



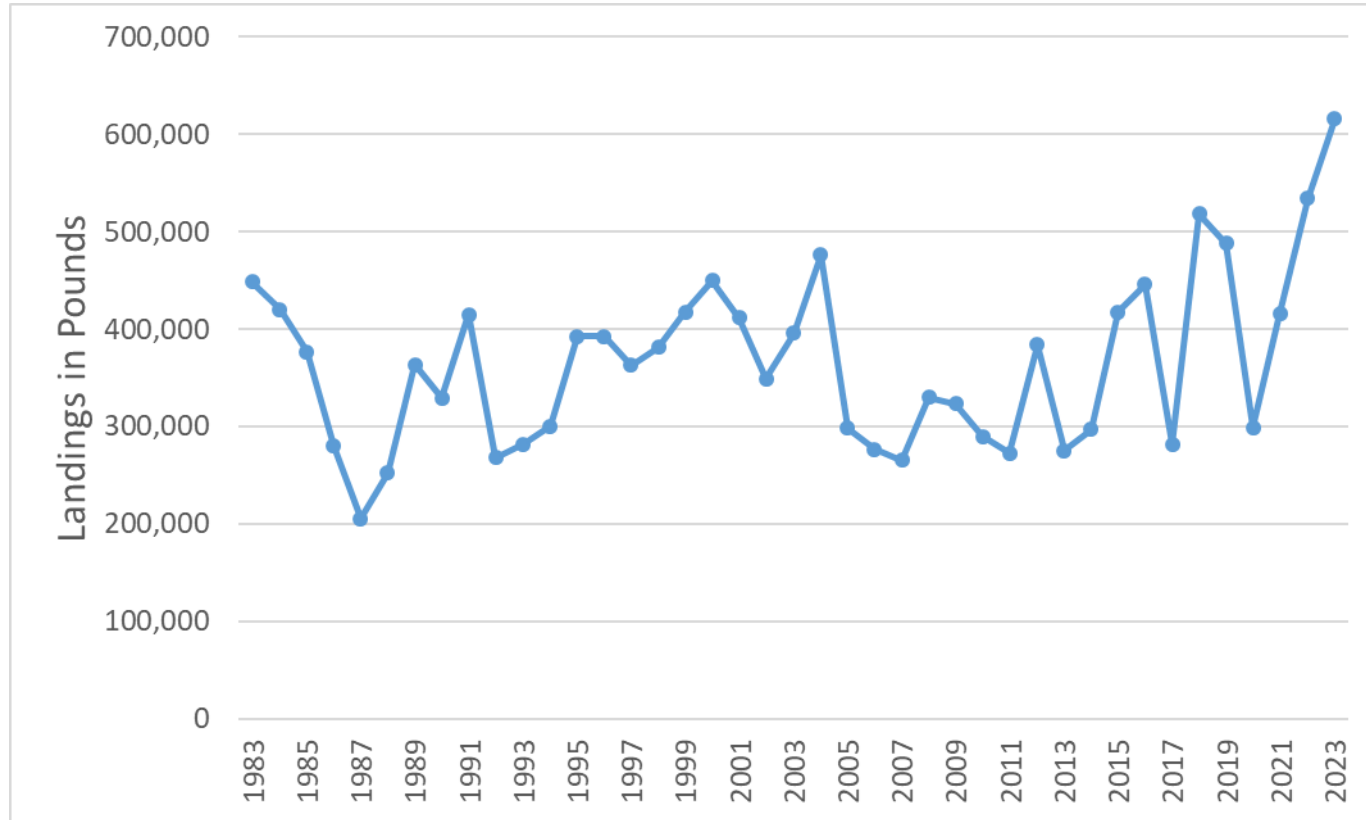
NOAA
FISHERIES

SEDAR 91 US Caribbean Spiny Lobster Index work

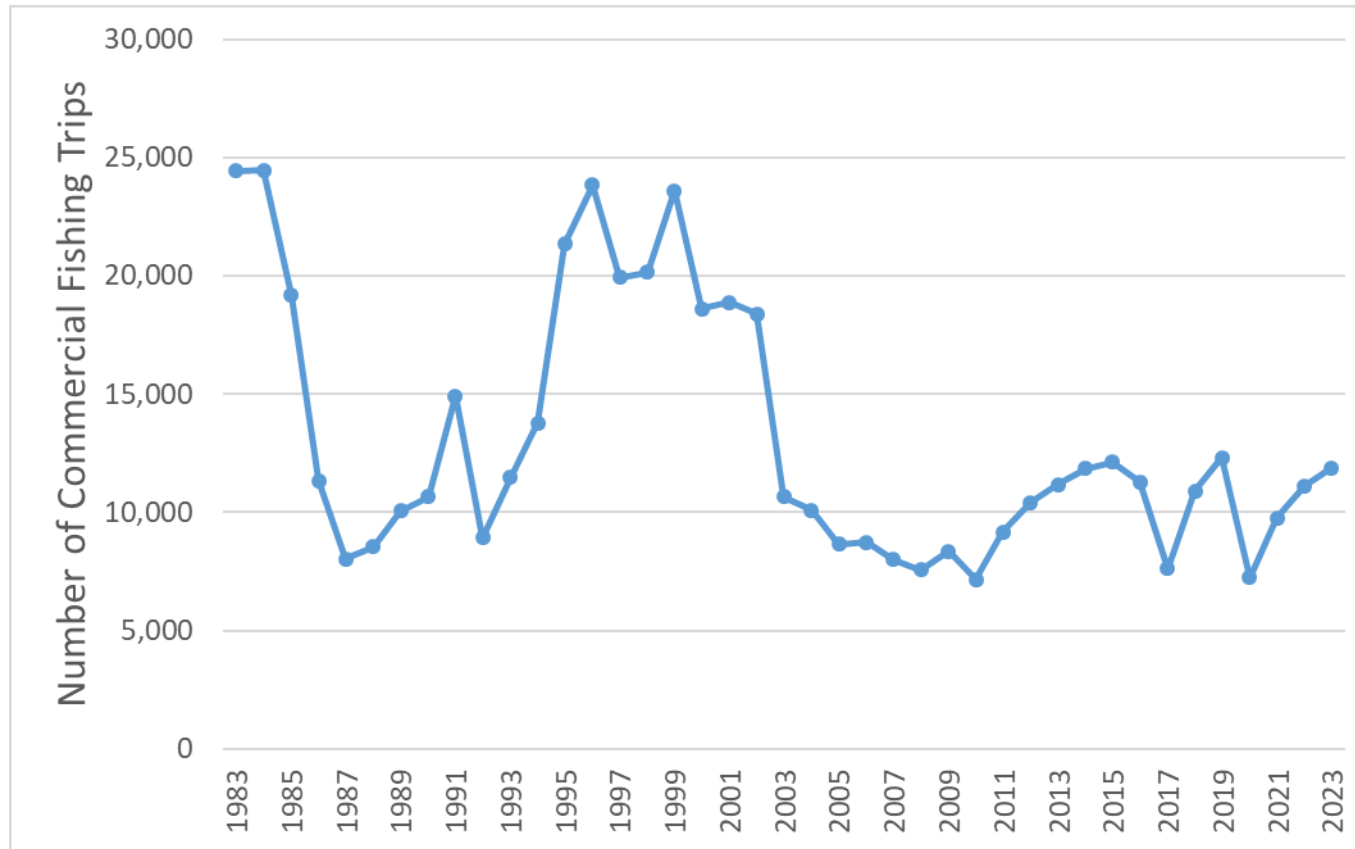
Stephanie Martínez Rivera, PhD
Fish Biologist
Southeast Fisheries Science Center
Caribbean Fisheries Branch

Kevin McCarthy
Branch Chief
Southeast Fisheries Science Center
Caribbean Fisheries Branch

SEDAR 91 Puerto Rico Spiny Lobster: Landings

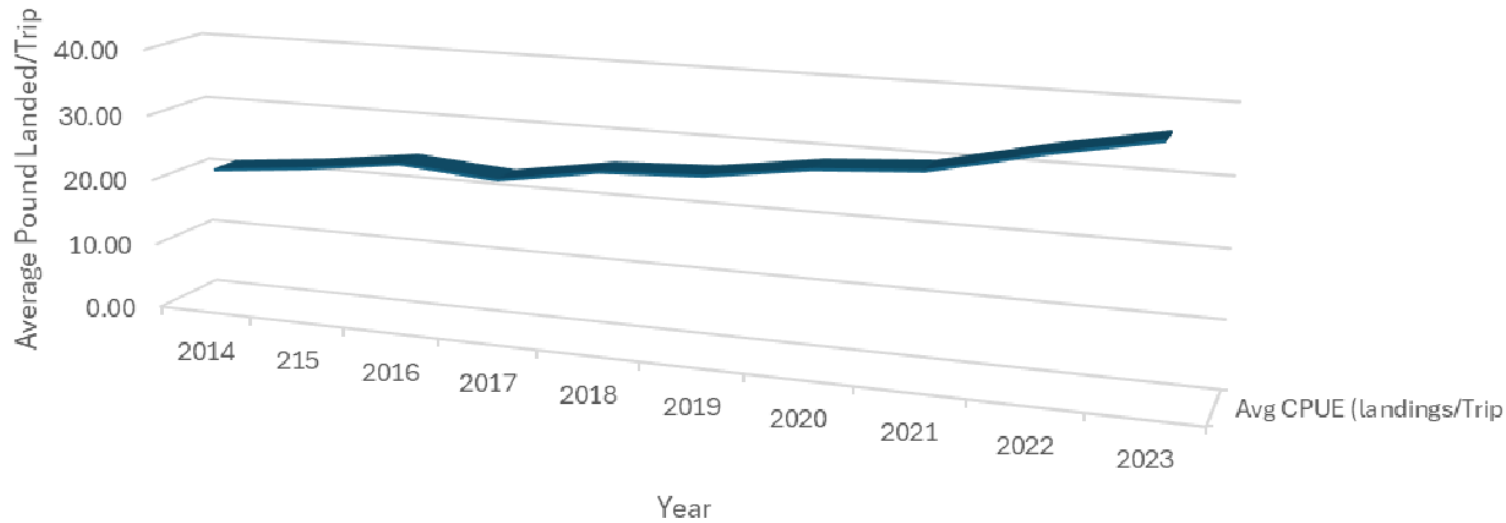


SEDAR 91 Puerto Rico Spiny Lobster: Trips



SEDAR 91 Puerto Rico Spiny Lobster: Nominal CPUE

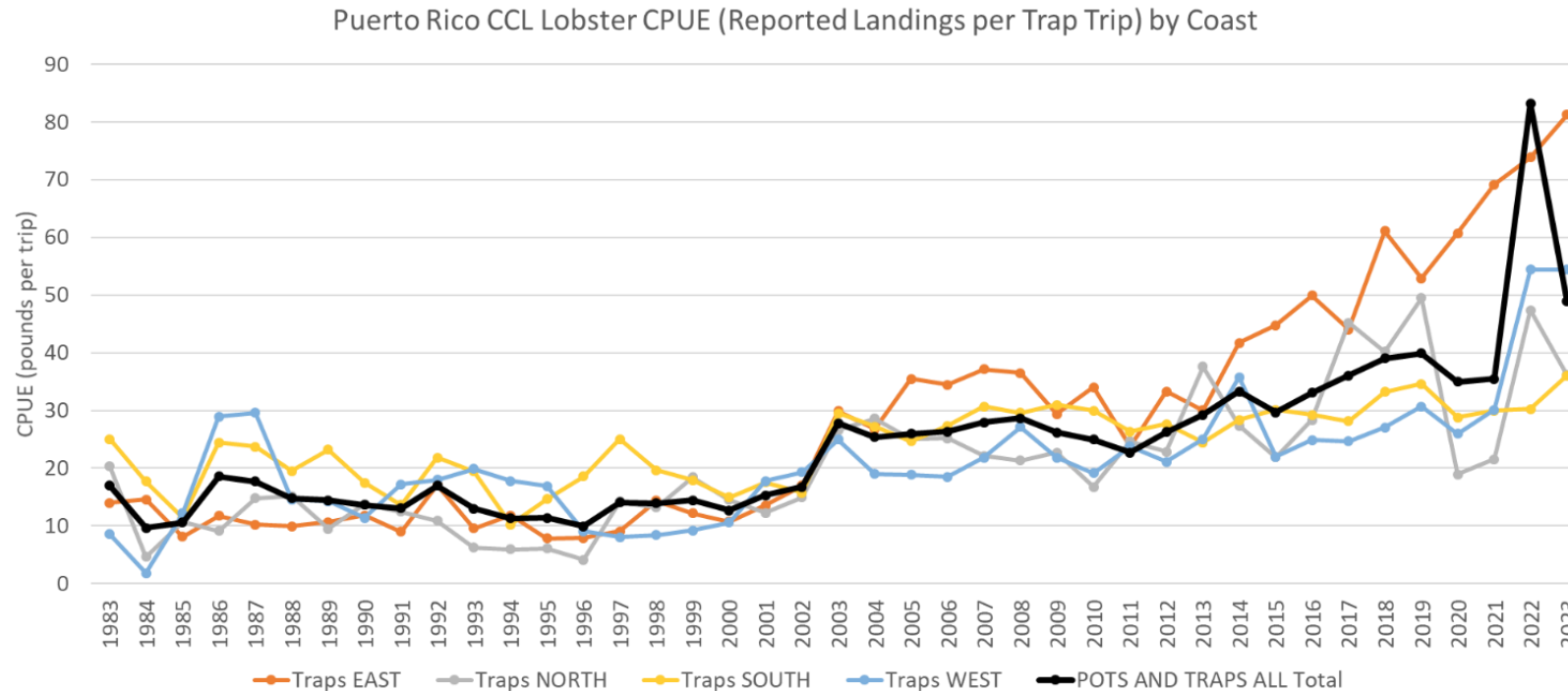
Figure 3. Catch Per Unit Effort CPUE (Average Pounds Landed/Trip)
Reported for Spiny Lobster in Puerto Rico's Commercial Fishery During
2014-23 (No Correction Factor Included)



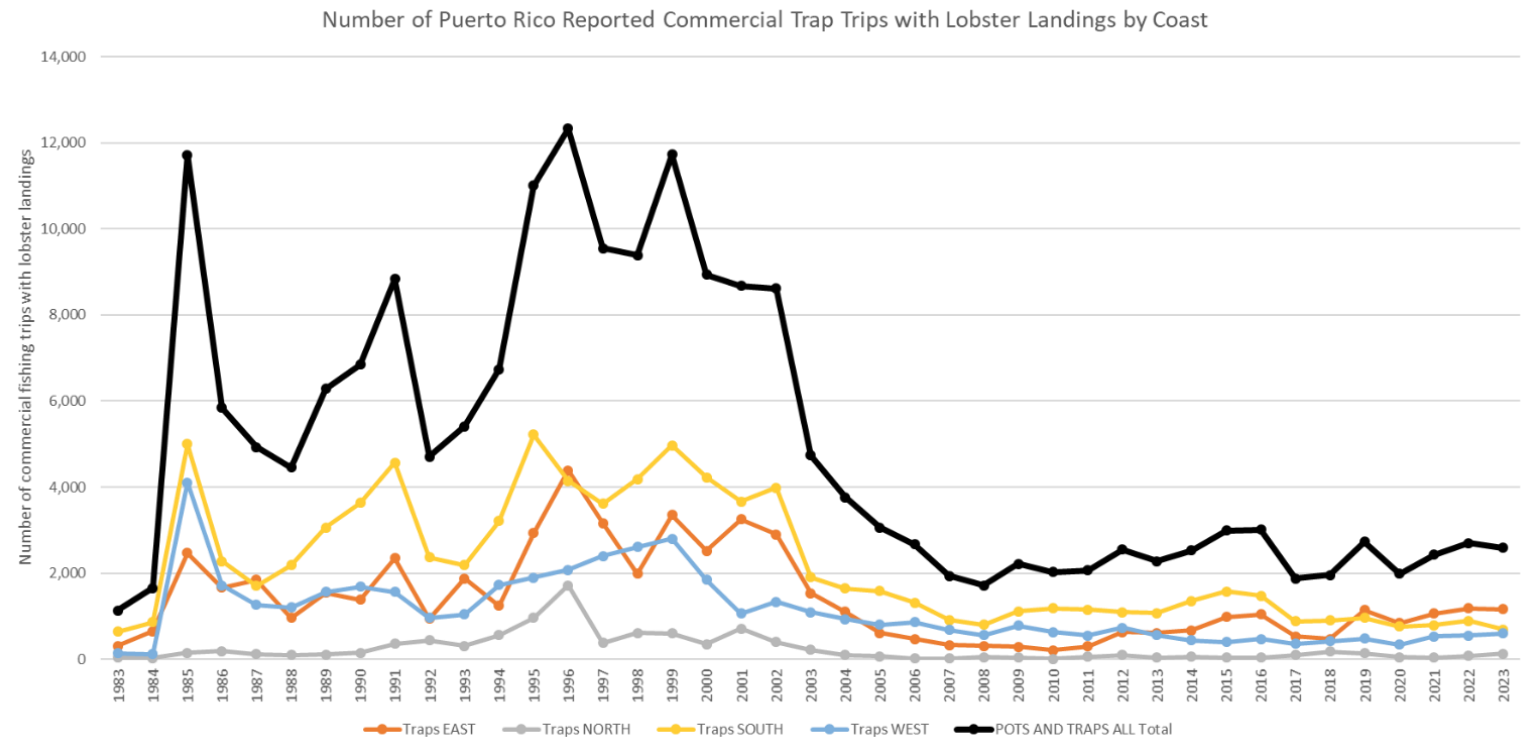
Daniel Matos-Caraballo, Jesús León-Fernández, Luis A. Rivera-Padilla, and Wilson Santiago-Soler
SEDAR91-DW-03



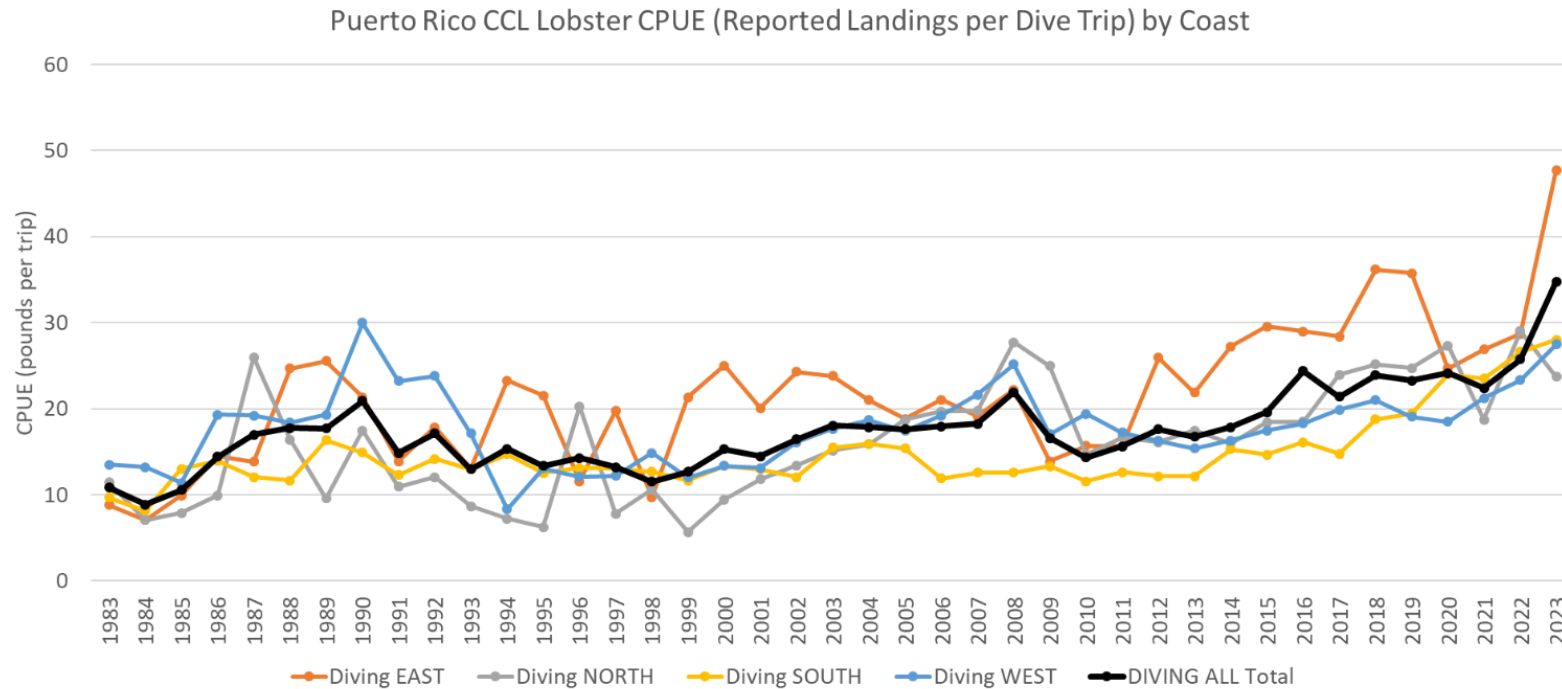
Puerto Rico Spiny Lobster: Trap Nominal CPUE



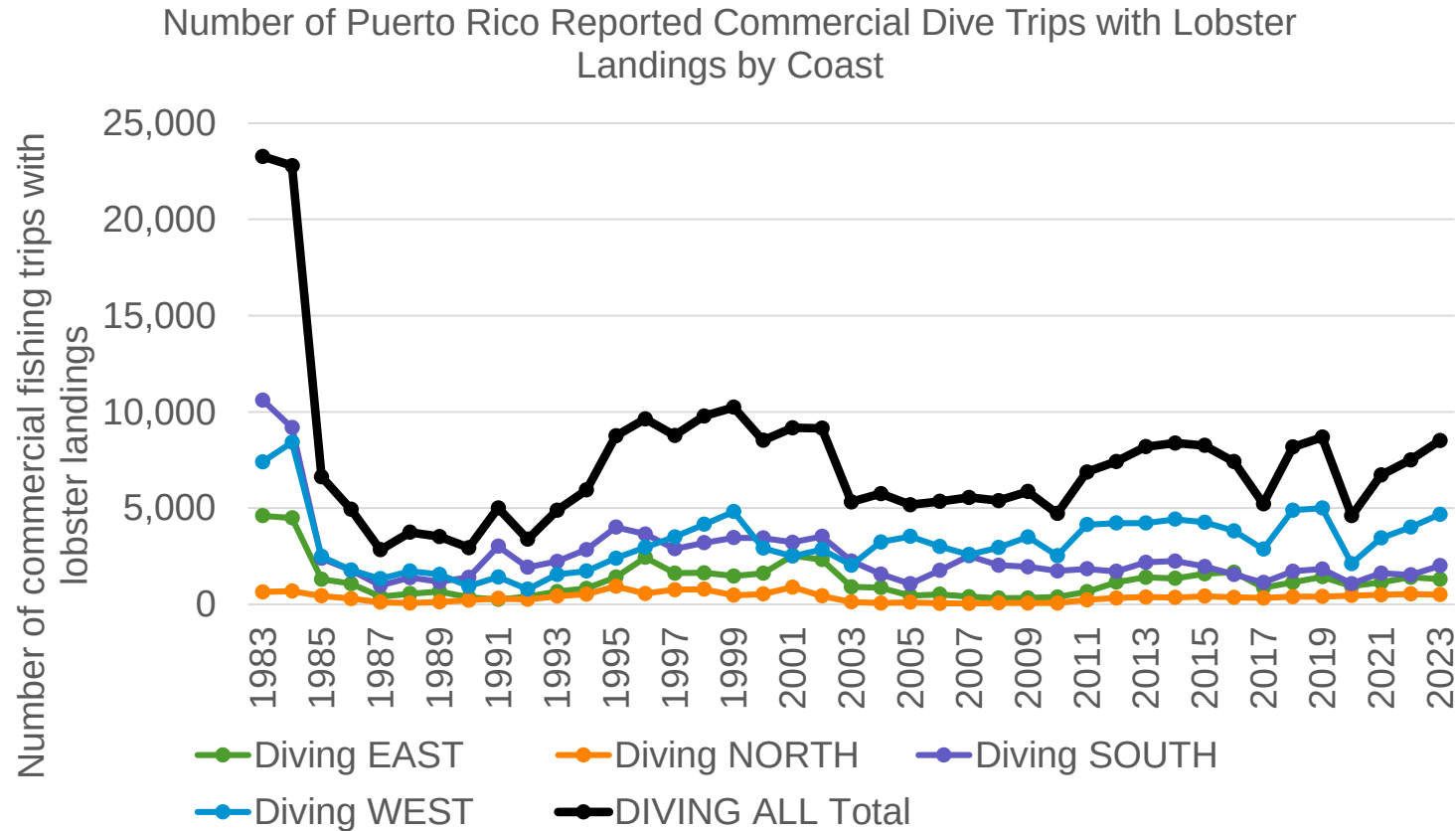
Puerto Rico Spiny Lobster: Trap Trips



Puerto Rico Spiny Lobster: Dive CPUE



Puerto Rico Spiny Lobster: Dive Trips



Puerto Rico Spiny Lobster: Standardized Index of Abundance

Fishery-dependent indices of abundance: available data

- ✓ Landings and fishing effort of commercial fishers from the Caribbean Commercial Logbook (CCL)
- ✓ Each fishing trip has a unique trip identifier, the landing date, fishing gear, coast, gear-specific fishing effort, species caught, and weight of the landings
- ✓ Data subsetting
- ✓ Catch per unit effort (CPUE) defined as whole weight per gear quantity (traps fished, SCUBA tanks used)

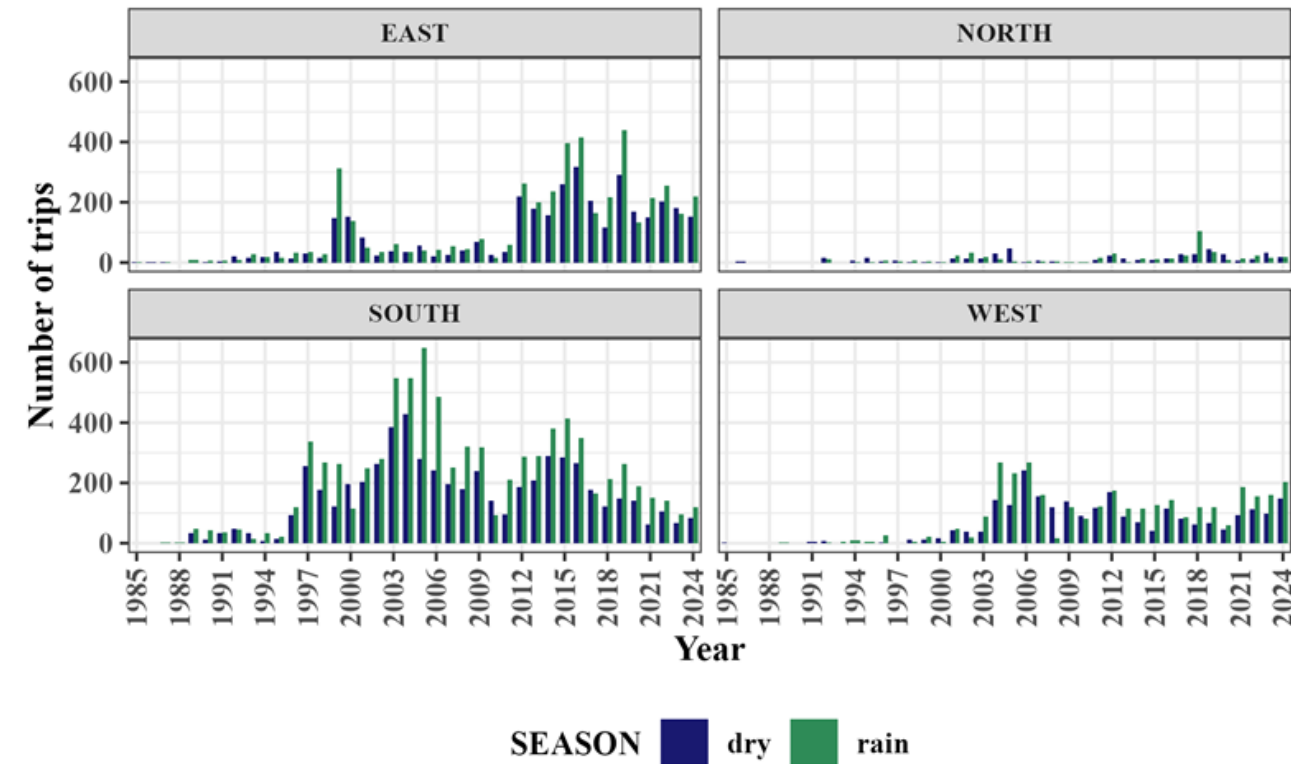


Methods

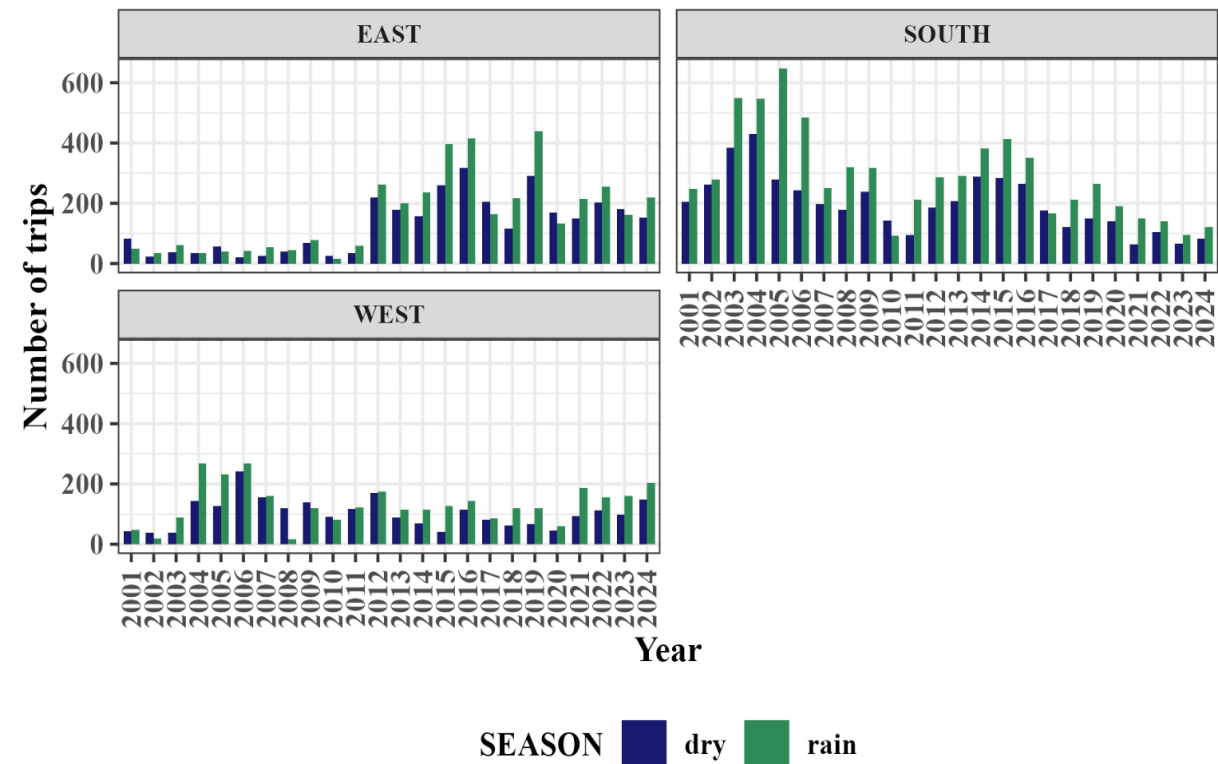
- Data exploration
 - Group similar gears
 - Outlier removal
 - Data exclusions
 - Years included
 - Time period based on sample size
- Data were restricted to include only trips that had gear effort information
- Calculated standardized CPUE

Fish Trap Index: sample size and time period

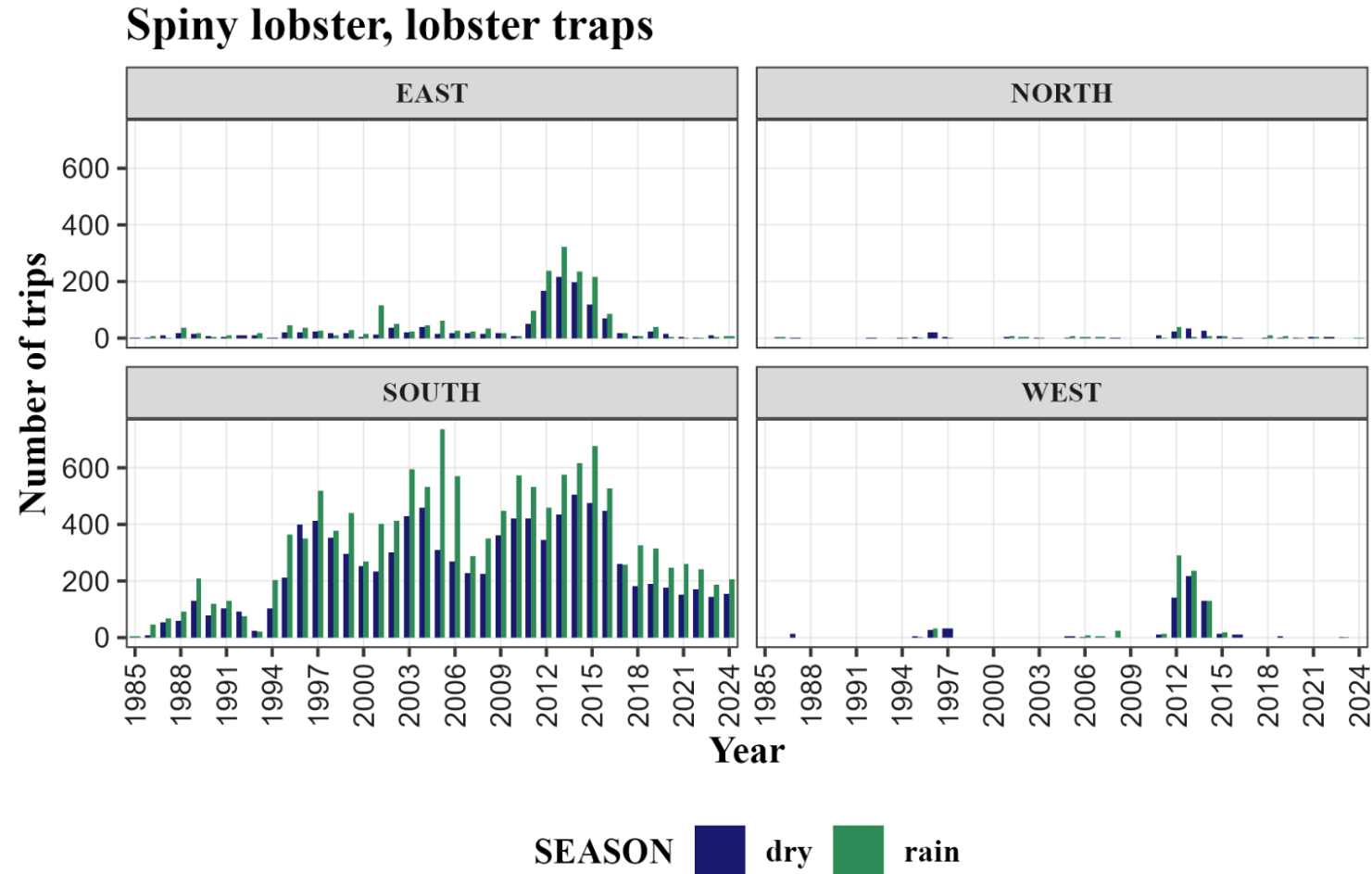
Spiny lobster, fish traps



Spiny lobster, fish traps

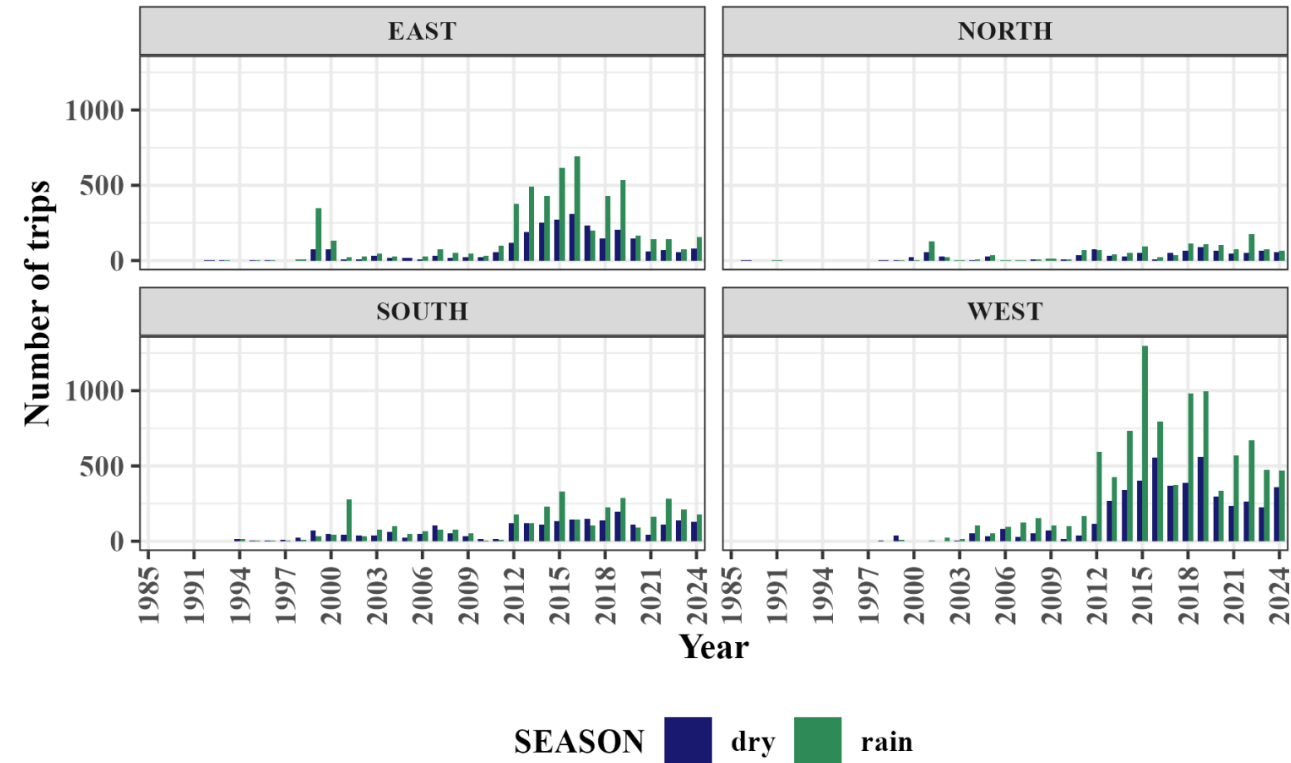


Lobster Trap Index: sample size and time period

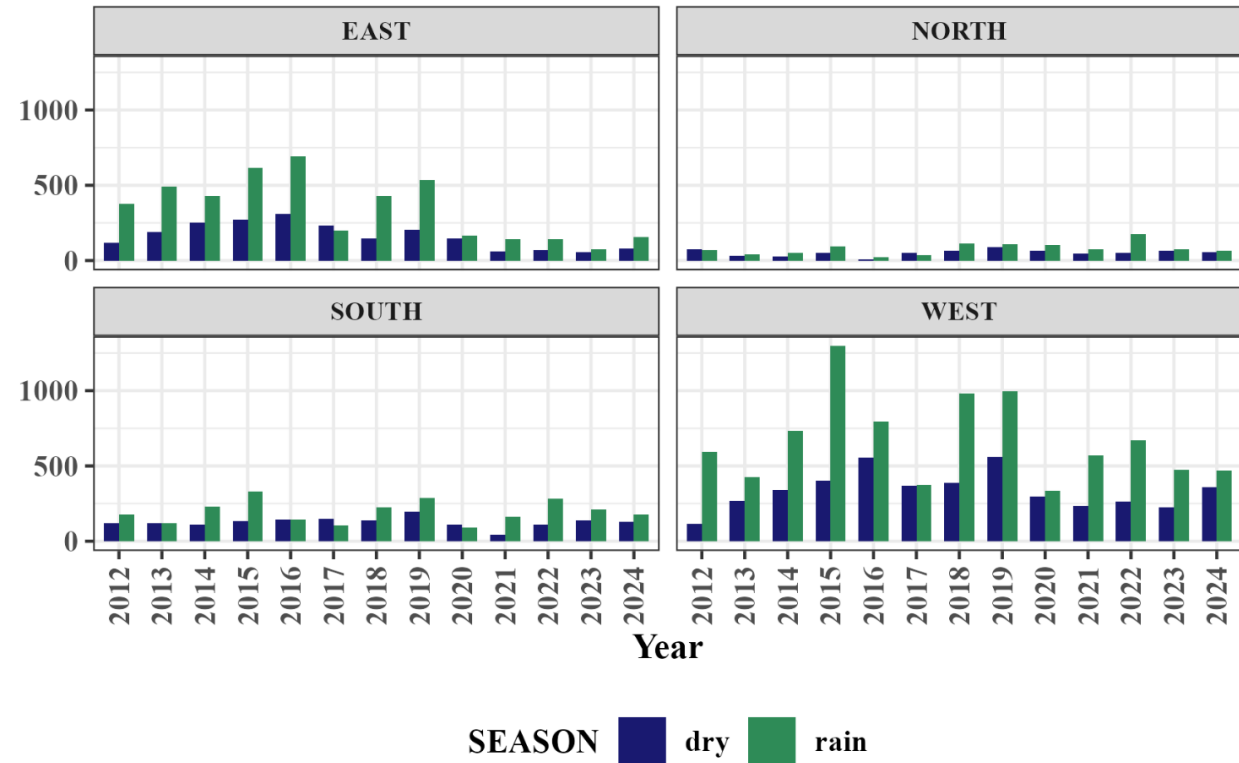


Dive Index: sample size and time period

Spiny lobster, dive



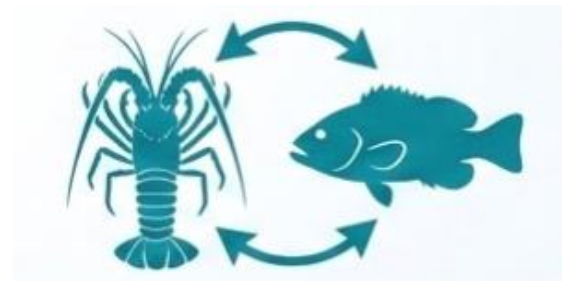
Spiny lobster, dive



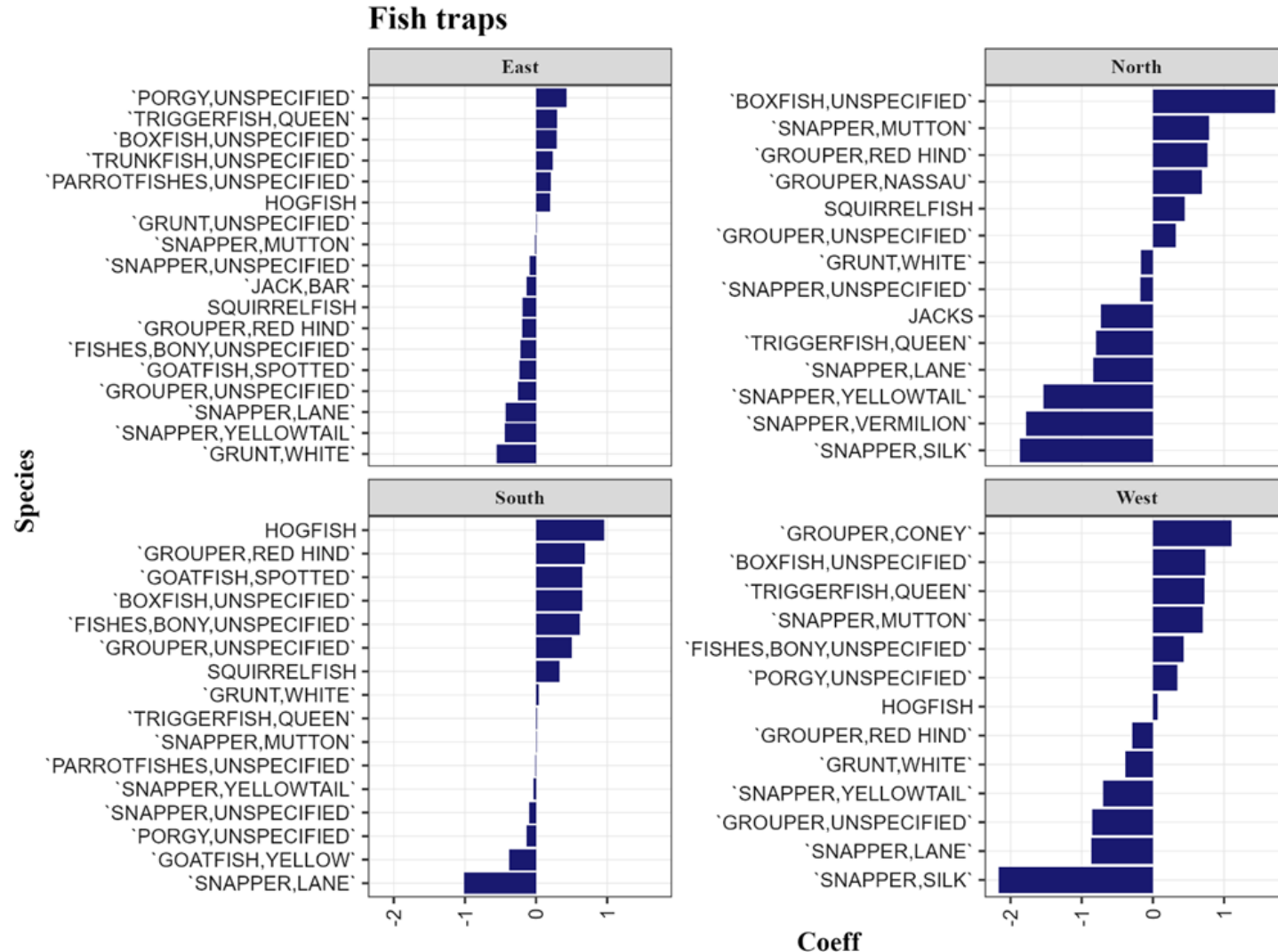
Data subsetting

Which trips fished in lobster habitat?

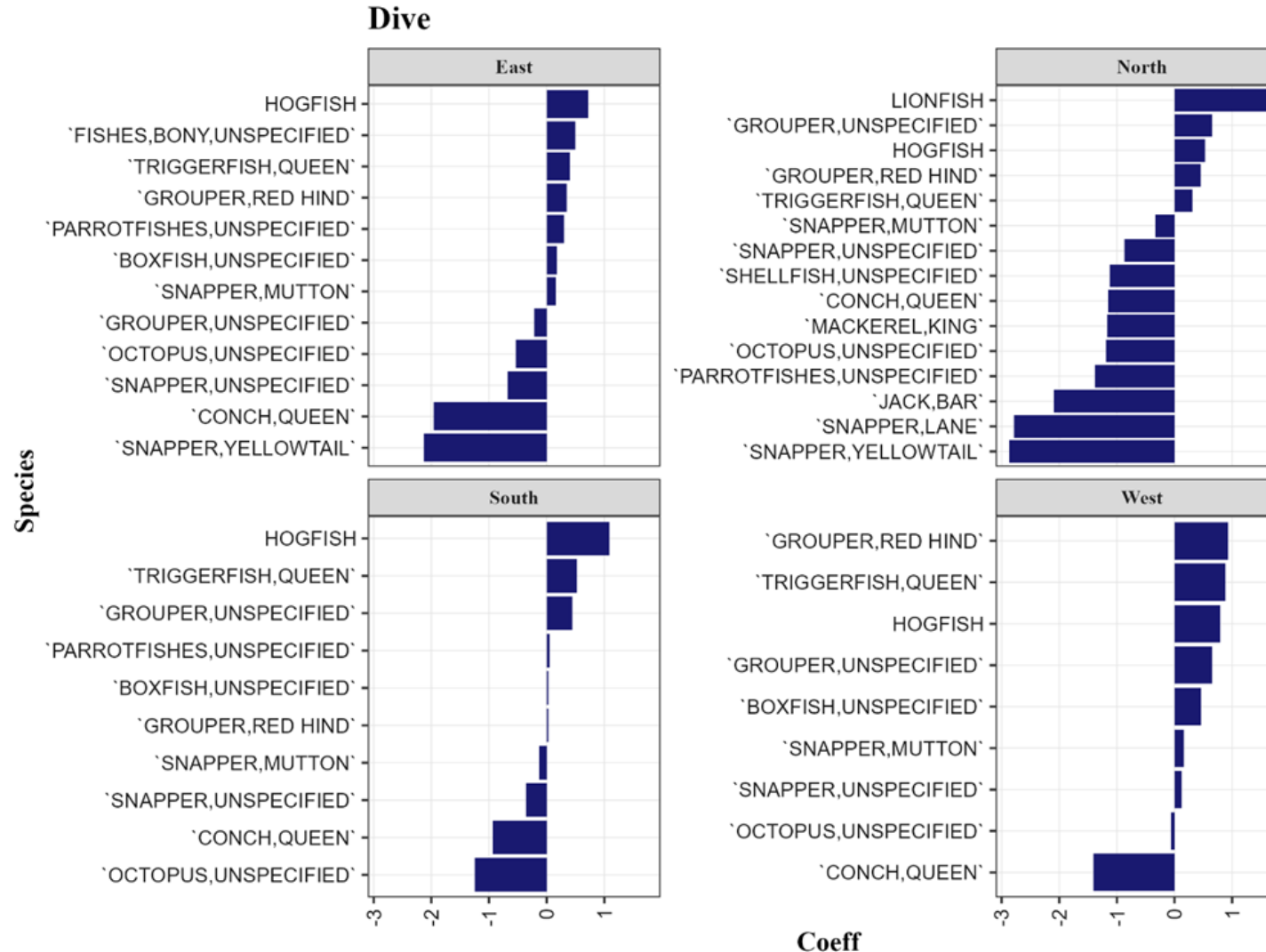
- Species association to identify trips
 - Stephens and MacCall method
 - uses multiple logistic regression to estimate a probability for each trip that spiny lobster was caught, given other species caught on that trip
- Gear - Dive and fish trap
- Coast – N, S, E, W



Stephens and MacCall results: Fish Traps



Stephens and MacCall results: Dive



Analyses

- CPUE was modeled using the delta-GLM approach
 - Combines two separate generalized linear models
 - One to describe presence/absence – Bernoulli submodel
 - One to describe catch rates of successful trips – Positive CPUE model

Analyses: Evaluation of explanatory variables

- YEAR – Years modeled were 2001-2024 (fish trap) and 2012-2024 (dive)
- SEASON –December-April, dry season; May-November, wet season
- COAST
 - fish trap index: South, East, West
 - dive index: North, South, East, West
- GEAR QUANTITY – Quantiles of gear quantity (number of traps fished, number of SCUBA tanks used), binomial model only

Analyses: Bernoulli submodel

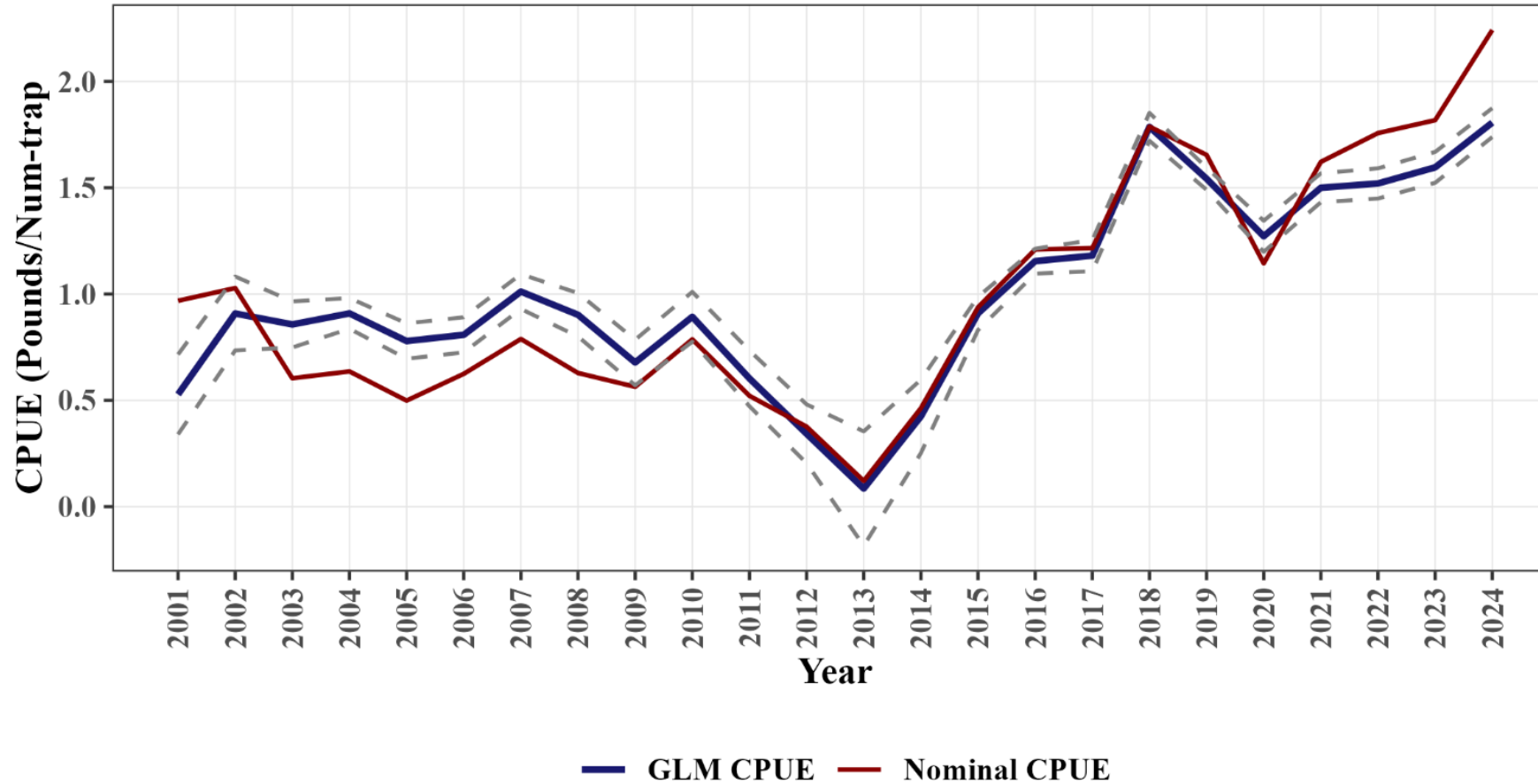
- Initially, all explanatory variables were included in the model as main effects
- Then stepwise AIC (Venables and Ripley 1997) with a backwards selection algorithm was used to eliminate those variables that did not improve model fit
- Final models:
 - *Fish trap index*
 - $\text{CPUE} \sim \text{YEAR} + \text{COAST} + \text{GEAR_QUANTITY}$
 - *Dive index*
 - $\text{CPUE} \sim \text{YEAR} + \text{COAST} + \text{SEASON} + \text{GEAR_QUANTITY}$

Analyses: Positive CPUE submodel

- Two parametric distributions were considered for modeling positive values of CPUE, lognormal and gamma – Lognormal outperformed gamma
- Initially, all explanatory variables were included in the model as main effects
- Then stepwise AIC (Venables and Ripley 1997) with a backwards selection algorithm was used to eliminate those variables that did not improve model fit
- Final models:
 - *Fish trap index*
 - $\text{CPUE} \sim \text{YEAR} + \text{COAST}$
 - *Dive index*
 - $\text{CPUE} \sim \text{YEAR} + \text{COAST}$

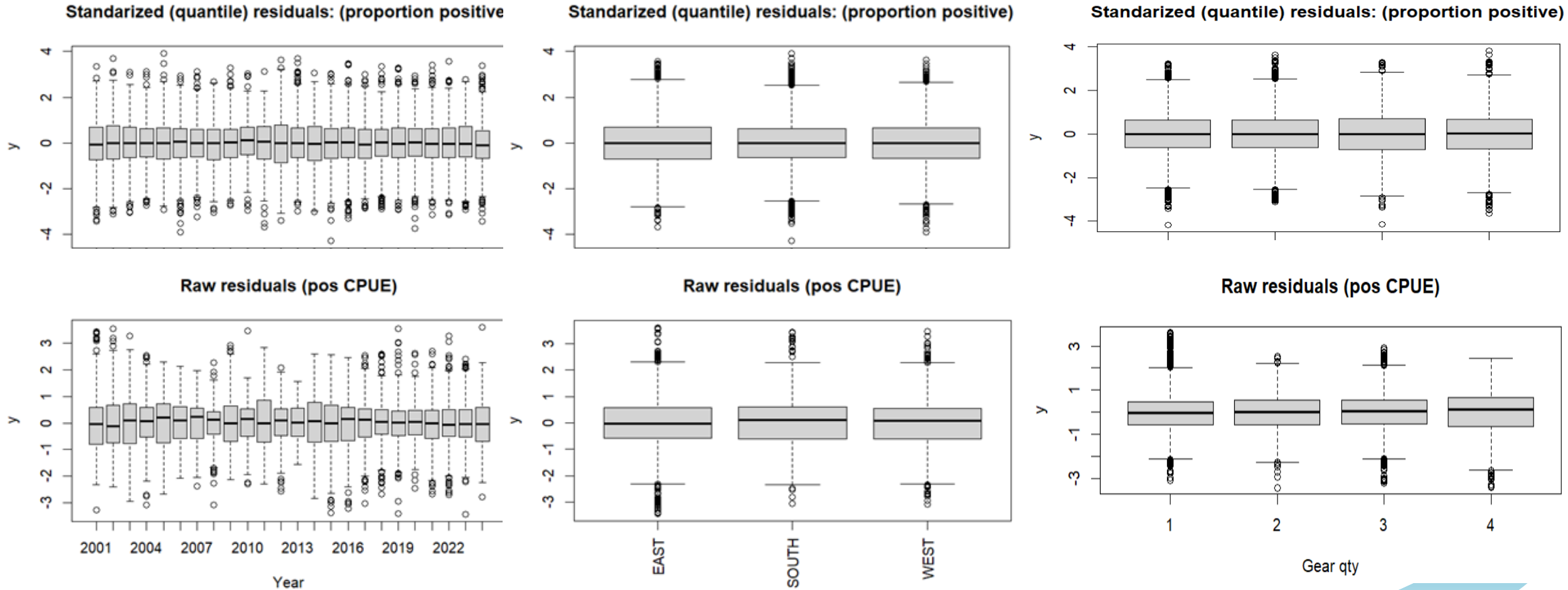
Fish Trap Index

SEDAR 91 Spiny Lobster Fish Trap Index



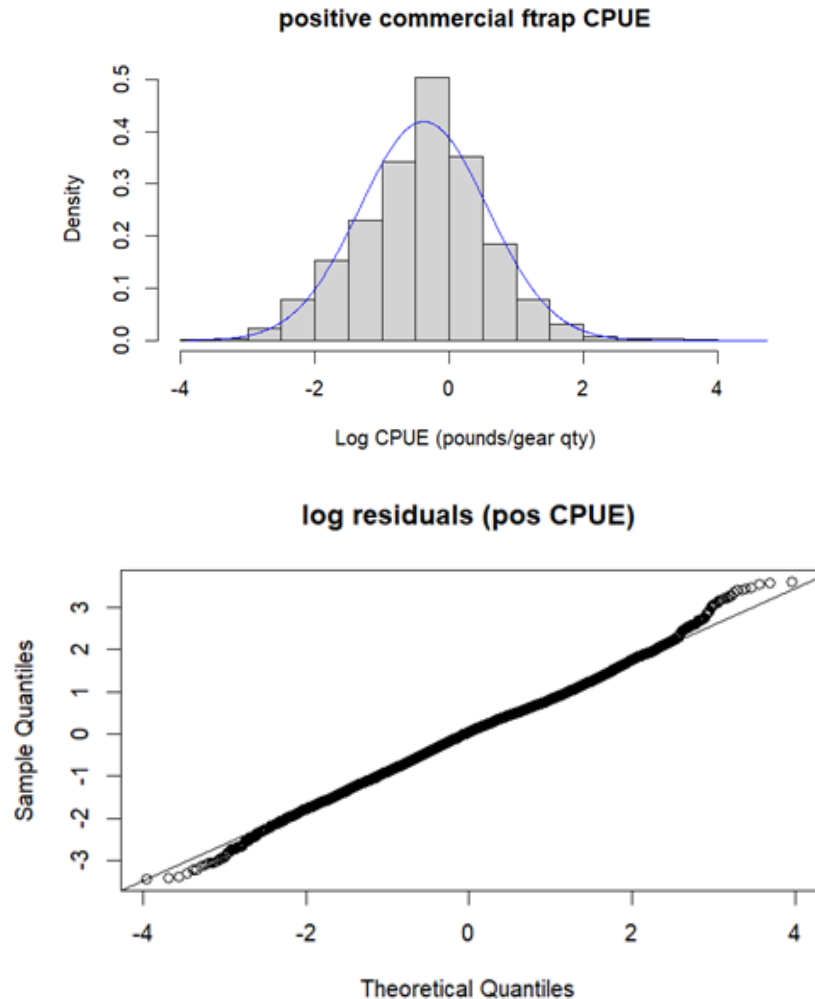
Fish Trap Index: diagnostics

Bernoulli submodel: fits to binomial data



Lognormal submodel fits to positive CPUE data

Fish Trap Index: diagnostics

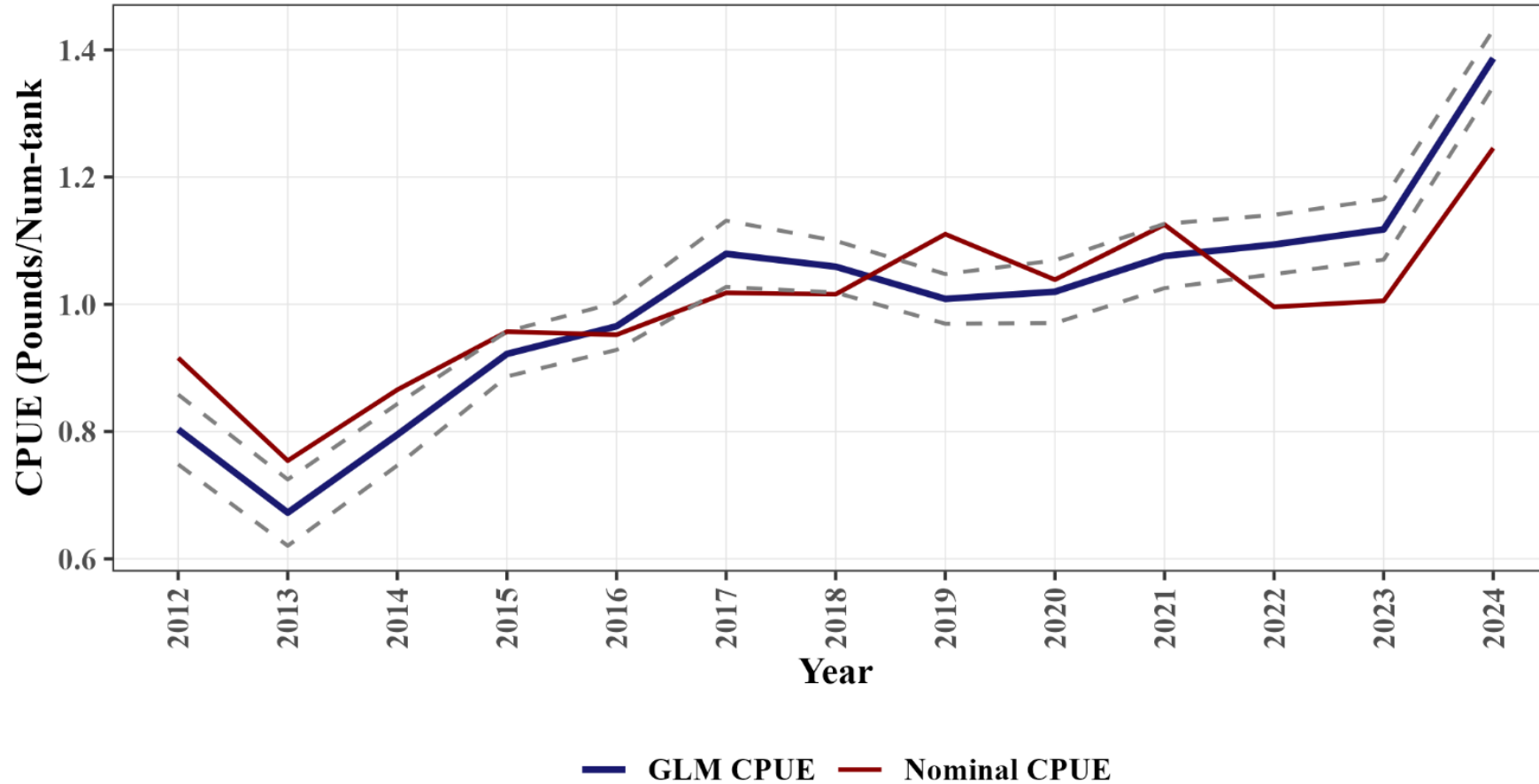


Top left - Histogram of empirical CPUE with the lognormal distribution overlaid

Bottom left - Quantile-quantile plot of residuals from the fitted lognormal submodel to the positive cpue catch

Dive Index

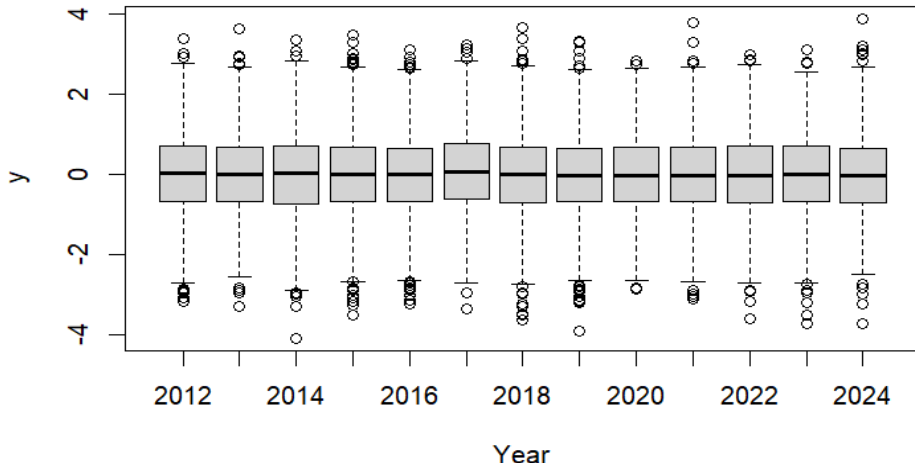
SEDAR 91 Spiny Lobster Dive Index



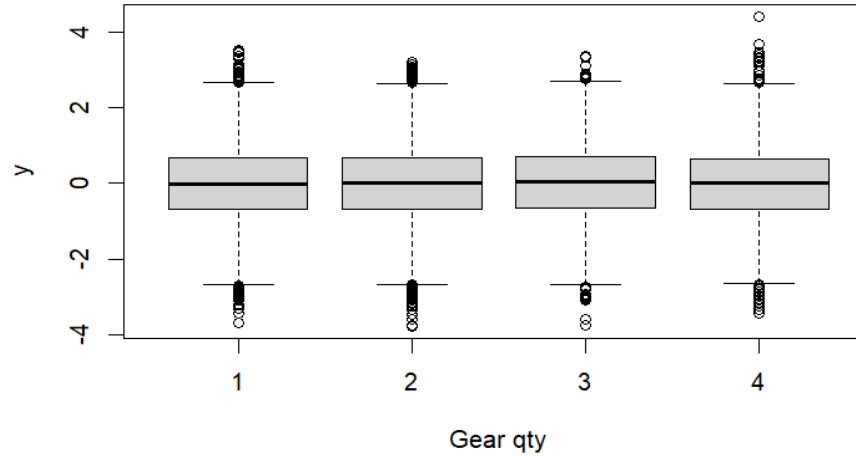
NOAA
FISHERIES

Dive Index: diagnostics

Standardized (quantile) residuals: (proportion positive)

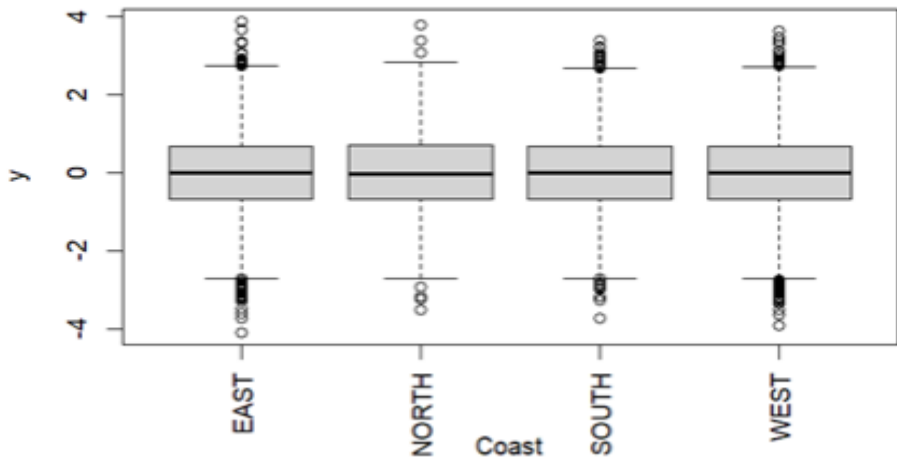


Standardized (quantile) residuals: (proportion positive)

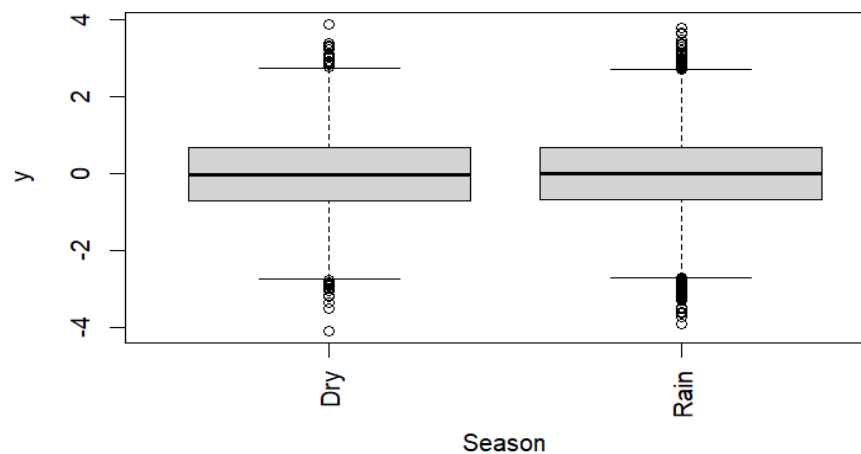


Bernoulli submodel: fits to binomial data

Standardized (quantile) residuals: (proportion positive)

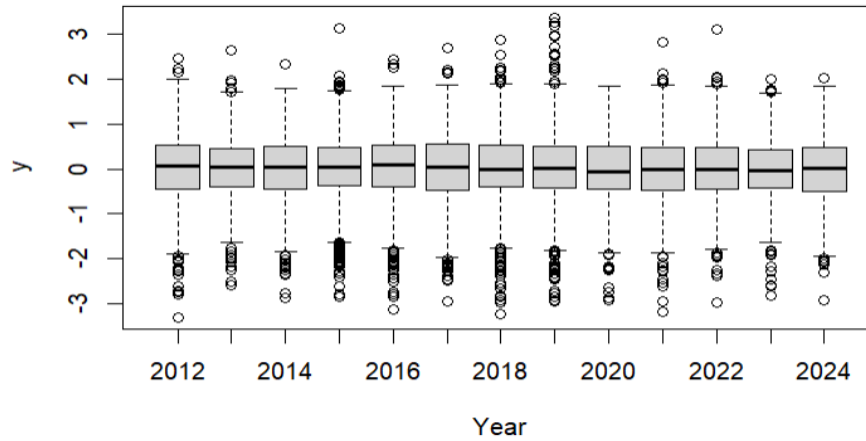


Standardized (quantile) residuals: (proportion positive)



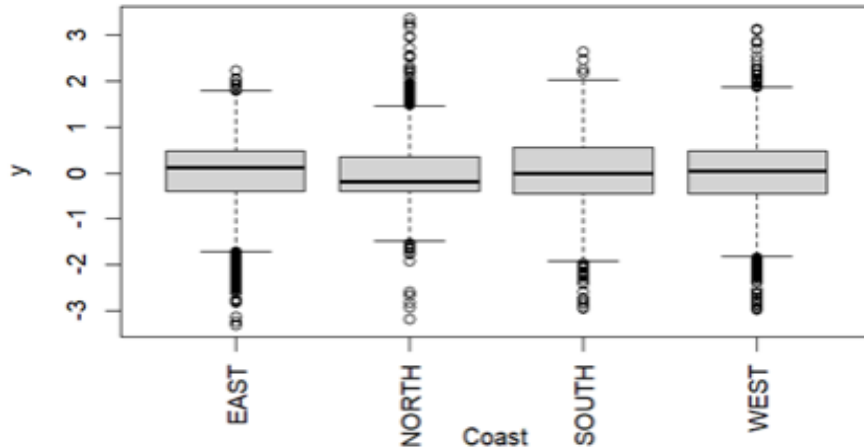
Dive Index: diagnostics

Raw residuals (pos CPUE)

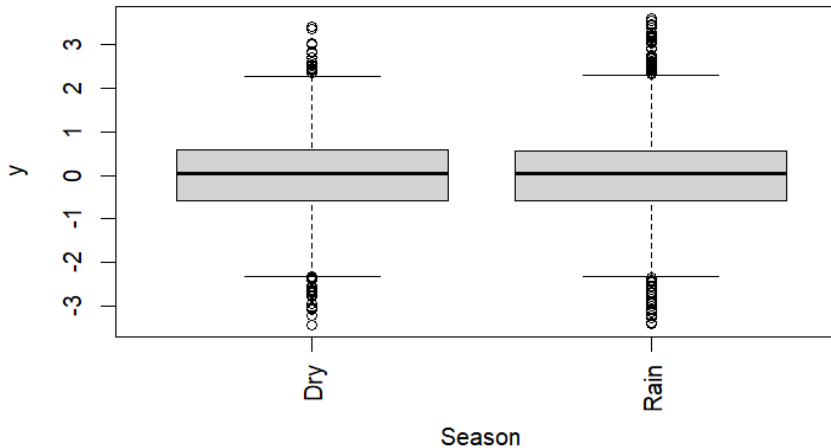


Lognormal submodel fits to positive CPUE data

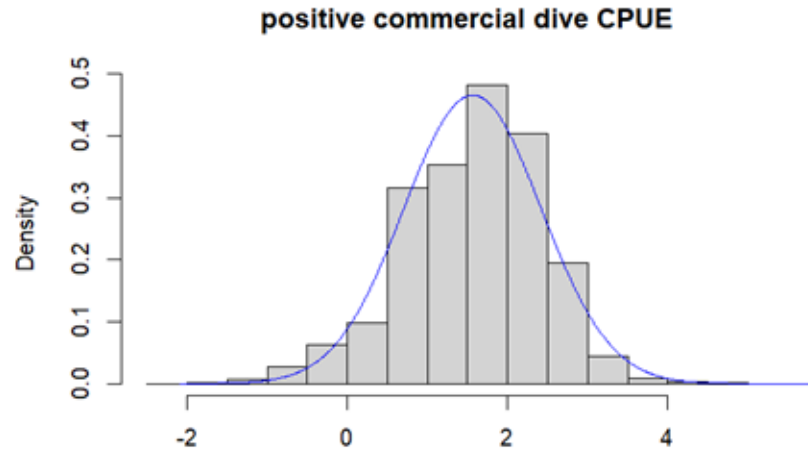
Raw residuals (pos CPUE)



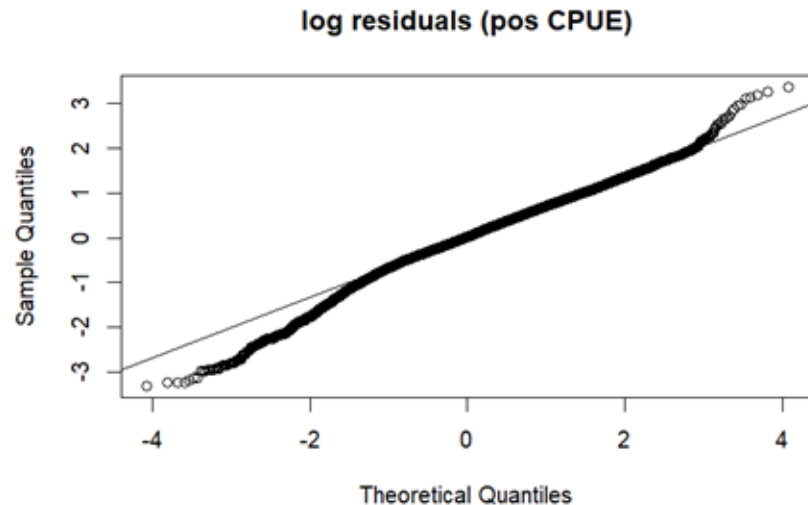
Raw residuals (pos CPUE)



Dive Index: diagnostics

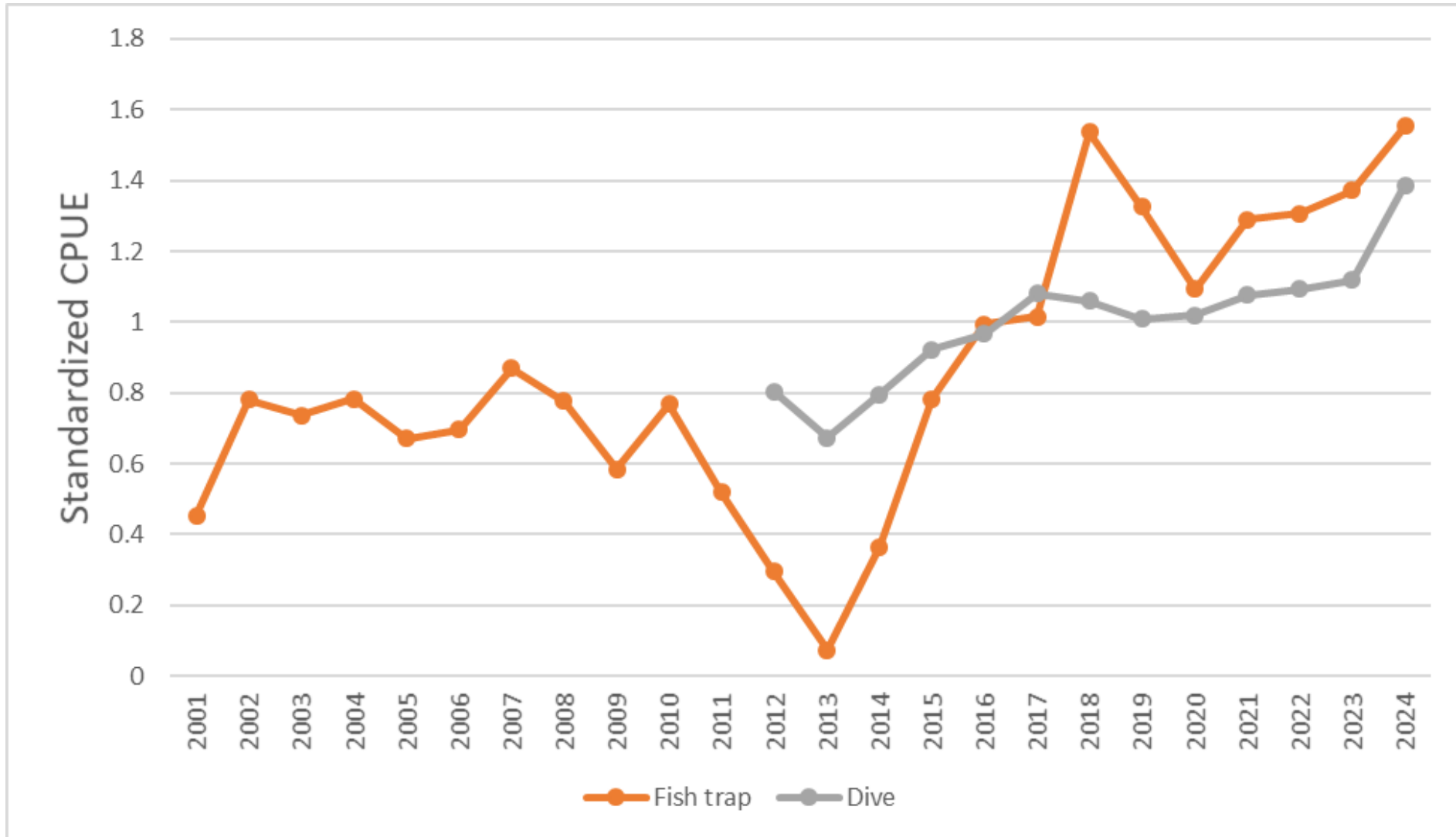


Top left - Histogram of empirical CPUE with the lognormal distribution overlaid



Bottom left - Quantile-quantile plot of residuals from the fitted lognormal submodel to the positive cpue catch

Standardized Indices of Abundance



An underwater photograph of a vibrant coral reef. The scene is filled with various types of coral, including branching and leafy varieties, in shades of brown, orange, and green. Several small, colorful fish are visible swimming in the clear blue water. The overall atmosphere is bright and healthy.

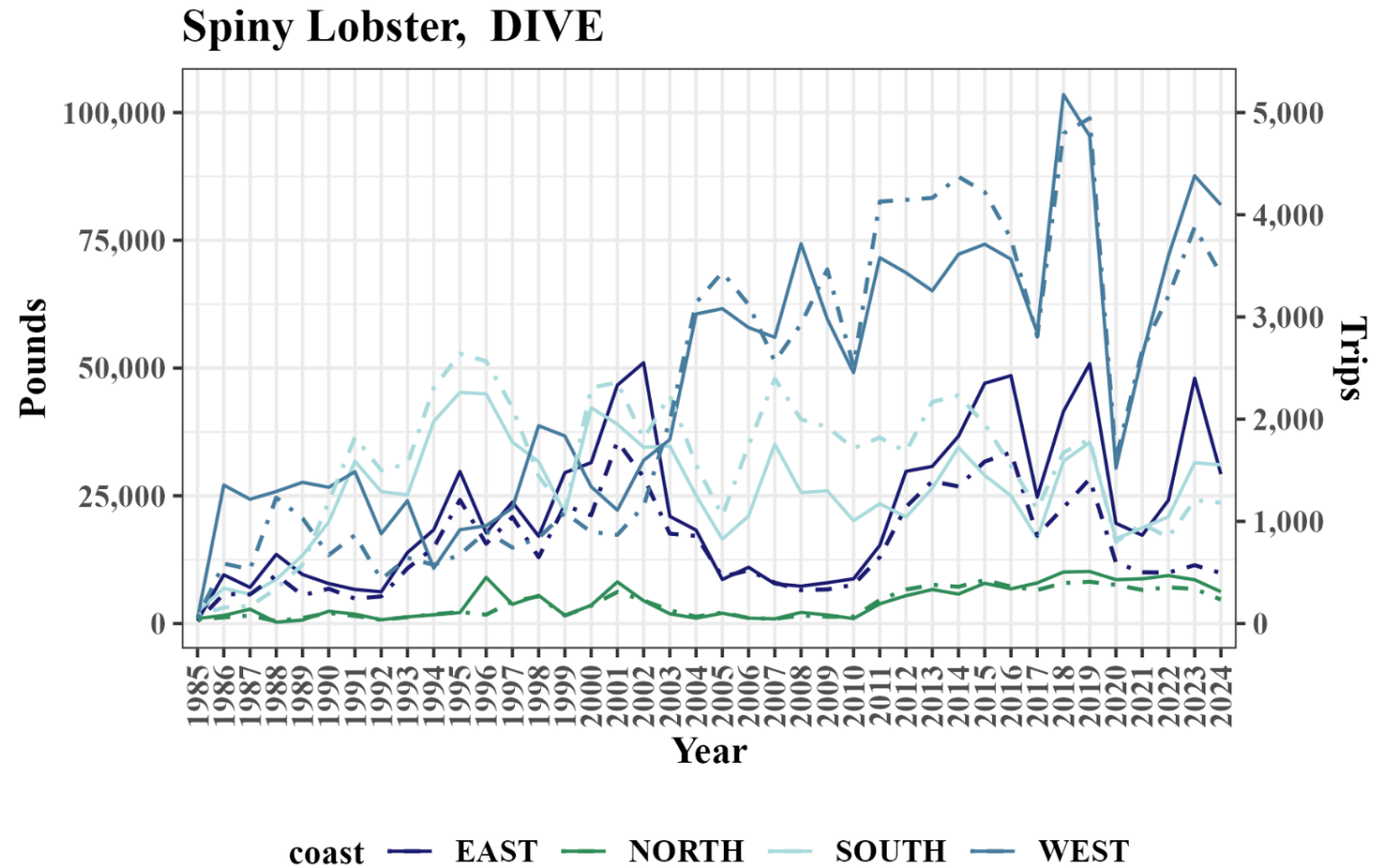
Thank you!

¡Gracias!

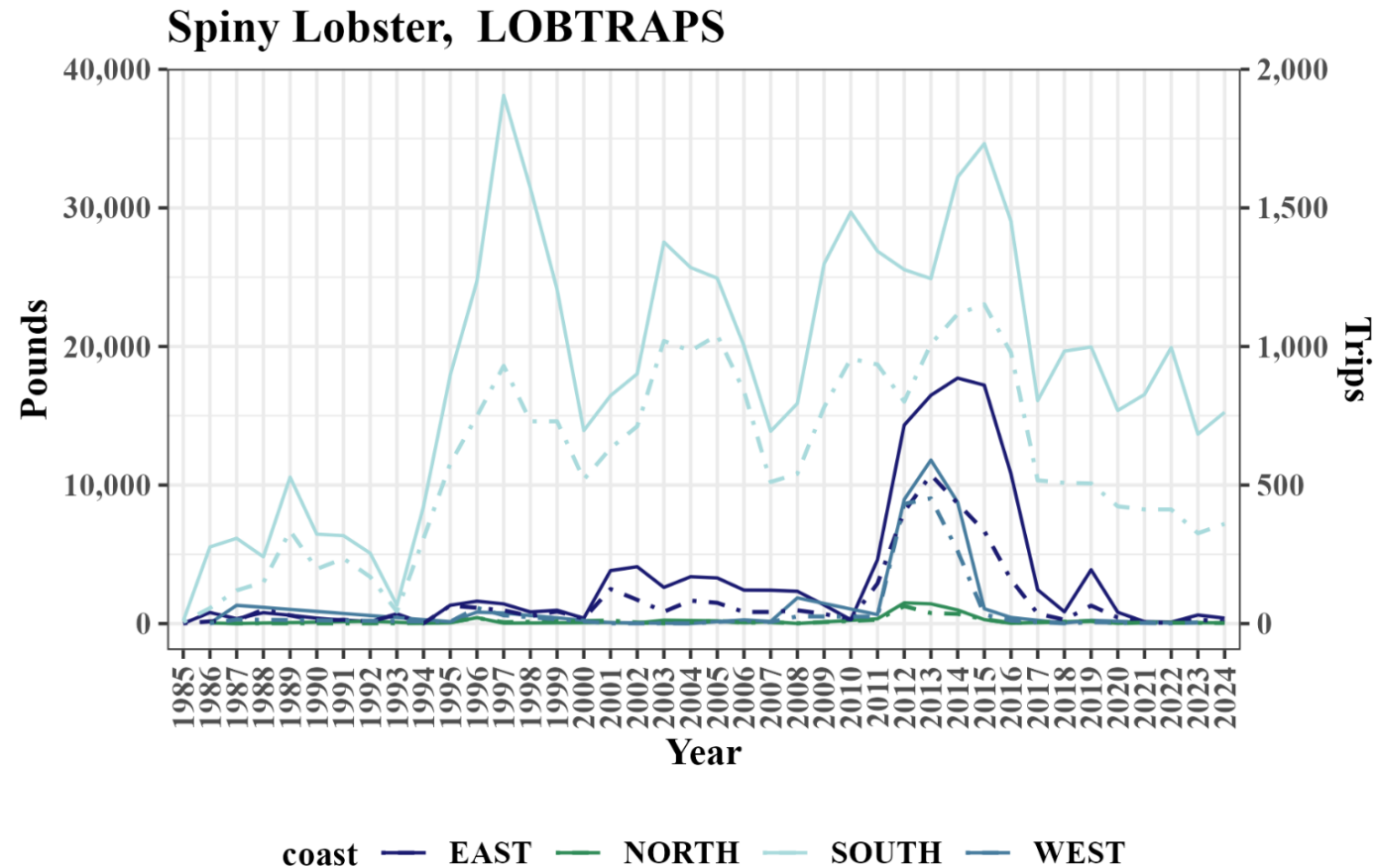


**NOAA
FISHERIES**

Data exploration

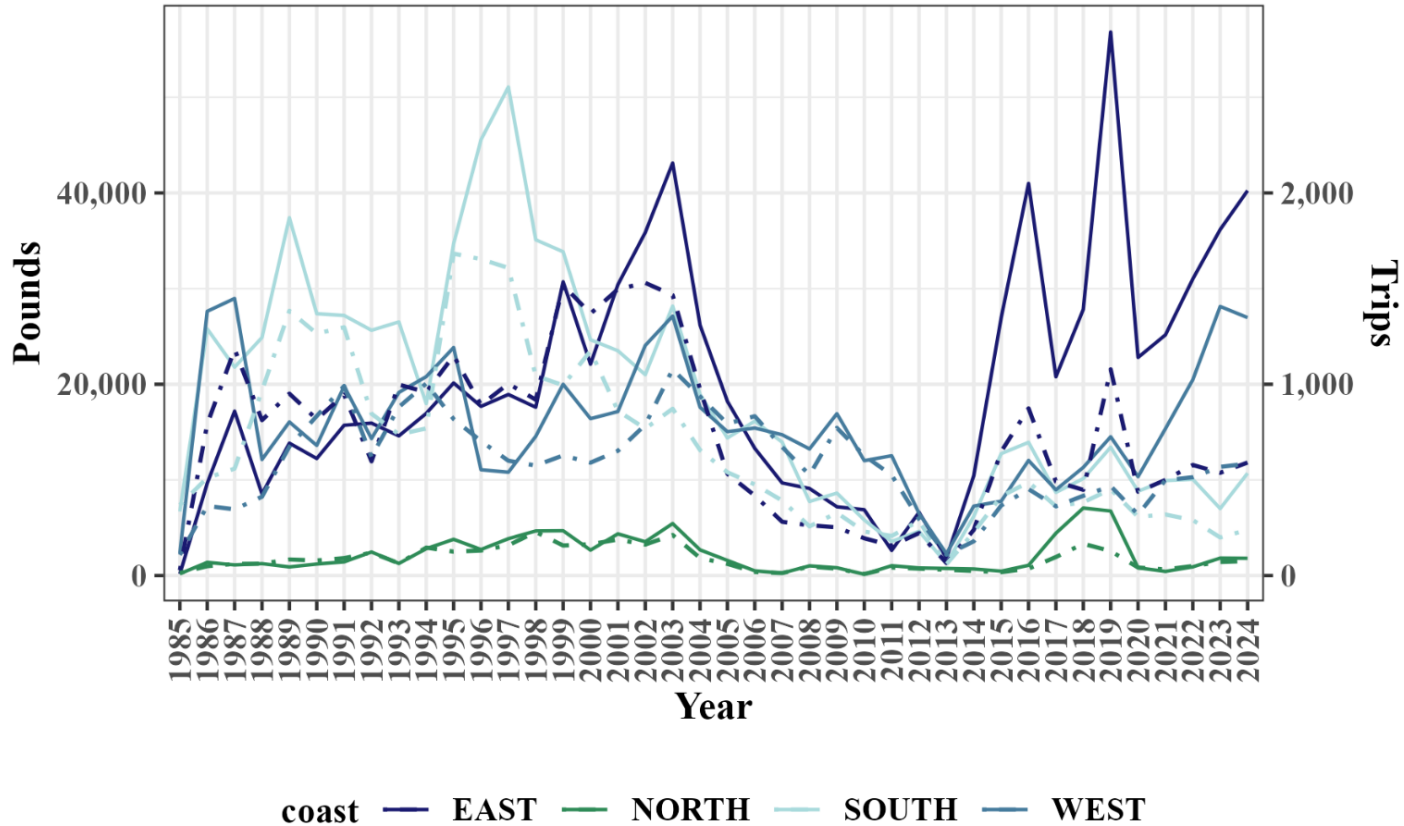


Data exploration

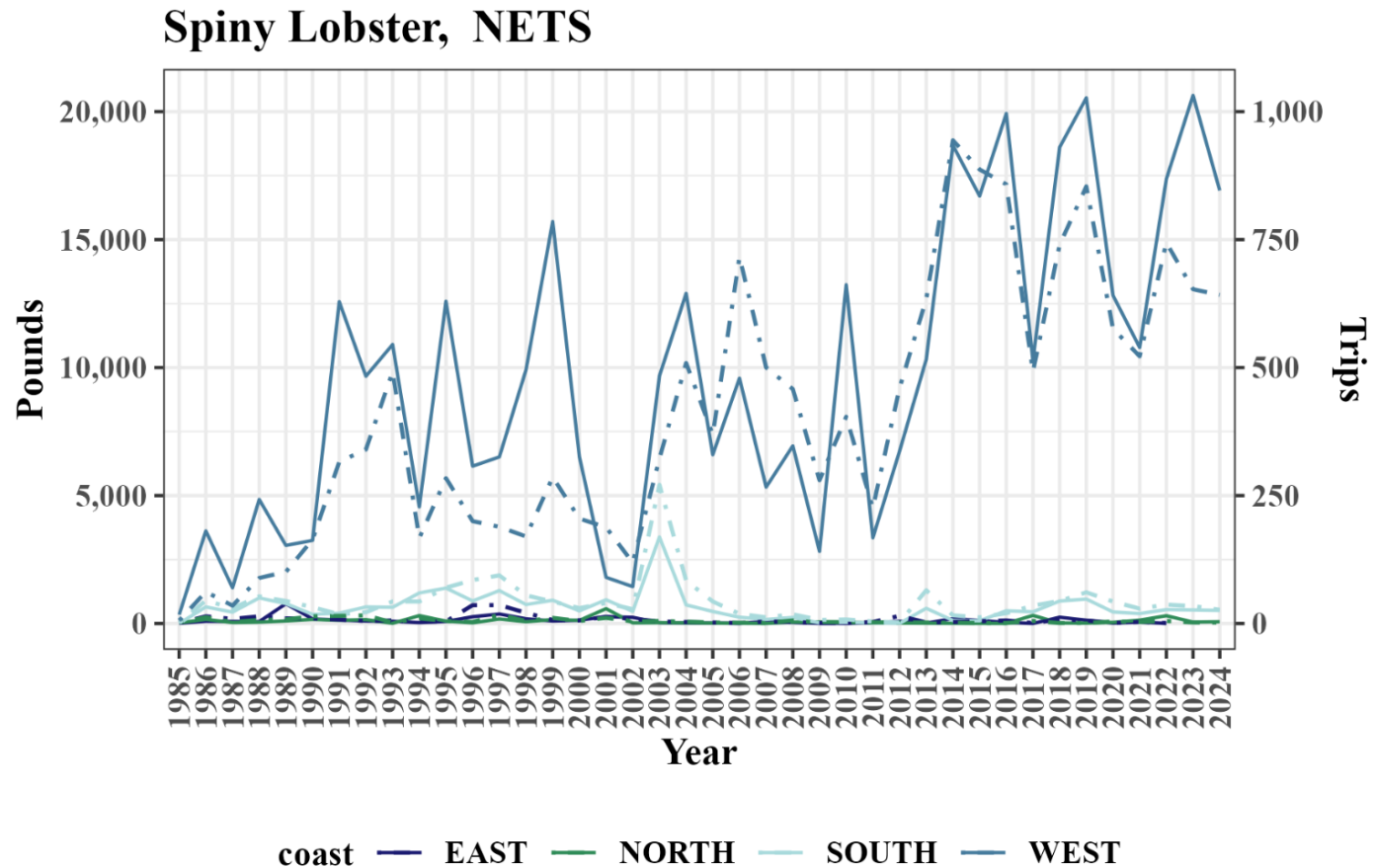


Data exploration

Spiny Lobster, FISHTRAPS

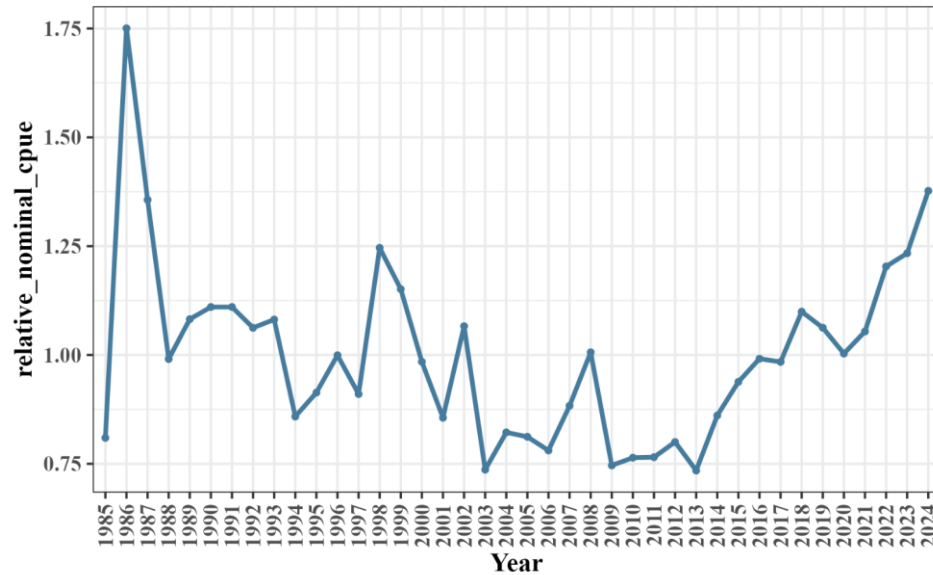


Data exploration

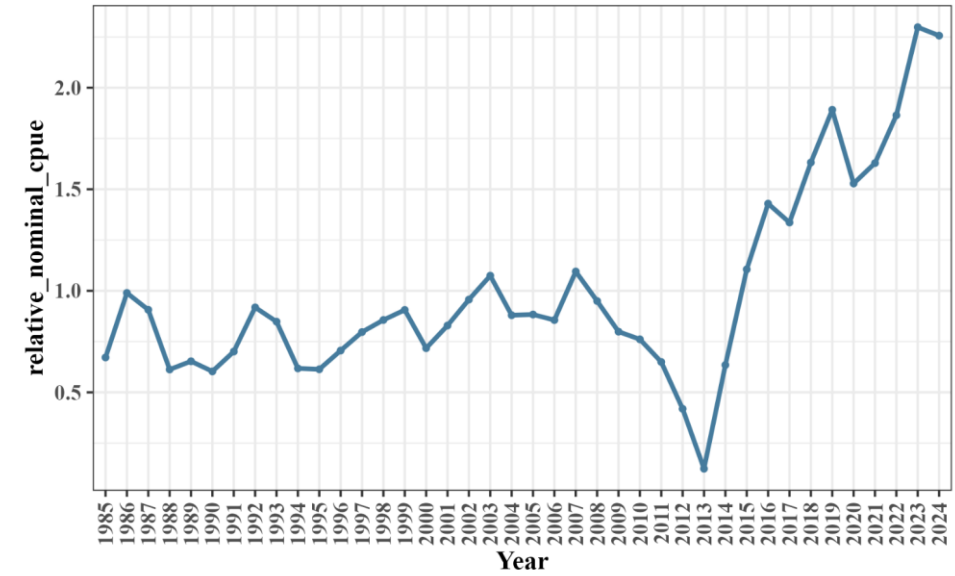


Relative nominal CPUE

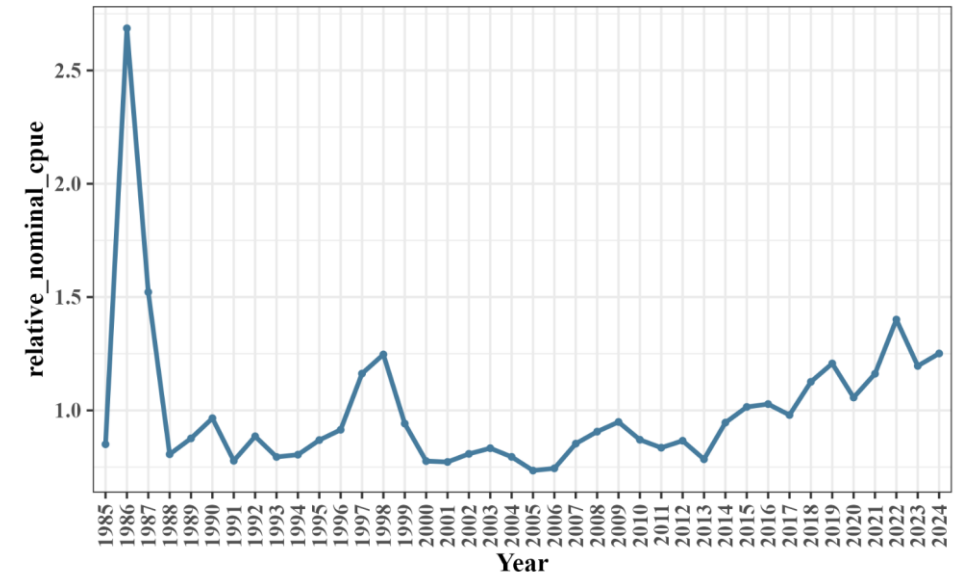
Spiny Lobster, DIVE



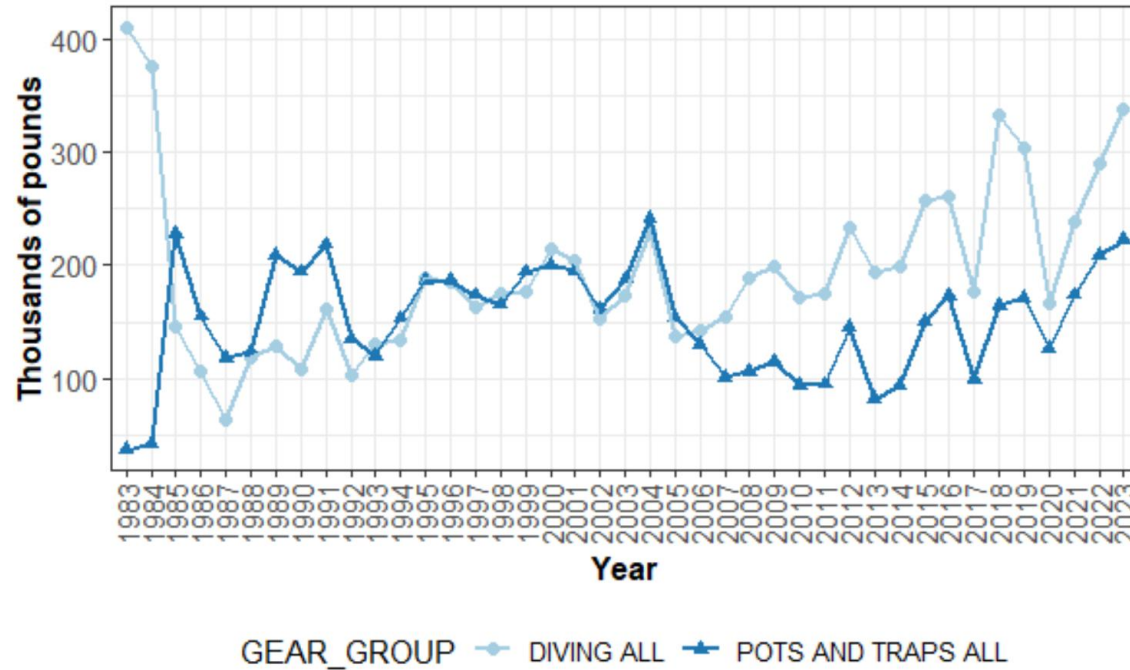
Spiny Lobster, FISHTRAPS



Spiny Lobster, LOBTRAPS



SEDAR 91 US Caribbean Spiny Lobster

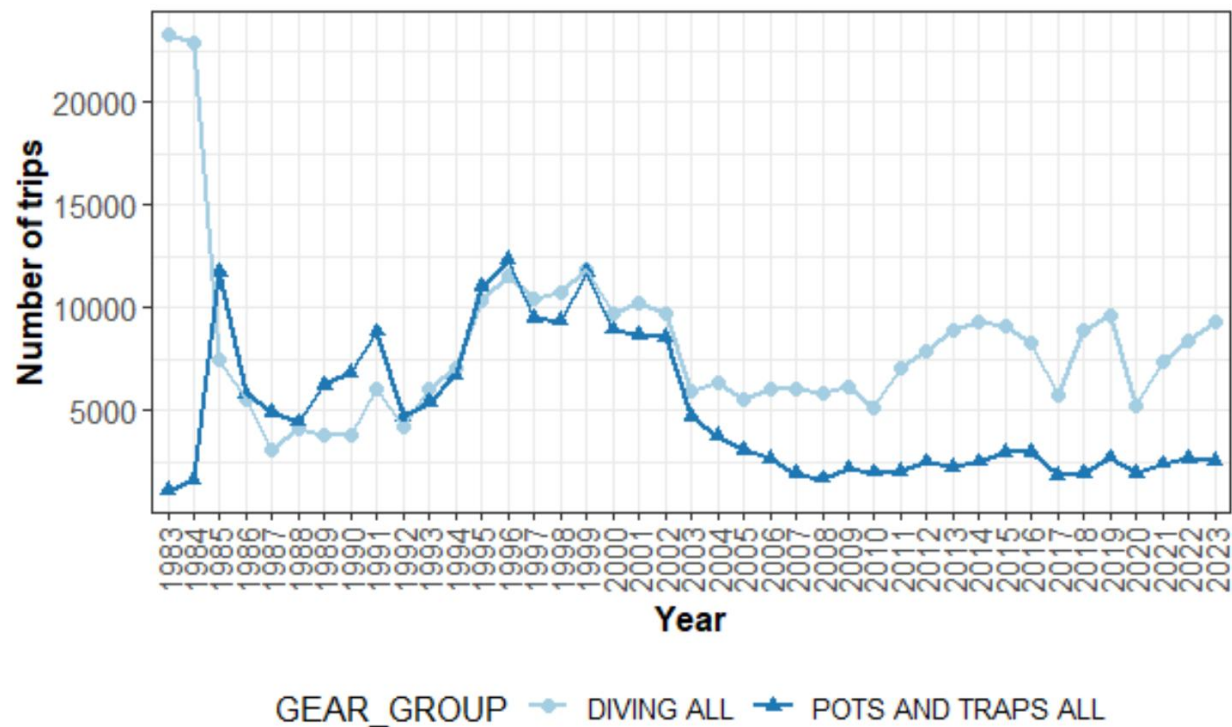


Data are not confidential.

Commercial landings in pounds of Caribbean Spiny Lobster by year and gear group in Puerto Rico after outlier removal



SEDAR 91 US Caribbean Spiny Lobster



Data are not confidential.

Number of trips with reported landings of Caribbean Spiny Lobster by year and gear group in Puerto Rico after outlier removal



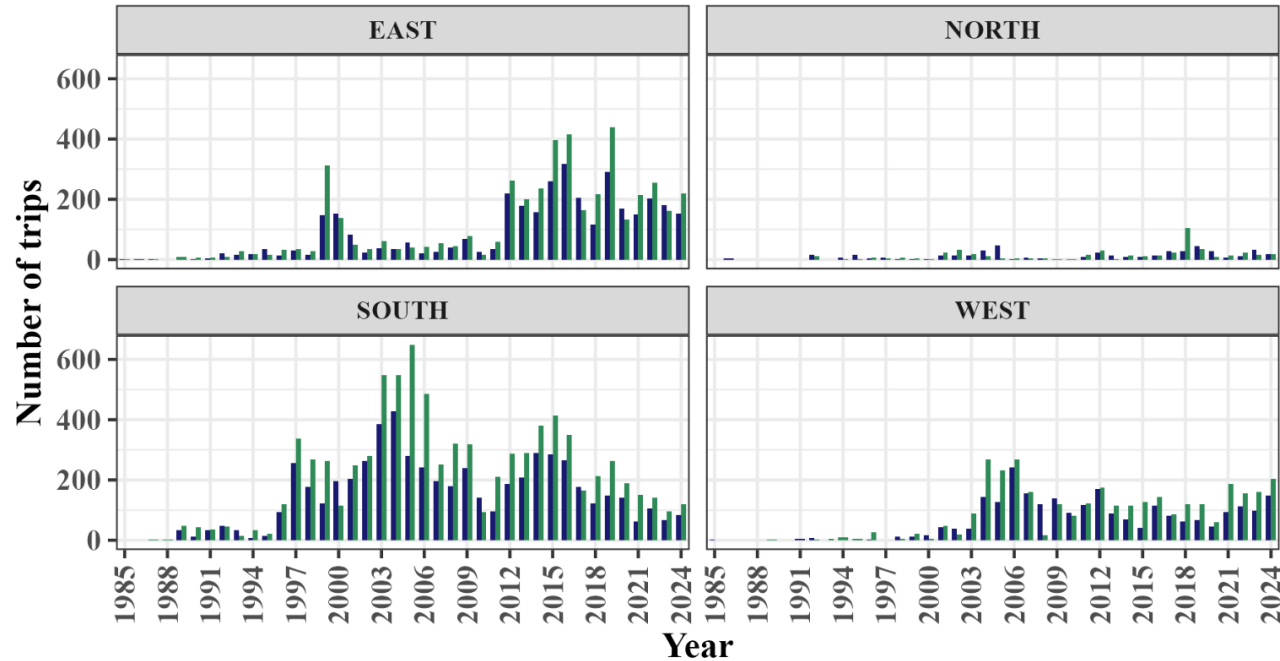
SEDAR 91 US Caribbean Spiny Lobster

- ✓ Fishery-dependent index work
- ✓ Landings and fishing effort of commercial fishers from the Caribbean Commercial Logbook (CCL)
- ✓ Each fishing trip has a unique trip identifier, the landing date, fishing gear, coast, gear-specific fishing effort, species caught, and weight (lbs) of the landings
- ✓ Stevens and McCall analysis
- ✓ Catch per unit effort (CPUE) defined as whole weight per gear quantity



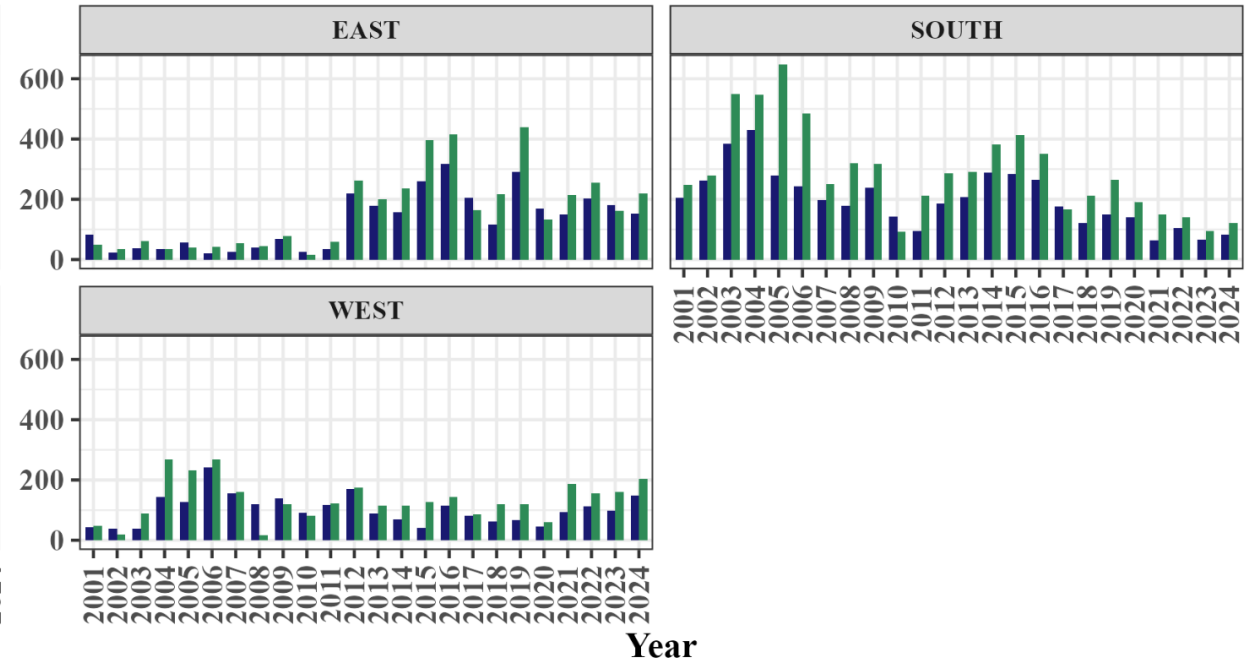
Fish trap trips with gear quantity data

Spiny lobster, fish traps



SEASON ■ dry ■ rain

Spiny lobster, fish traps



SEASON ■ dry ■ rain



NOAA
FISHERIES