Abundance of Pacific lamprey in the Columbia River and common hosts in the marine environment

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Wenatchee, Washington

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P.U.D.
CHELAN COUNTY

Overview

- Pacific lamprey life history
- Trends in the Columbia River
- Relationships with marine fishes
- Discussion on ecology

Lamprey life cycle

Reproductive Migration

Spawning

Larval Stage

Transformation

Seaward Migration

Parasitic Stage

Adults

Juveniles

Feeding of adult lampreys

- River lampreys
- Sea lampreys
- Pacific lampreys

69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92

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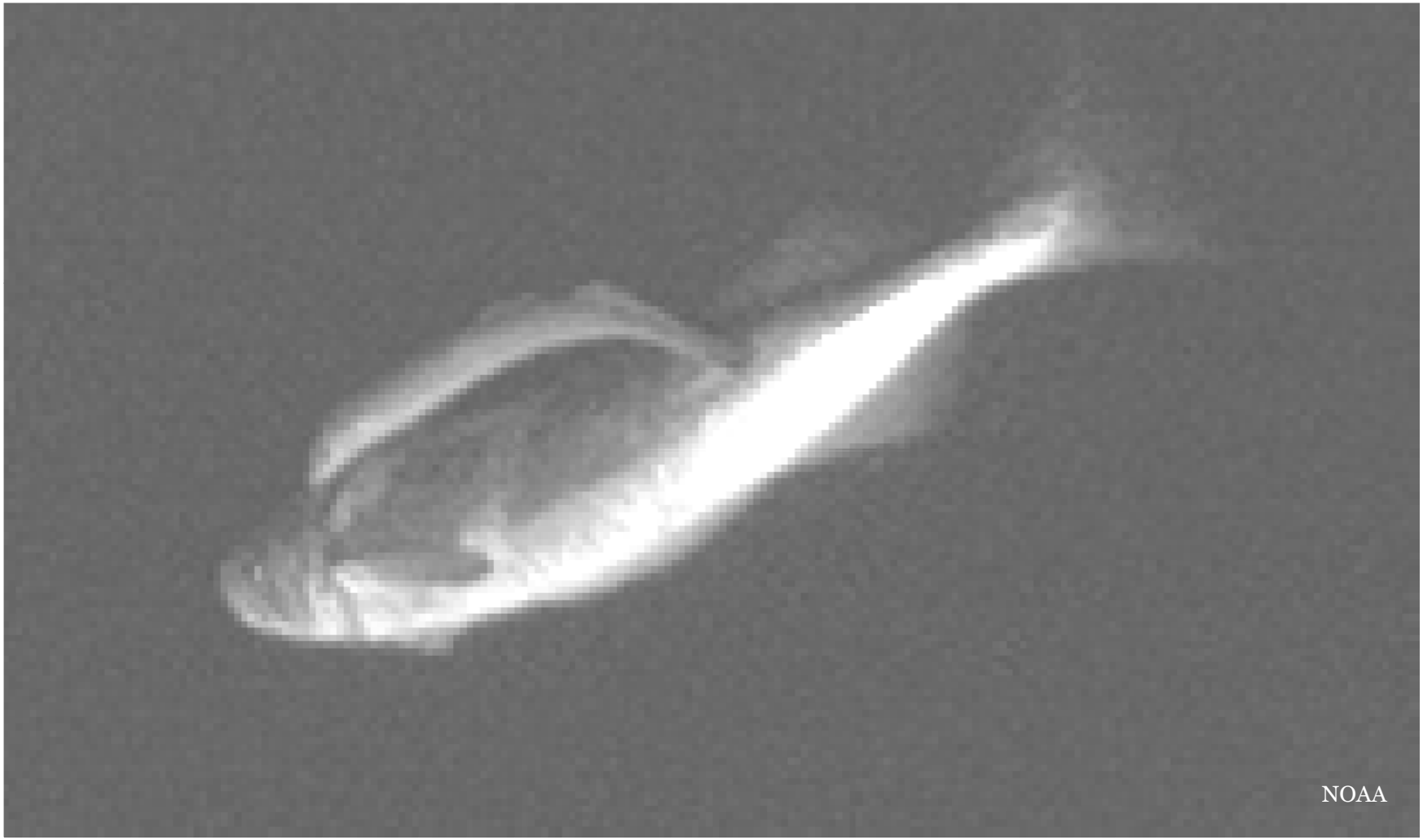
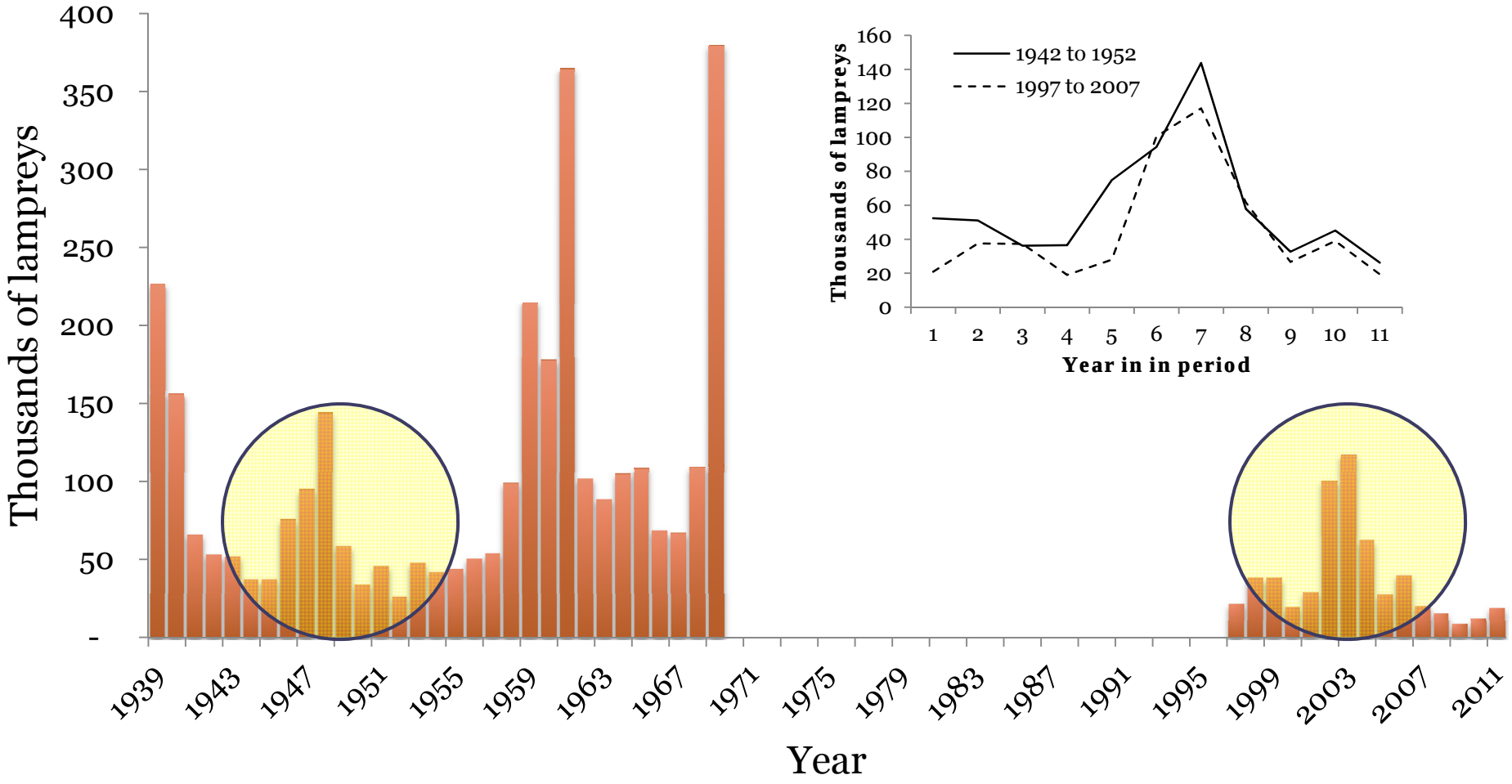

NOAA

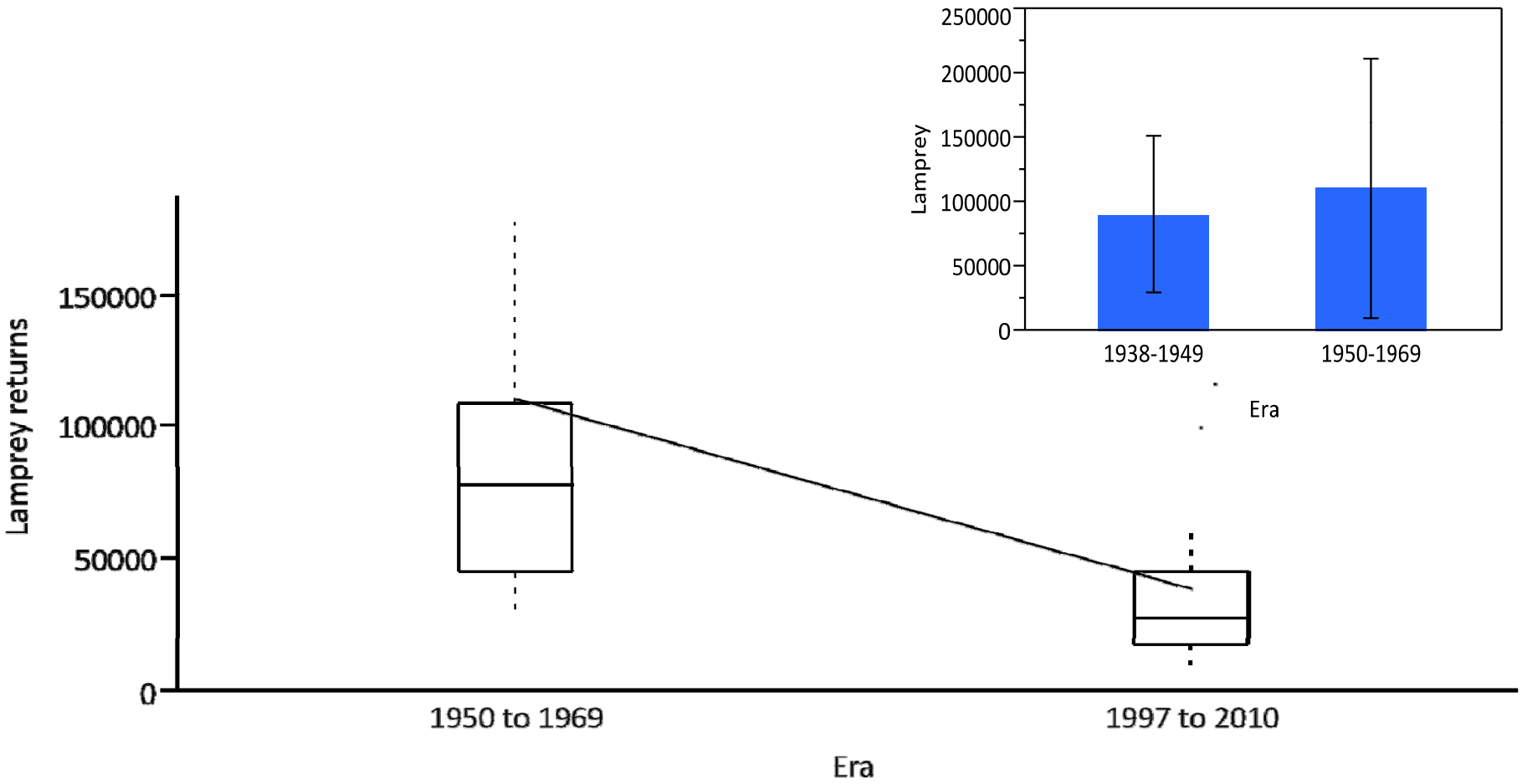
Columbia River Basin

- Largest in Pacific NW
- Hydroelectric projects
- Upstream access to Chief Joseph Dam (rkm 877)
- Significant runs of anadromous fishes

Trends in the Columbia River

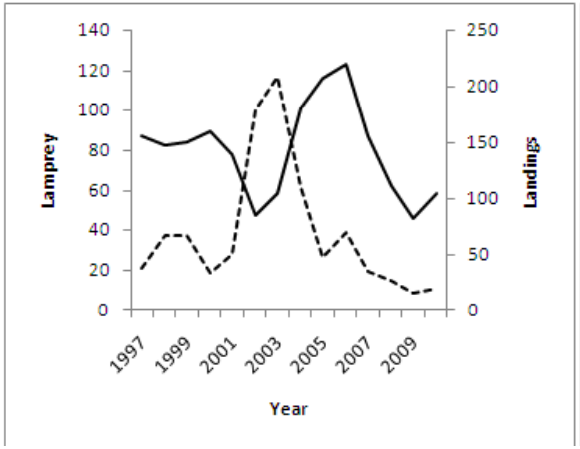


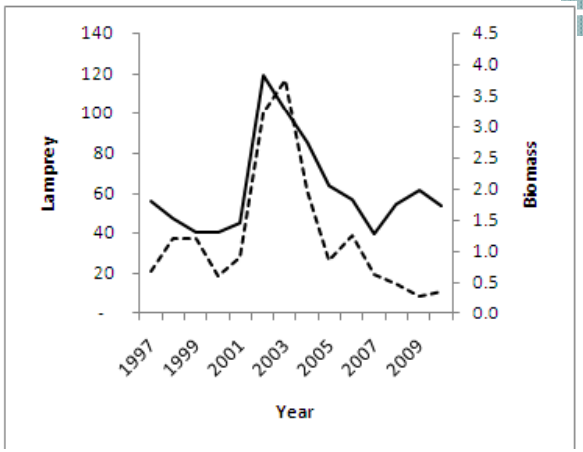
Trends in the Columbia River

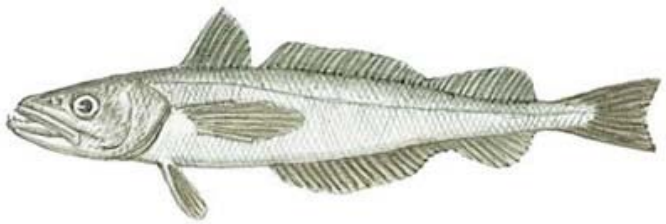


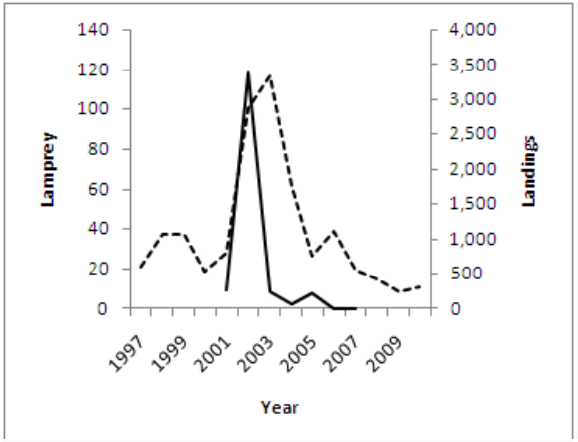
Our study – examine feeding stage

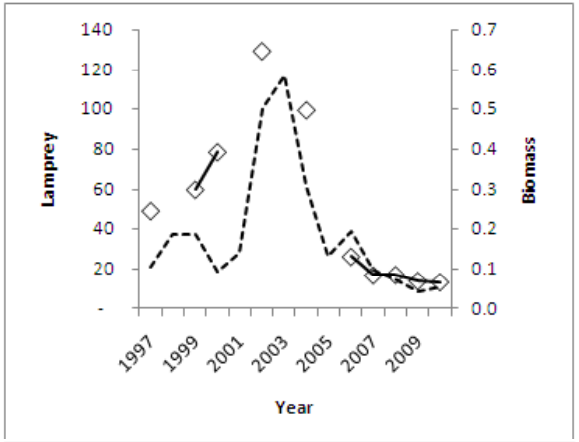
- Five host species
- Stock assessment data and commercial landings
- Lamprey returns to the Columbia River
- Correlation and regression analyses
- Population cycles

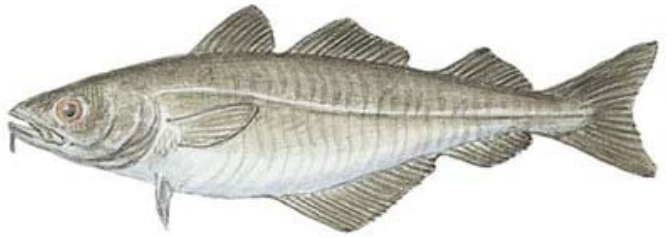

Lamprey
Landings
Year
1997
1999
2001
2003
2005
2007
2009

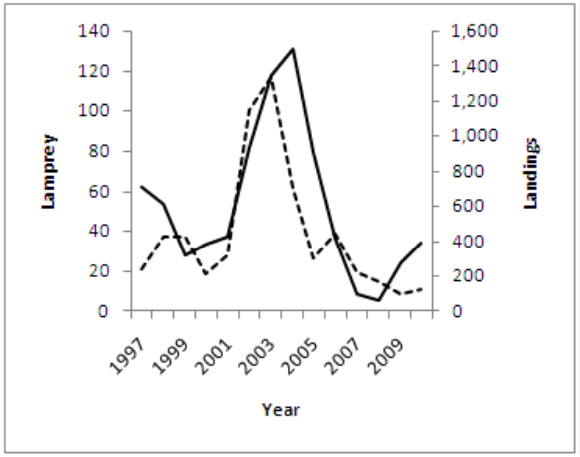

Lamprey
Biomass
Year
1997
1999
2001
2003
2005
2007
2009

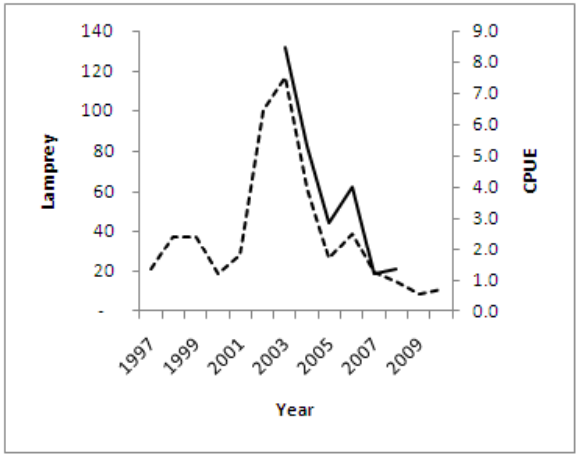


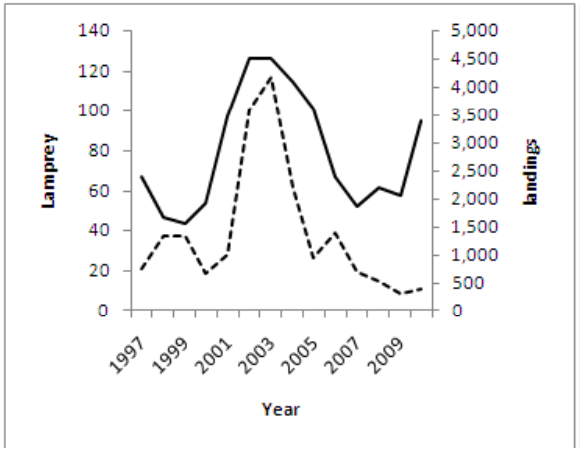

Lamprey
Landings
Year
1997
1999
2001
2003
2005
2007
2009

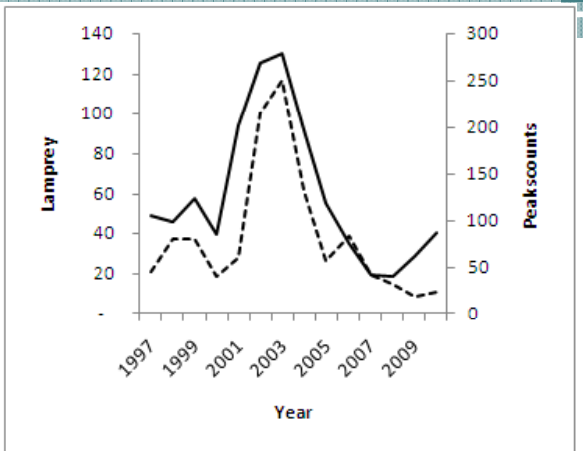

Lamprey
Biomass
Year
1997
1999
2001
2003
2005
2007
2009

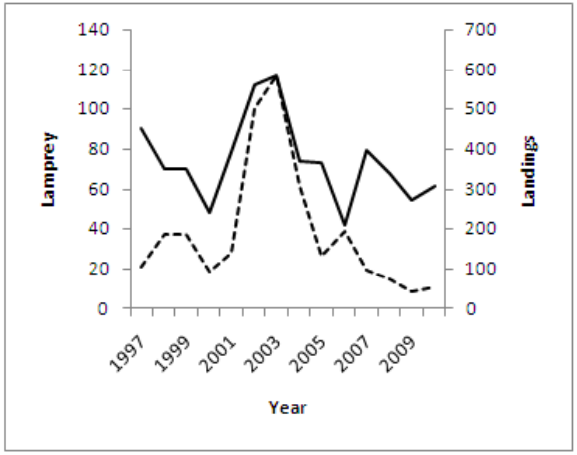


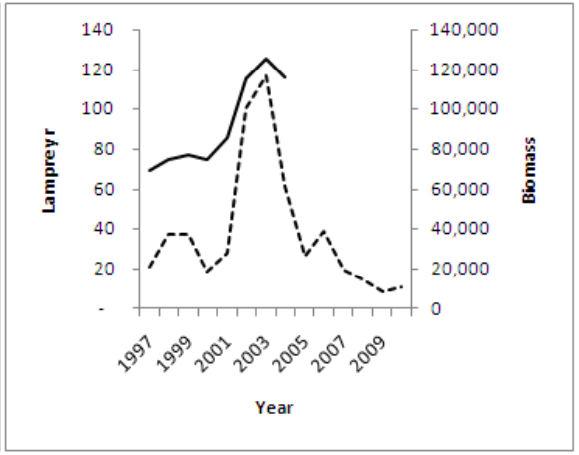

Lamprey
Landings
Year
1997
1999
2001
2003
2005
2007
2009

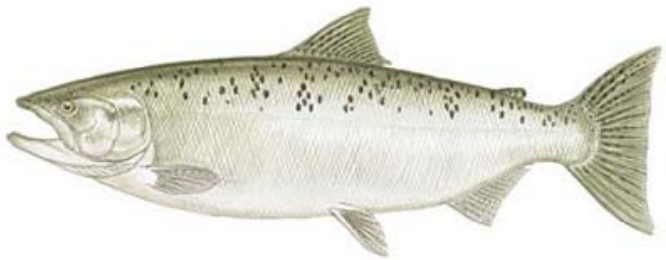

Lamprey
CPUE
Year
1997
1999
2001
2003
2005
2007
2009

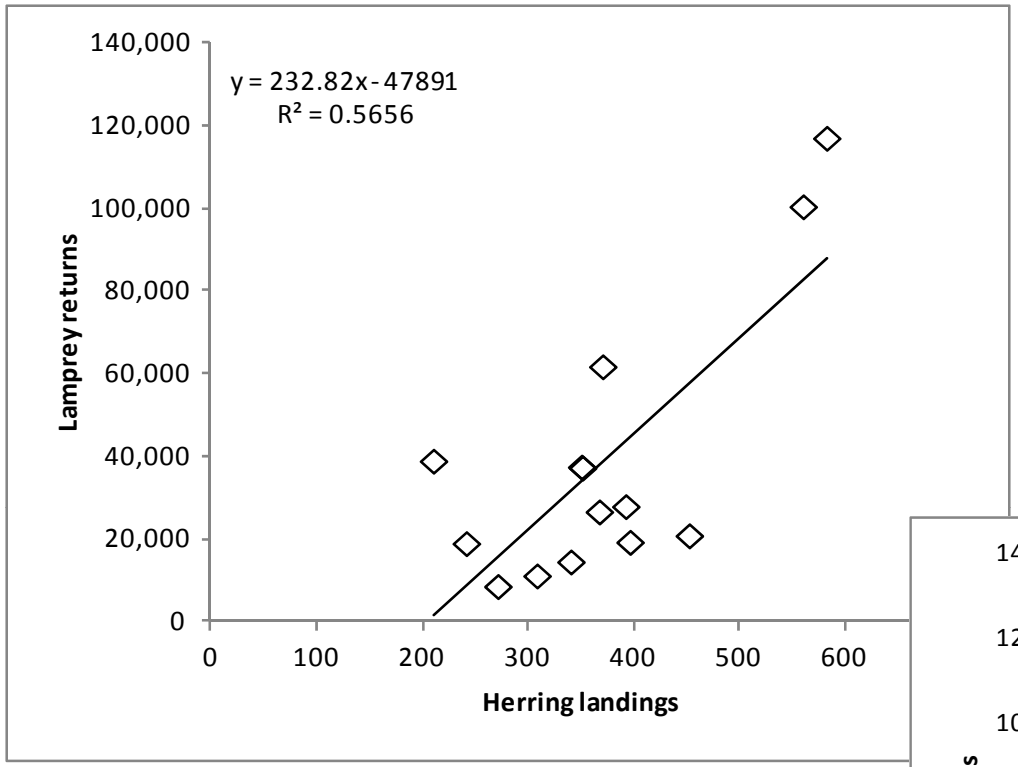

Lamprey
landings
Year
1997
1999
2001
2003
2005
2007
2009

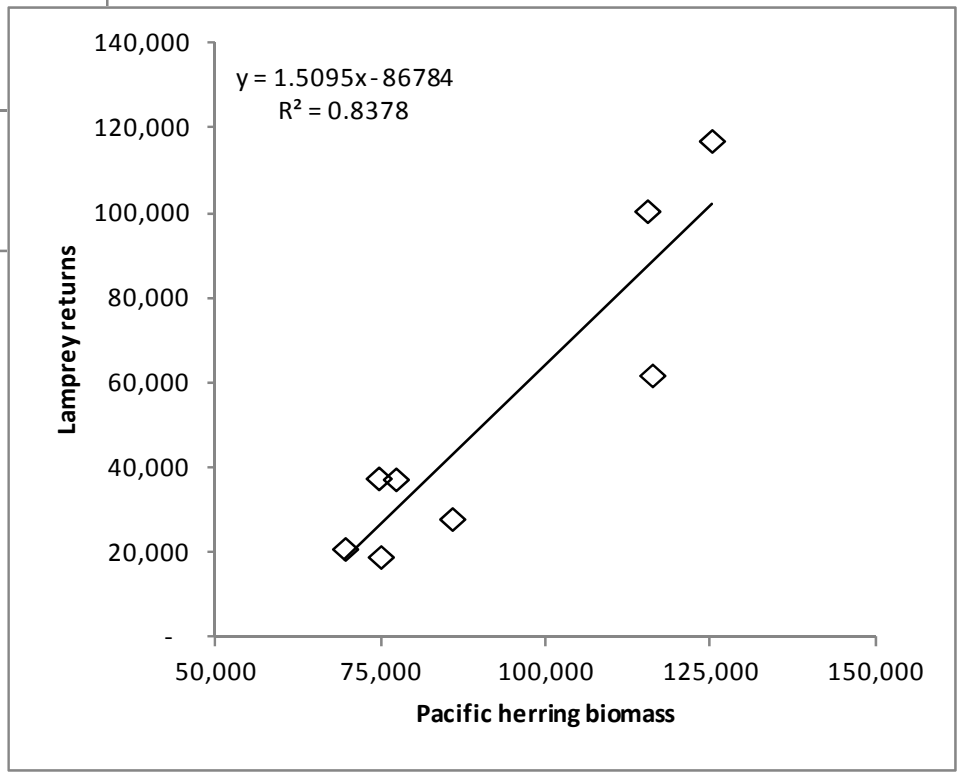

Lamprey
Peakscounts
Year
1997
1999
2001
2003
2005
2007
2009

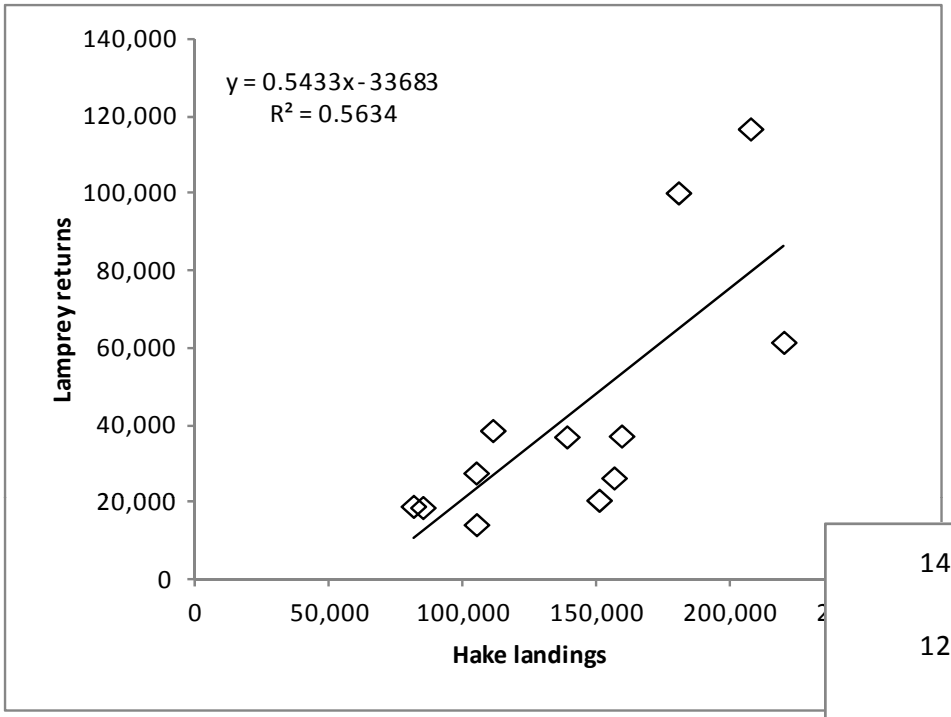

Lamprey
Landings
Year
1997
1999
2001
2003
2005
2007
2009

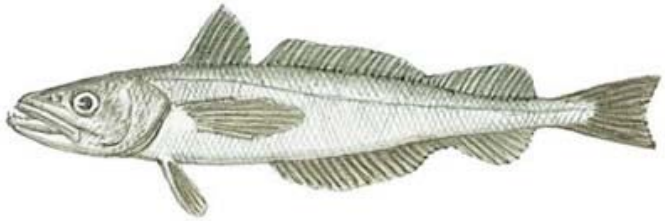

Lampreyr
Biomass
Year
1997
1999
2001
2003
2005
2007
2009

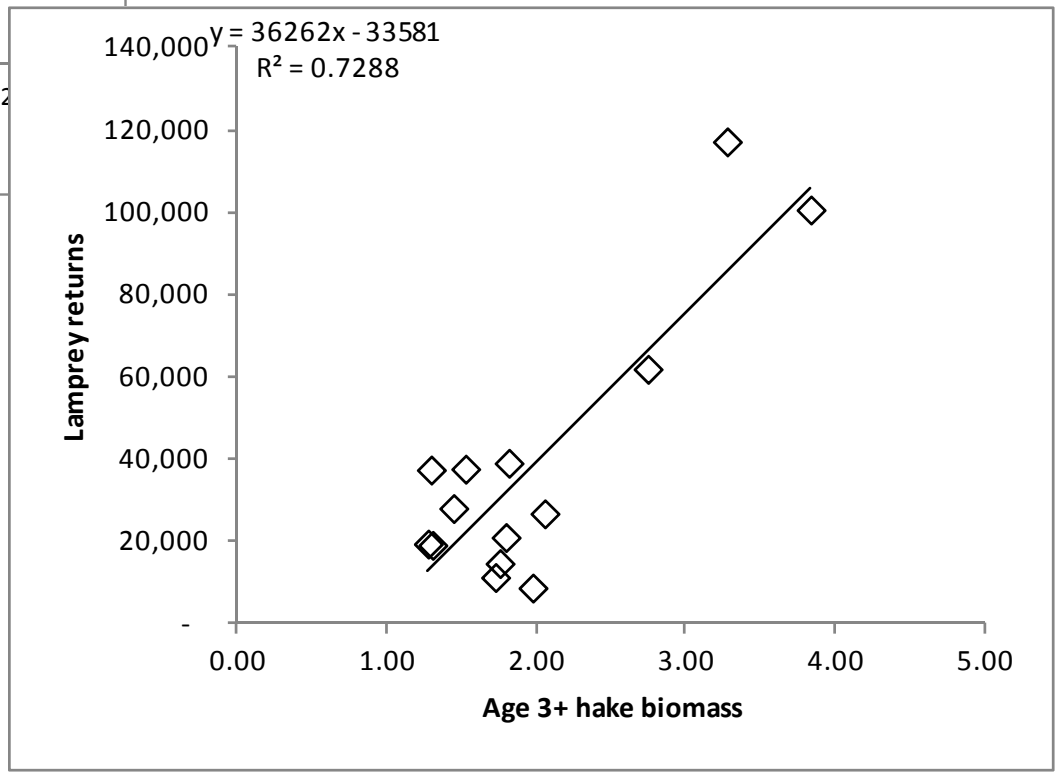


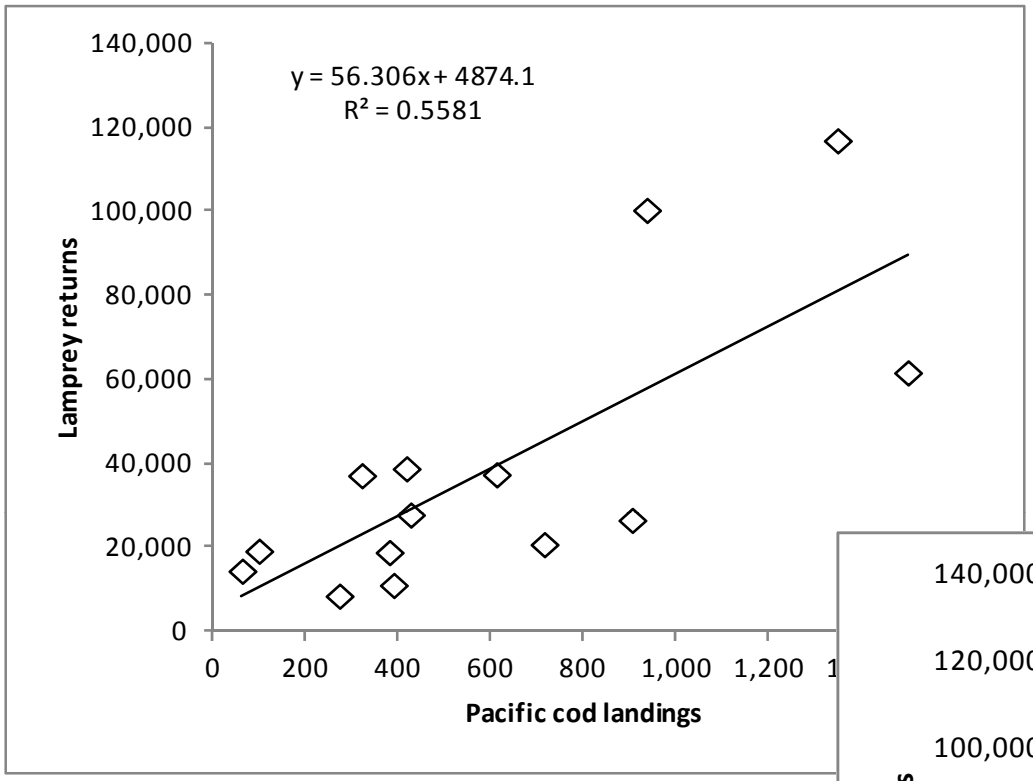

y = 232.82x - 47891
R² = 0.5656
Lamprey returns
Herring landings
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0
100
200
300
400
500
600

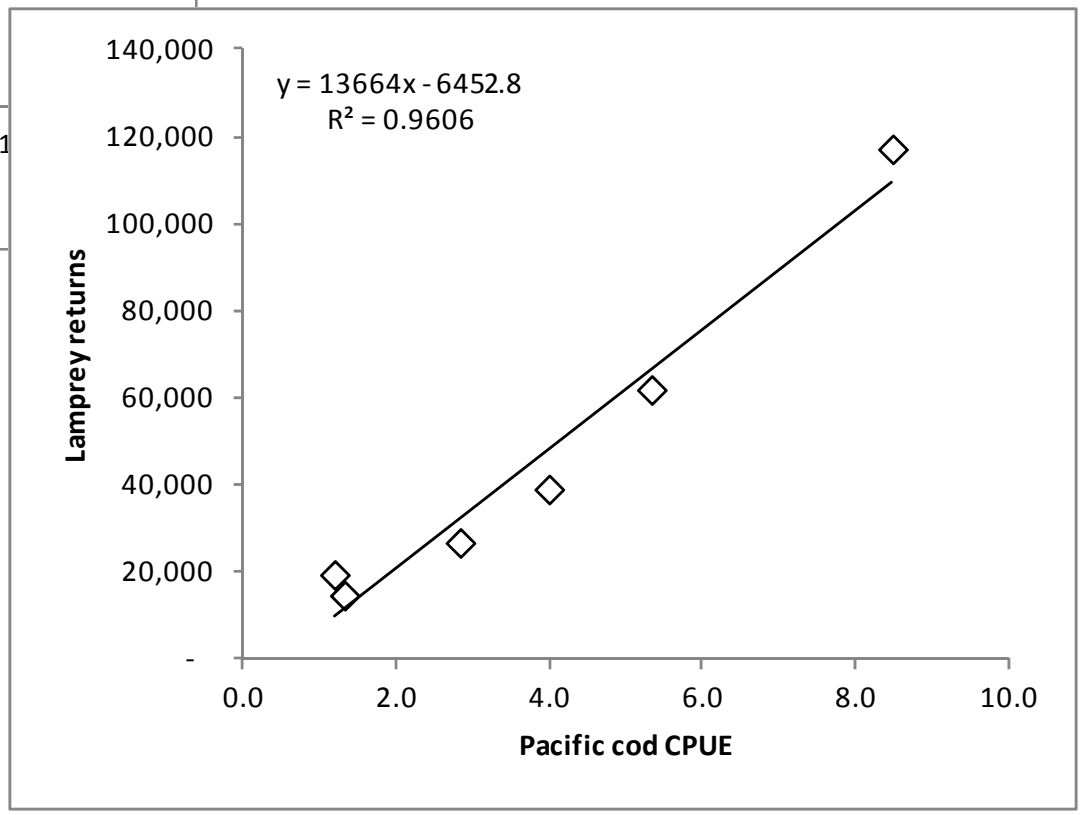

y = 1.5095x - 86784
R² = 0.8378
Lamprey returns
Pacific herring biomass
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
50,000
75,000
100,000
125,000
150,000

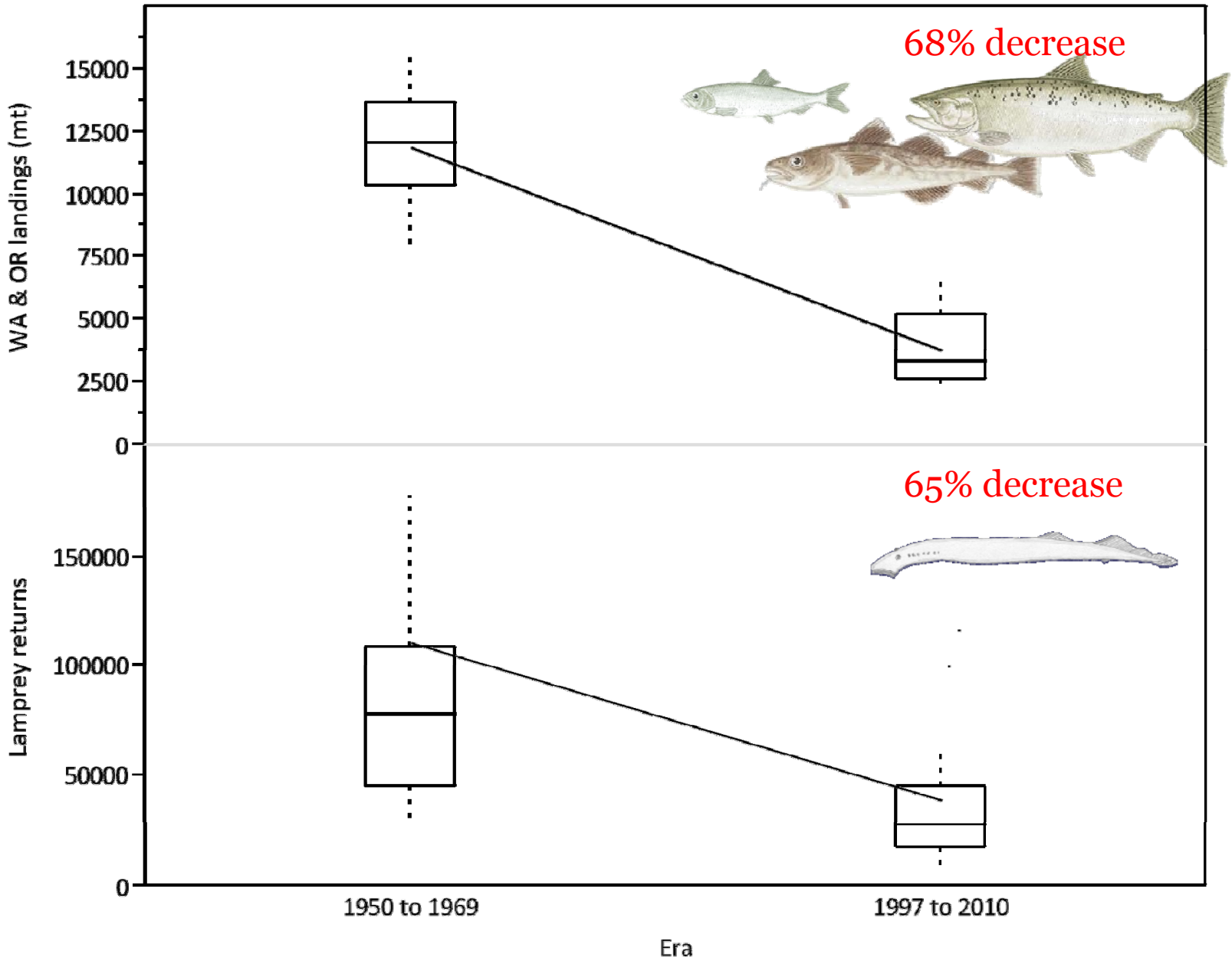

y = 0.5433x - 33683
R² = 0.5634
Lamprey returns
Hake landings
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0
50,000
100,000
150,000
200,000




y = 36262x - 33581
R² = 0.7288
Lamprey returns
Age 3+ hake biomass
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
0.00
1.00
2.00
3.00
4.00
5.00


y = 56.306x + 4874.1
R² = 0.5581
Lamprey returns
Pacific cod landings
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0
200
400
600
800
1,000
1,200

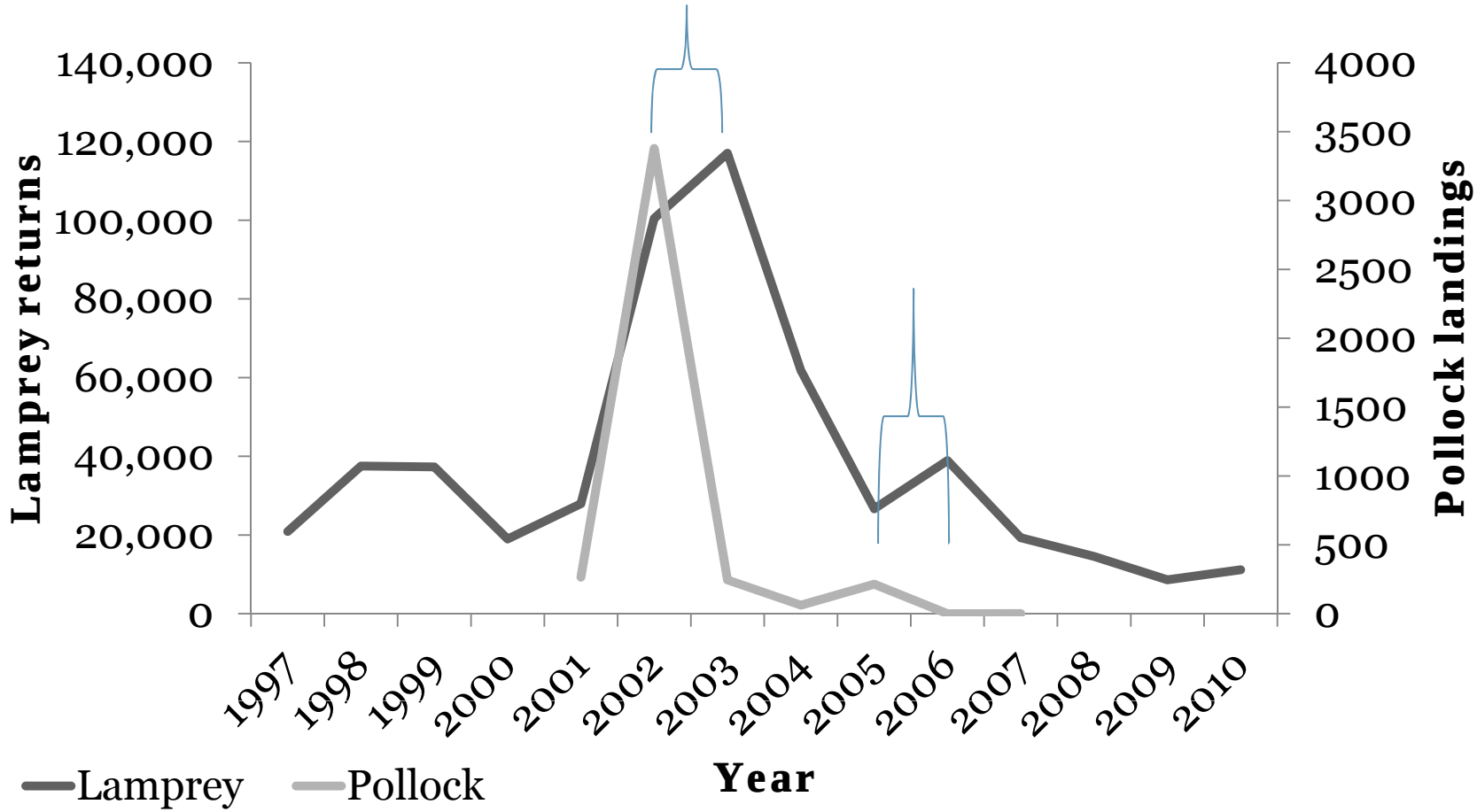

y = 13664x - 6452.8
R² = 0.9606
Lamprey returns
Pacific cod CPUE
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
0.0
2.0
4.0
6.0
8.0
10.0


68% decrease
65% decrease
WA & OR landings (mt)
15000
12500
10000
7500
5000
2500
0
Lamprey returns
150000
100000
50000
0
1950 to 1969
1997 to 2010
Era

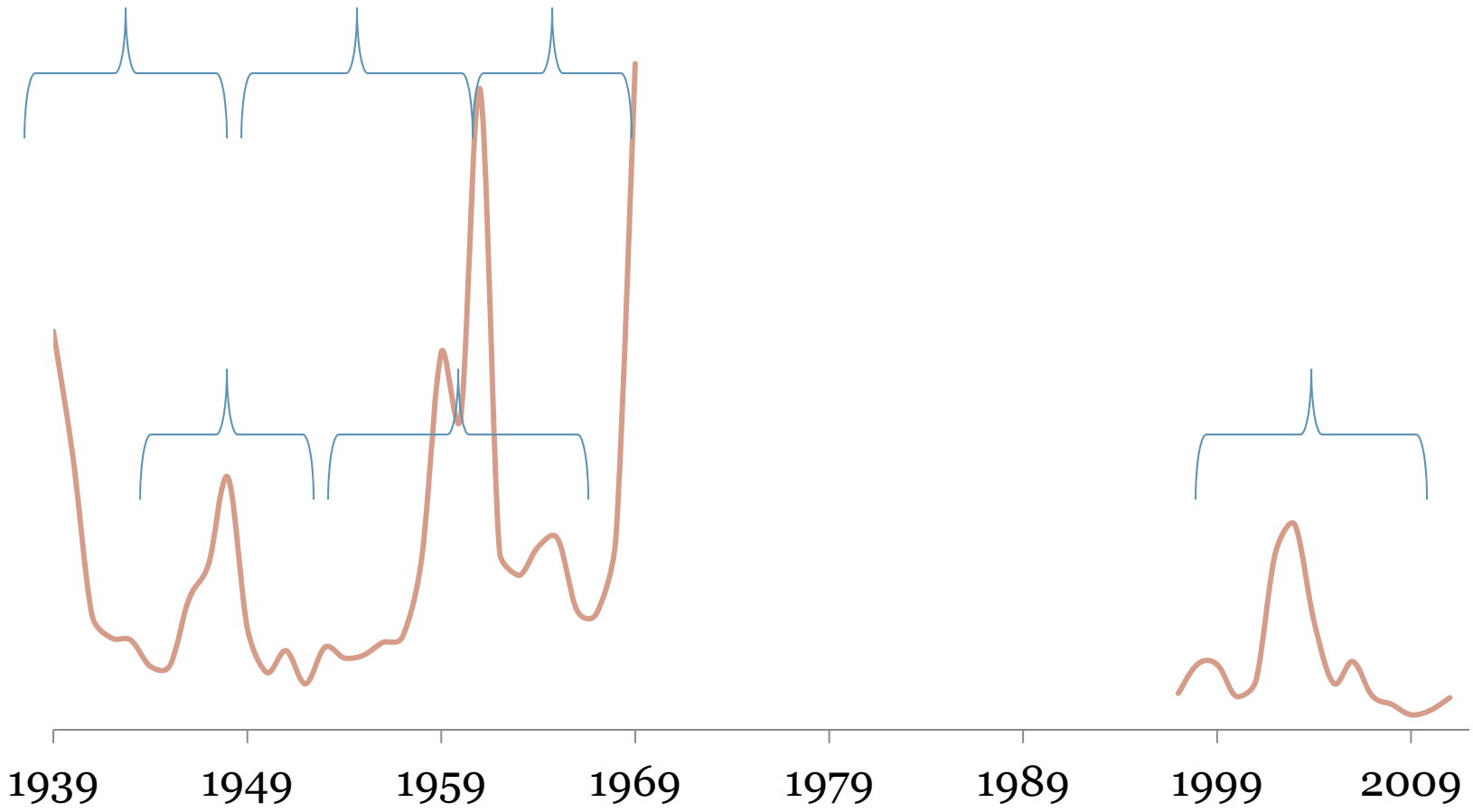
Species	Index	p-value	r
Pacific Hake	Biomass Age 3+ (mmt)	< 0.001	0.854
Walleye Pollock	Biomass (mmt)	0.002	0.857
Pacific Cod	CPUE (kg ha^{-1})	< 0.001	0.981
Chinook Salmon	Peak counts (adults mi^{-1})	< 0.001	0.882
Pacific Herring	Biomass (mt)	0.001	0.915
Pacific Hake*	Landings WA + OR (mt)	0.005	0.751
Walleye Pollock**	Landings WA + OR (mt)	0.059	0.737
Pacific Cod	Landings WA + OR (mt)	0.002	0.747
Chinook Salmon	Landings WA + OR (mt)	0.005	0.699
Pacific Herring	Landings WA + OR (mt)	0.002	0.752

* Time lag of +2 years, ** time lag of -1 year

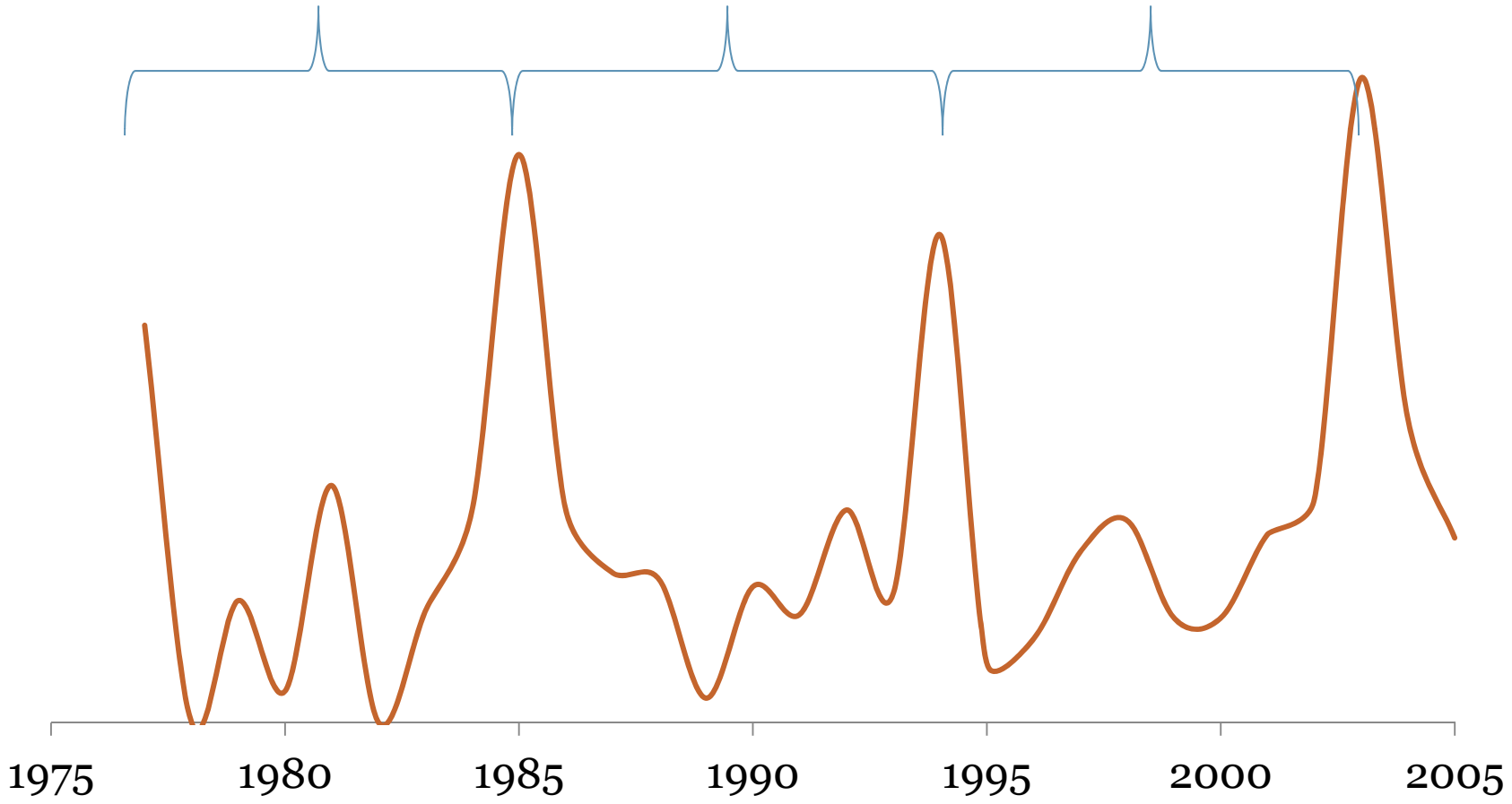
Time lags...


140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Lamprey returns
4000
3500
3000
2500
2000
1500
1000
500
0
Pollock landings
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Year
Lamprey
Pollock

Population cycles (Columbia)



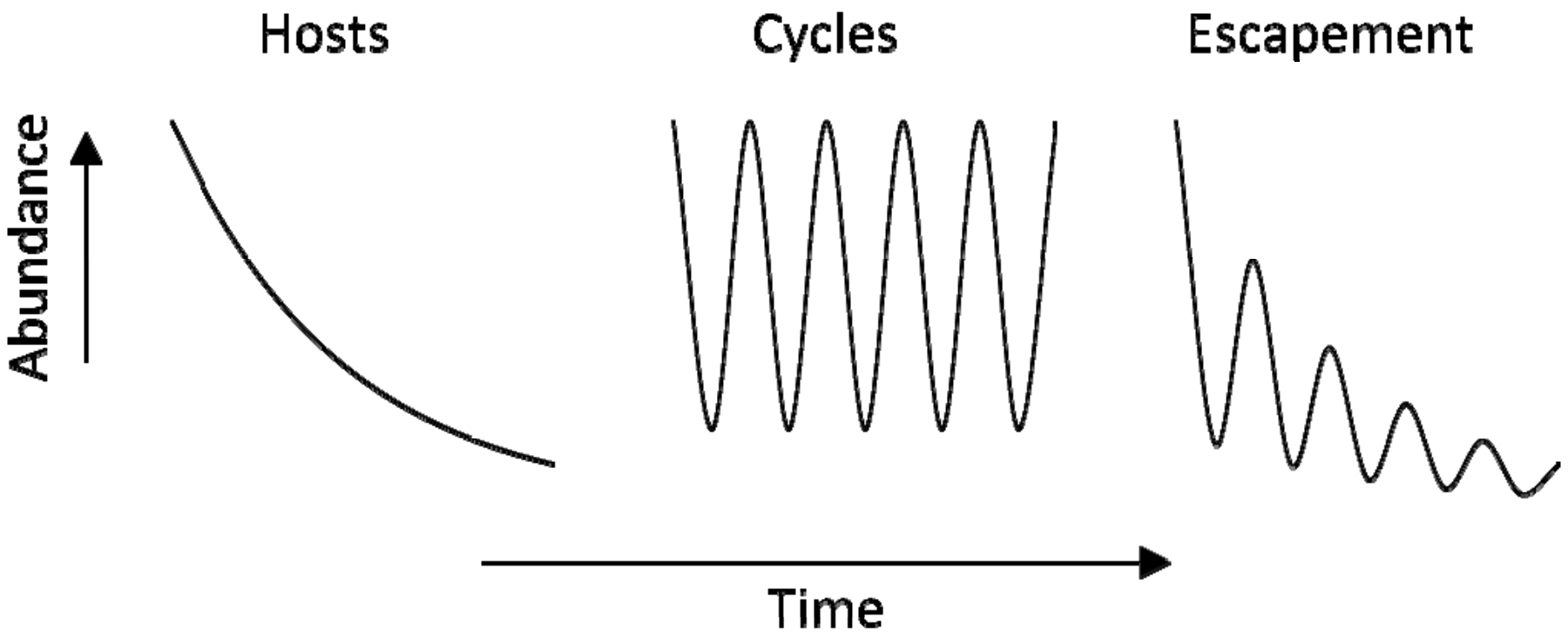
Population cycles (North Pacific)



Discussion

- Criticisms
  - Data, correlation & causation
- Underlying mechanisms
  - PDO, PNI?
- Other species
  - Rockfish, salmon, flatfishes
  - Predators?
- Host selectivity
  - With growth?
- Oceanic movements
  - With hosts
- Population cycles
  - Life cycle of lampreys
- Importance of marine survival
  - 10.00% vs. 0.02%

Population model



* Concept from Lawson 1993

Acknowledgments

- A. Orlov (VNIRO) and K. Siwicke (UAF)
- Several helpful reviewers
- TINRO-Center, Pacific Halibut Commission, NMFS