Scamp/Yellowmouth Grouper Fishery-Independent Indices of Abundance in US South Atlantic Waters Based on a Chevron Video Trap Survey and a Short Bottom Longline Survey

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Abstract

This report presents a summary of the fishery-independent monitoring of Scamp, *Mycteroperca phenax*, and Yellowmouth Grouper, *Mycteroperca interstitialis*, in the US South Atlantic region and includes data from three monitoring programs (MARMAP, SEAMAP-SA, and SEFIS, known collectively as SERFS). Specifically, it presents annual nominal catch per unit effort (CPUE), as well as age and length compositions of Scamp and Yellowmouth Grouper in chevron video traps from 1990 to 2018 and short bottom longlines from 1999 to 2018. Also included are annual CPUE estimates for chevron video trap and short bottom longline catches over this same time period that are standardized by a zero-inflated negative binomial model (ZINB) to account for the effects of potential covariates on these estimates.

Background

The Marine Resources Monitoring, Assessment, and Prediction program (MARMAP) has conducted fishery-independent research on reef fish species of the continental shelf and shelf edge between Cape Hatteras, North Carolina, and St. Lucie Inlet, Florida, for over 40 years. Although the MARMAP program has used various gear types and methods of deployment since its inception, starting in 1990, the chevron trap has been the primary gear deployed to allow for analyses of long-term changes in relative abundance, age compositions, length frequencies, and other information regarding reef fish species on live-bottom and/or hard-bottom habitats. The short bottom longline (SBLL) survey began in 1996 to collect this same information, but at deeper sites that have higher relief live-bottom and/or hard-bottom habitats. Scamp, *Mycteroperca phenax*, are one of the species regularly caught with both gears. Yellowmouth Grouper, *Mycteroperca interstitialis*, are less common but may potentially be confused with Scamp and so are included here as well. In 2008, with a first field season in 2009, the Southeast Area Monitoring and Assessment Program, South Atlantic Region (SEAMAP-SA) provided funding to assist with the expansion of the geographical sampling coverage of the MARMAP fishery-independent chevron trap and SBLL surveys. Again in 2010, with the formation of the Southeast Fishery-Independent Survey (SEFIS), additional funds were provided to, among other things, expand the geographical coverage and sampling intensity of the MARMAP fishery-independent chevron trap survey and consistently add video cameras to each trap. Collectively, we now refer to these three surveys' combined reef fish monitoring efforts from 2010 to present as the Southeast Reef Fish Survey (SERFS) and refer to the chevron trap as a chevron video trap.

Objective

This report presents standardized relative abundance indices of Scamp and Yellowmouth Grouper derived from the MARMAP/SERFS fishery-independent surveys. The chevron video trap standardized index accounts for annual sampling distribution shifts with respect to covariates that affect catch of Scamp and Yellowmouth Grouper during the years 1990-2018. Note that the video data is not included in these data, only catches from the traps. A standardized relative abundance index of Scamp and Yellowmouth Grouper derived from the SBLL survey also was initially explored during the period 1996-2018, but ultimately was developed for 1999-2018. In addition, annual length and age compositions of Scamp and Yellowmouth Grouper captured by chevron video trap and SBLL were

produced. This information is critical at informing the selectivity pattern at age of Scamp and Yellowmouth Grouper by these gears. Data presented in this report are based on the combined SERFS database accessed on January 23, 2020.

Methods

Survey Design and Gear

(see Smart et al. 2015 for full description)

Sampling area

- Cape Hatteras, NC, to St. Lucie Inlet, FL

Sampling season

- May through September
  - Limited earlier and later sampling in some years

Survey Design

- Simple random sample survey design
  - Randomly selected stations from chevron video trap or SBLL universes of confirmed live-bottom and/or hard-bottom habitat stations annually
  - No two stations are randomly selected that are closer than 200 m from each other
    - Minimum distance is typically closer to 400 m
- Gear deployed on suspected live-bottom and/or hard-bottom in a given year (reconnaissance) are evaluated based on catch and/or video or photographic evidence of bottom type for inclusion in the universe in subsequent years
  - If added to the known habitat universe, data from the reconnaissance deployment is included in index development

Sampling Gear – Chevron Traps

(see Collins 1990 and MARMAP 2009 for more detailed descriptions)

- Arrowhead shaped, with a total interior volume of 0.91 m^3
- Constructed of 35 x 35 mm square mesh plastic-coated wire with a single entrance funnel (“horse neck”)
- Baited with a combination of whole or cut clupeids (*Brevoortia* or *Alosa* spp., family Clupeidae), with *Brevoortia* spp. most often used
  - Four whole clupeids on each of four stringers suspended within the trap
  - Approximately 8 clupeids placed loose in the trap
- Deployed on low to moderate bottom relief and in depths ranging from 13 to 109 m
- Soak time of approximately 90 minutes
- Daylight hours

Sampling Gear – Short Bottom Longline

(see MARMAP 2009 and Smart et al. 2015 for more detailed descriptions)

- Groundline consists of 25.6 m of 6.4 mm diameter treated solid braid Dacron (polyester) dipped in green copper naphthenate
- 20 gangions, consisting of an AK snap, 0.5 m of 90 kg monofilament and a non-offset circle hook (14/0) are attached to the groundline at approximately 1.2 m intervals
- Baited with a whole squid (*Illex* sp. or *Loligo* sp.)
- Deployed on moderate to high relief bottom, in depths ranging from 65 to 360 m, with most stations deeper than 100 m
- Soak time of approximately 90 minutes
- Daylight hours

Oceanographic Data

- Hydrographic data collected via CTD during soaking of a "set" (typically 6 gear deployments, but may be less) deployed at the same time and same reef patch
    - Bottom temperature (°C) is defined as the temperature of the deepest recording within 5 m of the bottom

Data Filtering/Inclusion (provided to allow for reproduction of this data set from the SERFS database)

- The information provided below allows for a reproduction this data set from the SERFS database

Chevron video trap (Gear = 324) and SBLL (Gear = 061) data were limited to:

- Projects conducting monitoring efforts
    - P05 – MARMAP
    - T59 – SEAMAP-SA
    - T60 – SEFIS
- Reef fish monitoring samples
    - Data source ≠ "Tag-MARMAP" – represents special historic MARMAP cruises that were used to tag various species of fish
        - Because standard sampling procedures were not consistently used (e.g. not all fish were measured for length frequency) these samples are excluded from index development
- Gear that fished properly (i.e., appropriate catch IDs)
    - 0 – no catch
    - 1 – catch with finfish
    - 2 – catch without finfish
    - 8 - Species catch subsampled for Length Frequency
- Gear on live-bottom and/or hard-bottom habitat (i.e., appropriate station types)
    - Random –randomly-selected live-bottom stations
    - NonRandom – non-randomly sampled live-bottom station (a.k.a haphazard or opportunistic sample)
    - ReconConv – reconnaissance deployments that were subsequently converted into live-bottom chevron video trap or SBLL stations
    - Null – traps for which there is no station type value
        - Use of station codes is fairly new, with MARMAP historically using only the catch ID (see above) to indicate randomly-selected stations

    - Monitoring - Station whose sampling selection (random, nonrandom) is not known, but is part of overall station universe
- Gear with soak times that were neither extremely short nor long which often indicates an issue with the deployment not captured elsewhere (included 45-150 minutes)
    - MARMAP/SERFS targets a soak time of 90 minutes for all chevron video trap and SBLL deployments
- Excluded any gear deployment in which samples were missing covariate information
- Excluded all chevron traps sampled prior to 1990 and SBLL sampled prior to 1996 due to inconsistent fishing protocol previously

Standardized Index Model Formulation

- Response variable
    - Catch (by number of fish) per gear deployment
- Offset term
    - Soak time
- Dependent variables
    - Year
    - Covariates
        - 4 covariates explored
            - Depth – Continuous variable
            - Latitude (°N) - Continuous variable
            - Bottom temperature (°C) - Continuous variable
            - Day of year (DOY) - Continuous variable
        - Modelled with polynomials
            - Maximum allowed polynomial order set using preliminary generalized additive models (GAMs)
                - Limited polynomial to maximum of fourth order for biological relevance
        - Due to widely differing scales, the covariates were centered and scaled
            - Centered – subtract covariate mean
            - Scaled – divided centered values by their standard deviation prior to the GAMs
- Model structure – Zero-inflated negative binomial, zero-inflated Poisson, negative binomial, and Poisson error distributions were explored
    - Mixture model for both zero-inflated error structures
    - Two parts to the model, with Bayesian Information Criteria (BIC) used to select the best model from each of the 2 zero-inflated error distributions
        - Presence/absence (binomial sub-model)
        - Catch (count sub-model)
    - Sub-models optimized using a two-step approach due to computational demands
        - Count sub-model was optimized with all covariates removed from the zero-inflation (binomial) sub-model

        - Binomial sub-model was optimized using fixed count sub-model covariates obtained in previous step
        - Allows for different covariates to be included in the two sub-models
    - Bayesian Information Criteria (BIC) also used to select the best model from the negative binomial and Poisson error distribution models
    - Final model was selected amongst the best models from each of the 4 error distributions using BIC
- Annual year effect coefficients of variation (CVs) and standard errors (SE) computed using bootstrapping
    - 5,000 bootstraps
- Software used
    - R (Version 3.6.0; R Core Team 2019)

Age Composition

(see Smart et al. 2015 for more detailed descriptions)

- Aging methods – sagittal otoliths were removed from all fish to serve as the aging structure
    - Ages presented here are calendar age based on increment counts with an estimated increment formation on August 1
    - Only fish caught in chevron video traps or SBLL that had age samples taken were included in the age compositions
    - Age compositions were produced independently for each gear

Length Composition

- Lengths presented here are fork length (FL) in 10 mm bins centered around the integer
    - Meristic conversions from maximum total length (TL) where needed were calculated in mm using this equation developed from the SERFS database
        - FL = 0.8788*TL + 23.1993, r2 = 0.99, n = 4,402 (Bubley et al. 2019)
- All measured fish were included in the length compositions
- Length compositions were produced independently for each gear

Results

Chevron Video Trap

Sampling Area

- Gradual shift regarding the spatial density of samples through time (Table 1 and Fig. 1)
    - More dense geographic coverage in southern and northern latitudes in later years
- General increase in sampling intensity (# of annual chevron video trap deployments) through time (Table 2 and Fig. 1)
- Sampling depths range from 13 to 115 m (Table 1 and Fig. 2)
    - Generally less than 100 m

Sampling season

- May through September (Tables 1 and Fig. 2)

Data Filtering/Inclusion

- Included chevron video traps n = 18,057 (Table 2)

Standardized Index Model Formulation

- Dependent variables
  - Covariates (Inclusion and polynomial order in sub-models available Table 3)
    - The number and effect on positive and zero catches was determined (Figs. 2 and 3)
    - Count sub-model included all covariates in the final model (Table 3 and Fig. 4)
    - Binomial sub-model included depth, latitude, and temperature in the final model (Table 3 and Fig. 4)
- Model structure
  - Final model selected was ZINB (Table 3)
    - Selected over non-zero inflated models due to high proportion of zero counts (Fig. 5)
- Coefficients of variation (CVs) and variances stabilized within the 5,000 bootstraps (Fig. 6)
- Annual standardized and normalized (relative to the long-term mean) index values for Scamp and Yellowmouth Grouper, including CVs showed trends from 1990 to 2018 (Table 2 and Fig. 7)

Age Composition

- Calendar age count caught by chevron traps in 1990-2018 as both numbers and proportions (Tables 4 and 5)

Length Composition

- Binned fork length count caught by chevron traps in 1990-2018 as both numbers and proportions (Tables 6 and 7)

Short Bottom Longline

Sampling Area

- Spatial coverage consists mainly off SC and NC
- Spatial range and density of samples varied through time (Tables 8 and Fig. 8)
- Sampling depths range from 65 to 227 m (Table 8 and Fig. 9)
  - Generally greater than 100 m

Sampling season

- May through September (Table 8 and Fig. 9)

Data Filtering/Inclusion

- Included SBLL n = 893 (Table 9)
- Excluded data from 1996 to 1998 and 2012

    - 1996 had the lowest sample size in the survey (n = 12) and limited spatial extent (Table 8 and Fig. 8)
    - 1997 and 1998 had a limited spatial extent and deployments were in deeper depths than typical for the survey and deeper than any gear that have caught Scamp/Yellowmouth Grouper since MARMAP began in 1972 (Table 8 and Fig. 8)
    - 2012 was excluded due to low sample size as a result of a significant funding reduction to MARMAP in 2012 which led to limited spatial extent and deployments being in deeper depths than typical (Tables 8 and 9 and Fig. 8)

Standardized Index Model Formulation

- Dependent variables
    - Covariates (Inclusion and polynomial order in sub-models available Table 10)
        - The number and effect on positive catches and zero catches was determined (Figs. 9 and 10)
        - Depth was the only covariate included in either sub-model of the final model (Table 10 and Fig. 11)
- Model structure
    - Final model selected was ZIP (Table 10)
- Coefficients of variation (CVs) and variances stabilized within the 5,000 bootstraps (Fig. 13)
- Annual standardized and normalized (relative to the long-term mean) index values for Scamp and Yellowmouth Grouper, including CVs showed trends from 1999-2011 and 2013-2018 (Table 9 and Fig. 14)

Age Composition

- Calendar ages caught by SBLL in 1996-2018 as both numbers and proportions (Tables 11 and 12)

Length Composition

- Binned fork length count caught by SBLL in 1996-2018 as both numbers and proportions (Tables 13 and 14)

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Table 1. Sampling summary table for the MARMAP/SERFS fishery-independent chevron video trap survey. Provided are the average and range of all the covariates by year.

	Depth		Latitude		Temperature		Day of Year	
Year	**Avg**	**Range**	**Avg**	**Range**	**Avg**	**Range**	**Avg**	**Range**
1990	33.9	17-93	32.5	30.4-33.8	22	18.2-27.8	150	114-222
1991	34.1	17-95	32.6	30.8-34.6	24.9	15.9-27.5	217	163-268
1992	34	17-62	32.8	30.4-34.3	21.3	15.3-24.5	155	92-227
1993	34.9	16-94	32.4	30.4-34.3	22.8	17.8-28.5	176	131-226
1994	39.2	16-93	32.4	30.7-33.8	22.8	18.2-26.9	174	130-300
1995	33.8	16-60	32.1	29.8-33.7	24.6	20.1-28.4	198	124-299
1996	38.2	14-100	32.4	27.9-34.3	22	14.2-27.0	188	121-261
1997	39.4	15-97	32	27.9-34.6	22.6	15.0-28.0	195	126-273
1998	39.6	14-92	32.1	27.4-34.6	21.5	9.5-28.6	178	126-231
1999	35.8	15-75	32	27.3-34.6	22.9	17.9-28.8	199	153-272
2000	36.3	15-101	32.3	29.0-34.3	23.9	18.0-28.5	201	138-294
2001	38.5	14-91	32.3	27.9-34.3	23.5	16.0-29.2	204	144-298
2002	37.7	13-94	31.9	27.9-34.0	24.2	15.2-28.3	207	169-268
2003	39.8	16-92	32.1	27.4-34.3	18.9	13.4-25.1	203	155-266
2004	40.6	14-91	32.3	29.0-34.0	20.9	16.7-25.8	175	127-303
2005	38.5	15-69	32.1	27.3-34.3	23	18.0-28.5	191	124-273
2006	38.1	15-94	32.3	27.3-34.4	22.4	15.0-26.6	203	158-272
2007	37.9	15-92	32.2	27.3-34.3	23.2	15.3-28.9	201	142-268
2008	38	15-92	32.2	27.3-34.6	21.9	15.2-27.2	195	127-275
2009	36.3	14-91	32.2	27.3-34.6	22.6	15.4-27.2	203	127-282
2010	38.5	14-92	31.4	27.3-34.6	22.2	12.3-29.4	221	125-301
2011	40.7	14-93	30.9	27.2-34.5	21.6	14.8-28.8	210	140-300
2012	40.8	15-106	31.9	27.2-35.0	22.1	12.9-27.8	195	116-285
2013	38.2	15-110	31.3	27.2-35.0	22.1	12.4-28.1	197	115-278
2014	39.2	15-110	31.9	27.2-35.0	23.3	16.1-29.3	192	114-295
2015	39.2	16-110	31.9	27.3-35.0	22.6	13.6-28.4	187	112-296
2016	40.9	17-115	32.1	27.2-35.0	23.8	15.5-29.3	217	126-302
2017	40.5	15-114	32	27.2-35.0	22.6	14.8-28.2	187	117-273
2018	40.3	16-114	32	27.2-35.0	22.5	13.6-28.4	177	116-278

Table 2. The annual summary of chevron video trap data informative to index development and the results of the standardization. The data include number of collections included in index development, the number of positive collections for Scamp and Yellowmouth Grouper, the proportion of those positive collections in relation to the included collections, the total number of Scamp and Yellowmouth Grouper caught, and these totals for the survey. The results show the normalized nominal and standardized chevron video trap catch of Scamp and Yellowmouth Grouper from the MARMAP/SERFS fishery-independent chevron video trap survey which meet criteria to be included in the standardization process. The zero-inflated negative binomial (ZINB) standardized catch also includes a coefficient of variation (CV) calculated from a bootstrapping procedure.

					Nominal CPUE	ZINB Standardized CPUE	
Year	Included Collections	Positive Collections	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	313	32	0.1	63	1.34	1.33	0.17
1991	272	30	0.11	48	1.18	1.17	0.17
1992	288	29	0.1	49	1.13	1.42	0.19
1993	392	41	0.1	72	1.22	1.53	0.17
1994	387	71	0.18	127	2.19	1.41	0.12
1995	361	52	0.14	117	2.16	2.1	0.14
1996	361	41	0.11	69	1.27	1.35	0.16
1997	406	69	0.17	162	2.66	2.1	0.12
1998	426	51	0.12	120	1.88	1.87	0.15
1999	233	25	0.11	49	1.4	1.24	0.22
2000	298	43	0.14	60	1.34	1.2	0.16
2001	245	35	0.14	60	1.63	1.16	0.17
2002	244	25	0.1	37	1.01	1	0.22
2003	224	24	0.11	41	1.22	1.63	0.22
2004	282	36	0.13	54	1.28	1.64	0.19
2005	303	33	0.11	61	1.34	1.23	0.17
2006	297	10	0.03	15	0.34	0.36	0.34
2007	337	40	0.12	61	1.21	0.96	0.16
2008	303	10	0.03	13	0.29	0.28	0.33
2009	404	12	0.03	17	0.28	0.35	0.32
2010	725	31	0.04	47	0.43	0.74	0.2
2011	726	27	0.04	30	0.28	0.37	0.2
2012	1,174	42	0.04	58	0.33	0.55	0.18
2013	1,360	49	0.04	55	0.27	0.4	0.15
2014	1,472	53	0.04	72	0.33	0.38	0.18
2015	1,463	55	0.04	70	0.32	0.41	0.15
2016	1,484	41	0.03	51	0.23	0.22	0.16
2017	1,541	58	0.04	72	0.31	0.38	0.14
2018	1,736	29	0.02	39	0.15	0.19	0.2
Totals	18,057	1,094	0.06	1,789			

Table 3. Model structure comparison for chevron video trap catches, including covariates that were included and their polynomial level for both the count and binomial sub-models. Polynomial values of "0" indicate that the covariate was not included in the final model. Negative binomial and Poisson models only had the count sub-model. The best model (highlighted) was chosen based on Bayesian Information Criteria (BIC).

	Count Sub-model					Binomial Sub-model				
Model Error Structure	**Year**	**Lat**	**Depth**	**Temp**	**DOY**	**Lat**	**Depth**	**Temp**	**DOY**	**BIC**
Zero-Inflated Negative Binomial	1	3	3	2	2	3	1	1	0	9,002
Negative Binomial	1	3	3	2	2	—	—	—	—	9,129
Zero-Inflated Poisson	1	3	3	2	2	1	3	1	0	9,139
Poisson	1	3	3	2	2	—	—	—	—	10,023

Table 4. Annual age composition by calendar age of Scamp and Yellowmouth Grouper caught in the MARMAP/SERFS fishery-independent chevron video trap survey. Total fish caught and positive deployments are summarized by year.

Calendar Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	0	1	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
2	1	0	5	6	5	2	4	3	1	1	4	2	6	3	1	0	0	1	1	0	1	0	0	0	7	5	0	5	1
3	3	5	3	10	8	10	19	20	4	4	4	6	6	19	13	2	1	3	1	4	3	2	2	2	13	15	3	3	3
4	7	13	10	16	47	11	23	70	32	12	3	18	7	4	21	18	6	1	0	1	12	3	5	1	10	10	9	11	0
5	9	15	13	22	16	48	21	46	41	21	18	4	10	6	4	21	5	16	2	0	7	8	13	8	6	3	5	10	5
6	0	12	5	7	17	11	37	15	18	16	19	8	2	3	8	4	2	18	3	2	3	3	2	20	6	4	3	6	6
7	1	1	8	8	15	16	6	23	9	3	7	11	5	1	4	5	2	8	2	2	8	2	1	9	11	6	2	4	5
8	0	3	1	1	8	11	8	3	9	1	2	6	6	1	3	0	0	2	2	3	5	5	1	4	2	8	10	3	6
9	0	0	2	1	0	2	9	5	3	1	3	3	6	3	3	2	0	2	0	3	8	10	2	1	2	4	4	8	1
10	0	2	0	0	3	0	3	2	1	0	0	2	0	0	1	5	0	4	0	1	4	1	10	3	1	0	1	3	5
11	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	1	0	1	0	0	0	0	9	3	1	1	0	2	8
12	0	0	2	0	0	0	0	0	2	1	0	0	0	0	0	3	0	1	1	0	1	1	9	5	4	4	1	2	0
13	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	2	0	0	2	1	1	3	1	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	1	4	4	7	2	0
15	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	1	0	0	1	1	3	2	4	6	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	1	2	0	2	1
17	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	1
18	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
22	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Deployments	13	33	31	43	69	50	68	87	53	32	44	38	33	27	40	33	11	40	11	12	36	31	46	53	55	57	43	57	33
Fish	21	53	51	73	121	111	130	191	122	60	61	60	50	42	59	61	16	59	13	17	54	35	62	63	74	72	53	71	42

Table 5. Percentage of annual age composition by calendar age of Scamp and Yellowmouth Grouper caught in the MARMAP/SERFS fishery-independent chevron video trap survey. Total fish caught and positive deployments are summarized by year.

Calendar Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	0.0	1.9	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.4	0.0	0.0	0.0	0.0
2	4.8	0.0	9.8	8.2	4.1	1.8	3.1	1.6	0.8	1.7	6.6	3.3	12.0	7.1	1.7	0.0	0.0	1.7	7.7	0.0	1.9	0.0	0.0	0.0	9.5	6.9	0.0	7.0	2.4
3	14.3	9.4	5.9	13.7	6.6	9.0	14.6	10.5	3.3	6.7	6.6	10.0	12.0	45.2	22.0	3.3	6.3	5.1	7.7	23.5	5.6	5.7	3.2	3.2	17.6	20.8	5.7	4.2	7.1
4	33.3	24.5	19.6	21.9	38.8	9.9	17.7	36.6	26.2	20.0	4.9	30.0	14.0	9.5	35.6	29.5	37.5	1.7	0.0	5.9	22.2	8.6	8.1	1.6	13.5	13.9	17.0	15.5	0.0
5	42.9	28.3	25.5	30.1	13.2	43.2	16.2	24.1	33.6	35.0	29.5	6.7	20.0	14.3	6.8	34.4	31.3	27.1	15.4	0.0	13.0	22.9	21.0	12.7	8.1	4.2	9.4	14.1	11.9
6	0.0	22.6	9.8	9.6	14.0	9.9	28.5	7.9	14.8	26.7	31.1	13.3	4.0	7.1	13.6	6.6	12.5	30.5	23.1	11.8	5.6	8.6	3.2	31.7	8.1	5.6	5.7	8.5	14.3
7	4.8	1.9	15.7	11.0	12.4	14.4	4.6	12.0	7.4	5.0	11.5	18.3	10.0	2.4	6.8	8.2	12.5	13.6	15.4	11.8	14.8	5.7	1.6	14.3	14.9	8.3	3.8	5.6	11.9
8	0.0	5.7	2.0	1.4	6.6	9.9	6.2	1.6	7.4	1.7	3.3	10.0	12.0	2.4	5.1	0.0	0.0	3.4	15.4	17.6	9.3	14.3	1.6	6.3	2.7	11.1	18.9	4.2	14.3
9	0.0	0.0	3.9	1.4	0.0	1.8	6.9	2.6	2.5	1.7	4.9	5.0	12.0	7.1	5.1	3.3	0.0	3.4	0.0	17.6	14.8	28.6	3.2	1.6	2.7	5.6	7.5	11.3	2.4
10	0.0	3.8	0.0	0.0	2.5	0.0	2.3	1.0	0.8	0.0	0.0	3.3	0.0	0.0	1.7	8.2	0.0	6.8	0.0	5.9	7.4	2.9	16.1	4.8	1.4	0.0	1.9	4.2	11.9
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	1.7	0.0	0.0	0.0	0.0	14.5	4.8	1.4	1.4	0.0	2.8	19.0
12	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	1.6	1.7	0.0	0.0	0.0	0.0	0.0	4.9	0.0	1.7	7.7	0.0	1.9	2.9	14.5	7.9	5.4	5.6	1.9	2.8	0.0
13	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.5	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	3.7	0.0	0.0	3.2	1.4	1.4	5.7	1.4	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7	0.0	0.0	0.0	3.2	1.6	5.4	5.6	13.2	2.8	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	0.0	0.0	1.6	1.6	4.1	2.8	7.5	8.5	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	3.2	0.0	1.4	2.8	0.0	2.8	2.4
17	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	2.8	2.4
18	0.0	1.9	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	1.4	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	1.4	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	1.4	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0
Deployments	13	33	31	43	69	50	68	87	53	32	44	38	33	27	40	33	11	40	11	12	36	31	46	53	55	57	43	57	33
Fish	21	53	51	73	121	111	130	191	122	60	61	60	50	42	59	61	16	59	13	17	54	35	62	63	74	72	53	71	42

Table 6. Annual length composition in fork length of Scamp and Yellowmouth Grouper caught in the MARMAP/SERFS fishery-independent chevron video trap survey by centered cm bins. Total fish caught and positive deployments are summarized by year.

Fork Length	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
230	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
250	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
260	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
270	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
280	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
290	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
300	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
310	0	0	1	1	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
320	0	0	1	0	1	0	4	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0
330	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	1	1	0	0	0	0
340	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0
350	1	0	1	2	0	1	0	1	1	1	0	0	3	1	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0
360	0	1	1	0	0	0	2	2	1	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
370	0	1	3	2	3	0	5	8	3	0	2	1	1	3	3	1	0	0	1	0	1	0	0	0	2	1	0	2	0
380	4	1	0	1	0	7	4	6	0	1	1	0	0	2	2	2	0	0	0	0	1	0	0	0	0	2	0	3	0
390	1	0	0	2	1	1	4	7	1	1	1	1	1	4	1	1	3	1	0	0	1	0	1	0	2	0	0	1	0
400	4	1	1	1	5	3	6	11	3	4	1	4	0	4	3	0	1	0	0	1	1	0	0	0	3	1	0	1	0
410	1	2	1	0	8	3	11	14	2	2	0	1	0	1	3	1	2	2	1	0	0	0	0	0	3	0	2	1	0
420	3	2	0	1	6	3	4	11	2	3	2	1	0	1	1	0	1	1	0	1	0	0	0	0	1	3	0	0	0
430	4	1	2	3	4	6	4	8	4	0	1	2	2	2	1	4	0	2	0	1	1	2	1	1	1	0	0	0	0
440	2	0	2	2	5	6	3	15	10	2	2	2	2	0	1	2	0	2	0	2	3	0	0	0	4	2	0	1	1
450	8	2	9	3	11	12	9	15	20	9	4	9	3	5	4	8	1	5	0	0	1	1	2	1	6	7	1	1	0
460	3	3	0	6	10	4	4	14	10	5	2	4	3	2	2	6	1	5	1	0	3	1	4	0	4	1	1	1	1
470	2	1	2	6	3	5	2	9	5	4	2	2	3	1	6	4	1	0	1	0	1	3	0	2	0	3	2	1	1
480	1	2	0	9	5	4	3	6	7	2	4	4	1	1	4	0	2	7	1	0	2	1	0	2	2	2	2	1	1
490	7	3	2	5	5	8	4	12	4	4	3	4	1	0	2	4	0	1	0	0	2	1	2	2	1	1	2	5	0
500	4	2	3	3	3	4	6	4	5	4	3	5	2	2	1	3	0	3	0	0	2	3	6	3	2	3	2	3	1
510	3	5	2	2	4	2	8	3	7	2	4	3	4	1	1	2	0	1	1	2	4	3	0	5	2	3	3	0	2
520	5	4	4	5	11	11	10	7	5	5	8	8	3	1	2	5	1	3	0	0	3	1	8	6	3	5	4	7	5
530	1	2	2	1	2	3	7	2	8	1	2	0	1	0	3	0	0	3	2	2	1	2	2	7	4	1	0	2	1
540	0	2	1	2	2	4	3	3	3	0	2	1	1	2	3	2	0	3	0	0	1	1	1	2	0	3	4	4	2
550	2	1	2	1	4	5	4	4	3	0	2	2	1	1	0	4	0	1	0	0	2	1	2	0	1	2	0	4	2
560	1	4	1	1	2	0	4	5	3	2	0	2	0	0	0	3	0	3	0	2	1	0	1	0	1	0	4	2	0
570	1	1	2	1	4	3	4	1	1	1	2	1	0	0	0	1	2	1	2	0	0	2	2	4	1	1	3	1	1
580	1	1	0	2	2	4	4	4	2	2	3	1	2	1	1	1	0	2	0	1	4	3	2	2	1	2	0	4	2
590	2	0	2	2	2	2	3	7	5	1	4	1	2	1	3	2	0	3	1	0	1	1	4	2	3	1	2	2	3
600	1	3	2	1	2	1	1	3	1	0	2	1	3	0	0	2	0	0	0	1	1	0	0	3	2	2	0	2	1
610	1	0	2	0	4	4	1	1	1	1	2	0	1	0	1	0	0	0	0	0	1	1	1	6	4	5	1	2	7
620	0	1	0	0	2	1	1	2	1	0	0	0	0	0	1	0	0	3	1	0	3	1	3	1	0	5	0	1	2
630	0	1	0	1	2	4	3	1	1	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	2	2	1
640	2	2	0	0	1	2	1	1	0	0	0	1	2	1	1	1	0	2	0	1	0	0	4	2	0	2	4	0	1
650	0	1	0	1	3	0	1	0	0	1	0	1	1	0	0	0	0	1	0	1	5	2	0	2	2	3	1	2	0
660	1	1	1	0	2	3	4	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	2	1	0	0	1	3	0
670	1	0	1	0	2	1	4	2	0	0	0	0	0	1	1	3	0	2	0	0	3	0	3	3	2	1	4	3	0
680	0	1	1	0	1	0	2	0	2	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	2	0	0	1	0
690	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	2	0	2	1	1	2	1	2	0
700	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1
710	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	2	2	0	1	0	1
720	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2	2	0	0	1	0	1	1
730	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	2	1	0	0	1	0	0	1	1
740	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	4	1	0	0	2
750	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
760	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
770	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	2	0
780	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0
790	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
800	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	2	1	0
810	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
820	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
830	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
840	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
880	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Deployments	35	35	33	44	71	52	71	87	53	32	46	39	33	27	40	35	11	41	11	13	37	31	46	53	55	57	43	58	33
Fish	68	55	55	75	127	117	140	195	123	60	63	64	51	44	59	63	16	62	14	18	56	36	62	63	74	72	53	72	43

Table 7. Percentage of annual length composition in fork length of Scamp and Yellowmouth Grouper caught in the MARMAP/SERFS fishery-independent chevron video trap survey. Total fish caught and positive deployments are summarized by year.

Fork Length	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
230	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
250	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
260	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0
270	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0
280	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
290	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.3	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
300	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
310	0.0	0.0	1.8	1.3	2.4	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0
320	0.0	0.0	1.8	0.0	0.8	0.0	2.9	0.5	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	1.9	0.0	0.0
330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.3	1.7	1.6	0.0	1.6	0.0	0.0	0.0	0.0	0.0	1.6	1.4	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	0.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
350	1.5	0.0	1.8	2.7	0.0	0.9	0.0	0.5	0.8	1.7	0.0	0.0	5.9	2.3	1.7	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	1.4	0.0	0.0	0.0	0.0
360	0.0	1.8	1.8	0.0	0.0	0.0	1.4	1.0	0.8	0.0	0.0	1.6	5.9	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
370	0.0	1.8	5.5	2.7	2.4	0.0	3.6	4.1	2.4	0.0	3.2	1.6	2.0	6.8	5.1	1.6	0.0	0.0	7.1	0.0	1.8	0.0	0.0	0.0	2.7	1.4	0.0	2.8	0.0
380	5.9	1.8	0.0	1.3	0.0	6.0	2.9	3.1	0.0	1.7	1.6	0.0	0.0	4.5	3.4	3.2	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	2.8	0.0	4.2	0.0
390	1.5	0.0	0.0	2.7	0.8	0.9	2.9	3.6	0.8	1.7	1.6	1.6	2.0	9.1	1.7	1.6	18.8	1.6	0.0	0.0	1.8	0.0	1.6	0.0	2.7	0.0	0.0	1.4	0.0
400	5.9	1.8	1.8	1.3	3.9	2.6	4.3	5.6	2.4	6.7	1.6	6.3	0.0	9.1	5.1	0.0	6.3	0.0	0.0	5.6	1.8	0.0	0.0	0.0	4.1	1.4	0.0	1.4	0.0
410	1.5	3.6	1.8	0.0	6.3	2.6	7.9	7.2	1.6	3.3	0.0	1.6	0.0	2.3	5.1	1.6	12.5	3.2	7.1	0.0	0.0	0.0	0.0	0.0	4.1	0.0	3.8	1.4	0.0
420	4.4	3.6	0.0	1.3	4.7	2.6	2.9	5.6	1.6	5.0	3.2	1.6	0.0	2.3	1.7	0.0	6.3	1.6	0.0	5.6	0.0	0.0	0.0	0.0	1.4	4.2	0.0	0.0	0.0
430	5.9	1.8	3.6	4.0	3.1	5.1	2.9	4.1	3.3	0.0	1.6	3.1	3.9	4.5	1.7	6.3	0.0	3.2	0.0	5.6	1.8	5.6	1.6	1.6	1.4	0.0	0.0	0.0	0.0
440	2.9	0.0	3.6	2.7	3.9	5.1	2.1	7.7	8.1	3.3	3.2	3.1	3.9	0.0	1.7	3.2	0.0	3.2	0.0	11.1	5.4	0.0	0.0	0.0	5.4	2.8	0.0	1.4	2.3
450	11.8	3.6	16.4	4.0	8.7	10.3	6.4	7.7	16.3	15.0	6.3	14.1	5.9	11.4	6.8	12.7	6.3	8.1	0.0	0.0	1.8	2.8	3.2	1.6	8.1	9.7	1.9	1.4	0.0
460	4.4	5.5	0.0	8.0	7.9	3.4	2.9	7.2	8.1	8.3	3.2	6.3	5.9	4.5	3.4	9.5	6.3	8.1	7.1	0.0	5.4	2.8	6.5	0.0	5.4	1.4	1.9	1.4	2.3
470	2.9	1.8	3.6	8.0	2.4	4.3	1.4	4.6	4.1	6.7	3.2	3.1	5.9	2.3	10.2	6.3	6.3	0.0	7.1	0.0	1.8	8.3	0.0	3.2	0.0	4.2	3.8	1.4	2.3
480	1.5	3.6	0.0	12.0	3.9	3.4	2.1	3.1	5.7	3.3	6.3	6.3	2.0	2.3	6.8	0.0	12.5	11.3	7.1	0.0	3.6	2.8	0.0	3.2	2.7	2.8	3.8	1.4	2.3
490	10.3	5.5	3.6	6.7	3.9	6.8	2.9	6.2	3.3	6.7	4.8	6.3	2.0	0.0	3.4	6.3	0.0	1.6	0.0	0.0	3.6	2.8	3.2	3.2	1.4	1.4	3.8	6.9	0.0
500	5.9	3.6	5.5	4.0	2.4	3.4	4.3	2.1	4.1	6.7	4.8	7.8	3.9	4.5	1.7	4.8	0.0	4.8	0.0	0.0	3.6	8.3	9.7	4.8	2.7	4.2	3.8	4.2	2.3
510	4.4	9.1	3.6	2.7	3.1	1.7	5.7	1.5	5.7	3.3	6.3	4.7	7.8	2.3	1.7	3.2	0.0	1.6	7.1	11.1	7.1	8.3	0.0	7.9	2.7	4.2	5.7	0.0	4.7
520	7.4	7.3	7.3	6.7	8.7	9.4	7.1	3.6	4.1	8.3	12.7	12.5	5.9	2.3	3.4	7.9	6.3	4.8	0.0	0.0	5.4	2.8	12.9	9.5	4.1	6.9	7.5	9.7	11.6
530	1.5	3.6	3.6	1.3	1.6	2.6	5.0	1.0	6.5	1.7	3.2	0.0	2.0	0.0	5.1	0.0	0.0	4.8	14.3	11.1	1.8	5.6	3.2	11.1	5.4	1.4	0.0	2.8	2.3
540	0.0	3.6	1.8	2.7	1.6	3.4	2.1	1.5	2.4	0.0	3.2	1.6	2.0	4.5	5.1	3.2	0.0	4.8	0.0	0.0	1.8	2.8	1.6	3.2	0.0	4.2	7.5	5.6	4.7
550	2.9	1.8	3.6	1.3	3.1	4.3	2.9	2.1	2.4	0.0	3.2	3.1	2.0	2.3	0.0	6.3	0.0	1.6	0.0	0.0	3.6	2.8	3.2	0.0	1.4	2.8	0.0	5.6	4.7
560	1.5	7.3	1.8	1.3	1.6	0.0	2.9	2.6	2.4	3.3	0.0	3.1	0.0	0.0	0.0	4.8	0.0	4.8	0.0	11.1	1.8	0.0	1.6	0.0	1.4	0.0	7.5	2.8	0.0
570	1.5	1.8	3.6	1.3	3.1	2.6	2.9	0.5	0.8	1.7	3.2	1.6	0.0	0.0	0.0	1.6	12.5	1.6	14.3	0.0	0.0	5.6	3.2	6.3	1.4	1.4	5.7	1.4	2.3
580	1.5	1.8	0.0	2.7	1.6	3.4	2.9	2.1	1.6	3.3	4.8	1.6	3.9	2.3	1.7	1.6	0.0	3.2	0.0	5.6	7.1	8.3	3.2	3.2	1.4	2.8	0.0	5.6	4.7
590	2.9	0.0	3.6	2.7	1.6	1.7	2.1	3.6	4.1	1.7	6.3	1.6	3.9	2.3	5.1	3.2	0.0	4.8	7.1	0.0	1.8	2.8	6.5	3.2	4.1	1.4	3.8	2.8	7.0
600	1.5	5.5	3.6	1.3	1.6	0.9	0.7	1.5	0.8	0.0	3.2	1.6	5.9	0.0	0.0	3.2	0.0	0.0	0.0	5.6	1.8	0.0	0.0	4.8	2.7	2.8	0.0	2.8	2.3
610	1.5	0.0	3.6	0.0	3.1	3.4	0.7	0.5	0.8	1.7	3.2	0.0	2.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	1.8	2.8	1.6	9.5	5.4	6.9	1.9	2.8	16.3
620	0.0	1.8	0.0	0.0	1.6	0.9	0.7	1.0	0.8	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	4.8	7.1	0.0	5.4	2.8	4.8	1.6	0.0	6.9	0.0	1.4	4.7
630	0.0	1.8	0.0	1.3	1.6	3.4	2.1	0.5	0.8	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	2.8	1.6	1.6	0.0	0.0	3.8	2.8	2.3
640	2.9	3.6	0.0	0.0	0.8	1.7	0.7	0.5	0.0	0.0	0.0	1.6	3.9	2.3	1.7	1.6	0.0	3.2	0.0	5.6	0.0	0.0	6.5	3.2	0.0	2.8	7.5	0.0	2.3
650	0.0	1.8	0.0	1.3	2.4	0.0	0.7	0.0	0.0	1.7	0.0	1.6	2.0	0.0	0.0	0.0	0.0	1.6	0.0	5.6	8.9	5.6	0.0	3.2	2.7	4.2	1.9	2.8	0.0
660	1.5	1.8	1.8	0.0	1.6	2.6	2.9	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0	3.2	1.6	0.0	0.0	1.9	4.2	0.0
670	1.5	0.0	1.8	0.0	1.6	0.9	2.9	1.0	0.0	0.0	0.0	0.0	0.0	2.3	1.7	4.8	0.0	3.2	0.0	0.0	5.4	0.0	4.8	4.8	2.7	1.4	7.5	4.2	0.0
680	0.0	1.8	1.8	0.0	0.8	0.0	1.4	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	1.8	0.0	0.0	1.6	2.7	0.0	0.0	1.4	0.0
690	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	1.6	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	3.2	1.6	1.4	2.8	1.9	2.8	0.0
700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.7	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	1.4	0.0	1.9	0.0	2.3
710	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0	0.0	3.2	2.7	0.0	1.9	0.0	2.3
720	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	3.2	0.0	0.0	1.4	0.0	1.4	2.3
730	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1	0.0	3.6	2.8	0.0	0.0	1.4	0.0	0.0	1.4	2.3
740	0.0	1.8	1.8	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	0.0	5.4	1.4	0.0	0.0	4.7
750	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.9	1.4	0.0
760	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	1.6	0.0	0.0	0.0	0.0	0.0	0.0
770	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	2.8	0.0
780	0.0	0.0	1.8	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	1.4	1.4	0.0	0.0	2.3
790	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0
800	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	3.8	1.4	0.0
810	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.4	0.0	0.0
820	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0
830	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
840	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0
880	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Deployments	35	35	33	44	71	52	71	87	53	32	46	39	33	27	40	35	11	41	11	13	37	31	46	53	55	57	43	58	33
Fish	68	55	55	75	127	117	140	195	123	60	63	64	51	44	59	63	16	62	14	18	56	36	62	63	74	72	53	72	43

Table 8. Sampling summary table for the MARMAP/SERFS fishery-independent short bottom longline survey. Provided are the average and range of all the covariates by year.

	Depth		Latitude		Temperature		Day of Year	
Year	**Avg**	**Range**	**Avg**	**Range**	**Avg**	**Range**	**Avg**	**Range**
1996	159.0	79-217	32.4	32.1-32.7	14.2	7.9-20.8	206	124-236
1997	194.8	184-216	32.6	32.5-32.7	15.6	14.2-16.3	261	260-262
1998	192.4	174-220	32.7	32.5-32.9	11.3	8.9-15.4	181	126-232
1999	119.3	73-198	33.4	32.5-34.2	18.3	14.5-21.2	191	159-273
2000	160	70-198	32.9	32.5-33.9	16	12.8-23.7	212	173-230
2001	158	75-212	33.1	32.5-34.2	15.4	11.2-20.0	216	171-264
2002	85.8	71-113	32.9	32.1-33.4	17.4	16.4-18.6	194	191-200
2003	165.2	88-210	32.7	32.2-33.2	12.7	10.8-17.2	229	198-239
2004	131.6	72-215	32.1	32.1-32.3	15.5	11.6-18.4	167	128-219
2005	114	69-208	33.1	32.1-33.8	17.3	13.6-21.3	181	140-203
2006	153.8	65-219	33	32.5-34.2	12.9	9.8-18.6	205	174-271
2007	102.2	71-201	33.2	32.1-33.9	19.4	12.5-22.7	189	159-236
2008	152.8	72-198	32.5	32.1-32.7	16.8	15.1-20.4	220	172-242
2009	102.1	71-200	33.1	32.1-34.2	18.5	12.8-24.7	235	217-261
2010	128.4	66-205	32.7	32.1-33.8	14.6	10.2-18.8	170	127-266
2011	123.5	66-227	33	32.1-34.2	15.1	8.6-19.9	188	145-243
2012	173.8	71-201	32.9	32.7-34.6	14.7	13.7-22.6	218	197-244
2013	137.2	83-210	33.2	32.5-33.8	16.4	10.3-20.6	207	176-234
2014	148.3	72-212	32.8	32.1-33.8	16	12.7-20.9	198	128-282
2015	155.1	65-225	32.8	32.1-34.2	14.6	9.9-19.7	226	140-284
2016	144.7	72-218	32.7	32.1-33.5	14.1	10.6-20.0	270	225-295
2017	103.7	72-203	32.9	32.1-33.8	19.7	13.6-26.2	199	173-223
2018	145.3	65-211	32.8	32.3-33.8	14.8	10.6-22.0	185	125-243

Table 9. The annual summary of short bottom longline data informative to index development and the results of the standardization. The data include number of collections included in index development, the number of positive collections for Scamp and Yellowmouth Grouper, the proportion of those positive collections in relation to the included collections, the total number of Scamp and Yellowmouth Grouper caught, and these totals for the survey. The results show the normalized nominal and standardized short bottom longline catch of Scamp and Yellowmouth Grouper from the MARMAP/SERFS fishery-independent short bottom longline survey which meet criteria to be included in the standardization process. The zero-inflated Poisson (ZIP) standardized catch also includes a coefficient of variation (CV) calculated from a bootstrapping procedure. Excluded years from index development are 1996-1998 and 2012.

					Nominal CPUE	ZIP Standardized CPUE	
Year	Included Collections	Positive Collections	Proportion Positive	Total Fish	Normalized	Normalized	CV
1996	12	1	0.08	1	—	—	—
1997	33	0	0	0	—	—	—
1998	31	0	0	0	—	—	—
1999	36	10	0.28	19	1.85	1.4	0.32
2000	34	1	0.03	2	0.21	0.49	0.76
2001	29	9	0.31	32	3.88	4.17	0.21
2002	19	4	0.21	9	1.66	1.47	0.56
2003	51	5	0.1	8	0.55	1	0.39
2004	21	3	0.14	3	0.5	0.51	0.48
2005	42	9	0.21	11	0.92	0.65	0.3
2006	50	10	0.2	18	1.26	1.62	0.26
2007	52	17	0.33	27	1.82	1.14	0.24
2008	29	3	0.1	3	0.36	0.83	0.45
2009	43	9	0.21	11	0.9	0.57	0.3
2010	77	7	0.09	8	0.36	0.32	0.34
2011	61	13	0.21	23	1.32	1.17	0.27
2012	21	0	0	0	—	—	—
2013	41	7	0.17	14	1.2	1.11	0.48
2014	57	6	0.11	9	0.55	0.88	0.34
2015	75	4	0.05	5	0.23	0.45	0.44
2016	62	6	0.1	8	0.45	0.57	0.37
2017	48	9	0.19	10	0.73	0.43	0.31
2018	66	4	0.06	4	0.21	0.21	0.43
Totals	990	136	0.14	225			

Table 10. Model structure comparison for short bottom longline catches, including covariates that were included and their polynomial level for both the count and binomial sub-models. Polynomial values of "0" indicate that the covariate was not included in the final model. Negative binomial and Poisson models only had the count sub-model. The best model (highlighted) was chosen based on Bayesian Information Criteria (BIC).

	Count Sub-model					Binomial Sub-model				
Model Error Structure	**Year**	**Lat**	**Depth**	**Temp**	**DOY**	**Lat**	**Depth**	**Temp**	**DOY**	**BIC**
Zero-Inflated Negative Binomial	1	0	3	0	0	0	0	0	0	958
Negative Binomial	1	0	3	0	0	—	—	—	—	956
Zero-Inflated Poisson	1	0	3	0	0	0	0	0	0	951
Poisson	1	0	3	0	0	—	—	—	—	965

Table 11. Annual age composition by calendar age of Scamp and Yellowmouth Grouper caught in the MARMAP/SERFS fishery-independent short bottom longline survey. Total fish caught and positive deployments are summarized by year.

Calendar Age	1996	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013	2014	2015	2016	2017	2018
3	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	1	3	0	1	2	0	3	0	0	0	0	0	0	0	0	2	0	0
5	0	3	0	2	1	2	2	0	4	2	1	0	0	0	0	2	0	1	0	0
6	1	4	0	6	2	0	2	0	6	7	0	2	1	1	0	1	1	0	1	1
7	0	3	1	6	1	0	2	3	3	2	1	5	1	2	0	2	1	1	1	0
8	0	3	0	4	3	2	1	1	0	4	0	3	1	4	0	0	1	0	1	0
9	0	3	0	2	0	1	2	7	2	4	1	1	2	1	1	0	1	0	2	1
10	0	0	0	2	1	2	2	1	0	3	1	3	0	7	2	0	0	0	0	0
11	0	2	0	1	0	0	0	0	2	2	0	1	2	5	3	2	1	0	1	1
12	0	0	0	1	1	0	0	0	1	2	0	2	1	2	3	0	0	0	0	1
13	0	0	0	2	0	0	0	0	0	1	0	0	0	0	1	0	1	1	0	0
14	0	2	0	1	0	0	0	1	1	1	0	0	0	0	0	1	4	0	2	0
15	0	0	0	0	0	0	0	0	0	0	0	0	1	3	2	0	1	1	1	1
16	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0
17	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
20	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Deployments	1	12	1	9	4	5	11	11	14	21	4	13	9	15	7	6	7	6	9	5
Fish	1	21	2	31	9	8	14	13	23	28	4	18	10	25	13	9	12	8	10	6

Table 12. Percentage of annual age composition by calendar age of Scamp and Yellowmouth Grouper caught in the MARMAP/SERFS fishery-independent short bottom longline survey. Total fish caught and positive deployments are summarized by year.

Calendar Age	1996	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013	2014	2015	2016	2017	2018
3	0.0	0.0	0.0	3.2	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	50.0	9.7	0.0	12.5	14.3	0.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0
5	0.0	14.3	0.0	6.5	11.1	25.0	14.3	0.0	17.4	7.1	25.0	0.0	0.0	0.0	0.0	22.2	0.0	12.5	0.0	0.0
6	100.0	19.0	0.0	19.4	22.2	0.0	14.3	0.0	26.1	25.0	0.0	11.1	10.0	4.0	0.0	11.1	8.3	0.0	10.0	16.7
7	0.0	14.3	50.0	19.4	11.1	0.0	14.3	23.1	13.0	7.1	25.0	27.8	10.0	8.0	0.0	22.2	8.3	12.5	10.0	0.0
8	0.0	14.3	0.0	12.9	33.3	25.0	7.1	7.7	0.0	14.3	0.0	16.7	10.0	16.0	0.0	0.0	8.3	0.0	10.0	0.0
9	0.0	14.3	0.0	6.5	0.0	12.5	14.3	53.8	8.7	14.3	25.0	5.6	20.0	4.0	7.7	0.0	8.3	0.0	20.0	16.7
10	0.0	0.0	0.0	6.5	11.1	25.0	14.3	7.7	0.0	10.7	25.0	16.7	0.0	28.0	15.4	0.0	0.0	0.0	0.0	0.0
11	0.0	9.5	0.0	3.2	0.0	0.0	0.0	0.0	8.7	7.1	0.0	5.6	20.0	20.0	23.1	22.2	8.3	0.0	10.0	16.7
12	0.0	0.0	0.0	3.2	11.1	0.0	0.0	0.0	4.3	7.1	0.0	11.1	10.0	8.0	23.1	0.0	0.0	0.0	0.0	16.7
13	0.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	7.7	0.0	8.3	12.5	0.0	0.0
14	0.0	9.5	0.0	3.2	0.0	0.0	0.0	7.7	4.3	3.6	0.0	0.0	0.0	0.0	0.0	11.1	33.3	0.0	20.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	12.0	15.4	0.0	8.3	12.5	10.0	16.7
16	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	11.1	0.0	12.5	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	16.7
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	12.5	0.0	0.0
Deployments	1	12	1	9	4	5	11	11	14	21	4	13	9	15	7	6	7	6	9	5
Fish	1	21	2	31	9	8	14	13	23	28	4	18	10	25	13	9	12	8	10	6

Table 13. Annual length composition in fork length of Scamp and Yellowmouth Grouper caught in the MARMAP/SERFS fishery-independent short bottom longline survey by centered cm bins. Total fish caught and positive deployments are summarized by year.

Fork Length	1996	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013	2014	2015	2016	2017	2018
420	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
430	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
440	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
450	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
460	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1
470	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	1	0	0
480	1	2	0	0	0	0	0	0	1	2	1	0	0	0	0	0	1	1	0	0
490	0	2	0	1	0	1	0	1	1	0	0	1	0	0	0	1	0	0	0	0
500	0	0	0	2	1	0	0	0	3	3	0	0	0	0	0	1	1	1	0	0
510	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
520	0	0	0	2	2	1	1	4	0	3	0	2	0	0	2	0	0	1	1	0
530	0	1	0	1	1	0	0	0	0	2	1	1	0	0	1	0	0	0	1	1
540	0	0	0	4	1	0	3	0	0	2	0	0	1	1	0	1	1	0	1	0
550	0	2	0	1	1	0	1	1	1	1	0	0	0	1	1	0	0	0	0	0
560	0	1	0	1	0	1	0	1	1	0	0	2	1	2	0	2	1	0	1	0
570	0	1	0	2	0	1	2	3	0	1	0	1	0	1	0	0	1	0	0	1
580	0	0	0	0	0	0	1	0	2	0	1	0	0	0	0	0	1	0	0	0
590	0	1	0	2	3	1	1	1	0	1	1	3	1	3	2	0	0	1	0	0
600	0	2	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
610	0	2	0	0	0	0	0	0	1	1	0	0	2	1	1	0	0	0	0	0
620	0	2	1	1	0	0	0	0	1	0	1	1	1	2	1	0	0	0	1	0
630	0	0	0	0	0	0	0	1	0	4	0	2	0	3	0	0	0	0	0	0
640	0	0	0	2	0	0	2	0	0	1	0	0	0	1	1	0	2	0	0	2
650	0	0	0	2	0	0	0	0	0	0	0	2	0	0	1	1	0	0	0	0
660	0	0	0	0	0	0	1	0	1	1	0	0	2	2	0	0	0	0	0	0
670	0	1	0	1	0	0	0	0	3	0	0	1	0	2	0	0	2	1	2	0
680	0	1	0	1	0	0	0	0	0	2	0	1	1	1	0	0	1	1	0	0
690	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
700	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0
710	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0
720	0	0	0	3	0	0	0	0	1	0	0	2	0	1	0	0	0	0	1	0
730	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0
740	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	2	0	0	0	1
750	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
760	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
770	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
790	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
800	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deployments	1	12	1	9	4	5	11	11	14	21	5	14	9	15	7	6	7	6	9	5
Fish	1	22	2	32	9	8	15	13	23	29	6	19	10	25	14	9	12	8	10	6

Table 14. Percentage of annual length composition in fork length of Scamp and Yellowmouth Grouper caught in the MARMAP/SERFS fishery-independent short bottom longline survey. Total fish caught and positive deployments are summarized by year.

Year	1996	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013	2014	2015	2016	2017	2018
420	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
430	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
440	0.0	0.0	0.0	3.1	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
450	0.0	0.0	50.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
460	0.0	0.0	0.0	0.0	0.0	25.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7
470	0.0	0.0	0.0	0.0	0.0	12.5	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	11.1	0.0	12.5	0.0	0.0
480	100.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	4.3	6.9	16.7	0.0	0.0	0.0	0.0	0.0	8.3	12.5	0.0	0.0
490	0.0	9.1	0.0	3.1	0.0	12.5	0.0	7.7	4.3	0.0	0.0	5.3	0.0	0.0	0.0	11.1	0.0	0.0	0.0	0.0
500	0.0	0.0	0.0	6.3	11.1	0.0	0.0	0.0	13.0	10.3	0.0	0.0	0.0	0.0	0.0	11.1	8.3	12.5	0.0	0.0
510	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
520	0.0	0.0	0.0	6.3	22.2	12.5	6.7	30.8	0.0	10.3	0.0	10.5	0.0	0.0	14.3	0.0	0.0	12.5	10.0	0.0
530	0.0	4.5	0.0	3.1	11.1	0.0	0.0	0.0	0.0	6.9	16.7	5.3	0.0	0.0	7.1	0.0	0.0	0.0	10.0	16.7
540	0.0	0.0	0.0	12.5	11.1	0.0	20.0	0.0	0.0	6.9	0.0	0.0	10.0	4.0	0.0	11.1	8.3	0.0	10.0	0.0
550	0.0	9.1	0.0	3.1	11.1	0.0	6.7	7.7	4.3	3.4	0.0	0.0	0.0	4.0	7.1	0.0	0.0	0.0	0.0	0.0
560	0.0	4.5	0.0	3.1	0.0	12.5	0.0	7.7	4.3	0.0	0.0	10.5	10.0	8.0	0.0	22.2	8.3	0.0	10.0	0.0
570	0.0	4.5	0.0	6.3	0.0	12.5	13.3	23.1	0.0	3.4	0.0	5.3	0.0	4.0	0.0	0.0	8.3	0.0	0.0	16.7
580	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	8.7	0.0	16.7	0.0	0.0	0.0	0.0	0.0	8.3	0.0	0.0	0.0
590	0.0	4.5	0.0	6.3	33.3	12.5	6.7	7.7	0.0	3.4	16.7	15.8	10.0	12.0	14.3	0.0	0.0	12.5	0.0	0.0
600	0.0	9.1	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0	10.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0
610	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	4.3	3.4	0.0	0.0	20.0	4.0	7.1	0.0	0.0	0.0	0.0	0.0
620	0.0	9.1	50.0	3.1	0.0	0.0	0.0	0.0	4.3	0.0	16.7	5.3	10.0	8.0	7.1	0.0	0.0	0.0	10.0	0.0
630	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7	0.0	13.8	0.0	10.5	0.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0
640	0.0	0.0	0.0	6.3	0.0	0.0	13.3	0.0	0.0	3.4	0.0	0.0	0.0	4.0	7.1	0.0	16.7	0.0	0.0	33.3
650	0.0	0.0	0.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	0.0	0.0	7.1	11.1	0.0	0.0	0.0	0.0
660	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	4.3	3.4	0.0	0.0	20.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0
670	0.0	4.5	0.0	3.1	0.0	0.0	0.0	0.0	13.0	0.0	0.0	5.3	0.0	8.0	0.0	0.0	16.7	12.5	20.0	0.0
680	0.0	4.5	0.0	3.1	0.0	0.0	0.0	0.0	0.0	6.9	0.0	5.3	10.0	4.0	0.0	0.0	8.3	12.5	0.0	0.0
690	0.0	0.0	0.0	3.1	0.0	0.0	0.0	7.7	0.0	0.0	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0
700	0.0	4.5	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	7.1	0.0	0.0	12.5	10.0	0.0
710	0.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	10.0	0.0
720	0.0	0.0	0.0	9.4	0.0	0.0	0.0	0.0	4.3	0.0	0.0	10.5	0.0	4.0	0.0	0.0	0.0	0.0	10.0	0.0
730	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	7.1	0.0	8.3	0.0	0.0	0.0
740	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	16.7	0.0	0.0	4.0	0.0	22.2	0.0	0.0	0.0	16.7
750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
760	0.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
770	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
790	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
800	0.0	4.5	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Deployments	1	12	1	9	4	5	11	11	14	21	5	14	9	15	7	6	7	6	9	5
Fish	1	22	2	29	9	8	14	13	22	27	6	19	10	25	14	9	12	8	10	6

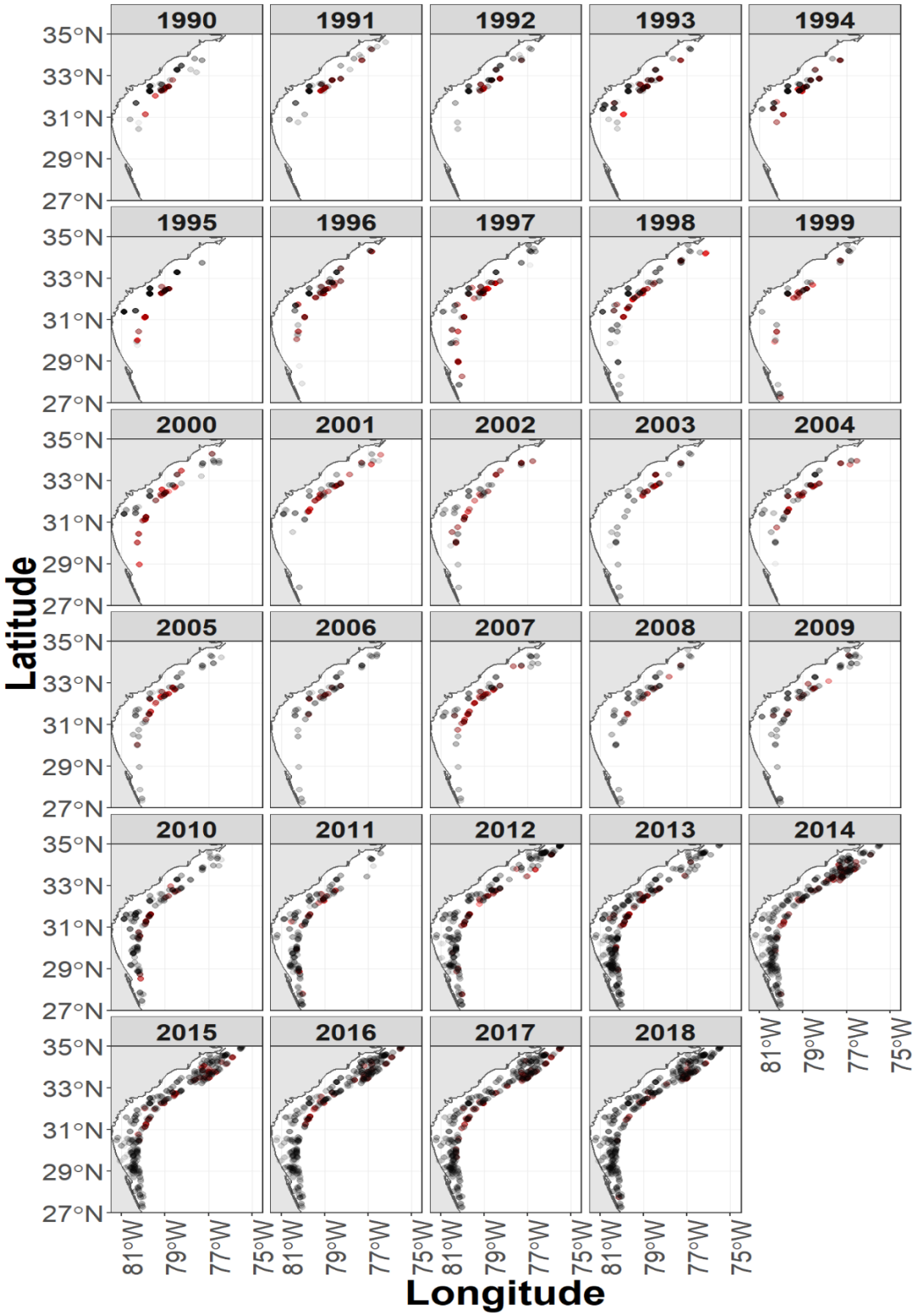

Figure 1. Sampling distribution of all collections by year of the MARMAP/SERFS fishery-independent chevron video trap survey. Red circles indicate positive collections for Scamp and Yellowmouth Grouper, while black circles represent no catch of Scamp or Yellowmouth Grouper.

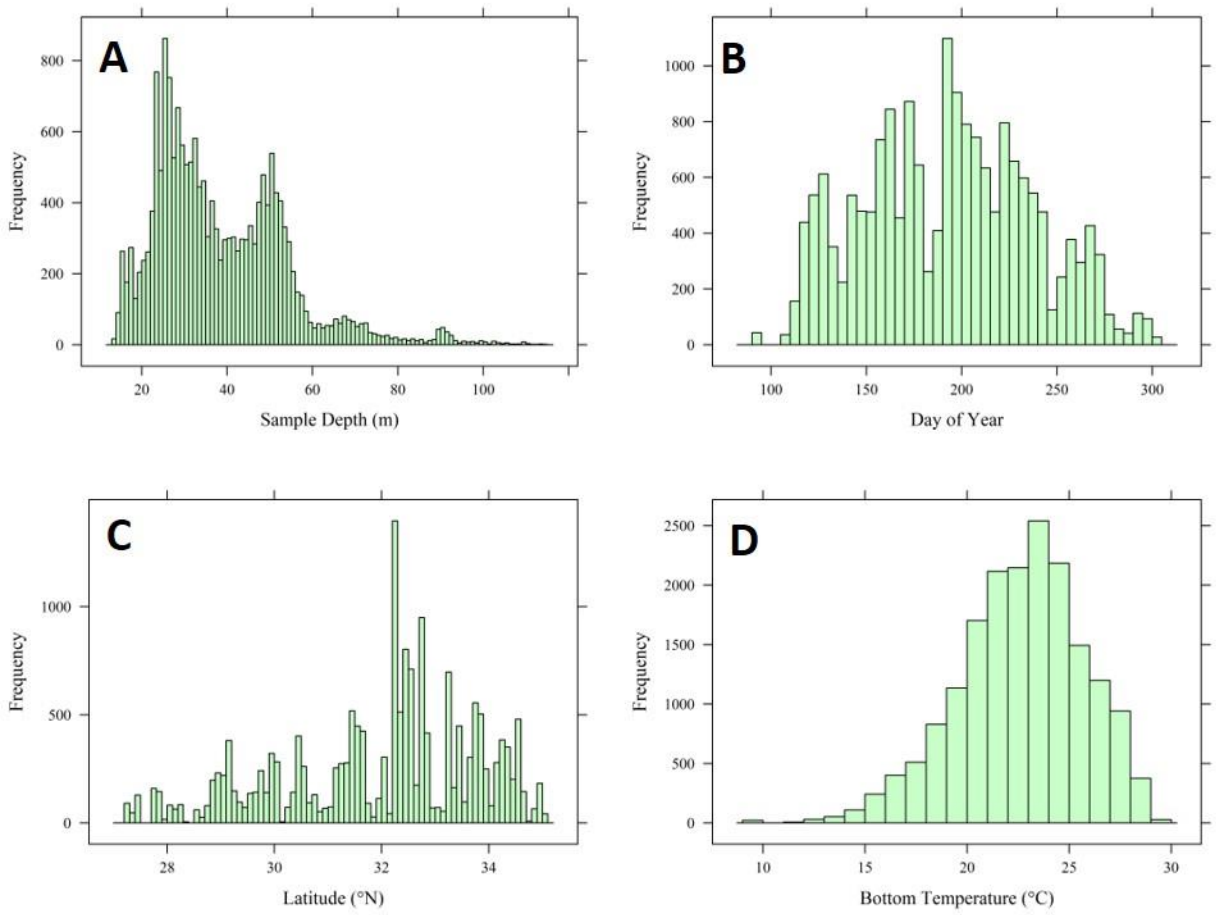

Figure 2. Sample distribution of covariate data from MARMAP/SERFS fishery-independent chevron video trap survey collections for depth (A), day of year (B), latitude (C), and bottom temperature (D).

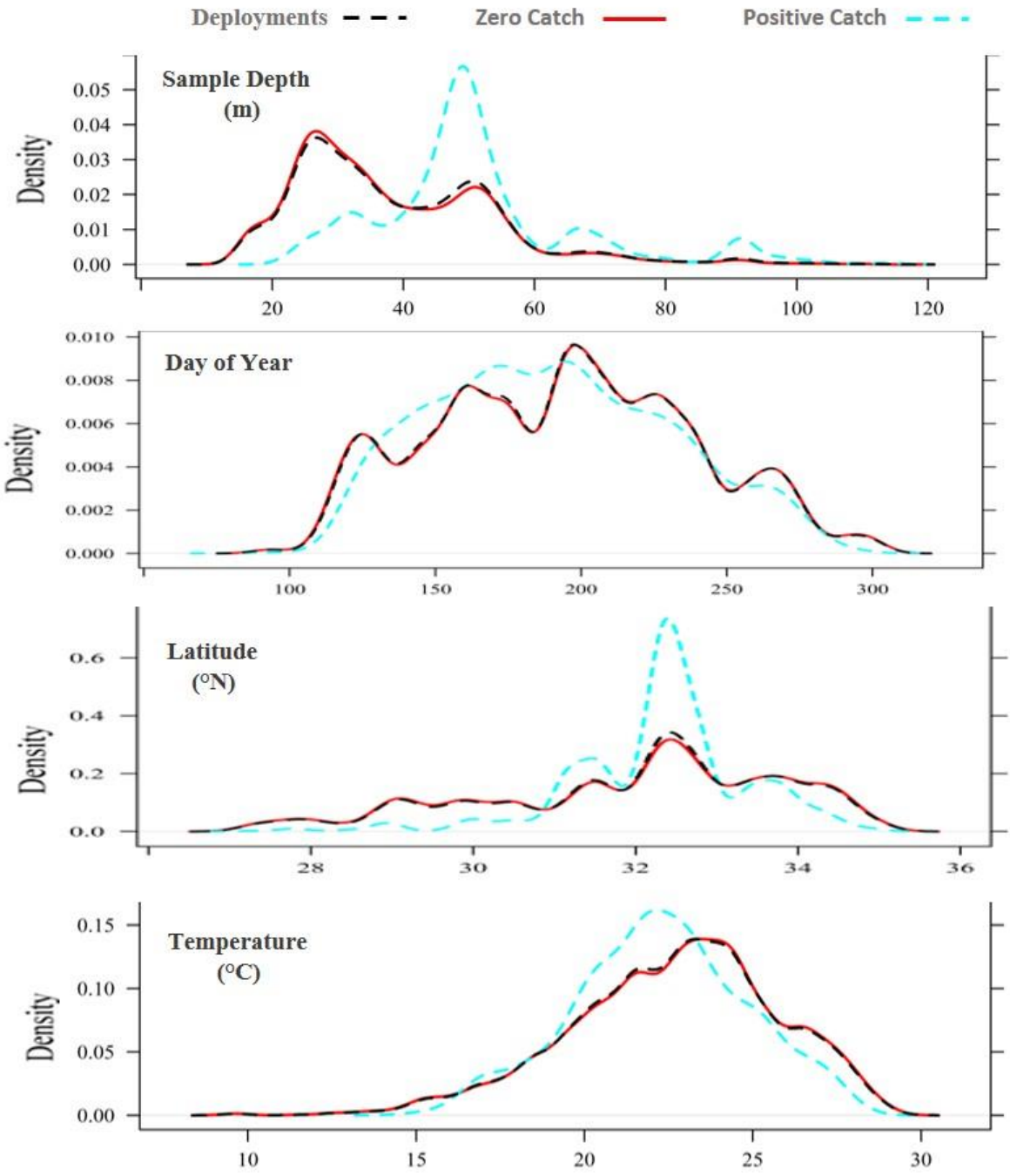

Figure 3. Sample distribution of Scamp and Yellowmouth Grouper catch by chevron video traps and effects by covariate on positive and zero catches.

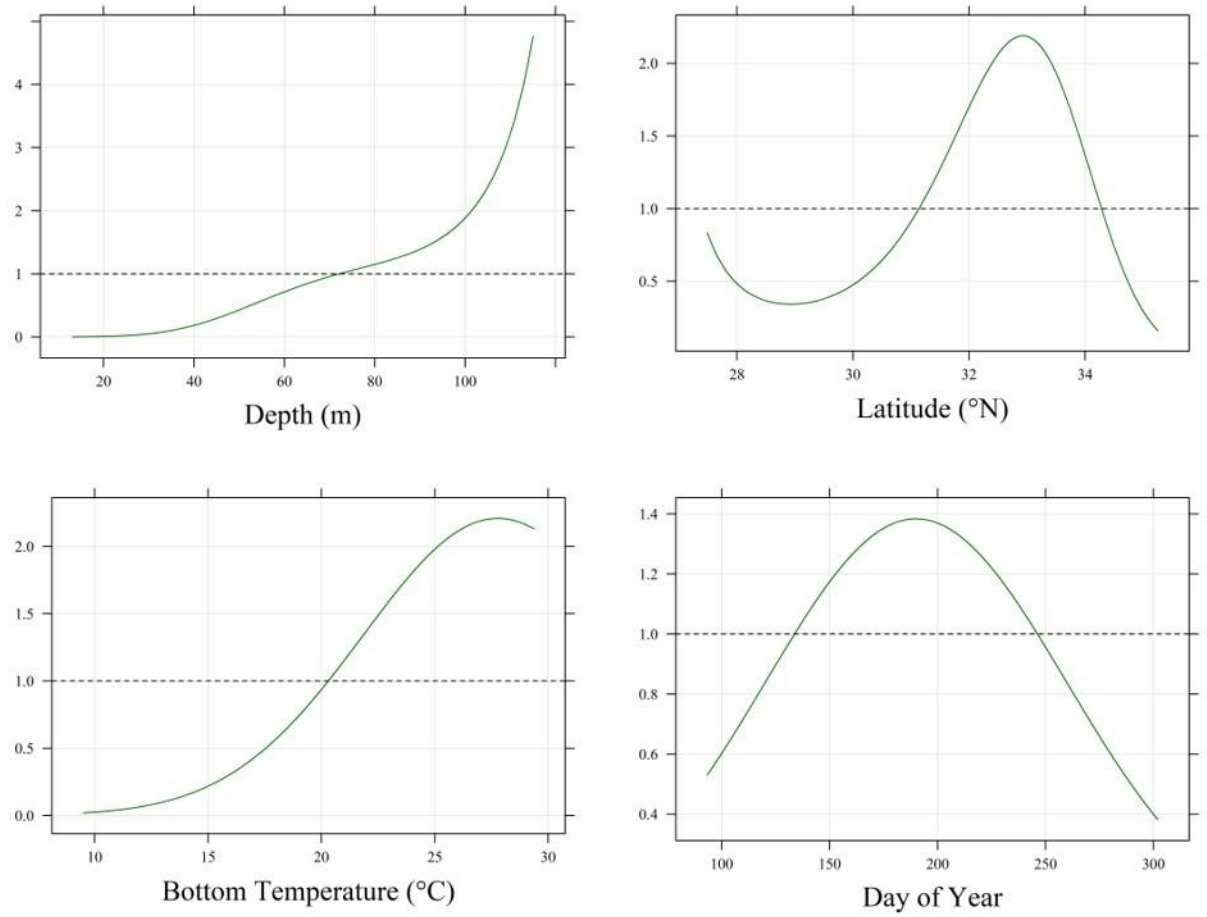

Figure 4. Final covariate effects on Scamp and Yellowmouth Grouper catch in chevron video traps from the ZINB standardization.

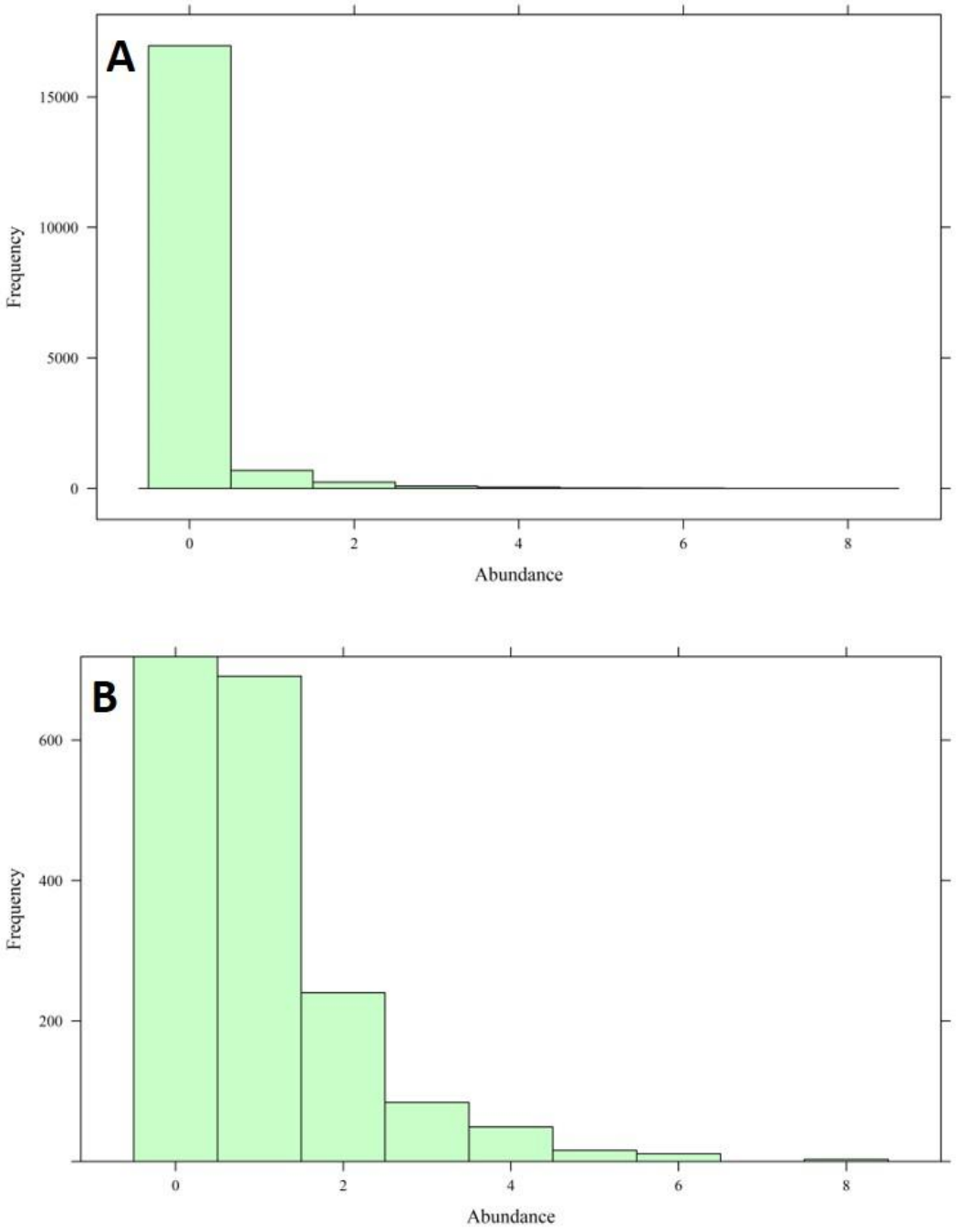

Figure 5. Count distribution of Scamp and Yellowmouth Grouper catch from MARMAP/SERFS fishery-independent chevron video trap survey showing full range of the distribution (A) and a truncated y-axis (B) to better show positive catches.

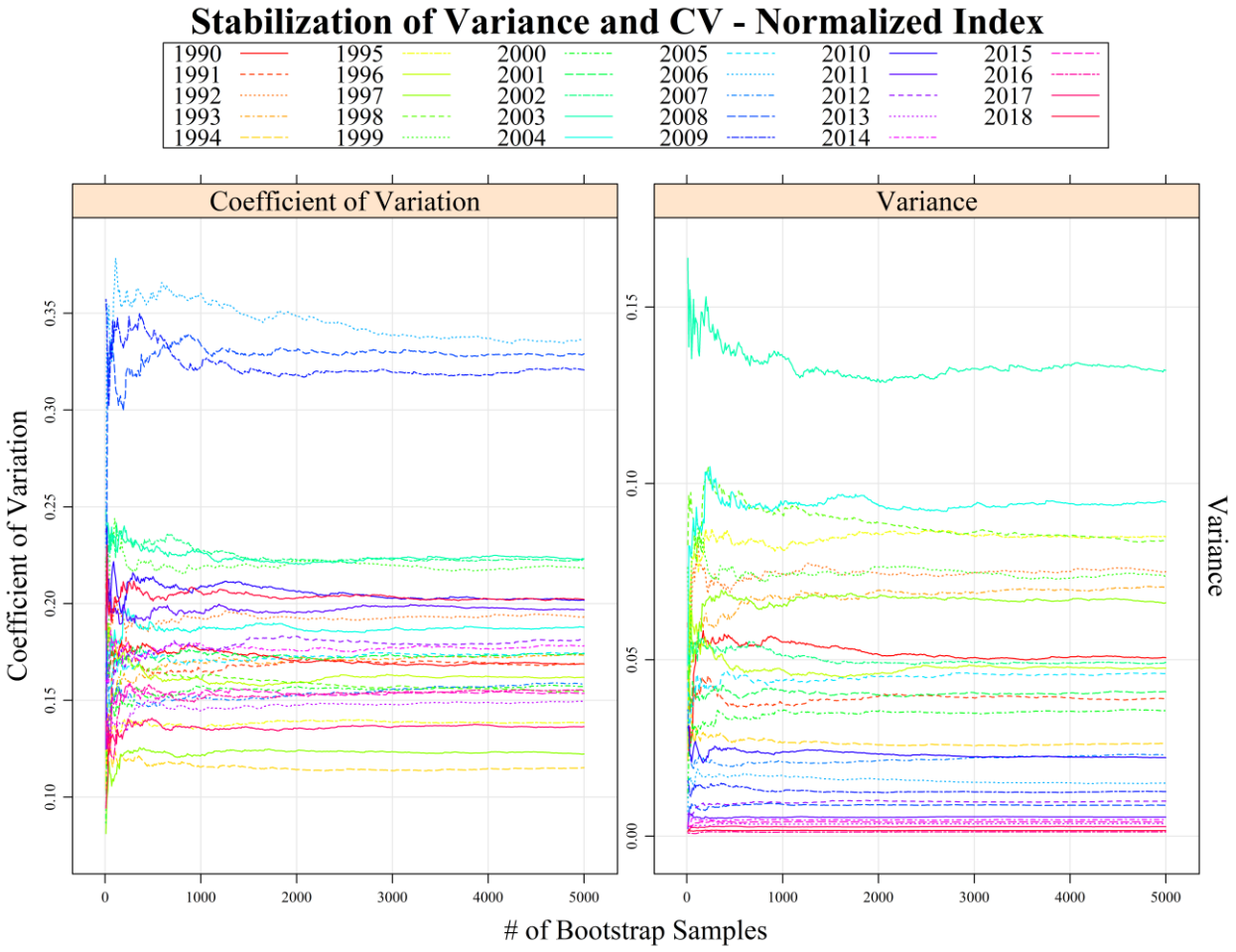

Figure 6. Stability of coefficient of variation and variance by bootstrap run during fishery-independent chevron video trap survey index development.

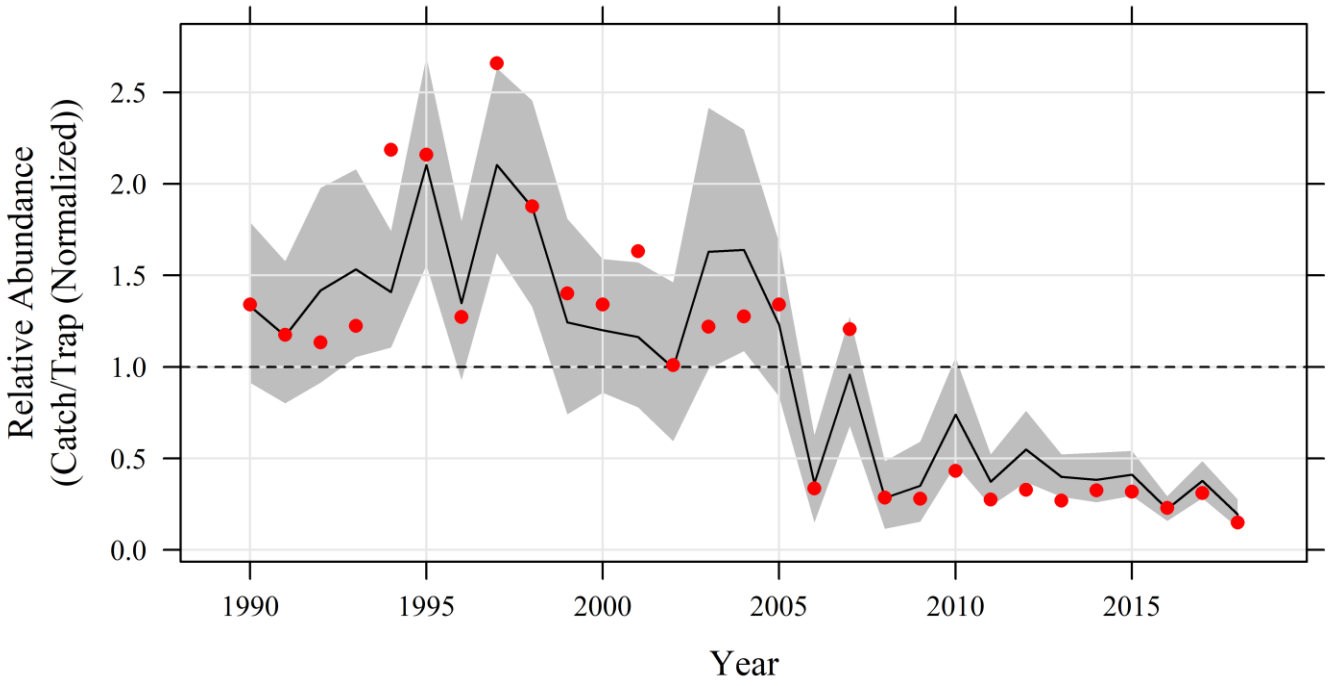

Figure 7. Normalized and standardized index (solid line) with 2.5% and 97.5% confidence intervals (gray) and the nominal index (red dots) for Scamp and Yellowmouth Grouper in the MARMAP/SERFS fishery-independent chevron video trap survey.

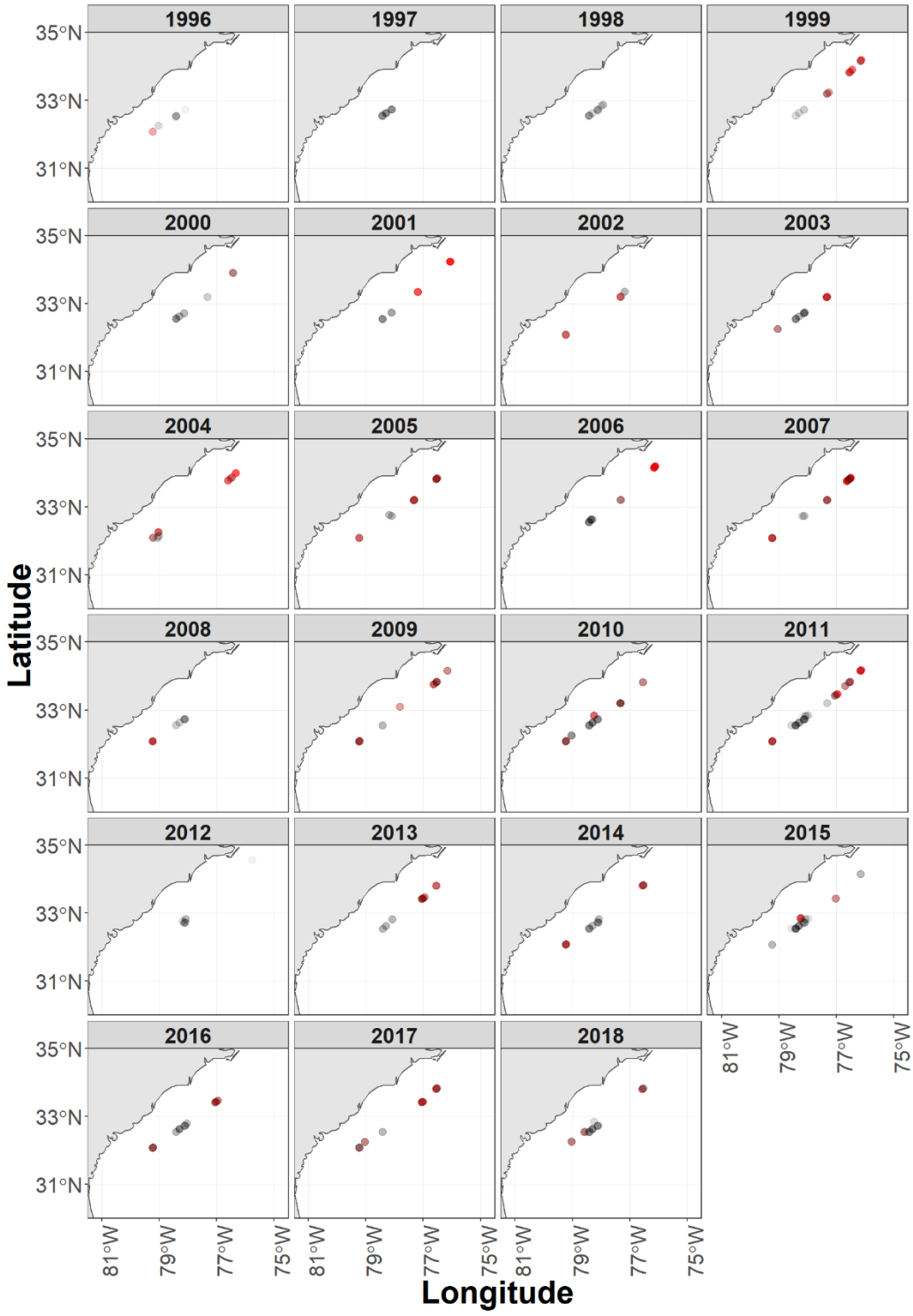

Figure 8. Sampling distribution of all collections by year of the MARMAP/SERFS fishery-independent short bottom longline survey. Red circles indicate positive collections for Scamp and Yellowmouth Grouper, while black circles represent no catch of Scamp or Yellowmouth Grouper.

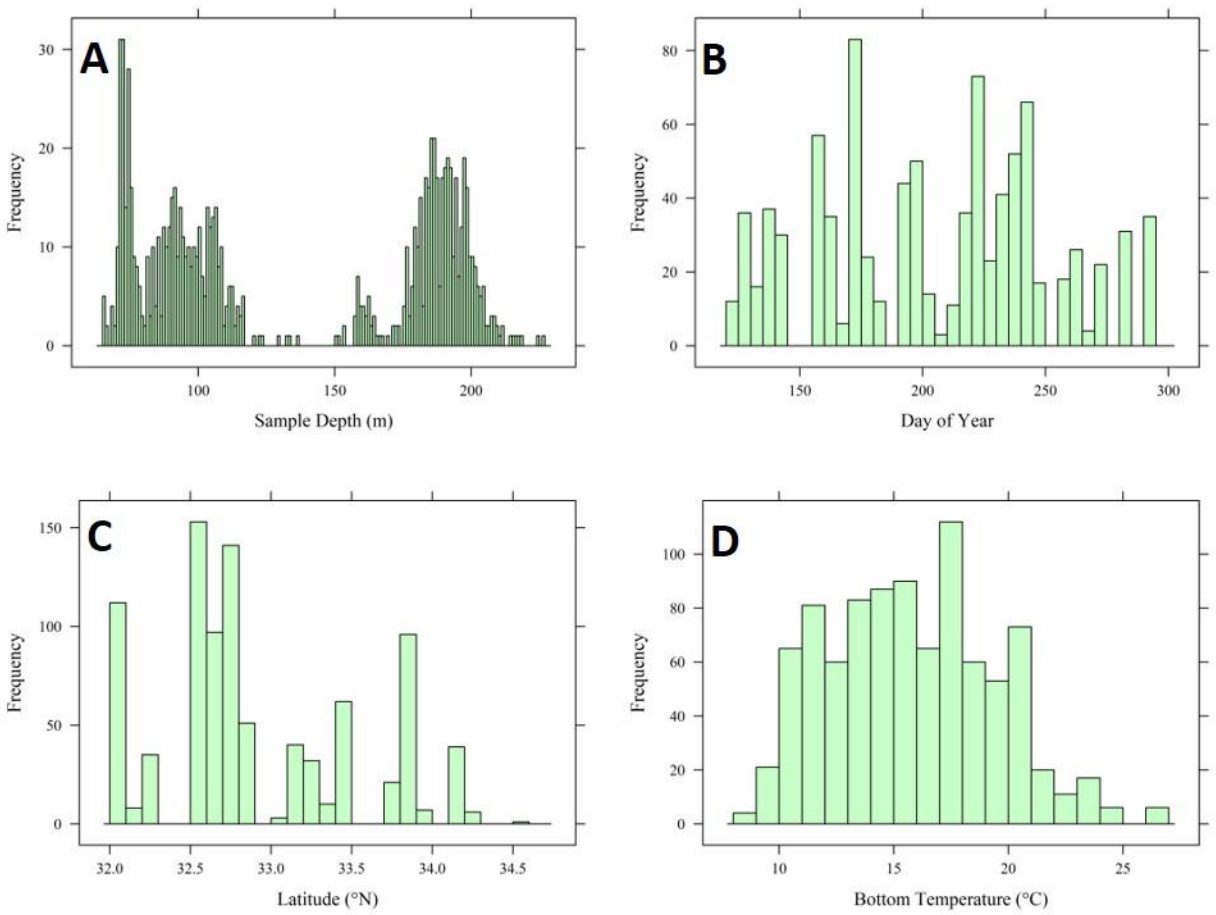

Figure 9. Sample distribution of covariate data from MARMAP/SERFS fishery-independent short bottom longline survey collections for depth (A), day of year (B), latitude (C), and bottom temperature (D).

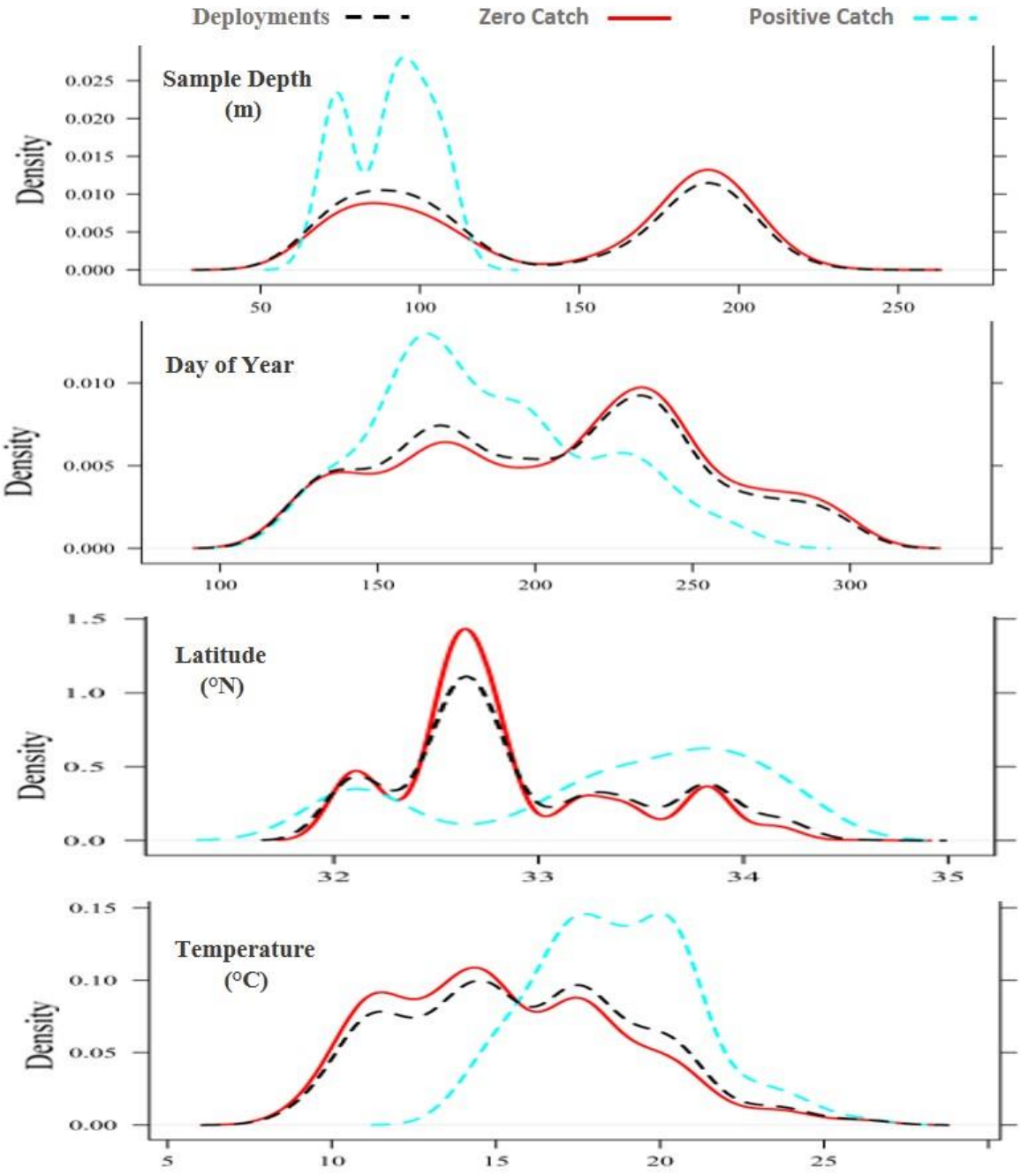

Figure 10. Sample distribution of Scamp and Yellowmouth Grouper catch by short bottom longlines and effects by covariate on positive and zero catches.

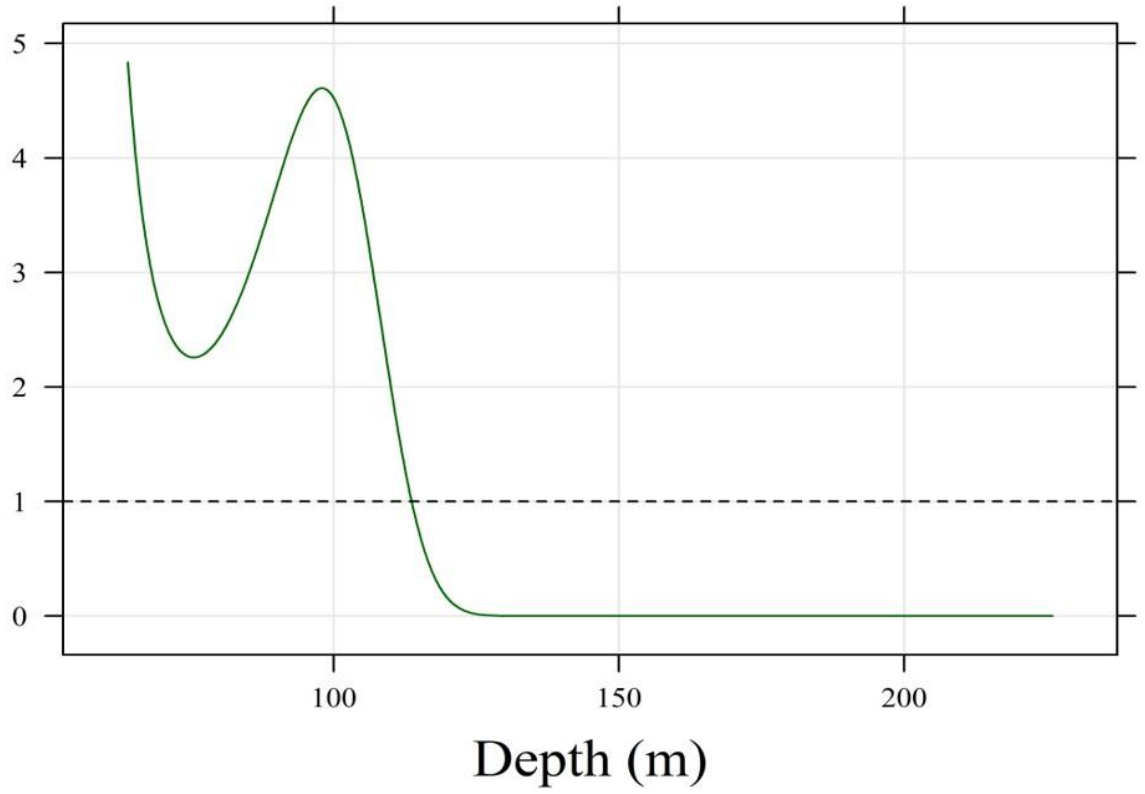

Figure 11. Modelled final covariate effects on Scamp and Yellowmouth Grouper catch by short bottom longline from the ZINB standardization. Latitude, bottom temperature, and day of year were not included in either sub-model of the final model.

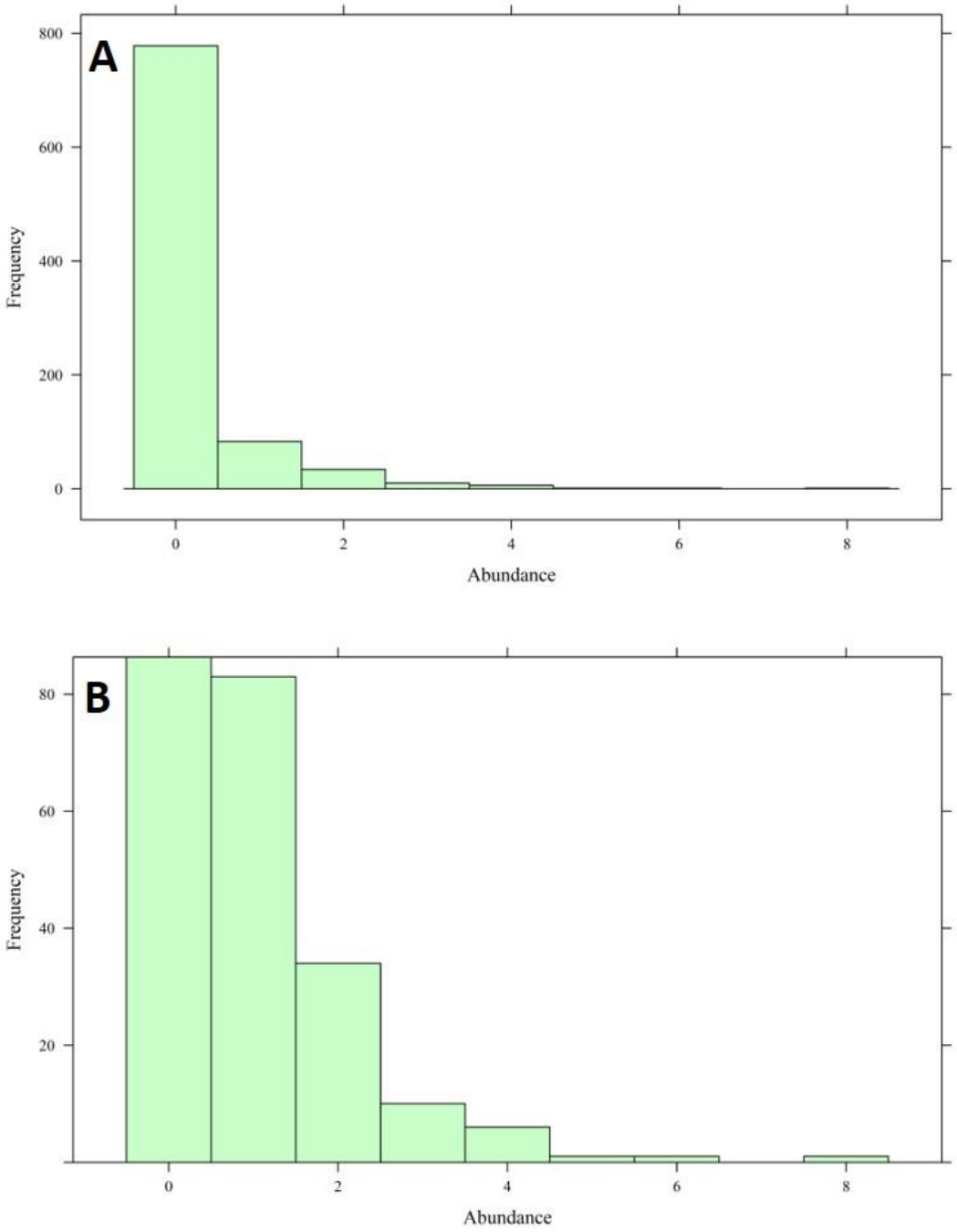

Figure 12. Count distribution of Scamp and Yellowmouth Grouper catch from MARMAP/SERFS fishery-independent short bottom longline survey showing full range of the distribution (A) and a truncated y-axis (B) to better show positive catches.

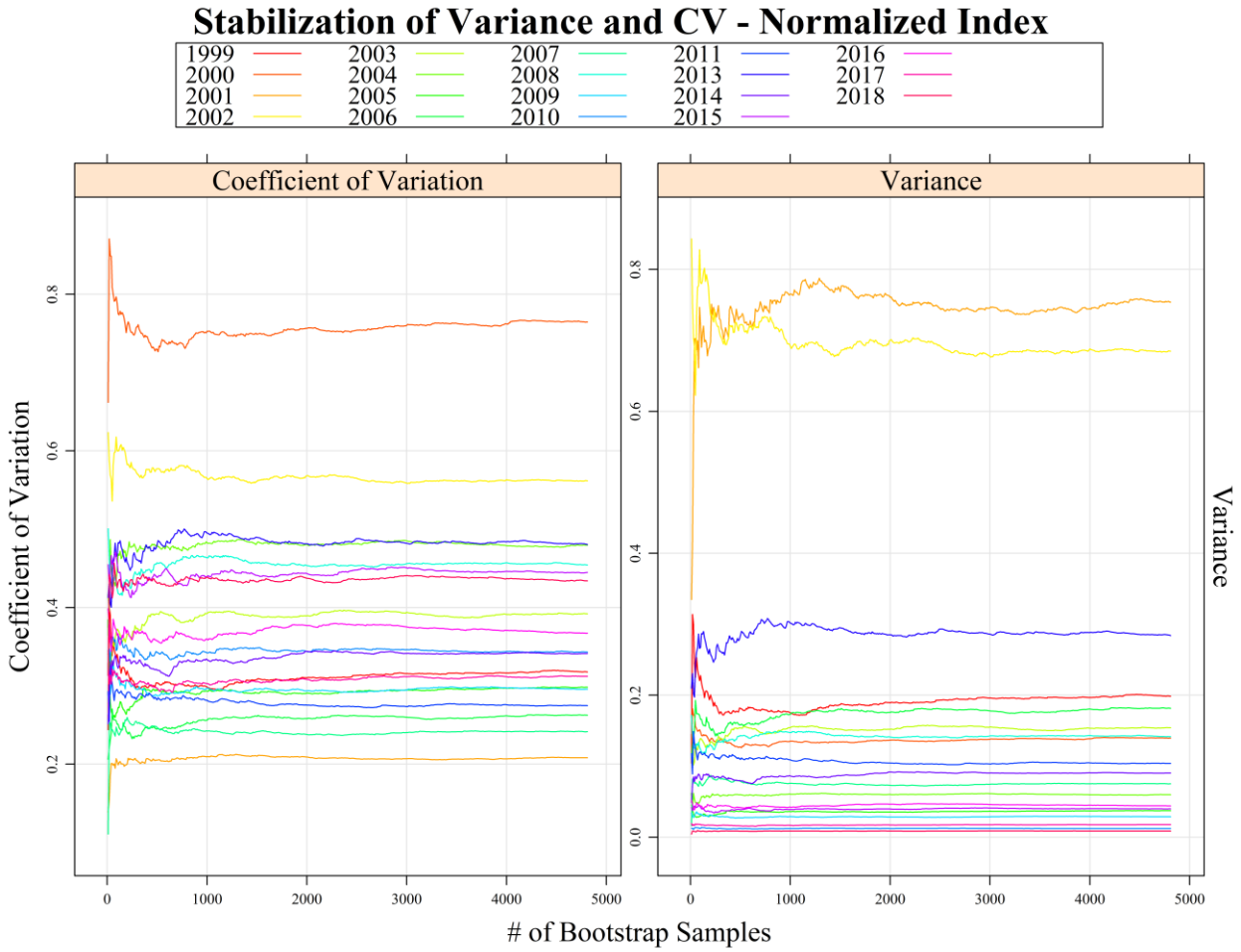

Figure 13. Stability of coefficient of variation and variance by bootstrap run during fishery-independent short bottom longline survey index development.

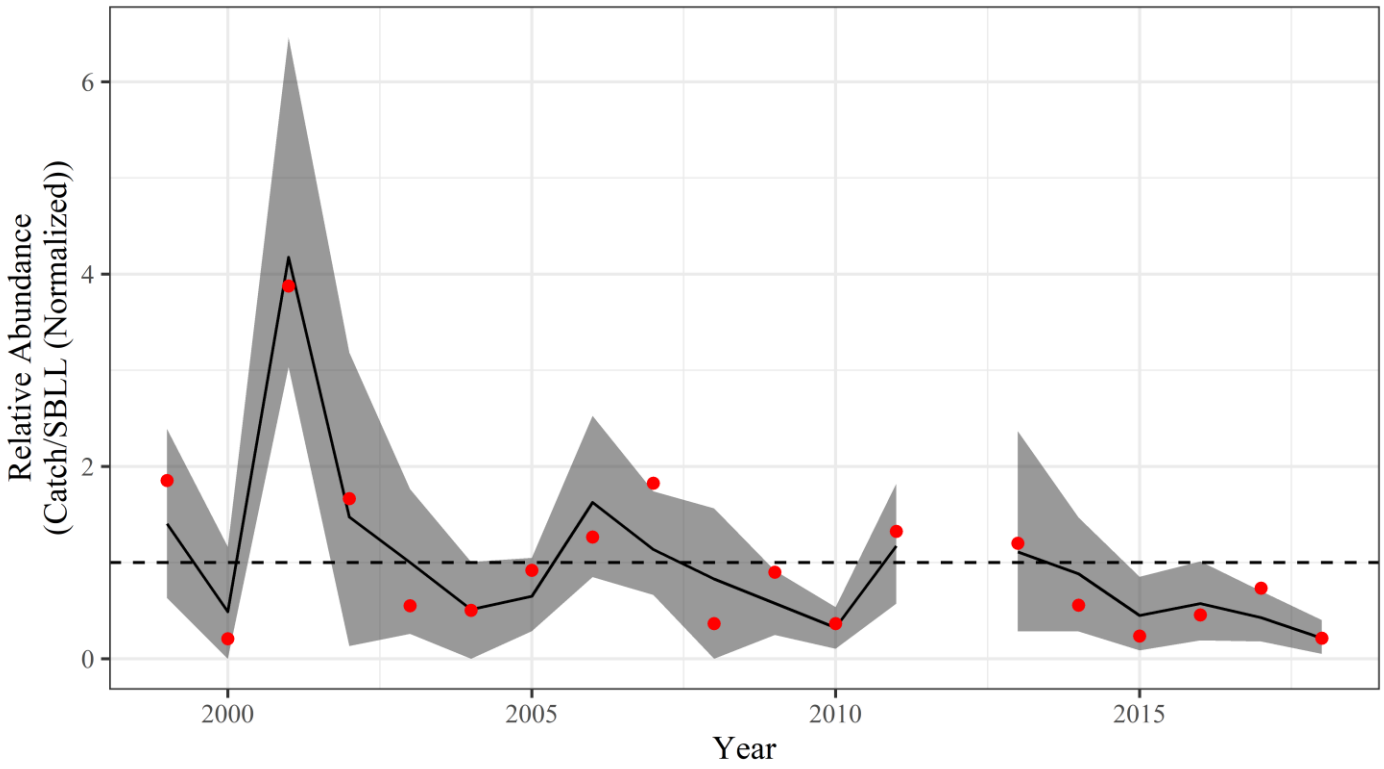

Figure 14. Normalized and standardized index (solid line) with 2.5% and 97.5% confidence intervals (gray) and the nominal index (red dots) for Scamp and Yellowmouth Grouper in the MARMAP/SERFS fishery-independent short bottom longline survey.