Valuing Freshwater Flow
in The Apalachicola River Basin

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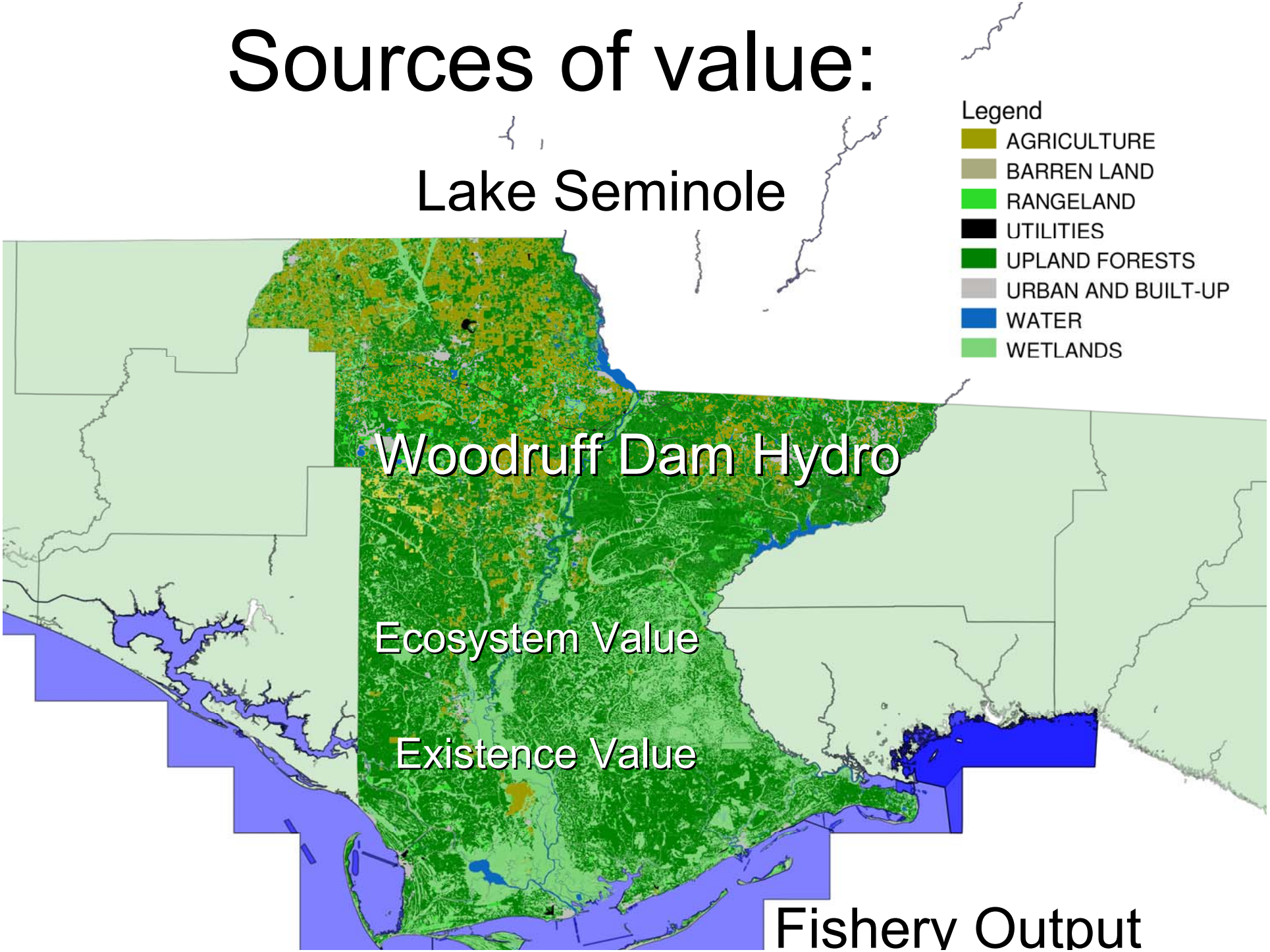
Sources of Value?

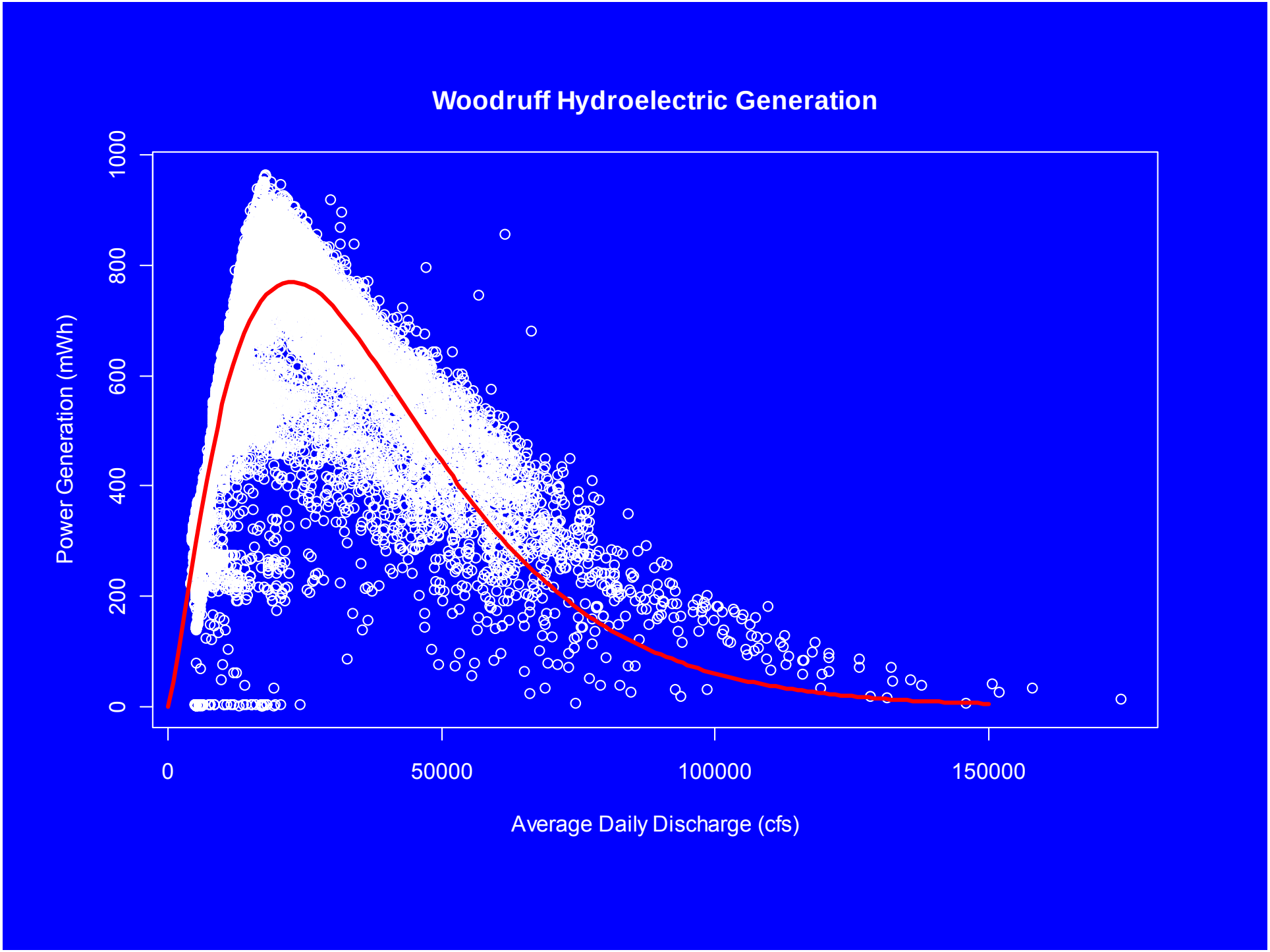
- Multiple sources
  - Market-based/direct
  - Non-market based/indirect
- Generation of value can depend on flow
- What flow regime maximizes value?
- Implications for entire ACF basin

Sources of value:



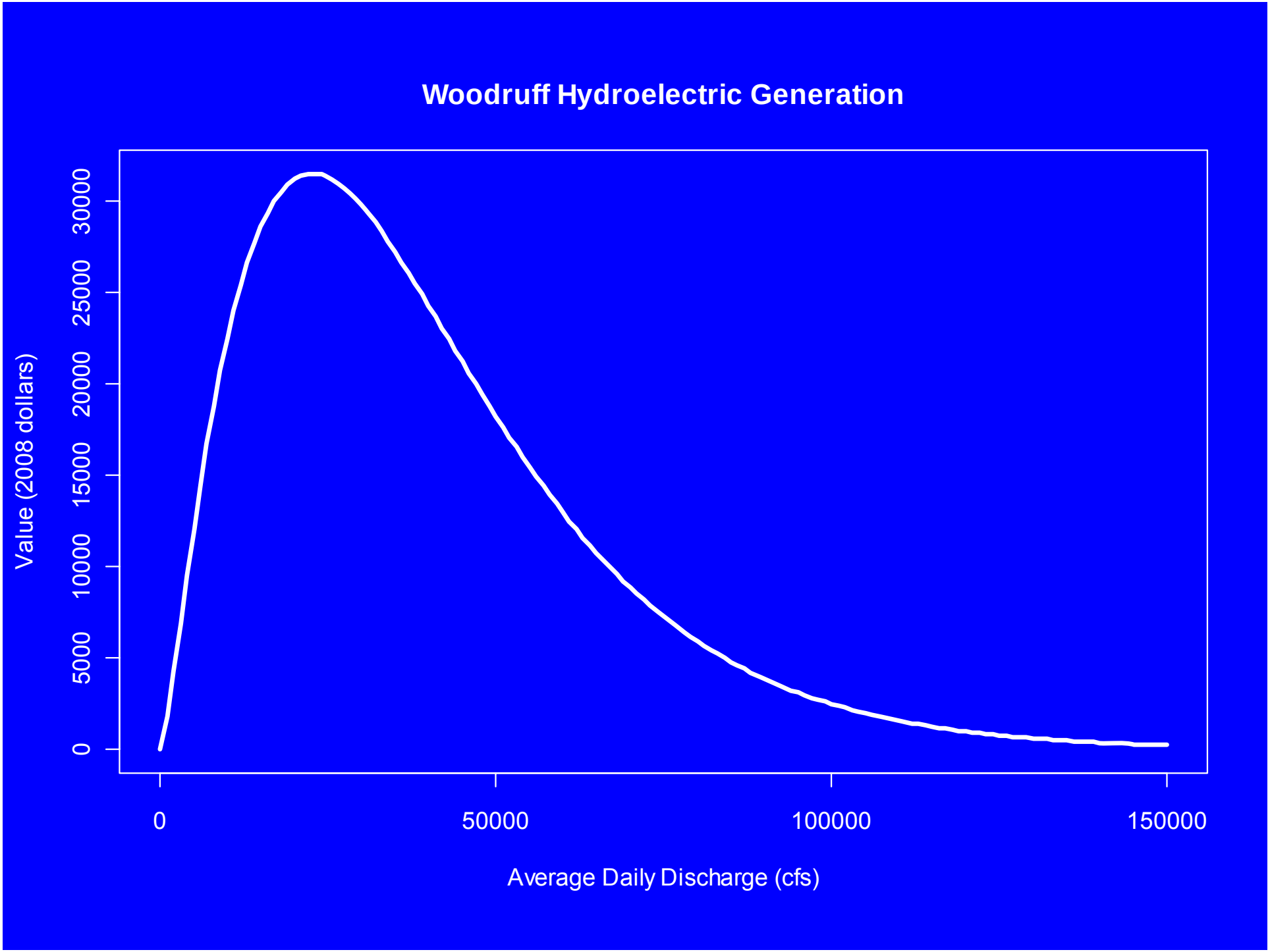
Two sources of Value (for now)

- “Low-hanging data”
  - Hydroelectric power
  - Oyster harvest
- What value does flow generate?


Woodruff Hydroelectric Generation
Power Generation (mWh)
0
200
400
600
800
1000
0
50000
100000
150000
Average Daily Discharge (cfs)

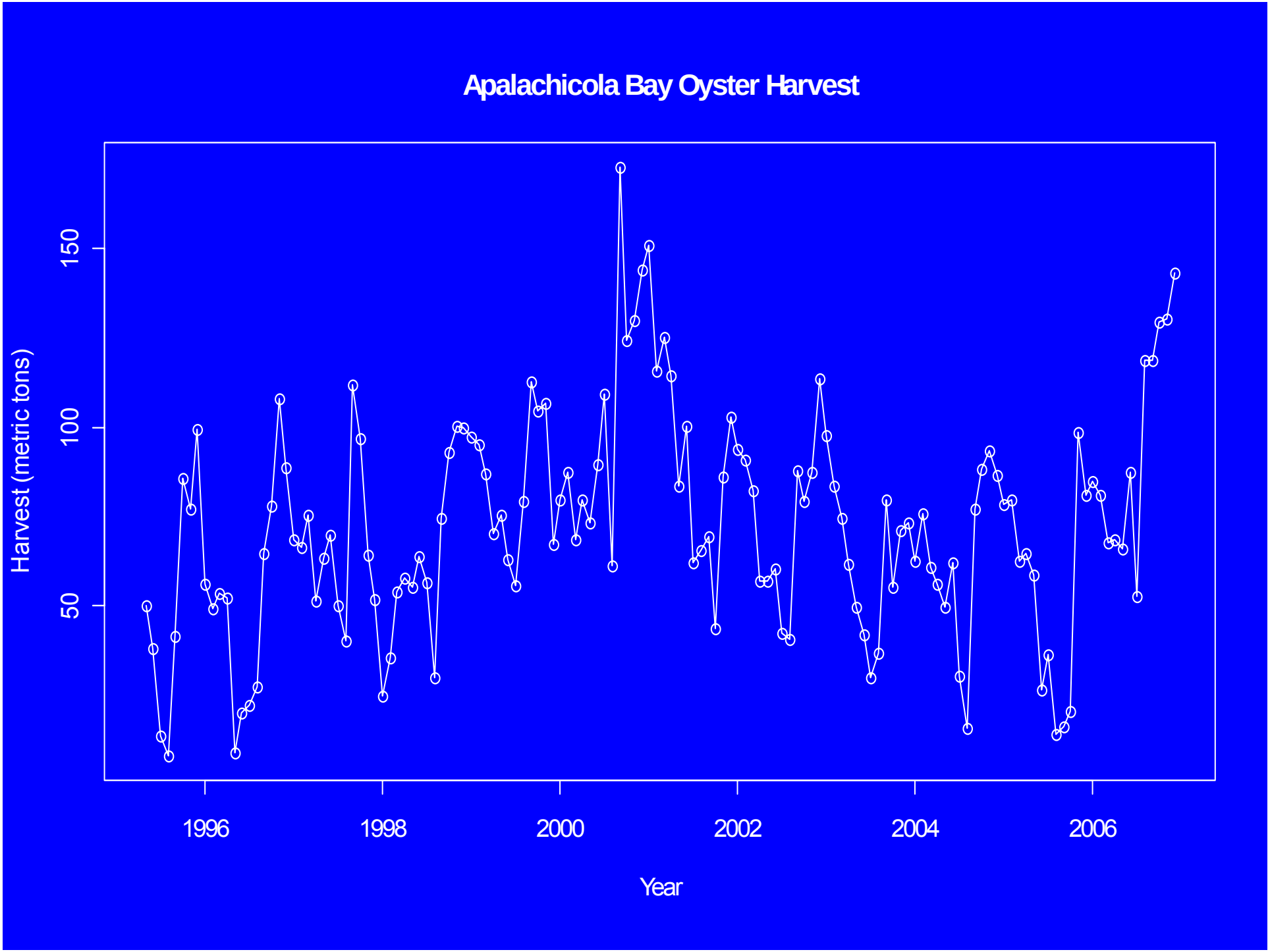
Hydroelectric Value

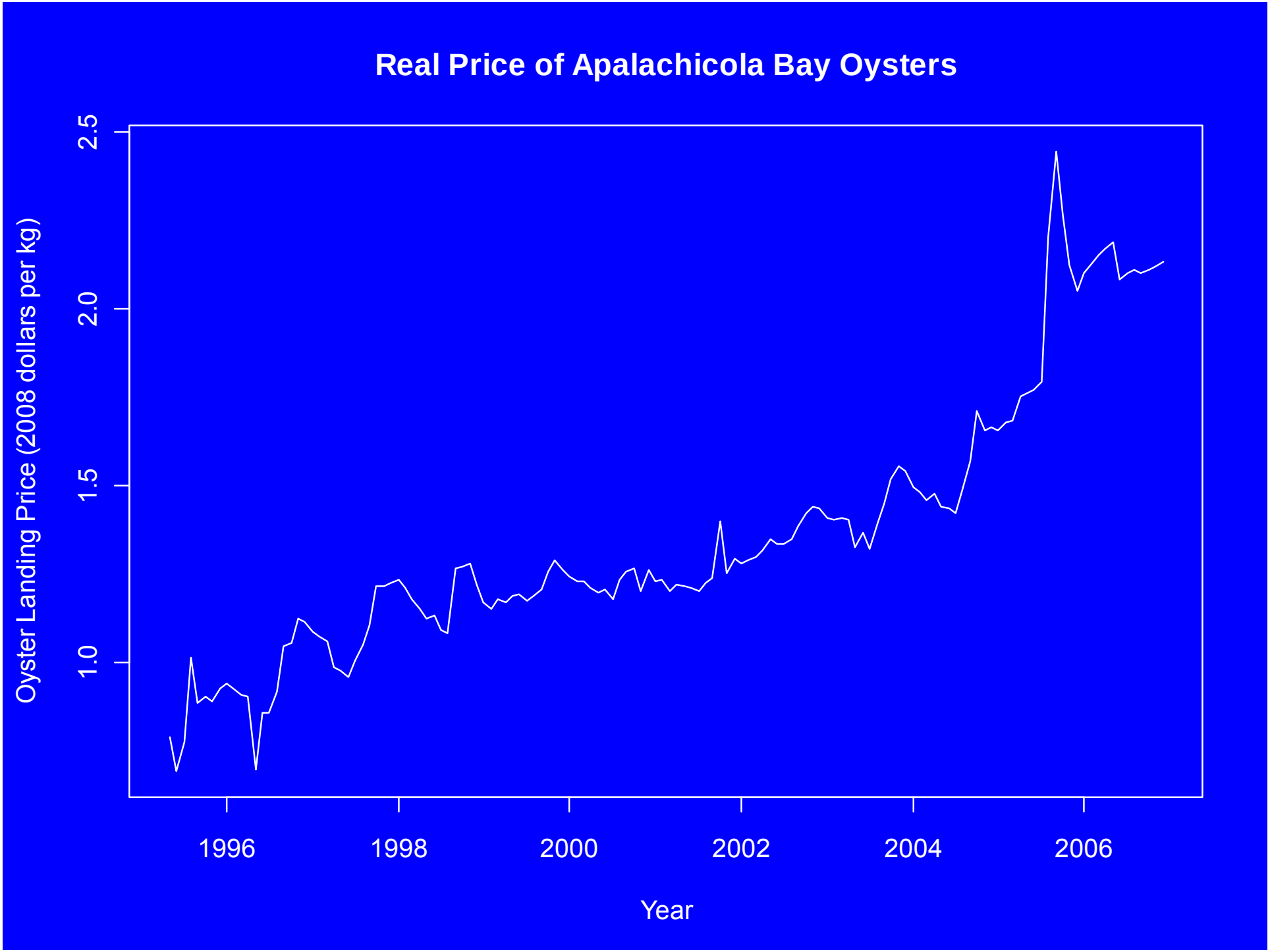
Year	Annual Generation (mWh)	Power Revenue (2008 dollars)	Implied electricity price (2008 dollars per mWh)
2003	235,316	$5,355,522	$19.45
2004	242,613	$5,593,169	$20.23
2005	240,879	$7,515,944	$28.31
2006	195,458	$7,799,930	$37.37
2007	171,470	$7,227,221	$40.60
2008	190,911	$7,806,000	$40.89

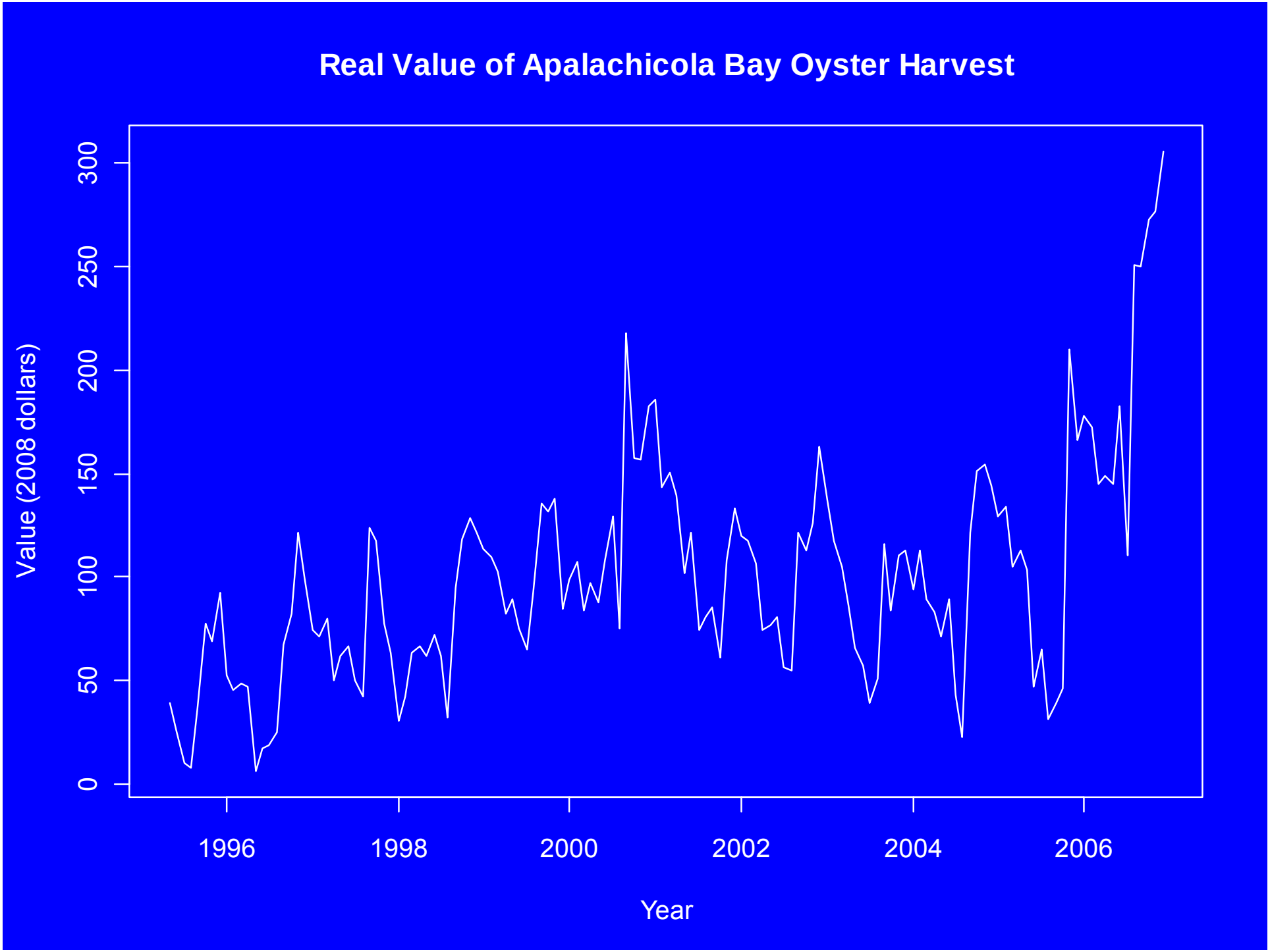

Woodruff Hydroelectric Generation
Value (2008 dollars)
0
5000
10000
15000
20000
25000
30000
0
50000
100000
150000
Average Daily Discharge (cfs)

Oyster Value

- Why oysters?
  - Highest-valued fishery output
  - Abundant existing data
  - Current food safety policy implications

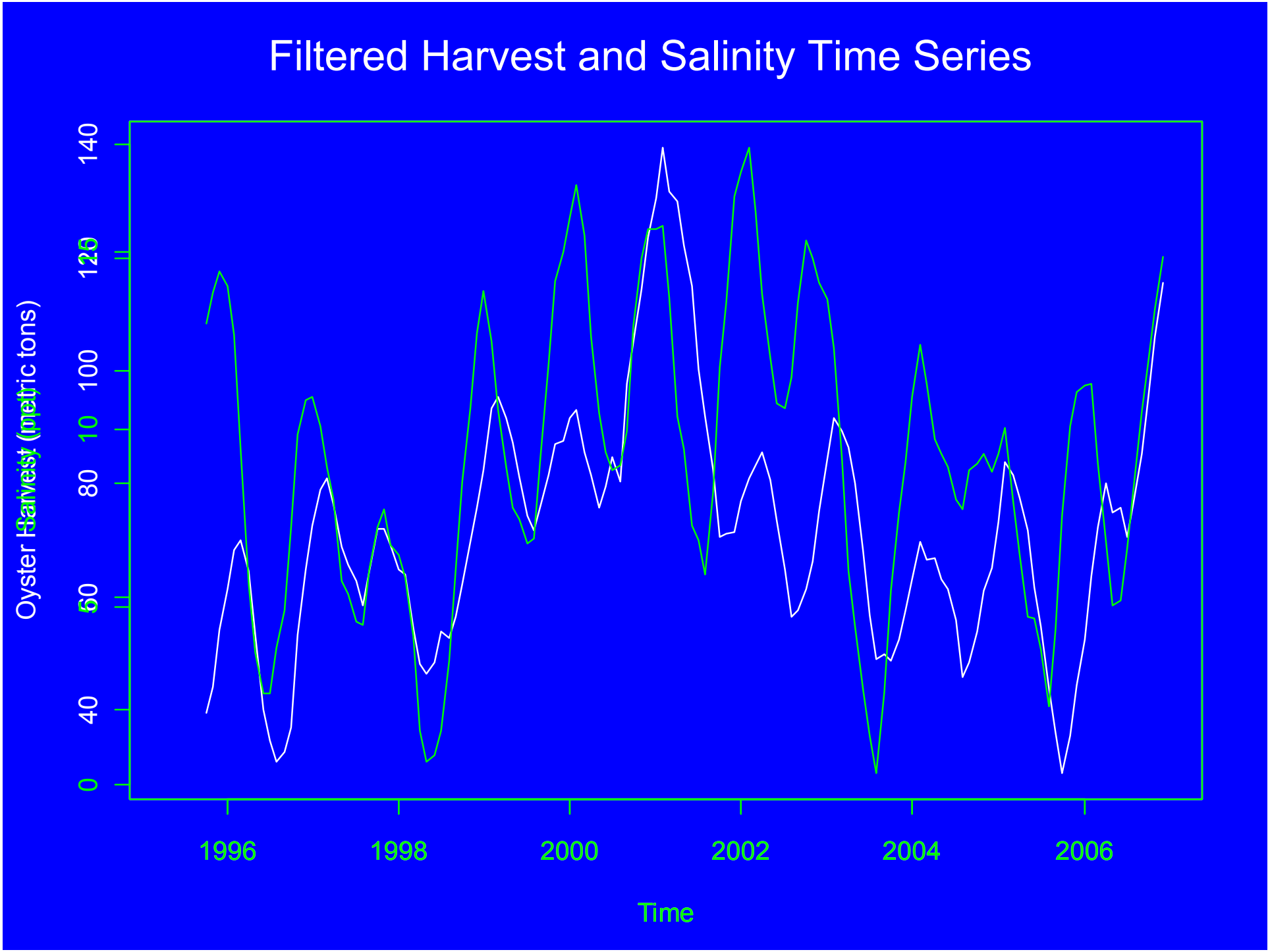

Apalachicola Bay Oyster Harvest
Harvest (metric tons)
50
100
150
1996
1998
2000
2002
2004
2006
Year


Real Price of Apalachicola Bay Oysters
Oyster Landing Price (2008 dollars per kg)
1.0
1.5
2.0
2.5
1996
1998
2000
2002
2004
2006
Year


Real Value of Apalachicola Bay Oyster Harvest
Value (2008 dollars)
0
50
100
150
200
250
300
1996
1998
2000
2002
2004
2006
Year

Harvest Value and Flow

- High flow drives low salinity
- High salinity and harvest quantity/quality
  - Peak growth at ~25ppt? (Wang, et al. 2008)
  - *V. vulnificus* inhibited at ~28ppt (Motes, et al. 1998)

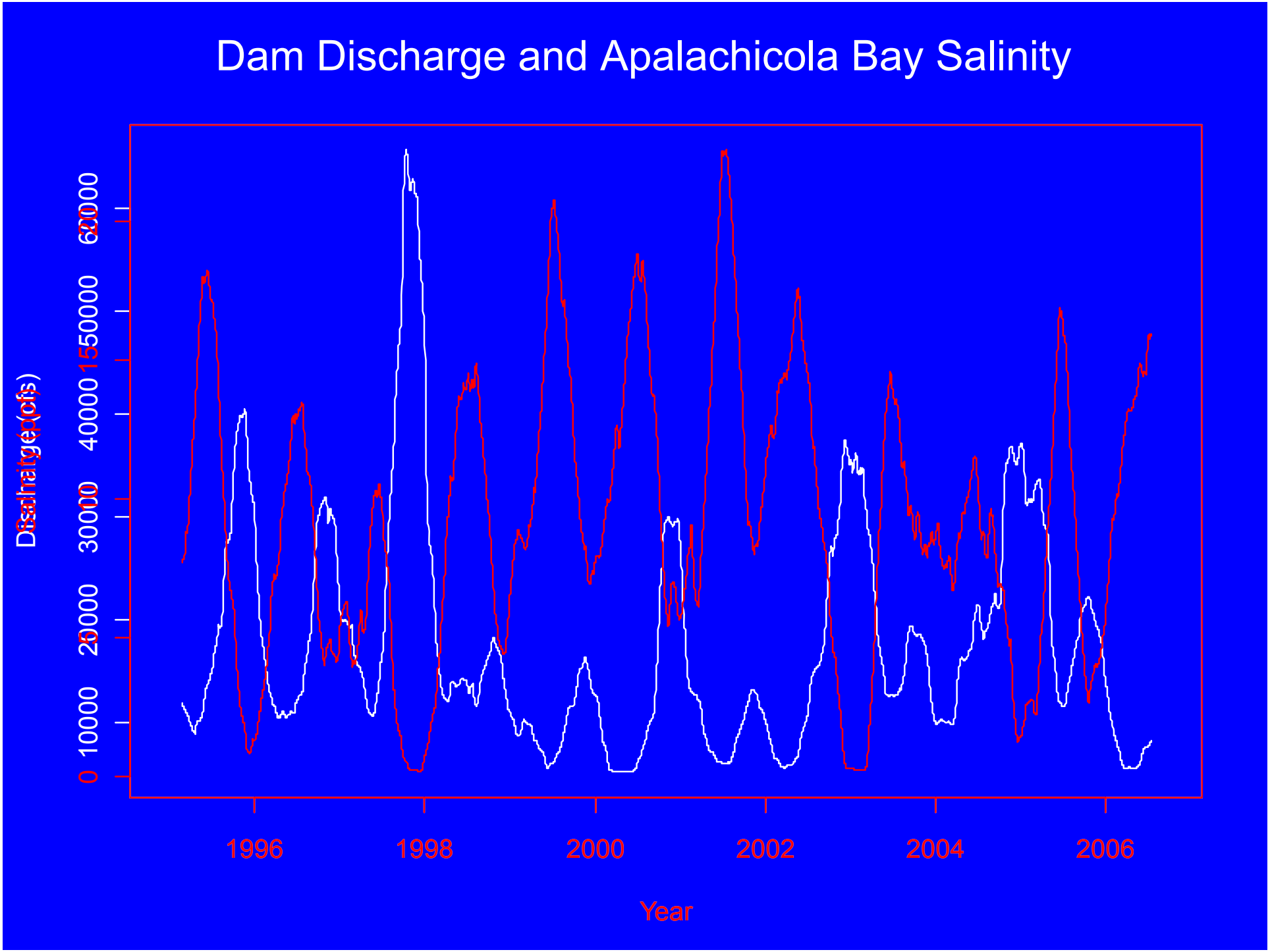

Filtered Harvest and Salinity Time Series
Oyster Harvest (metric tons)
Salinity (ppt)
0
40
60
80
10
100
120
140
1996
1998
2000
2002
2004
2006
Time

Salinity-Harvest Relation

- No evidence of quadratic response
- Simple linear relation:

Coefficient	*Estimate*	*t-value*	*Pr*[> |*t*|]
Intercept	20.2695	7.412	<.001
Salinity	5.7792	20.226	<.001

R^2 = .799

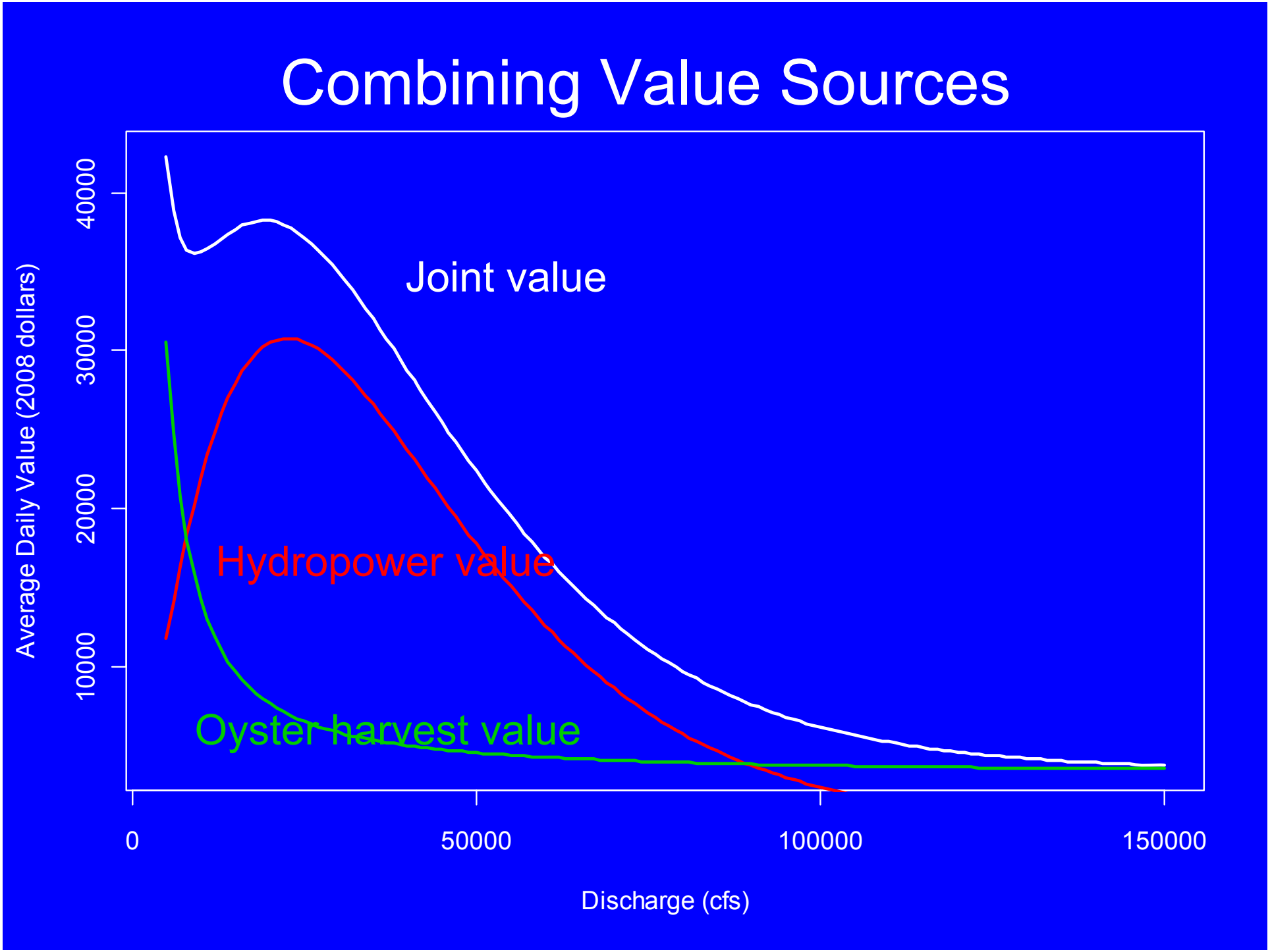

Dam Discharge and Apalachicola Bay Salinity
Discharge (cfs)
Salinity (ppt)
0
10000
20000
30000
40000
50000
60000
0
5
10
15
20
1996
1998
2000
2002
2004
2006
Year

Tie Salinity to Dam Discharge

- Crude model:
  - Discharge and salinity data from ACE/NMFS
  - Simple MA filter and lagged discharge
  - Log-linear: salinity = $\alpha(\text{discharge})^{\beta} + \varepsilon$

Coefficient	*Estimate*	*t-value*	*Pr*[> |*t* |]
ln(α)	14.49549	100.12	<.001
β	–1.305102	–86.82	<.001

$R^2 = .646$


Combining Value Sources
Joint value
Hydropower value
Oyster harvest value
Average Daily Value (2008 dollars)
10000
20000
30000
40000
0
50000
100000
150000
Discharge (cfs)

Optimal Flow Management

- Depends on price paths of
  - Oyster harvest
  - Electricity
- Marked increases in salinity
  - Price premium under proposed FDA rules?
  - Even if feasible, hydropower must be reduced
- Several other important tradeoffs missing

Future Goals

- Improve econometric/biophysical modeling
- Incorporate other sources of value
- Sensitivity to data source (oysters, salinity)
- Micro-scale time model:
  - Pathogen risk in summer
  - Value of salinity higher