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Appendix

# California Scorpionfish 2017 Stock Assessment

Melissa H Monk<sup>1</sup>, Xi He<sup>1</sup>, John Budrick<sup>2</sup>

<sup>1</sup>Southwest Fisheries Science Center

<sup>2</sup>California Department of Fish and Wildlife

STAR Panel meeting July 24-28, 2017



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## Background

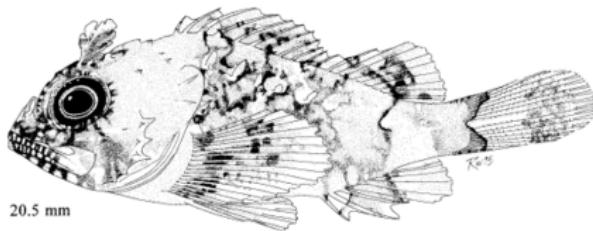
## California scorpionfish (*Scorpaena guttata*)

- Most common species of *Scorpaena* on the U.S. West Coast, more species in Mexico
  - Venomous dorsal, anal and pelvic spines
  - Demersal, found over both hard and soft bottom (anecdotal evidence suggests they prefer new structure)
  - Exhibit aggregating behavior (spawning and non-spawning aggregations)



## Early Life History

- Migration to spawning grounds, exhibit explosive breeding behavior just before dawn
  - External fertilization, females produce hollow gelatinous single-layer floating egg matrix
  - Eggs hatch after about 5 days
  - Juveniles settle at less than 2cm



<sup>o</sup>Line drawing from CalCOFI Atlas 33, pg. 789 Figure 26

## Distribution

- Distributed from central California to Punta Eugenia, Baja California Sur, Mexico
  - Rarely observed north of Pt. Conception
  - Observed from the intertidal to 600 ft, prefer depths of 20-450 ft
  - Proportion of the stock in Mexican waters unknown

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## Distribution

## Background



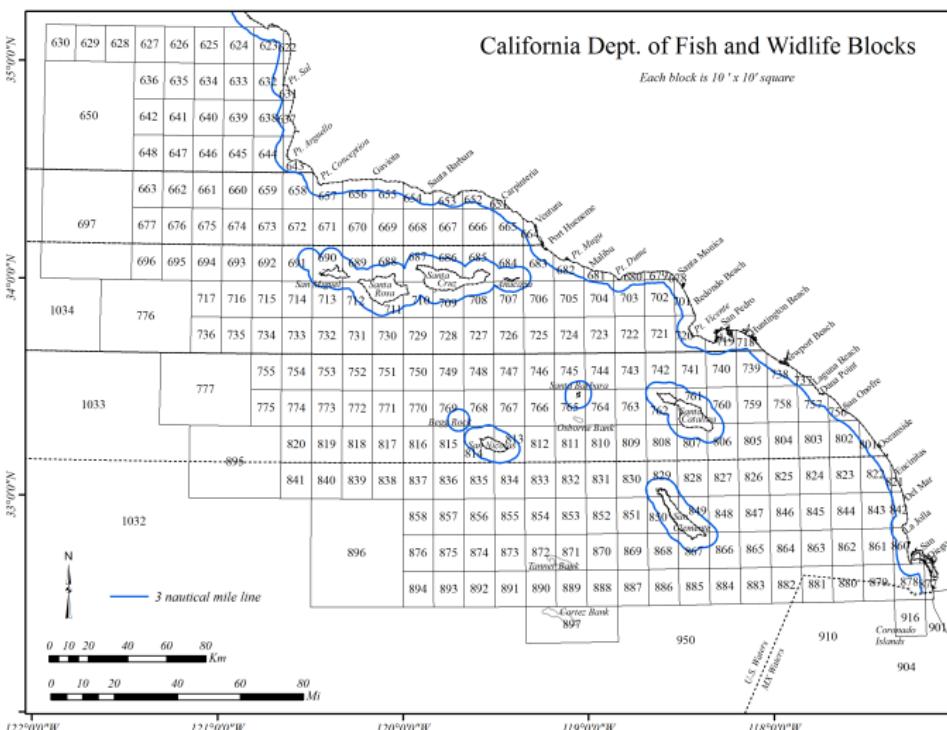
## Catch

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## Composition Data

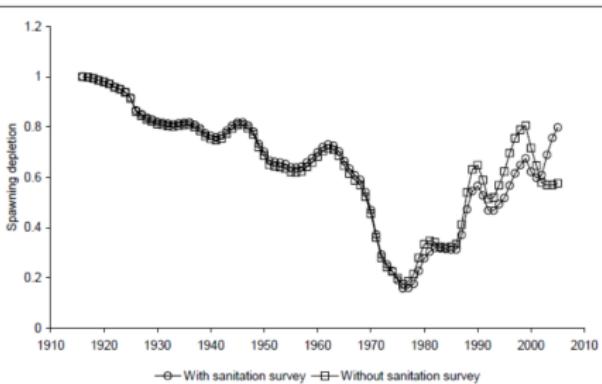
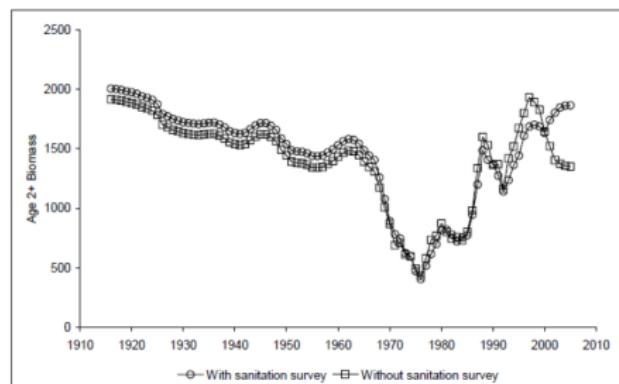
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## Stock Assessment Boundary



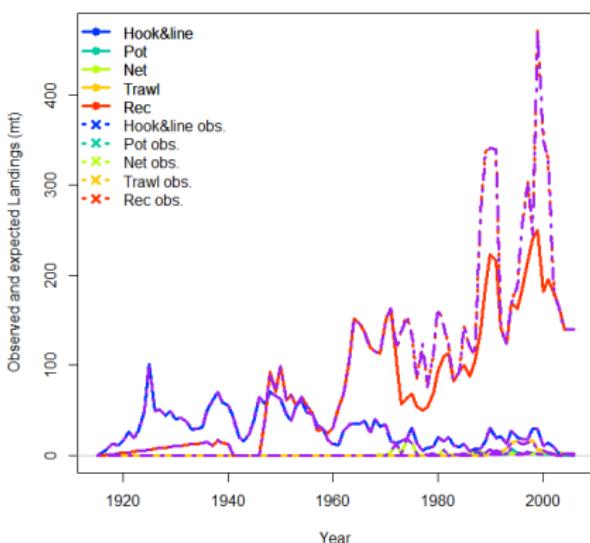
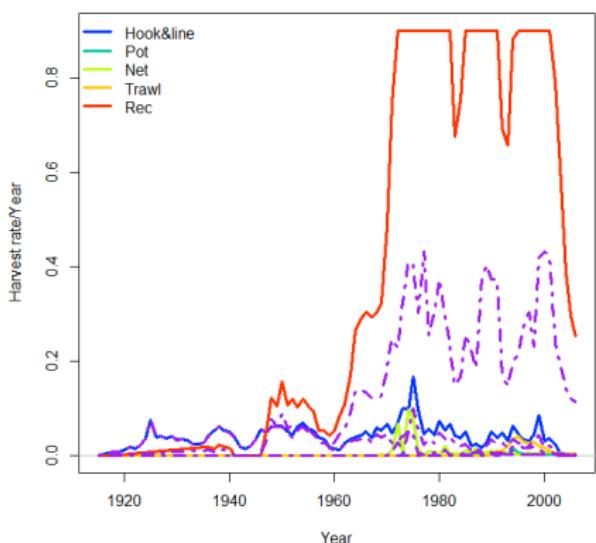
## 2005 Stock Assessment

- Stock first assessed in 2005
- South of Pt. Conception
- $M$  fixed at 0.25
- $h$  fixed at 0.7
- Publicly Owned Treatment Works (POTW) monitoring trawl survey was the axis of uncertainty in the 2005 assessment
  - POTW survey referred to as the Sanitation District Index in 2005



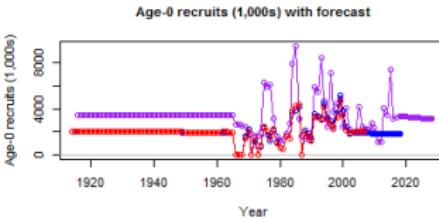
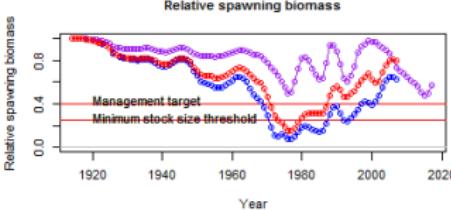
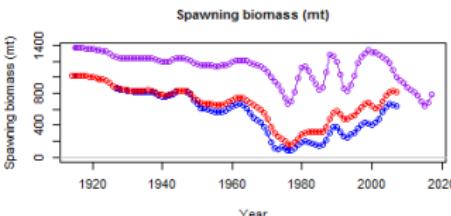
## 2005 Stock Assessment

- Transitioning from the 2005 assessment, an error was found
- Harvest rate hit the bounds for the recreational fleet
- Not all of the recreational catch was removed in the model
- Input vs. estimated catch was not standard output in SS v.1.8



# 2005 Stock Assessment

- 2005 assessment, SS v.1.8
- 2005 model in SS3.24z
- 2017 pre-STAR base model, SS3.30.0.05
- The two assessments have very similar trends over time, with  $B_0$  higher for the 2017 assessment that includes all removals



# 2017 Stock Assessment

## Pre-STAR Base Model

- One area south of Pt. Conception
  - Catches from Mexican waters excluded as in 2005
- Steepness fixed at 0.718
- Sex-specific  $M$  fixed for females, male  $M$  estimated as offset
- Re-evaluated fleet definitions
- Ages now available from the NWFSC trawl survey
- New indices and length compositions available

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## Catch

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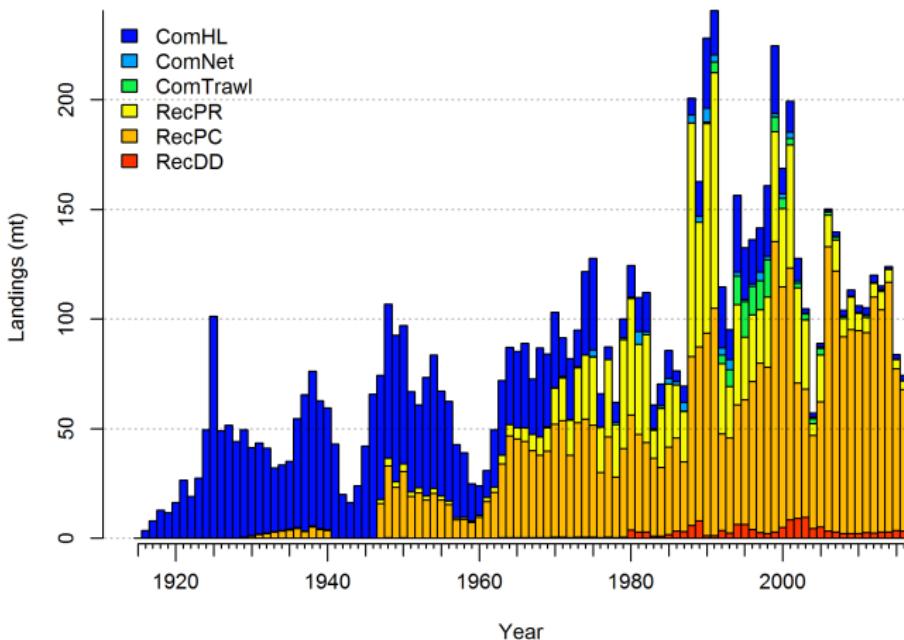
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## Catches by Fleet



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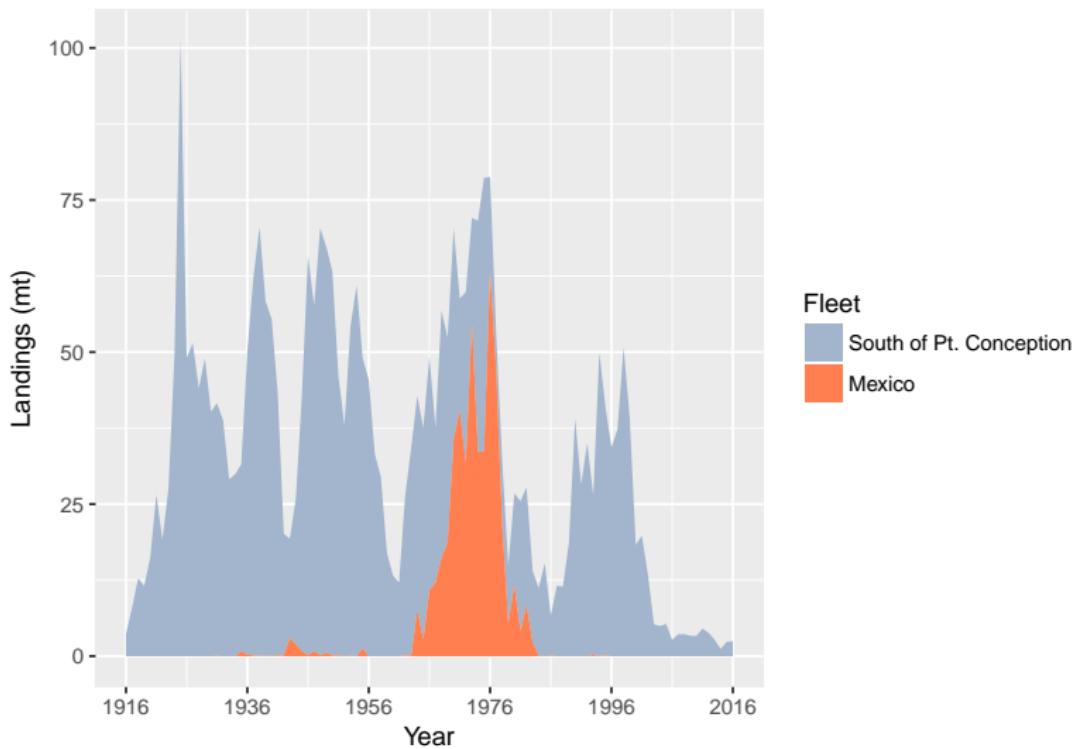
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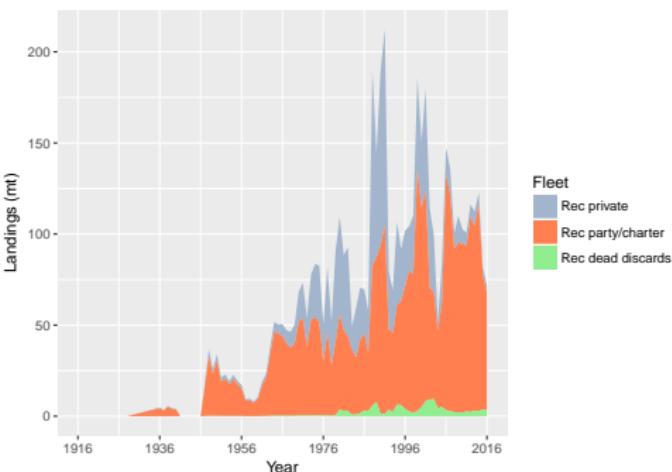
Appendix

## U.S. and Mexico Catch



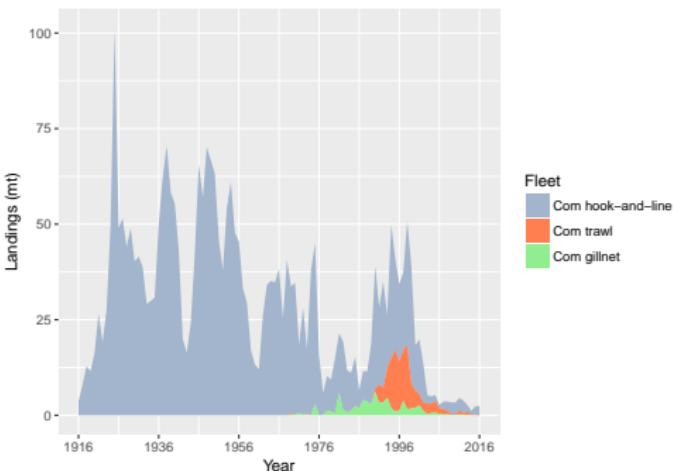
## Recreational Catch

- 2005 assessment used number of fish for recreational catches
- 2017 assessment includes one recreational discard fleet
  - Discard mortality rate of 7%
  - Discard biomass accounts for <3% of recreational mortality



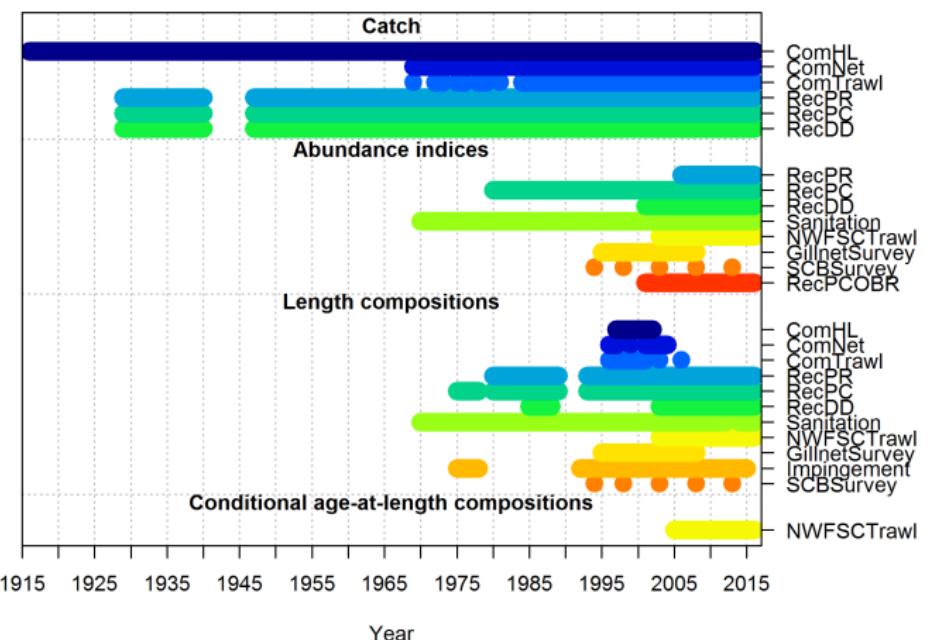
# Commercial Catch

- Historical catches same as the 2005 assessment
- California Fisheries Information System (CFIS) landings data used to update catches from 2005-2016
- Discards assumed negligible



# Summary of Data Sources

Data by type and year



## Indices of Abundance

All of the methods used to standardize indices have been endorsed by the SSC

Name	Years	Fishery ind.	Method
Recreational PR dockside CPUE	2004-2016	No	delta-GLM (bin-lognormal)
CPFV logbook CPUE	1980-2016	No	negative binomial
Onboard observer discard catch CPUE	2002-2016	No	delta-GLM (bin-lognormal)
Sanitation district CPUE	1970-2016	Yes	delta-GLM (bin-lognormal)
NWFSC trawl survey CPUE	2003-2016	Yes	VAST
CSUN/VRG Gillnet survey CPUE	1995-2008	Yes	delta-GLM (bin-lognormal)
Southern California Bight trawl survey CPUE	'94, '98, '03, '08, '13	Yes	delta-GLM (bin-lognormal)
Onboard observer retained catch CPUE	2002-2016	No	delta-GLM (bin-lognormal)



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## Fishery-Dependent Abundance Indices



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## Fishery-Dependent Abundance Indices

- CDFW dockside intercept survey of retained catch
  - Private/rental fleet
  - Party/charter fleet (developed and not used in base model)
- Commercial Passenger Fishing Vessel (CPFV) logbooks
- CDFW onboard observer survey of the CPFV fleet
  - Developed separate indices for retained and discarded catch



## Indices of Abundance: Delta-GLM Approach

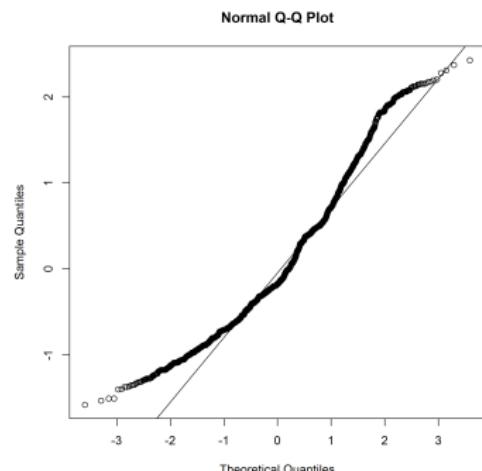
- Approach used for all indices except the NWFSC trawl survey and the CPFV logbook
- Two-part model
  - Binomial fit to the presence-absence data
  - Lognormal or Gamma fit to positives
- General approach
  - Filter data to identify most appropriate samples
  - Model selection
    - Gamma or Lognormal for positives
    - Covariates for each of the two models chosen using AIC
  - Uncertainty for final model estimated via jackknifing

# Recreational Dockside Private Boat Index

**Sample:** California CRFS only; **Years:** 2006-2016; **Effort:** Angler days

Filter	Criteria	Pos. Trips	Trips
Entire dataset			108,171
General data filters	CRFS-PR1 survey only, Southern California only (sub_reg = 1), Hook and line gear only (geara = 'H'), Ocean only (Area_X = 1 or 2)	3,802	43,956
Region	Remove trips from Santa Barbara	3,757	42,956
Year	Remove 2004-2005; fishery closed majority of year	3,094	33,770
Closed fishery	Remove remaining trips when fishery closed	3,056	32,236
Rare and co-occurring species	Remove trips with yellowfin tuna and dolphinfish and species present in <1% of all trips and in at least 5 years of data	3,056	30,033
Stephens-MacCall	Retain all positive trips, plus "False Positives" (trips predicted to be in California scorpionfish habitat, but with no California scorpionfish retained)	3,056	<b>8,590</b>

Model	Binomial	Lognormal
Year	6182	8103
Year + County	5862	8003
Year + Wave	6091	8092
Year + County + Wave	<b>5792</b>	<b>8000</b>



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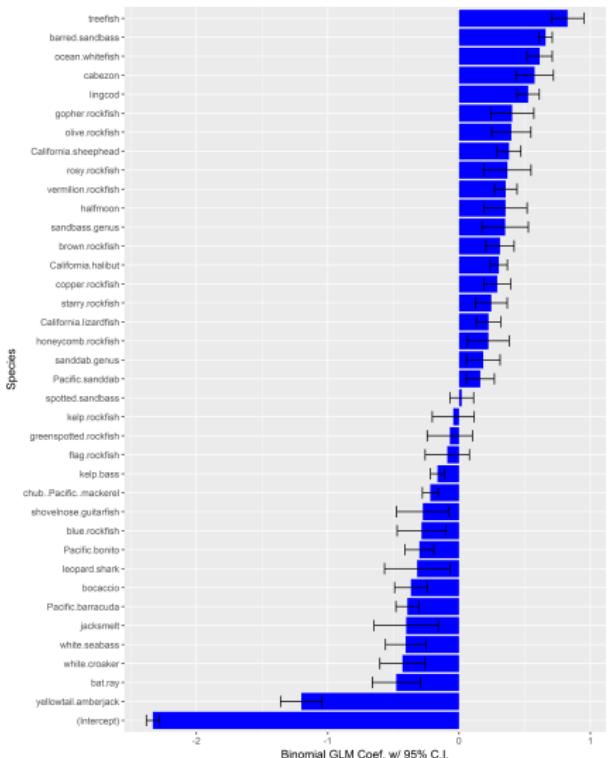
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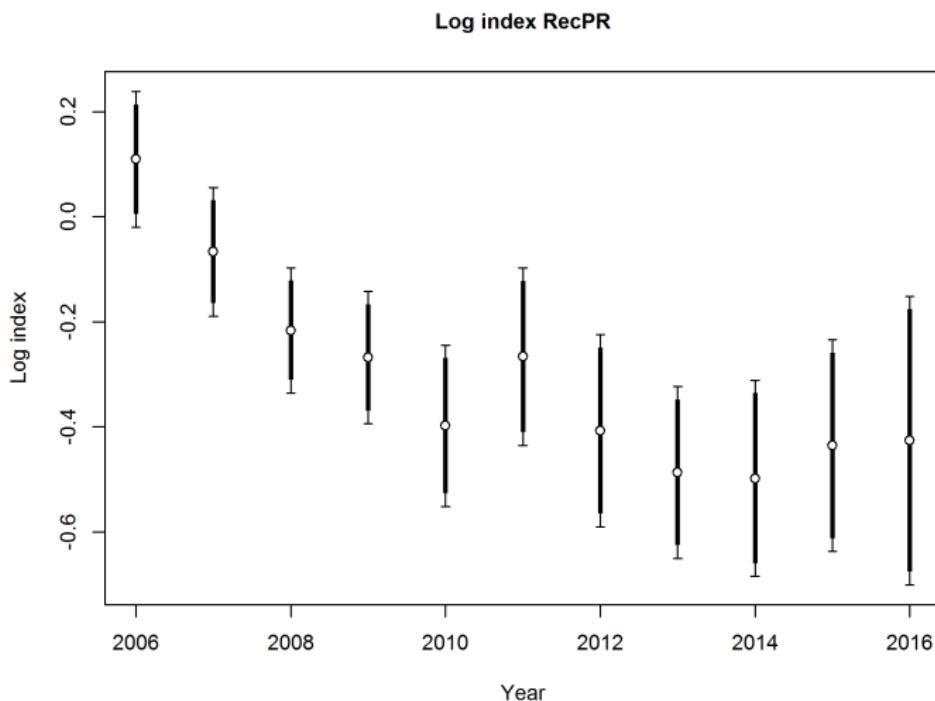
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# Recreational Dockside Private Boat Index



# Recreational Dockside Private Boat Index: Results



# Recreational CPVF Logbook Index

**Sample:** Captain-reported catch; **Years:** 1980-2016; **Effort:** Angler hours

Filter	Criteria	Trips
All CA data	No filter	1,164,662
Gear	Remove trips reported as diving, mooching or trolling	959,740
Effort or missing data	Remove trips with missing effort or species information	930,233
Year	Remove 2017, remaining years 1980-2016	929,781
Region	Remove trips north of Pt. Conception and in Mexico	568,222
Fish encountered	Remove trips reporting number of retained fish greater than in the 99% quantile (>325 fish)	564,433
Target species	Remove trips targeting sharks, striped bass, sturgeon, tun, misc. bay, and potluck	558,872
Single-species trips	Filter trips reporting catches of only species and that one species in <100 trips	558,833
Offshore trips	Remove trips catching yellowtail, tunas, and dolphinfish that were not designated as offshore trips	475,492
Vessel	Remove trips by vessels that had fewer than 10 trips catching scorpionfish	466,023
Anglers	Remove trips with number of anglers < the 1% and > the 99% quantile (retain 5-75 anglers)	452,938
Depth	Remove trips in blocks with a minimum depth of >140m	443,929
Scorpionfish targets	Blocks with at least 100 scorpionfish trips	433,248
Sample size	Blocks with at least 500 trips	<b>432,868</b>

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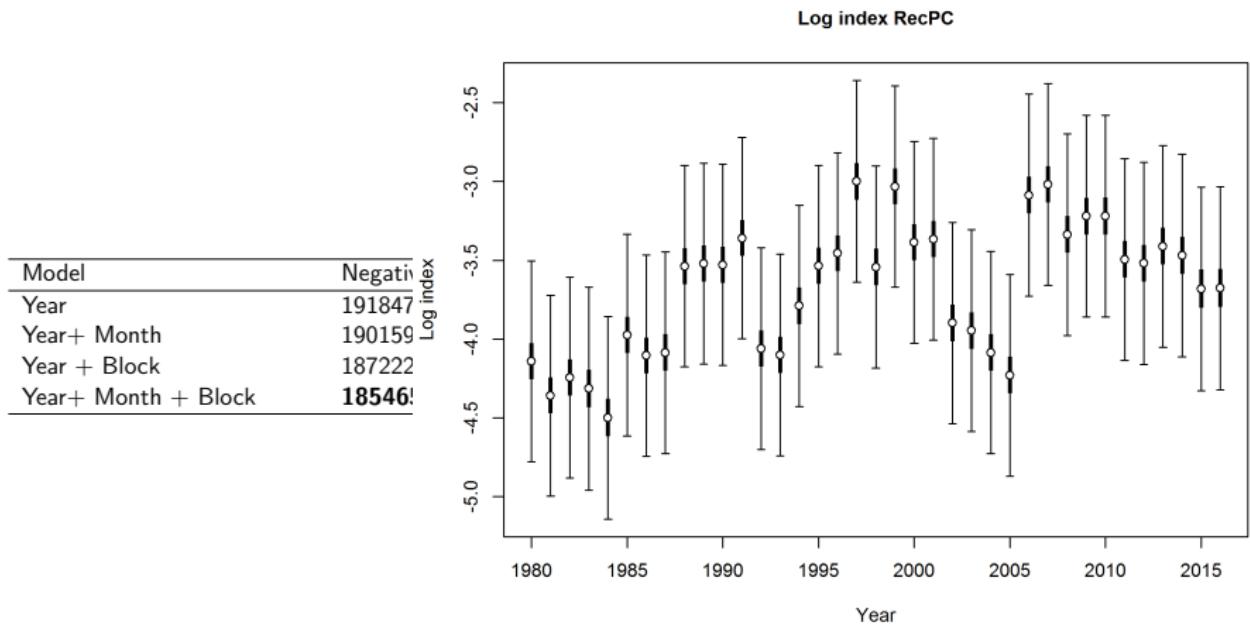
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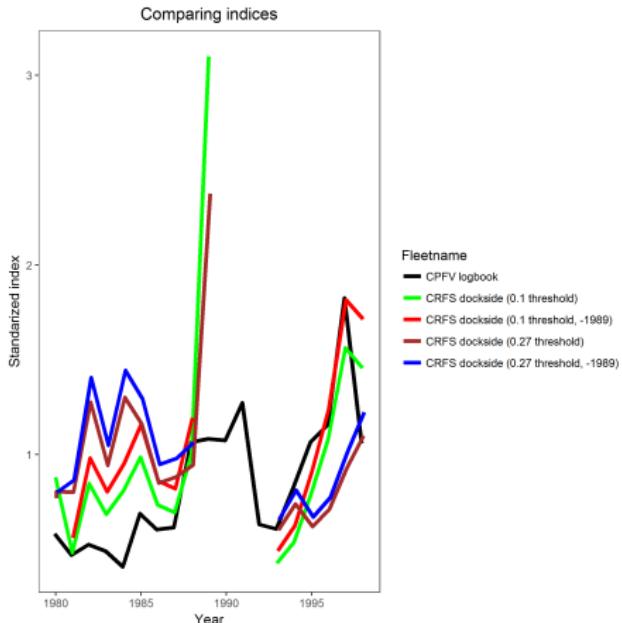
# Recreational CPFV Logbook Index: Results



# Recreational Dockside Party/Charter Boat Index

**Sample:** California MRFSS ; **Years:** 1980-2003; **Effort:** Angler hours

- *Index not used in the assessment*
- No MRFSS sampling from 1990-1992
- Index sensitive to Stephens-MacCall threshold
- Dockside index estimate for 1989 is high and anomalous
- 1989 estimate lower if a higher threshold is used



## Recreational Onboard Indices

**Sample:** Drift-level catch ; **Years:** 1999-2016; **Effort:** Angler hours

- Drift-level catch data collection onboard CPFVs
- Alpha hull method used to select suitable habitat for California scorpionfish
- Assume that suitable habitat is the same for discarded and retained fish

Filter	Criteria	Pa
Initial SQL filtering		6,
Habitat filter	Remove drifts >1000 m of alpha hull buffer, remove "reefs" with <0 drifts or 5% positives, or in CCA	6,
Exclude 1999 and 2000	Management changes (depth and gear restrictions)	5,
Depth	Remove upper and lower 1% of data (retain 26-330ft)	5,
Minutes Fished	Remove upper and lower 1% of data (retain 4 - 155 minutes)	5,
Observed Anglers	Remove upper and lower 1% of data (retain 4 - 15 anglers)	5,
Boats	Include boats encountering scorpionfish in at least 3 years; at least 30 drifts and 10 with scorpionfish	5,
Second depth filter	Remove anything >100 m after looking at 20 m depth bins	5,

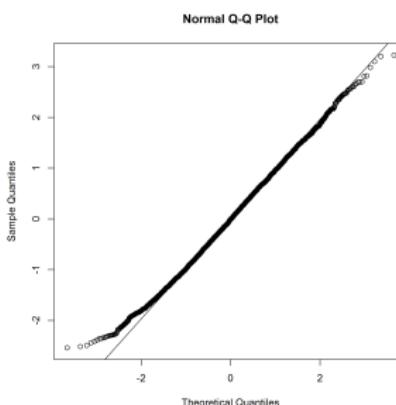
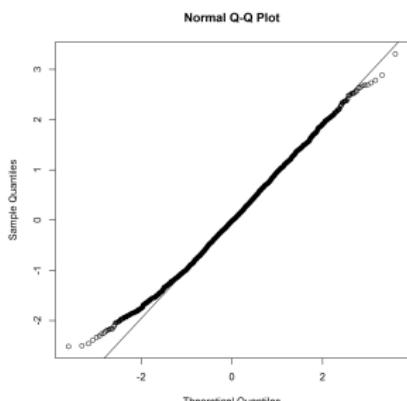
# Recreational Onboard Retained Catch

## Discarded Catch

Model	Binomial	Lognormal
Year	19619	9177
Year + Reef	18677	9177
Year + Depth	19374	8860
Year + Depth + Reef	18392	8778
Year + Month + Reef + Depth	<b>18318</b>	<b>8769</b>

## Retained Catch

Model	Binomial	Lognormal
Year	21826	11507
Year + Reef	21192	11325
Year + Depth	21265	10704
Year + Depth + Reef	20691	10619
Year + Month + Reef + Depth	<b>20453</b>	<b>10599</b>



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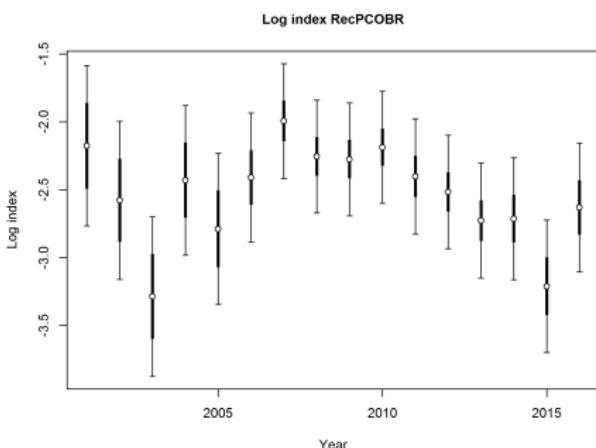
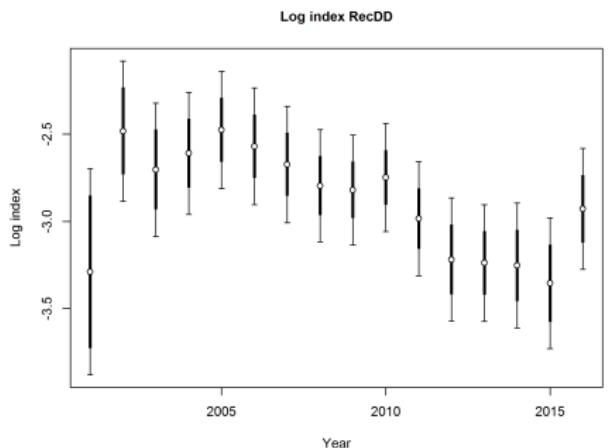
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# Recreational Onboard Indices: Results

Discard catch index (left) and retained catch index (right)



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## Fishery-Independent Abundance Indices



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## POTW Survey Index

**Sample:** California MRFSS and CRFS ; **Years:** 1980-2003; **Effort:**  
Angler hours

Program	0-24 m	25-49 m	50-74 m	100+ m	Total
City of Los Angeles	120	0	1372	0	1492
Los Angeles County	687	0	5879	450	7016
Orange County	161	669	2157	48	3035
City of San Diego	0	404	333	829	1566



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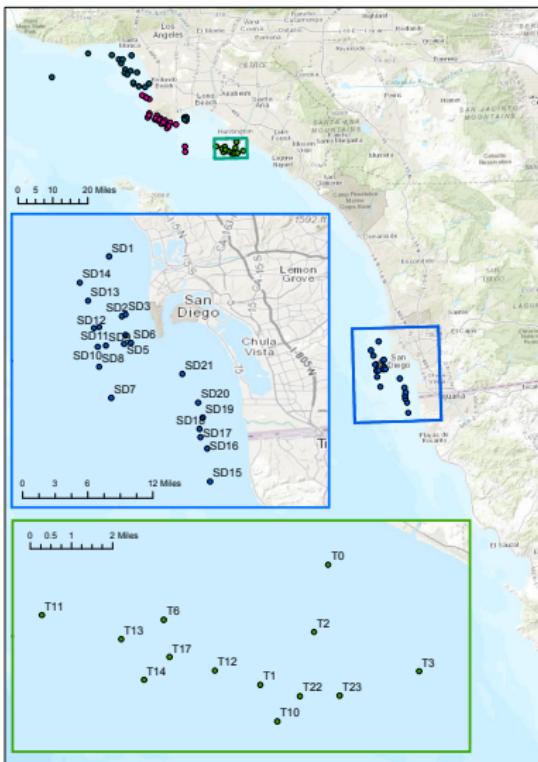
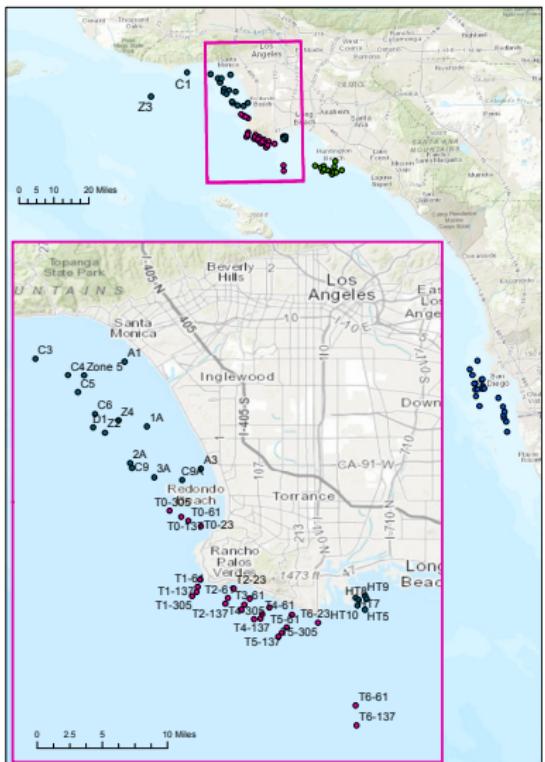
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# POTW Survey Index



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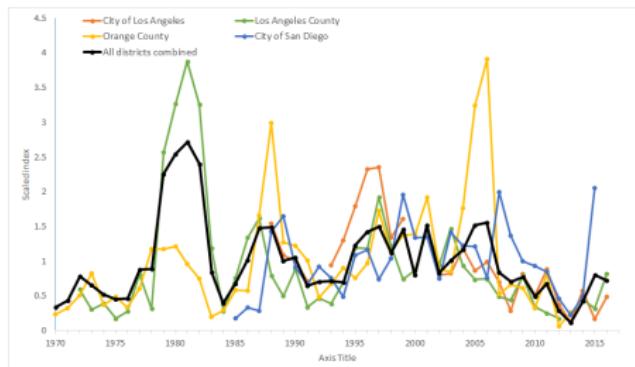
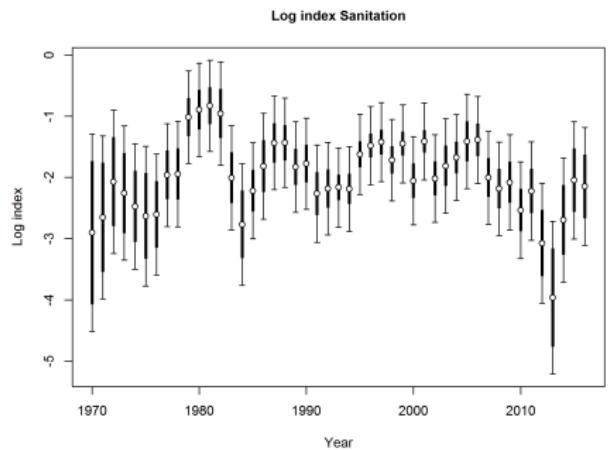
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# POTW Survey Index: Results



# NWFSC Trawl Survey Index

Geostatistical approach Vector Autoregressive Spatio-Temporal model

- Uses delta-GLMM framework
  - Probability of encounters
  - Catch rates for non-zero catches
- Geostatistical approach
  - Divides survey area into fine-scale grids
  - Assumes that nearby grids have more similar fish density than those further away
  - Smooths density estimates over the landscape
  - Reduces uncertainty in the estimates

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# NWFSC Trawl Survey Index

**Sample:** California MRFSS and CRFS ; **Years:** 1980-2003; **Effort:**  
Angler hours

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# NWFSC Trawl Survey Index

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# NWFSC Trawl Survey Index

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# NWFSC Trawl Survey Index: Results

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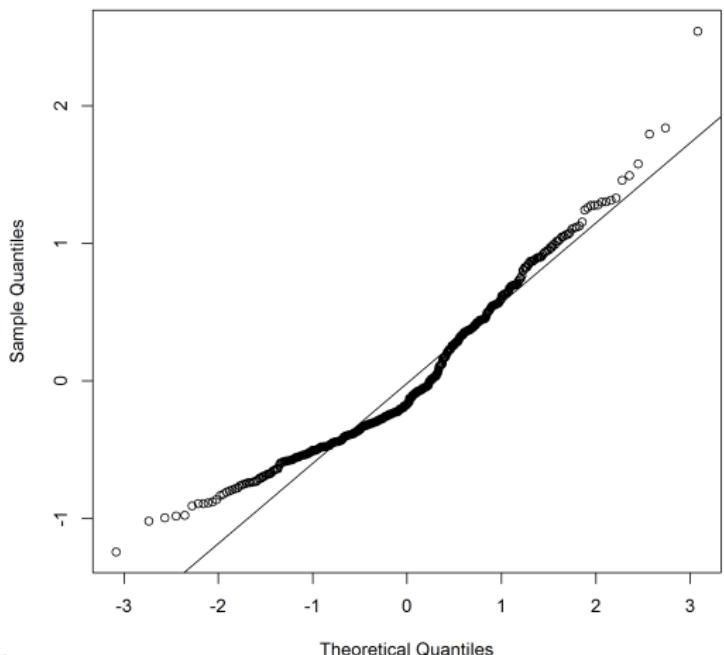
## Composition Data

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## Gillnet Survey Index

**Sample:** California MRFSS and CRFS ; **Years:** 1980-2003; **Effort:** Angler hours

## Normal Q-Q Plot



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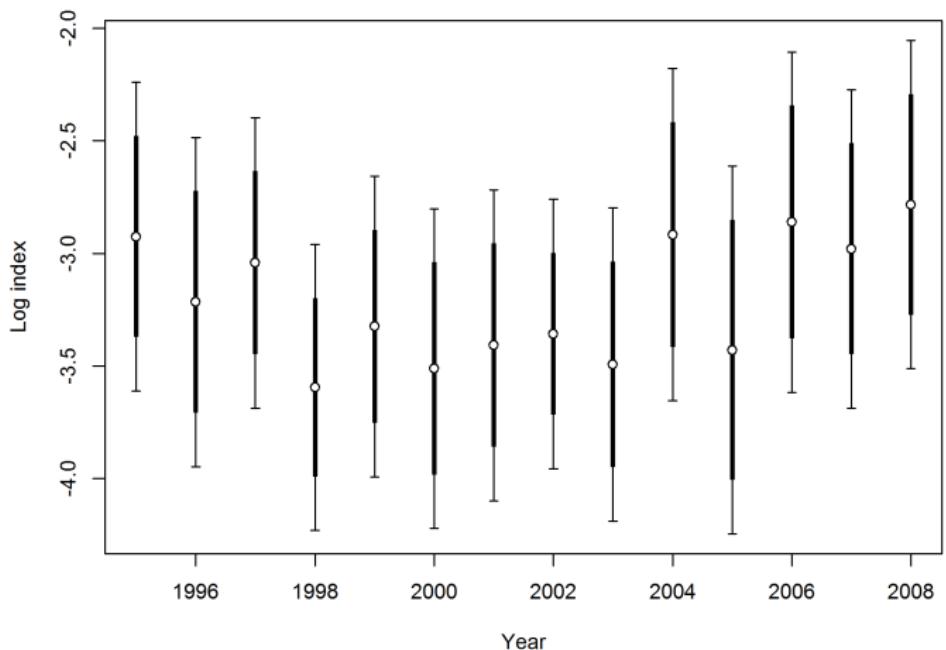
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# Gillnet Survey Index: Results

Log index GillnetSurvey



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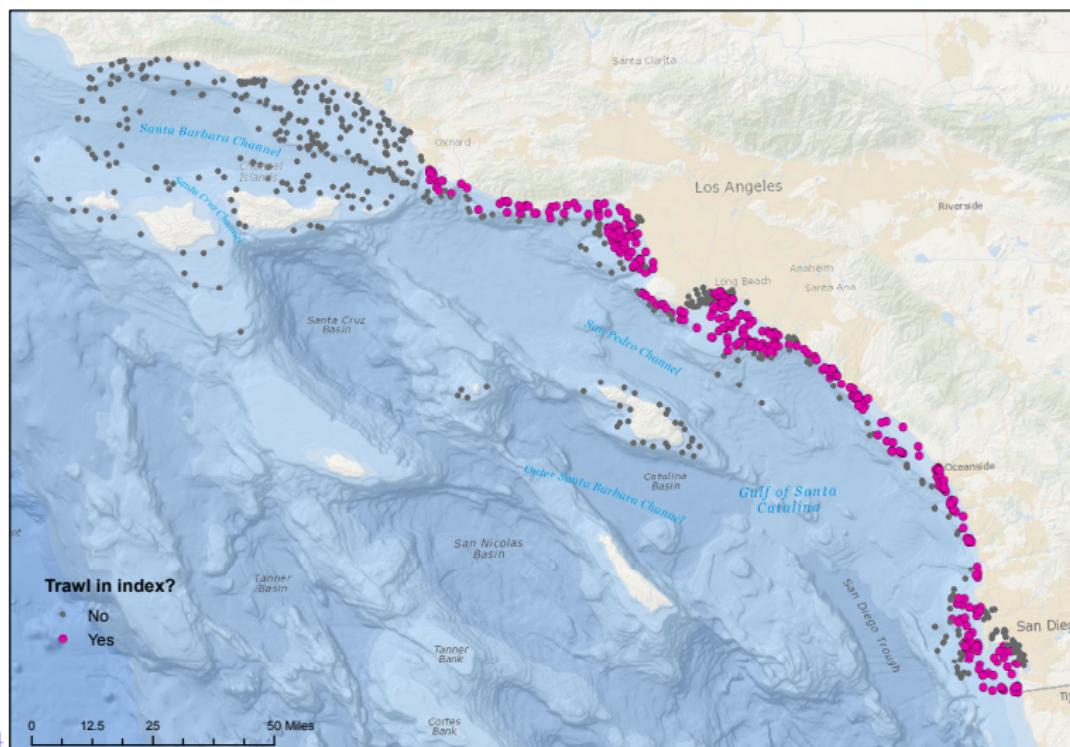
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# Southern California Bight Trawl Survey Index

**Sample:** California MRFSS and CRFS ; **Years:** 1980-2003; **Effort:**  
Angler hours



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### Indices of Abundance

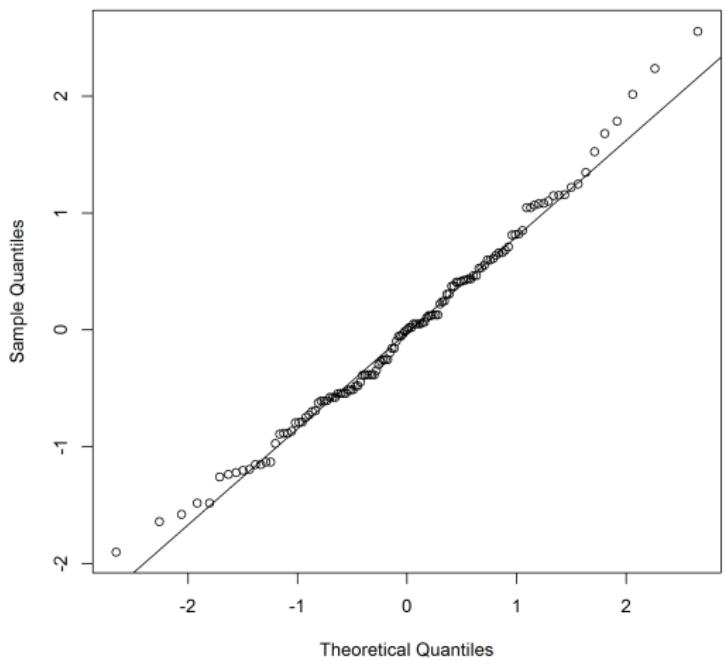
## Composition Data

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## Appendix

# Southern California Bight Trawl Survey Index

## Normal Q-Q Plot



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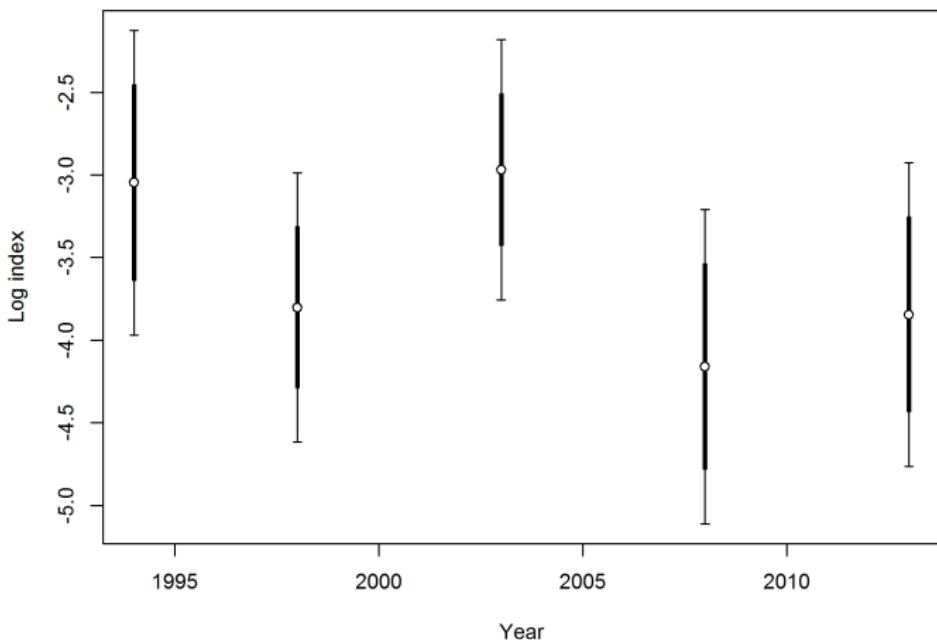
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# Southern California Bight Trawl Survey Index: Results

Log index SCBSurvey



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## Composition Data

## Length compositions were provided from the following sources:

- CDFW market category study (*commercial dead fish*, 1996-2003)
- CALCOM (*commercial dead fish*, 2013-2016)
- CDFW onboard observer (*recreational charter discards*, 2003-2016)
- Collins and Crooke onboard observer surveys (1975-1978)
- Ally onboard observer study (*recreational charter kept/discards*, 1984-1989)
- MRFSS (1980-2003) and CRFS (2004-2014) (*private and party/charter, kept*)
- POTW trawl surveys (*research*, 1970-2016)
- CSUN/VRG gillnet survey (*research*, 1995-2008)
- Power plant impingement surveys (*research*, 1974-2016)
- Southern California Bight trawl survey (*research*, 1994, 1998, 2003, 2008, 2013)

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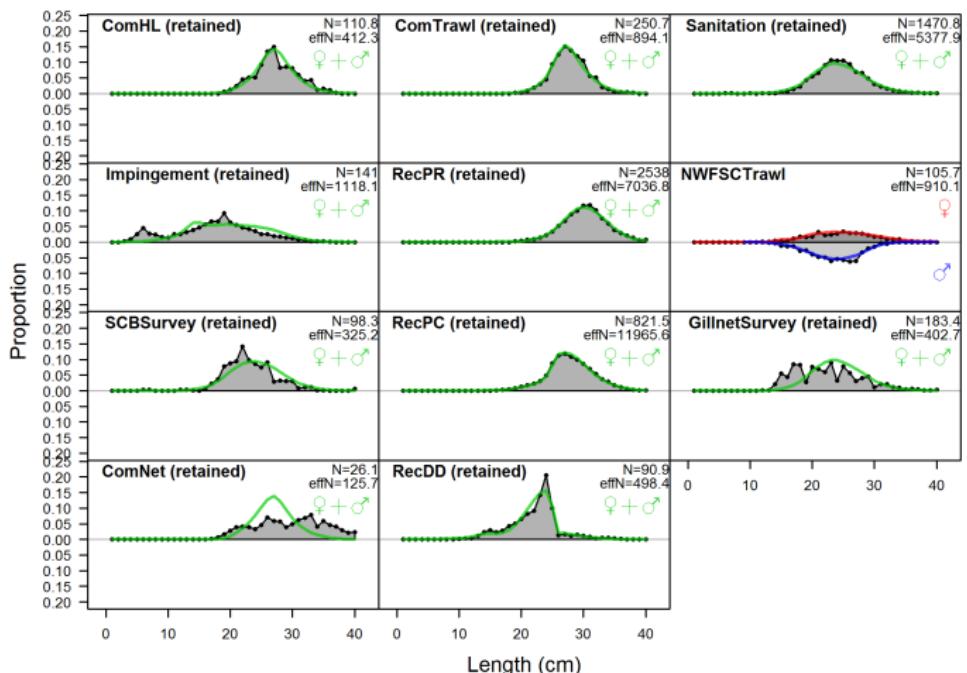
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# Aggregate length composition

Length comps, aggregated across time by fleet



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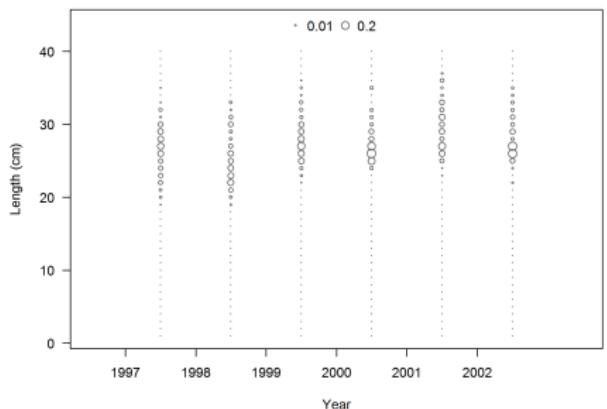
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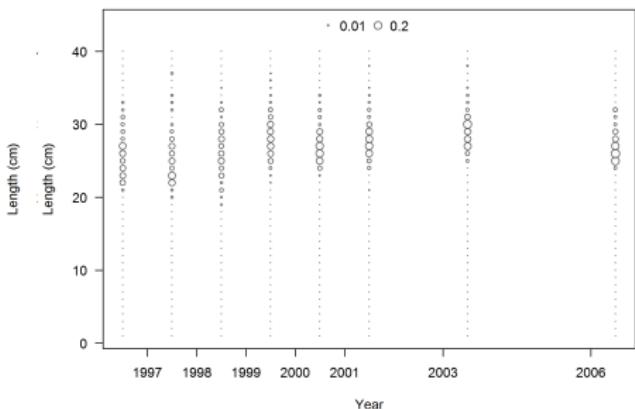
Appendix

# Commercial fishery length composition

Length comp data, retained, ComHL (max=0.25)



Length comp data, retained, ComTrawl (max=0.24)



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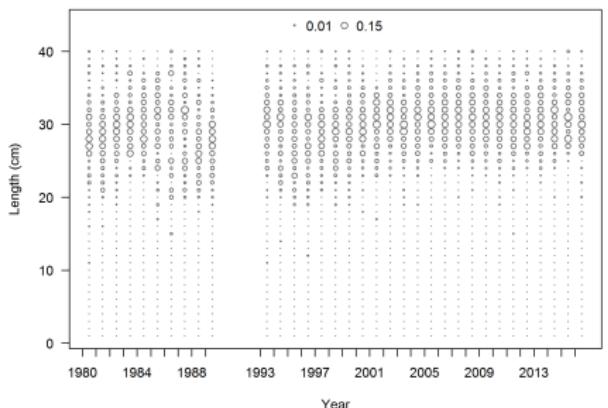
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Composition Data  
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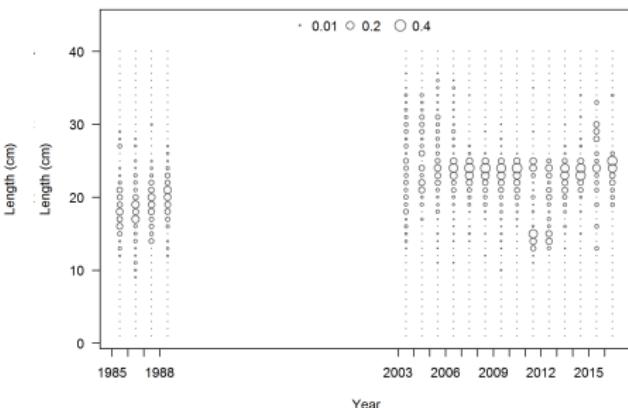
Appendix

# Recreational fishery length composition

Length comp data, retained, RecPR (max=0.19)



Length comp data, retained, RecDD (max=0.32)



Background  
oooooooooooo

Catch  
ooooo

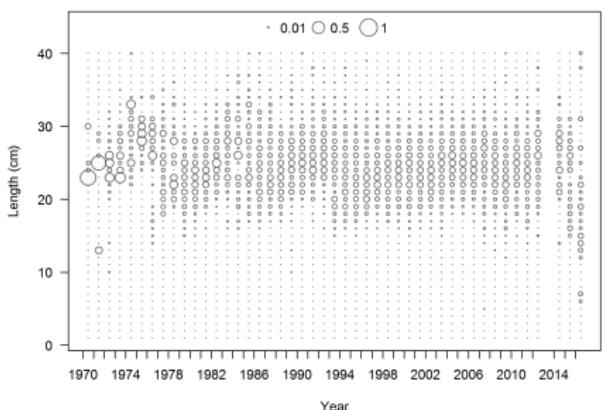
Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
ooooo●oooo

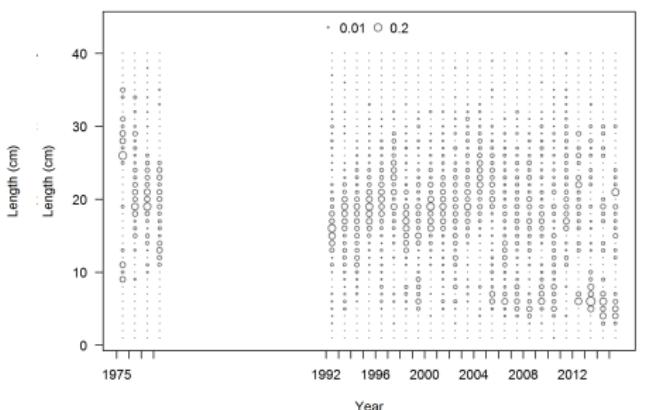
Appendix

# Research length composition

Length comp data, retained, Sanitation (max=0.78)



Length comp data, retained, Impingement (max=0.26)



Background  
oooooooooooo

Catch  
oooooo

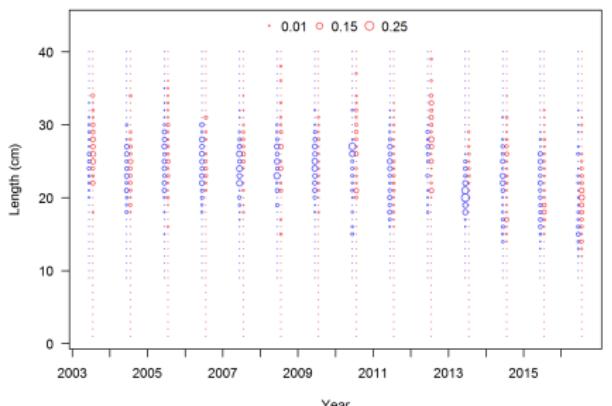
Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooo●○○○○○○○○

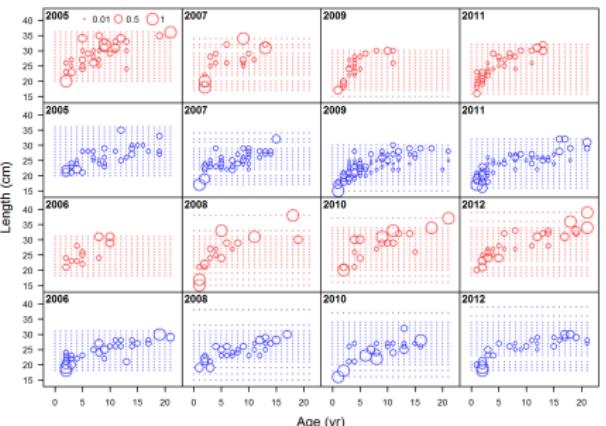
Appendix

## Research length and age composition

Length comp data, whole catch, NWFSC Trawl (max=0.21)

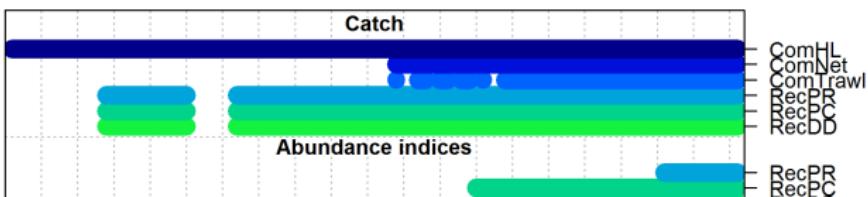


Conditional age-at-length data, whole catch, NWFSC Trawl (max=1)



#2017 assessment ##2017 assessment #####Summary of Data used in the 2017 Assessment

Data by type and year



Background  
oooooooooooo

Catch  
oooooo

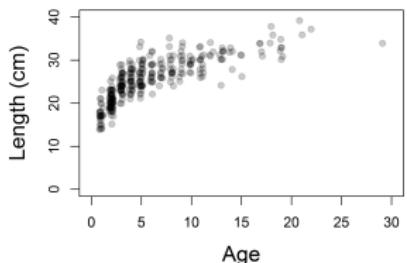
Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
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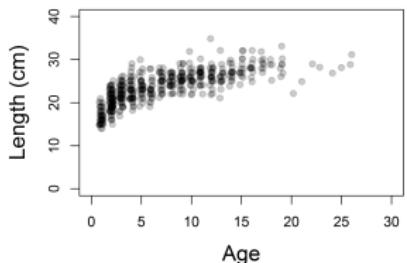
Appendix

# Length-at-age

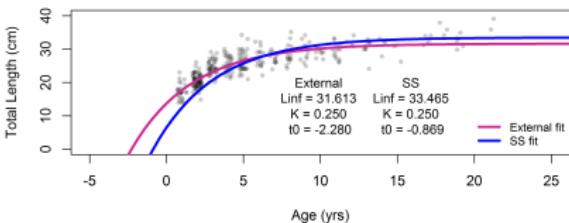
Female



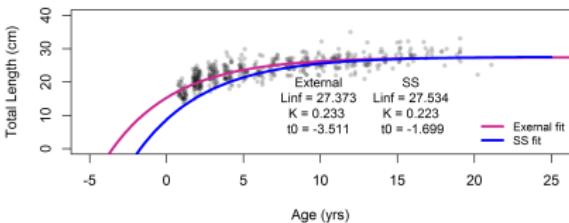
Male



Female



Male



Background  
oooooooooooo

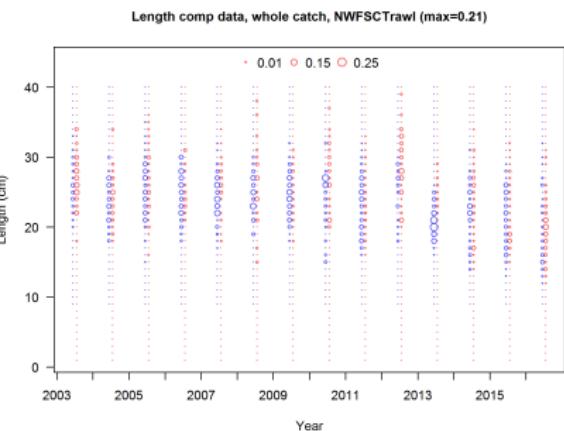
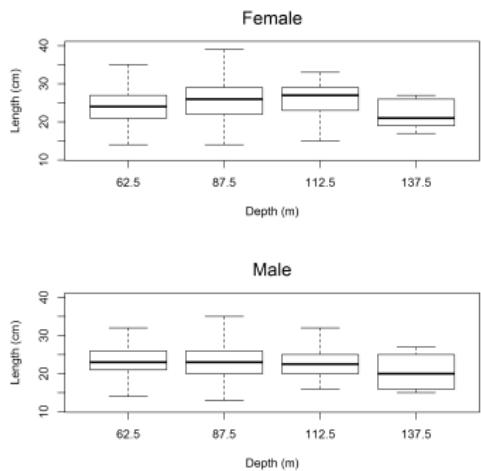
Catch  
ooooo

Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooo●oooo

Appendix

# Length-at-age



Background  
oooooooooooo

Catch  
ooooo

Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooo●oooo

Appendix

## Maturity and Fecundity



Background  
oooooooooooo

Catch  
ooooo

Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooo●oooo

Appendix

## Weight-at-length



Background  
oooooooooooo

Catch  
ooooo

Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooo●ooo

Appendix

## Natural mortality

Background  
oooooooooooo

Catch  
ooooo

Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooo●oo

Appendix

## Steepness: Density-Dependent Recruitment Compensation

Background  
oooooooooooo

Catch  
ooooo

Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooooo●●○

Appendix

## Retrospective analysis

Background  
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Catch  
ooooo

Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
ooooooooooooooo●○●

Appendix

# Sensitivities

Background  
oooooooooooo

Catch  
ooooo

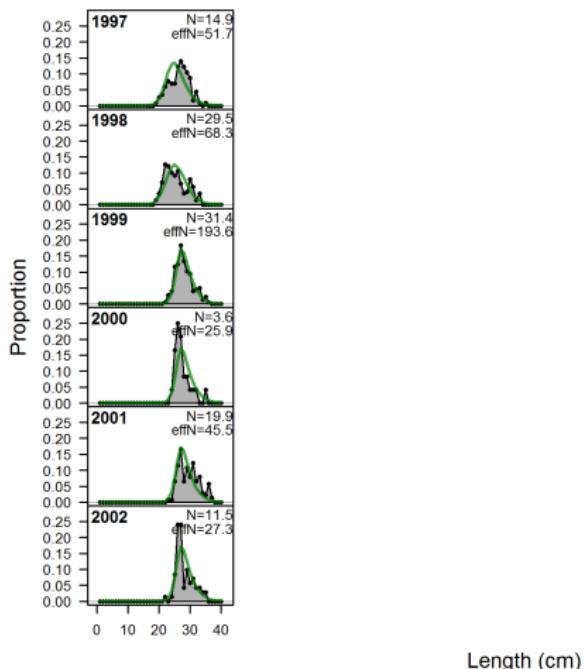
Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooooooooooo

Appendix

# Length composition

Length comps, retained, ComHL



Background  
oooooooooooo

Catch  
ooooo

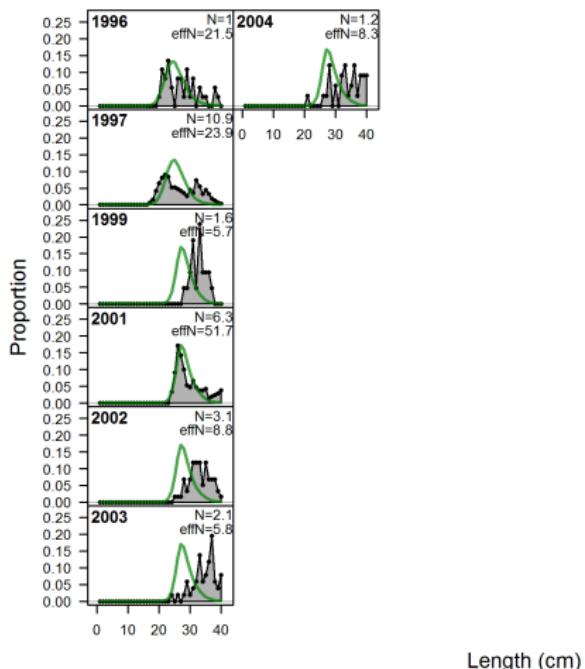
Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooooooooooo

Appendix

# Length composition

Length comps, retained, ComNet



Background  
oooooooooooo

Catch  
ooooo

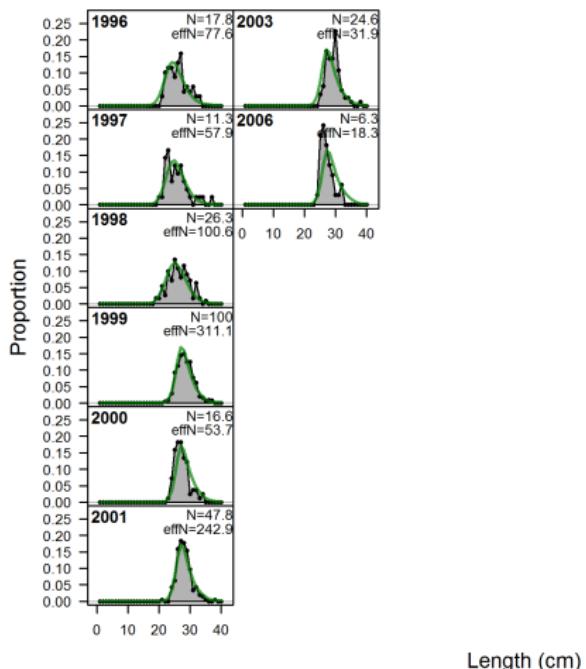
Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooooooooooo

Appendix

# Length composition

Length comps, retained, ComTrawl



Background  
oooooooooooo

Catch  
ooooo

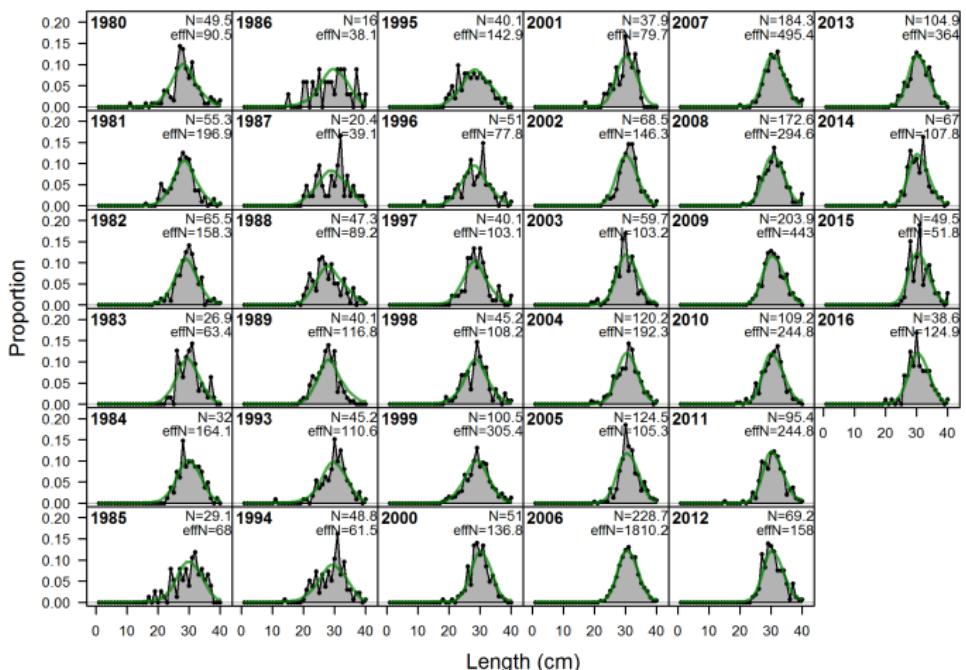
Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooooooooooo

Appendix

# Length composition

Length comps, retained, RecPR



Background  
oooooooooooo

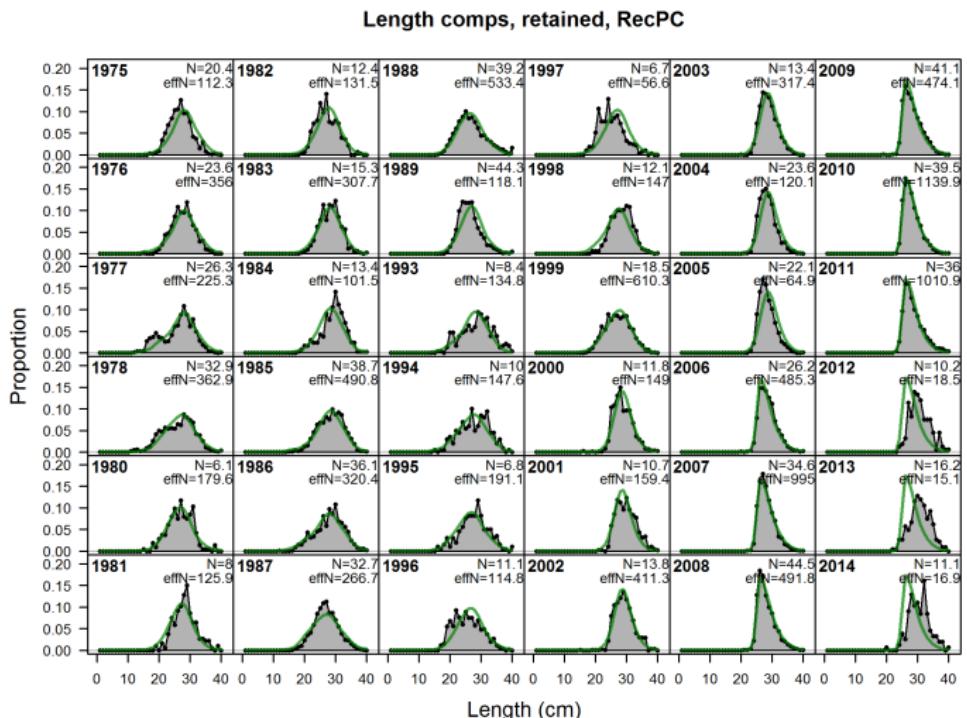
Catch  
ooooo

Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooooooooooo

Appendix

# Length composition



Background  
oooooooooooo

Catch  
ooooo

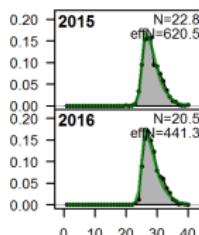
Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooooooooooo

Appendix

# Length composition

Length comps, retained, RecPC



Length (cm)



Background  
oooooooooooo

Catch  
ooooo

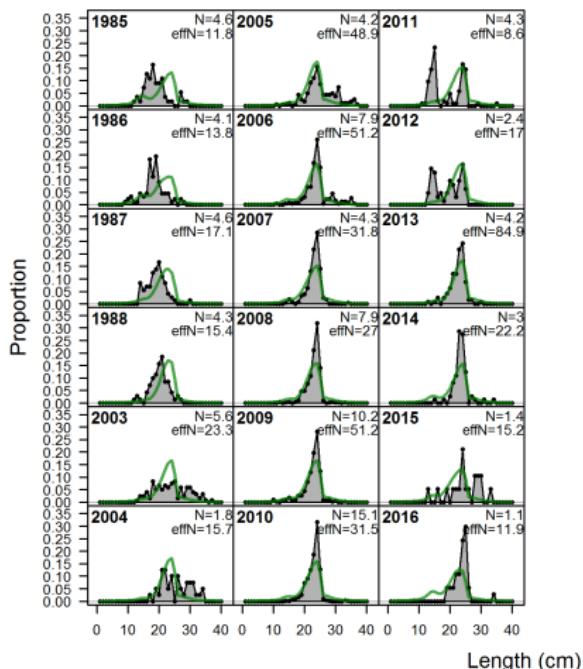
Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooooooooooo

Appendix

# Length composition

Length comps, retained, RecDD



Background  
oooooooooooo

Catch  
ooooo

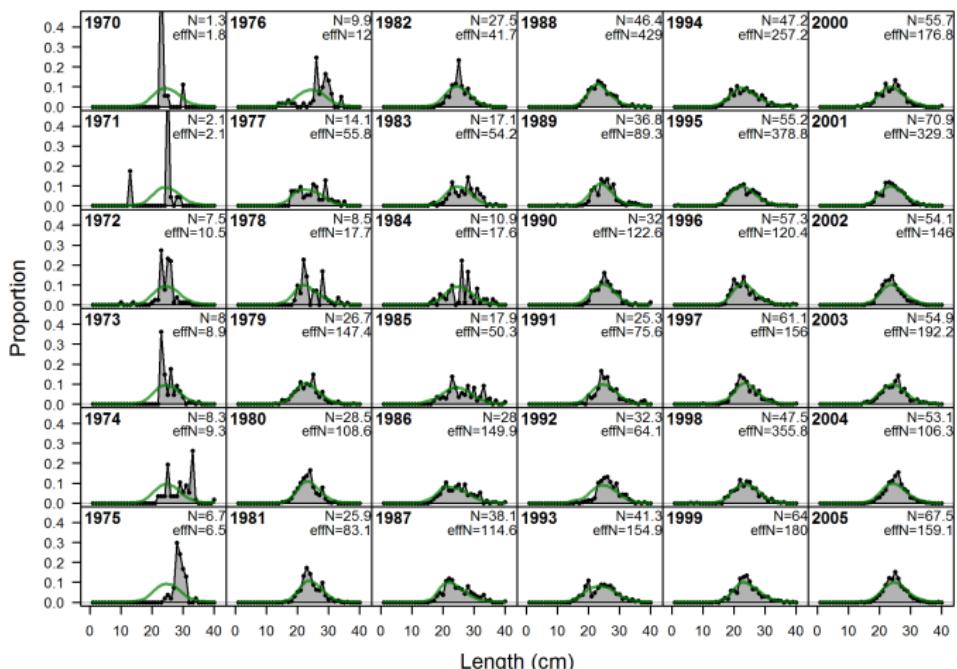
Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooooooooooo

Appendix

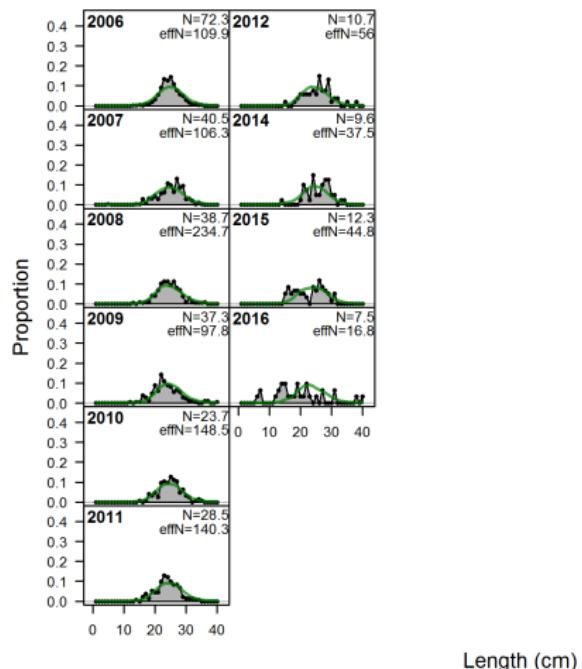
# Length composition

Length comps, retained, Sanitation



# Length composition

Length comps, retained, Sanitation



Background  
oooooooooooo

Catch  
oooooo

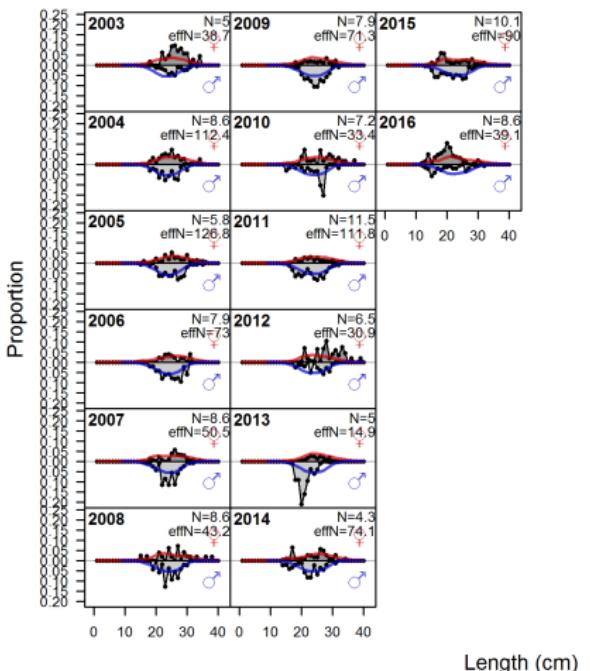
Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooooooooooo

Appendix

# Length composition

Length comps, whole catch, NWFSC Trawl



Background  
oooooooooooo

Catch  
ooooo

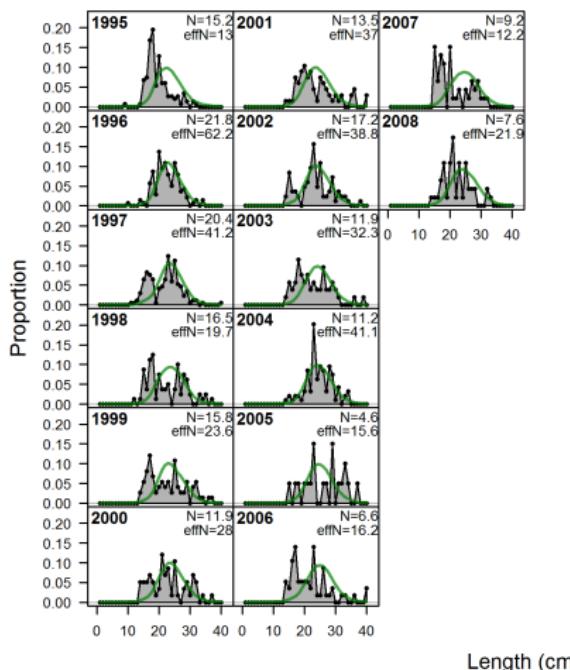
Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooooooooooo

Appendix

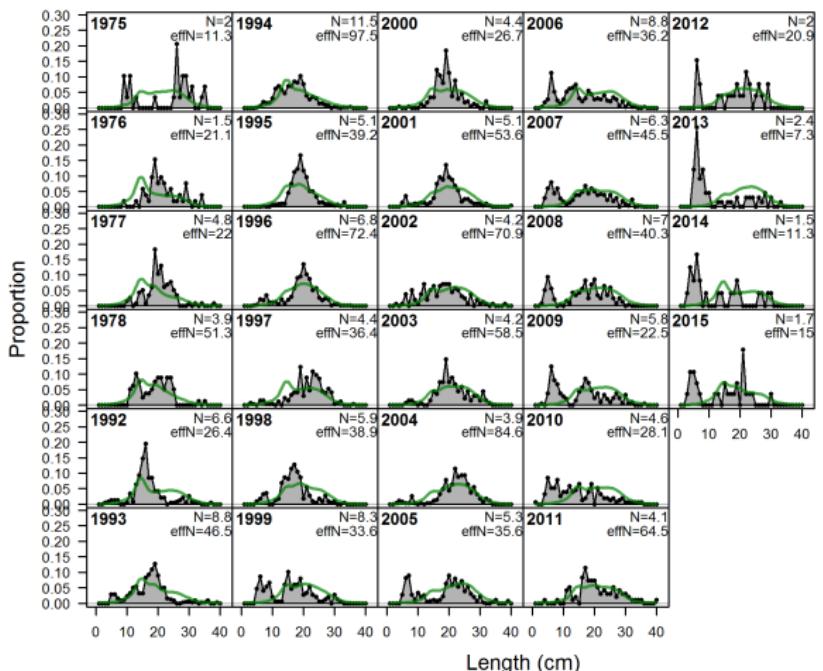
# Length composition

Length comps, retained, GillnetSurvey



# Length composition

Length comps, retained, Impingement



Background  
oooooooooooo

Catch  
ooooo

Indices of Abundance  
oooooooooooooooooooooooooooo

Composition Data  
oooooooooooooooooooo

Appendix

# Length composition

Length comps, retained, SCBSurvey

