Science, Service, Stewardship

SEDAR 31 Review Workshop: Data Inputs

Gulfport, MS

April 29 – May 3, 2013

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Commercial Statistics

- Modern landings
- Historic landings
- Discards
- Shrimp bycatch
- Size composition
- Age composition

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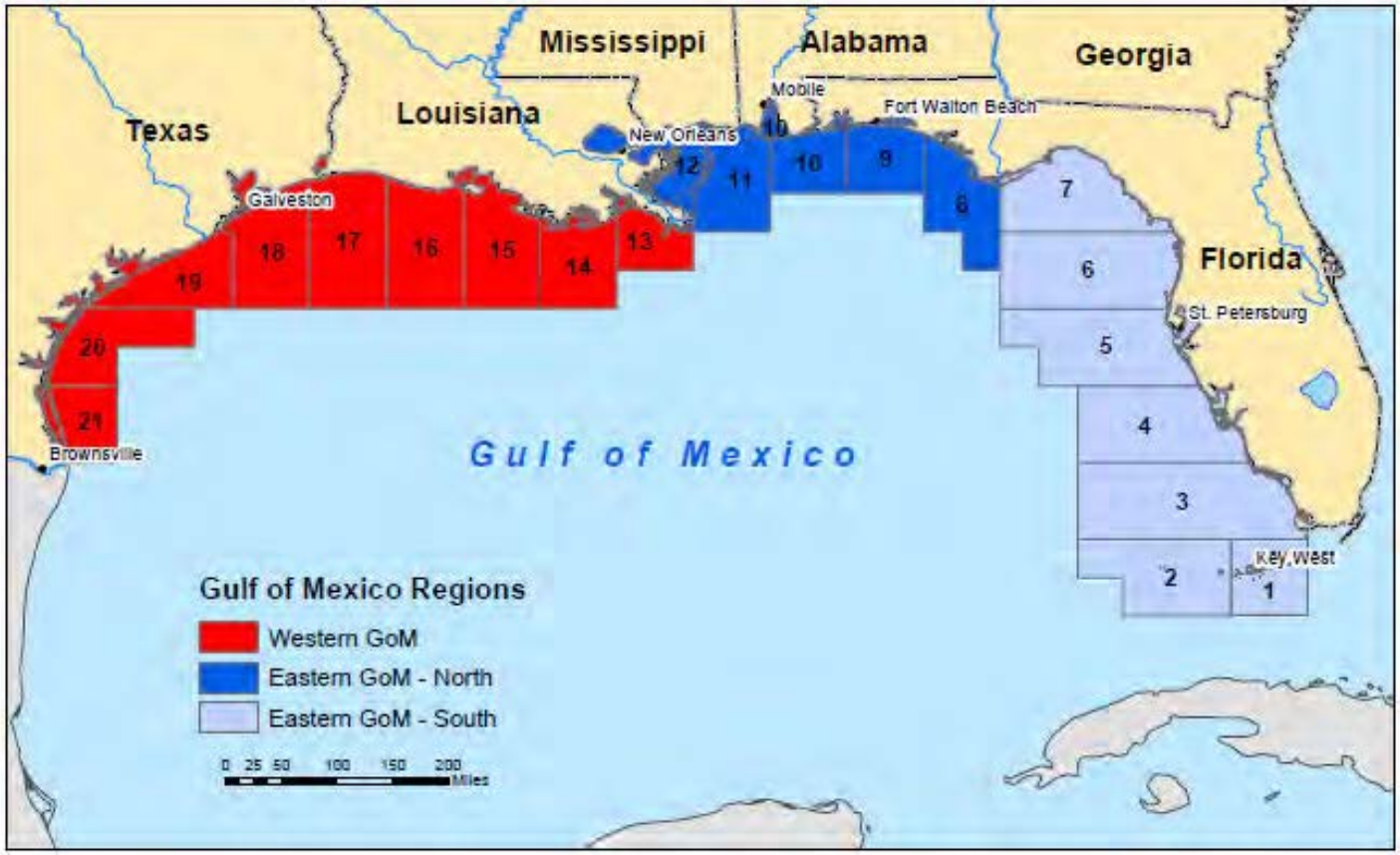
Regions



Only HL split out by NE and SE regions

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Modern Commercial Landings

- Fleets:
  - Longline, 1980-2011
  - Handline and other non-longline fisheries, 1964-2011
- Data sources:
  - ALS
  - IFQ program
- For IFQ period, ALS landings scaled to match IFQ landings to maintain gear and water body information
- 1978-1983 TX landings apportioned using Parrack and McClellan (1986)

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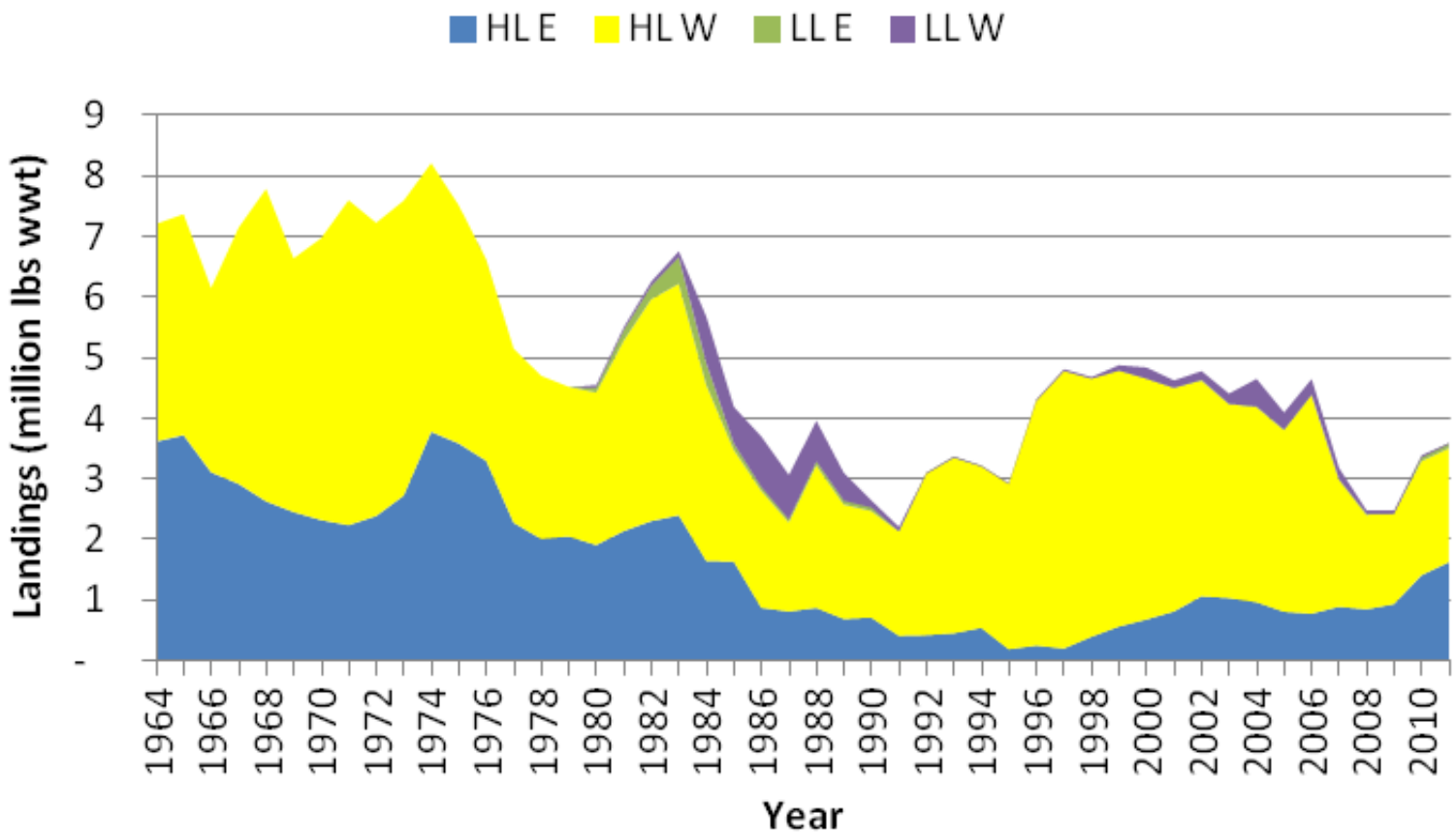
Modern Commercial Landings



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Historic Commercial Landings

- SEDAR 7 historic time series recommended for use in SEDAR 31 by DW
- Fleet: handline, 1872-1963

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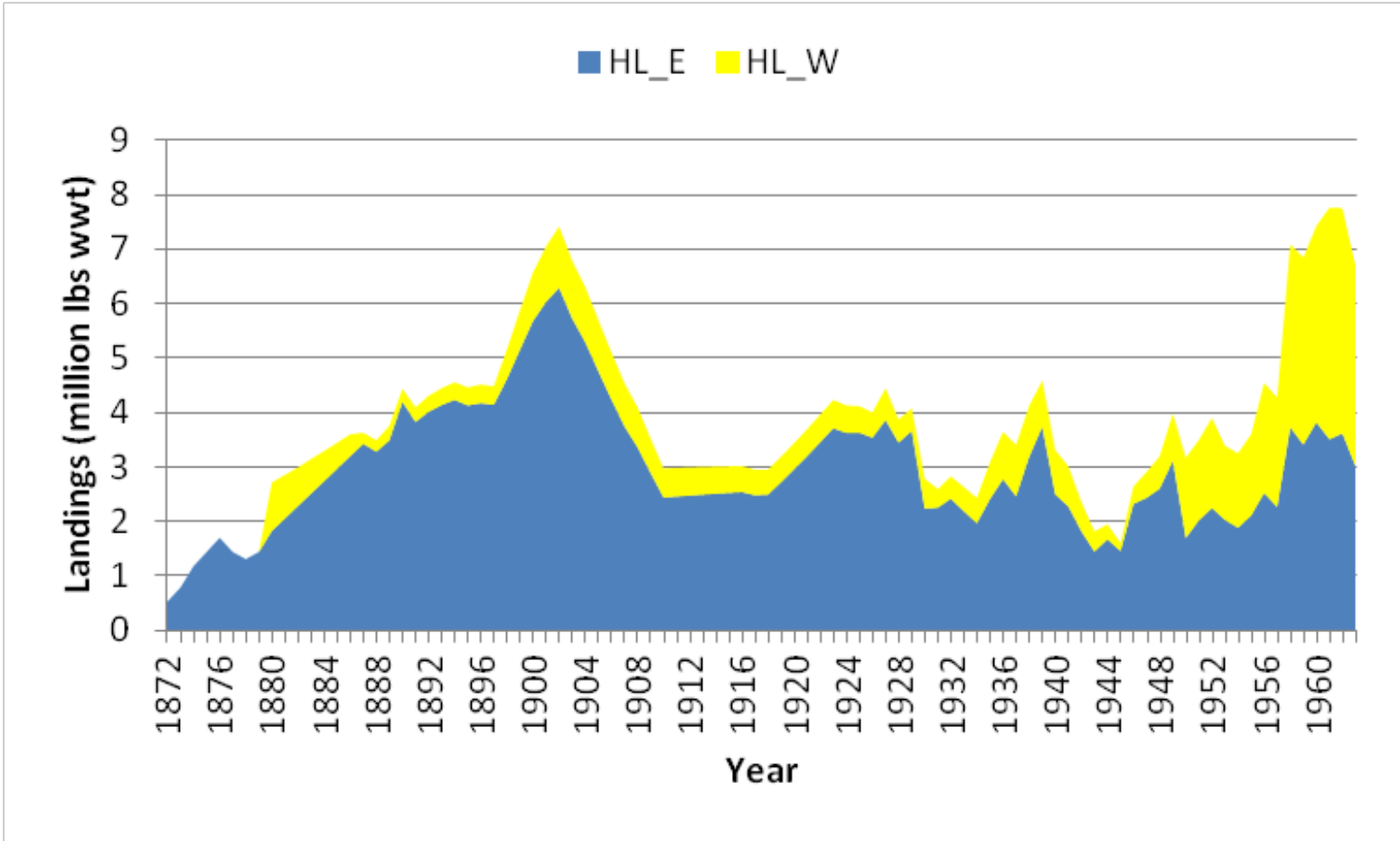
Historic Commercial Landings



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Commercial Discards

- Fleets:
  - Longline, 1990-2011
  - Handline, 1990-2011
- Data Sources:
  - Commercial logbooks, 1990-2006
  - Observer program, 2007-2011
- Trips reporting no discards of any species were excluded from analysis
- Discard rates calculated from logbook or observer data and applied to total effort

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Commercial Discards

- Discards apportioned into open and closed season, 1990-2006
- For IFQ period, 2007-2011
  - Open season discards = discards from trips with IFQ allocation
  - Closed season discards = discards from trips with no IFQ allocation
- Closed season discards from handline and longline combined into commercial closed season discard fleet

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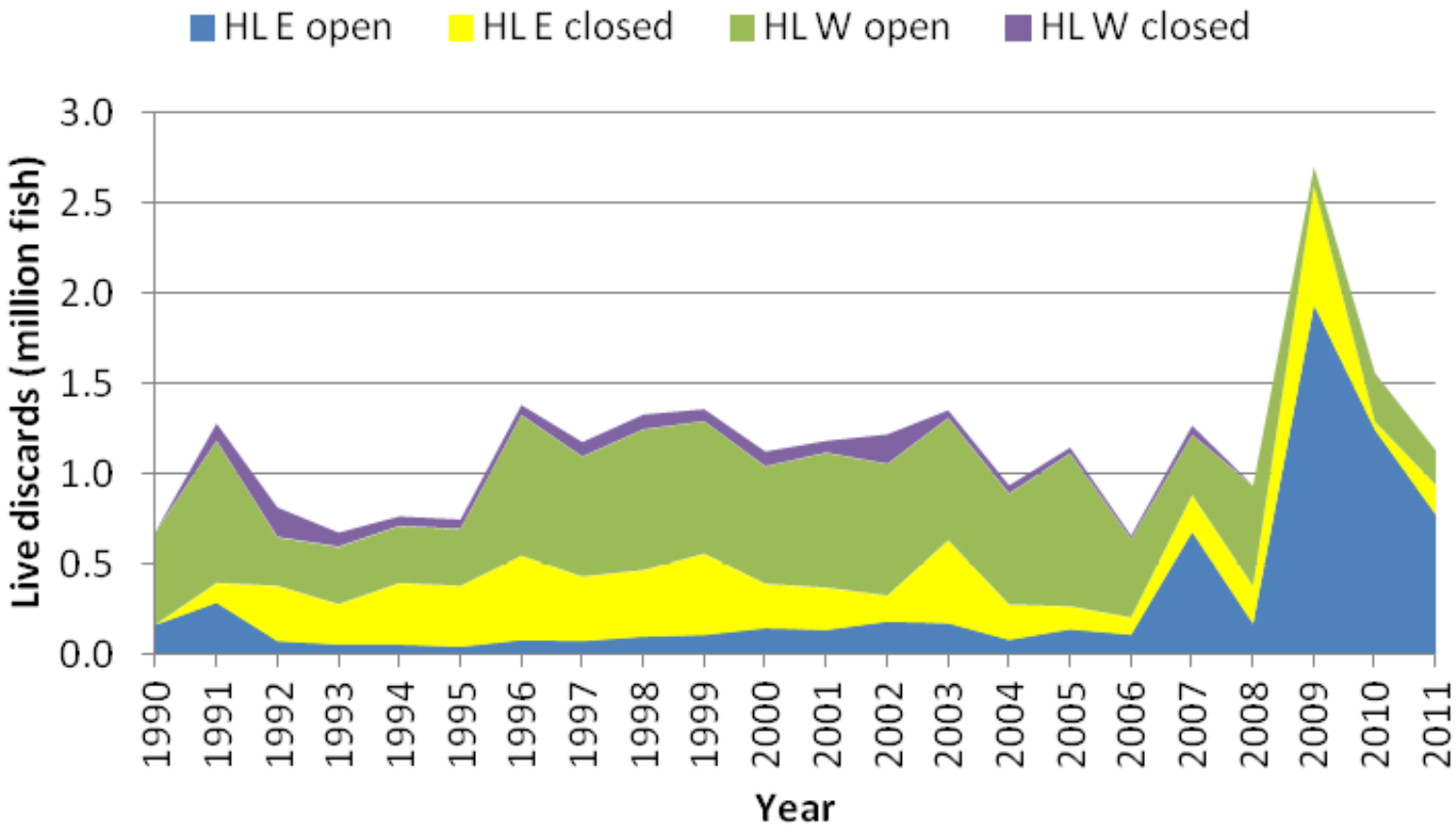
Commercial Handline Discards



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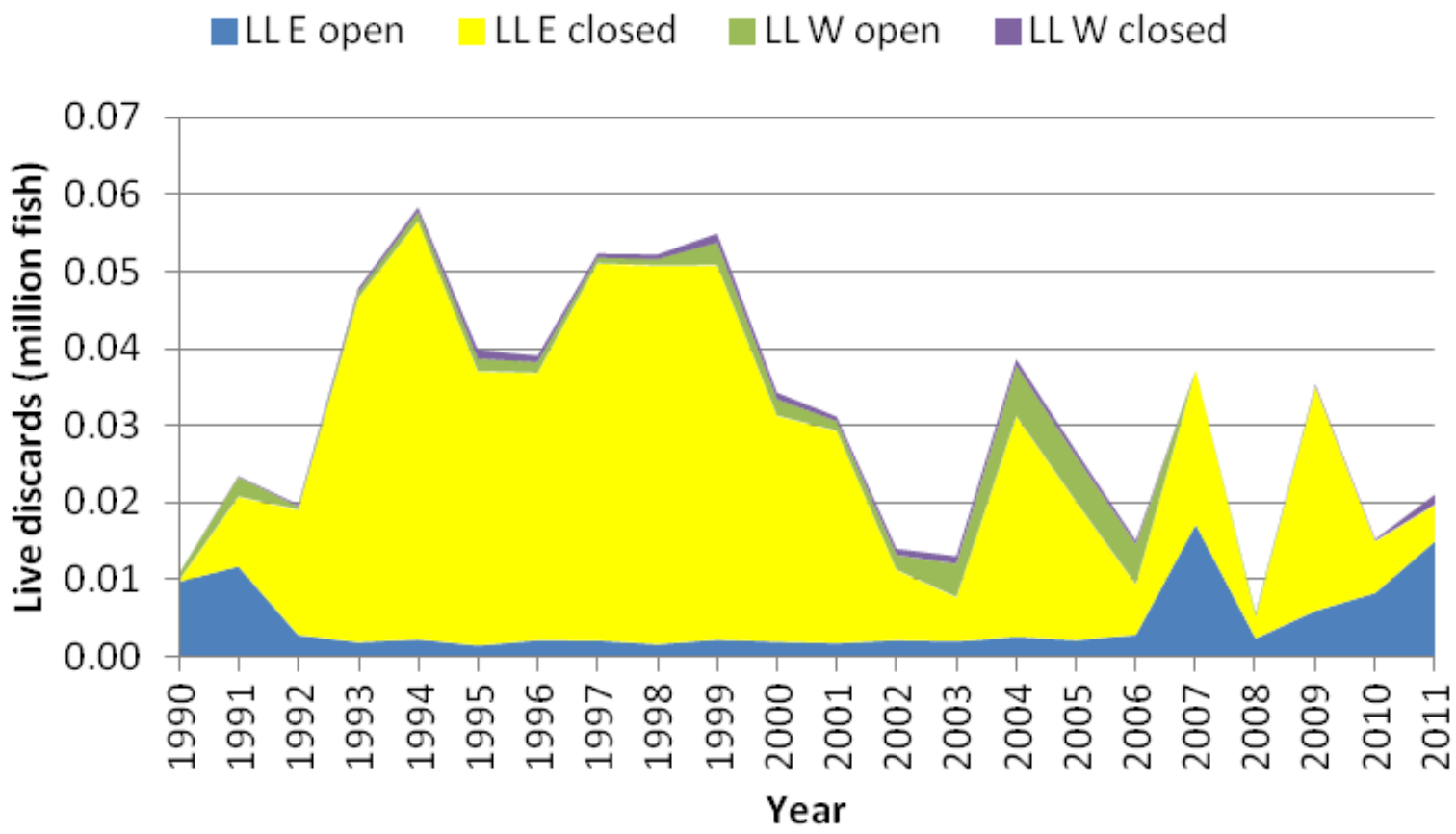
Commercial Longline Discards



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Shrimp Bycatch

- Used Bayesian approach developed by Scott Nichols for SEDAR 7: Gulf of Mexico Red Snapper Assessment
- Made two runs:
  - 2 depth zone run (inside 10 fm, outside 10 fm)
  - 3 depth zone run (inside 10 fm, 10-30 fm, outside 30 fm)
- DW recommended and AW approved use of 3 depth zone run in assessment model

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Shrimp Bycatch

- Annual shrimp bycatch estimates were highly uncertain (e.g., CVs > 200%)
- AW felt that uncertainty would be reduced by using estimates of median shrimp bycatch and shrimp effort
  - Effort series provides trend
  - Median bycatch provides scaling
- 1972-2011 Median shrimp bycatch estimates:
  - East = 1,118,000 fish
  - West = 20,680,000 fish

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Shrimp Effort

- Modern shrimp effort (1960-2011) estimated by Galveston lab using SN-pooled model
- Historic shrimp effort (1946-1959) derived from numbers of shrimp vessels reported in VOUF
- Used only shrimp effort for depths > 10 fm as representative of effort that catches red snapper
- Effort series used as an index of shrimp bycatch F

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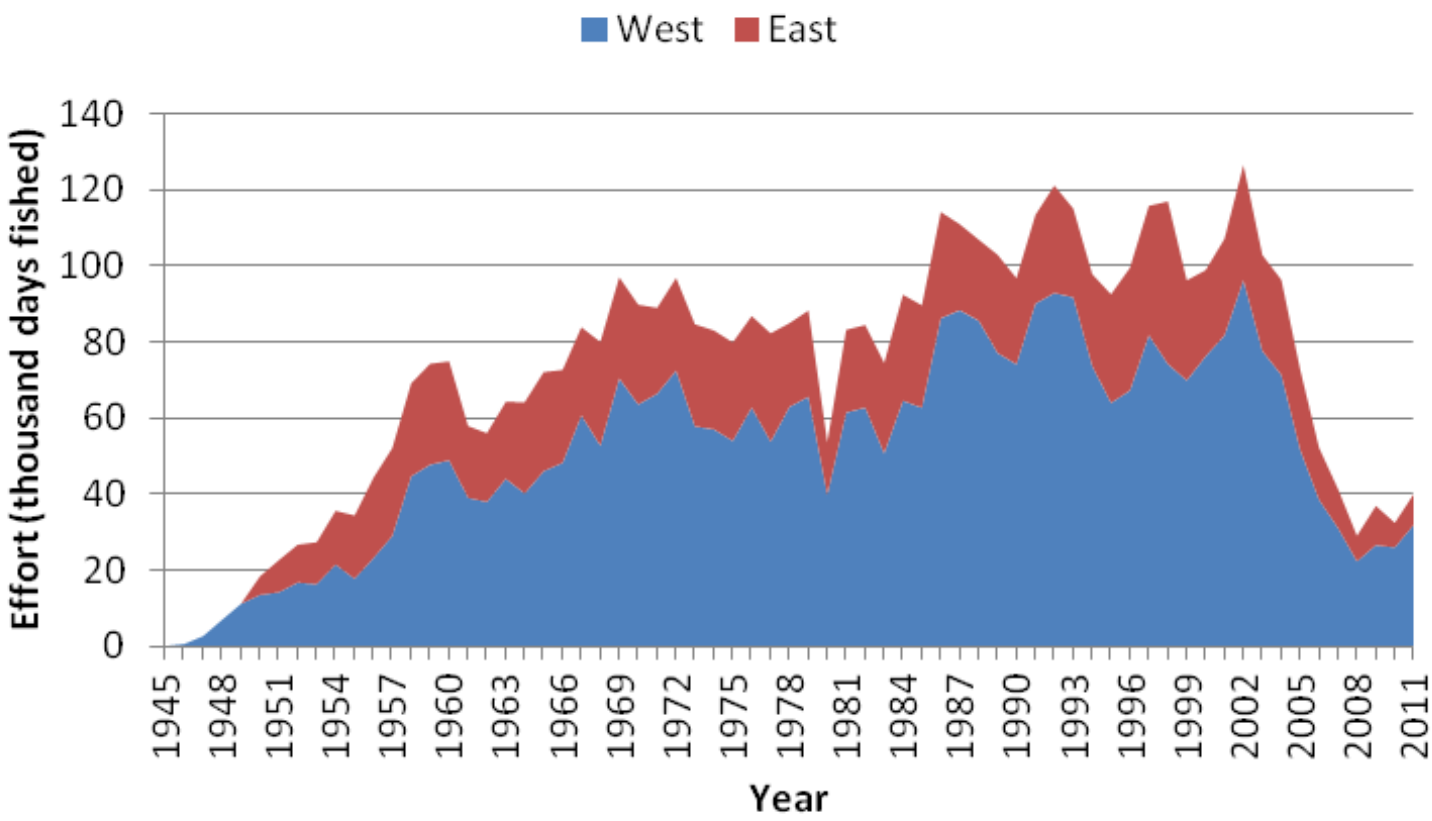
Shrimp Bycatch Effort (> 10 fm)



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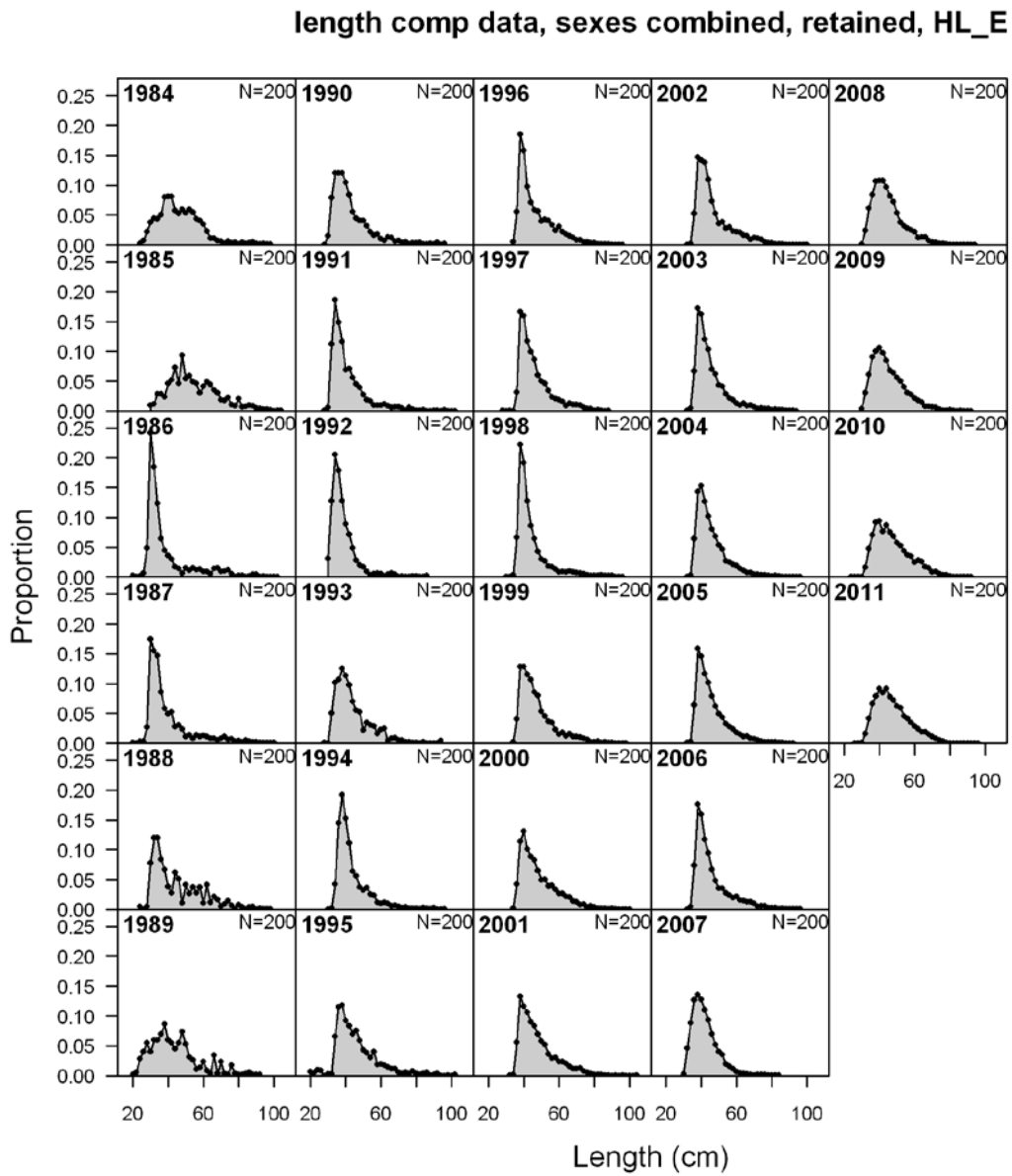
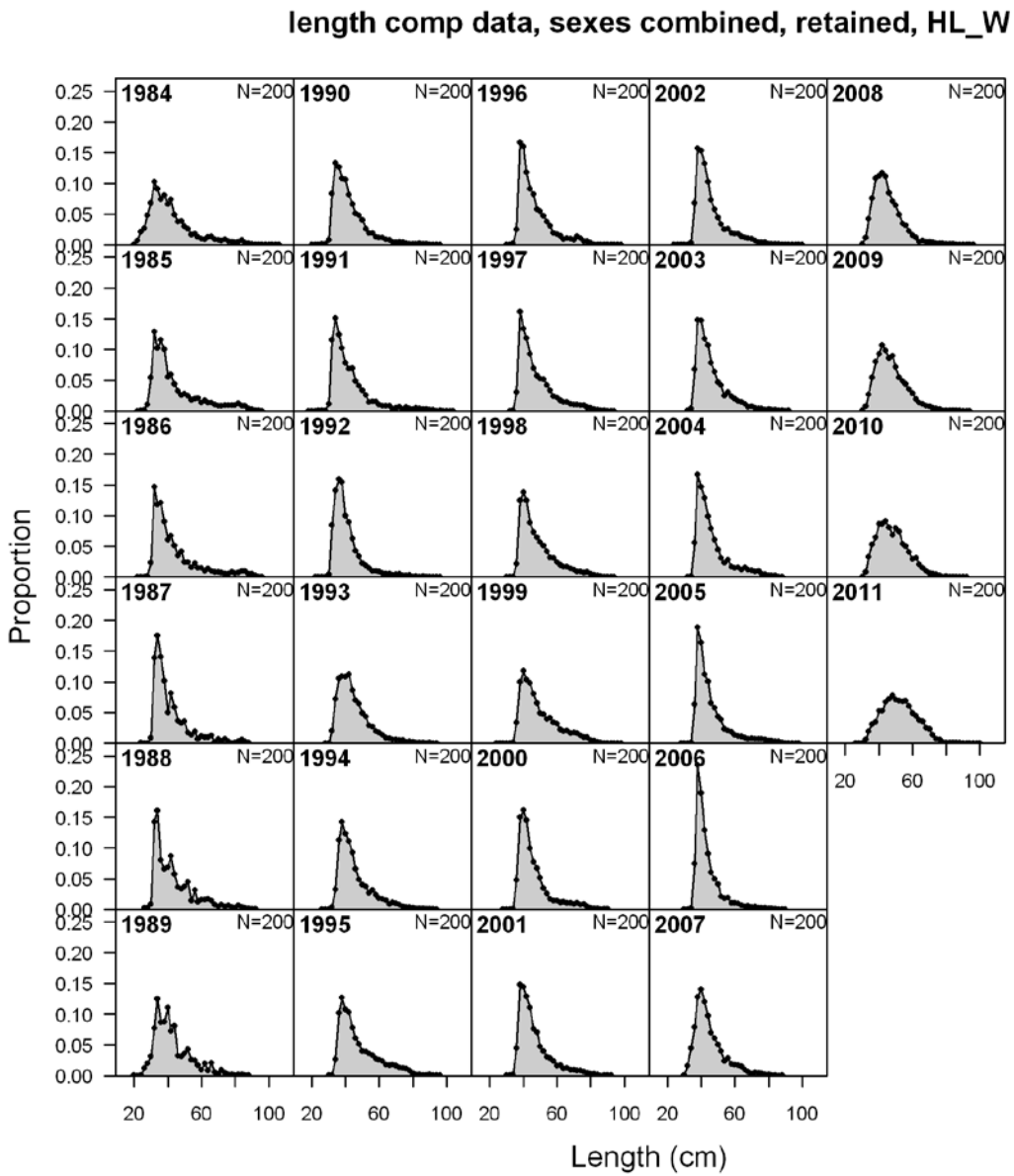
Commercial Size Composition

- Fleets:
  - Longline, 1992-2011
  - Handline, 1992-2011
- Data sources:
  - TIP
  - Gulf FIN
- NE and SE handline size comps weighted by landings to produce E handline size comps

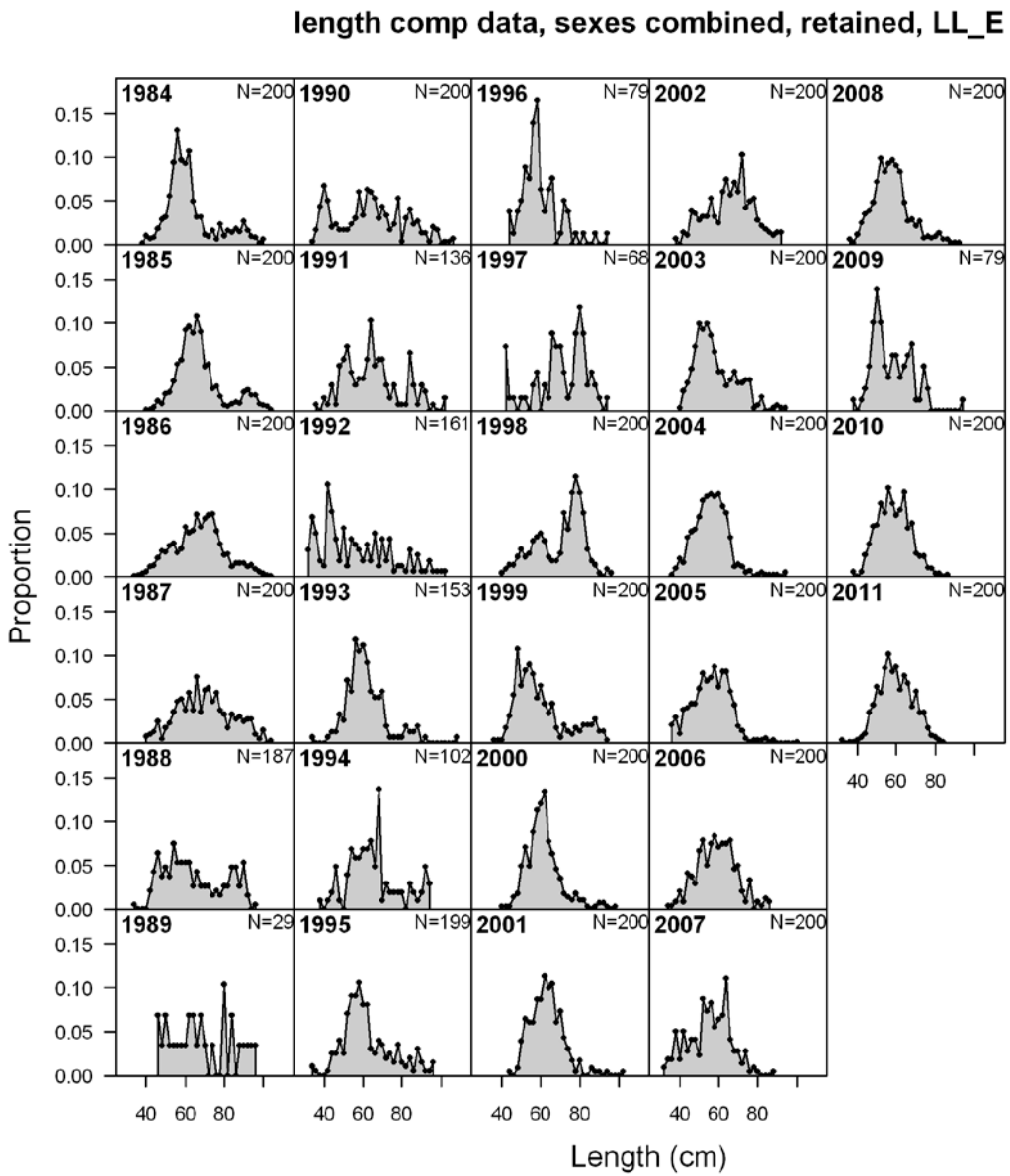
Handline East Size Comps



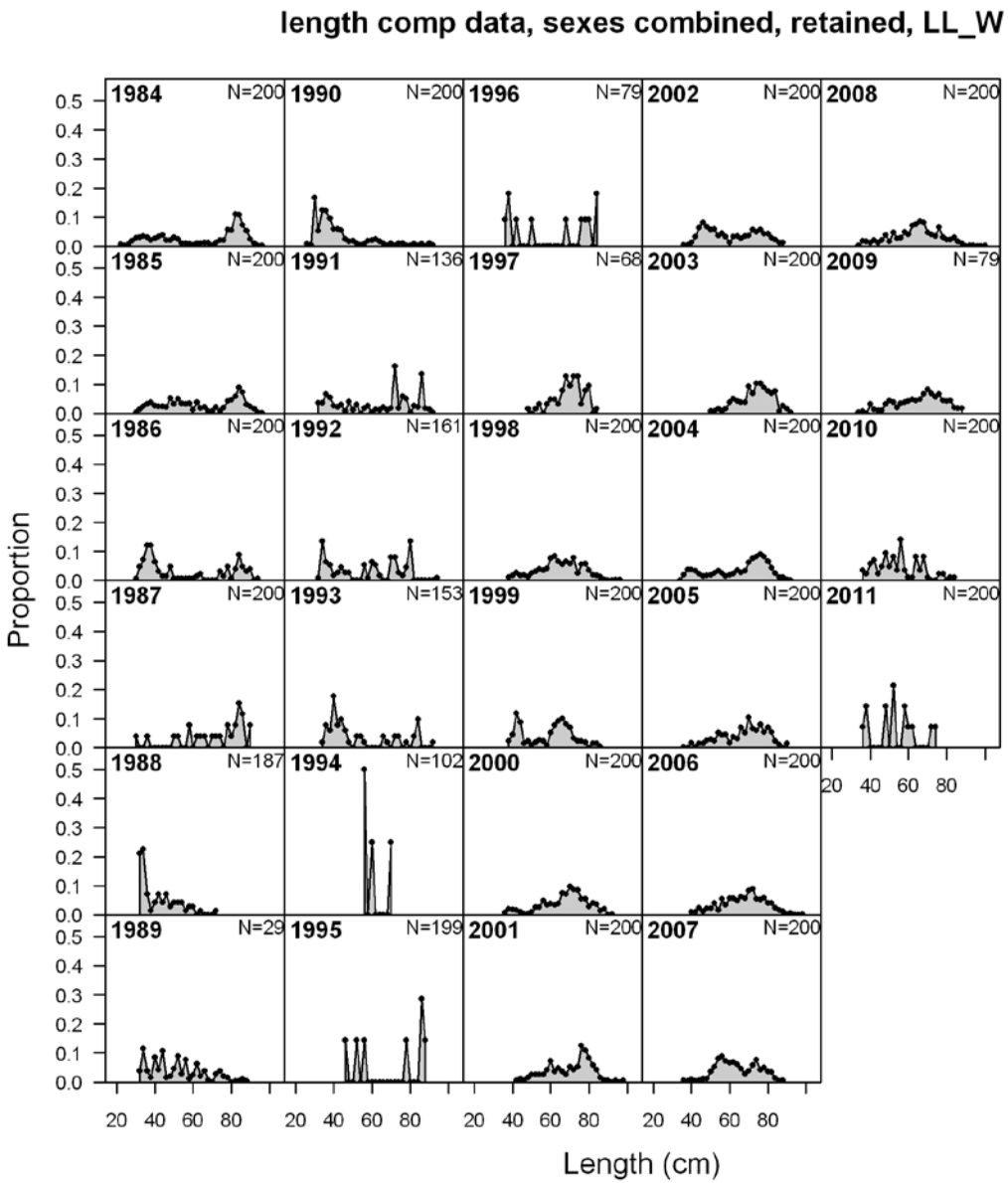
Handline West Size Comps



Longline East Size Comps



Longline West Size Comps



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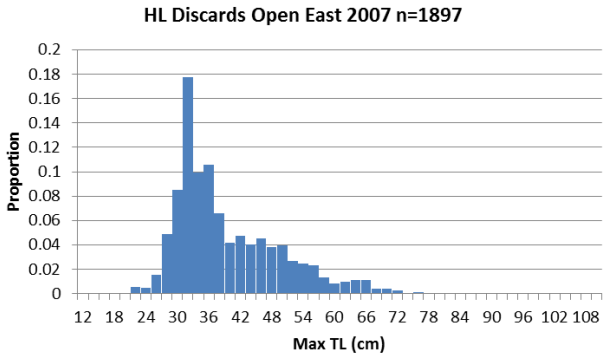
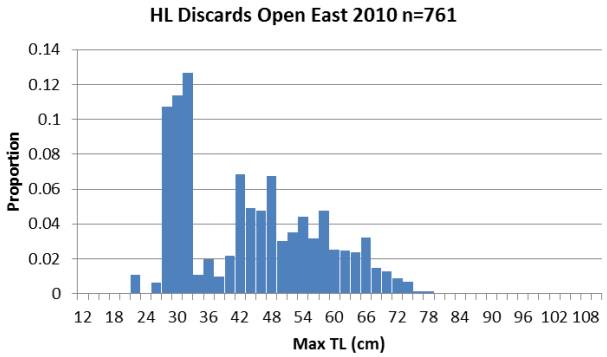
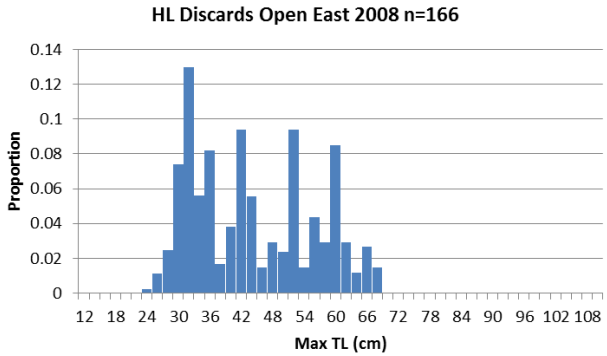
Commercial Discard Size Comps

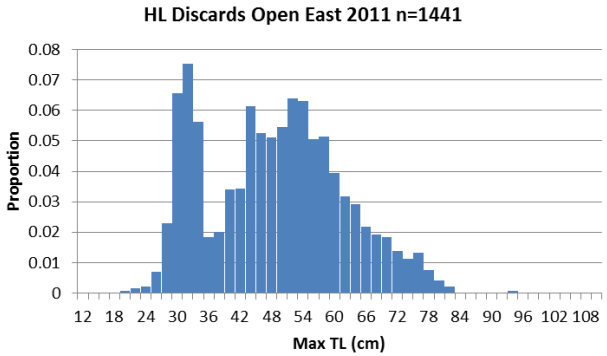
- Fleets:
  - Longline, 2007-2011
  - Handline, 2007-2011
- Data source:
  - Observer program
- Allocation bins in lbs:
  - Longline: 0, 1+
  - Handline: 0, 1-500, 500-1500, >1500
- Handline bins for 1+ lbs weighted by number of trips in each bin from commercial logbooks and combined

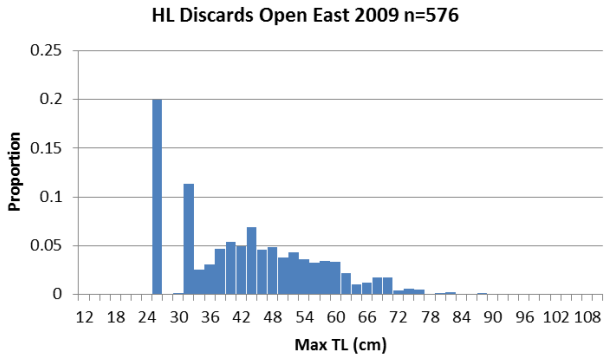
Handline Discard East Open Size Comps



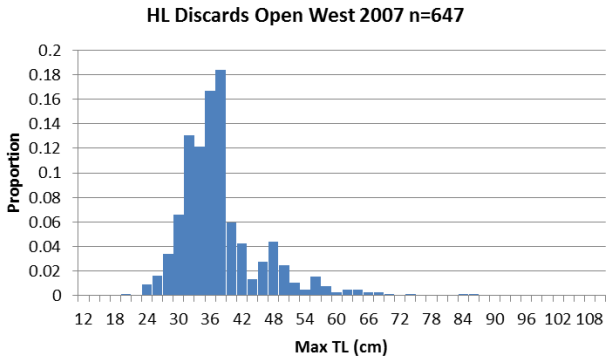


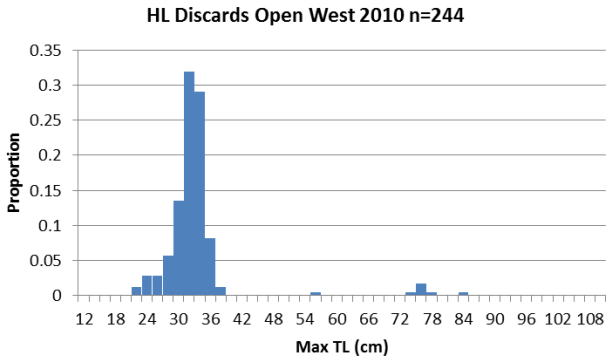


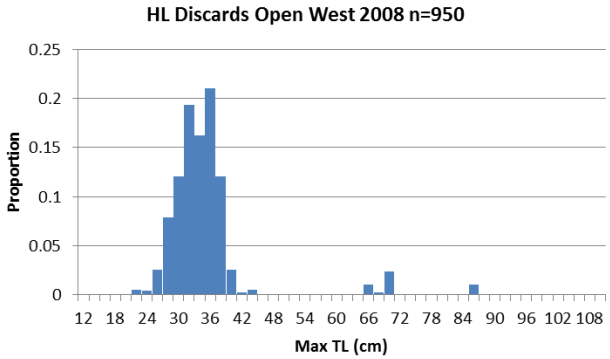


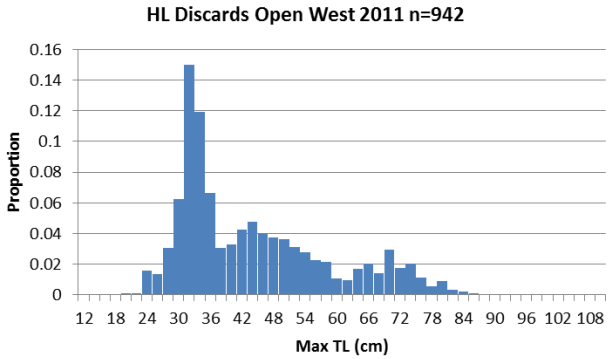


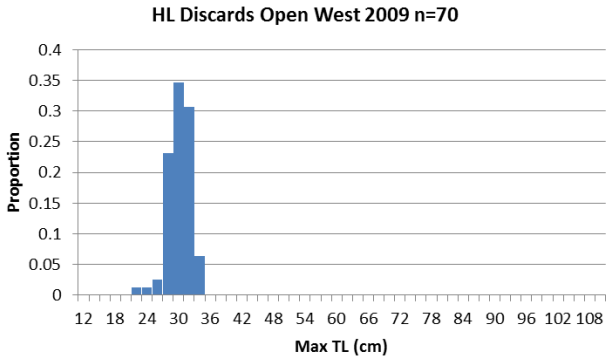
Handline Discard West Open Size Comps



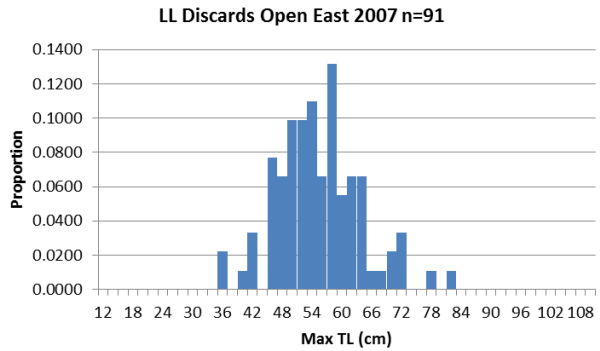


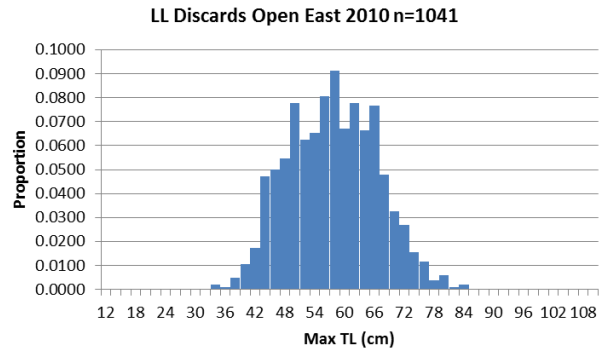


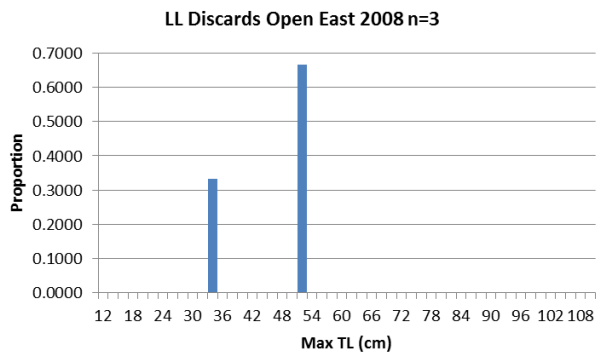


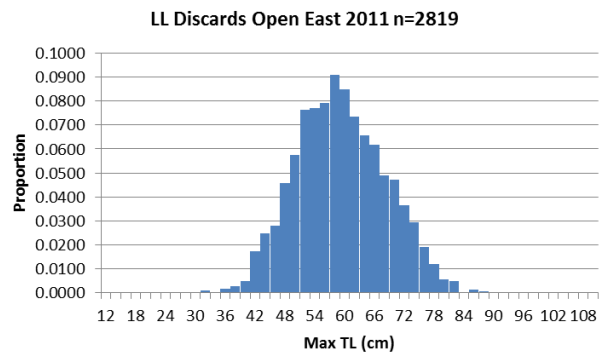


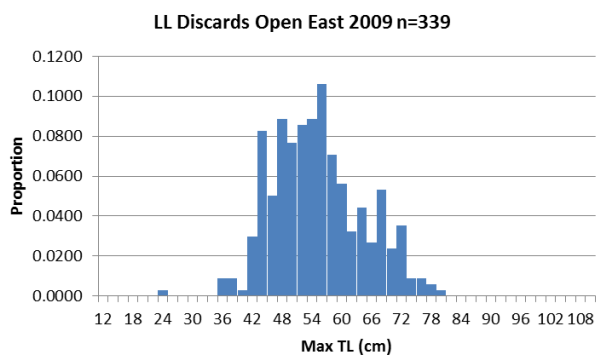
Longline Discard East Open Size Comps



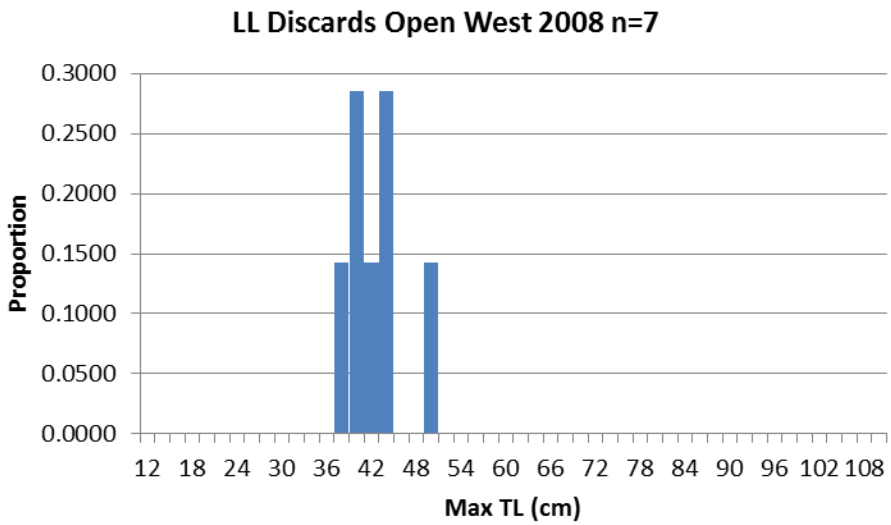


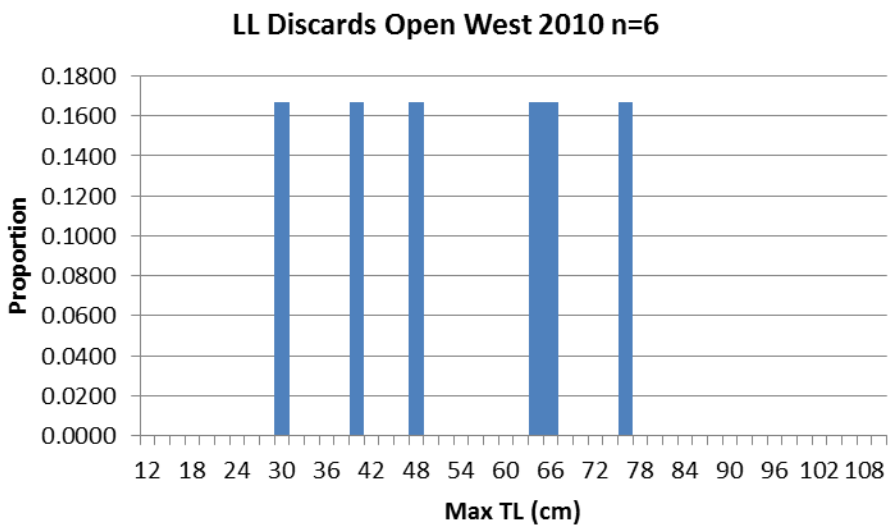




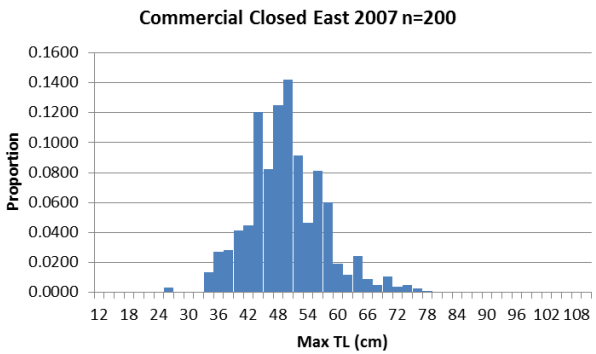


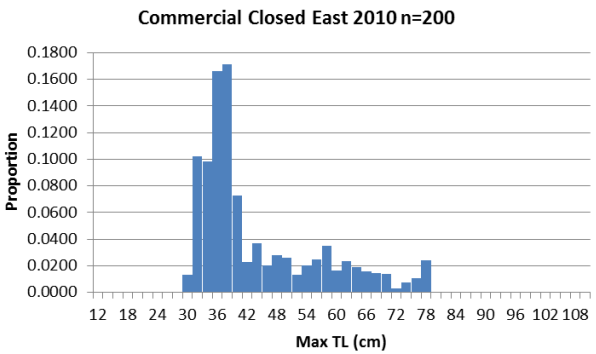
Longline Discard West Open Size Comps

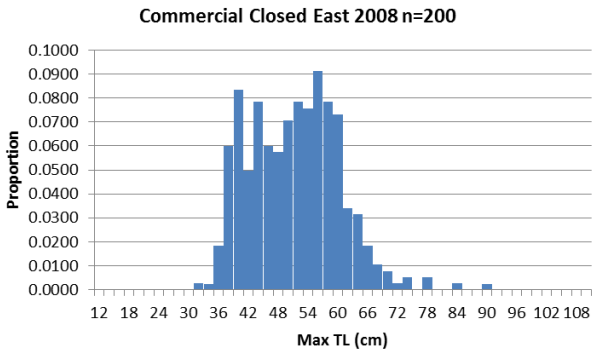


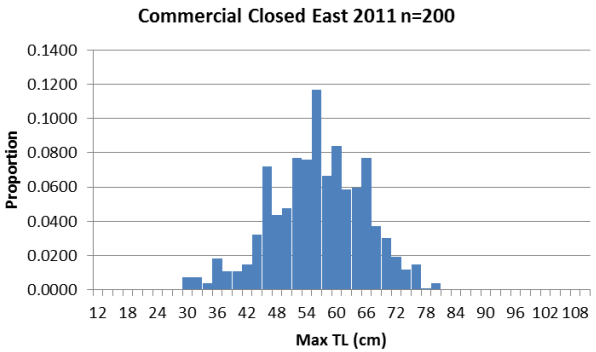


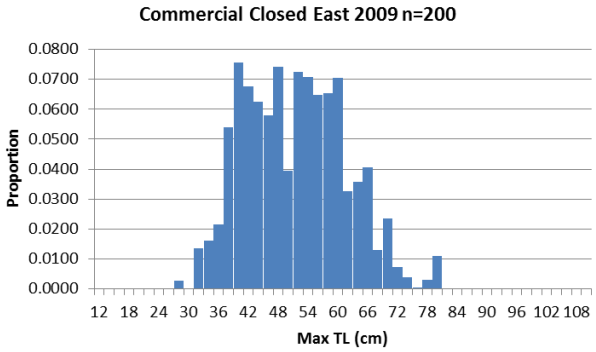
Commercial Closed Season East Size Comps



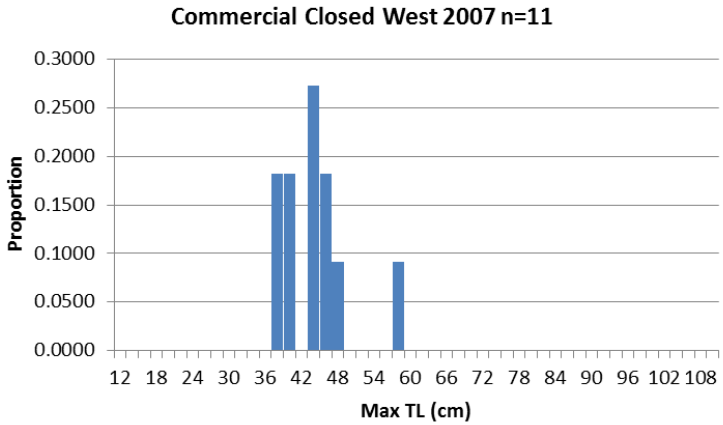


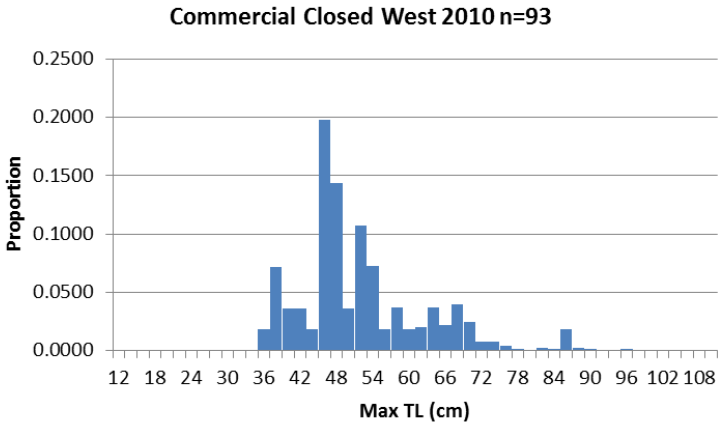


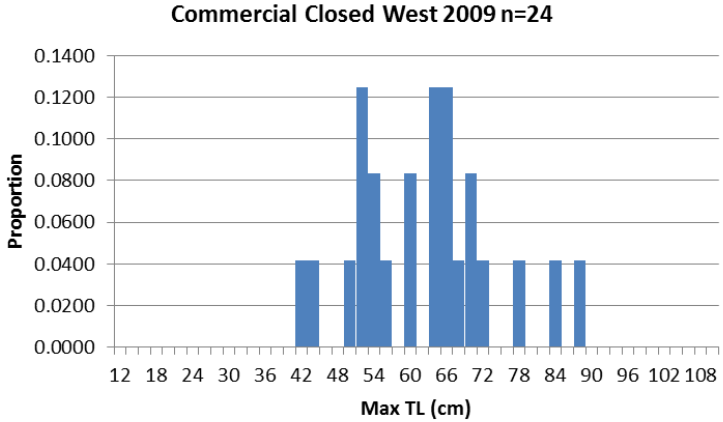


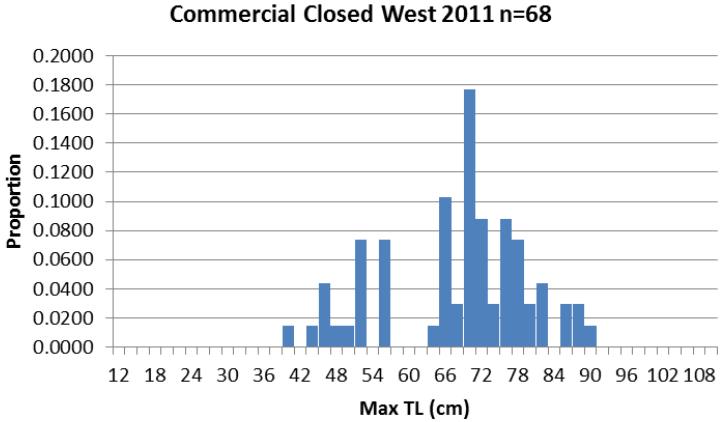


Commercial Closed Season West Size Comps









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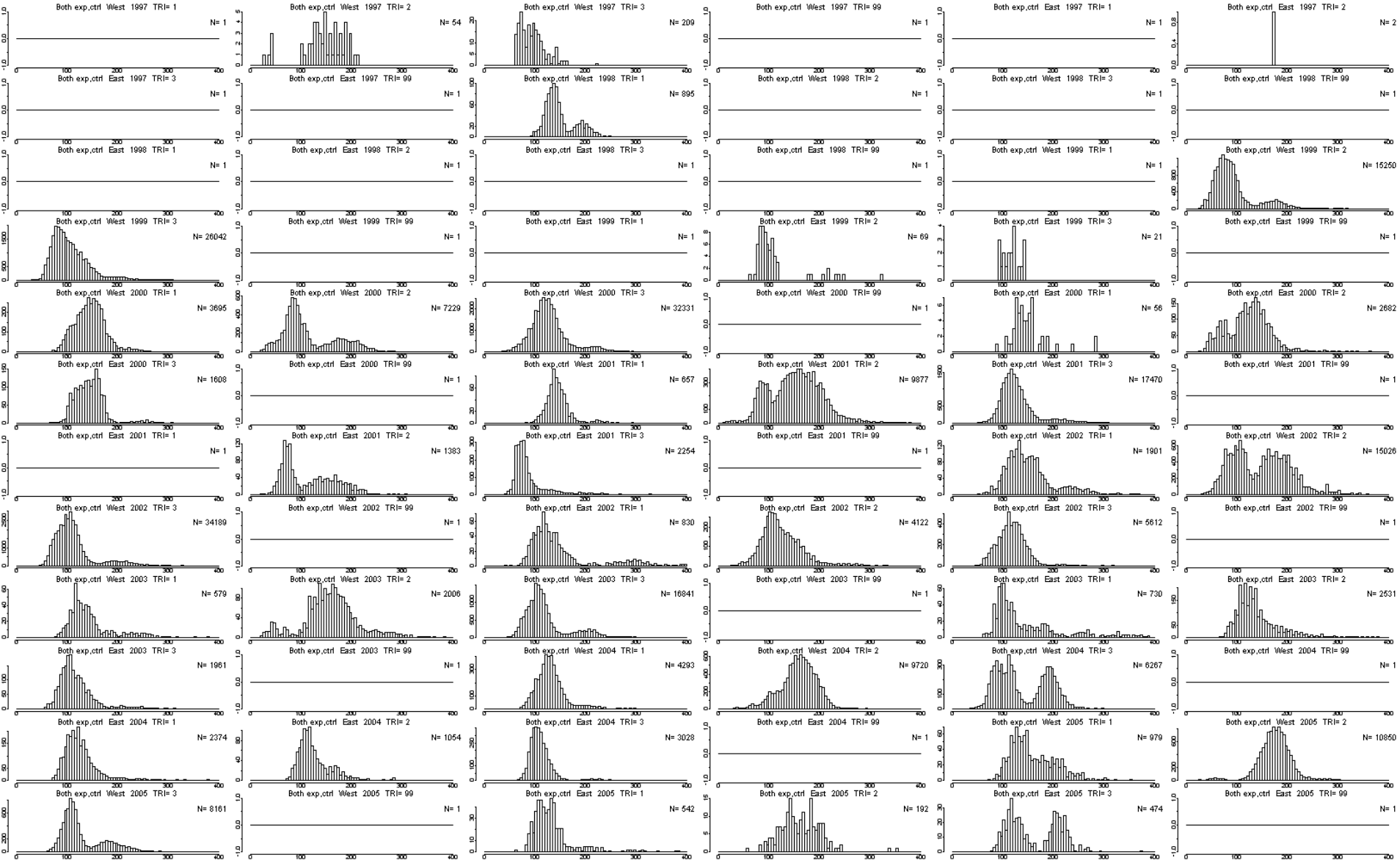
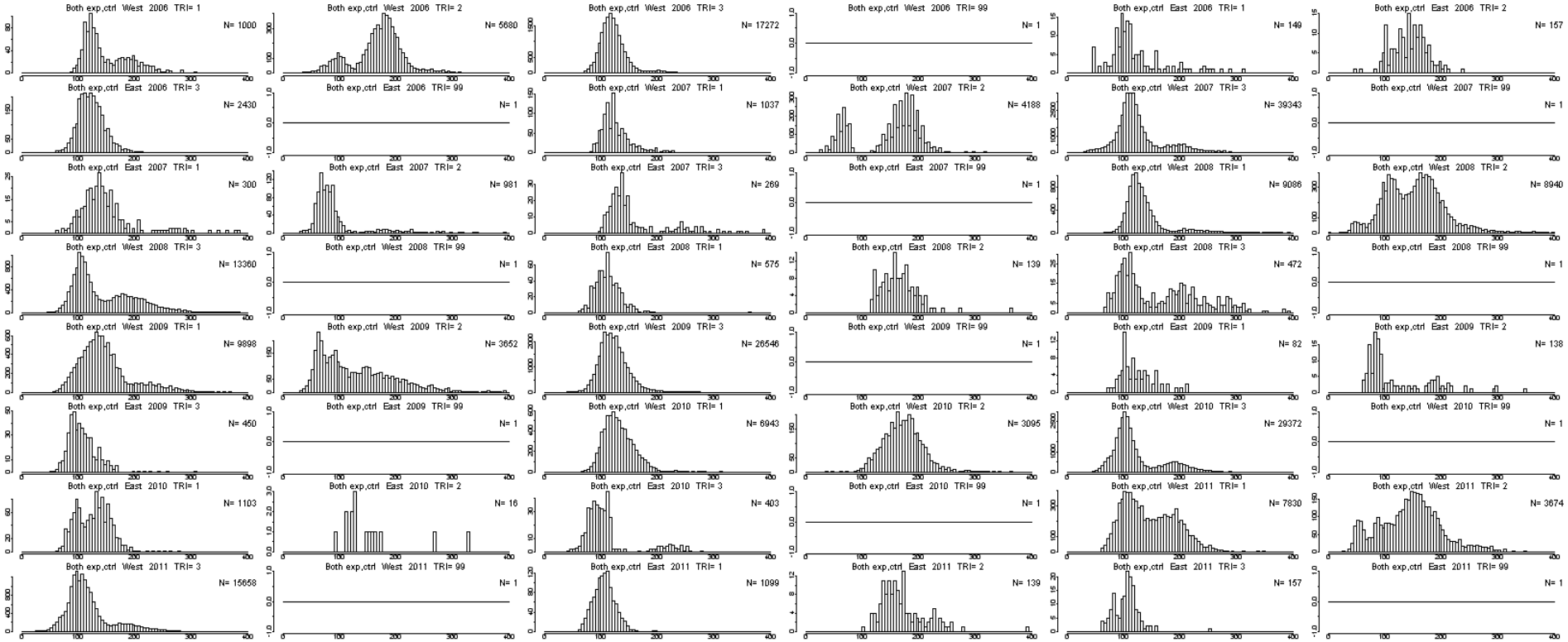
Shrimp Bycatch Size Comps

- Data source: shrimp observer program
- Not used directly in SEDAR 7 and 2009 update assessment
- Used indirectly to obtain shrimp bycatch age comps

Shrimp Bycatch Size Comps



Shrimp Bycatch Size Comps



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Commercial Age Comps

- Fleets:
  - Longline,
  - Handline,
- Data sources:
  - PC lab
  - Gulf FIN
  - FWRI
- NE and SE handline age comps weighted by landings to produce E handline age comps

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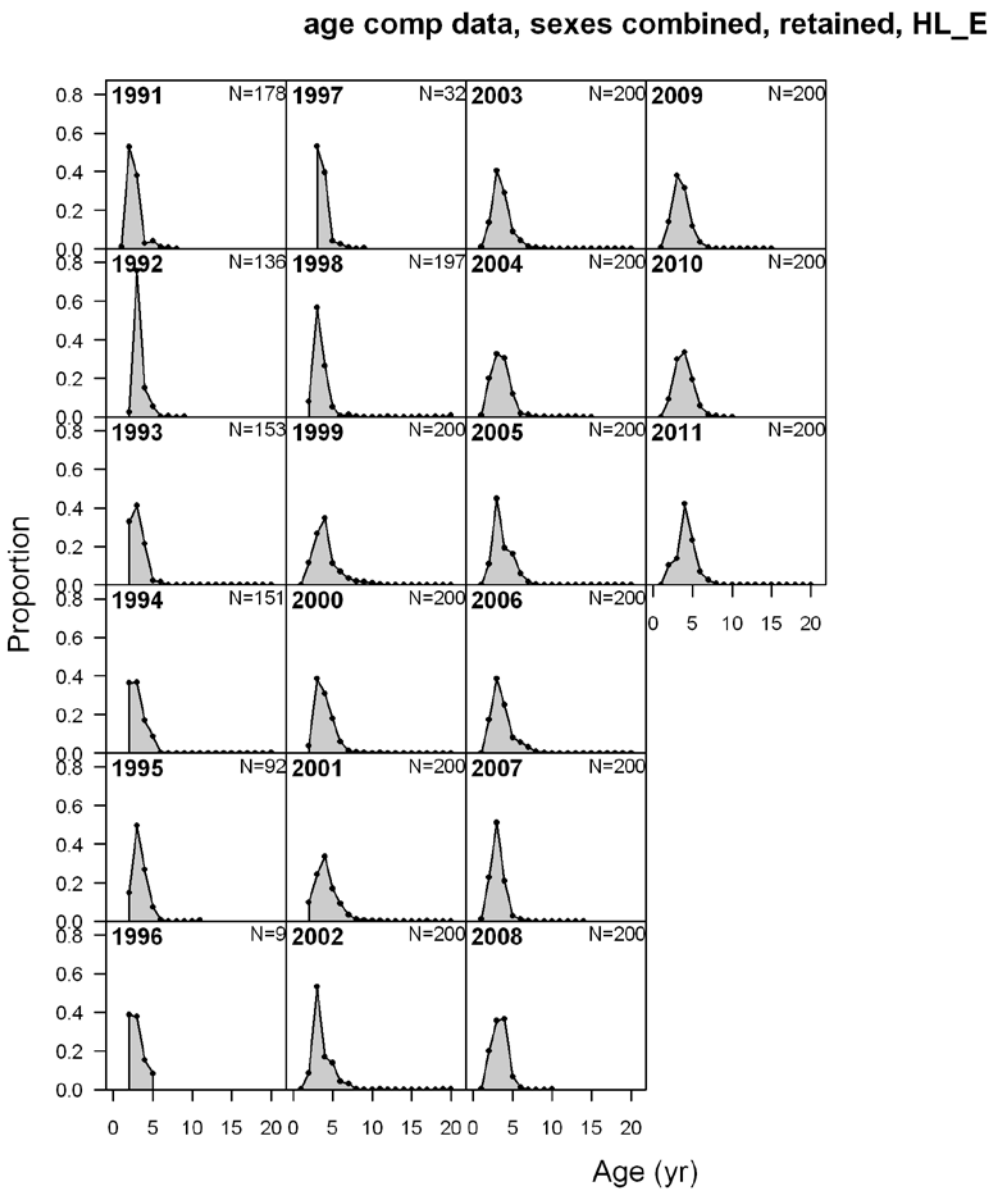
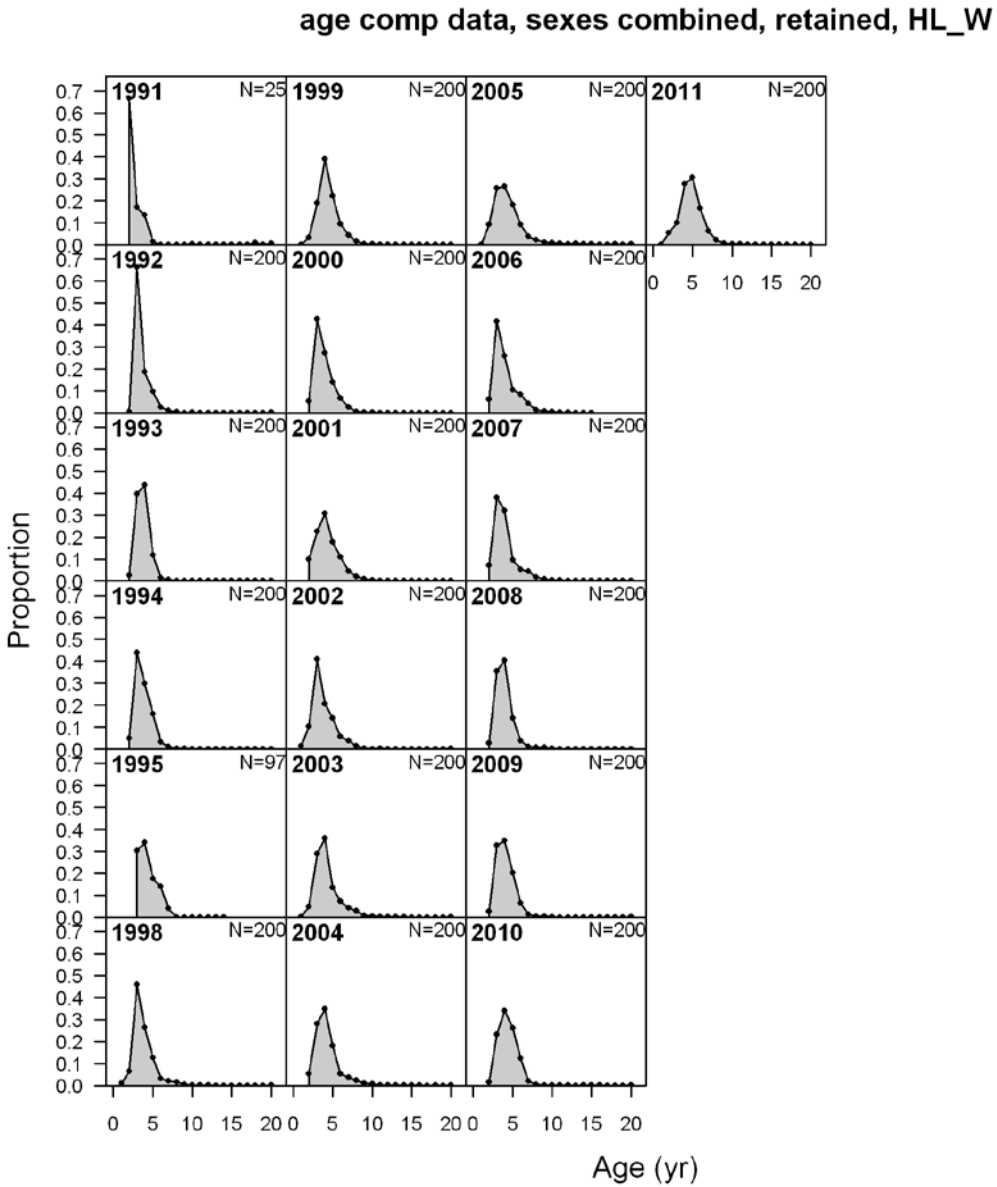
Commercial Age Comps

- SS advances age at beginning of each year, regardless of birth date
  - Red snapper are born on July 1 and age advances on Jan 1
- Age comps reweighted by length comps to deal with nonrepresentative age sampling in early years of time series

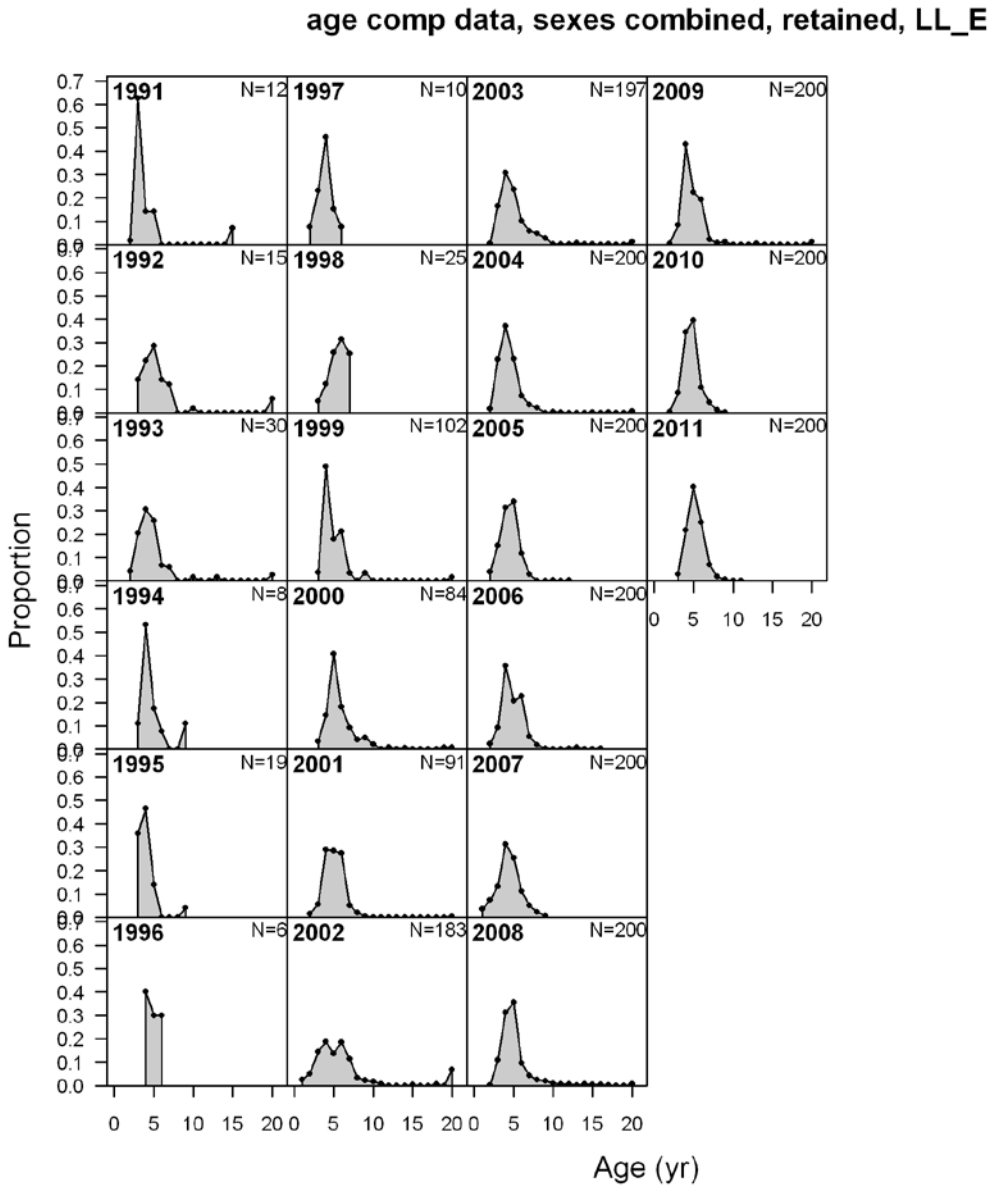
Handline East Age Comps



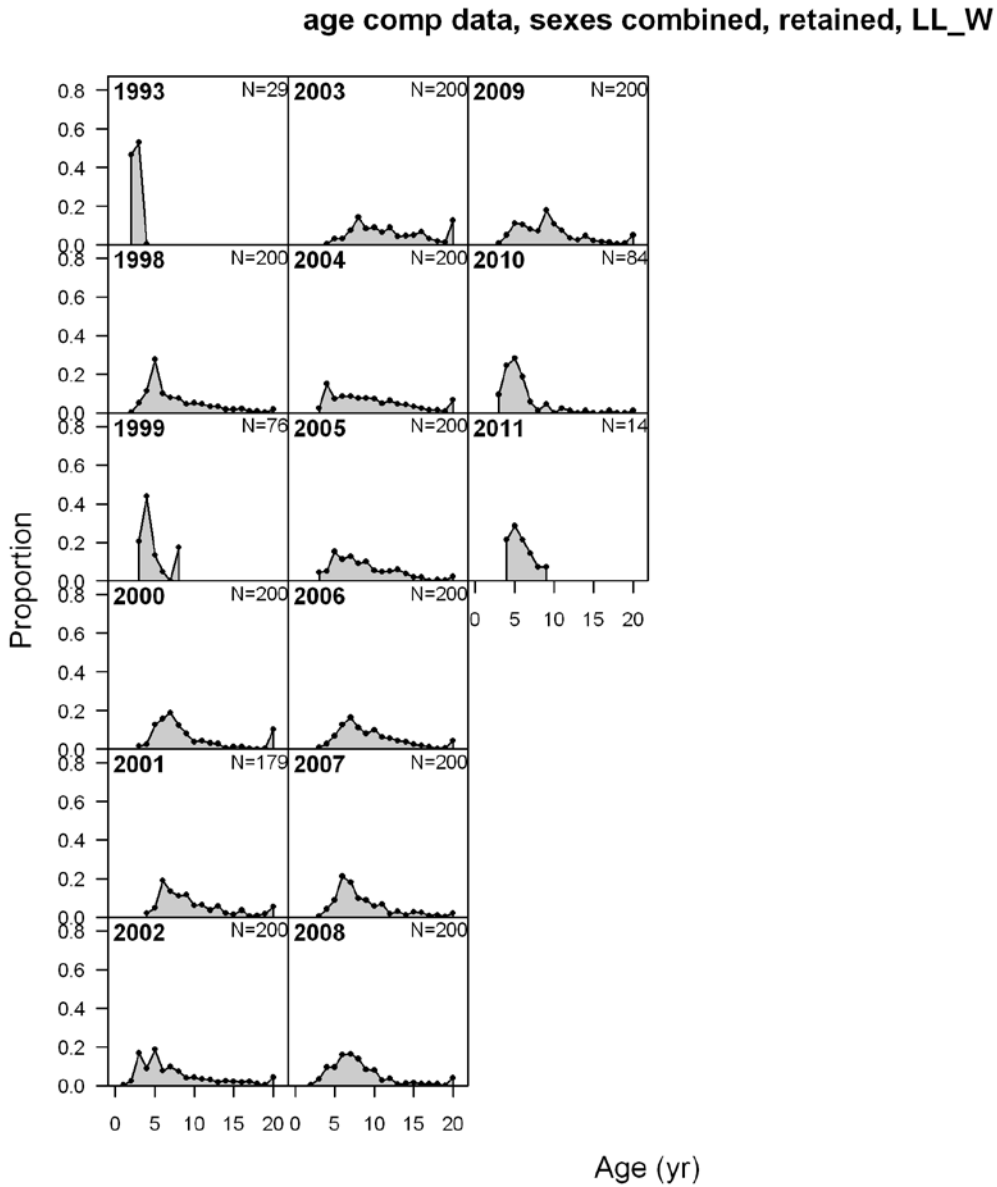
Handline West Age Comps



Longline East Age Comps



Longline West Age Comps



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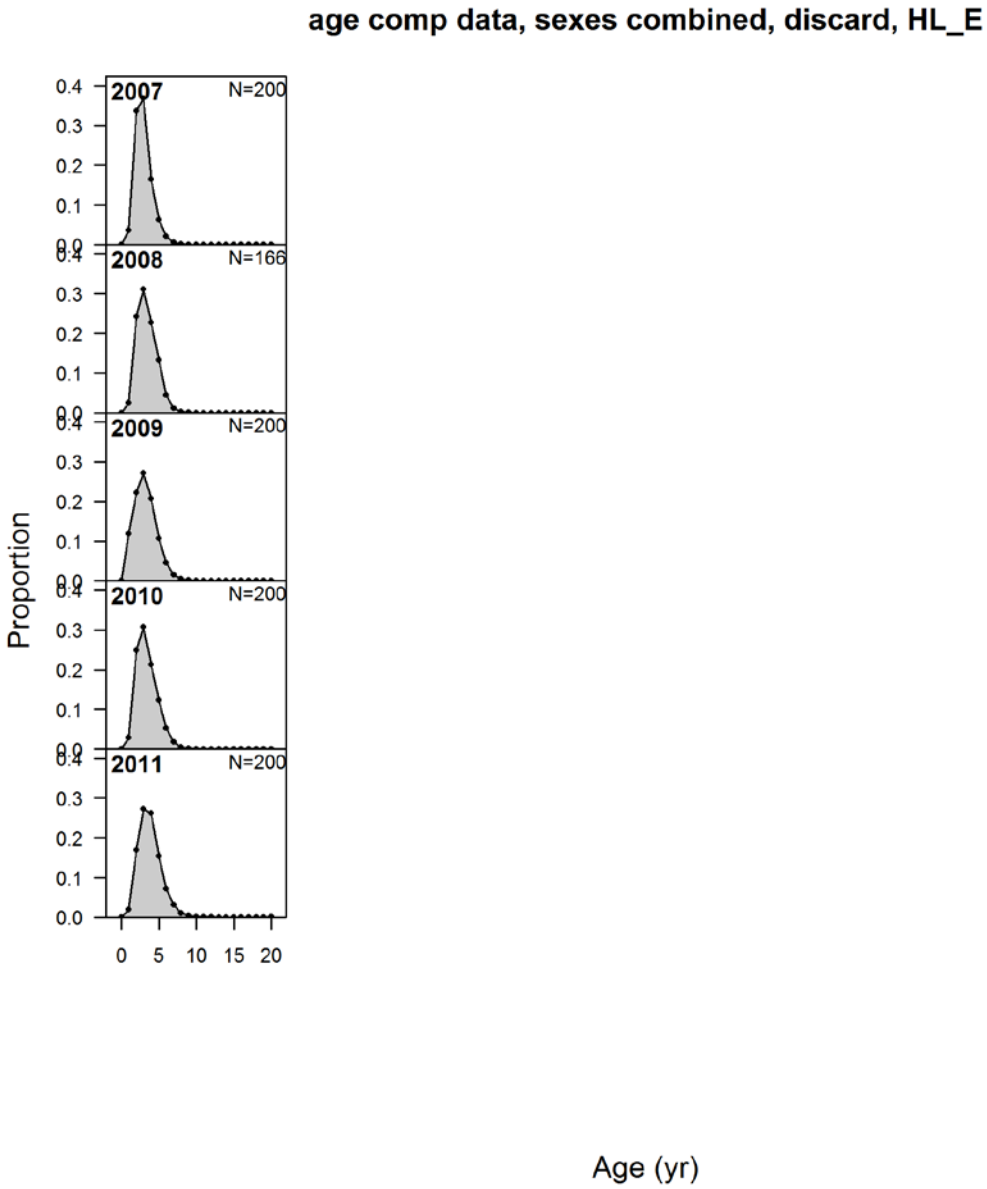
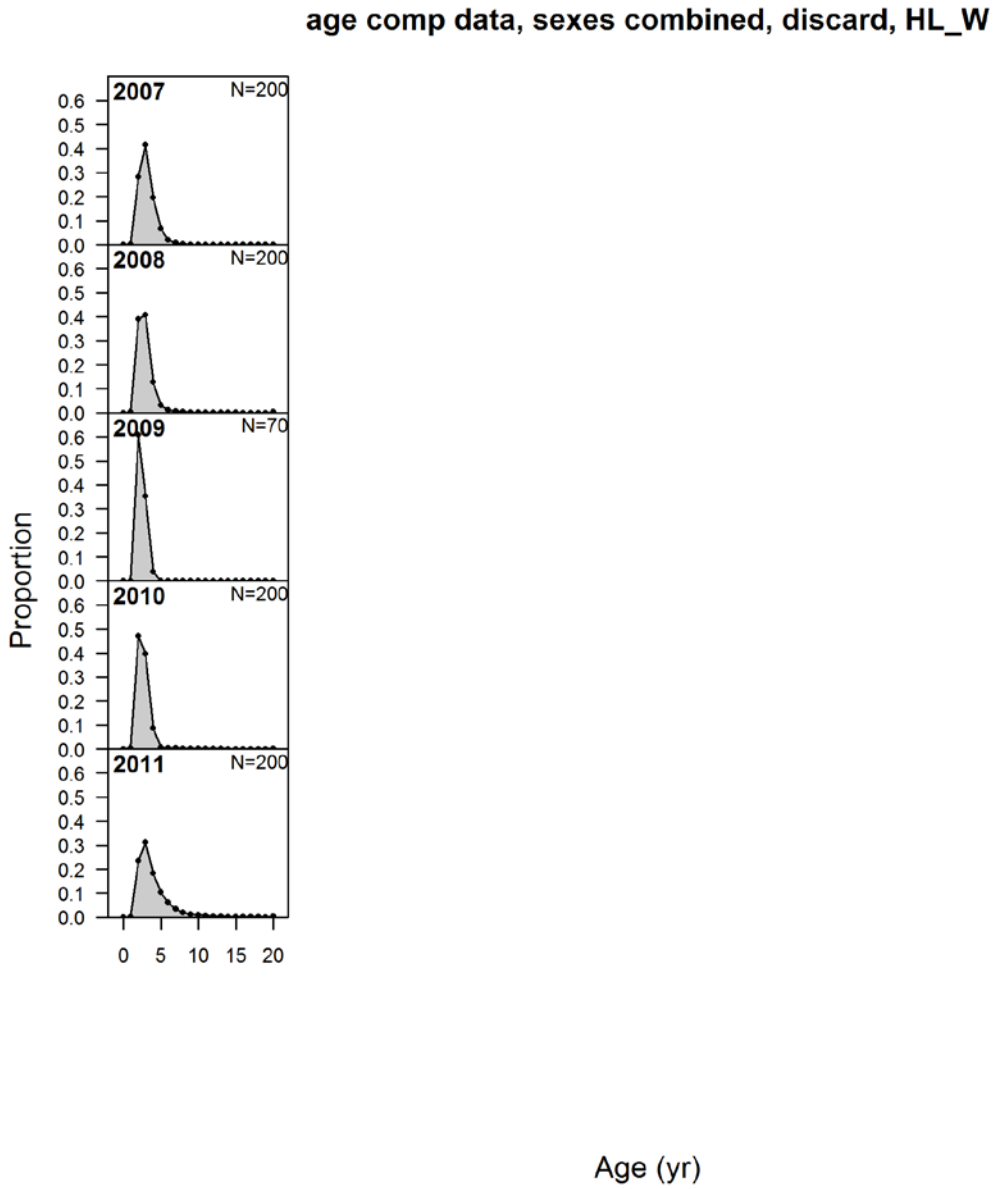
Commercial Discard Age Comps

- Commercial discard lengths converted to age using age-length keys
  - Combined ALKs were created for each region using commercial, recreational, and NMFS bottom longline survey age and length data

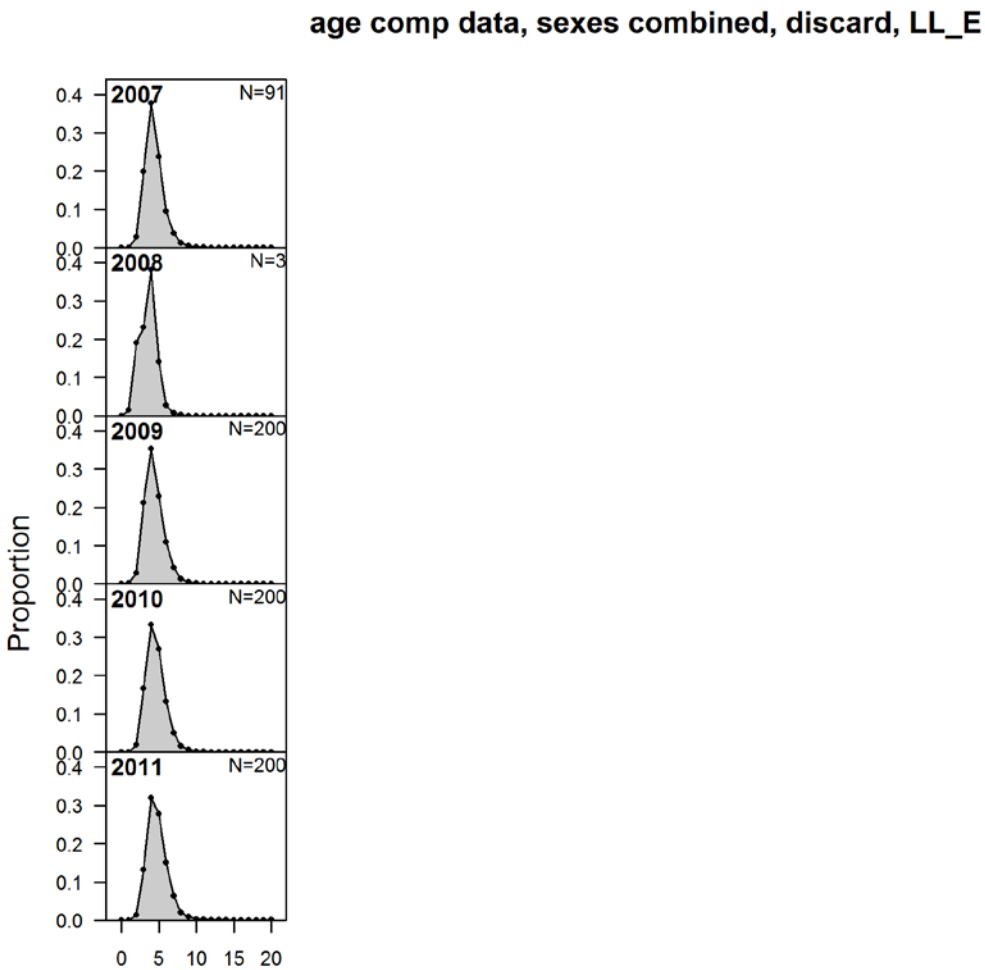
Handline Discard East Open Age Comps



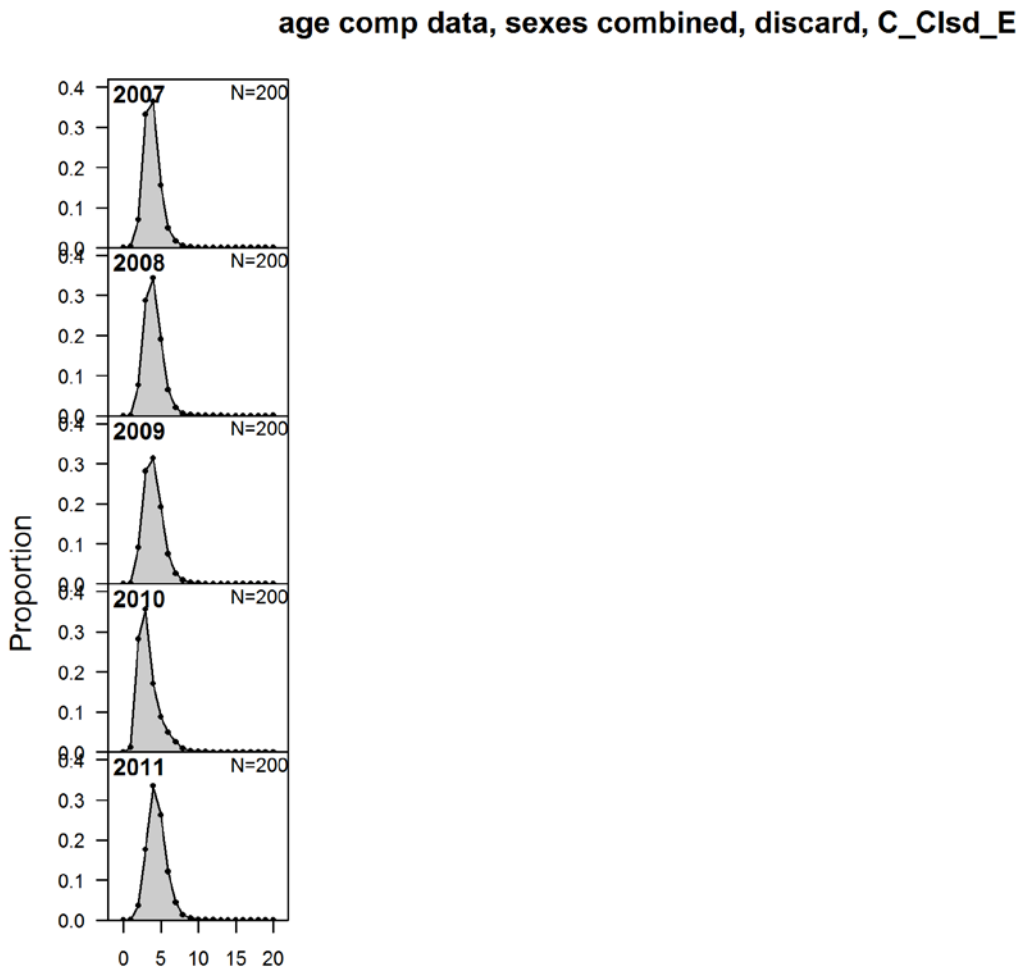
Handline Discard West Open Age Comps



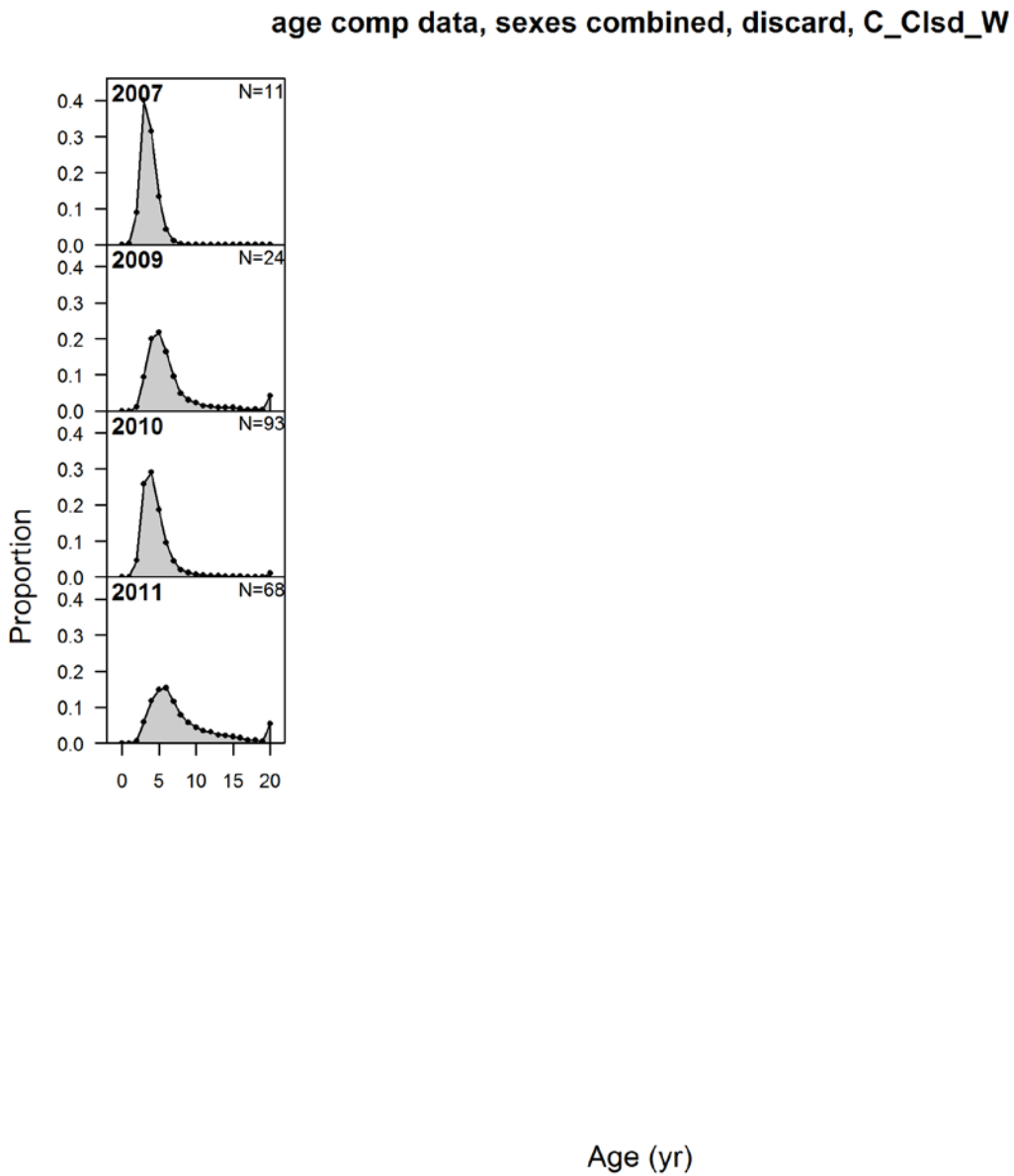
Longline Discard East Open Age Comps



Commercial Closed Season East Age Comps



Commercial Closed Season West Age Comps



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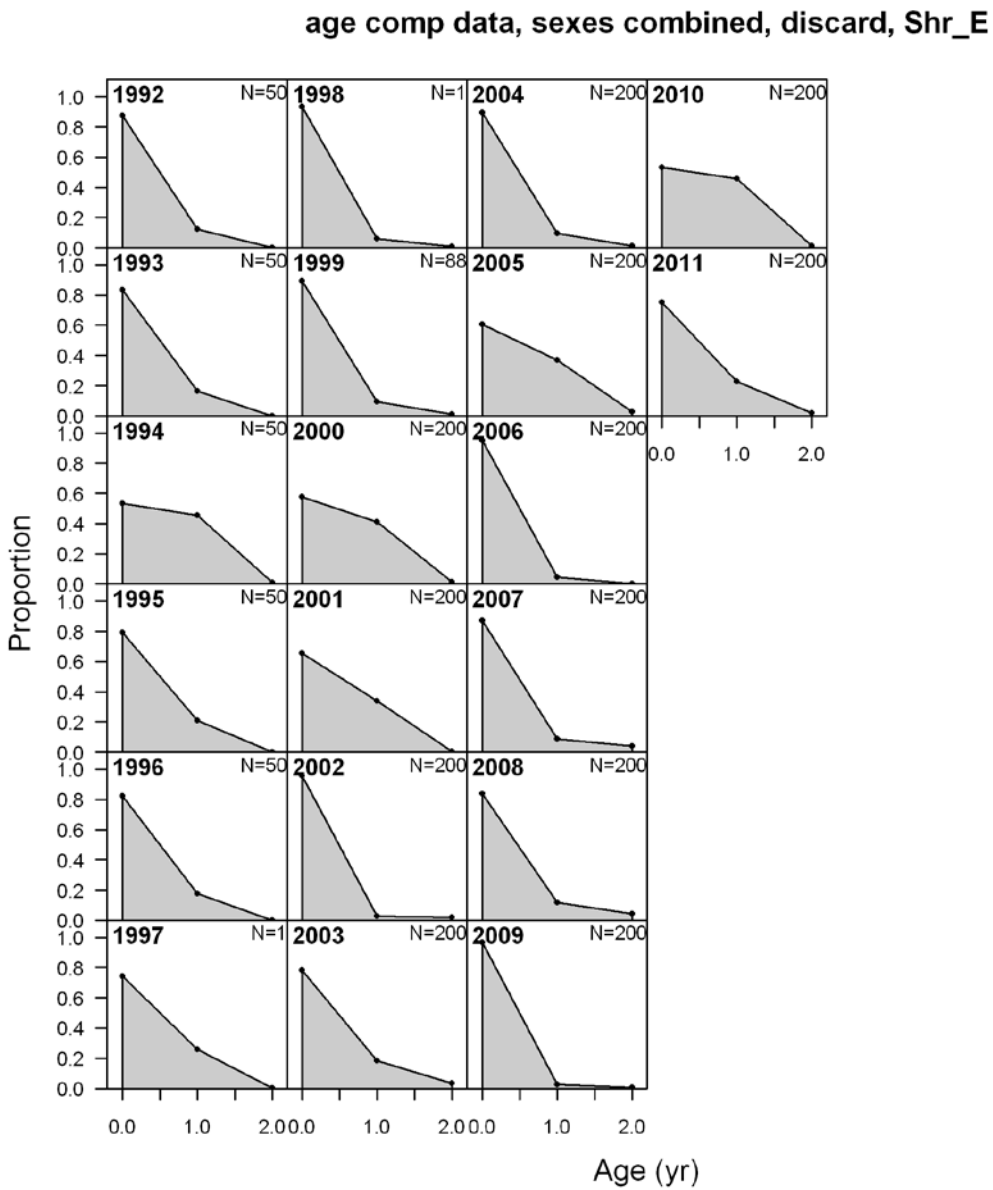
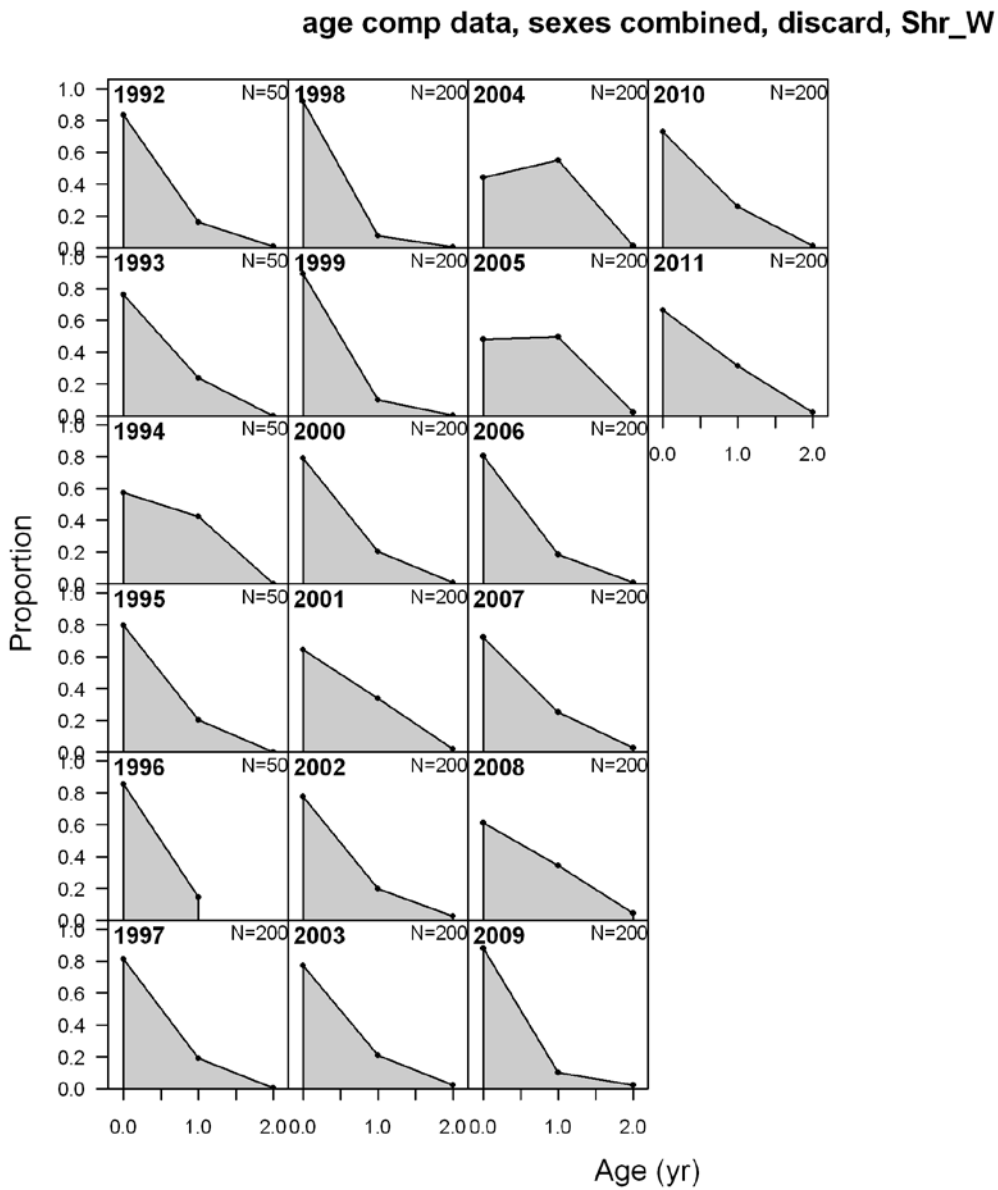
Shrimp Bycatch Age Comps

- Data source: Shrimp observer program
- Age comps produced using 2009 update assessment methodology
- Ages determined by visual inspection of size comps
- Gaps filled by substitution
  - Same region and trimester from adjacent year
- Age comps compiled by trimester
- Trimester age comps weighted by trimester shrimp bycatch estimates to produce annual age comps

Shrimp Bycatch East Age Comps



Shrimp Bycatch West Age Comps



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Recreational Statistics

- Modern landings
- Historic landings
- Discards
- Size composition
- Age composition

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Modern Recreational Landings

- Fleets:
  - Private/Charter, 1981-2011
  - Headboat, 1981-2011
- Data sources:
  - MRFSS/MRIP
  - Headboat survey
  - TPWD
- Landings = A + B1 estimates
- MRFSS landings calibrated to MRIP estimates using ratio estimators from common time period

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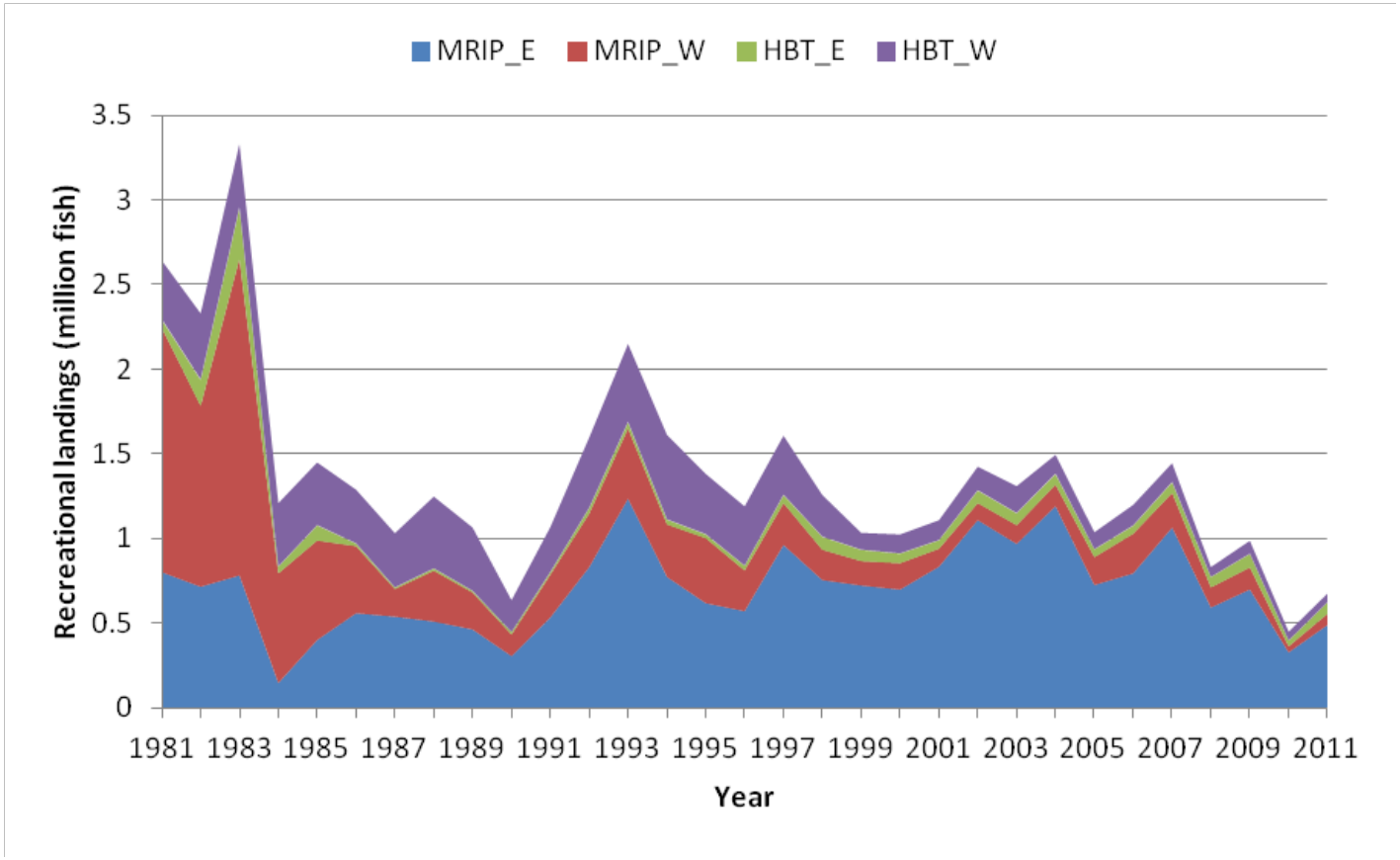
Modern Recreational Landings



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Historic Recreational Landings

- Fleets:
  - Private/Charter, 1950-1980
  - Headboat, 1950-1980
- Data sources:
  - MRFSS/MRIP
  - TPWD
  - FHWAR
- Private mode angler trips estimated using FHWAR saltwater angler trends
- Charter and headboat mode angler trips for 1956-1980 set equal to 1983-1985 averages

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Historic Recreational Landings

- Charter and headboat mode angler trips for 1950-1955 were linearly interpolated from 0 to 1956 effort levels
- Historical effort was converted to historical landings using average nominal CPUE from 1981-1984 (i.e., prior to first size and bag limits)

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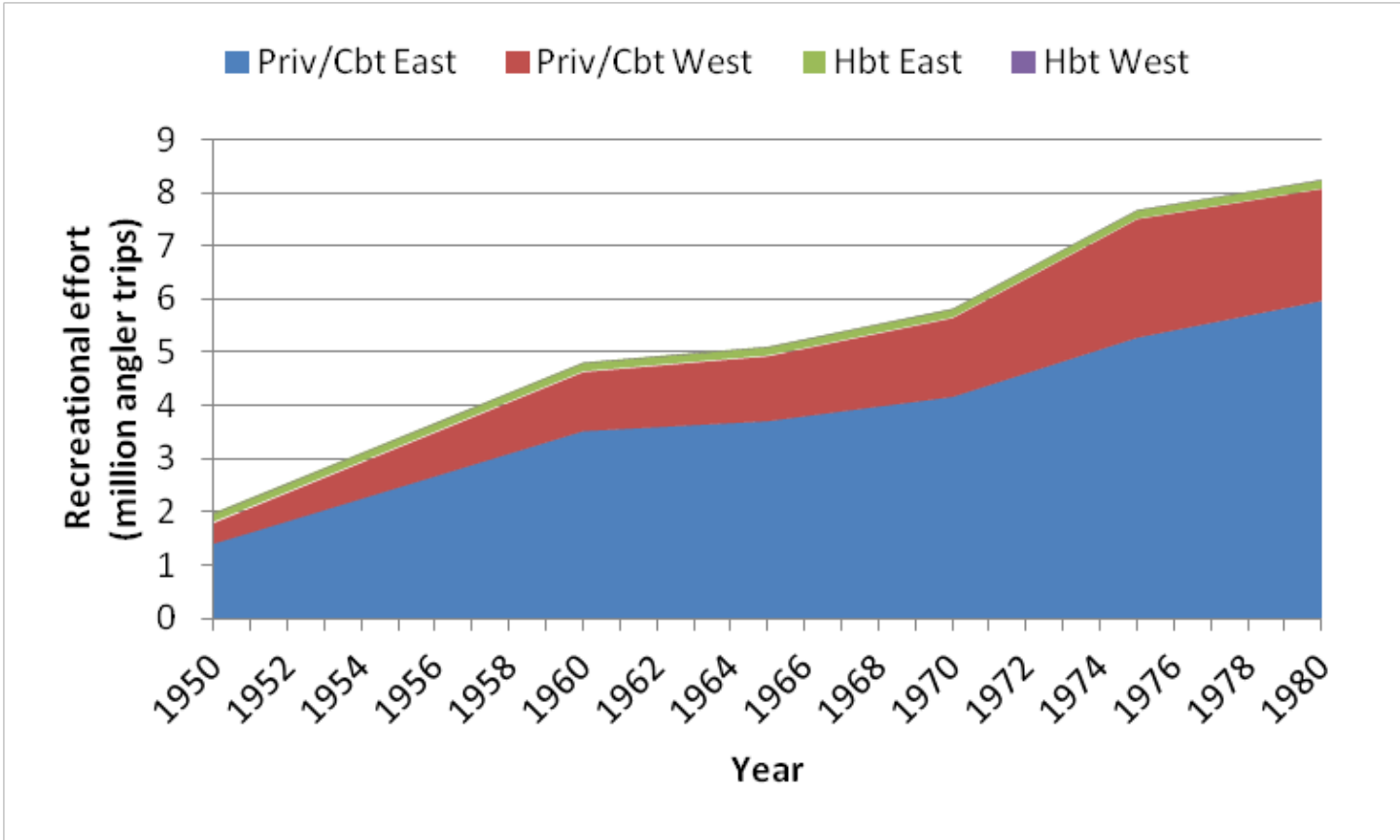
Historic Recreational Effort



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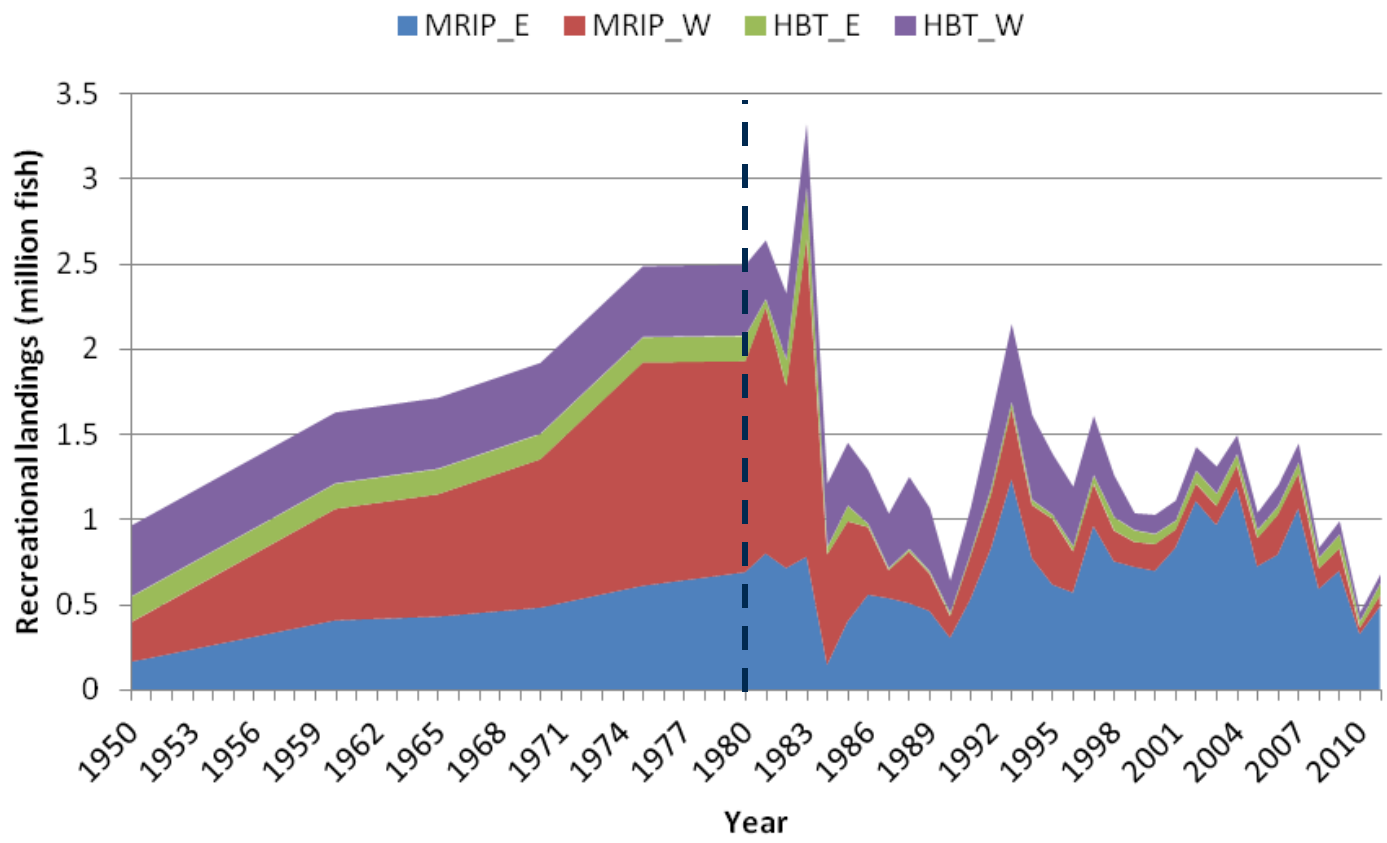
Historic Recreational Landings



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Recreational Discards

- Fleets:
  - Private/Charter, 1981-2011
  - Headboat, 1981-2011
- Data sources:
  - MRFSS/MRIP
  - Headboat survey
  - Headboat observer program
- MRFSS/MRIP use B2 estimates
- TPWD use MRFSS/MRIP discard ratios from LA

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Recreational Discards

- Self-reported discard rates from headboats with consistent reporting patterns used for 2004-2011
- Self-reported discard rates were scaled by discard rates from observer program
- 1981-2003 discard rates determined using MRIP proxy (i.e., MRIP mode(s) with highest positive correlation with 2004-2011 discard rates)
  - MRIP private in east
  - MRIP charter in west

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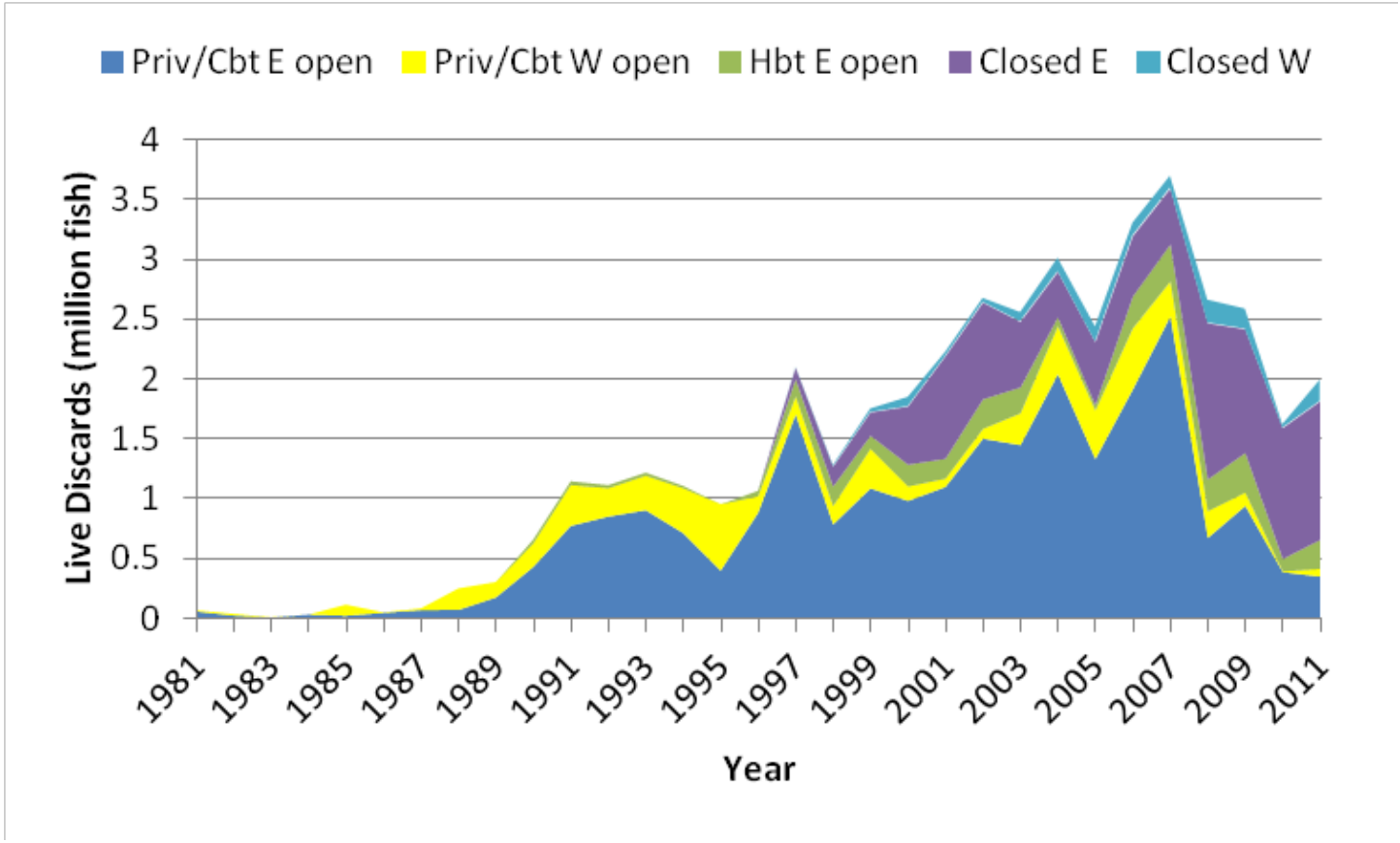
Recreational Discards



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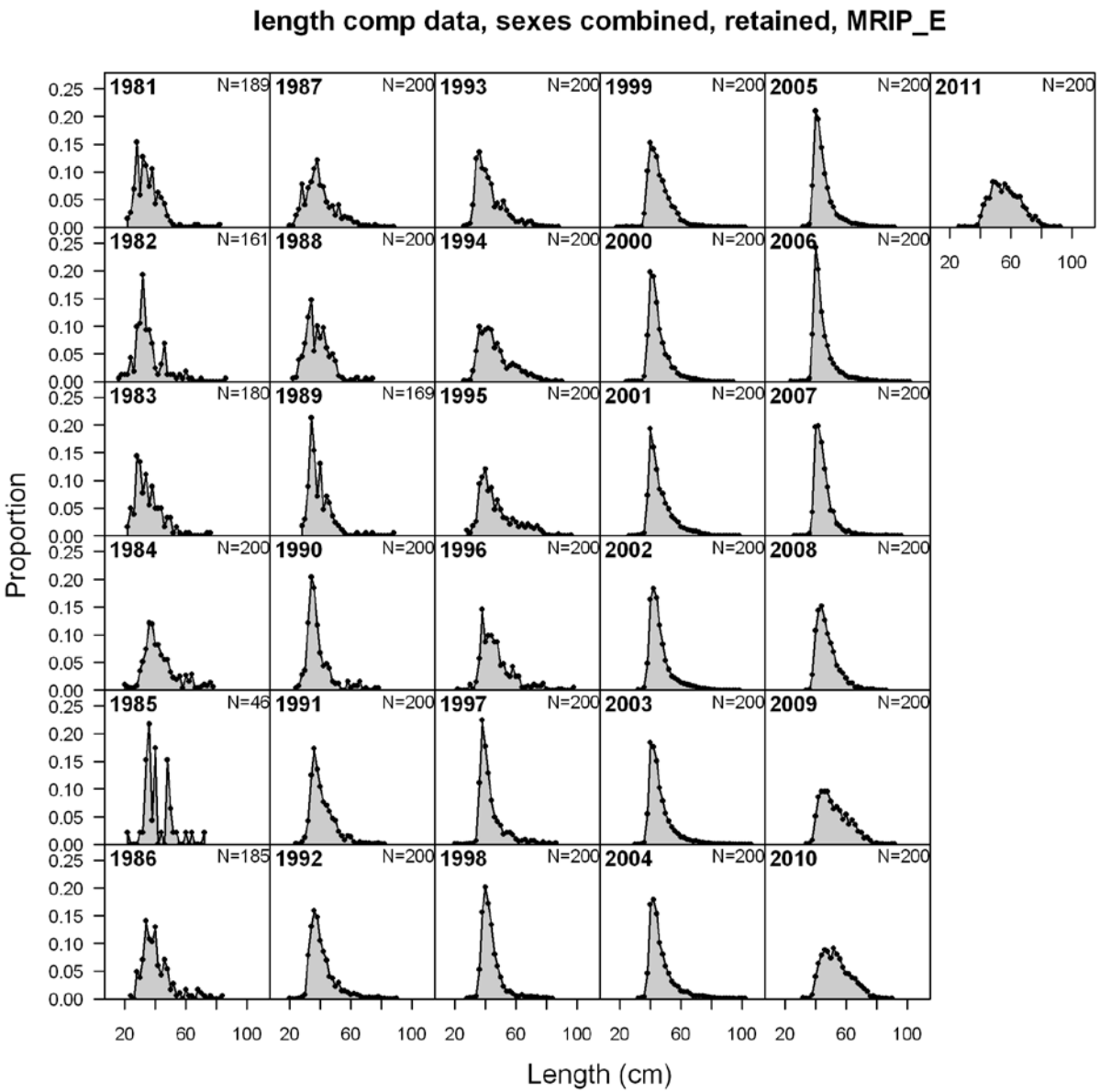
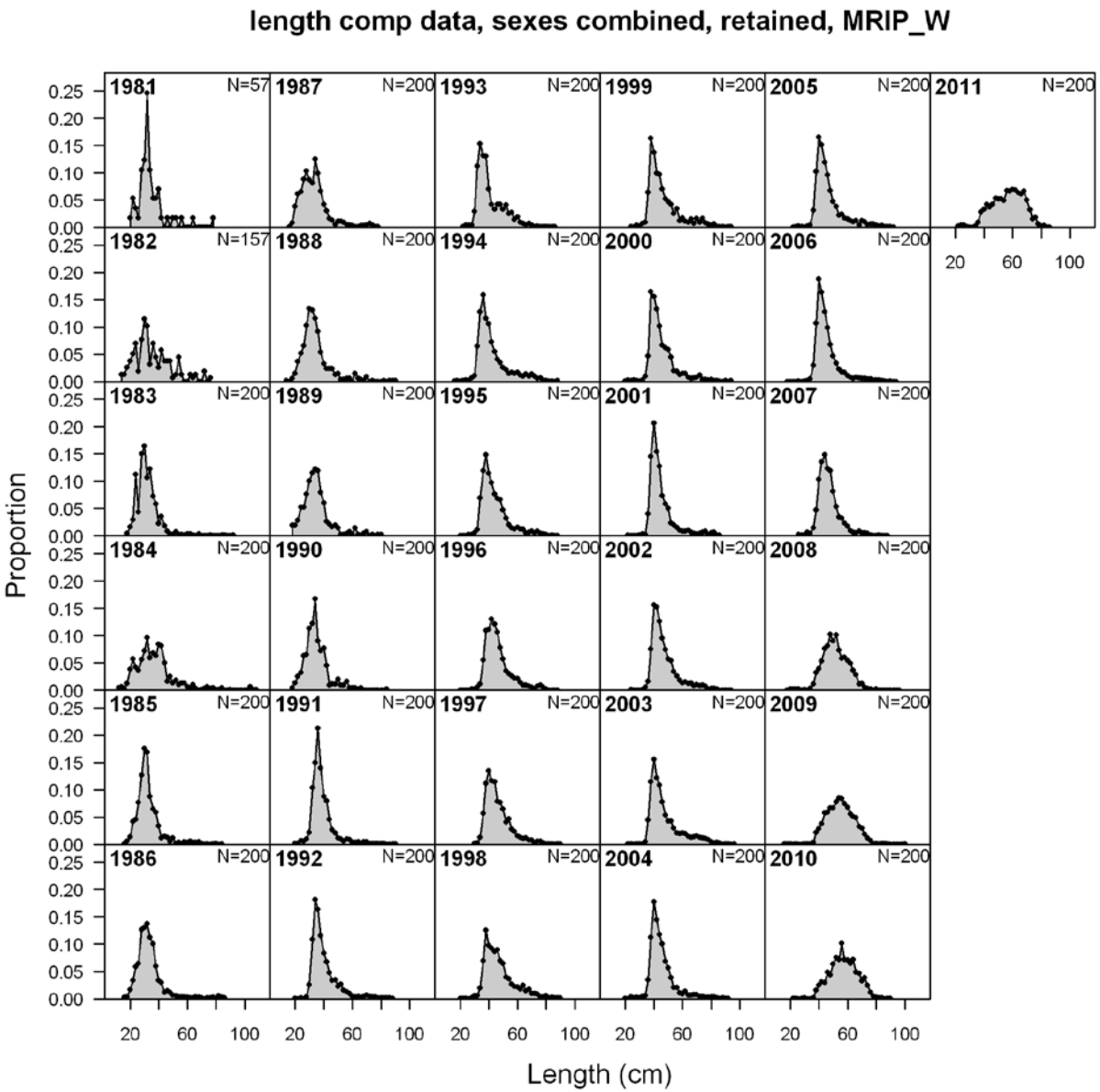
Recreational Size Comps

- Fleets:
  - Private/Charter, 1981-2011
  - Headboat, 1981-2011
- Data sources:
  - MRFSS/MRIP
  - Headboat survey
  - TPWD
  - Gulf FIN
  - TIP

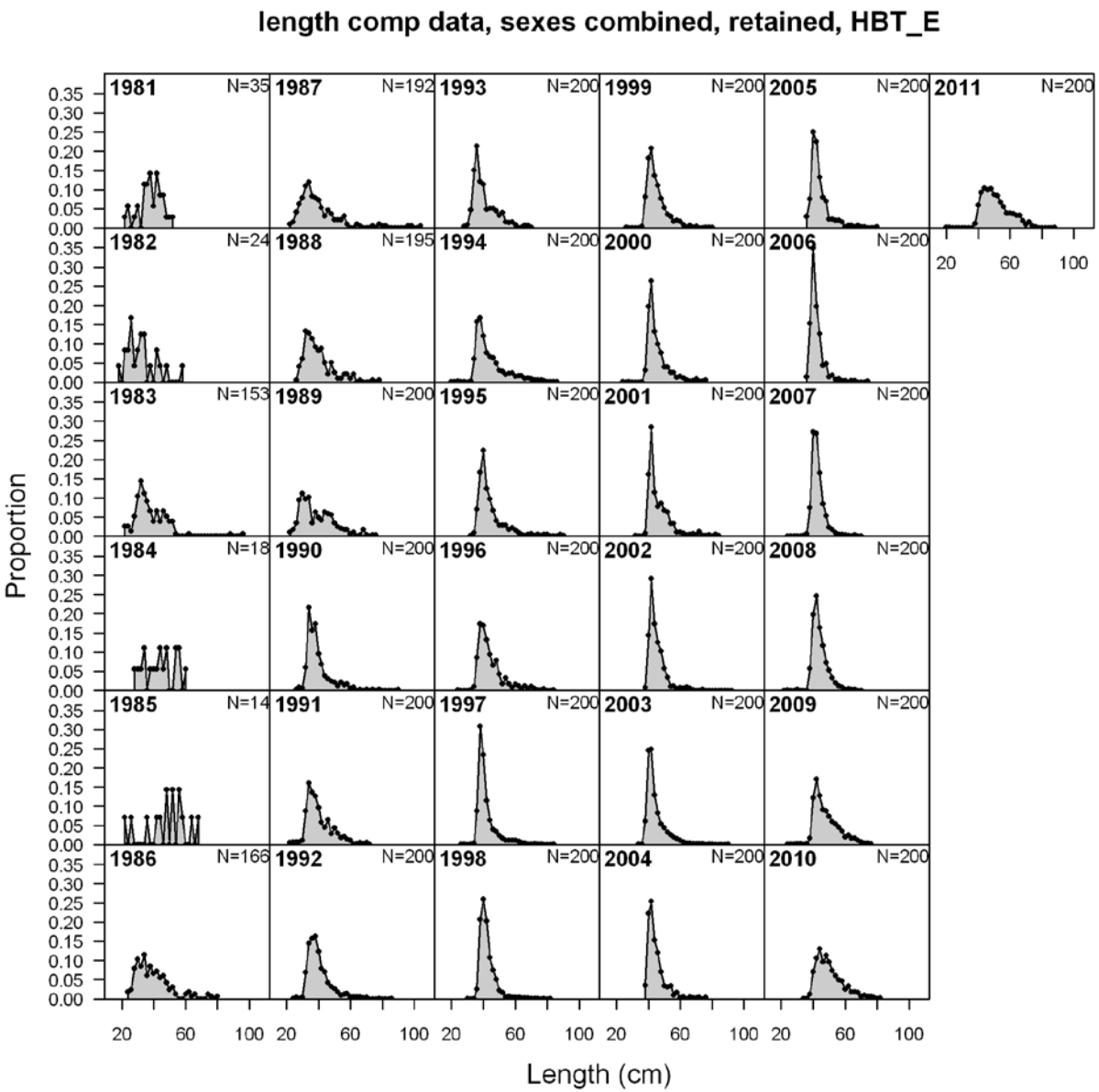
Private/Charter Size Comp East



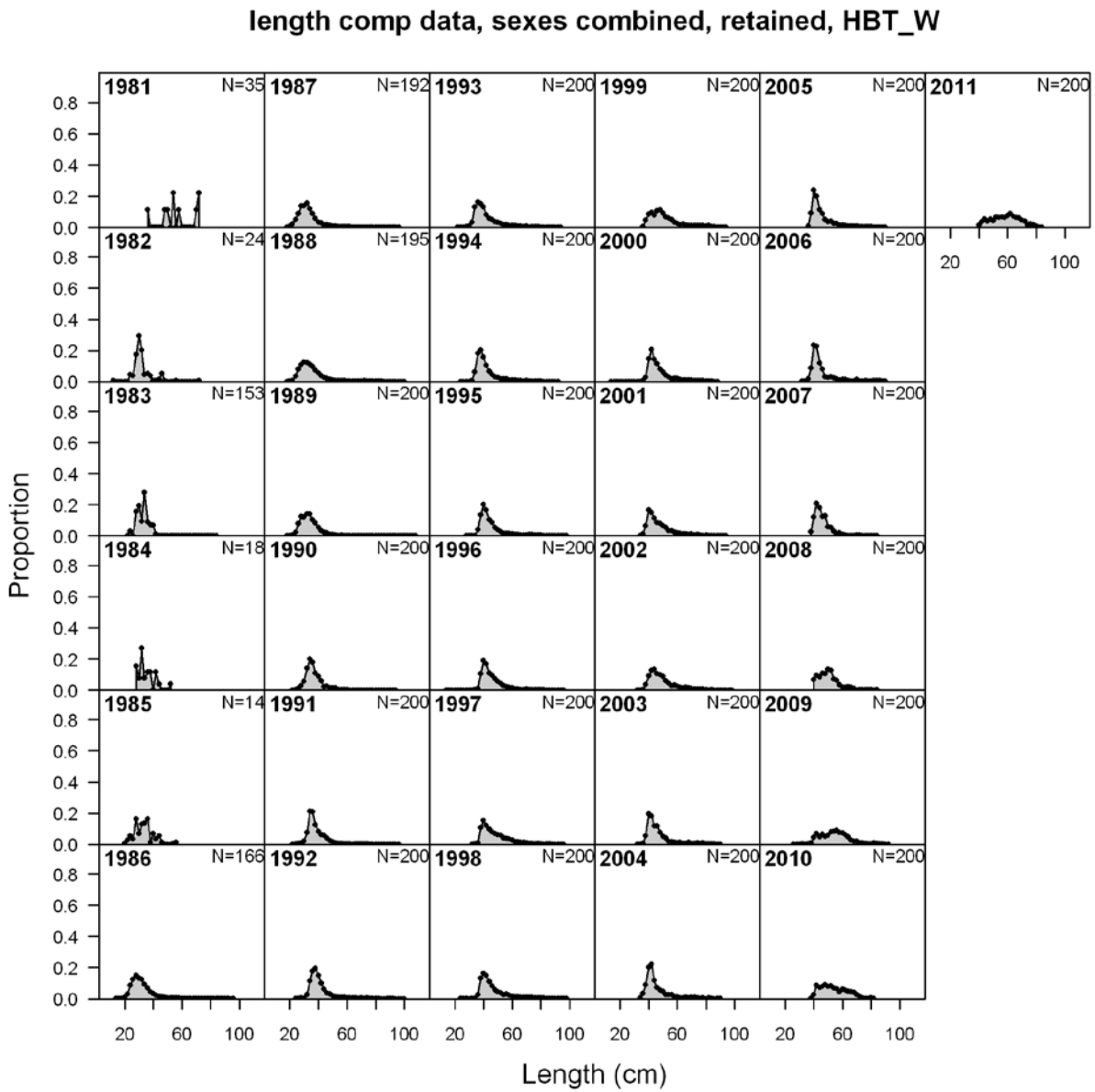
Private/Charter Size Comp West



Headboat Size Comp East



Headboat Size Comp West



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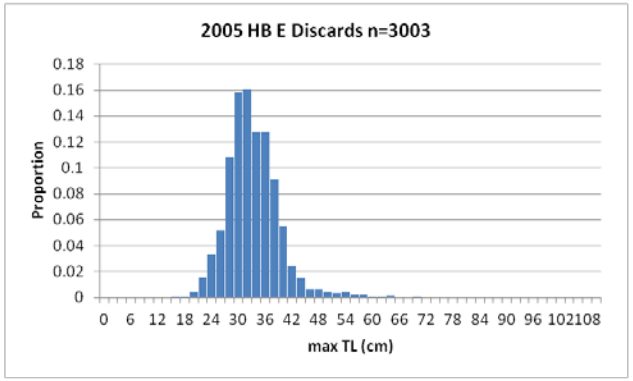
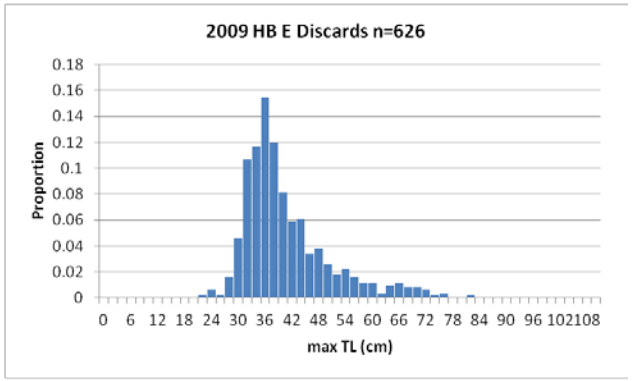
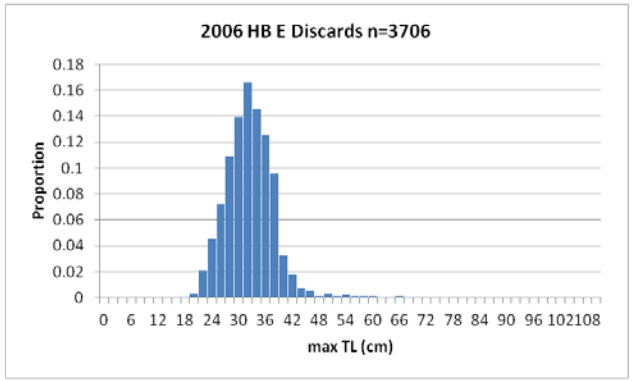
Recreational Discard Size Comps

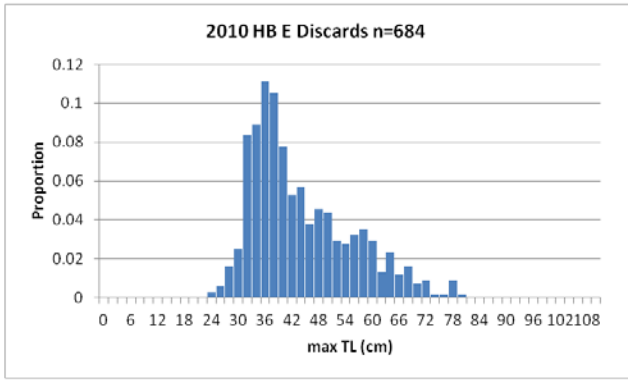
- Fleet:
  - Headboat (east only), 2005-2011
- Source:
  - Headboat observer program

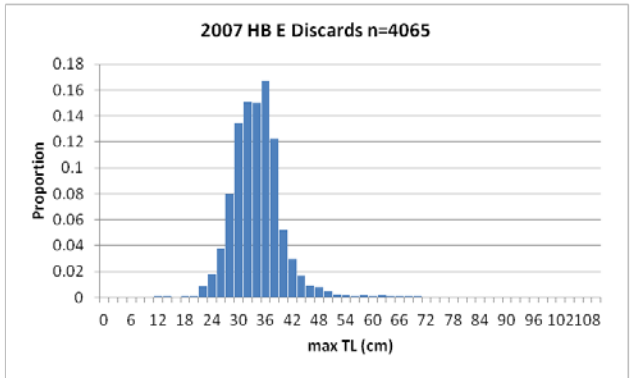
Headboat Discard Size Comp East

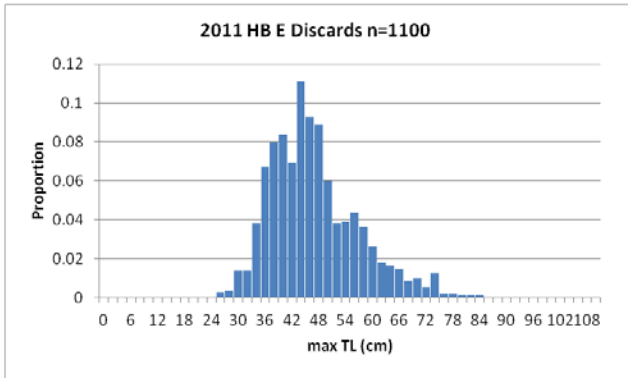












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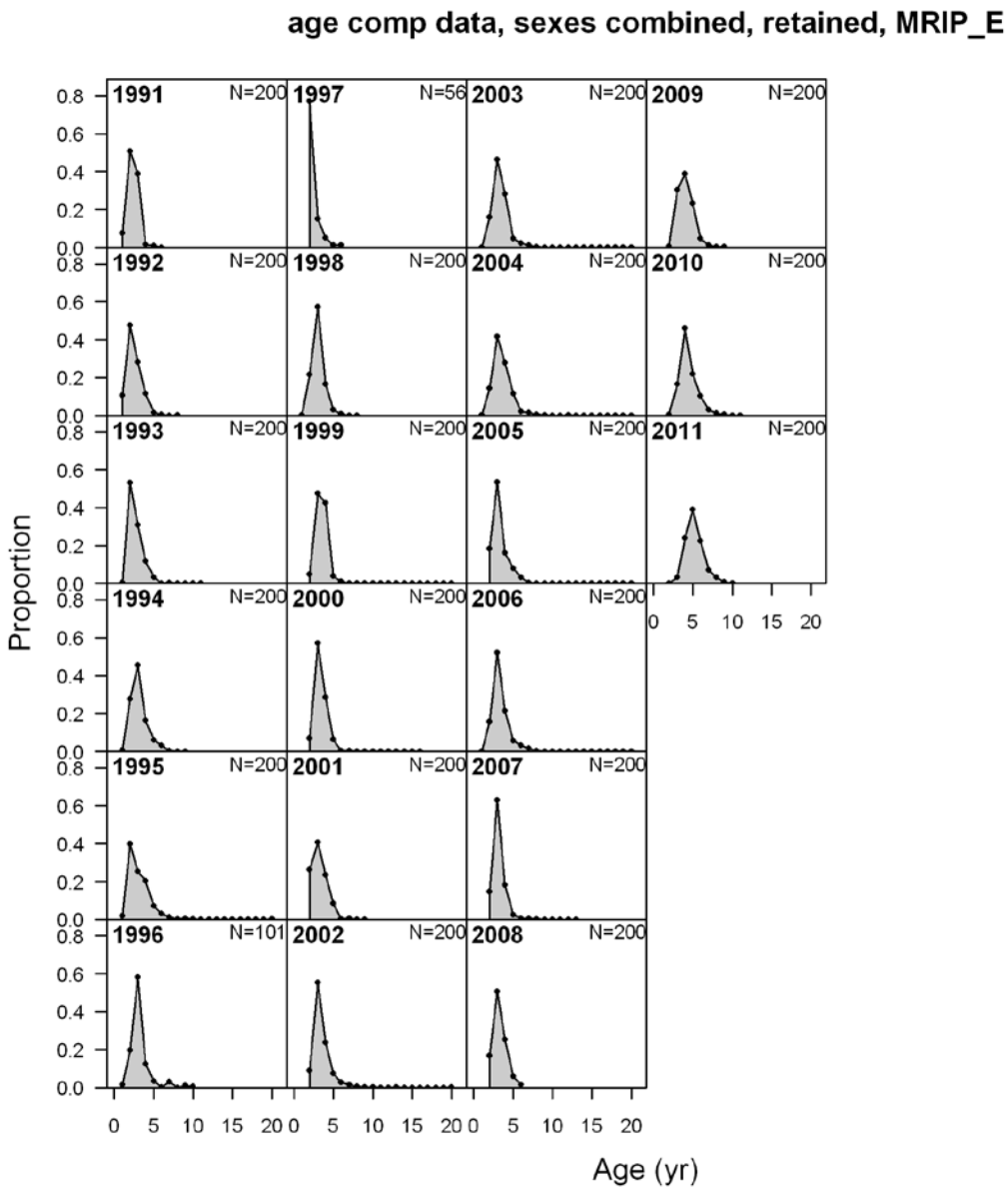
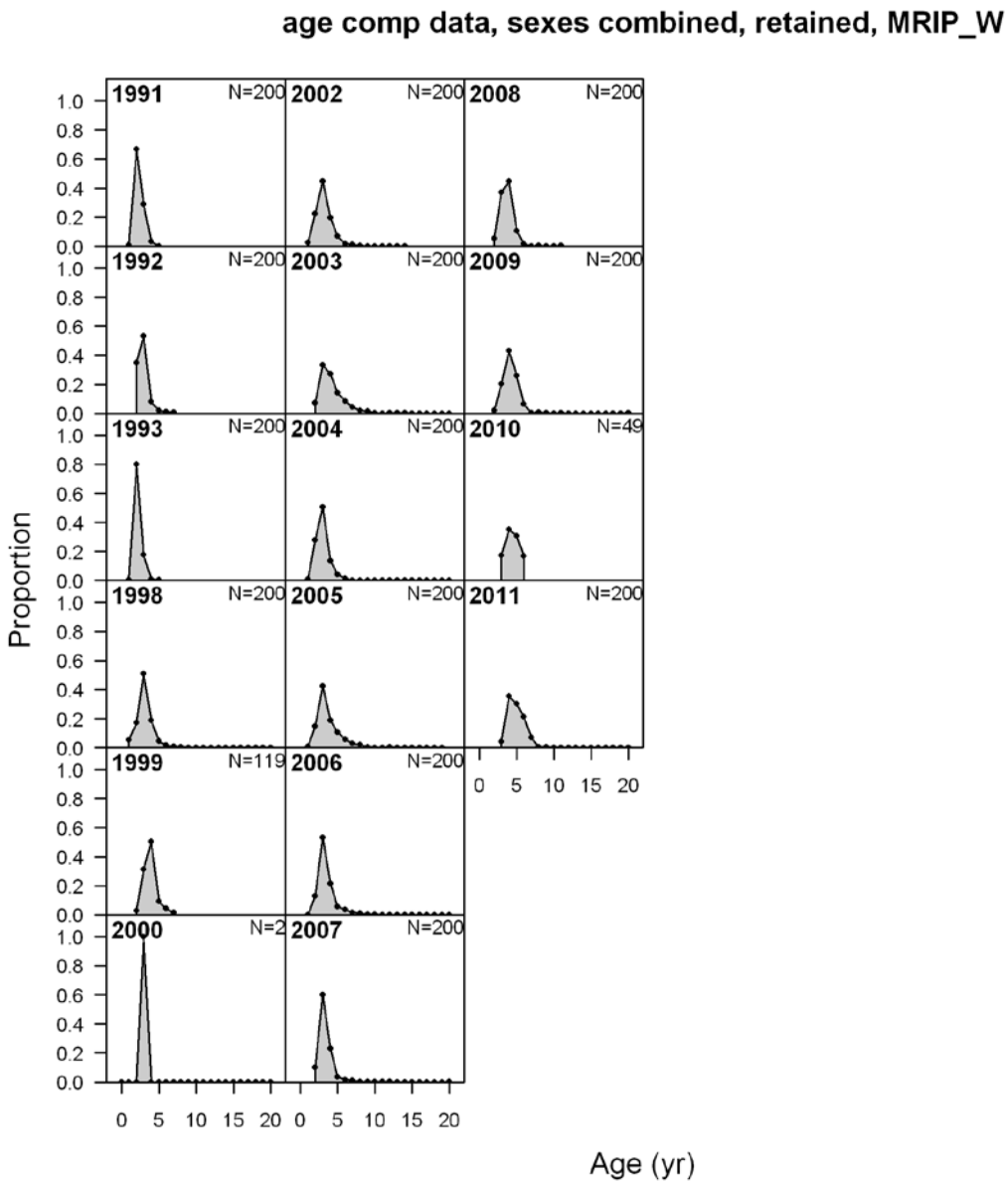
Recreational Age Comps

- Fleets:
  - Private/Charter, 1991-2011
  - Headboat, 1991-2011
- Data sources:
  - PC lab
  - Gulf FIN
  - FWRI
- Age comps reweighted by length comps to deal with nonrepresentative age sampling in early years of time series

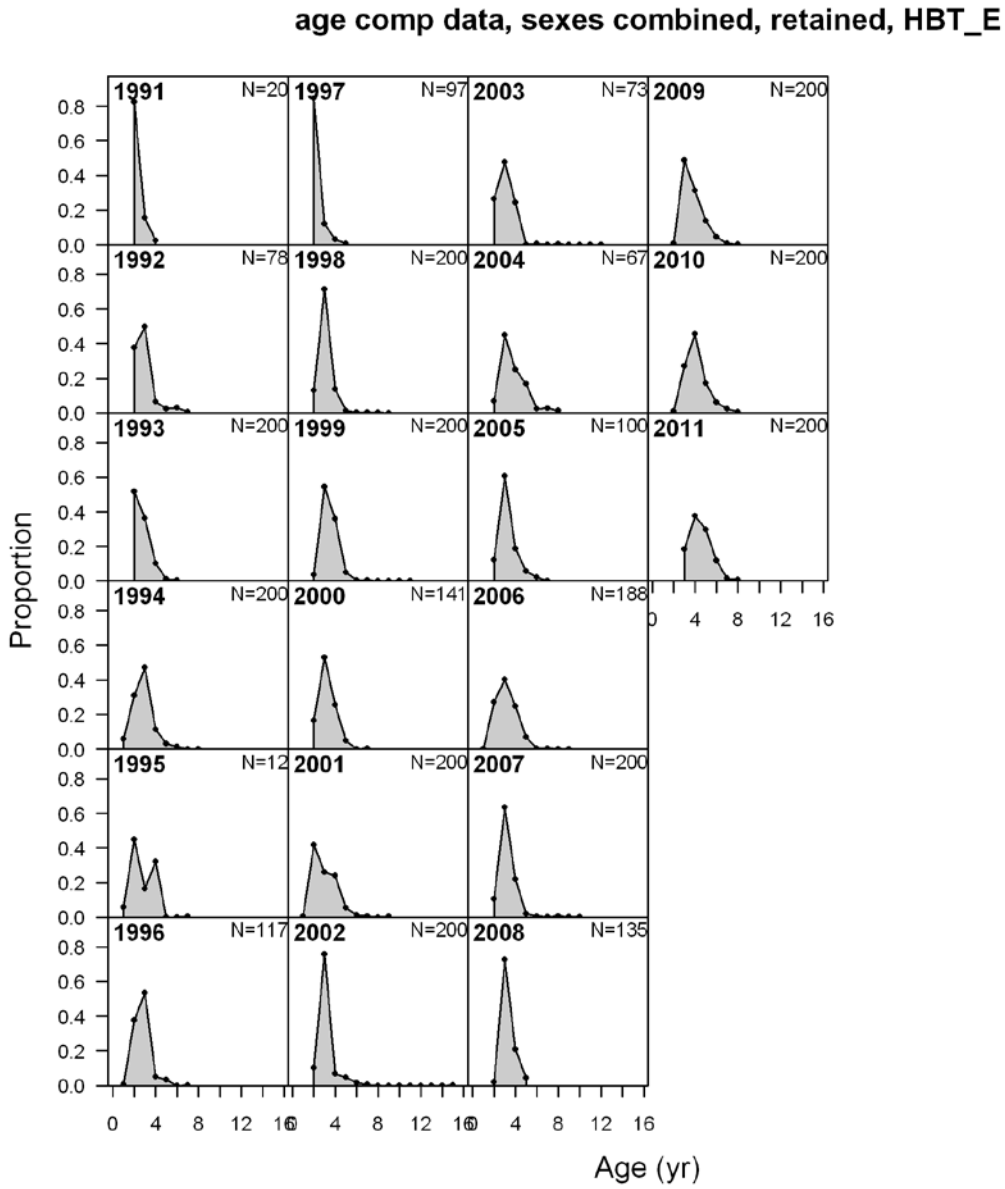
Private/Charter Age Comp East



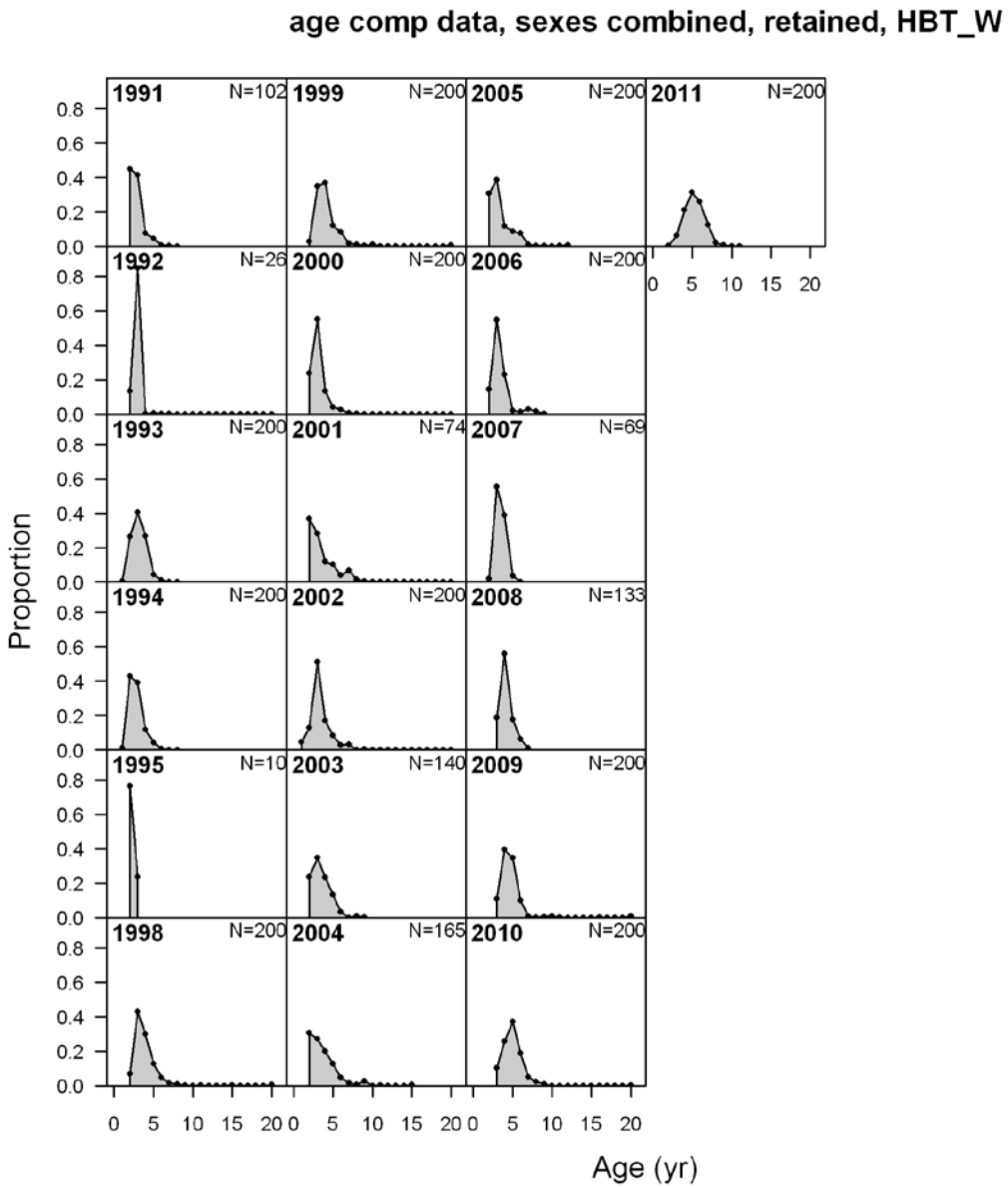
Private/Charter Age Comp West



Headboat Age Comp East



Headboat Age Comp West



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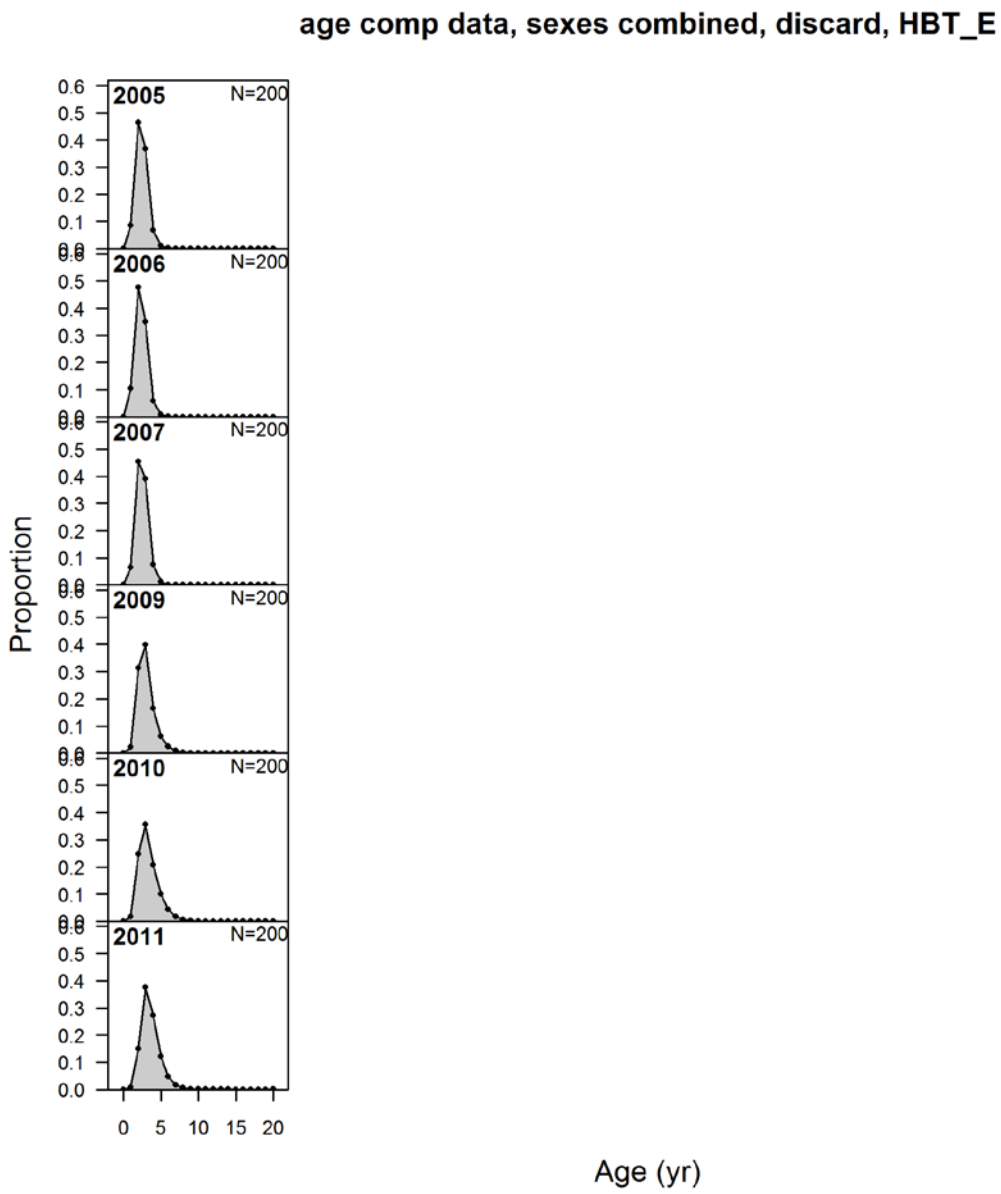
Recreational Discard Age Comps

- Recreational discard lengths converted to age using age-length keys
  - Combined ALKs were created for each region using commercial, recreational, and NMFS bottom longline survey age and length data

Headboat Discard Age Comp East



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DISCARD MORTALITY

Metadata

Liz Brooks
SEDAR 7

0-71%

Depth m	Season	Release Mortality	N	Method of observation	Region
20	Only collected during cool months	0	None reported	Hyperbaric	Panama City, FL
	None reported	21%	14	Cage+SCUBA	Daytona, FL
	All	20%	282	Cage	Louisiana gas platforms
	Fall	1%	140	Surface observation	Galveston, TX
	All	9%	2932	Surface observation	AL coast
	Only collected during cool months	0	None reported	Hyperbaric	Panama City, FL
25	Summer	41%	3851	Surface observation	Texas ports
	None reported	11%	44	Cage+SCUBA	Galveston, TX
	Fall	1%	31	Surface observation	Galveston, TX
	All	14%	2932	Surface observation	AL coast
	Only collected during cool months	0	None reported	Hyperbaric	Panama City, FL
	Summer and Fall	53%	38-47-30	Cage	Port Aransas, TX
	Summer	47%	3851	Surface observation	Texas ports
30	Summer and Fall	27%	137	Surface observation	Corpus Christi, Texas
	All	18%	2932	Surface observation	AL Coast
35	Summer	15%	3851	Surface observation	Texas ports
	Fall	44%	61	Surface observation	Galveston, TX
40	Summer	40%	3851	Surface observation	Texas ports
	Only collected during cool months	40%	None reported	Hyperbaric	Panama City, FL
	Summer and Fall	71%	9-56-32	Cage	Port Aransas, TX
45	Summer	63%	3851	Surface observation	Texas ports
	Fall	36%	55	Cage	Galveston, TX
	Summer and Fall	69%	36-35-39	Cage	Port Aransas, TX
50	Summer	61%	3851	Surface observation	Texas ports
55	Summer	58%	3851	Surface observation	Texas ports
	Only collected during cool months	45%	None reported	Hyperbaric	Panama City, FL
	Summer	38%	3851	Surface observation	Texas ports
60	Fall and summer	27%	282	Surface observation	Corpus Christi, Texas
65	Summer	37%	3851	Surface observation	Texas ports
70	Summer	33%	3851	Surface observation	Texas ports
75	Summer	23%	3851	Surface observation	Texas ports
80	Summer	47%	3851	Surface observation	Texas ports
95	Summer	56%	3851	Surface observation	Texas ports

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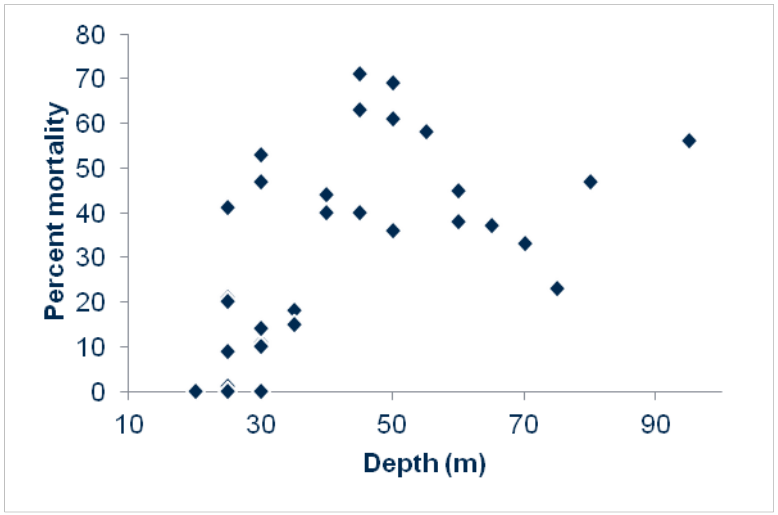
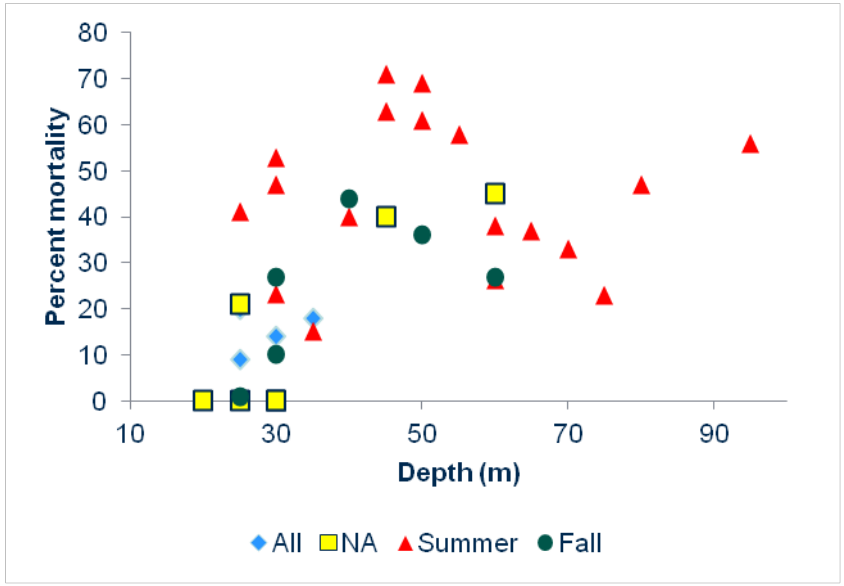
Depth



Season



- Study type
- Venting compliance
- Hook type
- Fishing sector

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Meta-analysis methods

Meta-analysis allows inclusion of all available point estimates, includes a sample size weighting scheme, and allows for the use of moderator variables in a mixed-effects modeling approach (Viechtbauer 2010).

The meta-analysis approach was developed, and is useful, because it reduces the introduction of bias that hinders non-parametric approaches often found in review papers (Sterne et al. 2000, Nakagawa and Santos 2012).

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Meta-analysis methods

Metafor package in R (Viechtbauer 2010)

Special case of a weighted general linear model

Uses effect size (*es*) , logit-transformed proportion

$$es = \log * \frac{x_i}{(n_i - x_i)}$$

x_i = number of mortalities

n_i = sample size.

es, and sampling variance

Heterogeneity (τ^2) estimated using REML

Coefficients for μ, $\beta_0,\ldots,\beta_p$, are estimated using

Weighted least squares

es weight = inverse of its variance

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Meta-analysis methods

Wald-type tests and confidence intervals were calculated for μ, $\beta_0,\ldots,\beta_p$, assuming normality.

Cochran's *Q*-test was used to assess the amount of heterogeneity among studies (i.e. a null hypothesis of $\tau^2 = 0$).

Predicted values converted back to proportions by taking the inverse of the logit transformed *es* value

$$Proportion = \frac{exp^{es}}{(1 + exp^{es})}$$

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Meta-analysis methods

<u>Effect size requires</u>

Proportion of mortalities

Sample size (*N*)

<u>Moderators</u>

Fishing depth (m), pressure, log-depth, volume

Fishing sector (commercial or recreational)

Venting compliance (100%, intermittent, 0%)

Season (winter, spring, summer, fall, annual)

Hook type (circle, J, mixed)

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Meta-analysis

Mortality ~ Depth, Comm, Delayed, Vent, IV, Winter, Spring, Fall, Annual, Circle, Mixed

Where:

commercial/recreational

Delayed/Immediate

No Vent/Intermittent Vent/Vent

Season

Hook type (circle, J or mixed)

Therefore:

Baseline = recreational, no venting, summer, j hook

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Final Model

	coef	se	z	pval
intrcpt	-1.35226	0.200127	-6.757	1.41E-11
Depth	0.020087	0.004118	4.877466	1.07E-06
comm	2.19531	0.291132	7.5406	4.68E-14
Vent	-0.86463	0.158936	-5.44012	5.32E-08
Winter	-0.89422	0.232041	-3.8537	0.000116
Spring	-0.63132	0.239966	-2.63087	0.008517
Fall	-0.40114	0.17862	-2.24578	0.024718
Mixed	1.445082	0.268201	5.388055	7.12E-08

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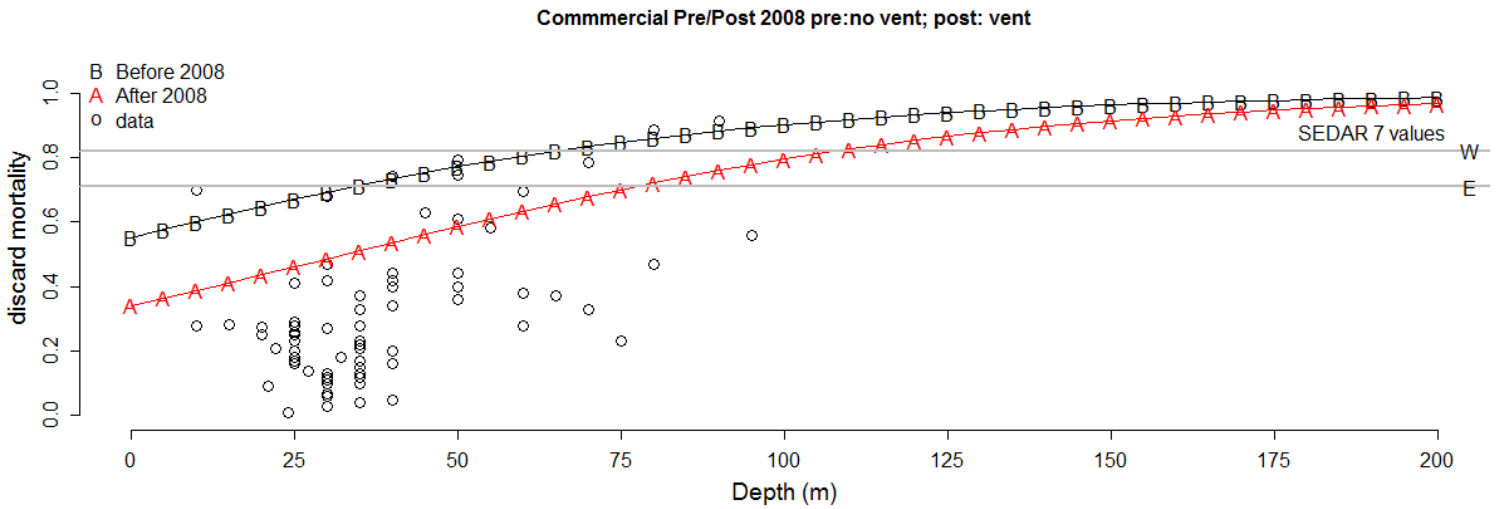
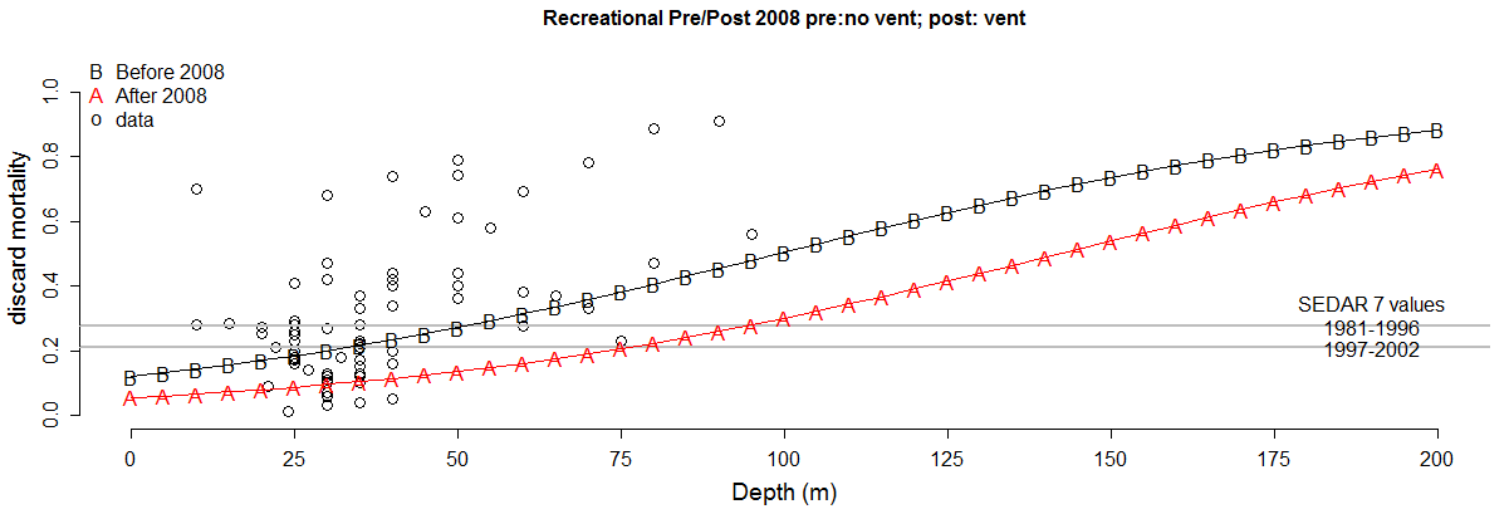
Final Model

- Season
  - Assumed average season effect
- Venting
  - Assumed no venting prior to 2008
  - Assumed venting after 2008
- Depth
  - Average commercial discard depths calculated from commercial observer program data
  - Average recreational discard depths calculated from iSnapper program data

Final Model


Commmercial Pre/Post 2008 pre:no vent; post: vent
B Before 2008
A After 2008
o data
SEDAR 7 values
W
E
discard mortality
0.0
0.2
0.4
0.6
0.8
1.0
0
25
50
75
100
125
150
175
200
Depth (m)


Recreational Pre/Post 2008 pre:no vent; post: vent
B Before 2008
A After 2008
o data
SEDAR 7 values
1981-1996
1997-2002
discard mortality
0.0
0.2
0.4
0.6
0.8
1.0
0
25
50
75
100
125
150
175
200
Depth (m)

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Commercial Discard Mortality

Gear	Handline				Longline			
Region	East		West		East		West	
Season	Closed	Open	Closed	Open	Closed	Open	Closed	Open
Average Depth (m)	42	45	84	53	66	62	132	104
Disc Mort - no venting	0.74	0.75	0.87	0.78	0.82	0.81	0.95	0.91
Disc Mort - venting	0.55	0.56	0.74	0.60	0.66	0.64	0.88	0.81

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Recreational Discard Mortality

Gear	Recreational			
Region	**East**		**West**	
Season	**Closed**	**Open**	**Closed**	**Open**
Average Depth (m)	33	34	36	35
Disc Mort - no venting	0.21	0.21	0.22	0.22
Disc Mort - venting	0.10	0.10	0.11	0.10

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Indices of Abundance

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Overview

- Working group decided on ten indices of abundance to recommend for inclusion into the model
- Unless otherwise specified, all indices standardized using the delta lognormal approach
- Please see data workshop report and individual data workshop working papers for specific methodological details.

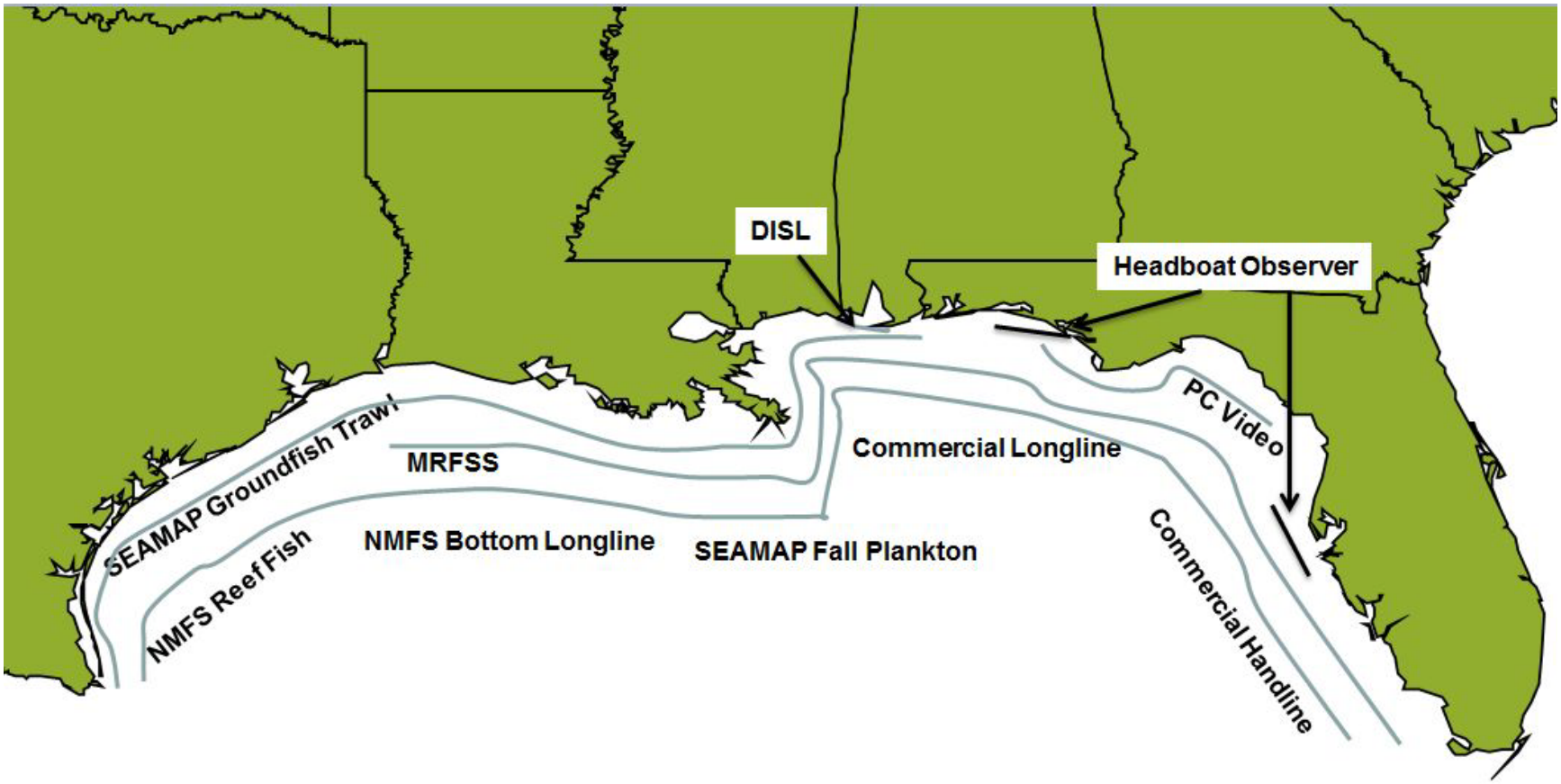
Indices of Abundance: Fishery Dependent

1. HL index East (retained catch) (1990 – 2006)
2. HL index West (retained catch) (1990 – 2006)
3. MRFSS/MRIP East (total catch) (1981 – 2011)
4. MRFSS/MRIP West (total catch) (1981 – 2011)
5. Headboat East (total catch) (1986 – 2011)
6. Headboat West (total catch) (1986 – 2011)
7. Shrimp Effort East (F) (1950 – 2011)
8. Shrimp Effort West (F) (1950 – 2011)

Indices of Abundance: Fishery Independent

1. SEAMAP Video East (1993 – 2011)
2. SEAMAP Video West (1993 – 2011)
3. SEAMAP Plankton East (1987 – 2010)
4. SEAMAP Plankton West (1986 – 2010)
5. SEAMAP Summer Groundfish Trawl West (1982 – 2011)
6. SEAMAP Fall Groundfish Trawl West (1972 – 2011)
7. SEAMAP Summer Groundfish Trawl w/ DISL East (1982 – 2011)
8. SEAMAP Fall Groundfish Trawl w/ DISL East (1972 – 2011)
9. NMFS bottom longline w/ supplemental sampling East (1996 – 2011)
10. NMFS bottom longline w/ supplemental sampling West (1996 – 2011)

Indices Spatial Coverage



Indices of Abundance: Fishery Dependent

- Commercial HL indices only go through 2006 because of the implementation of IFQs in 2007
- Recreational fishery indices (headboat and MRFSS) were fit using a censored delta lognormal approach to account for the increasingly strict bag limit regulations
  - Based on retained (A) catch
- Shrimp effort was incorporated as an index of F to estimate annual shrimp bycatch

Indices of Abundance: Fishery Dependent

Indices of Abundance: Fishery Dependent

Indices of Abundance: Fishery Dependent

Indices of Abundance: Fishery Independent

- SEAMAP groundfish trawl data in the east was combined with Dauphin Island Sea Lab's Artificial Reef Survey data
- SEAMAP plankton survey used as an index of spawning biomass
  - Plankton survey in the east calculated as a frequency of occurrence model due to low catches
- NMFS bottom longline survey includes 2011 supplemental sampling

Indices of Abundance: Fishery Independent

Indices of Abundance: Fishery Independent

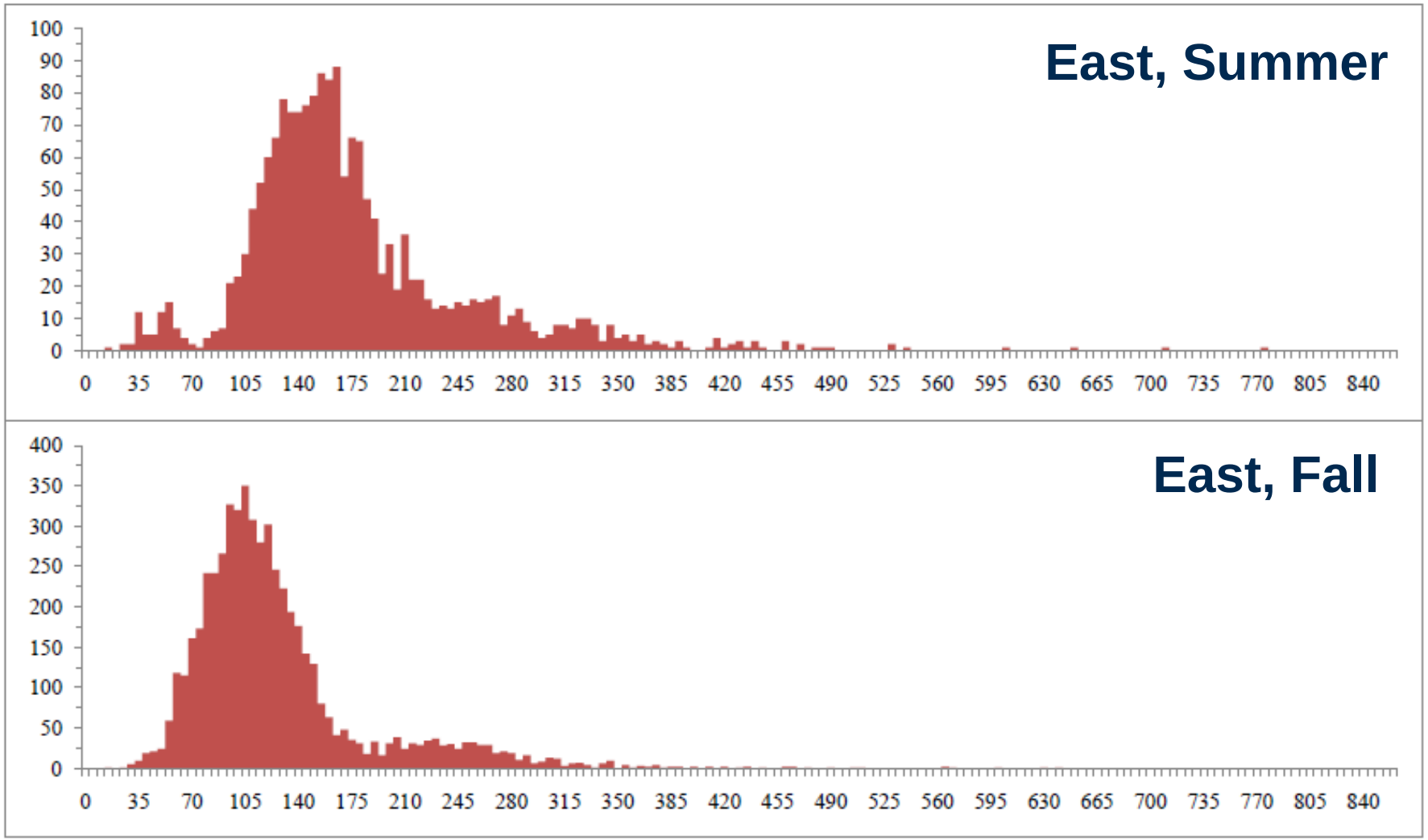
Indices of Abundance: Fishery Independent

Indices of Abundance: Fishery Independent

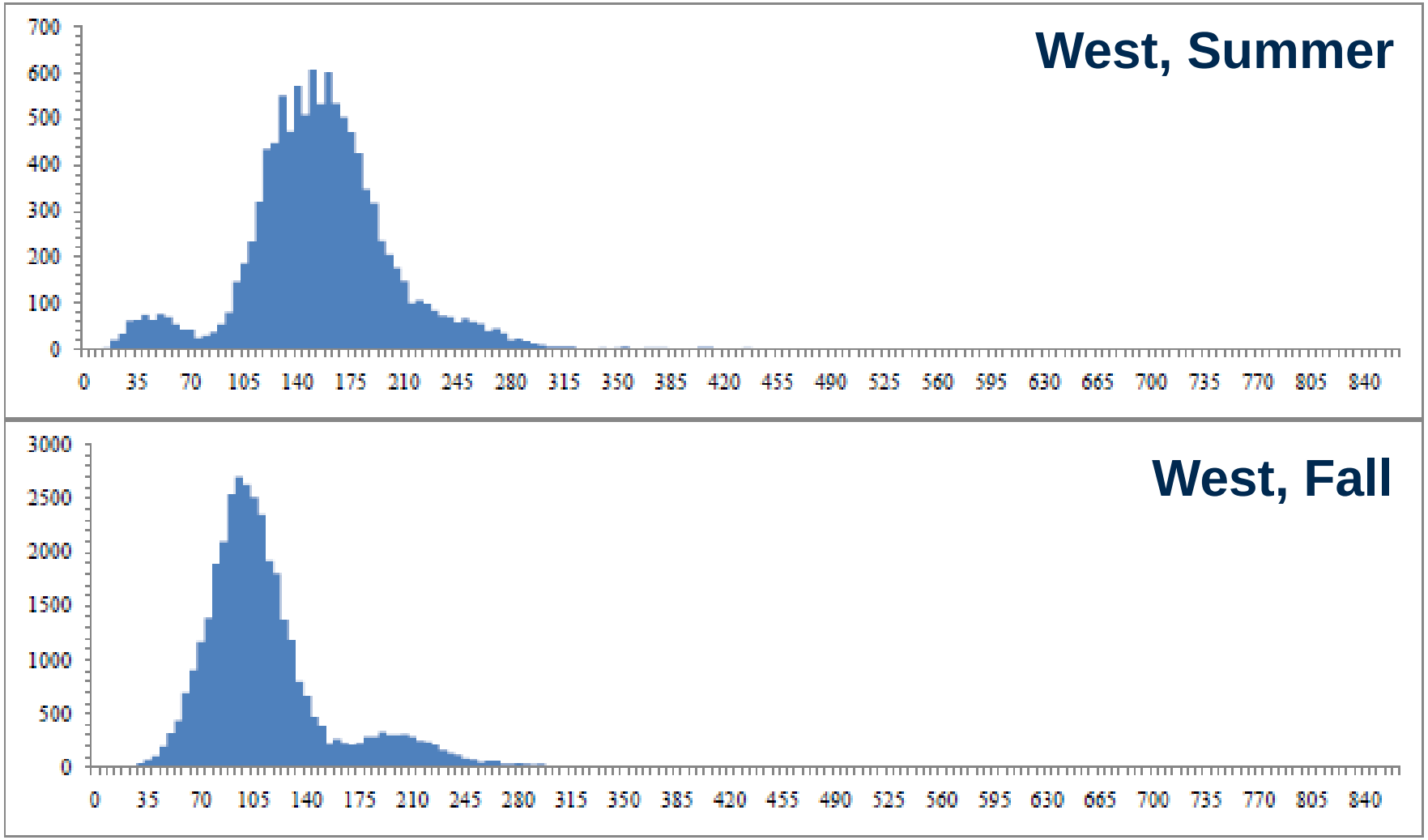
Indices of Abundance: Fishery Independent

Size Composition From Fishery Independent Surveys

Fish Length from Groundfish Survey



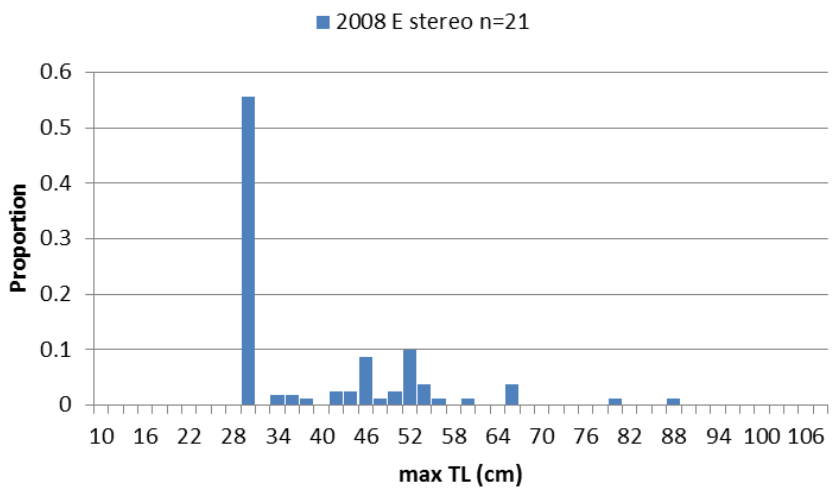
Fish Length from Groundfish Survey

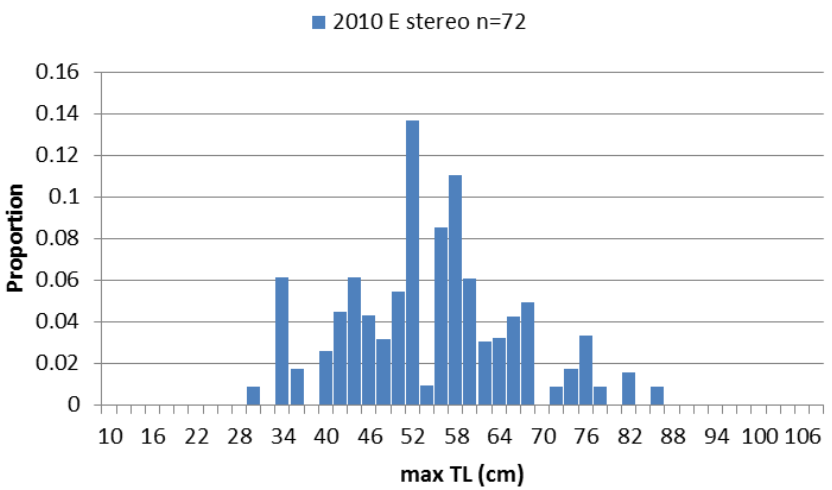


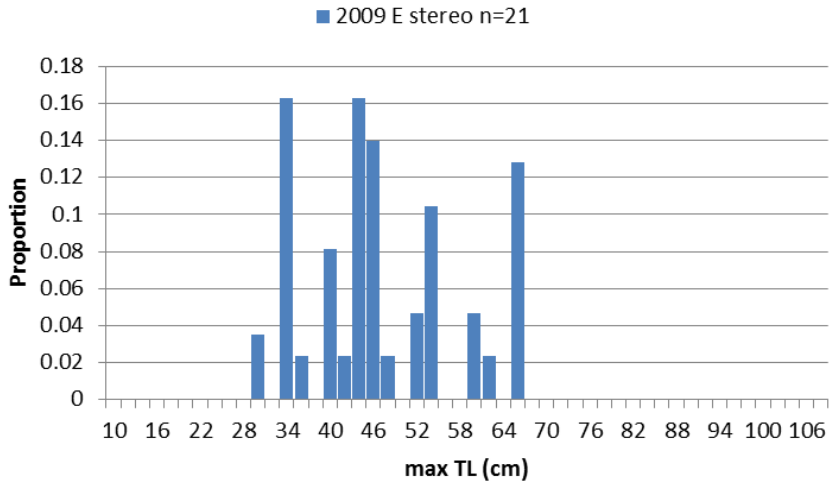
SEAMAP Reef Fish Video Survey Lengths

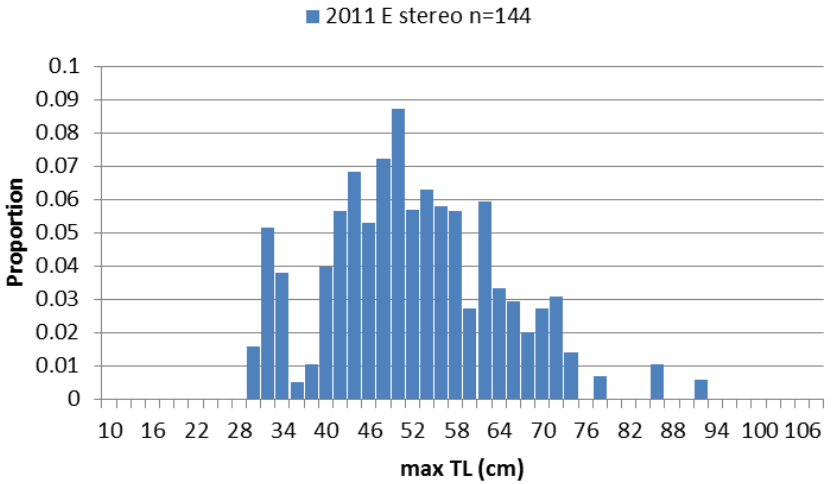
- 1995-2007 (+1 cruise in 2010): Used lasers to measure fish
  - High probability of double-counting fish
- 2008-2011: Used stereo cameras
  - Site-specific length comps weighted by mincount to get region specific length comps
- Therefore, only use stereo camera lengths in assessment

RFV Stereo Cameras East

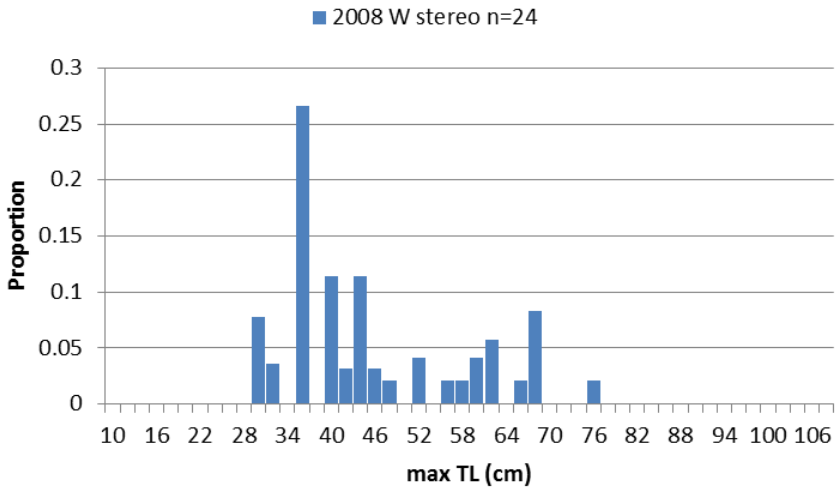


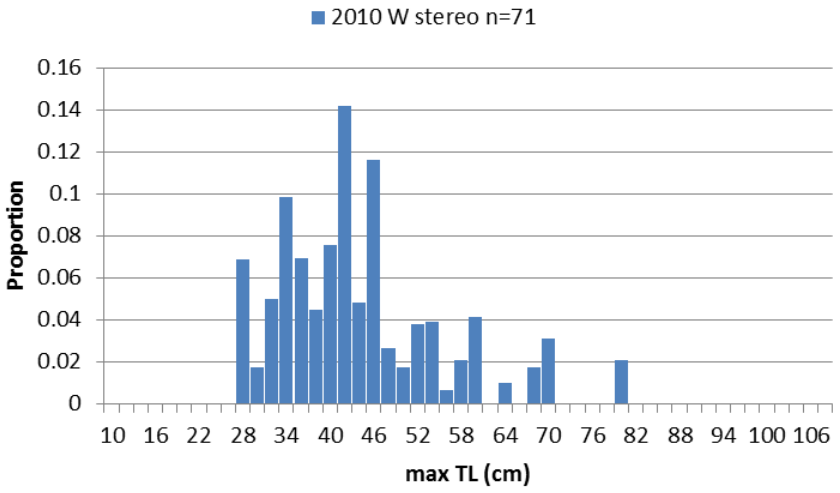


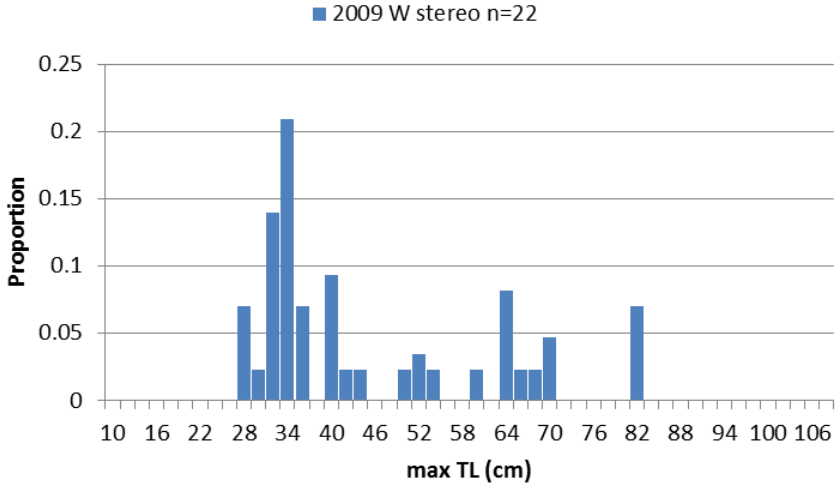


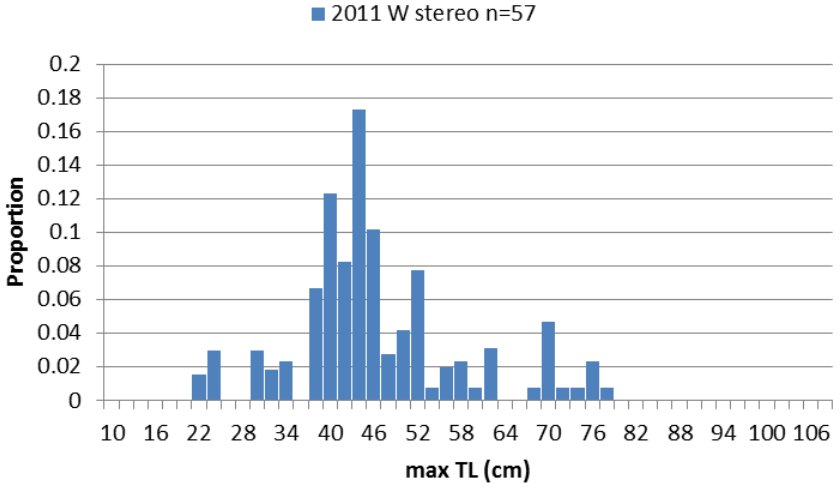


RFV Stereo Cameras West









NMFS BLL East Size Comps

NMFS BLL West Size Comps

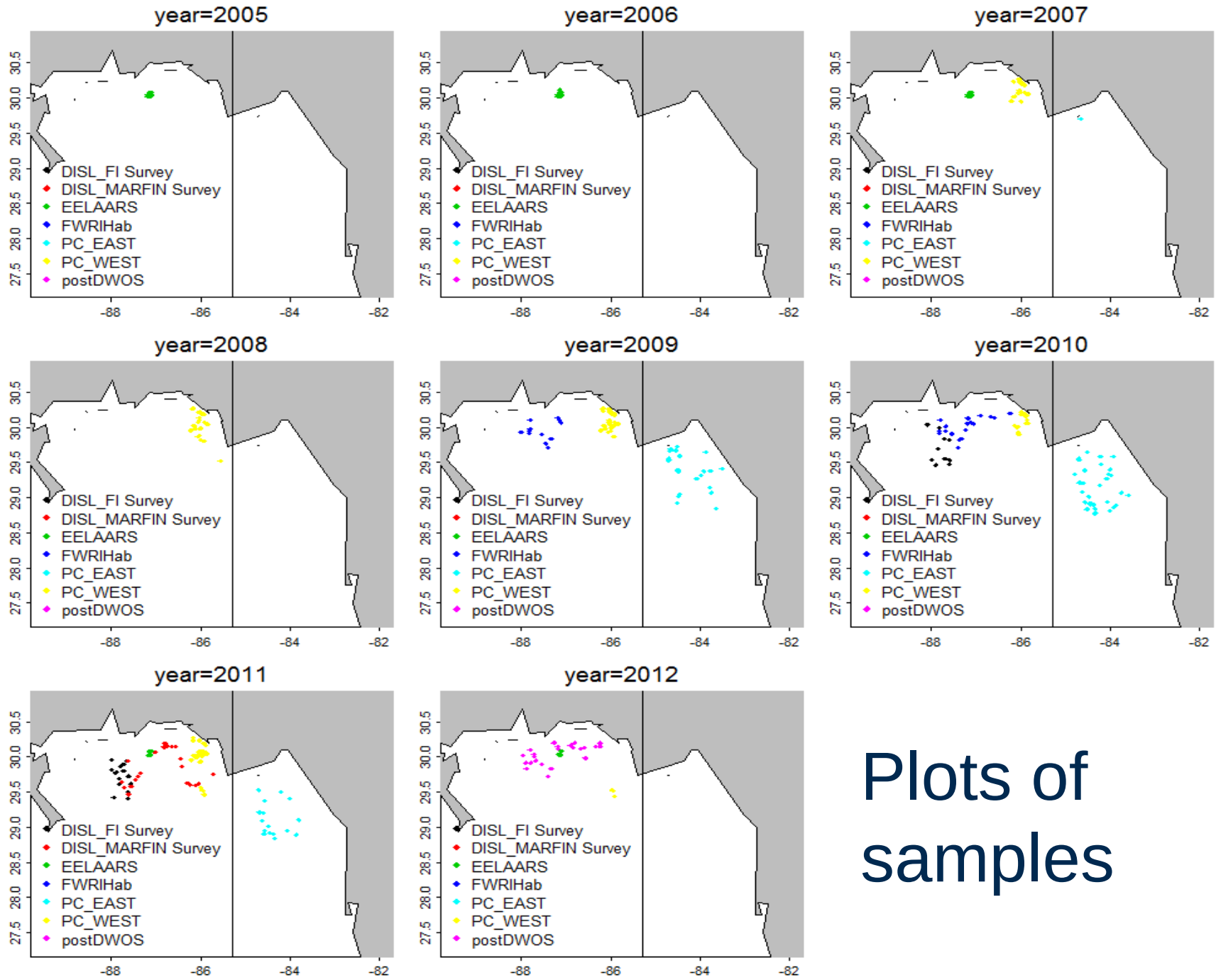
ROV/Camera surveys

University of West Florida surveys (Patterson et al. 2009)

Dauphin Island Sea Lab (DISL) surveys

Panama City ROV studies

Panama City NMFS stationary camera survey



Plots of samples

Multinomial regression model to predict the predict the probabilities associated with each length bin

TLcat ~ YEAR +SEASON + Longitude Bin ((-89,-85.3] (-85.3,-83]**) + Reef.type (**“natural”, “artificial”)

Final model:

TLcat ~ YEAR + Reef.type

Sample sizes = number of fish * area

Combined ROV East Size Comps

Fishery Independent Length Compositions

- Length compositions not used directly in base model, but were converted to age comps for use in the base model
  - Reef fish video survey and combined ROV survey lengths converted to age with combined ALKs
  - Combined ALKs were created for each region using commercial, recreational, and NMFS bottom longline survey age and length data
  - Groundfish trawl survey lengths converted to age by visual inspection of modes
- Except for NMFS BLL survey, which had direct otolith ages that were used in the base model

Age Composition From Fishery Independent Surveys

Reef Fish Video East Age Comps

Reef Fish Video West Age Comps

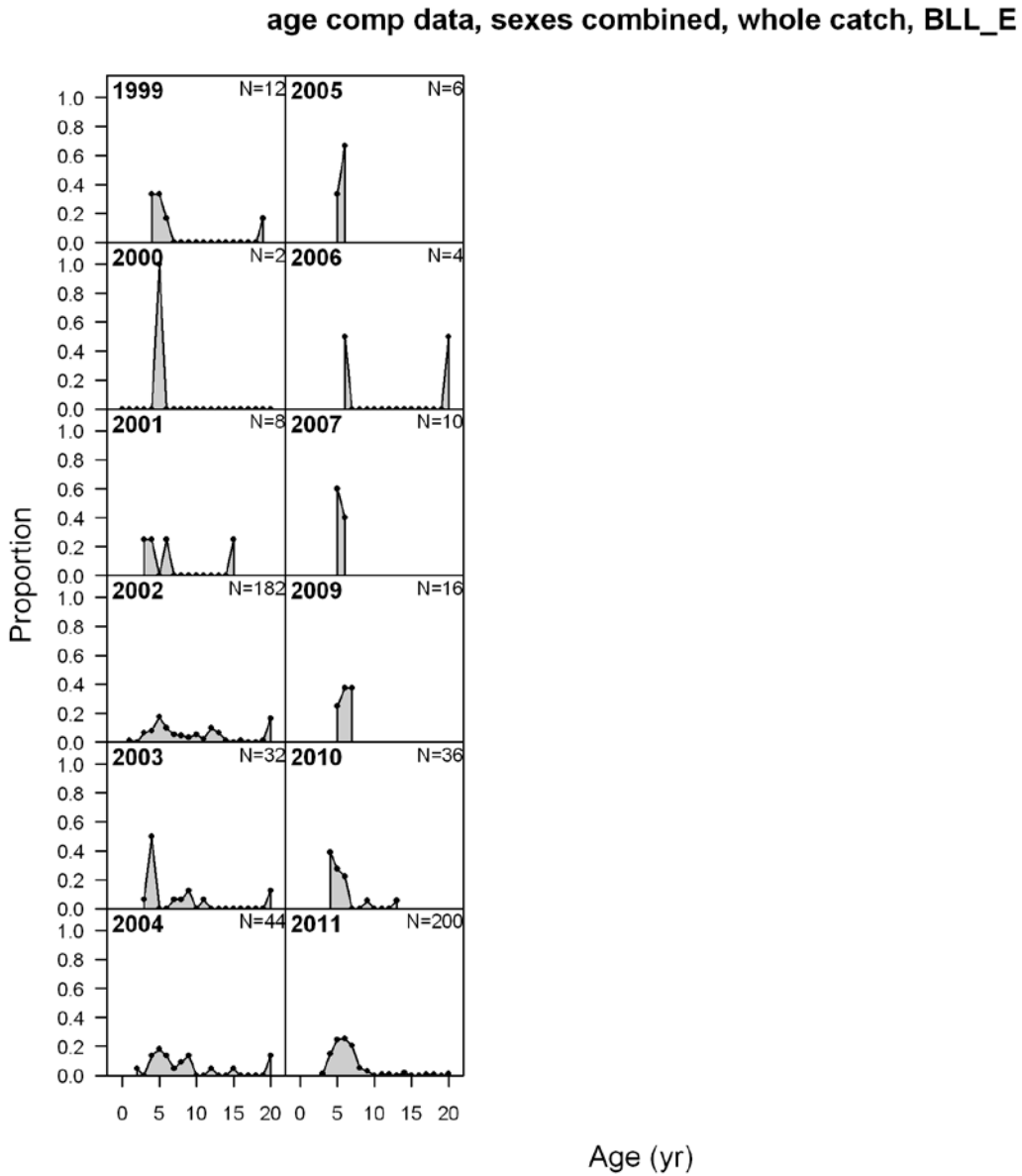
Summer Groundfish East Age Comps

Summer Groundfish West Age Comps

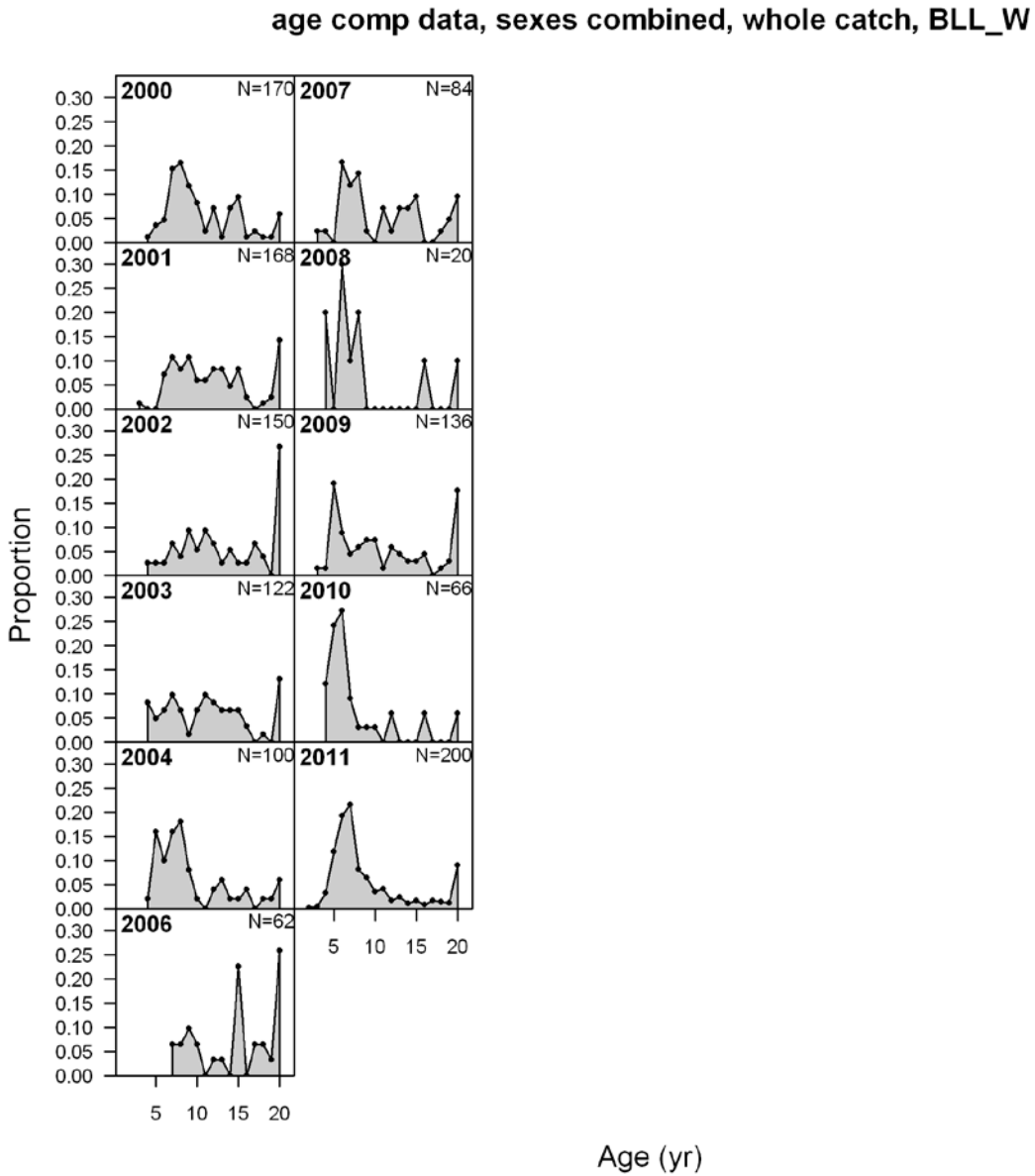
Fall Groundfish East Age Comps

Fall Groundfish West Age Comps

NMFS BLL East Age Comps



NMFS BLL West Age Comps



Combined ROV East Age Comps

Life History

Overview

- Stock definitions
- Habitat Requirements
- Natural mortality
- Age and Growth
- Reproduction
- Movement and Migration
- Conversion factors
- Episodic events
- Mortality due to oil and natural gas platform removals

Stock Definition

- Continued to support the two stock model
- Genetic results indicate that red snapper exhibit independent demographic assemblages on small spatial scales and support findings for a metapopulation stock-structure.
- While there is mechanism to transport larvae from west to east (WFS), it is in deeper waters with uncertainty about larval survivorship
- Connectivity between MX and TX not a significant source of recruits to western gulf,
- Connectivity between Campeche and WFS still undetermined
- Mixing rates east and west of Mississippi uncertain due to similar chemical signatures
- Recent connectivity study suggests east and west largely self-recruiting

Habitat Requirements

- Spawning occurs April – October, with peak in late June – mid July
- Larvae in plankton about 4 weeks, settle out in mid-June, and recruit to benthic habitat until mid-September.
- Settle on multiple habitat such as sand, mud and shell rubble
- In the Fall, they recruit to more structured habitats such as shell ridges, rock outcroppings, sand banks , and artificial reefs.
- Older red snapper become independent of structured habitat.

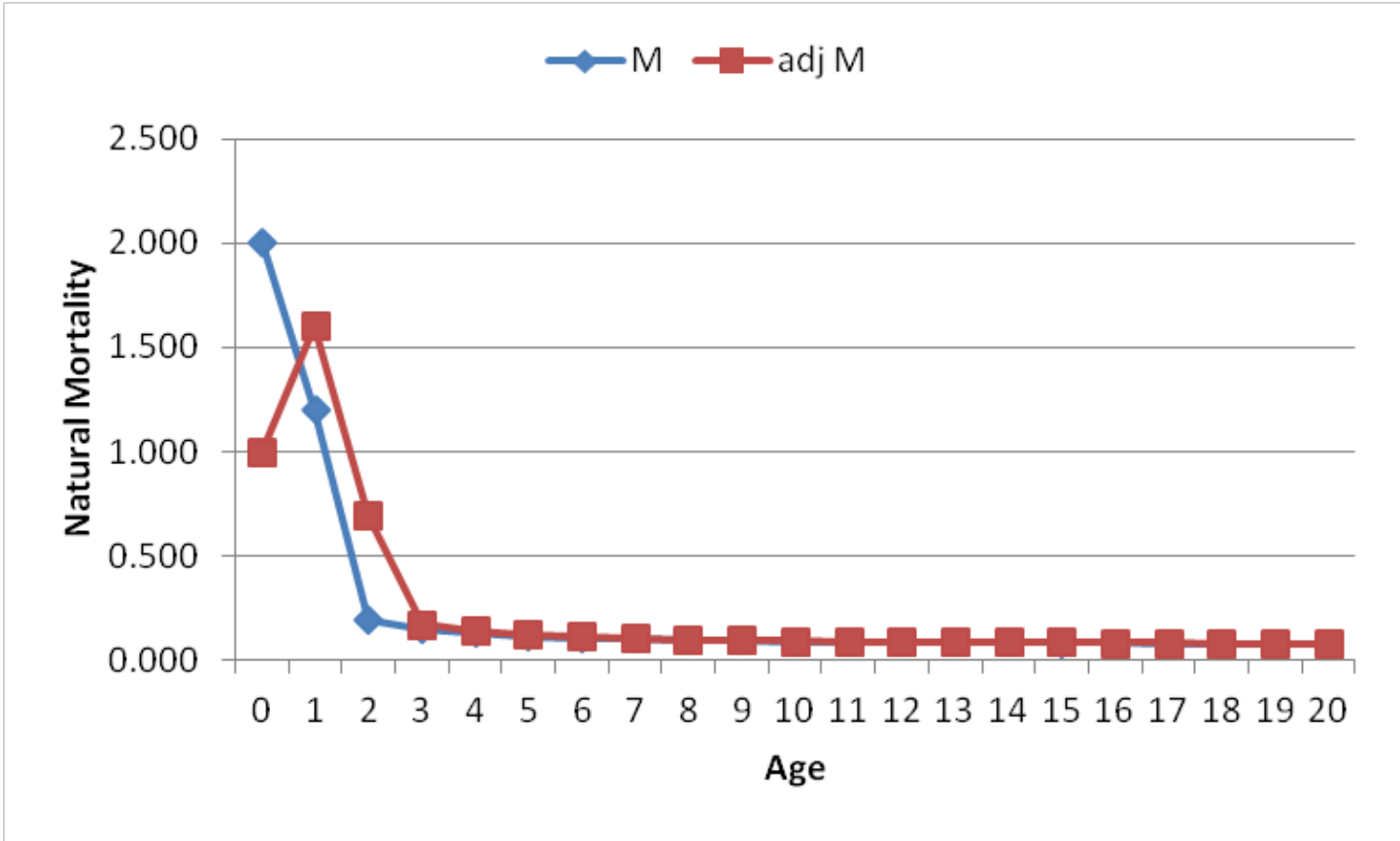
Natural Mortality

- Recent studies suggest M for ages 0 and 1 is higher than previously believed
- Therefore, base line age 0 and 1 M set equal to high M scenario from 2009 update assessment
  - Age 0 M = 2.0
  - Age 1 M = 1.2
- M for ages 2+ based on Lorenzen M scaled to Hoenig M of 0.094
  - Assumed max age of 48 years, midpoint between max observed age (57 yrs) and max validated age (38 yrs)

Natural Mortality

- M vector adjusted to account for SS approach for handling age
- SS advances age on Jan 1 regardless of birthdate
  - Red snapper born July 1 and advance age on Jan 1
- Therefore, an SS age 0 fish only experiences half a year of age 0 M

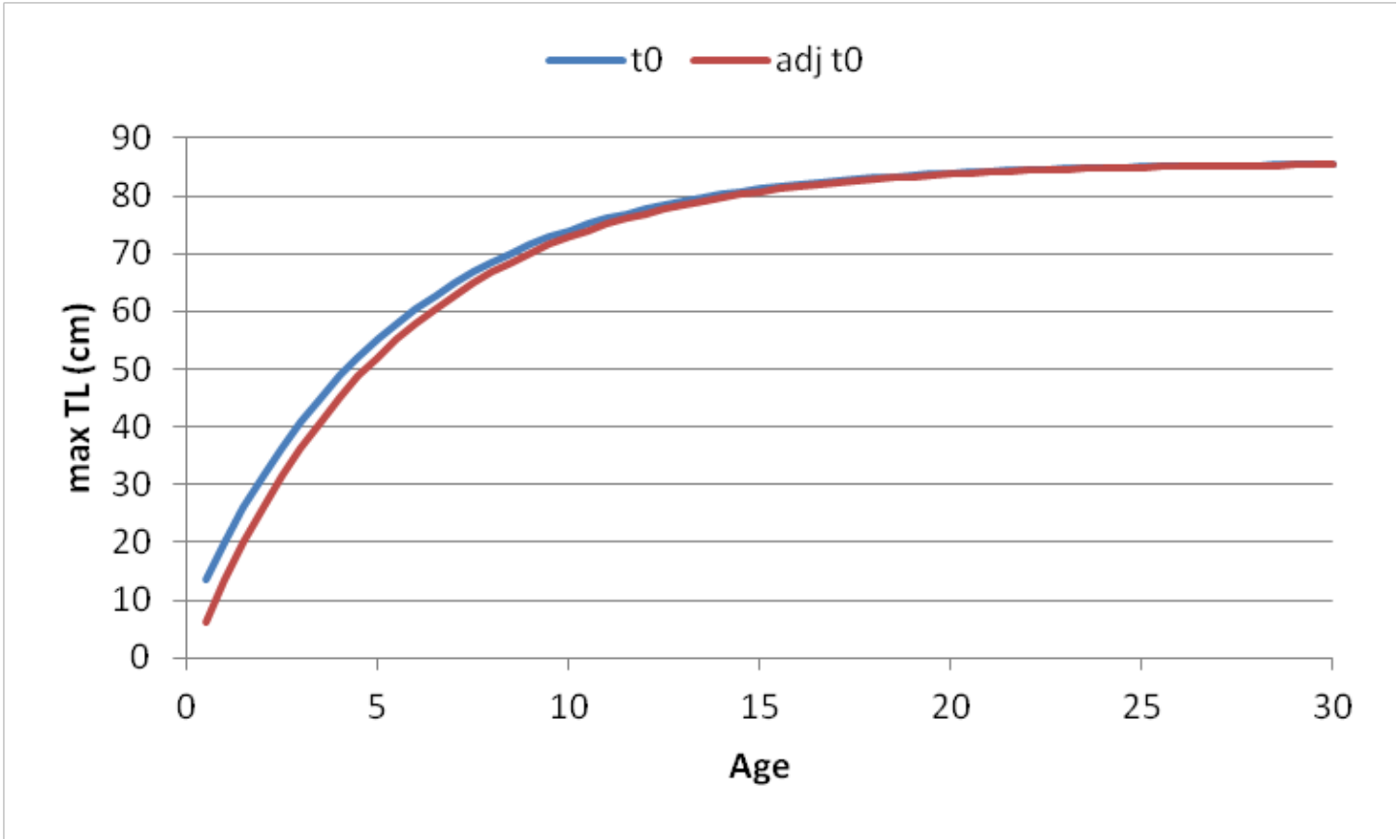
Natural Mortality



Age and Growth

- Used age data from 2003 to 2011 (when max TL measured)
- Growth model was size-modified for the effects of minimum size limits
- Growth curve estimated using biological age, then adjusted to SS ages by adding 0.5 to t0
- Growth curve parameters
  - Linf (max TL cm) = 85.6374
  - K = 0.191852
  - t0 = -0.394525
  - Adj t0 = 0.10547

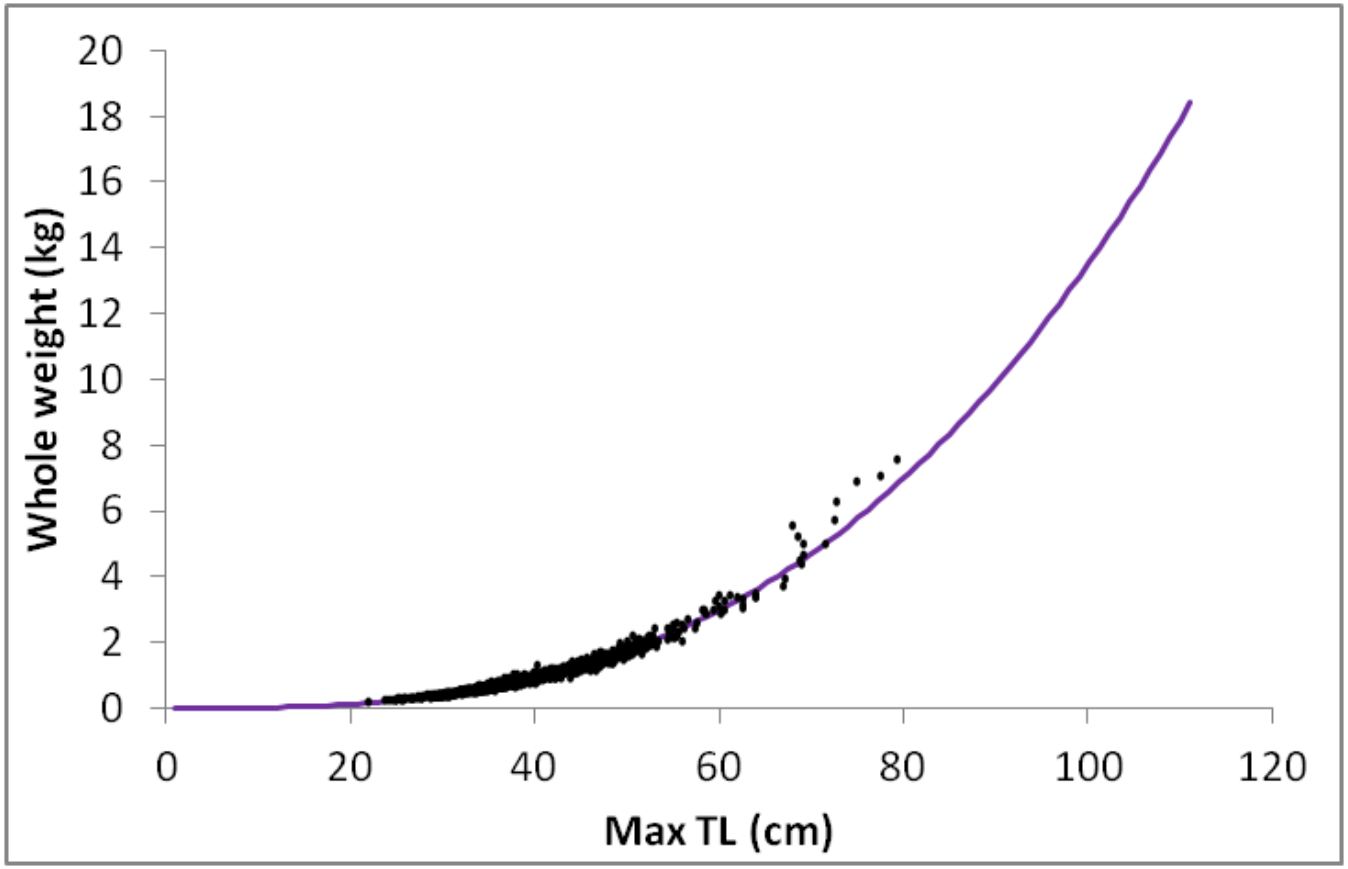
Age and Growth



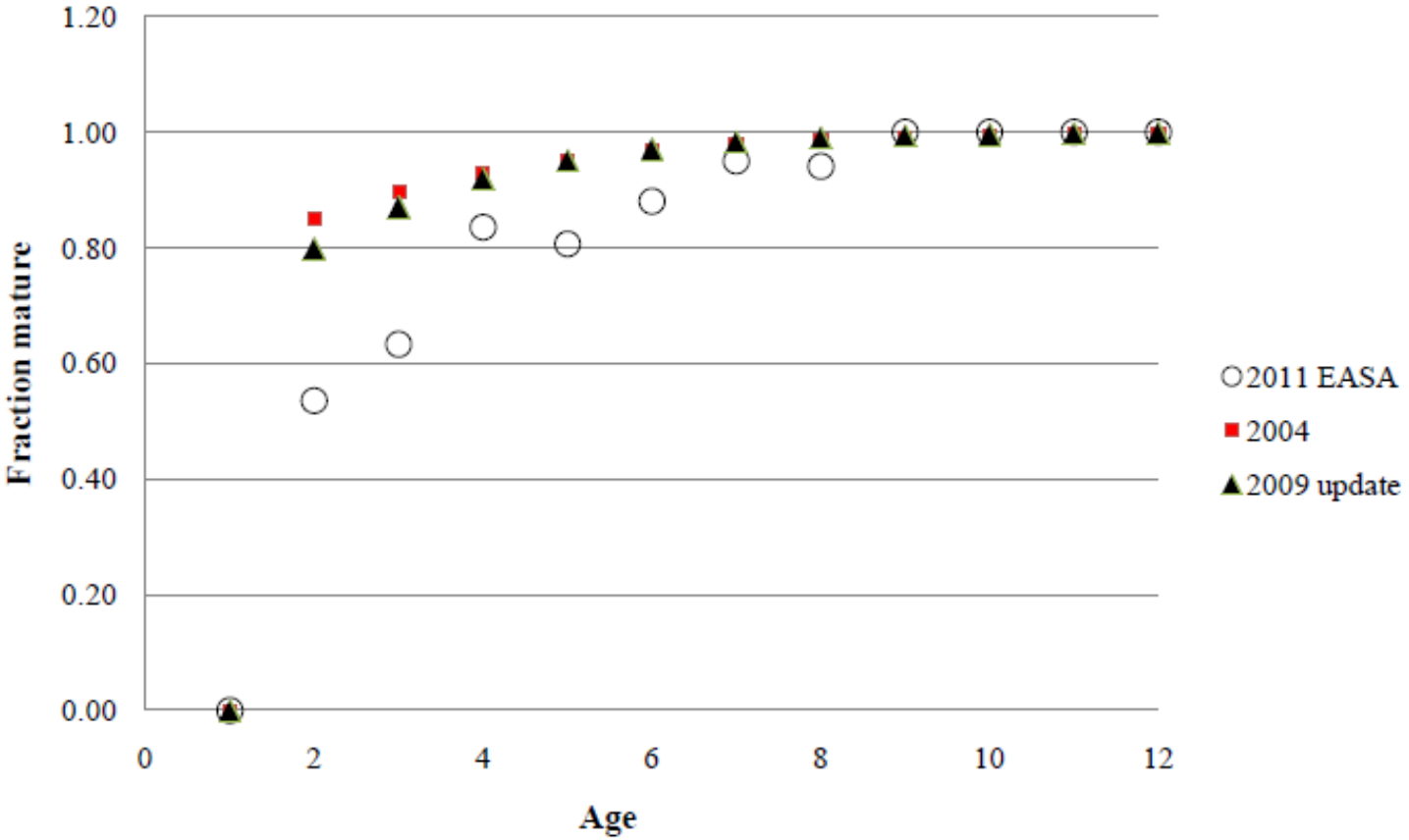
Length-Weight Relationship

- Used data from 2003 to 2011 (when max TL measured)
- Parameter estimates:
  - alpha = 1.673E-5
  - beta = 2.953

Length-Weight Relationship



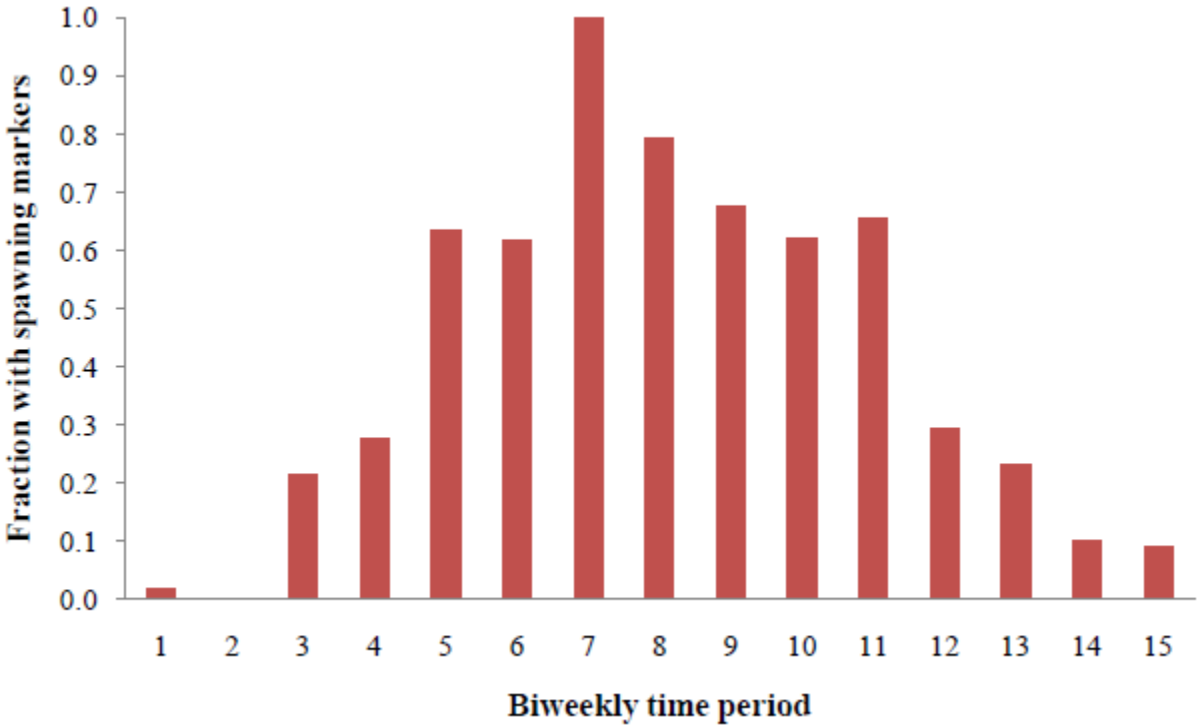
Maturity



- Additional unpublished data on red snapper reproduction is available since the 2009 update: EASA, Florida in 2009, and oil platforms in Louisiana.
- Additional data confirms the 1:1 sex ratio
- First age of maturity is age 2

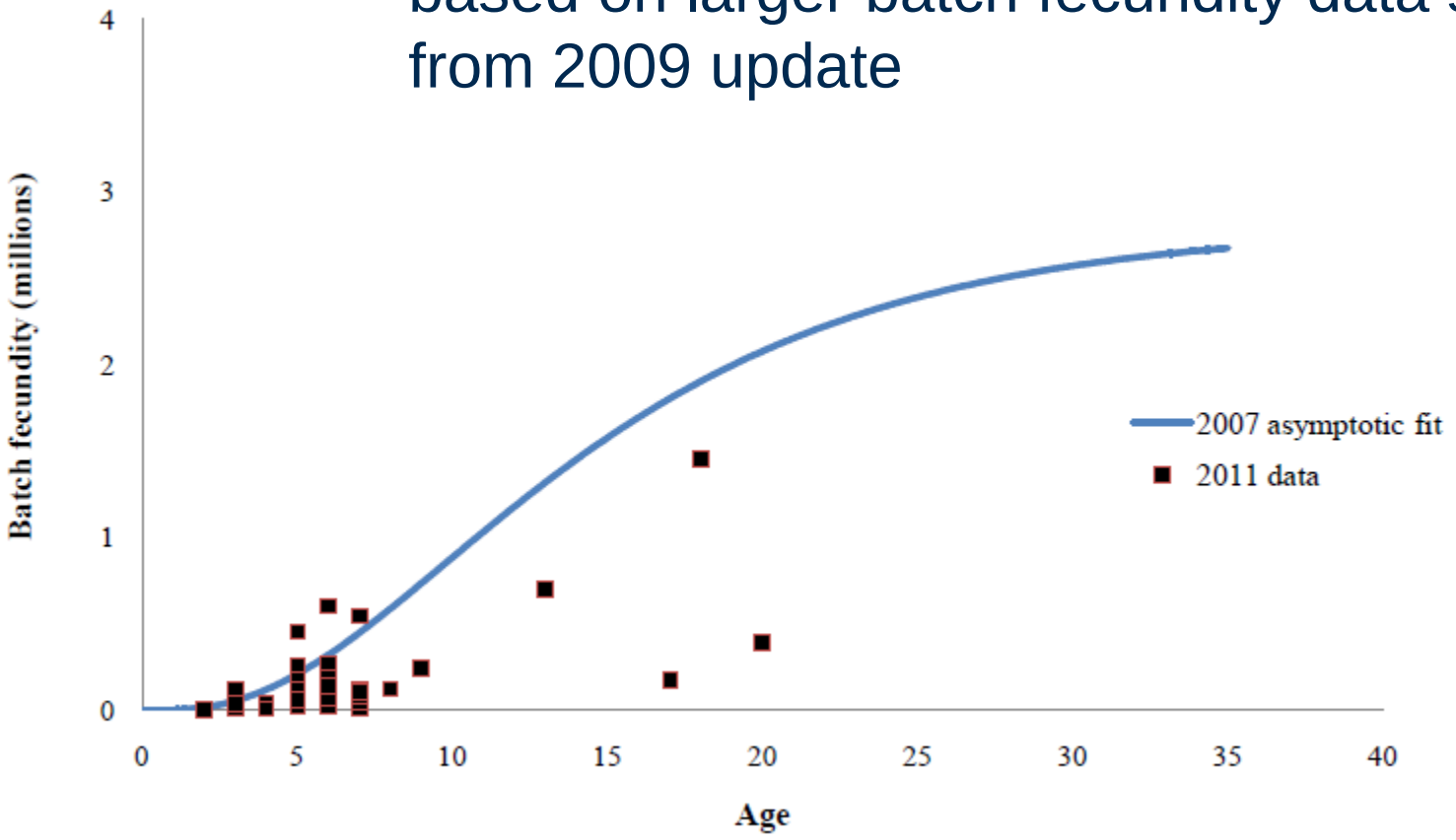
Spawning

- Spawning occurs April – October, with peak in late June – mid July
- Larvae in plankton about 4 weeks, settle out in mid-June, and recruit to benthic habitat until mid-September.



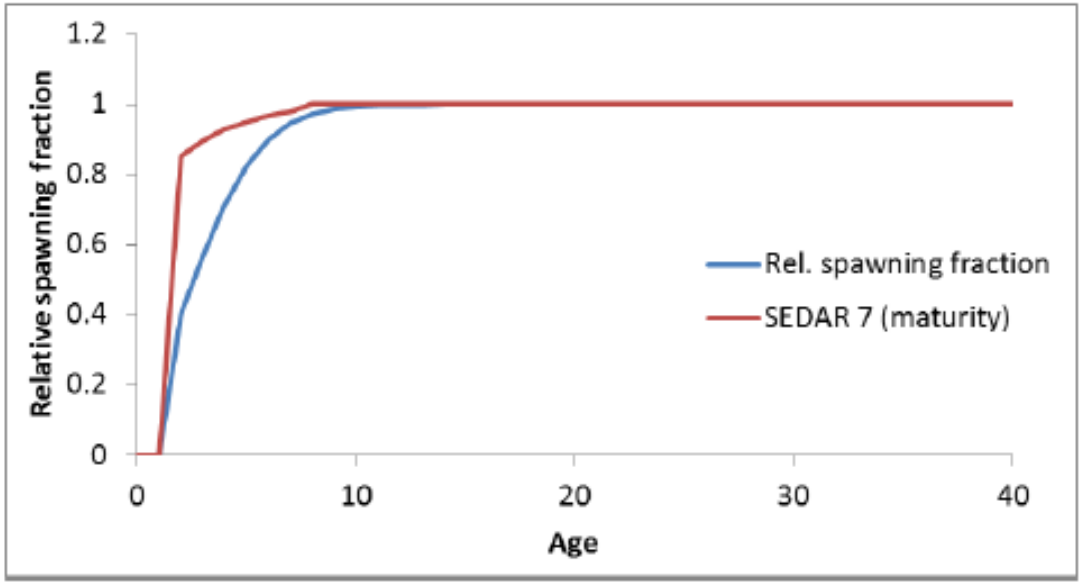
Batch Fecundity

Batch fecundity by EASA and curve based on larger batch fecundity data set from 2009 update

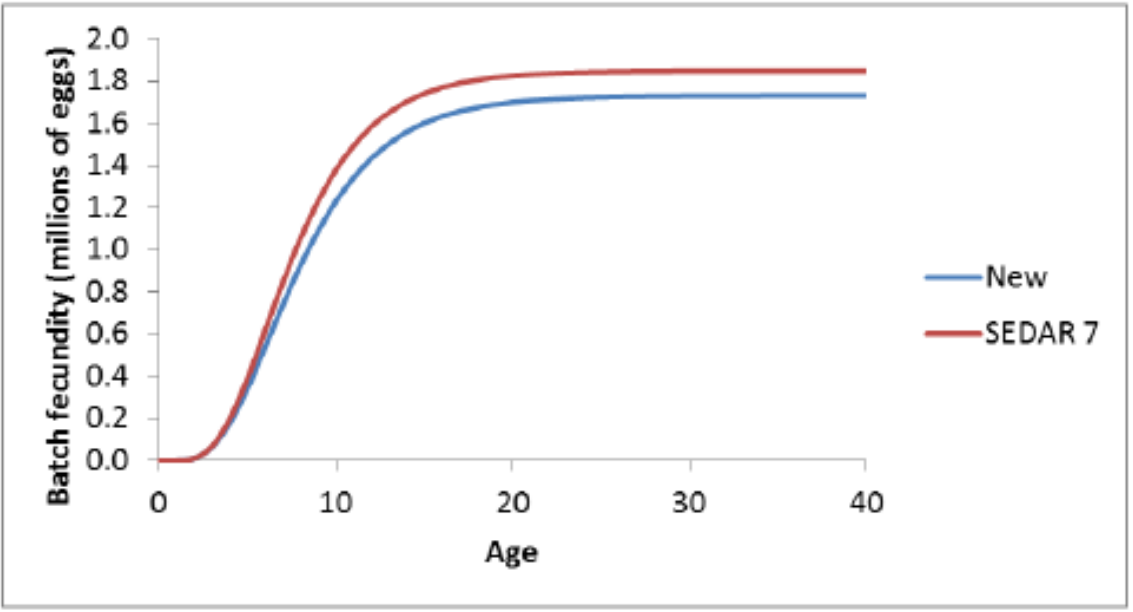


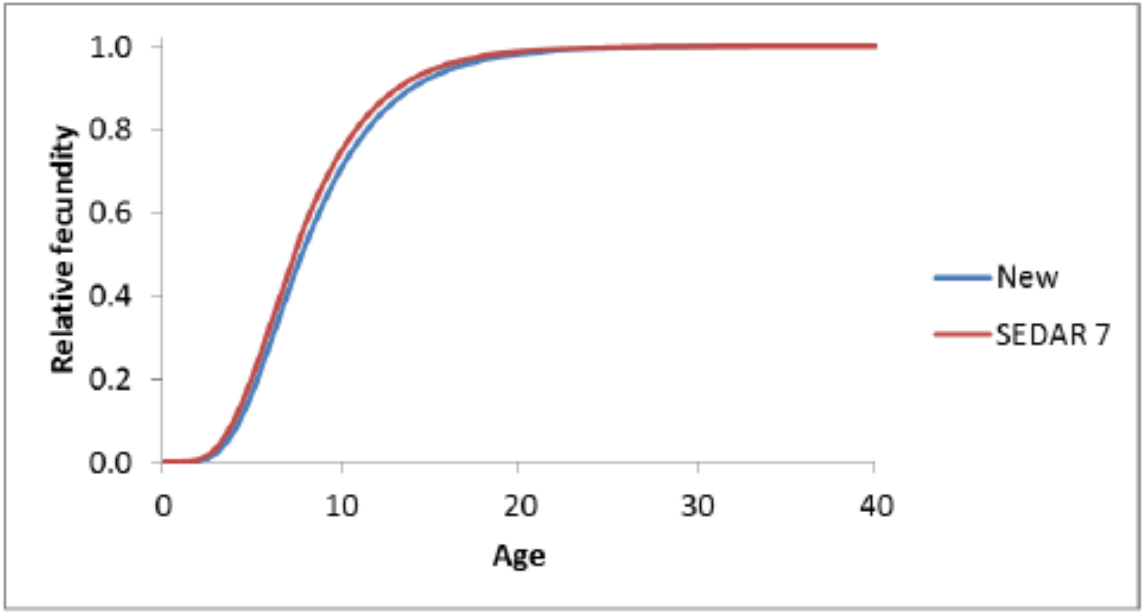
Batch Fecundity

- Relative fecundity of different age classes characterized by multiplying estimates of batch fecundity at age with estimates of maturity.
- New estimates of batch fecundity made using additional information
- New estimates of daily spawning fraction suggest red snapper <6 years old contribute less to the spawning population.
- Thus younger fish spawn less frequently than older fish.



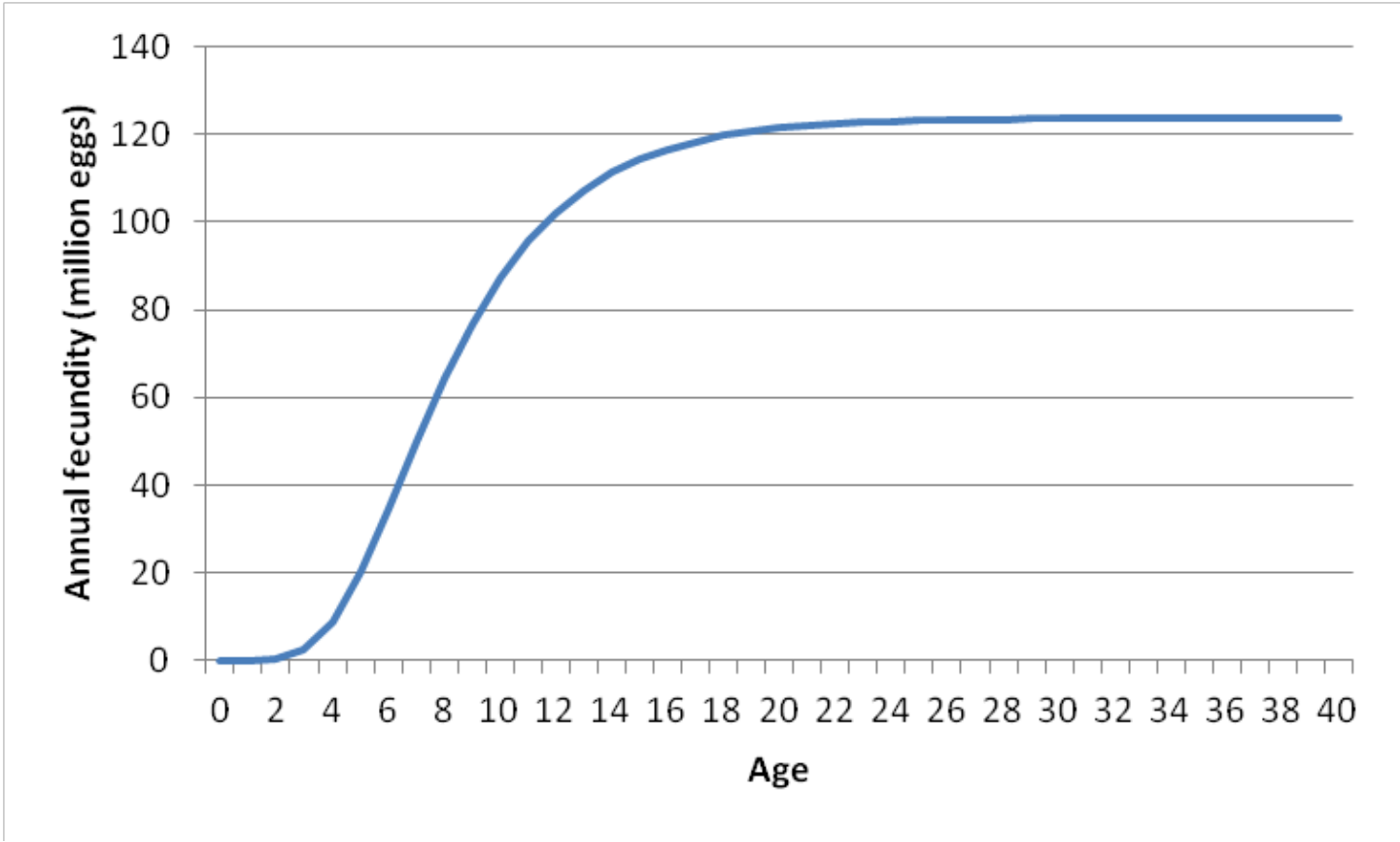
Batch Fecundity





However, the low batch fecundity values estimated for the younger age classes mitigate the importance of these differences to the estimation of per capita egg production, which is similar to that used in previous assessments.

Annual Fecundity



Annual fecundity obtained by applying spawning fraction to batch fecundity