Influence of stocking method and location on Lake Michigan Chinook salmon returns

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Outline

- Overview of stocking, net pen program
- Results of 1990s CWT study
- Discuss variability, implications for application
- Application of results to stocking decisions

Lake Michigan net pen program; 2002-2005

- 16 sites
- Fish per site (range; 10K – 375K)
- 7 sites with net pens
- 2.3 million stocked (annually)
- 1.0 million stocked in net pens
- 46% of total

Stocking, net pen, and CWT sites

Stocking site	Net pen	Coded-wire tag evaluation
BBDN (Ford River)		
LBDN (Gladstone)		
LBDN (Escanaba)		
Manistique River		
Charlevoix - Medusa Creek	**x**	1990-1994 (2/3 y)
Traverse City - Boardman		1991-1994 (4 y)
Portage Lake - Onekama		
Manistee River	**x**	
Little Manistee River		1990-1994 (5 y)
Big Sable River - Ludington	**x**	
Muskegon Lake (net pen)	**x**	
Muskegon Lake (direct)		
Muskegon River		
Grand River (net pen)	**x**	1990-1994 (5 y)
Grand River (direct)		1990-1994 (4/5 y)
Holland		
Kalamazoo R. - Saugatuck		
Black River - South Haven	**x**	
St. Joseph River (pond)	**x**	1991-1994 (4 Y)
St. Joseph River (pen)	**x**	1991-1994 (4 Y)

1990-1994 Chinook Salmon CWT Study Objectives

- Quantify effect of net pens on survival (returns)
- Quantify effect of upstream vs downstream stocking
- Determine spatial patterns in returns
- Evaluate spatial and temporal variability
- Make management decisions using best available data, given design and implementation problems

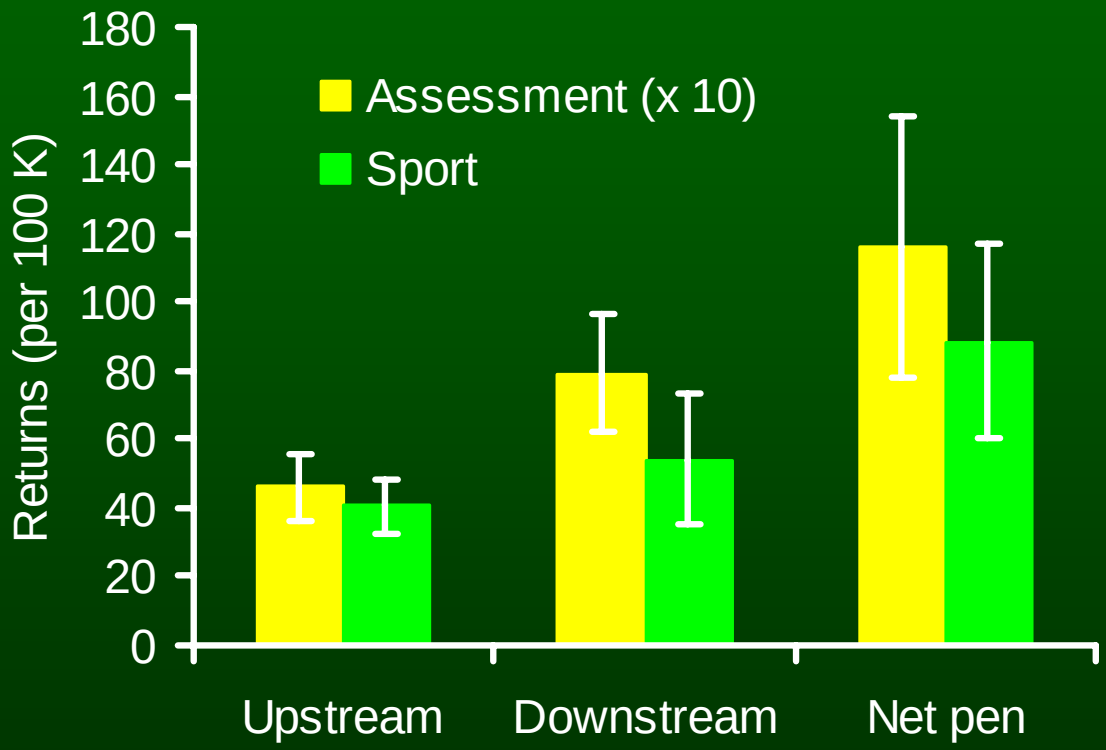
Study design

Year	Medusa	Boardman	Manistee	Grand	St. Joseph
1990	100,000 (direct)	ns	300,000 (direct)	200,000 (d,np)	ns
1991	100,000 (direct)	100,000 (direct)	300,000 (direct)	300,000 (d,np,us)	100,000 (np)
1992	100,000 (np)	100,000 (direct)	300,000 (direct)	300,000 (d,np,us)	100,000 (np)
1993	100,000 (np)	100,000 (direct)	300,000 (direct)	300,000 (d,np,us)	100,000 (np)
1994	100,000 (np)	100,000 (direct)	300,000 (direct)	300,000 (d,np,us)	100,000 (np)

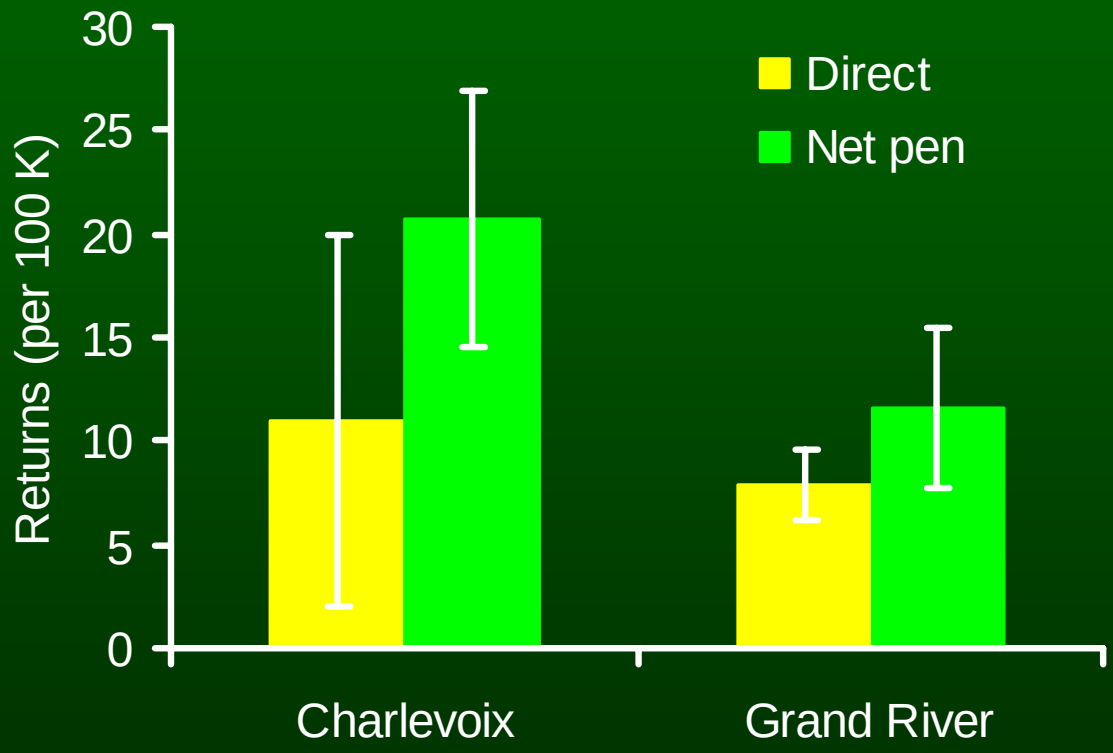
Other results – net pen

- Savitz et al. 1993 (N. Am. J. Fish. Mgmt.)
  - More adult salmon returned to release harbor than to other harbors
  - No significant differences in returns of mature salmon from caged and non-caged groups
- Wisconsin DNR (unpublished)
  - Pond > River > Shore-released fish
- West coast (numerous studies)
  - Mixed results

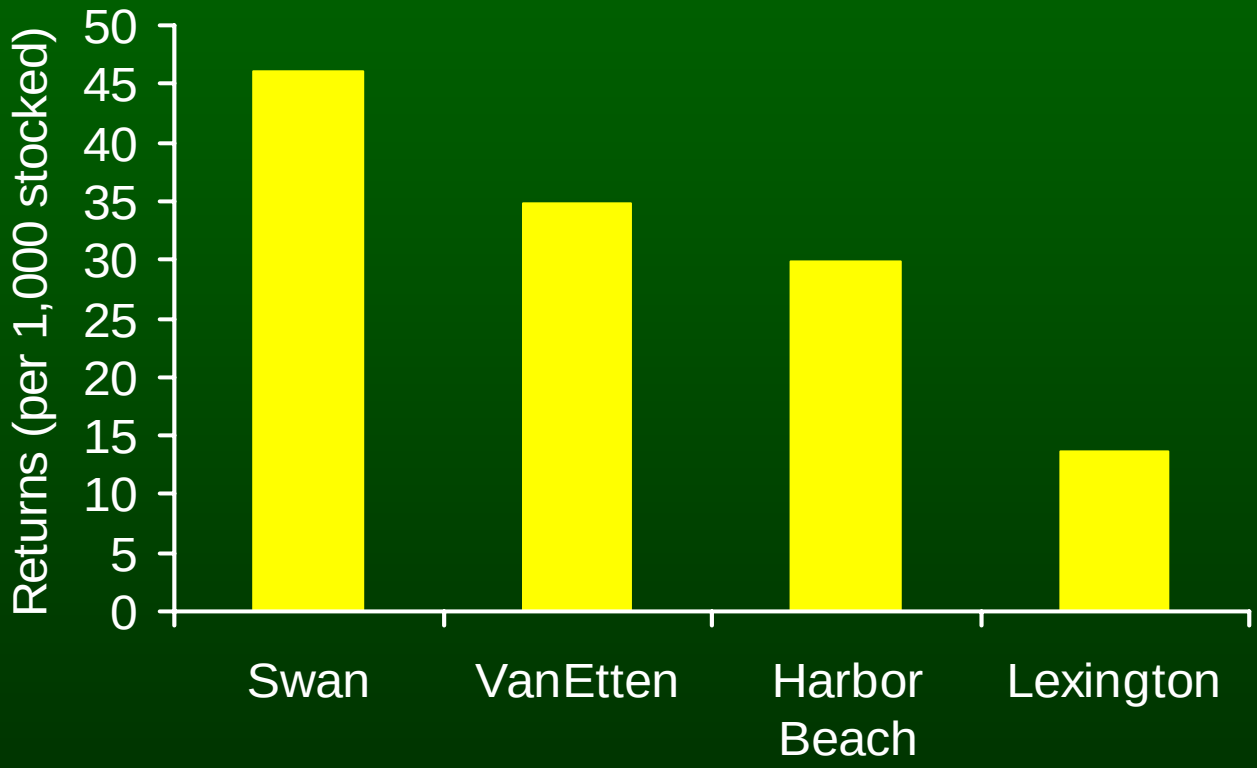
Grand Rapids - All Plants 1990-94



Other net pen sites - Assessment data, 1990-94

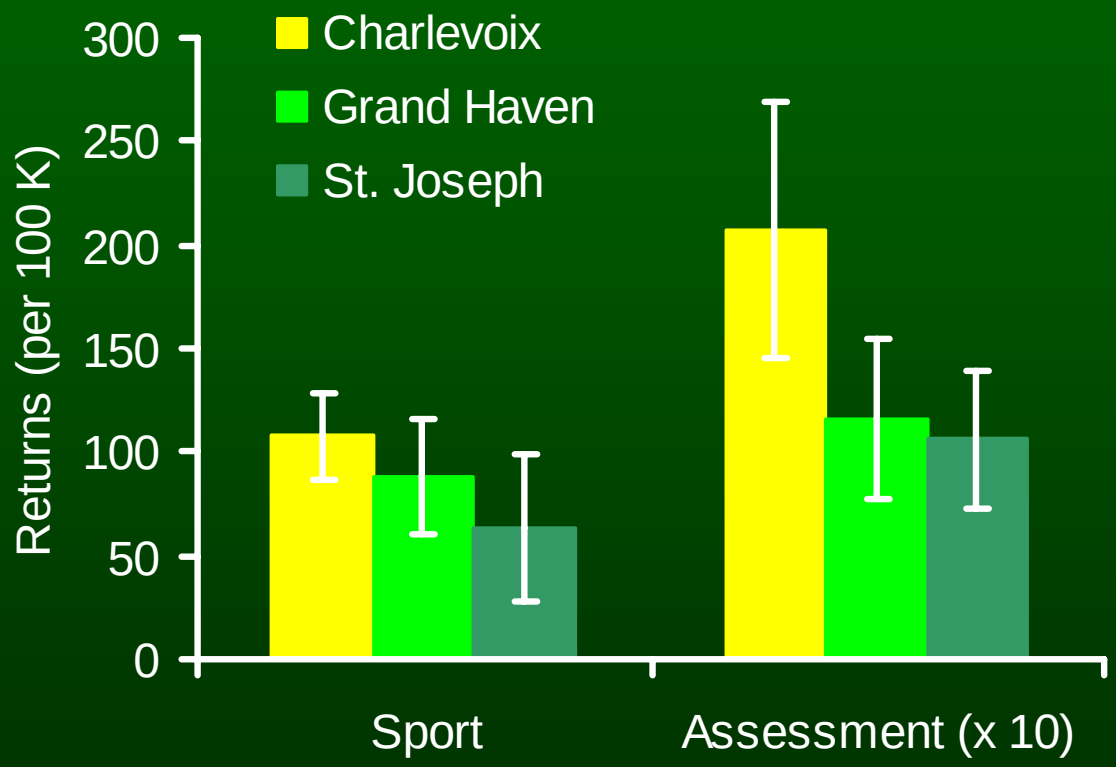


Other published results – spatial patterns (Lake Huron)

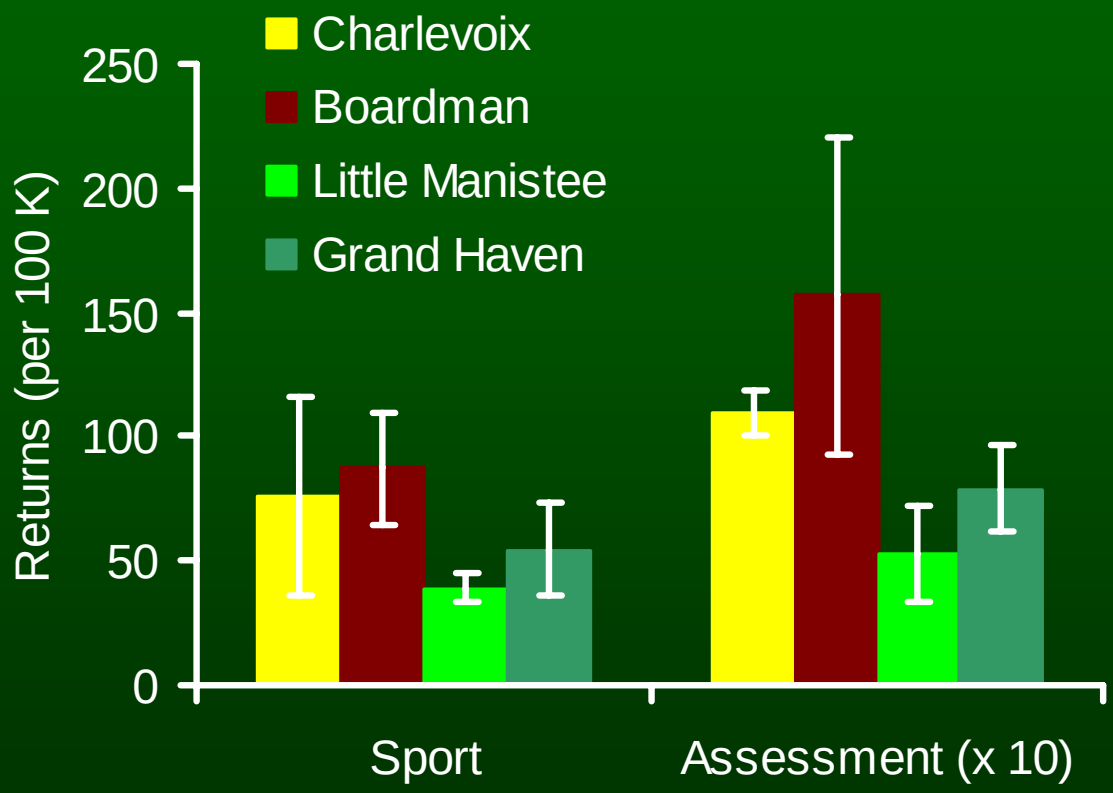


(Rakoczy 1991, #1983)

CWT returns to sport catch and assessments, 1990-94; net-pen plants



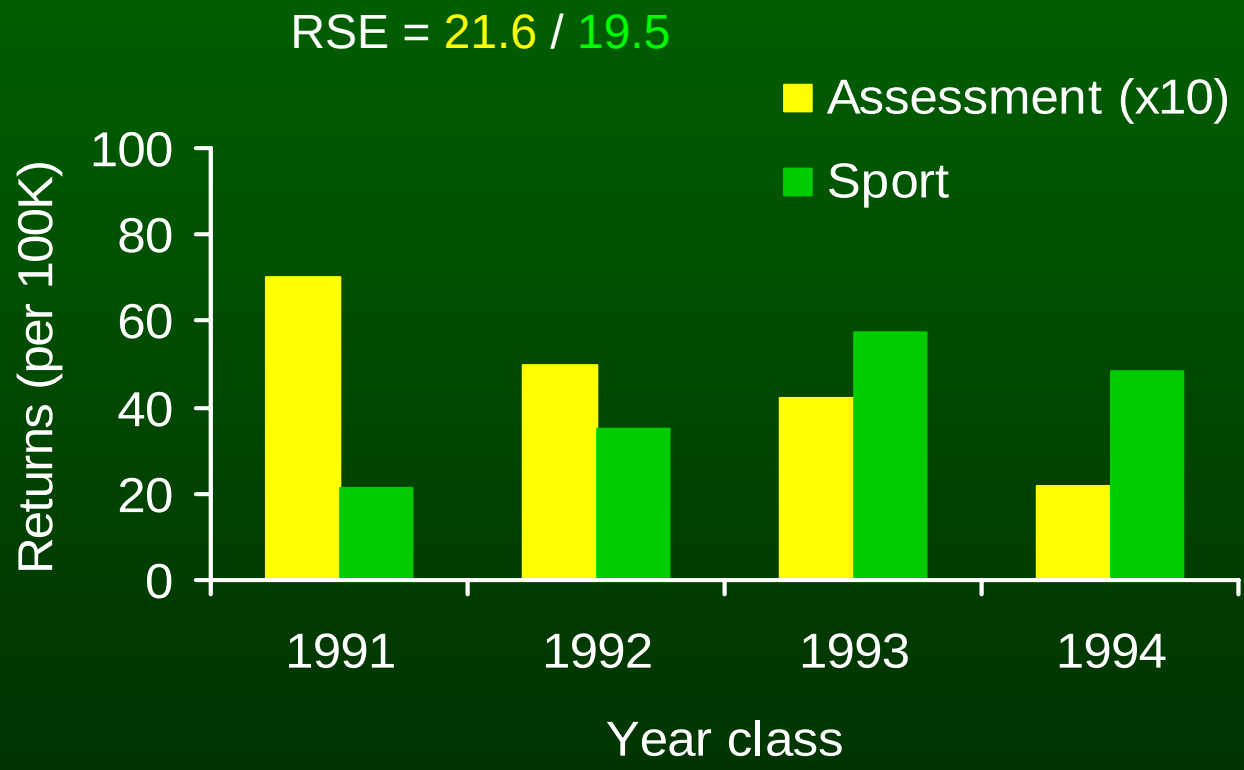
CWT returns to sport catch and assessments, 1990-94; direct plants



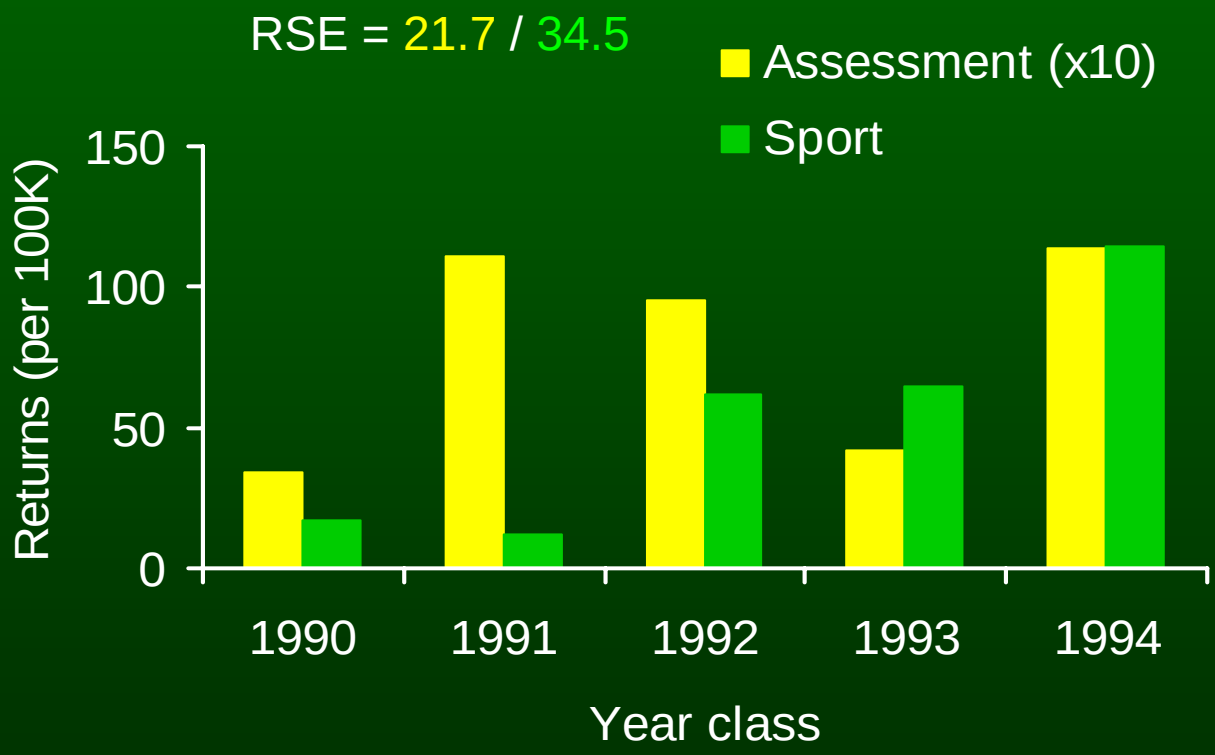
Summary of net pen and spatial comparisons

- Grand River; net pen versus direct downstream plant, NS (P=
- Charlevoix; net pen versus direct plant, NS (P=
- Spatial comparisons; NS for 3 net pen and 4 direct plant sites, using two data sets
- Pattern for net pen and spatial comparisons consistent across data sets, previous studies (?), expectations (?)
- “What do we do with all these non-significant results”

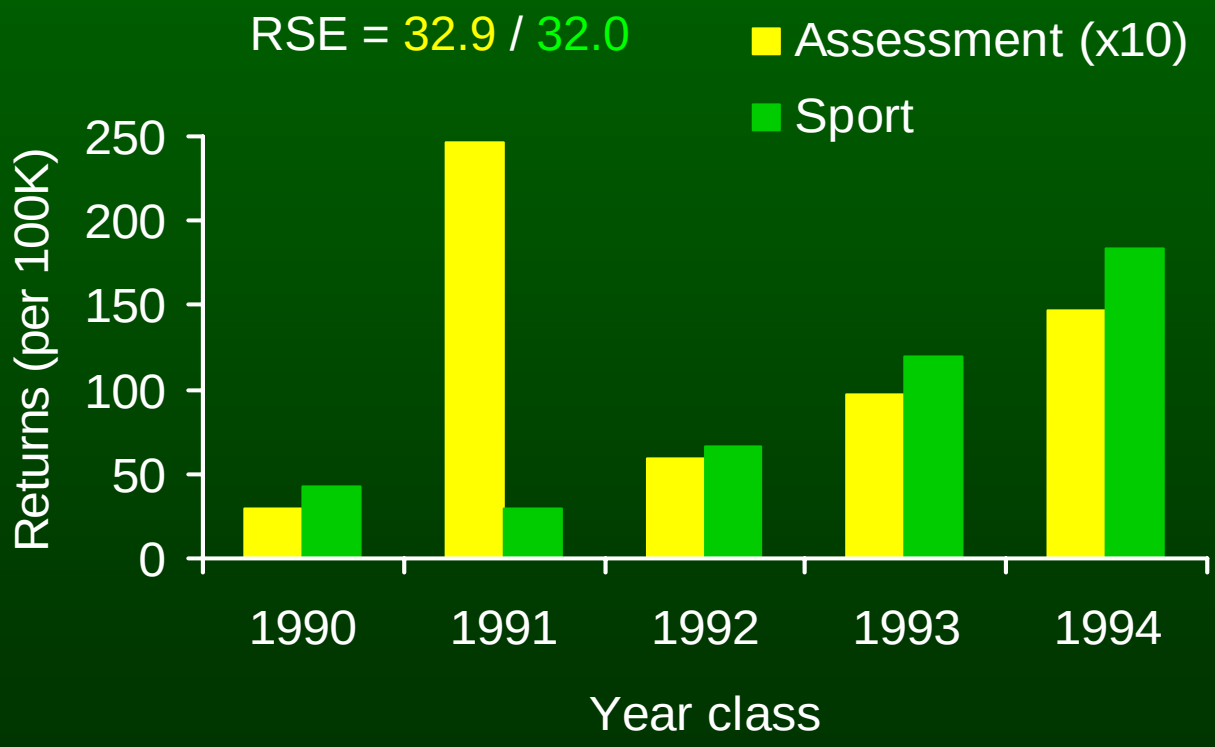
Grand Rapids - Direct Plants 1991-94 (upstream)



Grand Haven - Direct Plants 1990-94 (downstream)



Grand Haven - Net Pen 1990-94



Management applications

- Variability due (primarily) to “lake” effects; alewife, etc.
- Unlikely / Unable to conduct another study to address deficiencies
- Current management goal; balance predator demand with prey production, maintain world-class salmonid fishery
- Use CWT results to increase efficiency, although…

Net pen data - application

- Grand River (net pen : direct : upstream)
  - Sport returns = 2.2:1.3:1.0
    = 1.6:1.0
  - Assessment returns = 2.5:1.7:1.0
    = 1.5:1.0

Net pen data – application (cont.)

Data source	Year	Direct returns	Pen returns	Pen:Direct
Sport	1991	46.9	19.5	0.4
	1992	57.9	63.8	1.1
	1993	56.6	85.3	1.5
	1994	89.4	163.8	1.8
			Avg.	1.2

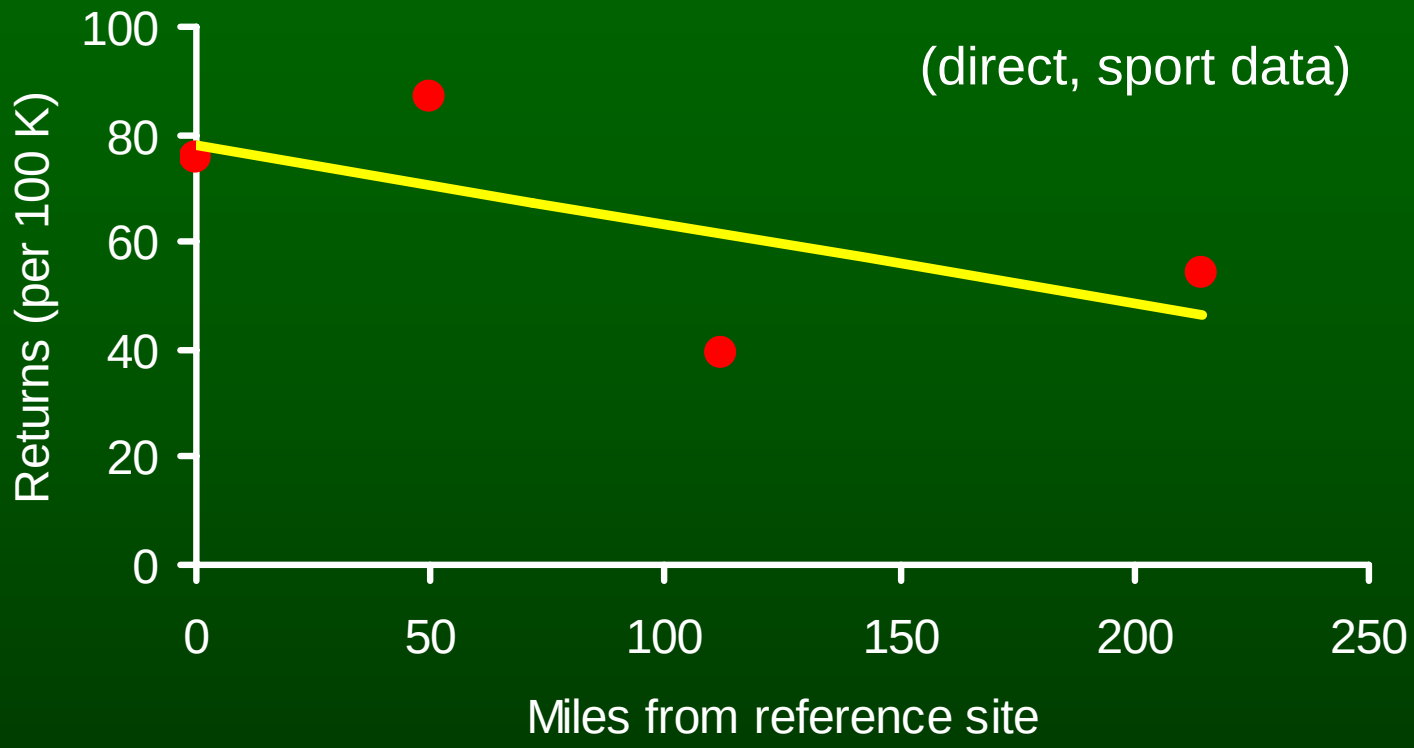
Data source	Year	Direct returns	Pen returns	Pen:Direct
Assessment	1991	8.8	22.4	2.5
	1992	15.0	16.4	1.1
	1993	5.8	10.3	1.8
	1994	8.3	11.6	1.4
			Avg.	1.7

Spatial data - application

- North:South ratio
  - Lake Huron; 3.4:1 (237 miles)
  - Net pen (sport); 1.7:1 (269 miles)
  - Net pen (assessment); 2.0:1
  - Direct (sport); 1.4:1 (215 miles)
  - Direct (assessment); 1.4:1

Average; 1.98:1.00

Spatial data – application (cont.)



(ex.) St. Joseph returns = 77.713 – (269 miles)*0.1458
= 38.5 returns/100K
= 1:2.02 ratio

Conclusions

- Using available data to make best management decision
- Adjusting existing sites for net pen use and location relative to “best” sites
- 70% chance that the patterns observed are “real” and of the magnitude…
- To do…fall port fisheries, mechanisms, Lake Huron,
- Develop model of potential effects of these decisions…

Thank you

Charlevoix Fisheries
Research Station

SPORT FISH RESTORATION

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