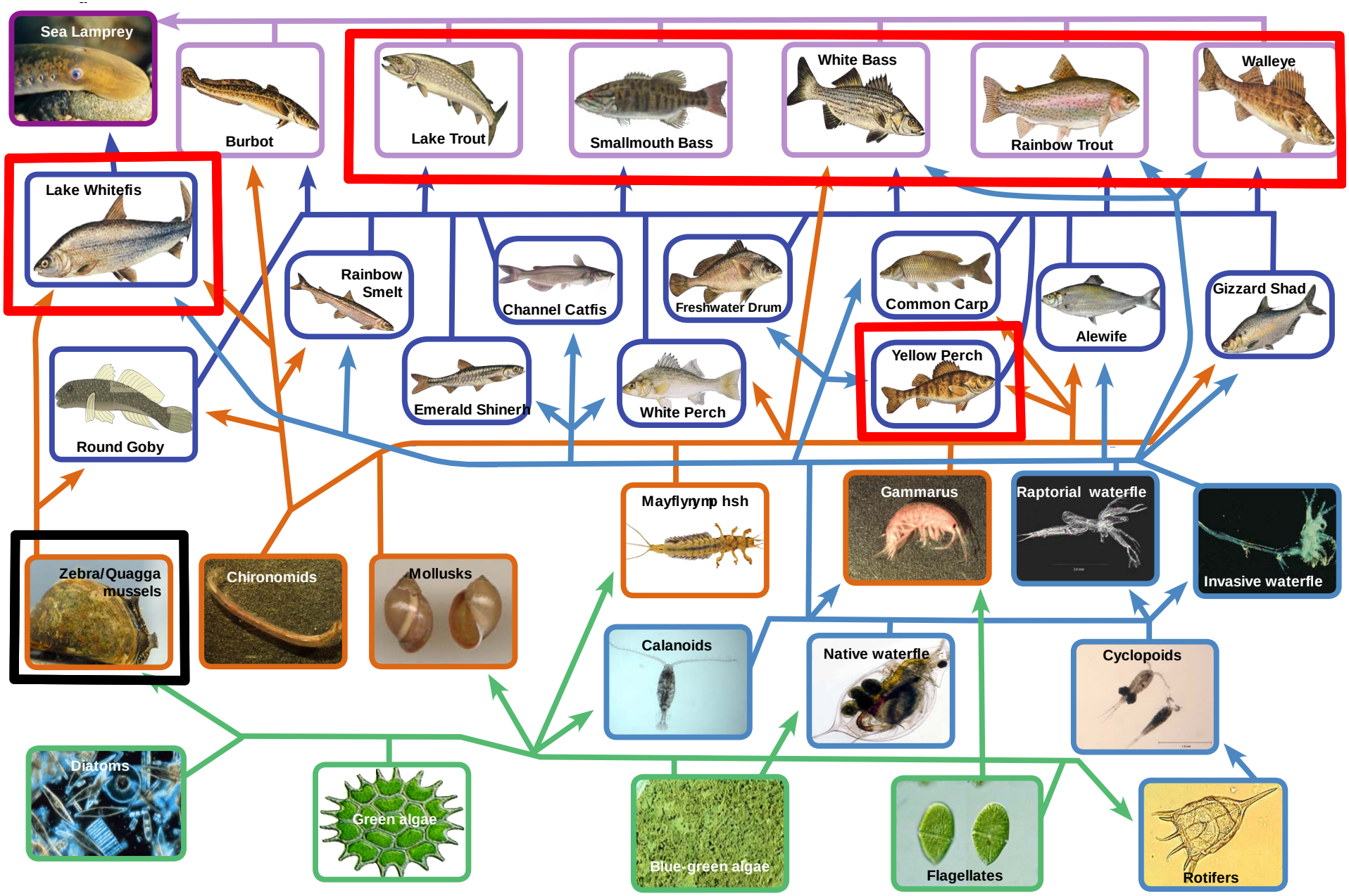




Lake Michigan Food Web (NOAA GL Envir. Res. Laboratory)

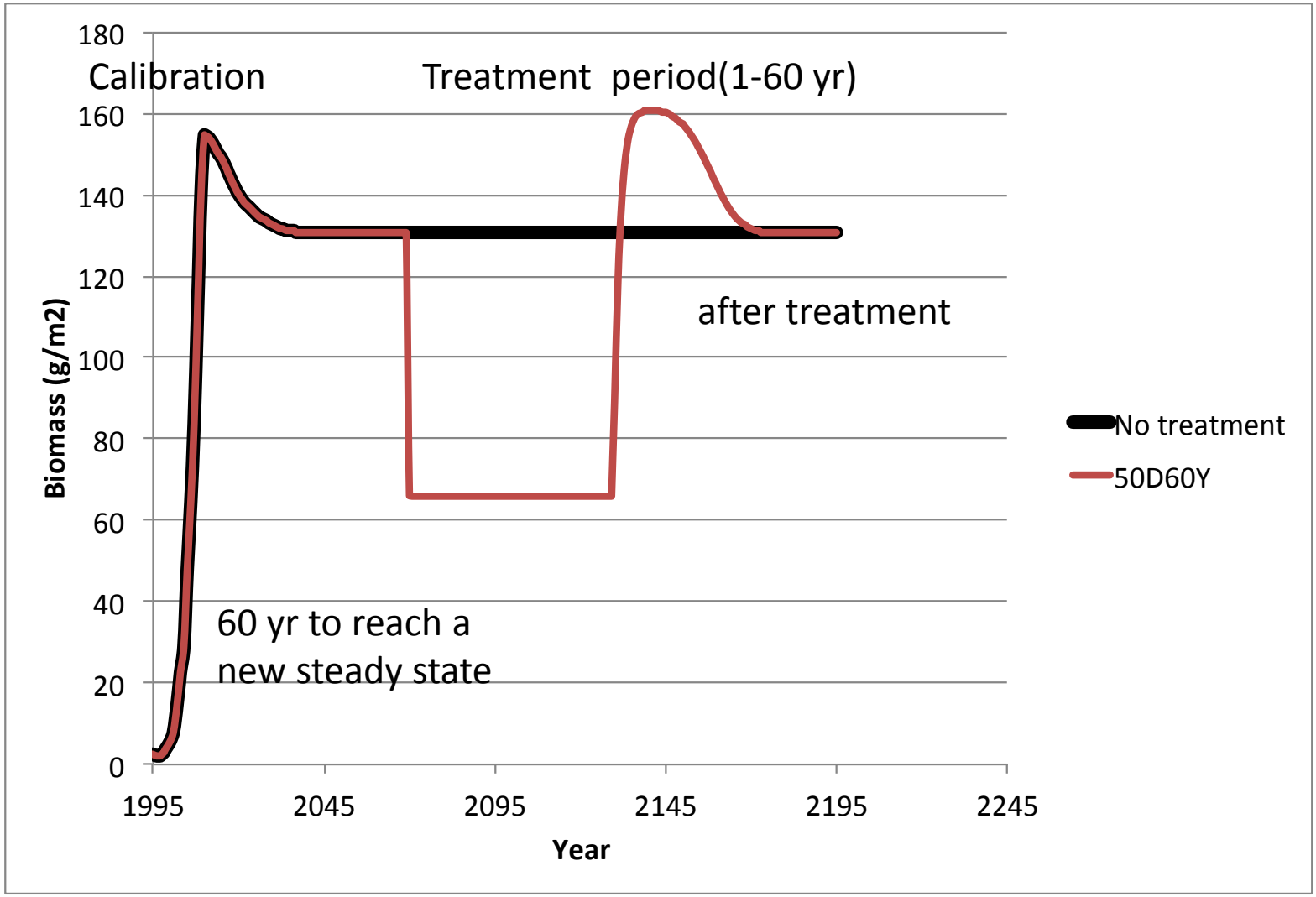


Lake Erie Food Web (NOAA GL Envir. Res. Laboratory)



Dreissenids reductions

Treatments – decreased by 50%, 75%, 90% and 99% for 1, 10, 30 and 60 years.



Lake Michigan

Treatment Intensity

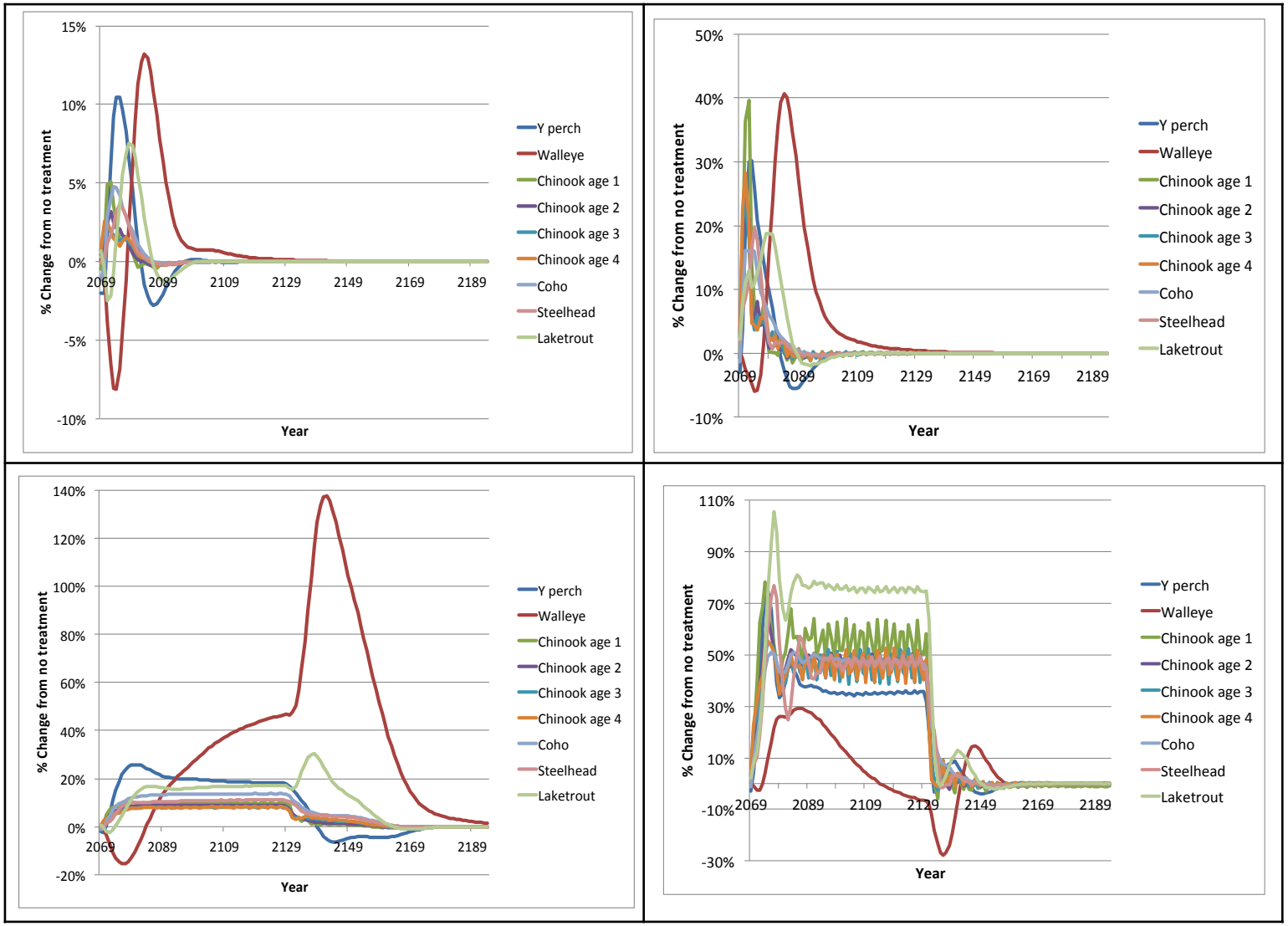
50%

99%

Treatment Duration

1-yr

60-yr



Lake Erie

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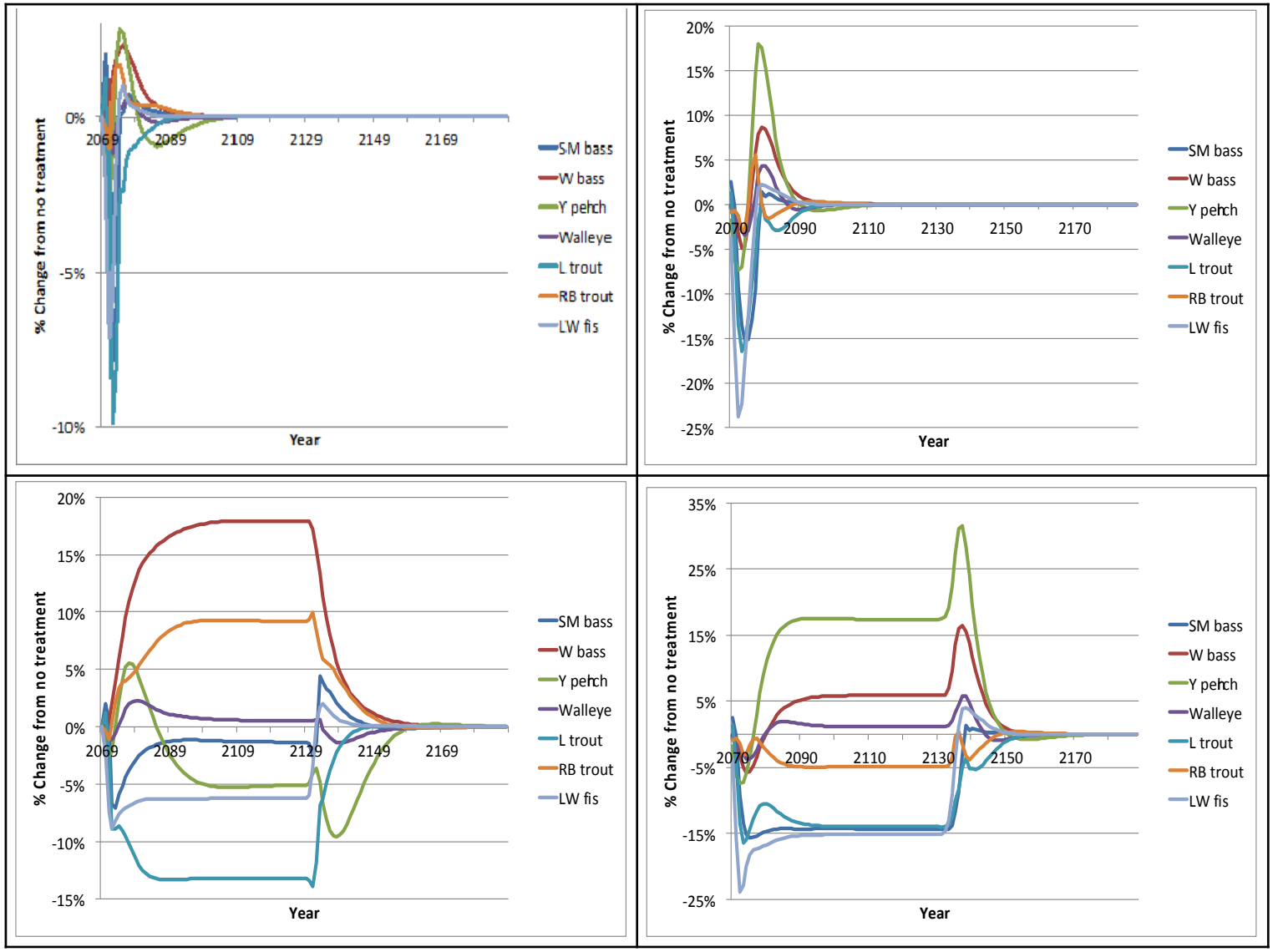


Michigan Angling

Characteristic		Species	$/fish	Trips
Angler income	$39,151*	Yellow perch	$0.83	2.2
Local anglers	379,200	Walleye	$16.58	3.18
Trips	9	Chinook age 1	$64.70	0.12
Trip cost	$53	Chinook age 2	$64.70	0.60
		Chinook age 3	$64.70	0.56
		Chinook age 4	$64.70	0.05
		Coho	$40.30	0.85
		Steelhead	$64.73	0.70
		Lake Trout	$8.35	0.66

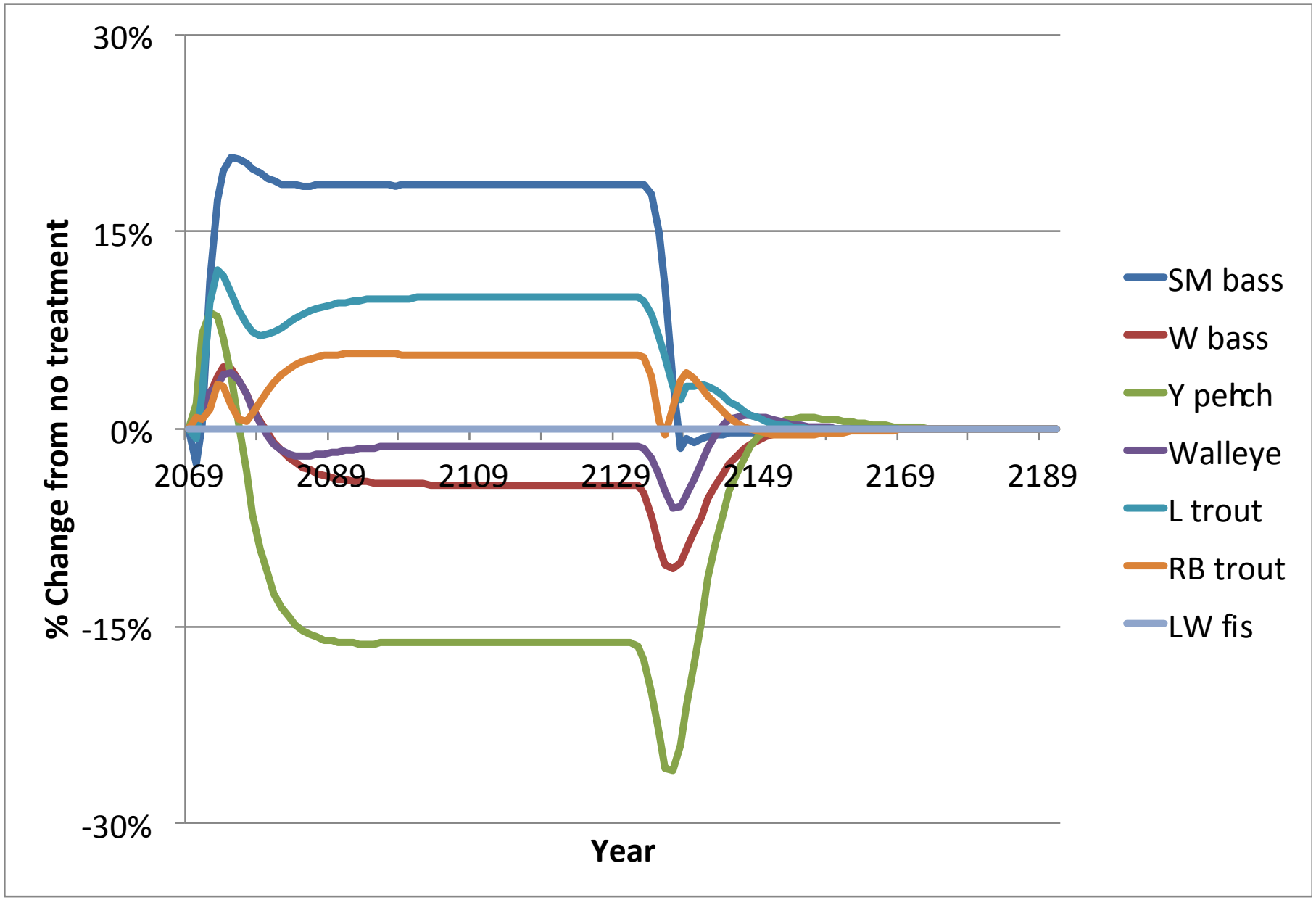
From Richard T. Melstrom & Frank Lupi (2013) Valuing Recreational Fishing in the Great Lakes, North American Journal of Fisheries Management, 33:6, 1184-1193.

Erie Angling

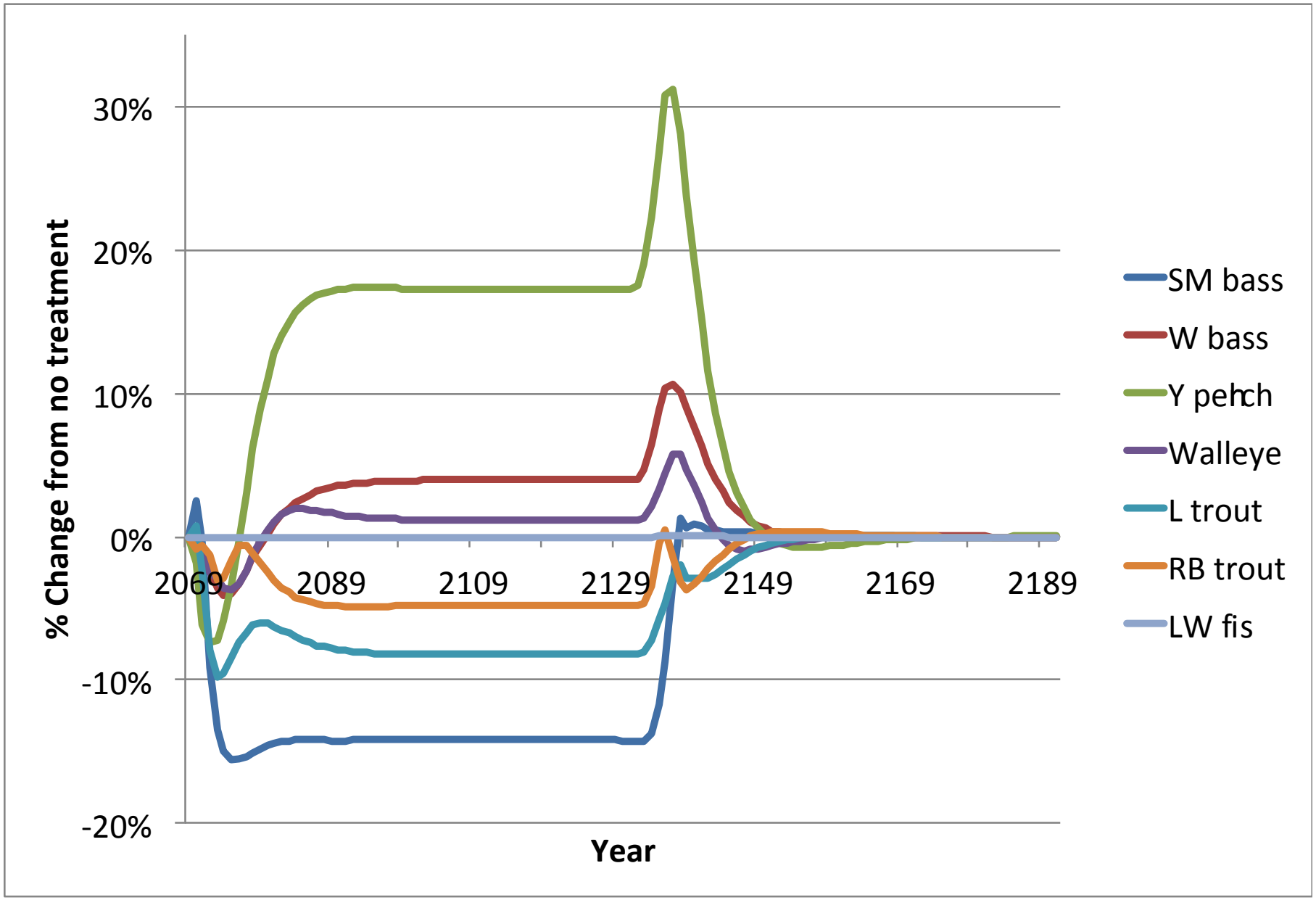
Characteristic		Species	$/fish	Trips
Angler income	$39,151*	Small mouth Bass	$12.86	0.26
Local anglers	420,800	White Bass*	$2.47	2.29
Trips	15	Yellow Perch*	$2.47	2.66
Trip cost	$32	Walleye	$18.43	2.79
		Lake Trout*	$20.13	1.05
		Rainbow Trout*	$20.13	4.45
		Lake Whitefish*	$2.47	1.52

From Besedin, E., M. Mazzotta, D. Cacela, and L. Tudor. 2004. Combining ecological and economic analysis: An application to valuation of power plant impacts on Great Lakes recreational fishing, presented at American Fisheries Society Meeting symposium: “Socio-economics and extension: Empowering people in fisheries conservation.”

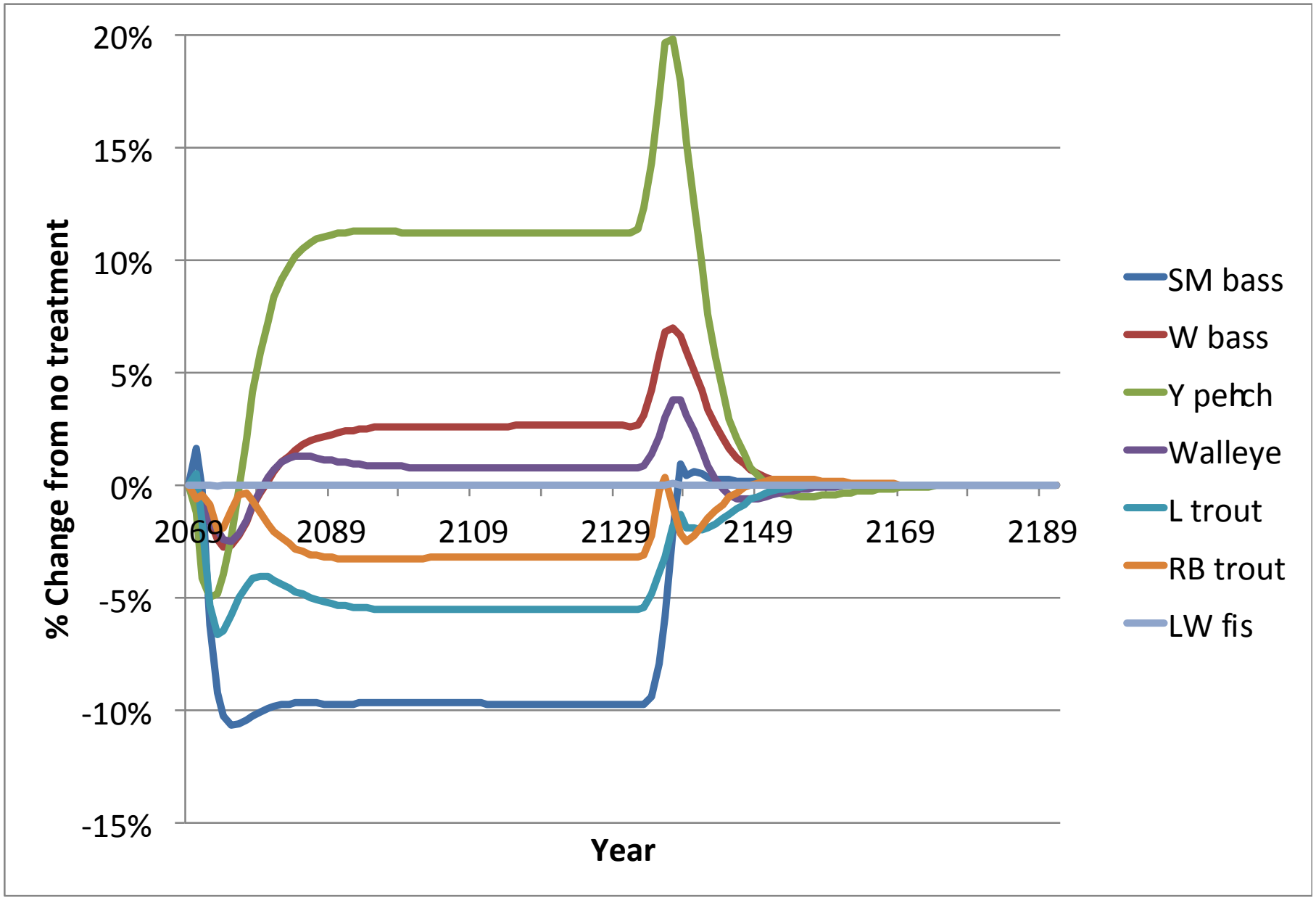
Erie Cost per Trip, 99D60Y



Erie Trips, 99D60Y



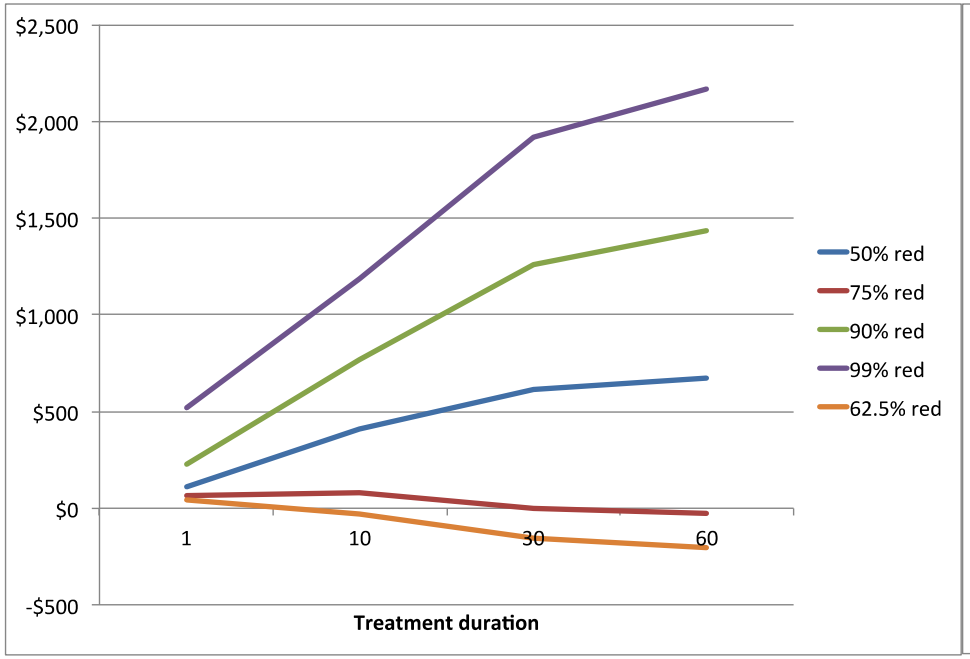
Erie Catches, 99D60Y



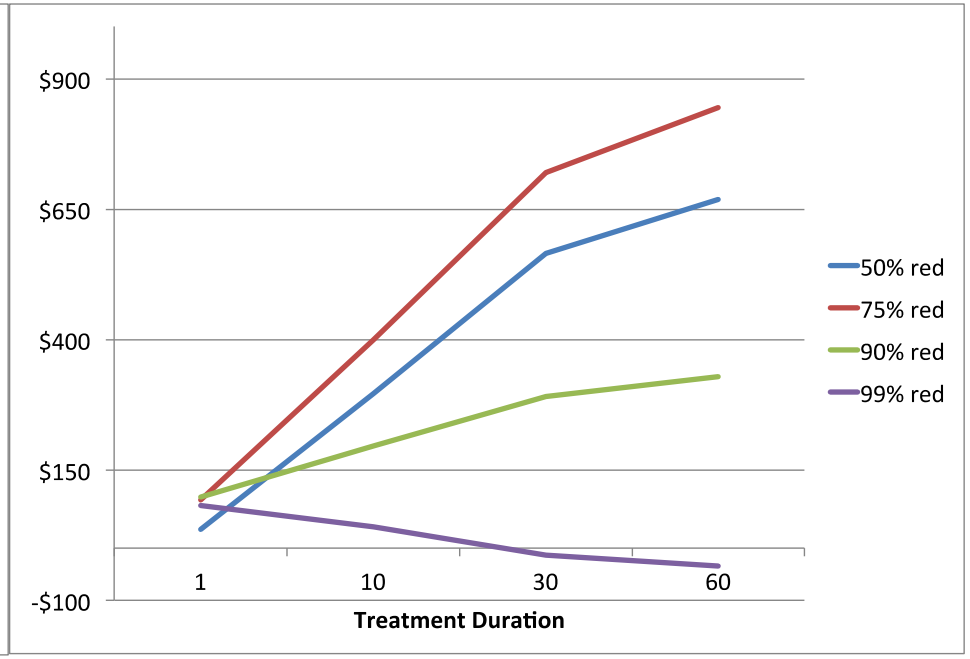
Welfare Changes per Household:

Equivalent Variation = income a consumer would be willing to forgo, or have to be paid, to avoid the impacts induced by biomass changes

Michigan: Discounted Cumulative Equivalent Variation ($)

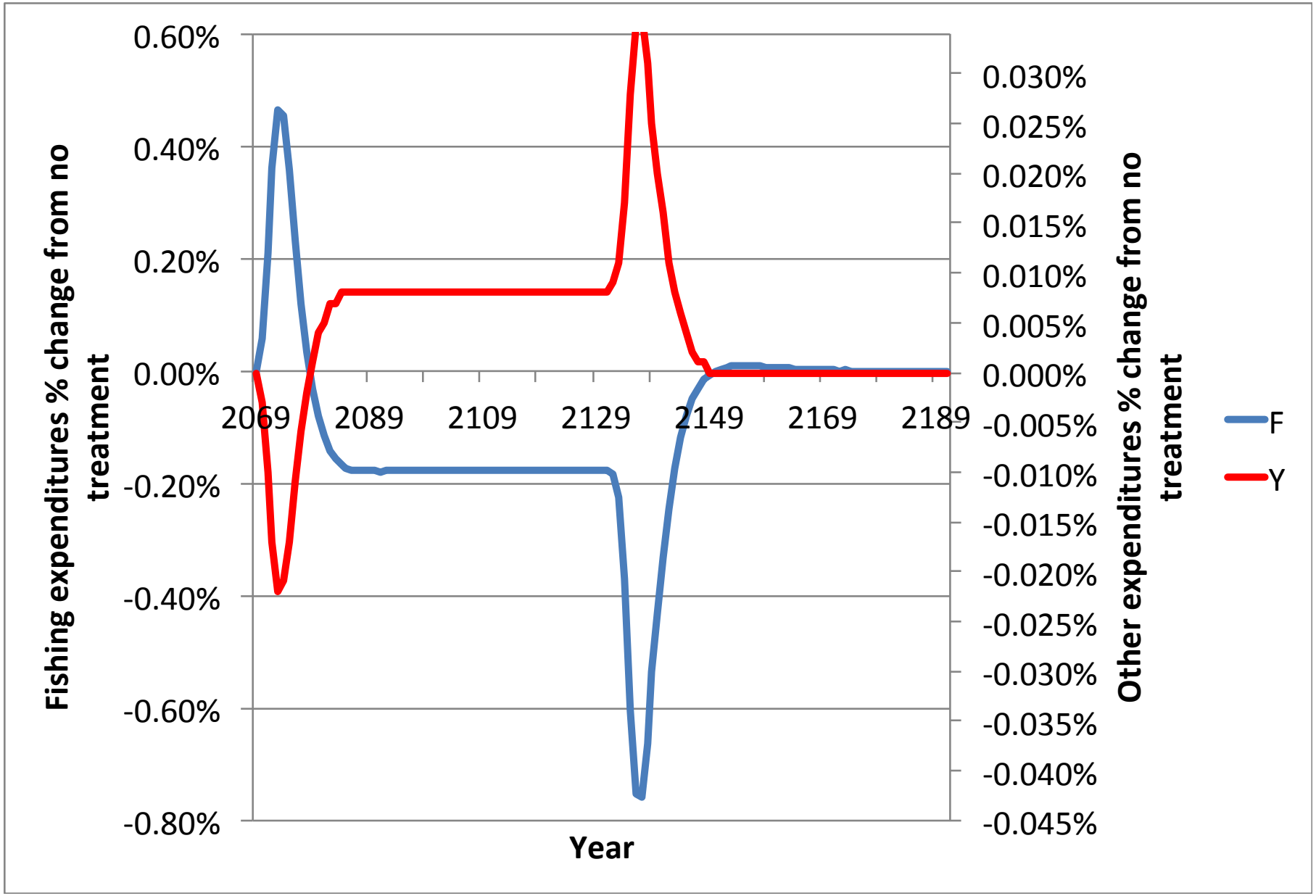


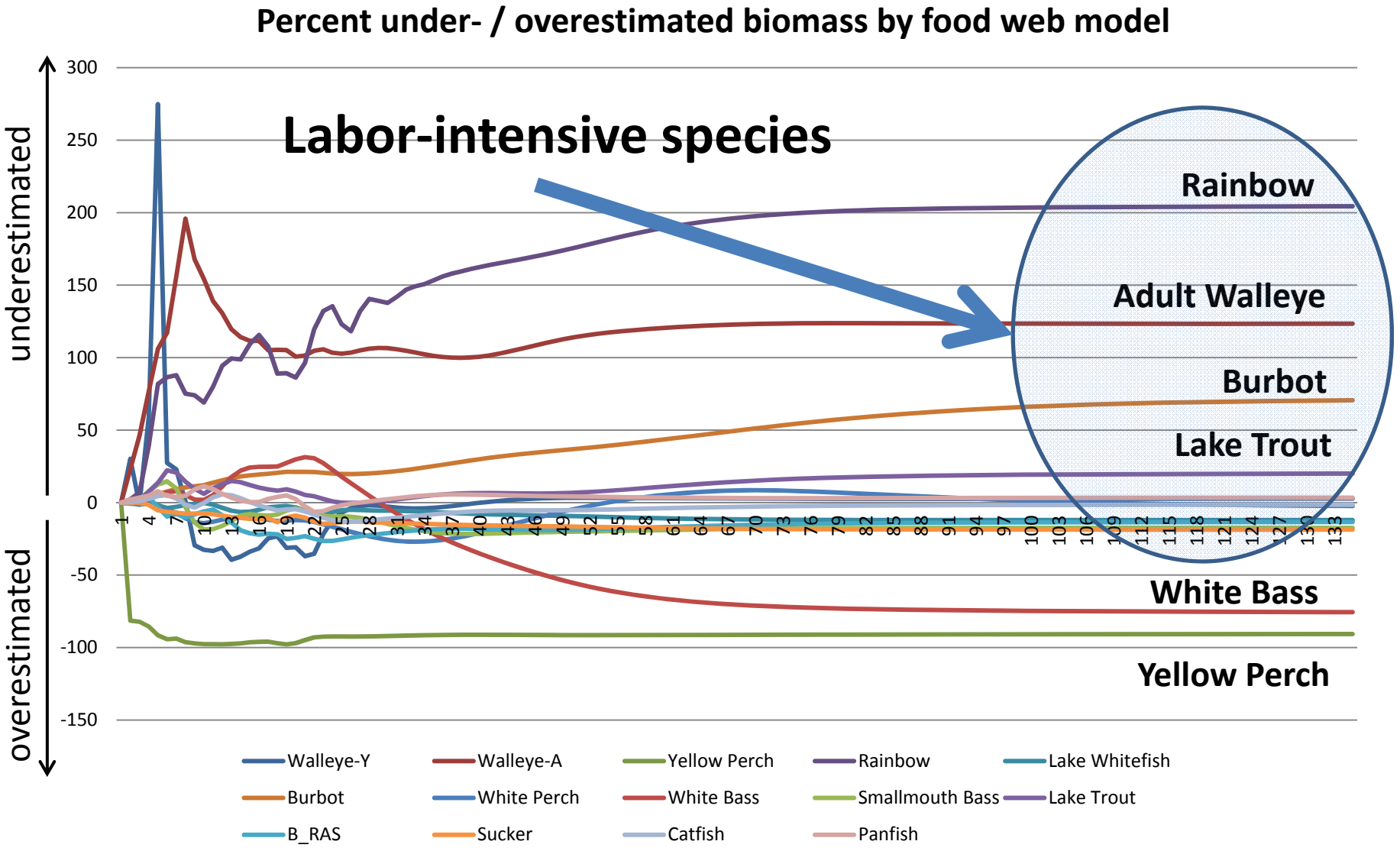
Erie: Discounted Cumulative Equivalent Variation ($)



Why? Michigan Aggregates, 99D60Y

Why? Erie Aggregates, 99D60Y




Percent under- / overestimated biomass by food web model
Labor-intensive species
Rainbow
Adult Walleye
Burbot
Lake Trout
White Bass
Yellow Perch
underestimated
overestimated
300
250
200
150
100
50
0
-50
-100
-150
Walleye-Y
Walleye-A
Yellow Perch
Rainbow
Lake Whitefish
Burbot
White Perch
White Bass
Smallmouth Bass
Lake Trout
B_RAS
Sucker
Catfish
Panfish

Discussion

- As biomass of species change due to treatment intensity and duration, the relative cost of catching each adjusts.
- A relative increase in a specie's biomass makes it relatively cheaper to target and increases the purchasing power of income the angler spends on fishing. Welfare improves.
- The opposite occurs when a biomass declines.

Discussion

- What is at risk depends on the food web repercussions, the ecosystem service portfolio, human characteristics and human behavior (devil is in the details and they matter)
- Michigan
  - Most high valued species do well during intense treatments
  - Best to treat intensely for long periods
  - Worst to treat moderately for long periods
- Erie
  - Only 1 of 3 high valued species does well under intense treatments (although big gains for lower valued species)
  - Best to treat moderately over a long period
  - Worst to treat intensely over a long period

Thank You

Travis Warziniack

US Forest Service

Rocky Mountain Research Station

Fort Collins, Colorado

twwarziniack@fs.fed.us

(note the two w’s and the .us)