Alaska sablefish

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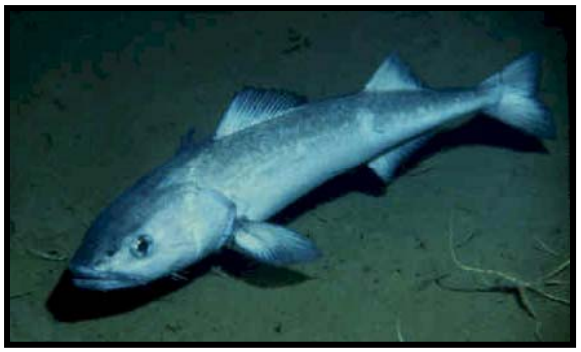
November 2010

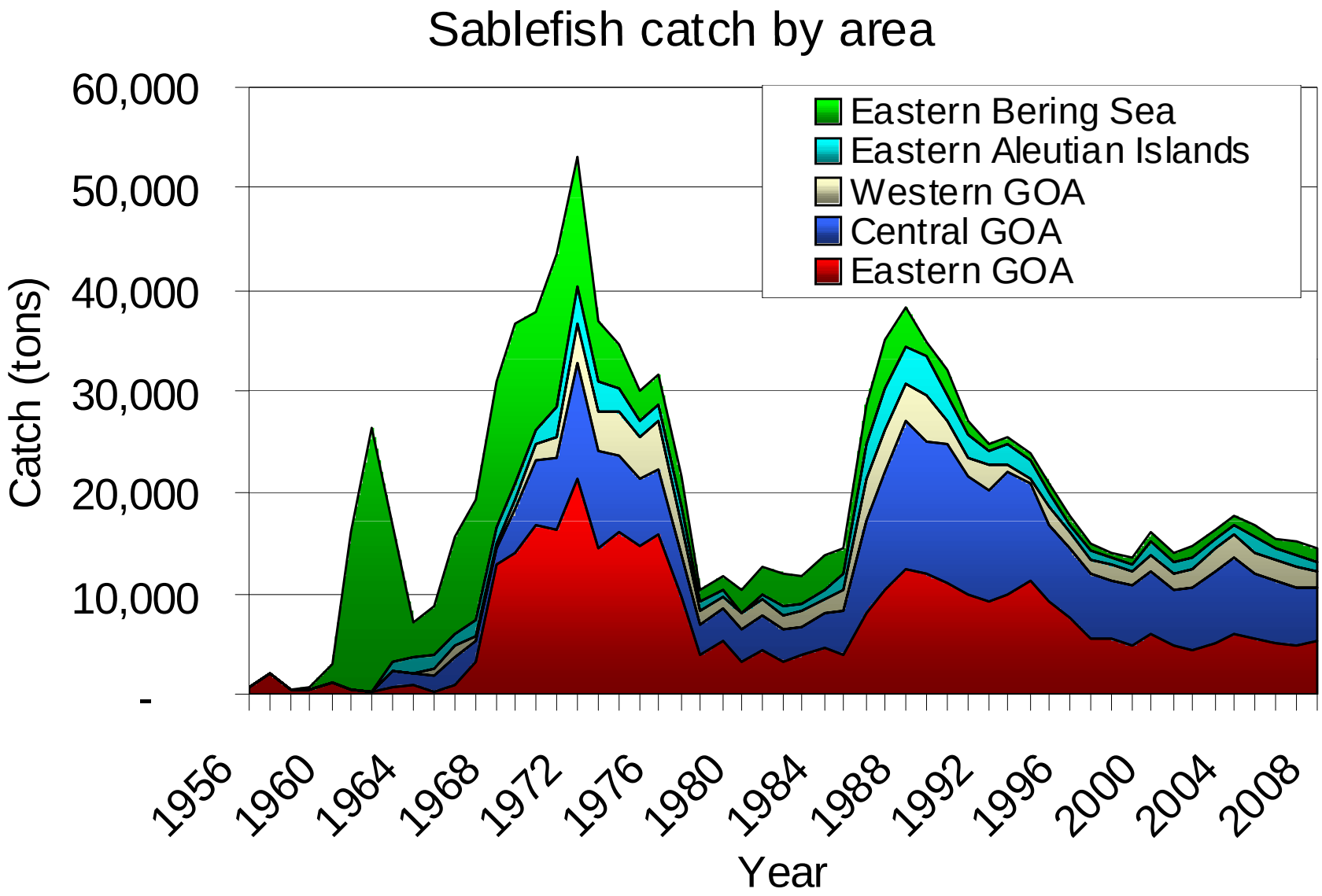
Outline

- What's new in the 2010 assessment
- Abundance indices
- Model comparisons
- Model results
- Projections
- Future
- Sablefish recruitment factors

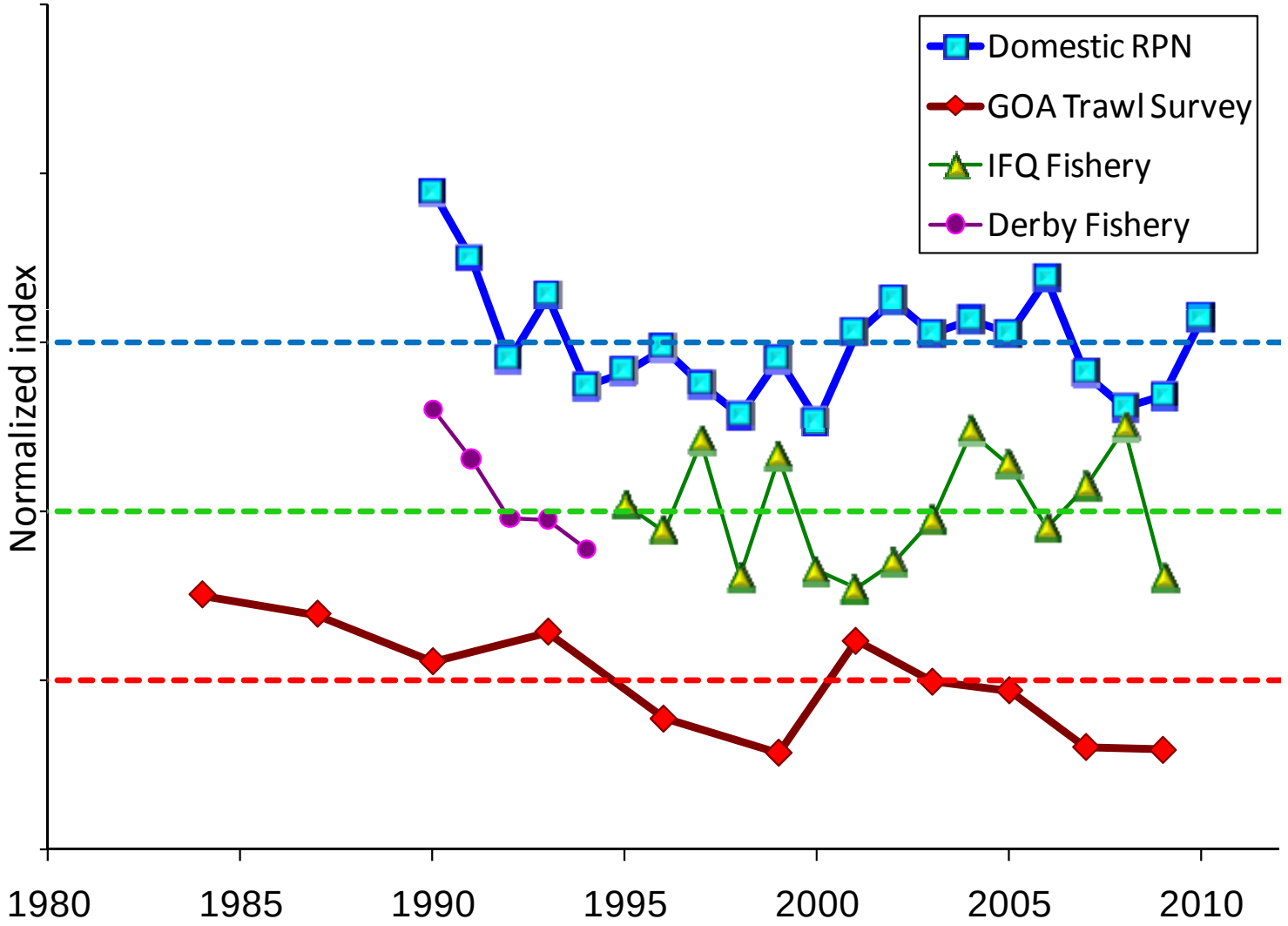
What's new

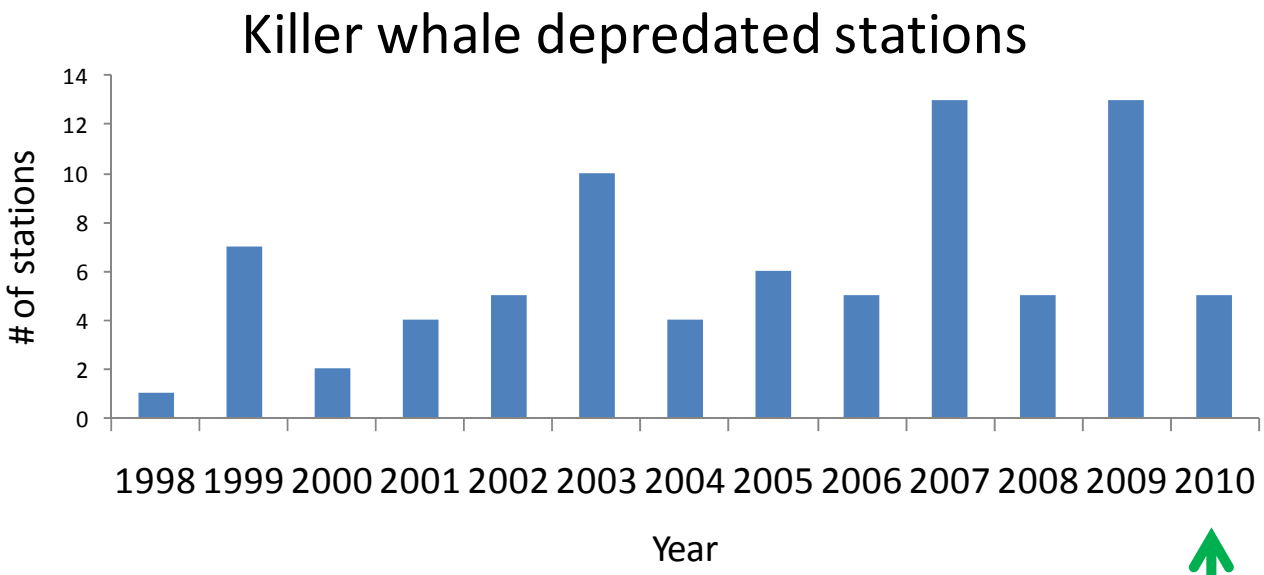


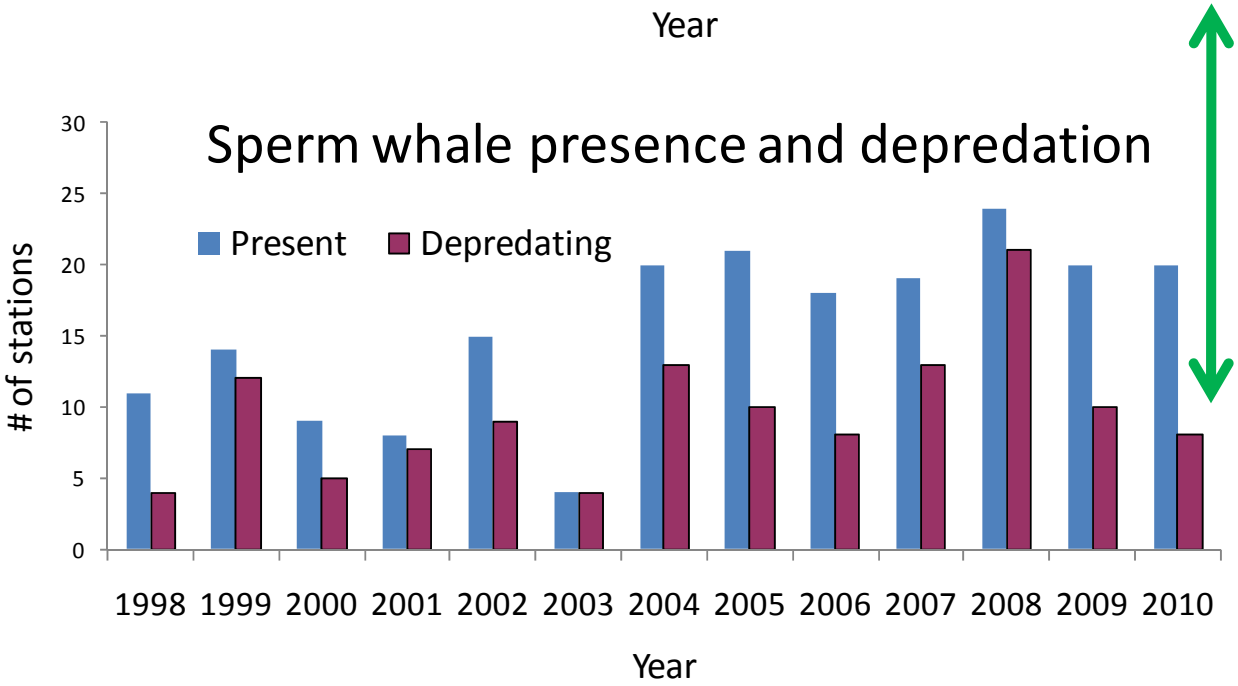
- Model
  - Removal of RPW index
  - Required rebalancing of data weights
- Data
  - Catch: updated 2009, and new catch for 2010
  - Relative abundance: 2010 Longline survey, 2009 Longline fishery
  - Ages: 2009 Longline survey, 2009 Longline fishery
  - Lengths: 2010 Longline survey, 2009 Longline fishery, and 2009 Trawl fishery

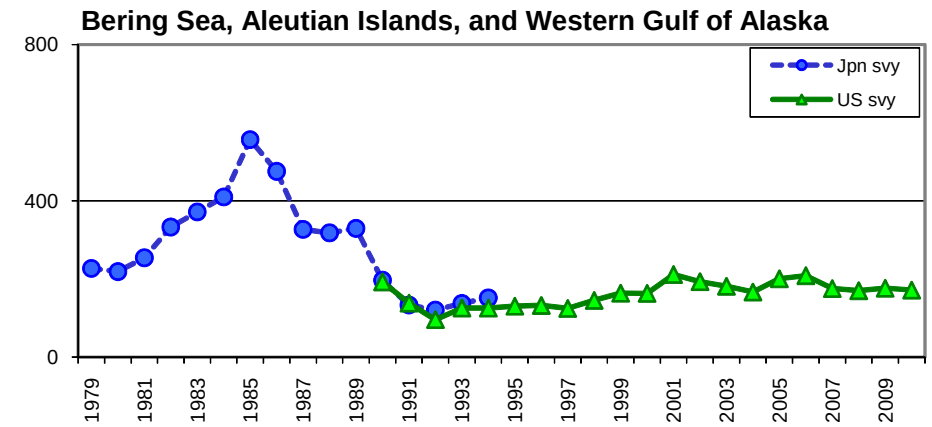

Sablefish catch by area
60,000
50,000
40,000
30,000
20,000
10,000
-
Catch (tons)
Eastern Bering Sea
Eastern Aleutian Islands
Western GOA
Central GOA
Eastern GOA
1956
1960
1964
1968
1972
1976
1980
1984
1988
1992
1996
2000
2004
2008
Year

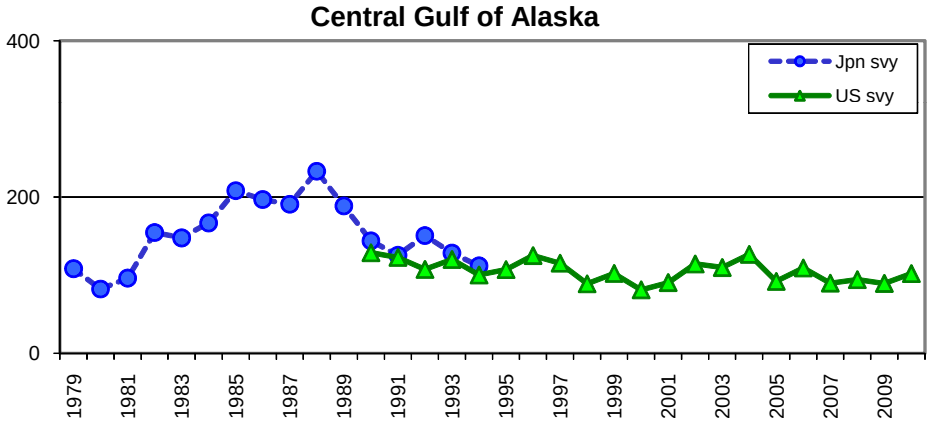
Sablefish Abundance Indices

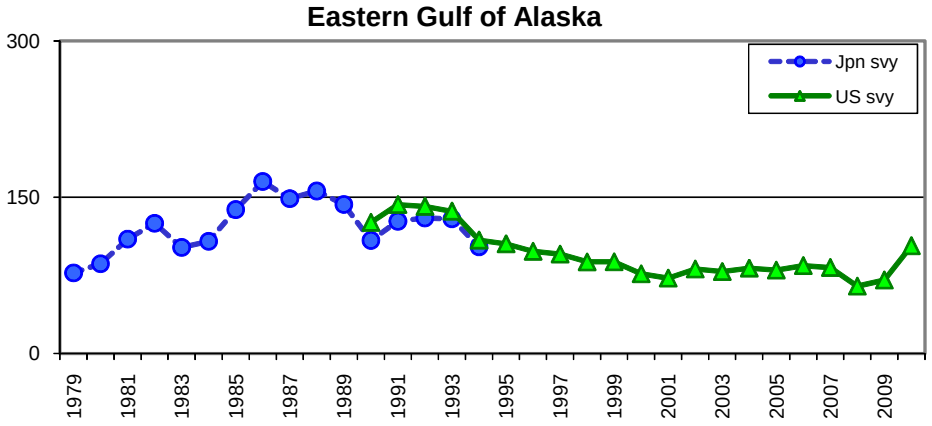


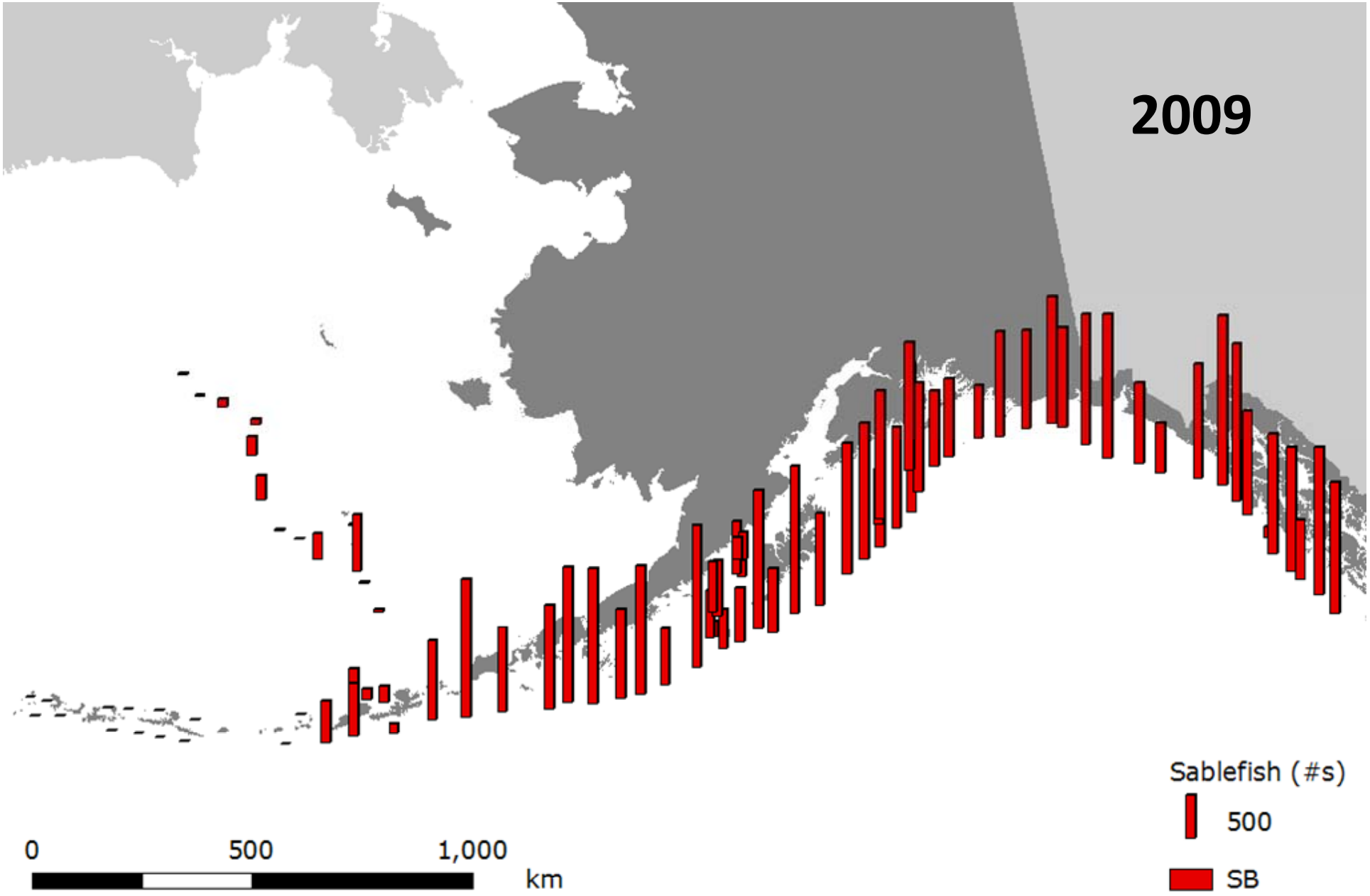

Killer whale depredated stations
# of stations
14
12
10
8
6
4
2
0
1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
Year

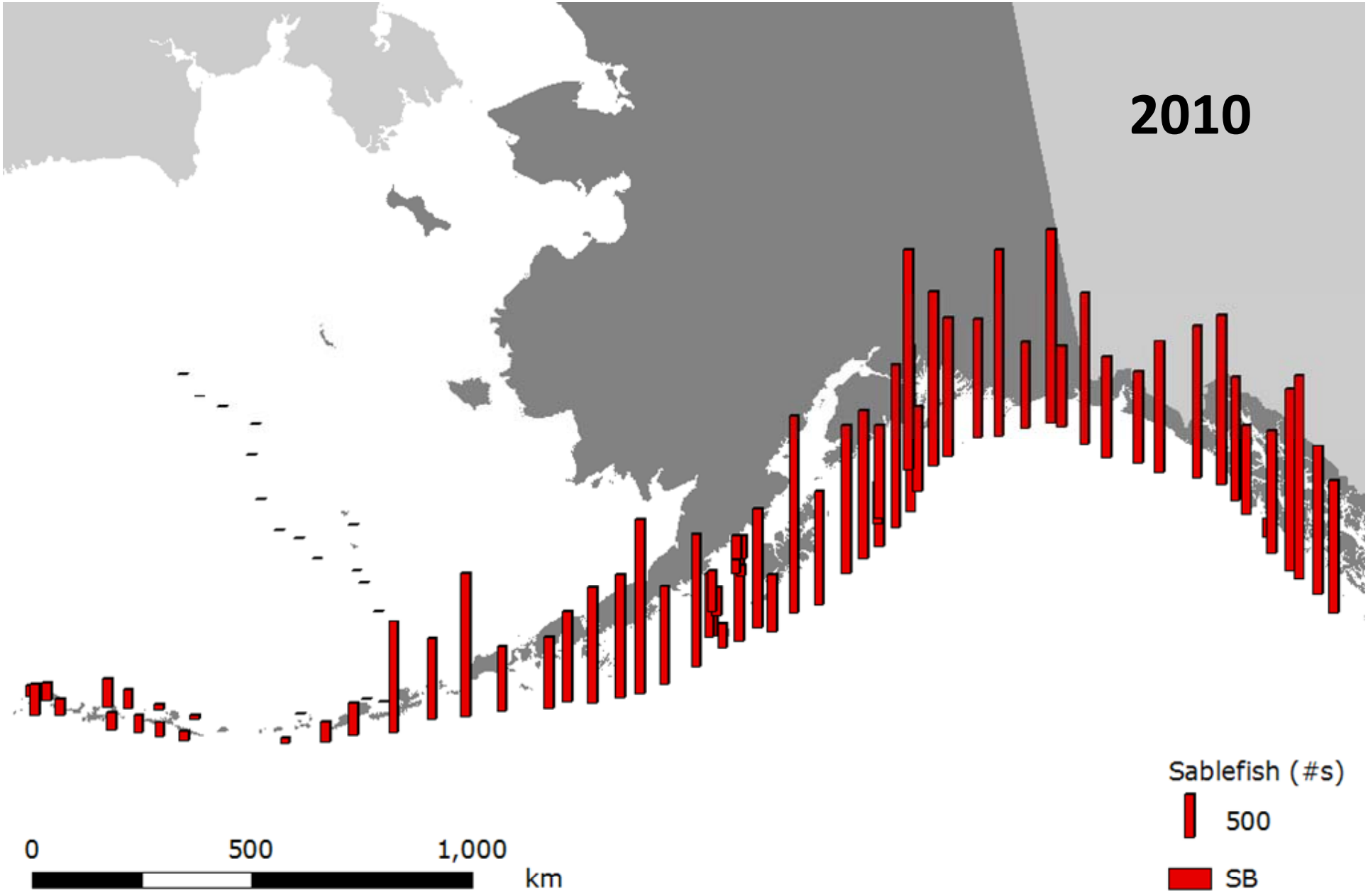

Sperm whale presence and depredation
Present
Depredating
# of stations
30
25
20
15
10
5
0
1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
Year

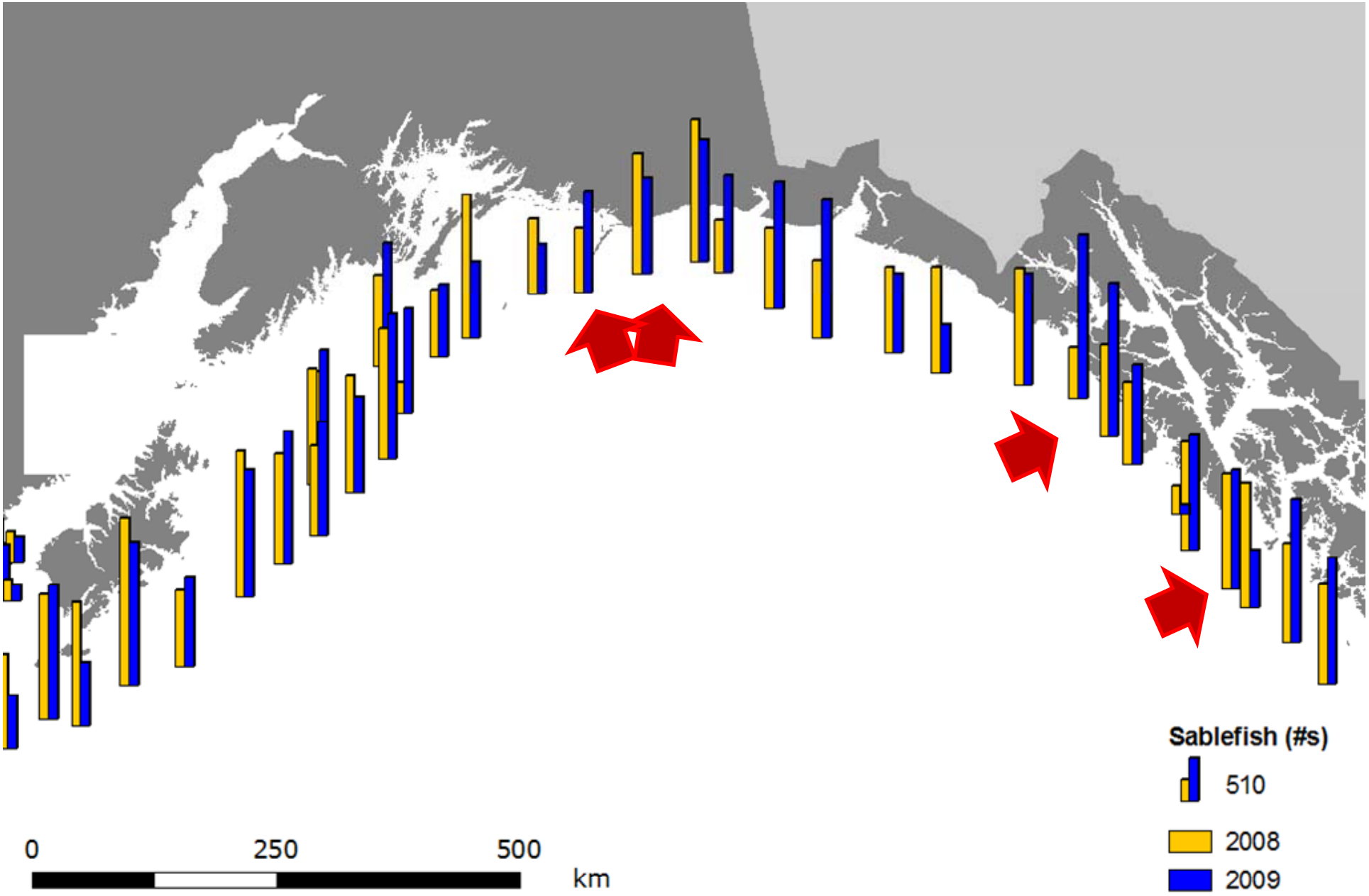

Bering Sea, Aleutian Islands, and Western Gulf of Alaska
800
400
0
Jpn svy
US svy
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009

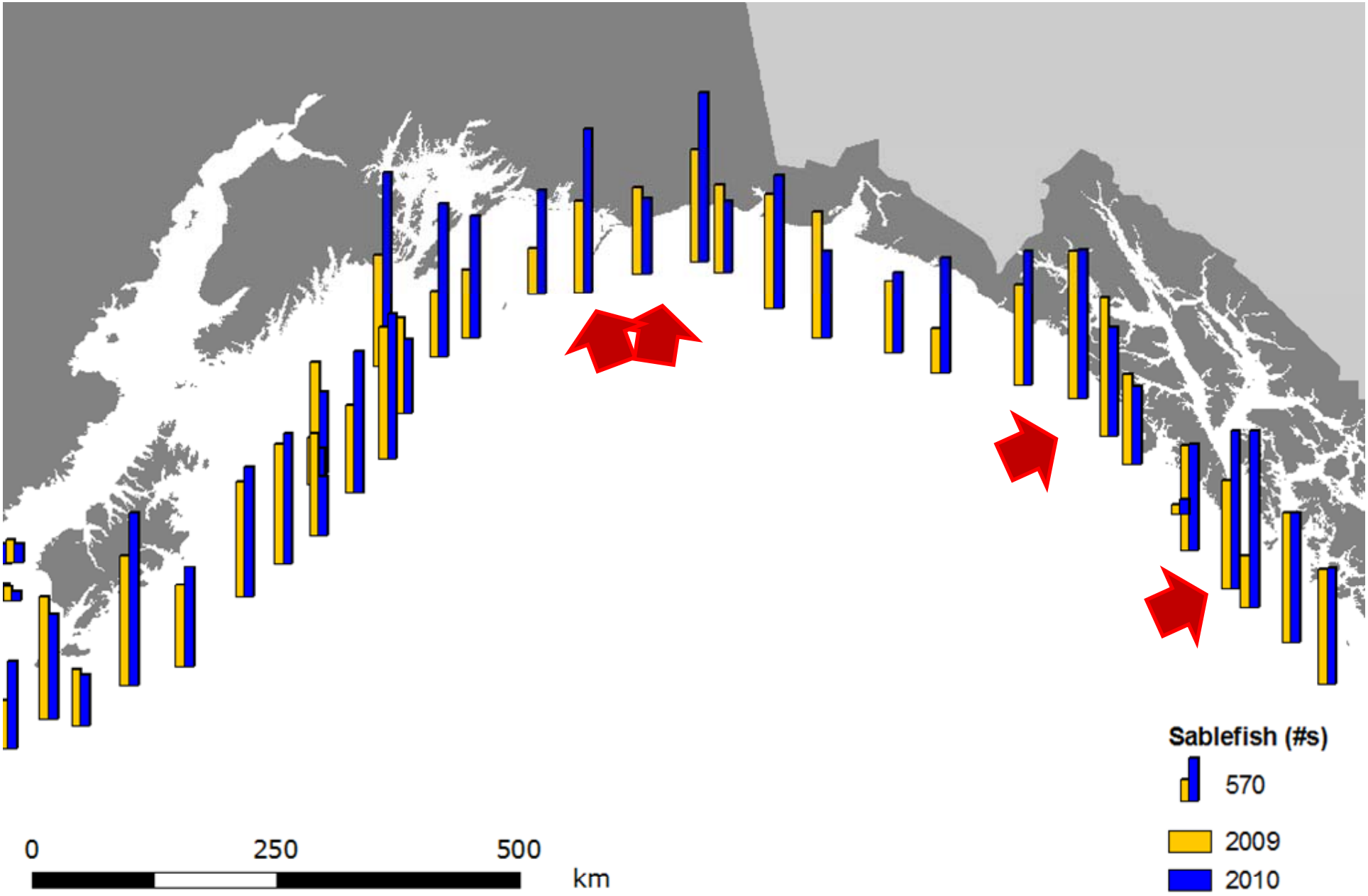

Central Gulf of Alaska
400
200
0
Jpn svy
US svy
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009

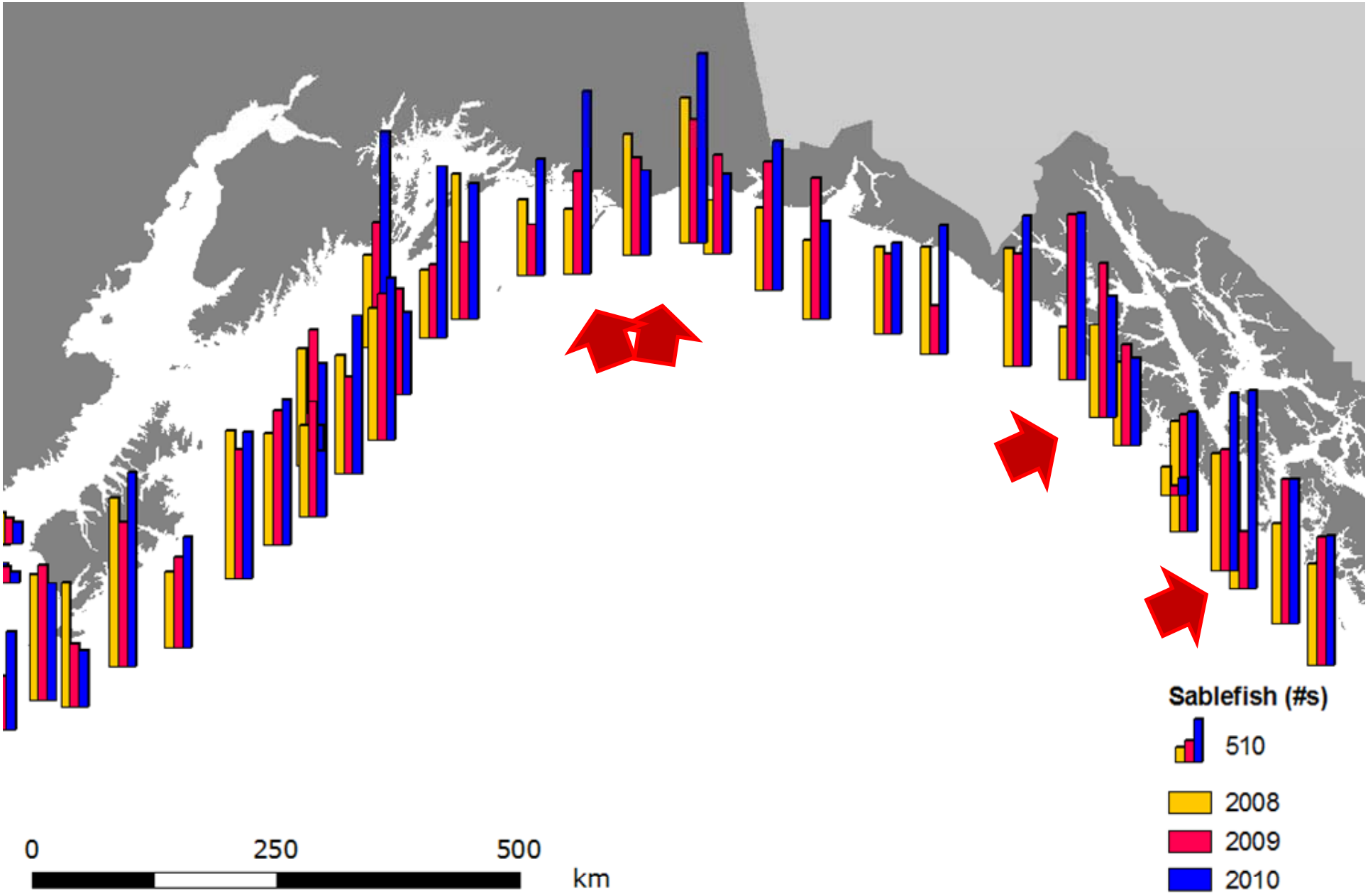

Eastern Gulf of Alaska
300
150
0
Jpn svy
US svy
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009


2009
Sablefish (#s)
500
SB
0
500
1,000
km

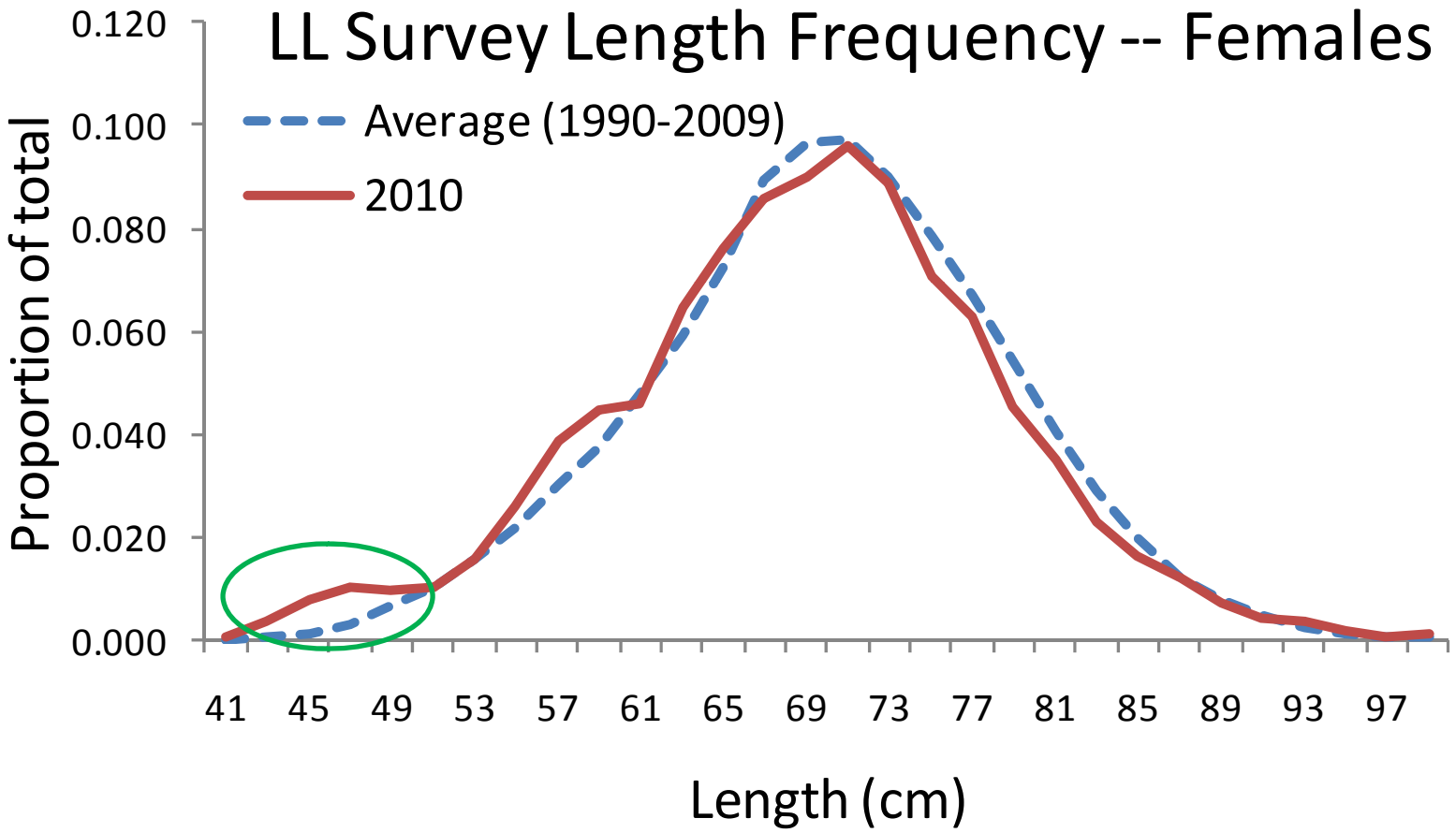

2010
0
500
1,000
km
Sablefish (#s)
500
SB


Sablefish (#s)
510
2008
2009
0
250
500
km

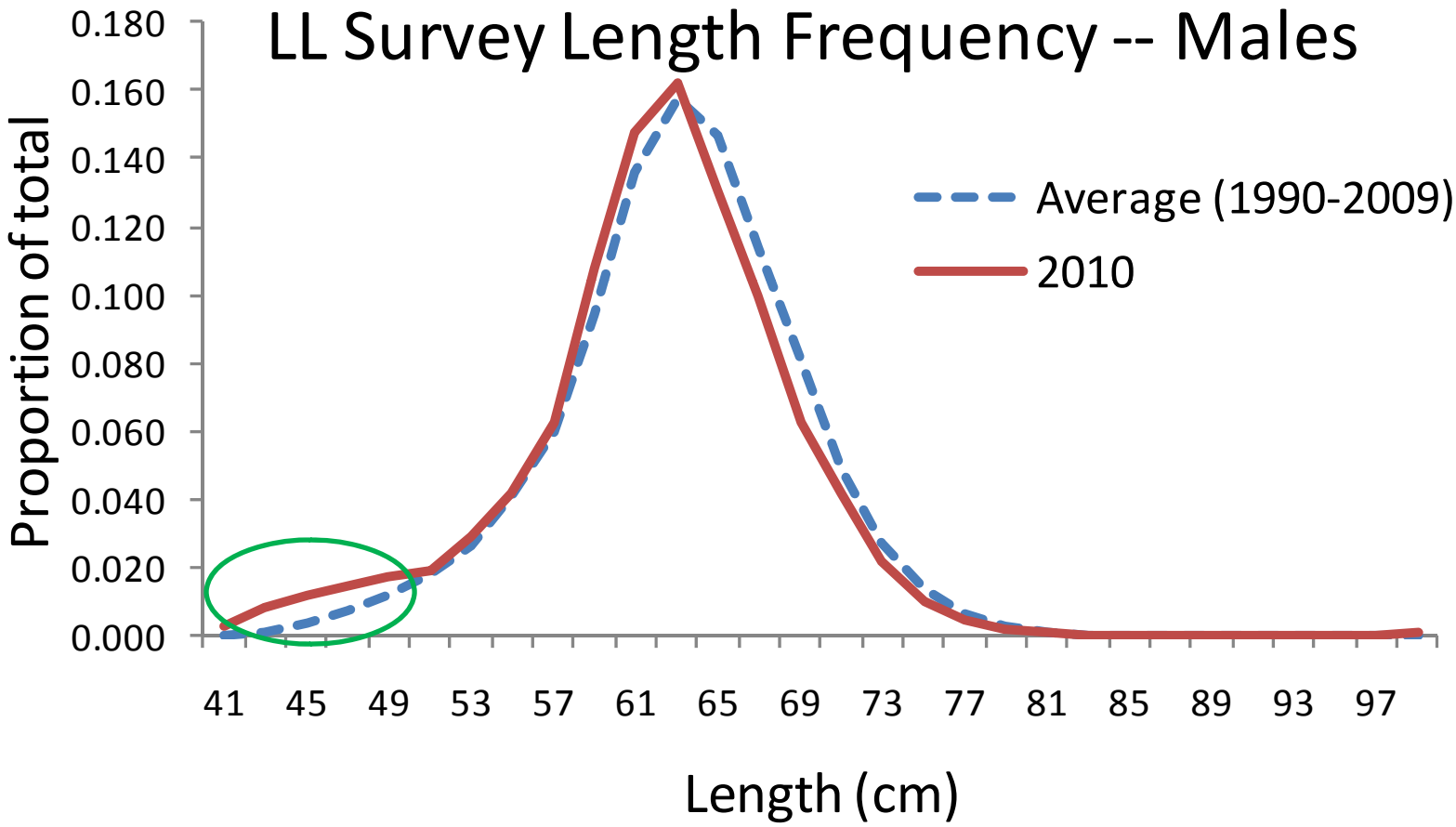

Sablefish (#s)
570
2009
2010
0
250
500
km


Sablefish (#s)
510
2008
2009
2010
0
250
500
km

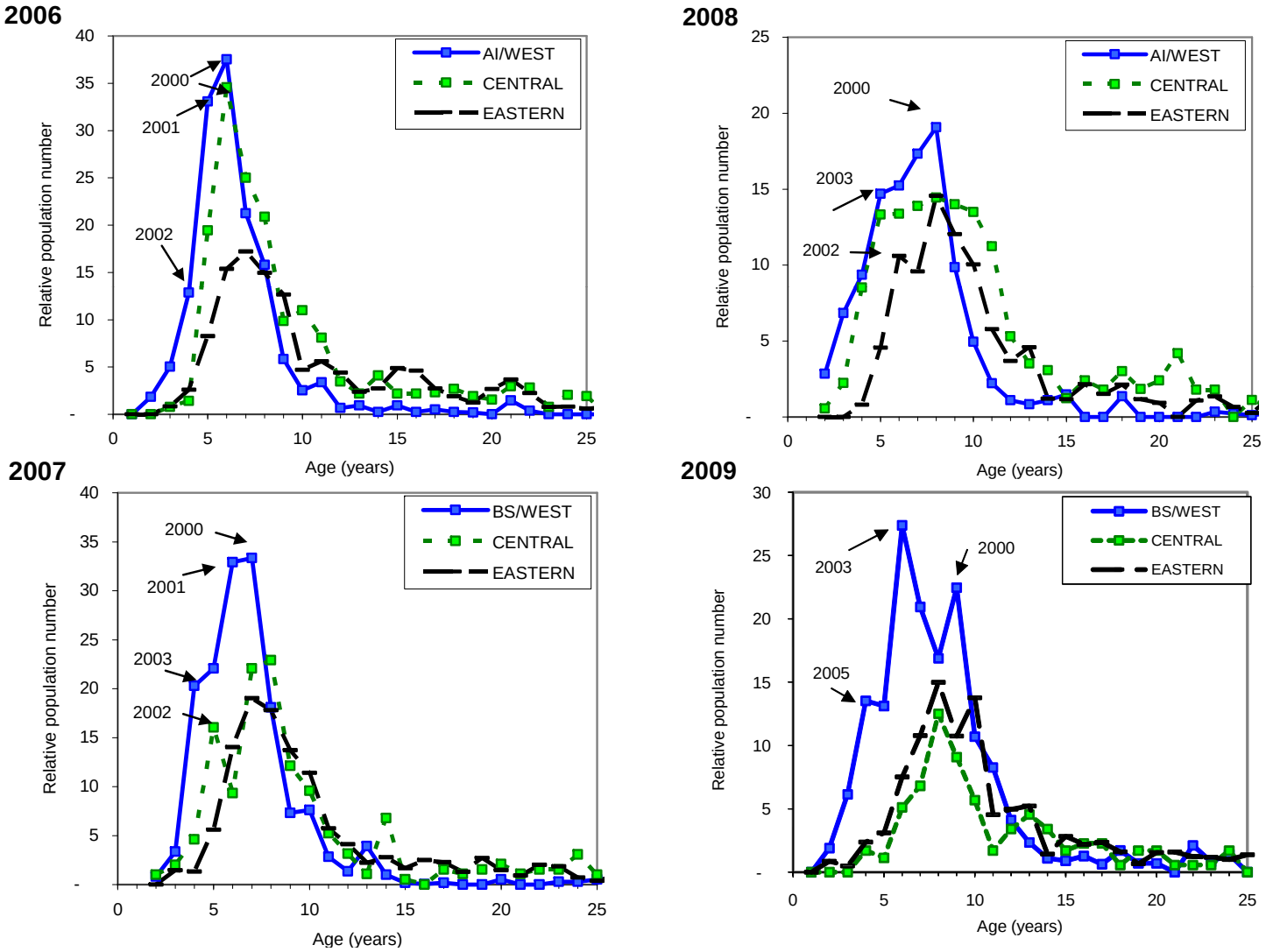
Recruitment?



Recruitment?

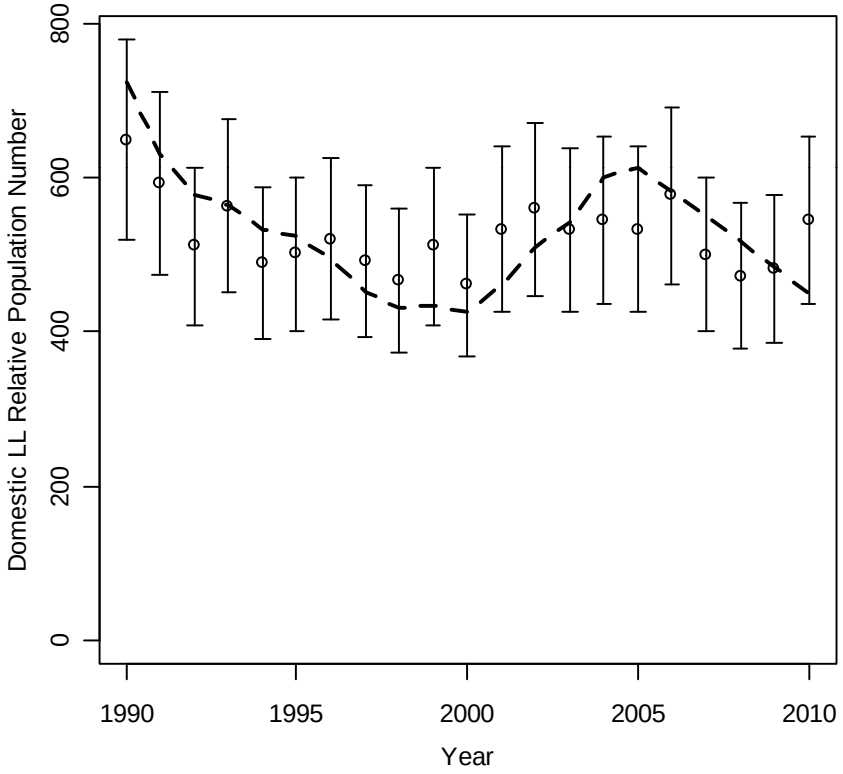


Sablefish: Longline Survey Ages

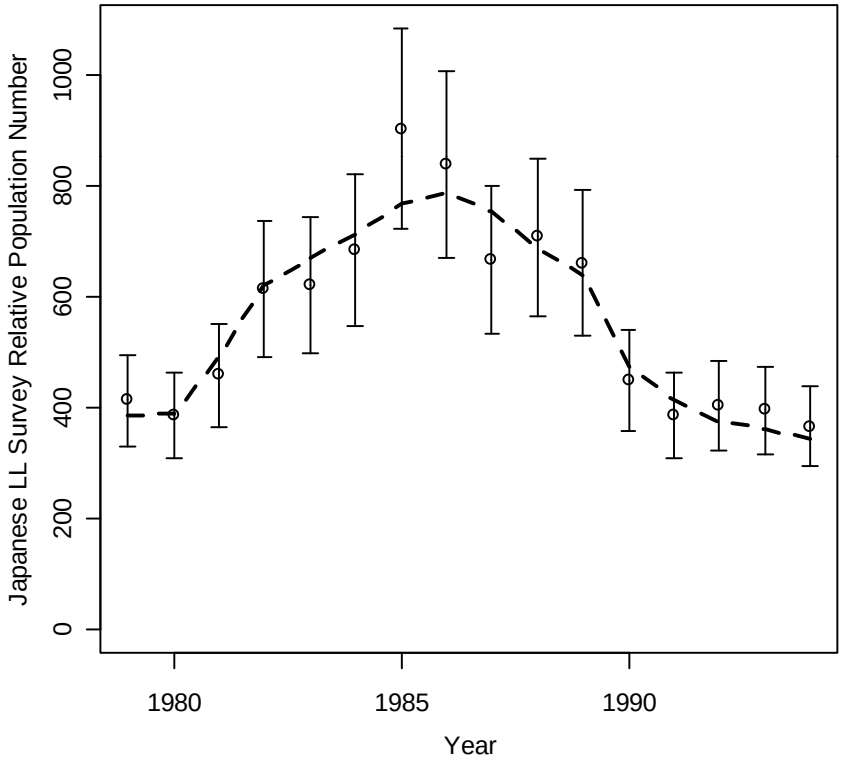


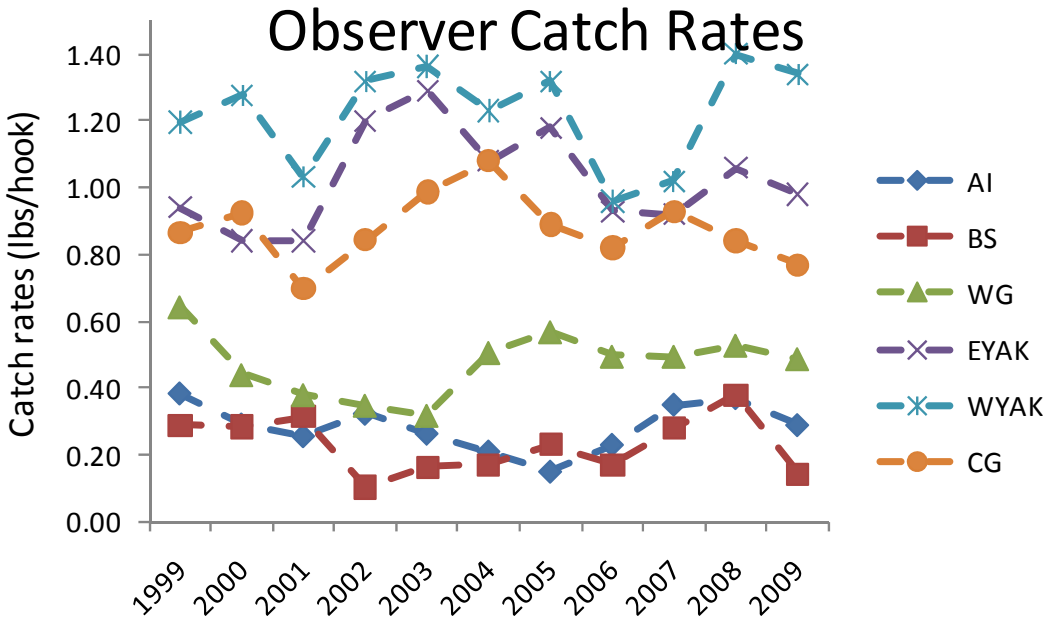
Sablefish: Fit to LL Survey RPN

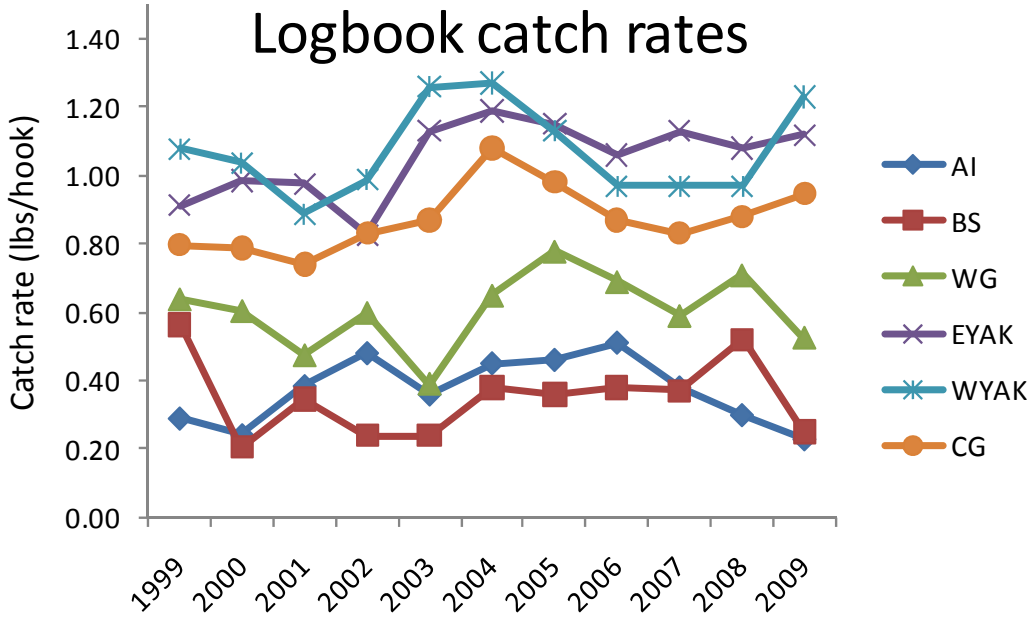
Domestic



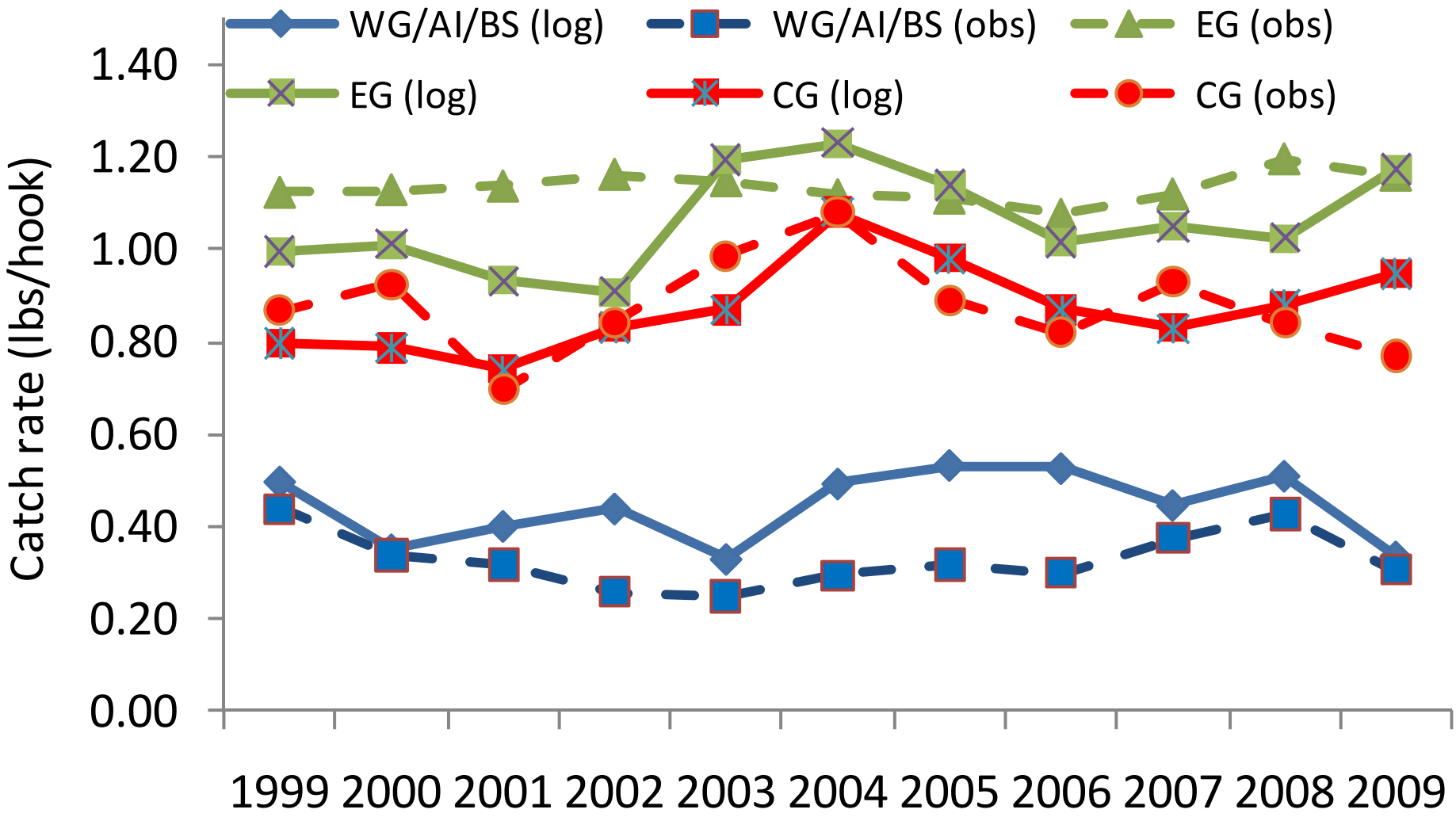
Japanese



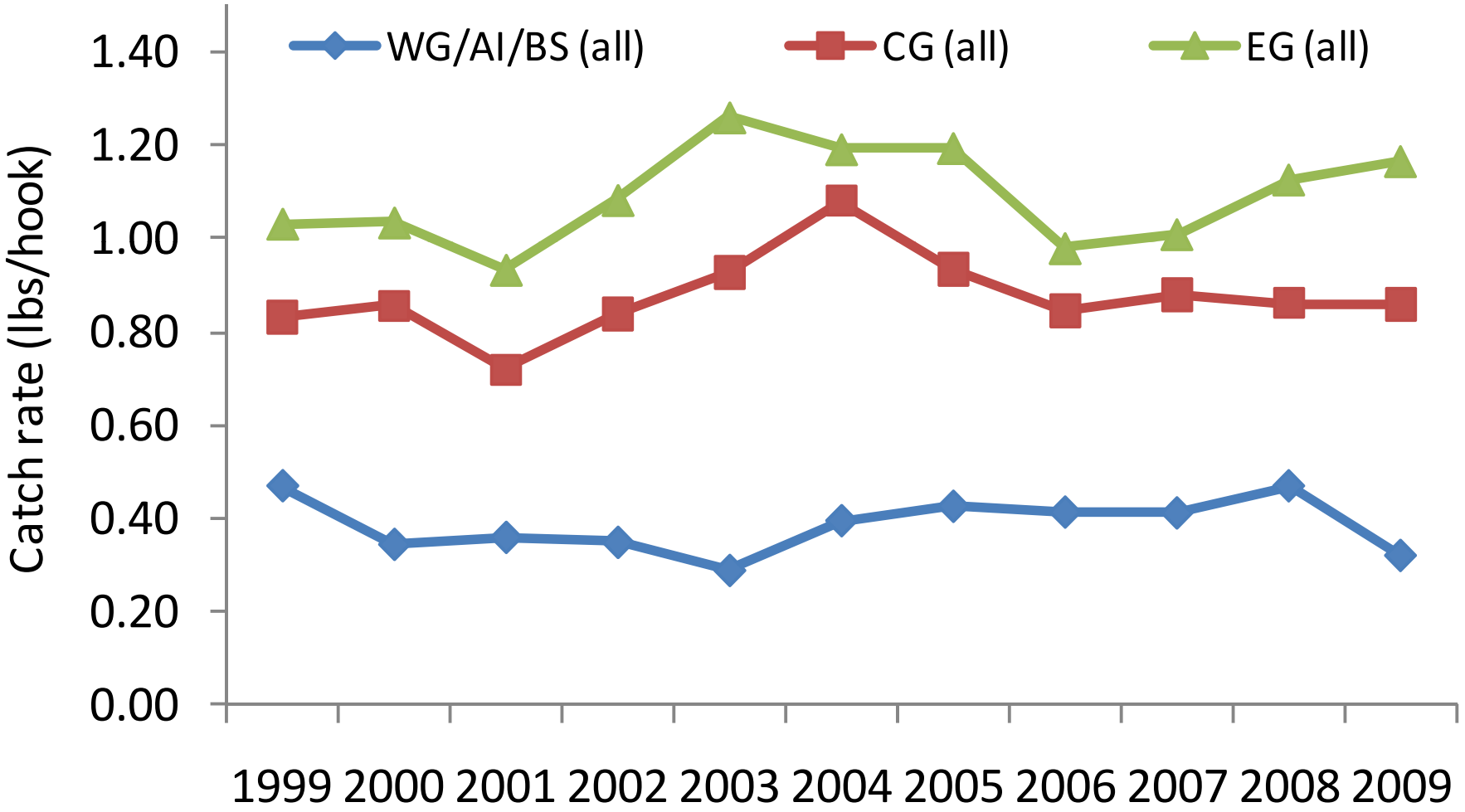

Observer Catch Rates
Catch rates (lbs/hook)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
AI
BS
WG
EYAK
WYAK
CG


Logbook catch rates
Catch rate (lbs/hook)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
AI
BS
WG
EYAK
WYAK
CG

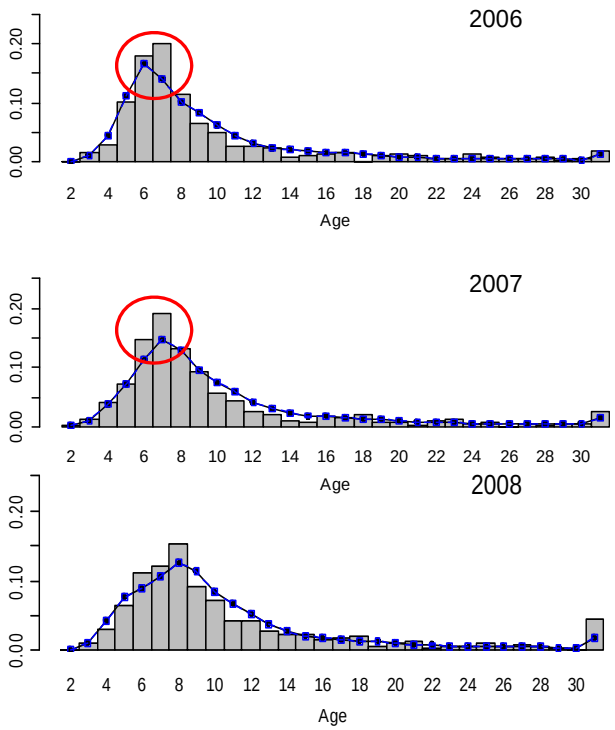
Average by area and source

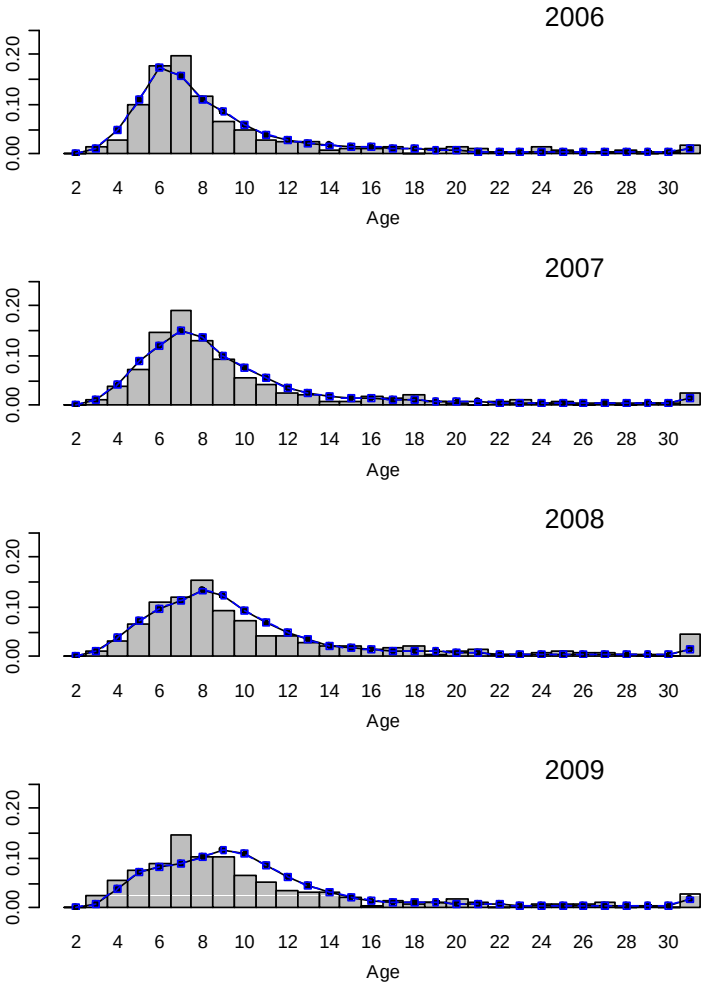


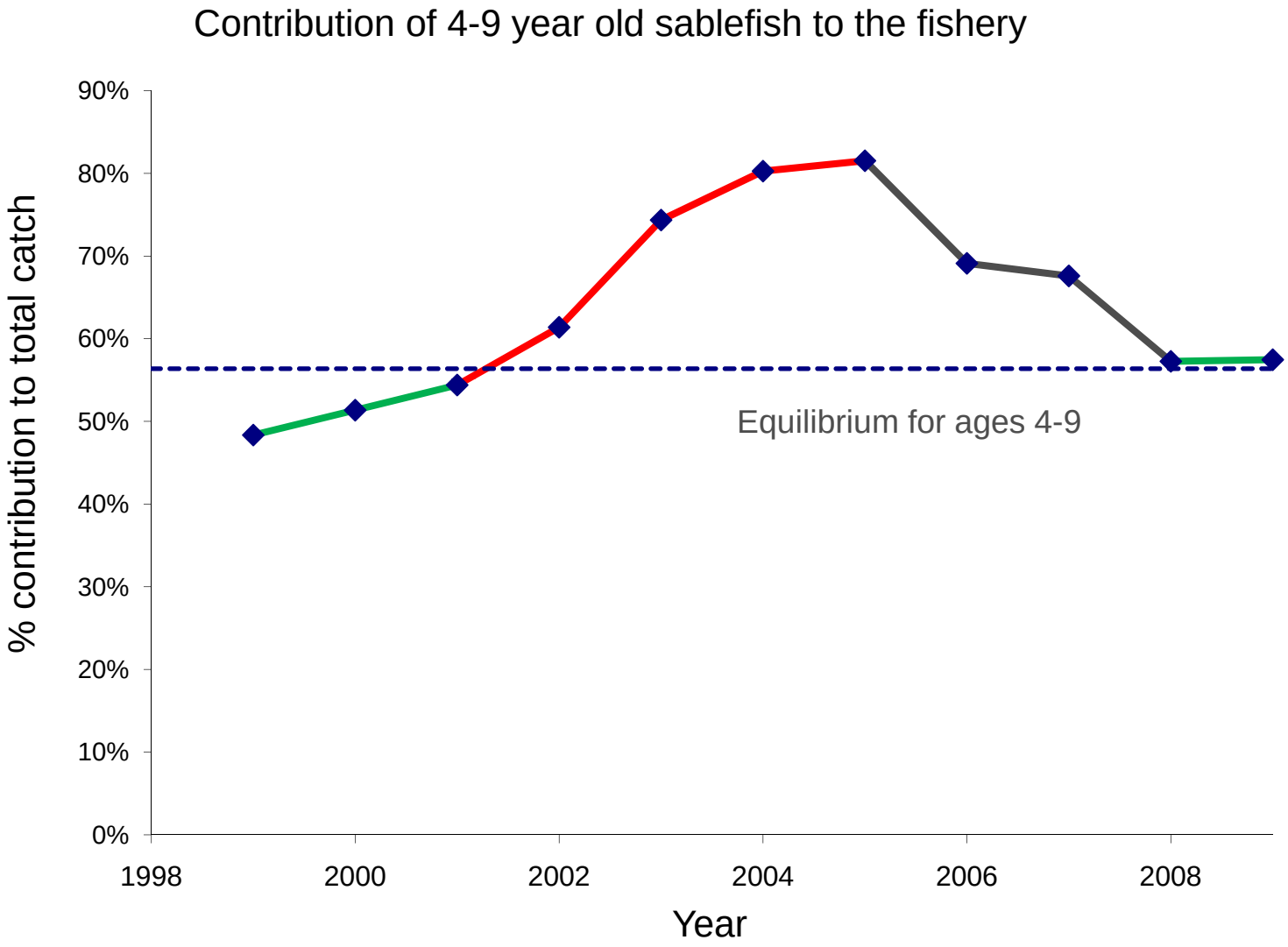
Overall average catch rates by region



Sablefish: Fishery Ages



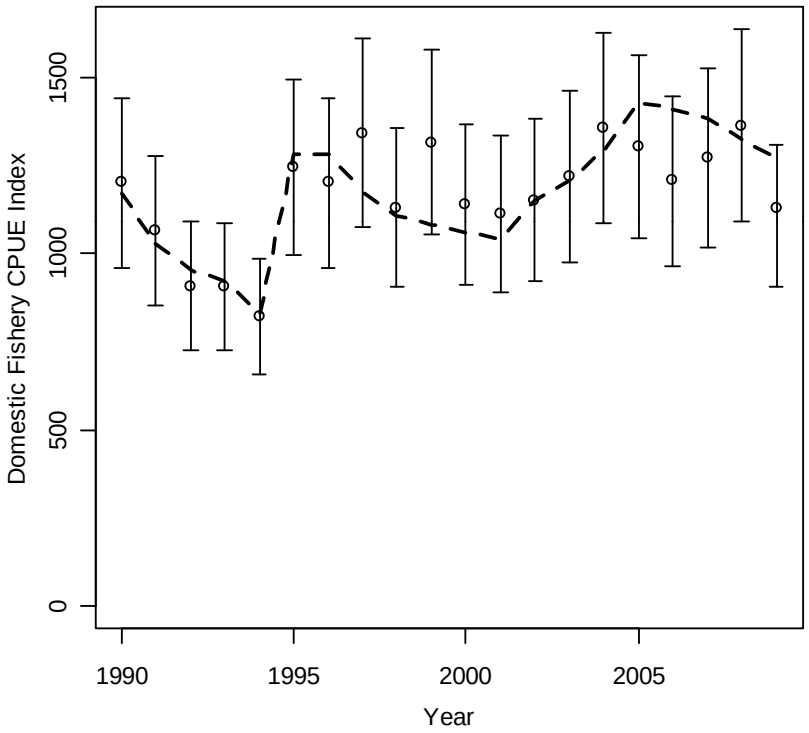




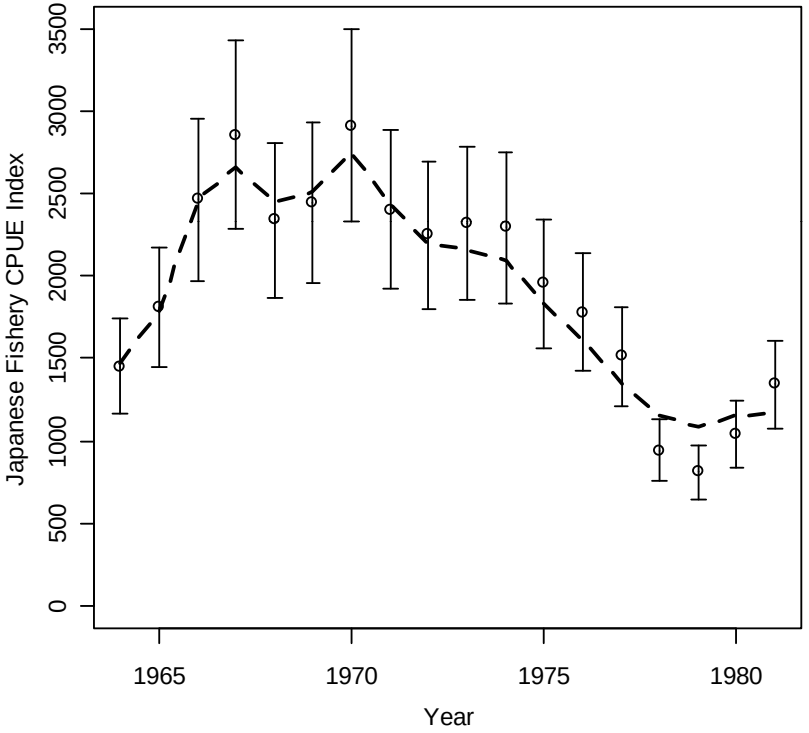
Not targeting year classes, targeting best catch rates…

Sablefish: Fit to Fishery RPW

Domestic

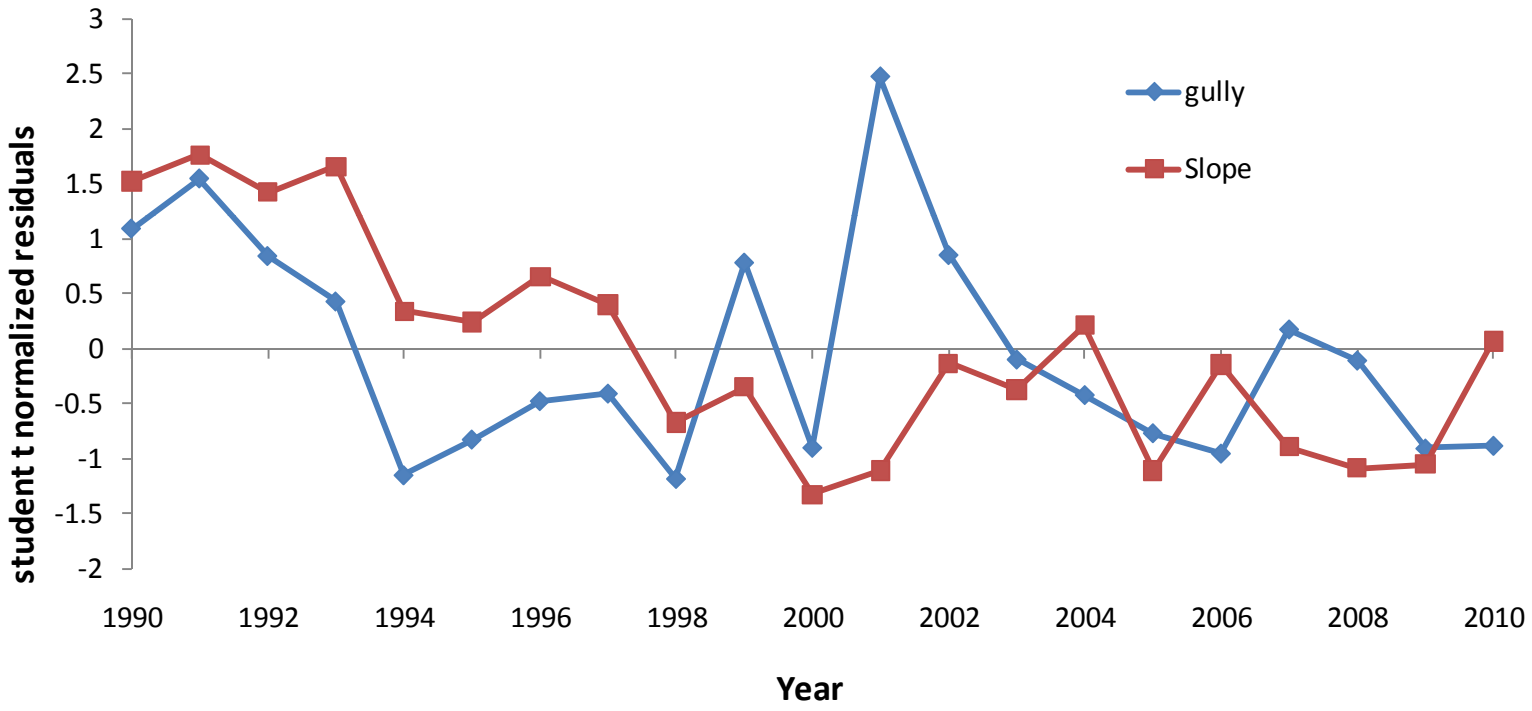


Japanese

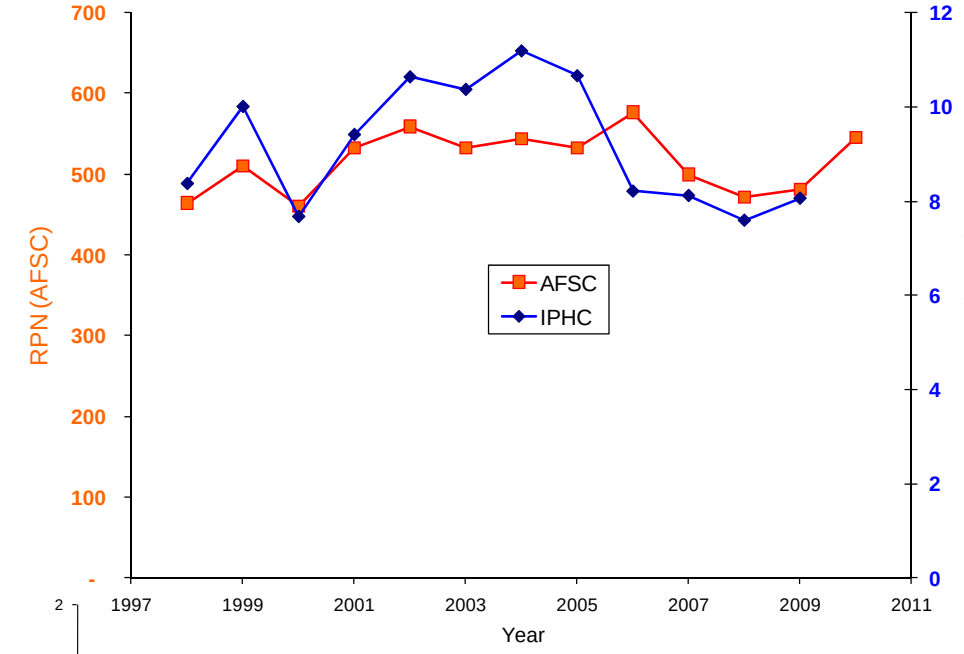


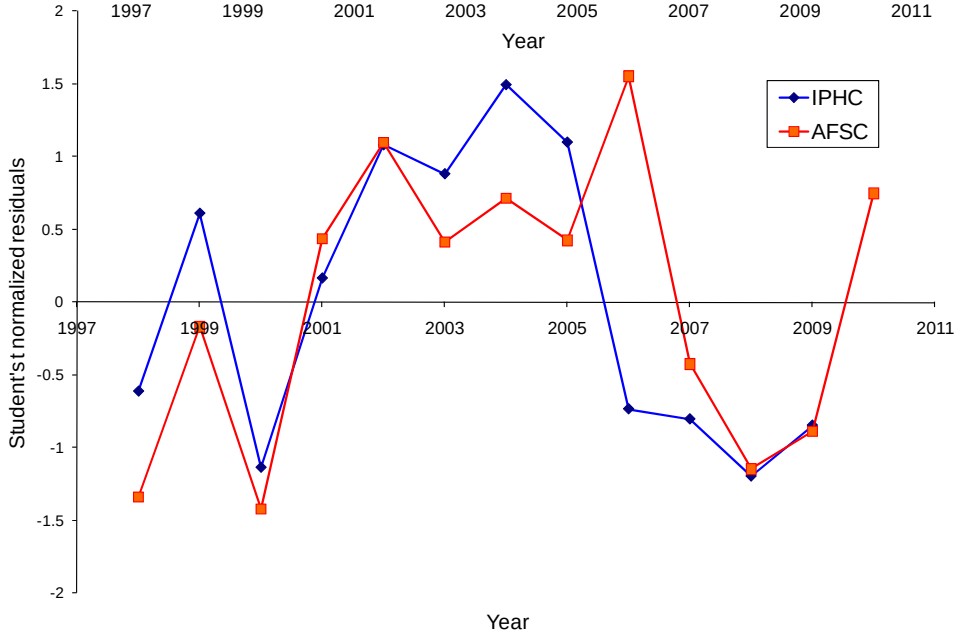
Gullies

- Trends in same direction, but not in 2010



- May track year classes better





IPHC Survey

- Trends match well
- IPHC More variable

- Match very well with normalized residuals
- *r=0.63*

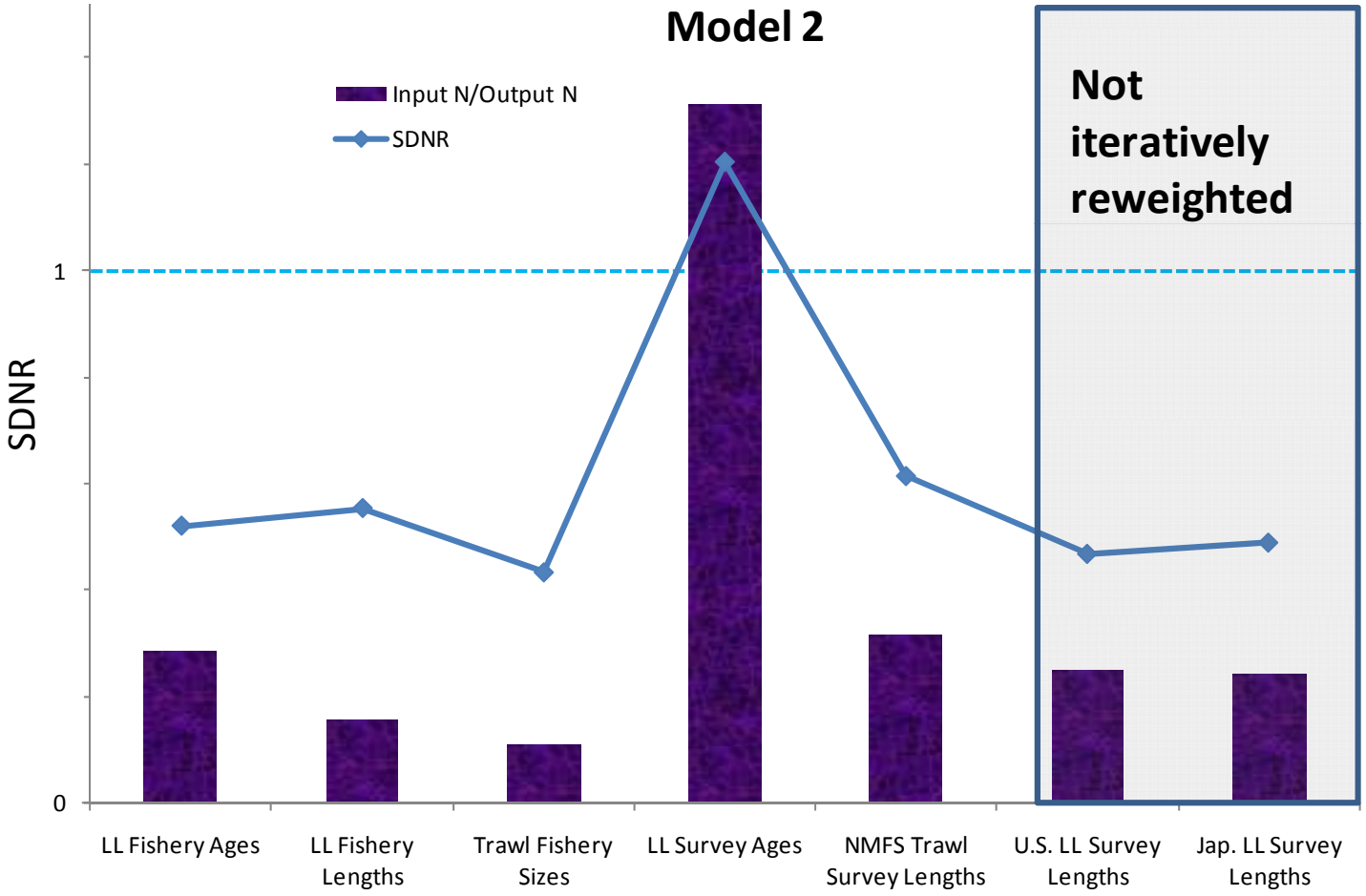
Changes from last year

- Removal of RPW part of index (recommended by CIE and workshop)
- Avoid double using index data
- Also using multiple growth relationships
- Required rebalancing of data weights
- How?

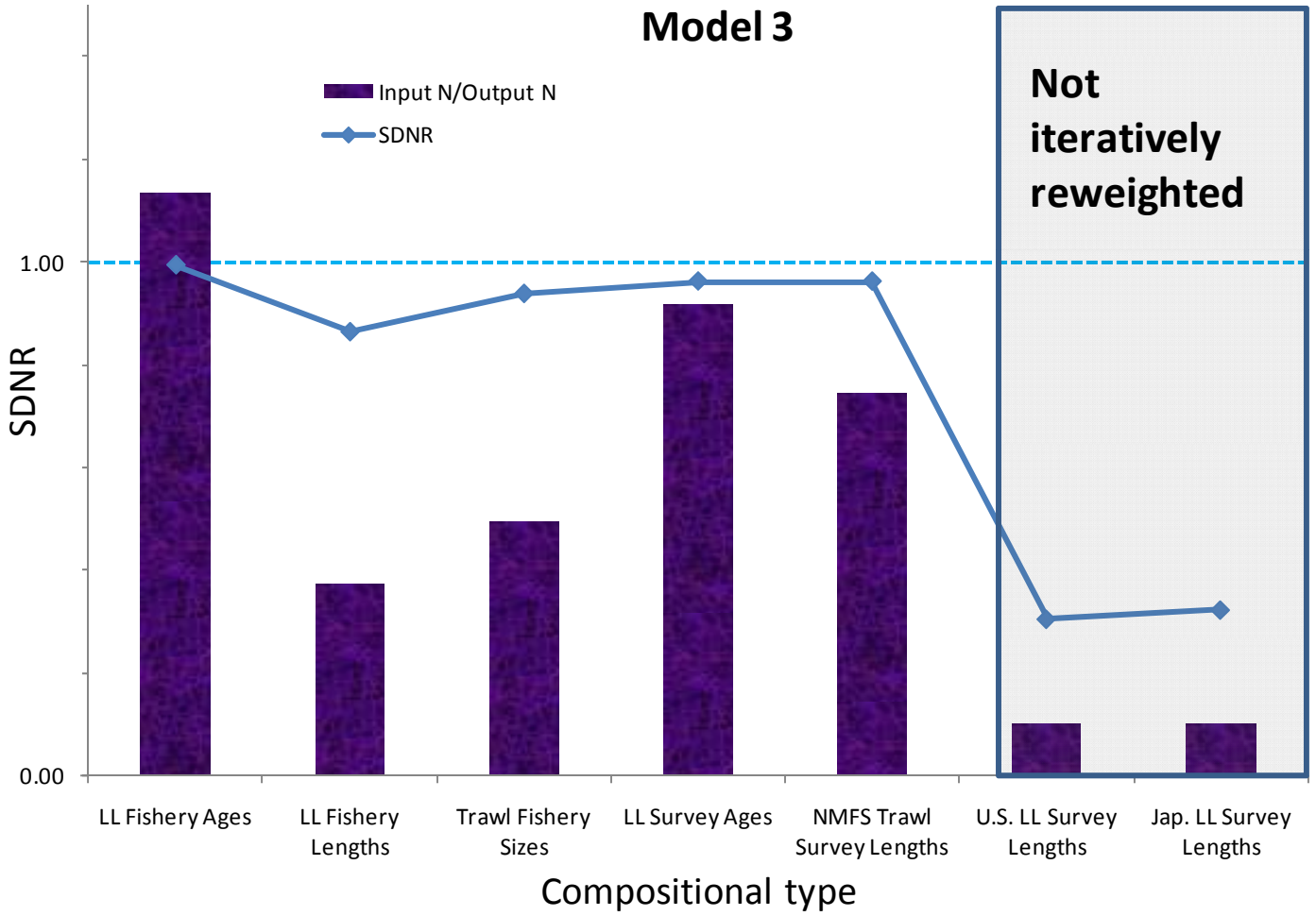
Compositional Criteria

- Effective sample size
- SDNR
  - Standard deviation of normalized residuals
  - Used commonly in New Zealand assessments
  - Recommended to AK in Atka mackerel (Francis) and rockfish CIEs (Cordue) as objective criterion for data weighting
- Intention of both measures is to match input and output variance for different data sources
- We chose to fit mean SDNR close to 1 for ages, and lengths where there were no ages in the 2009 model by iteratively reweighting
- Fixed these weights in 2010 Model 3

Improvement in SDNR



Improvement in SDNR

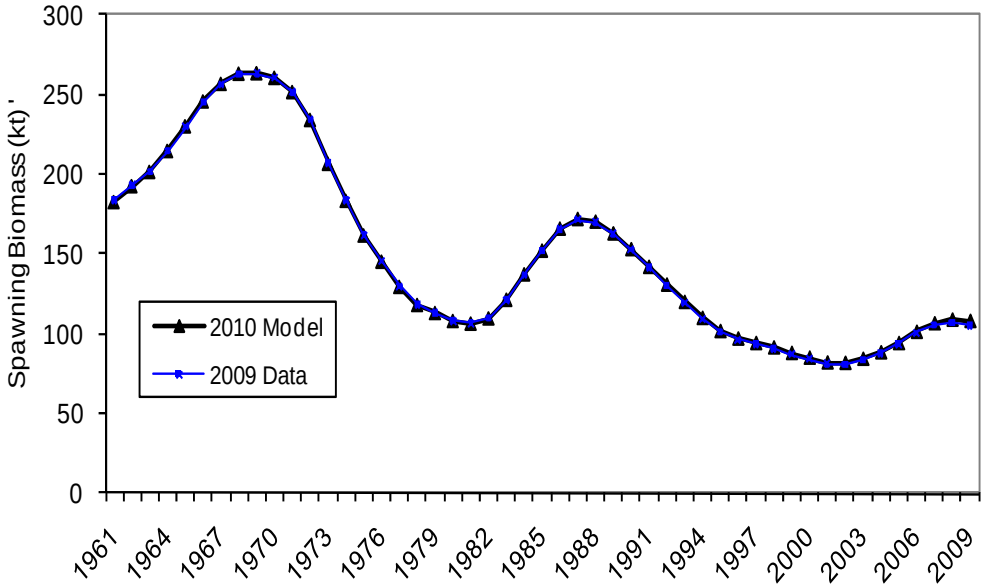


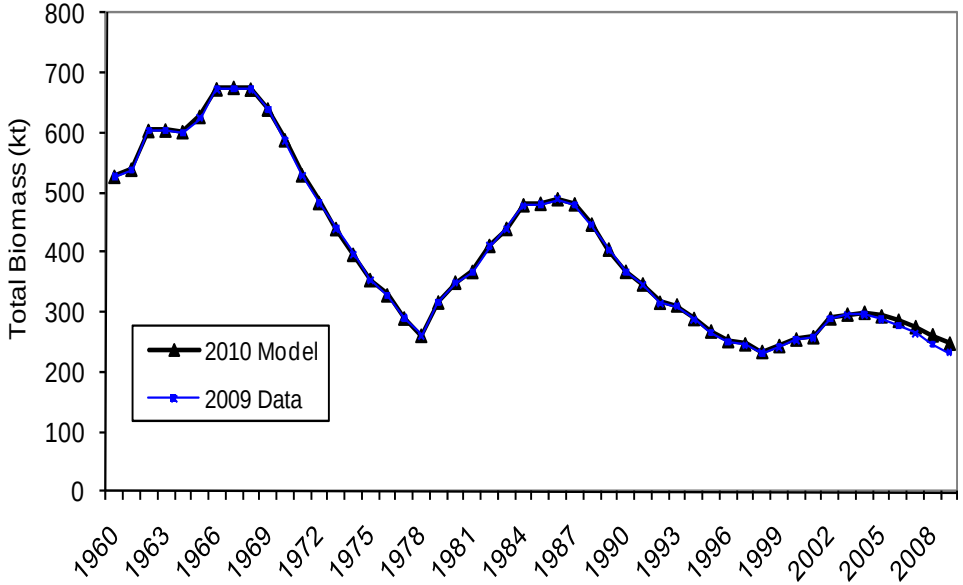
Candidate Models

- Model 1 (2009 base model)
- Model 2 (2009 base model with RPWs removed)
- Model 3 (Model 2 with compositional reweighting
  - All models are similar in terms of parameter estimates and results
  - Removal of RPW recommended by several reviews
  - Model 2 has inherent change in data weights on all other data sources (particularly abundance)
  - Model 3 has two appealing benefits
    - Variance assumptions more realistic for compositions
    - Retrospective patterns disappear

Model evaluation

Model Likelihood Components (Data)	**2009** **Model 1**	**Model 1**	**2010** **Model 2**	**Model 3**
Catch	4	4	3	8
Domestic LL survey RPW	46	49	0	0
Domestic LL survey RPN	24	29	40	40
Japanese LL survey RPW	31	31	0	0
Japanese LL survey RPN	26	27	20	18
Domestic LL fishery RPW	17	17	21	7
Japanese LL fishery RPW	21	21	23	11
NMFS GOA trawl survey	53	58	56	14
Domestic LL survey ages	224	238	221	141
Domestic LL fishery ages	41	44	40	148
Domestic LL survey lengths	123	128	123	53
Japanese LL survey ages	216	216	214	143
Japanese LL survey lengths	106	106	106	46
NMFS trawl survey lengths	83	88	88	216
Domestic LL fishery lengths	80	85	81	195
Domestic trawl fishery lengths	23	28	28	126
Data likelihood	1118	1168	1064	1165
Total objective function value	1141	1190	1086	1184
Key parameters				
Number of parameters	204	207	207	207
$B_{2011\ (Female\ spawning\ biomass)}$	100	99	94	102
$B_{40\%\ (Female\ spawning\ biomass)}$	113	110	107	110
$B_{1960\ (Female\ spawning\ biomass)}$	151	147	161	177
$B_{0\%\ (Female\ spawning\ biomass)}$	282	276	268	275
SPR% current	35%	36%	35%	37%
$F_{40\%}$	0.095	0.095	0.096	0.097
$F_{40\%\ (adjusted)}$	0.084	0.085	0.083	0.089
ABC	**15.2**	**16.2**	**14.9**	**16.0**
$q_{Domestic\ LL\ survey}$	7.8	7.8	8.1	7.7
$q_{Japanese\ LL\ survey}$	6.0	5.9	6.1	6.3
$q_{DomesticLL\ fishery}$	4.2	4.1	4.3	4.2
$q_{Trawl\ Survey}$	1.0	1.0	1.0	1.0
$a_{50\%\ (domestic\ LL\ survey\ slectivity)}$	3.8	3.8	3.9	3.9
$a_{50\%}$ (LL fishery selectivity)	4.1	4.1	4.1	4.1
μ_r *(average recruitment)*	18.0	18.5	18.0	18.5
σ_r *(recruitment variability)*	1.20	1.20	1.20	1.20

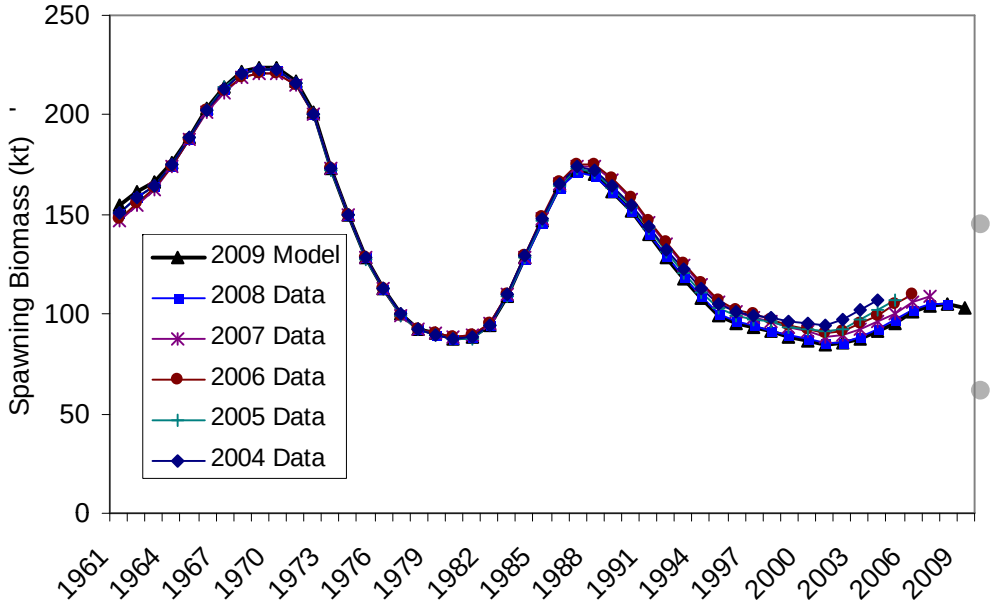


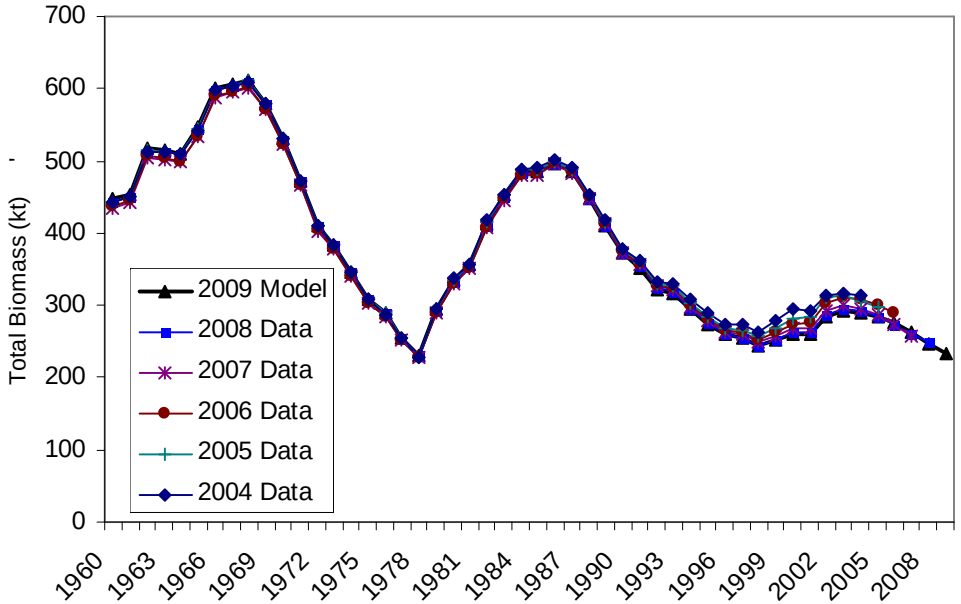


Trends

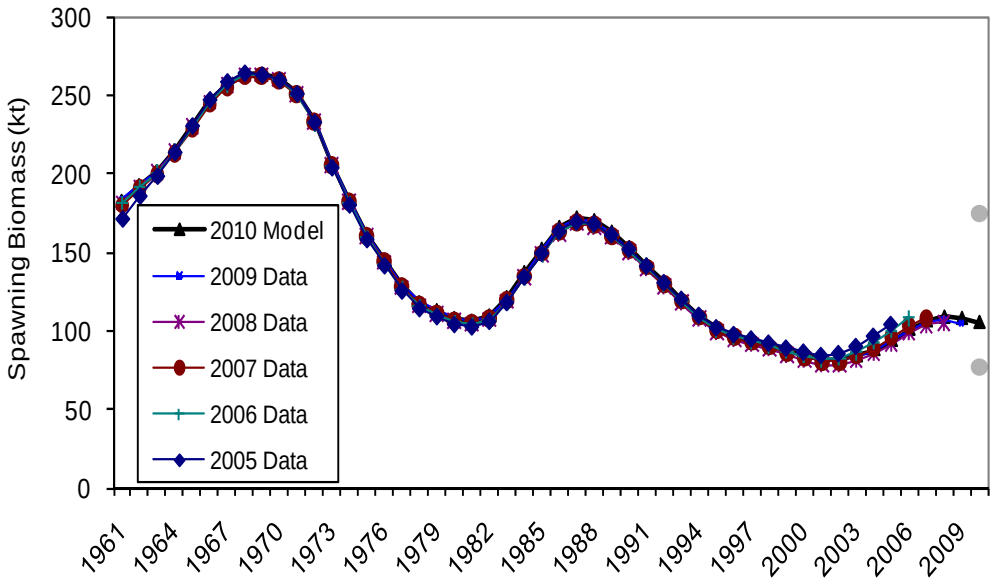
- Spawning biomass leveling off
- Total biomass has increased slightly from last year's estimates

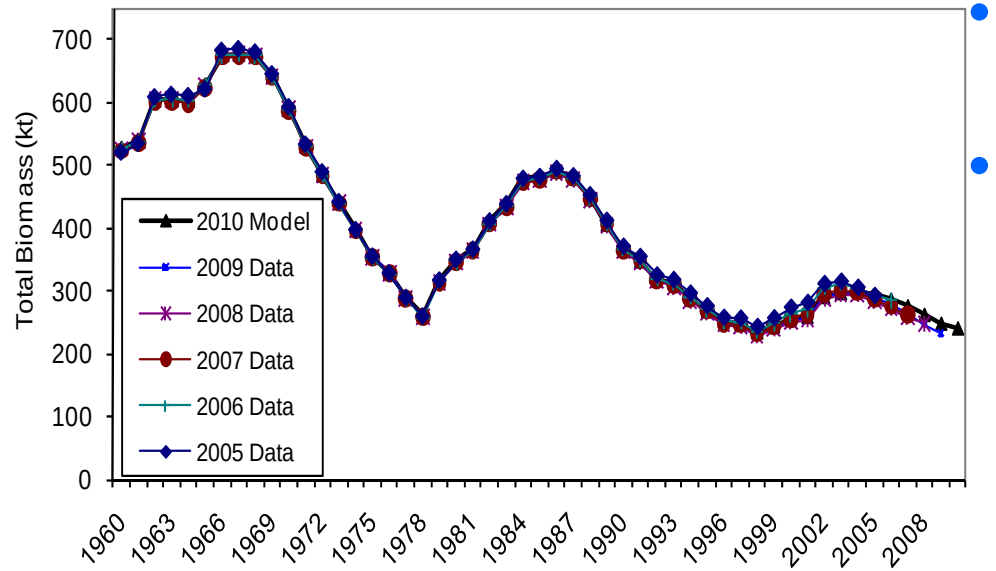
Trends





- Spawning biomass leveling off
- Total biomass has increased slightly from last year's estimates
- Retrospective pattern dissipating last year

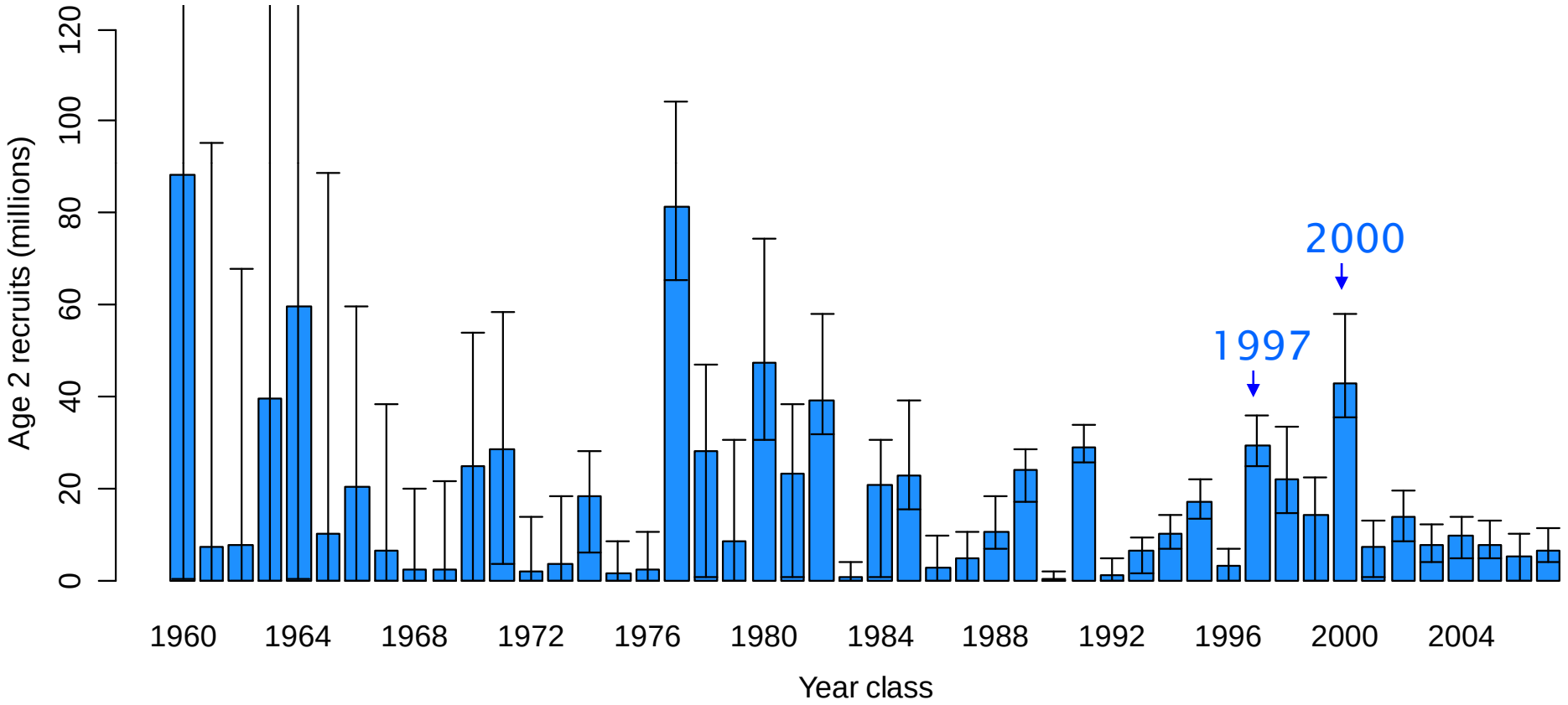




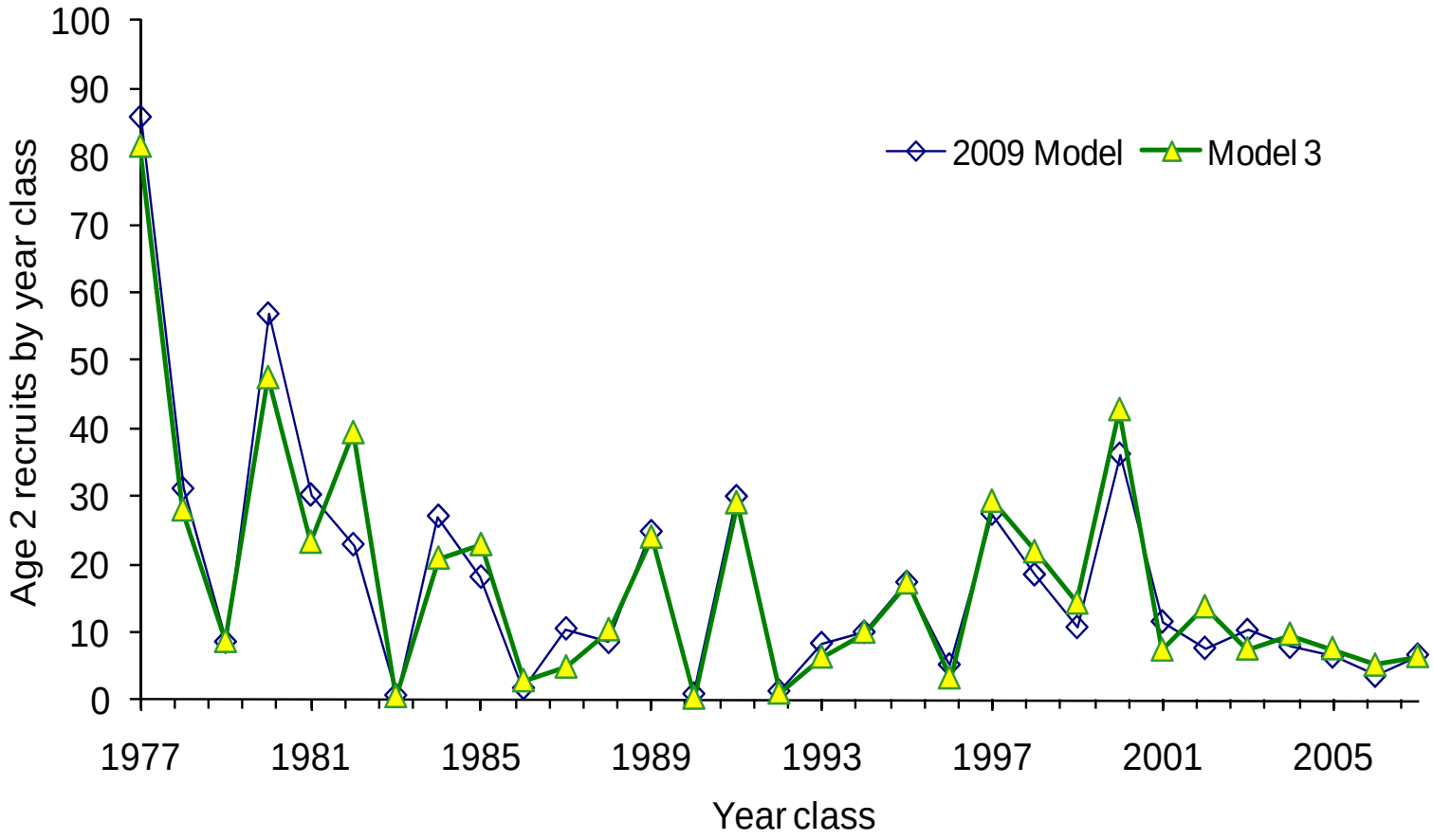
Trends

- Spawning biomass leveling off
- Total biomass has increased slightly from last year's estimates
- Retrospective pattern dissipating last year
- Pattern gone this year

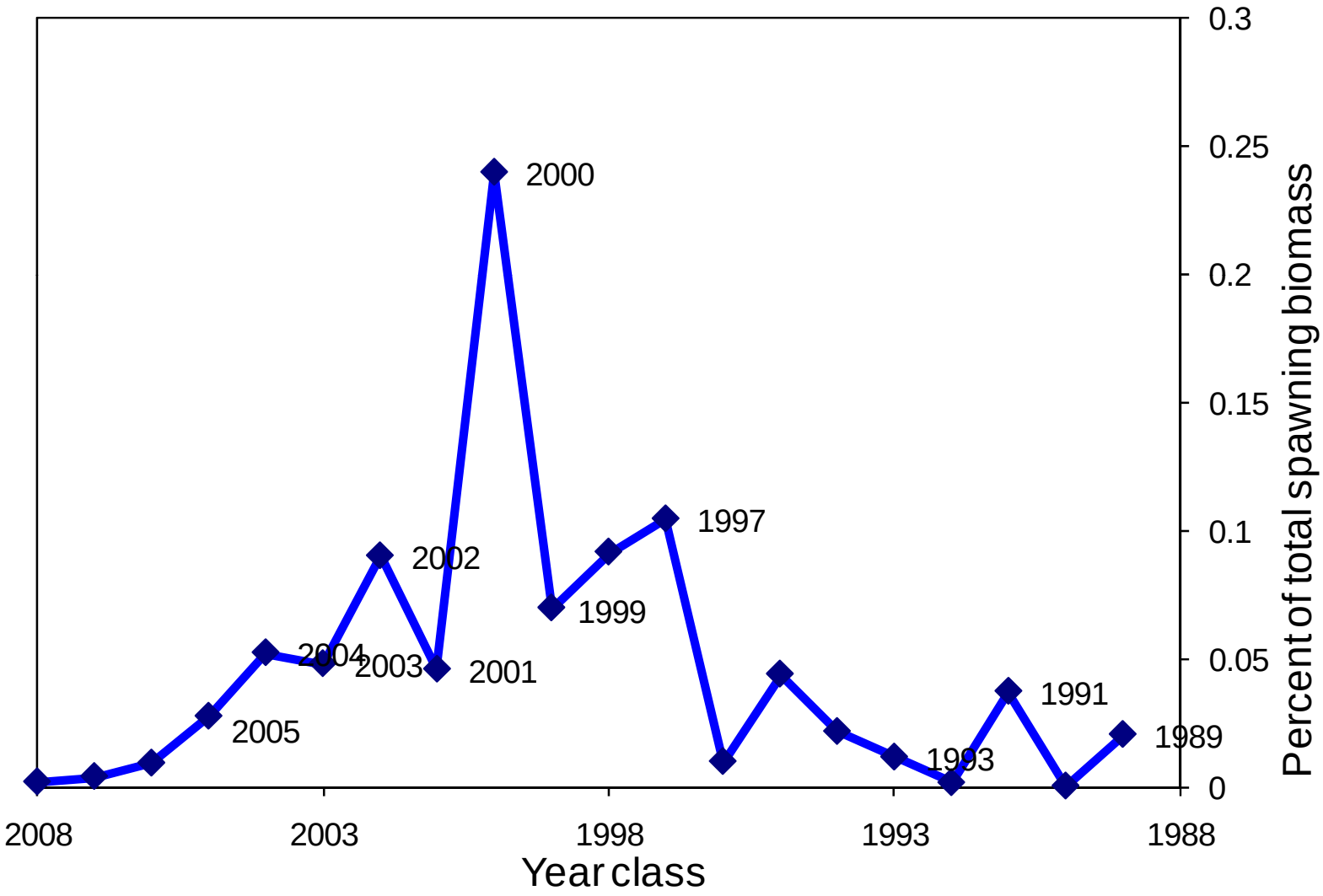
Sablefish: Recruitment



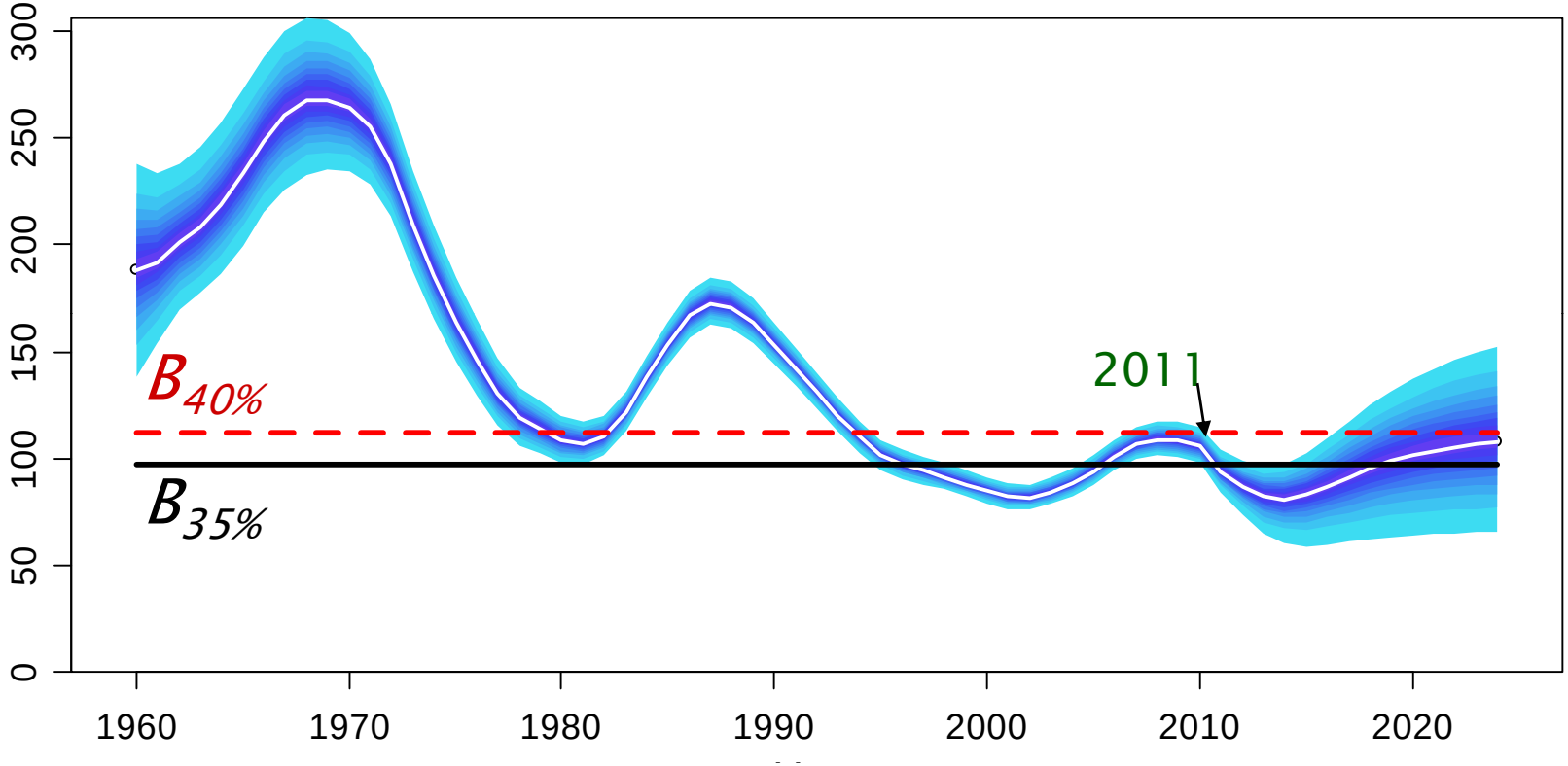
Recruitment



Projected Spawners by year class



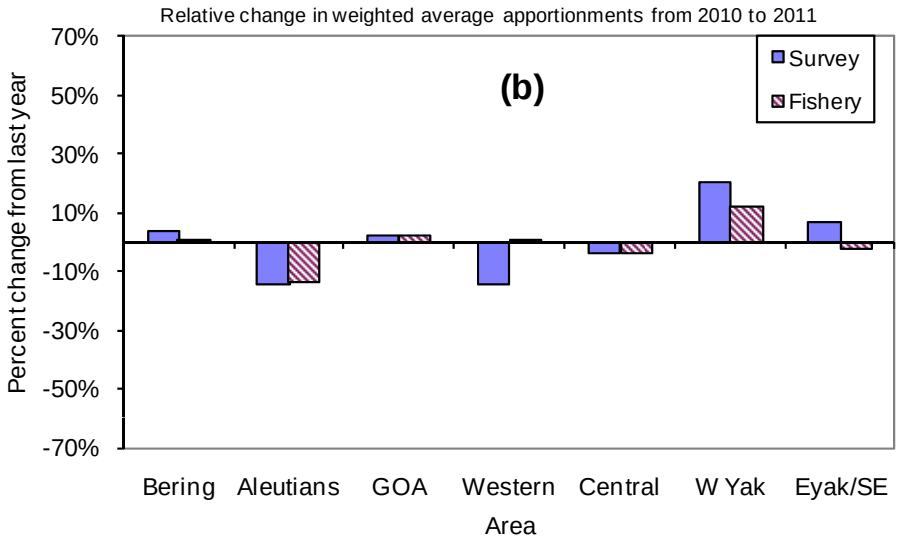
Sablefish: Projection

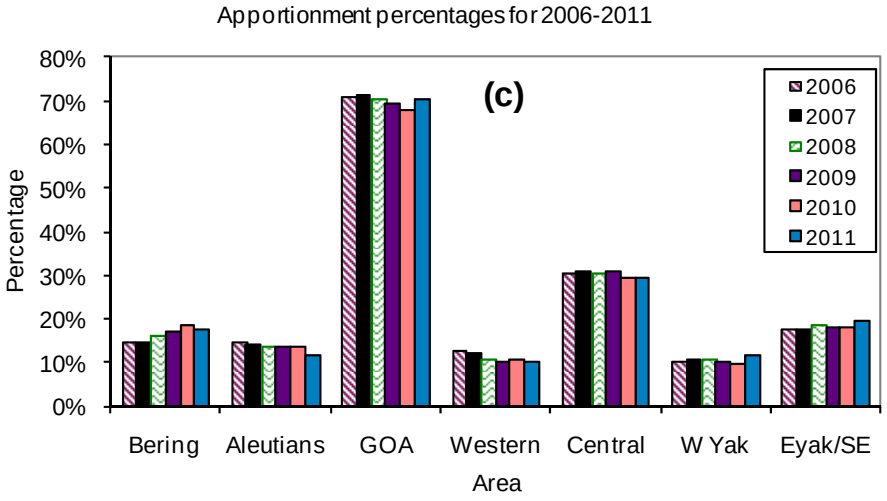


Sablefish: ABC

- 37% unfished spawning biomass
- ABC 2010: 15,230 t
- ABC 2011: 16,040 t (vs. 13,660 projected)
  - 5 % increase from 2010
- 2012? May be lower, but two surveys next year (14,700 projected for 2012)

Sablefish: Apportionment





- Eastern Gulf increase
  - Wyak up 24%
- All western areas decrease share
  - WG and AI ABC decrease
- Central GOA ABC increase in line with overall increase

Take home message

- No real changes in model, changes are in data
- Data changes in response to requests and in preparation for new RPN index
- Changes in workforce
- Production model versus research model
- We may change the data, but not the model

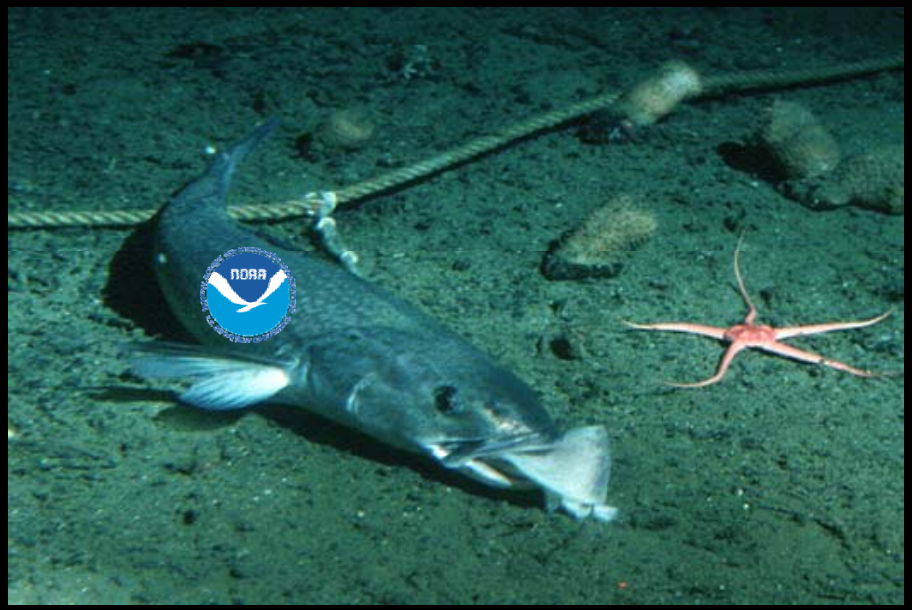
Future

- Modeled survey RPN index that incorporates both types of whale depredation
- Modeled fishery index to better track abundance
- Analyze recent tagging data to revisit movement estimates and apportionment

Factors Affecting Sablefish Recruitment in Alaska

Marine Ecology and Stock Assessment Staff

ABL 2010



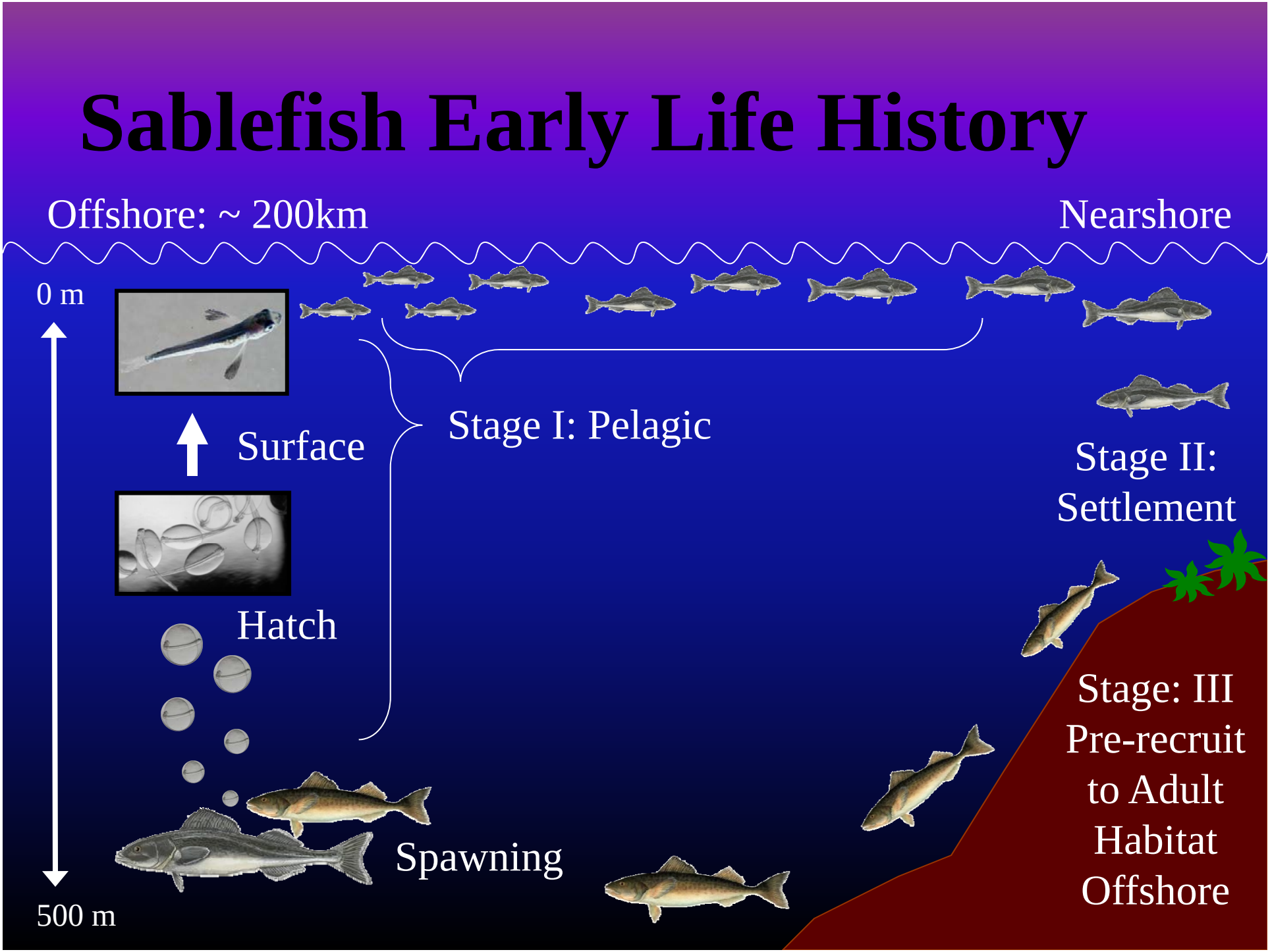
Background

- 2009 Alaska Sablefish EFH Update
  - Little known on juvenile EFH, but known to reside in habitat subject to intense fishing
  - Authors suggested for NMFS to consider implementing small, unobtrusive research closures within multi-species context
  - Will increase understanding of changes to the ecosystem and to EFH for multiple species
- In response, Council requested document on all factors that may affect sablefish recruitment
- This document is a response to that request

Outline

- Early life history (ELH) of sablefish
- Issues estimating recruitment for sablefish
- Three-stage rationale defining recruitment along with available data for each stage
  - Stage I: pelagic offshore to nearshore
  - Stage II: nearshore settlement
  - Stage III: pre-recruit migration to adult habitat
- Potential factors affecting recruitment
  - Environment, competition, predation, fishing
- Discussion
  - Current research projects, data gaps, conservation

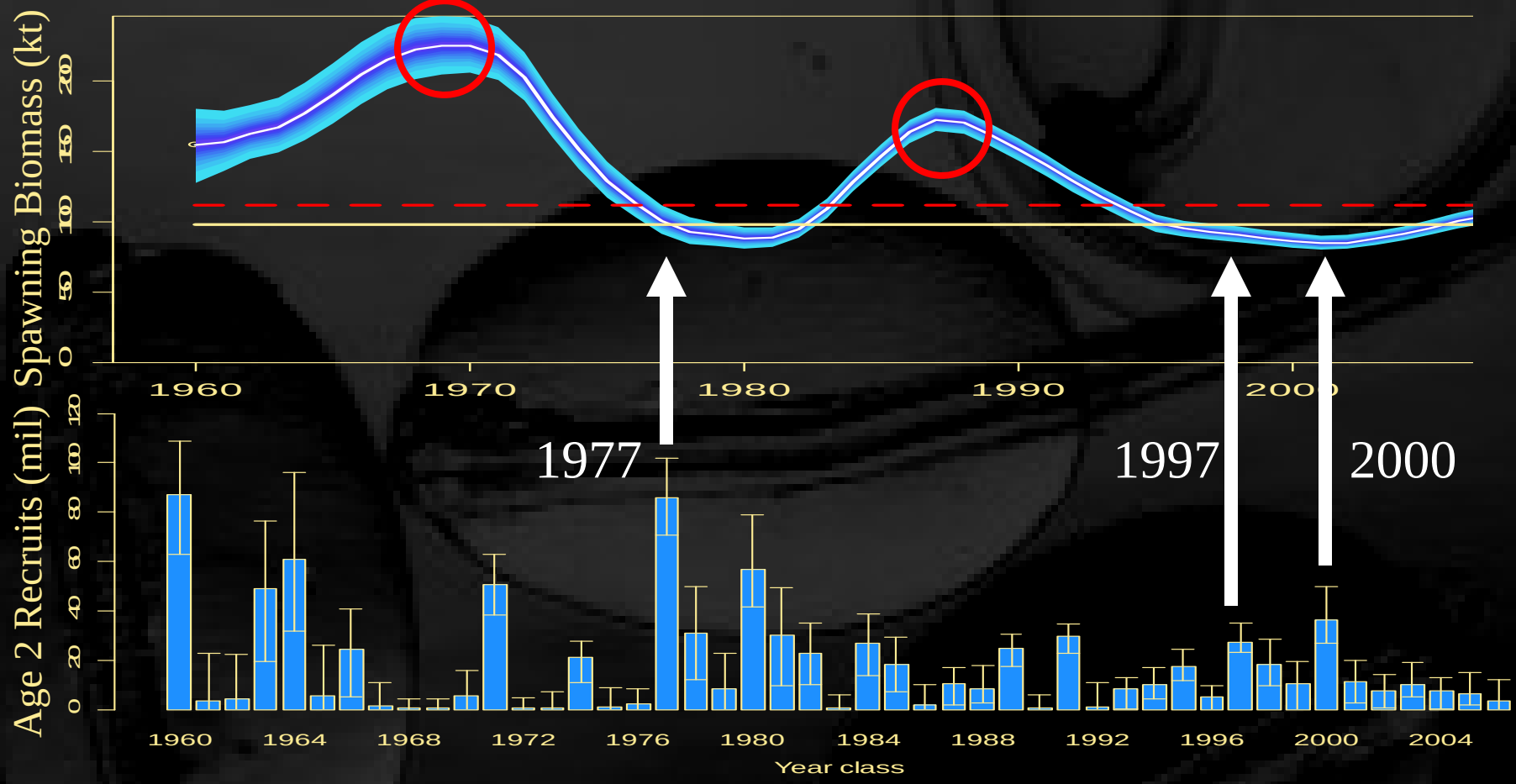
Sablefish Early Life History



Issues Estimating Recruitment

- Alaska sablefish model
  - No stock/recruit relationship, only mean recruitment and annual deviations, estimates as 2-yr-olds
- Problem: developing a recent reliable estimate
  - Limited understanding of the underlying processes that influence recruitment
  - High uncertainty in most recent recruitment estimates where little information from other data sources
  - Issues produce a net loss of efficiency in catch level setting system, potential to under/over harvest

Sablefish Trends



Peak in biomass in late 1980s due to large 1977 year class , but low levels of spawning biomass. Also in 1997 and 2000 when low levels of fishing. Recruitment likely more related to the environment.

Stages of Recruitment

- Stage I: pelagic offshore to nearshore
  - Rapid growth requirements and transport
  - FOCI, GLOBEC, MESA, SECM data
- Stage II: nearshore settlement
  - Suitable demersal habitat, competition, predation
  - ADFG, MESA, high res bathymetry and substrate data
- Stage III: pre-recruit migration to adult habitat
  - Competition, predation, fishing interactions
  - AFSC, MESA, IPHC trawl/longline surveys

Factors Affecting Recruitment

- Environment
  - S1: transport influenced by mesoscale features (eddies)
  - S1: features impact stability of water column and blooms
- Competition
  - S1-2: diet of euphausiids high overlap with other species
- Predation
  - S2-3: not primary food source, but seabirds in nearshore and adult groundfish on shelf could influence survival
- Fishing
  - S2-3: direct removals or habitat degradation, but overall low discard mortality

Discussion

- Three new research projects on recruitment
  - P1-NASA: utilizing satellite derived variables in assessment
  - P2-FATE: polar front dynamics to identify mechanisms
  - P3-NPRB GOA-IERP: offshore/nearshore surveys on sablefish distribution and condition, ecosystem modeling
- Data Gaps/Priorities
  - Spatial distribution of spawners
  - Juvenile benthic habitat preferences

Conservation Concerns

- Ecological factors likely the main influence on sablefish recruitment
  - Transport, food, competition, predation, habitat
- New research projects provide insight
  - May highlight areas or seasons that could respond well to protection
- Premature to recommend conservation measures specifically for sablefish at this time
  - Continue to suggest small, unobtrusive closures are one tool for understanding effects of fishing
  - Future conservation should be in multi-species context