Summary of the Trip Interview Program data from the US Caribbean

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Introduction

Trip Interview Program

The Trip Interview Program (TIP) is a port sampling program that collects data to provide information that is otherwise not collected through logbook reporting. Size frequency data, species composition information, and sometimes other biological information are collected. Information about fishing area, fishing gear, etc., is collected.

Report objectives

The main objectives of this report are to:

1. Make recommendations about how the TIP data should be treated.
    a. Identify which length types to use for analysis
    b. Evaluate whether gear types should be aggregated and recommend aggregation strategies
2. Evaluate temporal, gear, and spatial characteristics of the TIP length data.
3. Summarize the TIP length data for twenty-four select species.

Length types

Table 1 summarizes the number of lengths and percentage of lengths by length type and island as reported in the TIP database. The vast majority of length observations are measured as fork length for finfish species and carapace length for crustaceans. Approximately 91%, 84%, and 90% of the length measurements are in fork length for Puerto Rico, St. Thomas, and St. Croix, respectively. All other length types represent less than 5% of the length measurements. Isolating the length types to those used when measuring finfish yields a similar result (Table 2).

Recommendation

Length-length conversion parameters were not available at the time of data processing. Given this and that the vast majority of lengths are recorded as fork length, only the fork length observations should be used for the mean length estimator approaches and for catch-at-length approaches in the DLMtool.

Gear types and gear grouping recommendations

Objectives

The goals of this section are to:

1. review previous gear aggregations,
2. review the gear types reported in the TIP database, and
3. suggest gear groupings or choose the most representative gears in the database for each island.

Previous gear aggregations

The gear types found in the TIP database have been re-classified during previous US Caribbean SEDARs. The gear types and their previous re-classifications are shown in Table 3. The former classification system represents a rather broad-brushed approach. The data were further evaluated to determine the best way to aggregate the gear types.

Gear types by island

Figure 1- Figure 3 show the cumulative proportion of the number of intercepts by gear type and island. Figure 4 shows the number of interviews over time by the predominant gear types for each island.

The predominant gear types, representing 95% of the intercepts, in Puerto Rico are hand lines, diving gear (by hand), pots and trap (fish), power lines (troll, other), trammel nets, entangling nets, and haul seines (Figure 1a). The remaining 5% of the intercepts are represented by, in descending order, pots and traps (spiny lobster), longlines set with hooks, rod and reel, by hand, cast nets, skin diving, diving with spears, and manual troll lines (Figure 1a). There have been temporal changes in the gear types in Puerto Rico (Figure 4). The number of pot and trap intercepts began to decline in the late 1980s and hand line intercepts began to increase during this time. The number of intercepted diving gear (by hand) trips has also been increasing since the mid-1990s in Puerto Rico.

The predominant gear types in St. Thomas and St. John have been pots and trap (fish), hand lines, pots and traps (spiny lobster), pots and traps (CMB), diving gear (by hand), encircling nets (purse), haul seines, and rod and reel (Figure 2a). Approximately 95% of the TIP intercepts in St. Thomas and St. John are represented by these gears. The remaining 5% of the St. Thomas intercepts is represented by 13 other gear types (Figure 2a). Over time the most predominant gear type intercepted by TIP in St. Thomas and St. John has been pots and traps (fish) (Figure 4). Since 2005 there has been an increase in the number of intercepted handline trips (Figure 4).

The predominant gear types in St. Croix have been pots and traps (fish), hand lines, diving gear (by hand), pots and traps (CMB), rod and reel, spears, and electric or hydraulic reel (Figure 3a). Approximately 95% of the TIP intercepts in St. Croix are represented by these gears. The remaining 5% of St. Croix intercepts is represented by 16 other gear types (Figure 3a). The three most predominantly intercepted gear types by TIP in St. Croix in the 1980s included pots and traps (fish and CMB) and hand lines (Figure 4). Pots and traps (CMB) has not been intercepted by TIP since 1992. The number of pots and traps (fish) and handline intercepted trips has generally declined since the late 1980s with a slight increase between 2007 and 2010, which was followed by a decline. Intercepted diving gear (by hand) trips generally increased until 2002 then declined (Figure 4).

Number of interviews with multiple gear types

Multiple gear types can be recorded as part of the TIP interview. Table 5 summarizes the percentage of interviews that indicated fishing with more than one gear type. In general, the percentage was less than one percent in Puerto Rico, exceptions included gill net (2.3%), pots and traps (2.76%), and troll (1.78%). In St. Thomas, the percentage of interviews reporting

secondary gear types ranged between zero percent and 5.88%. Interviews reporting longlines as the primary gear indicated the use of a secondary gear type in 5.88% of the interviews. The percentage of interviews reporting secondary gear types in St. Croix ranged from zero to 12.77%. Approximately 6.57% of the interviews reporting longlines as the primary gear type and 12.77% of interviews reporting trolling gear types as the primary gear also reported a secondary gear type.

Recommendations[1]

Each island had somewhat different predominant gear types represented in the TIP database; however, each had seven main gear types that made up 95% of the intercepted trips. This could be used to argue against grouping different gear types, but to ensure maximum use of the TIP length data new gear aggregations are recommended for SEDAR 46 (Table 4). The main recommendations include grouping gear types that are assumed to have similar selectivities. The main gear groupings recommended include:

1. All pot and trap gear types grouped into a pot and trap category,
2. Diving, by hand, and spear gear types grouped into a dive/by hand/spear category,
3. Electric rod and reels, electric or hydraulic reels and handlines grouped into a handline category,
4. Manual rod and reel, manual troll, power troll, and rod and reel gears grouped into a troll category,
5. Longline gear types grouped into a longline category,
6. Gill net gear types grouped into a gill net category, and
7. Grab hooks and sponge hooks grouped into an "other" hook category.

It is recommended that interviews reporting more than one gear type be removed from the dataset for use in length based models. This is being recommended to ensure the length data associated with a particular reflects its selectivity rather than the combination of multiple selectivities.

USVI Fishing Areas

Fishing area and county landed can be reported as part of the TIP interview. In Puerto Rico the county landed matches with a municipality, whereas in the USVI the county landed is St.Croix, St. Thomas, or St. John. County landed in the USVI does not specify where sampling takes place.

[1] Recommendations made throughout this report are preliminary and should be reviewed and discussed by the analysts and panel.

Objective

The purpose of this section is to determine whether the recorded fishing area information as part of the TIP interview can shed light about the spatial distribution of the TIP samples and compare these to the spatial distribution of the landings. Understanding how the spatial distribution of the samples in TIP compare to the spatial distribution of the landings is one element is determining whether the TIP data can be used to represent the species composition of the historic landings in the USVI.

Previous work

The maps used to report area fished in the USVI has changed over time (see Figure 1- Figure 6). Valiulis and Messineo (2005) reviewed the fishing areas maps used for reporting commercial landings in the USVI for the 1974 to 2004 fishing years. The purpose of their review was to determine whether the different map codes could be converted to a universal map and apportion landings accordingly. A main conclusion from their report was that there is no clear transition between the maps making it difficult to fully evaluate spatial trends in the commercial catch. These same maps have been used to collect fishing area information as part of the TIP data collection in the USVI. This section of the report provides a brief update to Valiulis and Messineo (2005) and demonstrates whether the data collected by the TIP in the USVI can be used to evaluate spatial trends.

St. Croix

Three fishing area maps have been used in St. Croix since 1974 (Figure 5 - Figure 6). Figure 5 and Figure 6 show the St. Croix fishing area maps used between 1974 and 2005. Figure 7 shows the biological grid map that was created as part of the US Caribbean Data Collection Improvement Plan. Fishers began reporting fishing area according to this map in 2012. The grid codes from this map have not been used while collecting TIP data in St. Croix to date, which is partially due to a lack of TIP data collection in St. Croix since 2012.

Comparing Figure 5 and Figure 6, it is evident that areas C-1 and C-4 (Figure 5) overlap the western (XNW and XSW) and eastern areas (XNE and XNW) shown in Figure 6. Area codes indicating North, South, East, and West were also used in St. Croix from 1981-1992 (Table 6). These can be translated to the "C"-codes shown in Figure 5, but again the East and West areas overlap with western (XNW and XSW) and eastern (XNE and XNW) areas shown in Figure 6. Figure 8 shows the overlap in reporting the St. Croix fishing areas over time and demonstrates the difficulty in assigning the fishing areas to form a continuous series.

St. Thomas and St. John

Table 7 summarizes the area codes used in the TIP database for intercepted trips in St. Thomas and St. John between 1981 and 2013. Figure 9 - Figure 12 show the St. Thomas and St. John fishing area maps used between 1974 and 2005 (Valiulis and Messineo, 2005). Figure 13 shows the biological grid map that was created as part of the US Caribbean Data Collection Improvement Plan. This figure also shows how the biological grid corresponds with Figure 12. Fishers began reporting fishing area according to this map in 2012. The grid codes from this

map have not been used for the purposes of TIP data collection in St. Thomas and St. John to date.

Each map of St. Thomas and St. John were devised to be used for specific years and there is some apparent overlap. Figure 9 and Figure 10 overlap between 1987 and 1990, Figure 9 and Figure 11 overlap in 1992, and Figure 9 and Figure 12 overlap in 1997 and 1998. Figure 14 shows that the recording of fishing area has not always corresponded with the appropriate map and the many variants have been used over time. One difficulty in developing consistent spatial assignments over the entire time series is that "St. Thomas-West" overlaps with "St. Thomas-Northwest" and "St. Thomas- Southwest" and all three fishing areas have been reported over time. Another difficulty is that "St. Thomas-East" overlaps with "St. Thomas-Northeast" and "St. Thomas- Southeast" and all three fishing areas have been reported over time. Similarly "St. Thomas-North" overlaps with "St. Thomas-Northwest" and "St. Thomas-Northeast"; all three fishing areas have been reported over time. There is no clear way how to aggregate these fishing areas to produce a consistent time-series of fishing area.

Recommendations

Considering the changes in the fishing area maps of St. Croix, the overlap of the area designations, and the current data available, a feasible option is to aggregate the fishing area data and create two areas, east and west St. Croix. East St. Croix would represent areas C3, C4, C5, St. Croix-East, St. Croix-Northeast, and St. Croix southeast. West St. Croix would represent areas C1, C2, C6, St. Croix-West, St. Croix-Northwest, and St. Croix southwest. Areas St. Croix-North and St. Croix-South would have to be ignored as the overlap the east and west fishing areas. They make up less than 1% of the interviews.

The combination of the changes in the fishing area maps for St. Thomas and St. John and the overlap in use of these maps for reporting makes it difficult to devise a consistent time-series of area assignments. Given these difficulties, it is not possible to conduct a spatial evaluation of the TIP samples from St. Thomas and St. John at this time.

These recommendations should be discussed by the panel as another approach to aggregating the fishing area information in the TIP data may be feasible.

Time and gear characteristics

Objective

The main goal of this section is to determine whether there are any temporal patterns in the TIP intercept data for the USVI with respect to gear and space (STX only). The focus is on the USVI because a previous analysis of Puerto Rico has been done (Ault et al. 2011, Ault et al. 2014).

Species classification

The TIP database contains information about a variety of species. Species were classified as reef-fish, reef-associated species, and other. The classification system followed that used by Ault et al. (2011) and Ault et al. (2014) and expert opinion. Table 8 - Table 10 summarize how the species were classified.

The intercept data were summarized to evaluate temporal changes by island and with respect to the gear types used in the USVI. These data were also evaluated for spatial trends in the data following the fishing area aggregation method recommend for St. Croix in the "USVI Fishing Areas" section.

The numbers of annual TIP intercepts in St. Croix were highest in the 1980s, especially between 1983 and 1988 (Figure 15). The number of annual interviews has generally declined over time, with an increase in 2010 followed by another decline (Figure 15). In St. Croix, TIP intercepts were not collected in 2013. Figure 15 shows gaps in the TIP data collection on St. Thomas and St. John. The number of TIP intercepts in St. Thomas and St. John was highest in 1984 and 1985 and was followed by a general decline in the number of intercepts. The number of intercepts increased between 2009 and 2011 and declined thereafter. There were no obvious seasonal trends in the number of intercepts collected in St. Croix or St. Thomas/St. John (Figure 16a,b). The same was true for the proportion of reef-fish and reef-fish associated trips, which make up close to 100% of the trips (Figure 16c, d).

The gear types with the longest time-series of intercepts in St.Croix include pots and traps, handlines, and dive/by hand/spears (Figure 17). In the 1980s and early 1990s, when the number of intercepts were highest, the intercepts were mainly from pots and traps and handlines. The number of intercepts for pots and traps and handlines generally declined over time, whereas the number of dive/by hand/spear intercepts increased (Figure 17). Intercepts collected from gill net and longline trips in St. Croix have been intermittent over time and intercepts from trolling trips were mainly from the 1980s.

The gear types with the longest time-series of intercepts in St.Thomas and St. John include pots and traps and handlines (Figure 17). Intercepts collected from dive/by hand/spear trips were early and late in the time series and those from trolling trips are mainly from the most recent years.

There were no consistent seasonal trends in the intercepts over time for any of the gear types (Figure 18). This was true for St. Croix and St. Thomas and St. John. There were also no seasonal trends in the proportion of reef-fish or reef-fish associated trips (Figure 19).

Given the crude spatial aggregation into east and west St. Croix, the spatial evaluation was relatively fruitless and the results are not shown here.

Summary of TIP length data for select species

Objective

Twenty-four finfish species were identified as potential candidates for assessment. These species were identified by looking at the commercial landings and logbook data, the MRIP recreational landings and interview data (Puerto Rico only), and the TIP length data. The TIP data for these species will be summarized here. The predominant gear types for each island are identified and the length frequency distributions for these gear-island combinations are presented. Additionally, a logistic model was fit to the length data for each gear-island combination to provide some insight about the length at 50% and full selectivity. This information can be used to inform decisions about the critical length (L_c) parameter that is a

required input parameter of mean length estimators. This information along with summary statistics of the annual length frequency data should be used to identify the most appropriate L_c for each stratum being considered. The number of tables summarizing this information would greatly increase the size of this report. The summaries were made available to the analysts to reduce the size of this document.

Blue tang

Prevalence in gear types and islands

The majority of Blue Tang lengths are from St. Croix (32,118) followed by St. Thomas and St. John (3,054) and Puerto Rico (133). Given the paucity of lengths from Puerto Rico, less than one per year on average, the summary of data will focus on St. Croix and St. Thomas. The majority of lengths collected in St. Thomas were associated with pots and traps (3,002 lengths), which is also true in St. Croix (30,901 lengths). Blue Tang lengths measured on St. Croix were also associated with gillnets (853 lengths) and diving/byhand/spears (193 lengths).

Length frequency and critical length (L_c)

The overall distribution of Blue Tang lengths for each island is shown in Figure 13. There is an obvious outlier (> 600mm FL) in St. Croix. This observation should be removed for any length-based analysis.

The length frequency plots for the most representative gear types are shown for St. Croix and St. Thomas/St. John in Figure 21 and Figure 22, respectively. The length at 50% selectivity, assuming a logistic relationship, for St. Croix and St.Thomas/St. John pot and traps is approximately 175mm FL and 190mm FL (Figure 21a, Figure 22a). The length at full selection for St. Croix and St.Thomas/St. John pot and traps is approximately 220mm FL and 270mm FL (Figure 21b, Figure 22b).

Recommendations

The number of annual lengths from the pot and trap intercepts from St. Croix and from St. Thomas and St. John are adequate for application to the non-equilbirum and equilibrium mean length estimators. The terminal year of data from St. Croix is 2011 therefore mortality estimates would not be up to date, whereas the terminal year of data from St. Thomas and St. John is 2013.

Coney

Prevalence in gear types and islands

A total of 17,958, 11,930, and 2,815 Coney lengths were measured in Puerto Rico, St. Croix, and St. Thomas/St. John, respectively. Handline (PR: 6956 (231 per year), STT: 1122 (37 per year), and STX: 1851 (61.7 per year)) and pot and traps (PR: 9787, STT: 1646, and STX: 9303) were the predominant gears with Coney lengths for all three islands.

Length frequency and critical length (L_c)

Figure 23 and Figure 24 show the annual Coney length frequency distributions for handlines and pots and traps in Puerto Rico. Figure 25 and Figure 26 show the annual Coney length frequency distributions for handlines and pots and traps in St. Thomas/St. John. Figure 27 and Figure 28 show the annual Coney length frequency distributions for handlines and pots and traps in St. Croix.

The annual number of lengths from the pot and trap intercepts and the handline intercepts from Puerto Rico were relatively large through the early 2000s after which they declined (Figure 23-Figure 24). The majority of samples from the handline intercepts from St. Thomas were between 2010 and 2012 (Figure 25). The annual sample sizes were greatest early in the time series, 1984-1993, and in more recent years, 2009-2012 (Figure 26). The majority of annual samples from the handline intercepts in St. Croix were from 1984 and 1985 (Figure 27). The annual sample sizes from the pot and trap intercepts from St. Croix were relatively large early in the time series, 1983-1989, and then decline through 2011(Figure 28).

Assuming a logistic relationship the length at 50% and full selection by island and gear type are as follows (Figure 23b - Figure 28b):

Island	Gear type	L50%	Lfull
Puerto Rico	Handlines	225mm FL	320mm FL
	Pots and traps	220mm FL	280mm FL
St. Thomas/St. John	Handlines	235mm FL	300mm FL
	Pots and traps	255mm FL	310mm FL
St. Croix	Handlines	215mm FL	270mm FL
	Pots and traps	225mm FL	270mm FL

Recommendation

Non-equilibrium and equilibrium mean lean approaches can be applied to the handline and pot and trap length data from Puerto Rico. Both time-series had a reduction in sample size in recent years; therefore. caution should be used when interpreting the absolute mortality estimates for recent years.

The non-equilibrium mean length estimator would be inappropriate applied to the handline data from St. Thomas given that there are few years with adequate sample size before 2010. An equilibrium approach could be applied to the 2010-2012 data. The non-equilibrium mean length approach could be applied to the pot and trap data from St. Thomas and St. John, although between 1993 and 2009 annual sample sizes are relatively small sample sizes.

The non-equilibrium mean length estimator would be inappropriate applied to the handline data from St. Croix given that the annual sample sizes are generally low. Applying an equilibrium mean length estimation approach to aggregated data would also be inappropriate given that the mortality estimates would represent the 1980s and not more recent year.

Red Hind

Prevalence in gear types and islands

A total of 24,864, 7,882, and 7,104 Red Hind lengths were measured in Puerto Rico, St. Croix, and St. Thomas/St. John, respectively. Handline (PR: 10193, STT: 1428, and STX: 3677), pot and traps (PR: 8601, STT: 5394, and STX: 2969), and diving/by hand/spears (PR: 4450 and STX: 1052) were the predominant gears with Red Hind lengths.

Length frequency and critical length (L_c)

Assuming a logistic relationship the length at 50% and full selection by island and gear type are as follows (Figure 29b - Figure 36b):

Island	Gear type	L50%	Lfull
Puerto Rico	Handlines	315mm FL	440mm FL
	Pots and traps	275mm FL	380mm FL
	By hand/dive/spear	325mm FL	430mm FL
St. Thomas/St. John	Handlines	325mm FL	420mm FL
	Pots and traps	325mm FL	420mm FL
St. Croix	Handlines	315mm FL	410mm FL
	Pots and traps	295mm FL	390mm FL
	By hand/dive/spears	280mm FL	360mm FL

Recommendations

Non-equilibrium and equilibrium mean lean approaches can be applied to the handline and pot and trap length data from Puerto Rico. Both time-series had a reduction in sample size in recent years; therefore. caution should be used when interpreting the absolute mortality estimates for recent years.

The non-equilibrium mean length estimator would be inappropriate applied to the handline data from St. Thomas given that there are few years with adequate sample size before 2010. An equilibrium approach could be applied to the 2010-2012 data to give some idea about mortality. The non-equilibrium mean length approach could be applied to the pot and trap data from St. Thomas and St. John.

The non-equilibrium mean length estimator would be inappropriate applied to the handline data from St. Croix given that the annual sample sizes are small between 1994 and 2012. Applying an equilibrium mean length estimation approach to aggregated data would also be inappropriate given that the mortality estimates would represent the 1980s and not more recent year. The same is true for the pot and trap data from St. Croix.

Mutton hamlet (accidental inclusion in report and can be ignored)

Prevalence in gear types and islands

A total of 296 Mutton Hamlet lengths were collected out in Puerto Rico. Mutton hamlet lengths were negligible in St. Thomas/St. John (6) and St. Croix (1). The predominant gear type with Mutton hamlet lengths was pots and traps (254 lengths). Between one and 15 lengths were collected from other gear types such as, dive/ by hand/ spear, gill_nets, handlines, haul seines, and pots and traps.

Length frequency and critical length (L_c)

Mutton hamlet length observations from pots and traps in Puerto Rico are intermittent over time, 1984-1989, 1991, 1993, 1997, 2008, and 2009) in the TIP database (Figure 30a). The majority of Mutton hamlet lengths were collected in 1986 (123 lengths) and 1987 (75 lengths) (Figure 30a). Assuming a logistic relationship the length at 50% and full selection were estimated to be ~205mm FL and ~260mm FL, respectively (Figure 30b).

Recommendations

Given the inconsistent time-series of Mutton hamlet lengths associated with pots and traps and Puerto Rico these data should not be applied to the non-equilibrium mean length estimator. Equilibrium mean length methods could be applied to these data if aggregated over time. A caveat of this application would be that the mortality estimate would reflect levels in 1986-1987. Application to equilibrium mean length methods also assumes that sampling was done in a way that is representative of the population length structure.

Lane snapper

Prevalence in gear types and islands

A total of 42402, 1236, and 312 Lane snapper lengths were collected in Puerto Rico, St. Thomas/St. John, and St. Croix, respectively. The predominant gear types in Puerto Rico were pots and traps (16237 lengths), handline (14003 lengths), longlines (5788 lengths), gill nets (3468 lengths), and haul seines (1533 lengths). The predominant gear type in St. Thomas was pots and traps (1204 lengths). The majority of lane snapper lengths collected in St. Croix were associated with pots and traps (280 lengths).

Length frequency and critical length (L_c)

The annual length frequency distributions for the predominant gear type and island combinations are shown in Figure 38a - Figure 44a.

Assuming a logistic relationship the length at 50% and full selection by island and gear type are as follows (Figure 38b - Figure 44b):

Island	Gear type	L50%	Lfull
Puerto Rico	Pots and traps	215mm FL	280mm FL
	Handlines	240mm FL	330mm FL
	Longlines	220mm FL	295mm FL
	Gill nets	265mm FL	320mm FL
	Haul seines	225mm FL	310mm FL
St. Thomas/St. John	Pots and traps	255mm FL	320mm FL
St. Croix	Pots and traps	245mm FL	300mm FL

Recommendations

Non-equilibrium and equilibrium mean length estimators could be used to obtain estimates of total mortality when applied to the length data for each of the predominant gear types in Puerto Rico given the relatively large annual sample sizes in most years.

Sample sizes were generally low in St. Thomas, except in 1985 (251 lengths), 1987 (170 lengths) and 2010 (209 lengths) (Figure 43a). This in combination with inconsistent sampling indicates that it is inappropriate to apply these data to the non-equilibrium mean length estimator. If a mean length method is applied to these data, an equilibrium approach may be more appropriate. The small annual sample sizes from the St. Croix pot and trap data make them inappropriate for use with mean length estimation approached (Figure 44a).

Silk snapper

Prevalence in gear types and islands

A total of 27782, 3385, and 1021 Silk snapper lengths were collected by TIP in Puerto Rico, St. Croix, and St. Thomas/St. John, respectively. The predominant gear types in Puerto Rico were handlines (18217 lengths), pots and traps (8675), trolling gear (435 lengths), and longline (332 lengths). The predominant gear types in St. Croix were handlines (2377 lengths) and longline (691 lengths). The predominant gear types in St. Thomas/St. John were pots and traps (547) and handlines (297 lengths).

Length frequency and critical length (L_c)

The annual length frequency histograms for Silk snapper and the predominant gear types by island are shown in Figure 45 - Figure 52.

Recommendation

Previous attempts to use the non-equilibrium mean length estimator have been carried out (SEDAR 2011b). Problems with changing selectivity complicated the interpretation of the results during the previous assessments. Mean length estimators assume constant, knife-edge selectivity. Given the problem with changing selectivity, application of these data to mean length estimators it is not recommended.

Queen snapper

Prevalence in gear types and islands

A total of 6602, 4517, and 217 Queen snapper lengths were collected by TIP in Puerto Rico, St. Croix, and St. Thomas/St. John, respectively. The predominant gear type in Puerto Rico was handline (6233 lengths). In St. Croix, handlines (3146 lengths) and longlines (1196) were the predominant gear types.

Length frequency and critical length (L_c)

The annual length frequency plots for the predominant gear type-island combinations are shown in Figure 53 - Figure 55. The majority of Queen snapper lengths collected from handline trips by TIP in Puerto Rico are from the late 1990s through 2013 (Figure 53a). An appreciable number of Queen snapper lengths were also measured in 1989, 1990, and 1991. The collection of Queen snapper lengths from handline intercepts in St. Croix has not been consistent over time (Figure 54a). The majority of lengths were collected between 1987 and 1995. There was a data gap between 1998 and 2007 and then a few hundred lengths were collected between 2008 and 2012(Figure 54a). The collection of Queen snapper lengths from longline intercepts in St. Croix has not been consistent over time There were data gaps between 1988 and 1991, 1997 and 2001, and 2010-present (Figure 55a).

Assuming a logistic relationship the length at 50% and full selection by island and gear type are as follows (Figure 53b - Figure 55b):

Island	Gear type	L50%	Lfull
Puerto Rico	Handlines	420mm FL	660mm FL
St. Croix	Handlines	375mm FL	530mm FL
	Longline	370mm FL	550mm FL

Recommendation

The annual length samples from the handline intercepts in Puerto Rico and St. Croix are adequate for use with mean length estimation appraoches. The non-eqilibirum mean length estimation approach has been applied to these data before (see SEDAR 2011a) and could be applied to these data again.

Yellowtail snapper

Prevalence in gear types and islands

A total of 94218, 11277, and 6765Yellowtail snapper lengths were collected by TIP in Puerto Rico, St. Thomas/St. John, and St. Croix, respectively. Yellowtail snapper intercepts in Puerto Rico were associated with a wide variety of gear types handlines (76619 lengths), haul seines (7017 lengths), pots and traps (6662 lengths), gill nets (1263 lengths), and trammel nets(1001 lengths). Yellowtail snapper intercepts in St. Thomas/St. John were associated with handlines (8480 lengths) and pots and traps (1333 lengths). Yellowtail snapper intercepts in St. Croix were associated with handlines (5140 lengths) and pots and traps (1566 lengths).

Length frequency and critical length (L_c)

The time-series of lengths measured in Puerto Rico was most consistent and had the greatest sample size from handlines followed by haul seines and pots and traps (Figure 56a - Figure 58a). Annual sample sizes associated with gill nets and trammel nets were generally less than 50 per year (Figure 59a - Figure 60a). The time-series with the greatest number of lengths measured during years when there was sampling in St. Thomas/St. John was from handlines, sample sizes associates with pots and traps was not as consistent annually and in most years was less than 40 measured lengths per year (Figure 61a). The greatest of length measurements associated with handlines intercepts from St. Croix were from early in the time-series (1983-1988) and later in the time-series (2008 - 2012).

Assuming a logistic relationship the length at 50% and full selection by island and gear type are as follows (Figure 56b - Figure 64b):

Island	Gear type	L50%	Lfull
Puerto Rico	Handlines	290mm FL	410mm FL
	Haul seines	245mm FL	340mm FL
	Pots and traps	240mm FL	335mm FL
	Gill nets	255mm FL	335mm FL
	Trammel nets	265mm FL	345mm FL
St. Thomas and St. John	Handlines	320mm FL	435mm FL
	Pots and traps	290mm FL	370mm FL
St. Croix	Handlines	320mm FL	440mm FL
	Pots and traps	265mm FL	350mm FL

Recommendations

The mean length estimation approaches can be applied to the data from the handline, haul seine, and pot and traps intercepts collected in Puerto Rico given adequate annual sample size. The annual sample sizes from the pot and trap intercepts decline after 2004, so mortality estimates representing the most years should be interpreted with caution.

The time-series of length data from the pot and trap intercepts from St. Thomas is short due to gaps in data collection over time; however, the annual sample size in the years of data collection seem adequate for application to mean length estimation approaches.

Vermillion snapper

Prevalence in gear types and islands

A total of 13008, 585, and 562Vermillion snapper lengths were collected by TIP in Puerto Rico, St. Thomas/St. John, and St. Croix, respectively. Vermillion snapper lengths in Puerto Rico were predominantly associated with handlines (9894 lengths) and pots and traps (2689 lengths). Approximately 394 Vermillion lengths were measured from pot and trap intercepts in St. Thomas/St. John and 400 Vermillion lengths were measured from handline intercepts in St.Croix.

Length frequency and critical length (L_c)

Figure 65 - Figure 68summarizes the annual length frequency data for Vermilion snapper for the predominant gear type and island combinations. In general, the time-series of lengths measured from handlines and pots and traps in Puerto Rico covers the majority of years between 1983 and 2013, where samples sizes associated with pots and traps declines in more recent years (Figure 65a - Figure 66a). The time-series and annual sample sizes for St. Thomas and St. Croix are relatively short and few (Figure 67a - Figure 68a).

Assuming a logistic relationship the length at 50% and full selection by island and gear type are as follows (Figure 65b - Figure 68b):

Island	Gear type	L50%	Lfull
Puerto Rico	Handlines	215mm FL	280mm FL
	Pots and traps	205mm FL	255mm FL
St. Thomas and St. John	Pots and traps	200mm FL	280mm FL
St. Croix	Handlines	280mm FL	370mm FL

Recommendations

Non-equilibrium and equilibrium mean length estimation approaches can be applied to the handline and pots and traps length data from Puerto Rico given the length of the time-series and annual sample sizes. One caveat is that for the pot and trap length data, annual sample sizes have declined (generally less than 40 lengths per year) since 1993. Mortality estimates from more recent years will likely not be accurate.

The time-series of the measured lengths from pot and trap intercepts in St. Thomas/St.John is relatively short and the samples sizes are small, except in 1987 when 200 Vermilion lengths were measured. The lack of a consistent time-series with relatively few annual lengths suggests that these data should not be applied to the non-equilibrium mean length estimator. Aggregating the data over all years and applying an equilibrium mean length estimator may give some indication of fishing mortality in 1987, but not the most recent years (Figure 67a).

The time-series of the measured lengths from handline intercepts in St. Croix is relatively short and the annual samples sizes are small (Figure 68a). The greatest number of lengths was measured in 1990 (100 lengths). The lack of a consistent time-series with relatively few annual lengths suggests that these data should not be applied to the non-equilibrium mean length estimator. Aggregating the data over all years and applying an equilibrium mean length estimator may give some indication of fishing mortality in 1990 and not the most recent years

Tripletail

Prevalence in gear types and islands

Tripletail length observations were measured in Puerto Rico only and intermittently between 1990 and 2010. A total of 263 tripletail lengths were measured, the majority (119) of which were collected in 2002 and were associated with handlines.

Length frequency and critical length (L_c)

The annual length frequency distributions for Tripletail caught by handlines in Puerto Rico are shown in Figure 69. This gear type had the longest time-series, seven years. Other gear types that captured Tripletail and were sampled by TIP were gillnets (one year of data), pots and traps (two years of data), and troll (six years of data). The only year with an appreciable amount of data for handline was 2002. All other years generally had anywhere from one to 30 lengths, this was also true for the other gear types.

Recommendation

The annual length data for Tripletail are relatively few and should not be applied to the non-equilibrium mean length estimator. Equilibrium methods could be used with the caveat that the mortality estimate would reflect levels in 2002. Application to equilibrium methods also assumes that sampling was done in a way that is representative of the population length structure.

White Grunt

Prevalence in gear types and islands

A total of 52004, 22299, and 3694 White grunt lengths were collected by TIP in Puerto Rico, St.Croix, and St. Thomas/St. John, respectively. White Grunt lengths measured in Puerto Rico were associated with a variety of gear types; pots and traps (29086 lengths), trammel nets (9171 lengths), handlines (7979 lengths), gill nets (3046 lengths), and haul_seines (1761 lengths). The predominant gear type with White grunt lengths in St. Croix was pots and traps (21631 lengths). The predominant gear type with White grunt lengths in St. Thomas/St.John was pots and traps (3620 lengths).

Length frequency and critical length (L_c)

Figure 70 - Figure 76 summarize the annual length frequency data for White grunt for the predominant gear type and island combinations. The time-series of measured lengths from Puerto Rico are relatively complete (Figure 70a - Figure 74a). Annual sample sizes are generally adequate, except for gill nets and haul seines (Figure 73a - Figure 74a). The time-series of measured lengths from the pot and trap intercepts collected in St. Croix is relatively complete, missing samples from 2004, 2005, 2012, and 2013, and annual sample sizes were generally large (Figure 75a). The time-series of measured lengths from the pot and trap intercepts collected in St. Thomas/St. John was relatively complete, missing years are years when sampling was not conducted (Figure 76a). The majority of samples from St. Thomas/St. John were collected between 1992 and 1996 and between 2005 and2013.

Assuming a logistic relationship the length at 50% and full selection by island and gear type are as follows (Figure 70b - Figure 76b):

Island	Gear type	L50%	Lfull
Puerto Rico	Pots and traps	205mm FL	270mm FL
	Trammel nets	215mm FL	260mm FL
	Handlines	230mm FL	290mm FL
	Gill nets	215mm FL	270mm FL
	Haul seines	195mm FL	260mm FL
St. Croix	Pots and traps	205mm FL	250mm FL
St. Thomas/St. John	Pots and traps	245mm FL	300mm FL

Recommendations

Non-equilibrium and equilibrium mean length estimation approaches could be applied to most of the island and gear combination mentioned in this section. Given the relatively low annual

sample sizes for the data associated with the gill net and haul seine data collected in Puerto Rico, the non-equilibrium method is not appropriate.

Great barracuda

Prevalence in gear types and islands

Great barracuda length observations were relatively rare in Puerto Rico (34 lengths) and St. Thomas/St. John (25 lengths). There was a total of 482 observed Great barracuda in St. Croix, 360 of which were caught by handlines. Of the 360 observations, 159 were intercepted in 1989. Generally less than 10 Great barracuda were intercepted in St. Croix in all other years.

Length frequency and critical length (L_c)

The annual length frequency distributions for Great barracuda caught by handlines in St. Croix are shown in Figure 77.

Recommendation

The annual length data for Great barracuda are relatively few and not consistently intercepted over time. The data should not be applied to the non-equilibrium mean length estimator. Equilibrium mean length methods could be used with the caveat that the mortality estimate would mainly reflect levels in 1989. Application to equilibrium methods also assumes that sampling was done in a way that is representative of the population length structure.

Hogfish

Prevalence in gear types and islands

The majority of measured lengths were in Puerto Rico (5718 lengths) followed by St. Thomas/ St. John (388 lengths). Hogfish length observations were rare in St. Croix (64 lengths). Hogfish lengths were predominantly associated with diving/ by hand/spears (4207 lengths in Puerto Rico. They were also associated with pots and traps (958 lengths), and trammel nets (276 lengths). Hogfish lengths in St. Thomas were associated with pots and traps (373 lengths).

Length frequency and critical length (L_c)

Figure 78 - Figure 81 summarize the measured lengths for the predominant island and gear combinations. In Puerto Rico the gear type with the greatest number of measured lengths was diving/by hand/spears and the majority of the measured lengths from this gear were measured between 1998 and 2013 (Figure 78a). The annual sample sizes associated with the pot and trap intercepts in Puerto Rico were relatively small, except in 1984 (157 lengths), and generally small after 1990 (Figure 79a). The annual sample sizes associated with the trammel net intercepts in Puerto Rico were relatively small (Figure 80a). The annual sample sizes associated with the pot and trap intercepts in St. Thomas/St. John were relatively small and ranged between two and 66 measured lengths (Figure 81a).

Assuming a logistic relationship the length at 50% and full selection by island and gear type are as follows (Figure 78b - Figure 81b):

Island	Gear type	L50%	Lfull
Puerto Rico	Diving/ by hand/spears	360mm FL	550mm FL
	Pots and traps	305mm FL	460mm FL
	Trammel nets	315mm FL	480mm FL
St. Thomas/St. John	Pots and traps	390mm FL	590mm FL

Recommendation

The length data from the diving/by hand/spear intercepts form Puerto Rico could be applied to the non-equilibrium and equilibrium mean length estimators. If a mean length approach will be applied to the other gear and island combination an equilibrium approach would be more appropriate, but the mortality estimates will generally reflect an early time period rather than more recent years.

Queen Parrotfish

Prevalence in gear types and islands

A total of 1240, 820, and 13 Queen parrotfish lengths were collected by TIP in Puerto Rico, St. Croix, and St. Thomas, respectively. The main gear type associated with Queen parrotfish in Puerto Rico was trammel nets (972 lengths). The main gear types associated with Queen parrotfish lengths in St. Croix were pots and traps (523 lengths) and gill nets (260 lengths).

Length frequency and critical length (L_c)

Figure 82- Figure 84 summarize the length data for the predominant gear and island combinations. The overall number of measured lengths for each combination resulted in generally low sample sizes.

Assuming a logistic relationship the length at 50% and full selection by island and gear type are as follows (Figure 82b- Figure 84b):

Island	Gear type	L50%	Lfull
Puerto Rico	Trammel nets	285mm FL	345mm FL
St. Croix	Pots and traps	295mm FL	380mm FL
	Gill nets	315mm FL	400mm FL

Recommendation

The annual sample sizes for the length data presented for Queen parrotfish are generally small making these data inappropriate for use in the non-equilibrium mean length estimator. The majority of lengths from the pot and traps intercepts in St. Croix were collected in 1987 and 1988. An equilibrium mean length approach could be applied to these data (aggregated), but the mortality estimates would be representative of the late 1980s and not recent years.

Redtail Parrotfish

Prevalence in gear types and islands

A total of 37971, 14015, and 2060 Redtail parrotfish lengths were collected by TIP in St. Croix, Puerto Rico, and St. Thomas, respectively. The majority of Redtail parrotfish lengths collected in St. Croix was associated with pots and traps (29387 lengths) followed by gill nets (5152 lengths) and diving/ by hand/ spear (3172 lengths). In Puerto Rico, Red tail parrotfish length measurements were mainly from trammel nets (7658 lengths) and pots and traps (4637 lengths) followed by gill nets (706 lengths) and dive/by hand/spears (476 lengths). In St. Thomas, the Redtail parrotfish length measurements were mainly from pots and traps.

Length frequency and critical length (L_c)

Figure 85 - Figure 92 summarize the Redtail parrotfish length data for the predominant island and gear combinations. The annual sample sizes from the pots and trap intercepts in St. Croix are consistently large over time, except in 2011 (Figure 85a). The time-series from the gill net intercepts in St. Croix is short, 1993-2010 with missing years in 1999, 2004-2009 (Figure 86a). The time-series from the dive/by hand/spear intercepts in St. Croix is short1996-2011 with missing years in 1997-2001 and 2005-2006 (Figure 87a). The annual sample sizes from the trammel net intercepts from Puerto Rico are generally large (Figure 88a). The length samples from the pot and trap intercepts are generally large until 2004 (Figure 89a). The length samples from the gill net and dive/by hand/spear intercepts are generally small (Figure 90a - Figure 91a). The annual sample sizes fluctuated over time, with large sample sizes between 1984 and 1986, between 1993 and 1994, 2002, between 2009 and 2012 (Figure 92a).

Assuming a logistic relationship the length at 50% and full selection by island and gear type are as follows (Figure 82b- Figure 92b):

Island	Gear type	L50%	Lfull
Puerto Rico	Trammel nets	265mm FL	310mm FL
	Pots and traps	245mm FL	305mm FL
	Gill nets	255mm FL	310mm FL
	Dive/by hand/spears	280mm FL	340mm FL

Island	Gear type	L50%	Lfull
St. Thomas/St. John	Pots and traps	270mm FL	325mm FL
St. Croix	Pots and traps	245mm FL	285mm FL
	Gill nets	265mm FL	320mm FL
	Dive/by hand/spears	265mm FL	315mm FL

Recommendations

The non-equilibrium mean length estimation approach is not recommended for the length data from the gill net and dive/by and/spear intercepts from Puerto Rico. The non-equilibrium and equilibrium mean length estimation approaches could be applied to all other gear and island combinations.

Stoplight Parrotfish

Prevalence in gear types and islands

A total of 27966, 16894, and 1851 Stoplight parrotfish lengths were collected by TIP in St. Croix, Puerto Rico, and St. Thomas, respectively. The main gear types associated with the Stoplight parrotfish length measurements from St. Croix were pots and traps (22957), dive/by hand/ spears (2605 lengths), and gill nets (2270 lengths). The main gear types associated with the Stoplight parrotfish length measurements were trammel nets (10895 lengths), pots and traps (2806 lengths), gill nets(1734 lengths), and dive/ by hand/spears (1219 lengths) in Puerto Rico. The majority of the lengths in St. Thomas were associated with pots and traps (1806 lengths).

Length frequency and critical length (L_c)

Figure 93 - Figure 100 summarize the length data from the predominant island and gear combinations. The number of lengths measured annually from the pot and trap intercepts in St. Croix was adequate between 1983 and 1994 and was followed by years of small sample size (Figure 93a). The majority of length samples from the dive/by hand/spear intercepts were from 2007 – 2010, with no samples in 2011-2013 (Figure 94a). The time-series from the gill net intercepts in St. Croix was short (1993-2003 and 2010), sample size was relatively large in most years except 1996, 2000, and 2010 (Figure 95a). The number of lengths measured annually from the trammel net intercepts in Puerto Rico were generally adequate over the time-series (Figure 96a).The number of lengths measured annually from the pot and trap intercepts in Puerto Rico were generally small except early in the time series between 1986 and 1994 (Figure 97a). The number of lengths measured annually from the gill net intercepts in Puerto Rico were generally small except in 1985 (857 lengths), 1988 (171 lengths) , 1989 (165 lengths) and 1990 (147 lengths) (Figure 98a). The number of measured lengths from the pot and trap intercepts in St. Thomas were generally small, except in 1985 (179 lengths), 1986 (135 lengths), and between 2009 and 2012 (162, 318, 208, and 140 lengths) (Figure 100a).

Assuming a logistic relationship the length at 50% and full selection by island and gear type are as follows (Figure 93b- Figure 100b):

Island	Gear type	L50%	Lfull
Puerto Rico	Trammel nets	265mm FL	330mm FL
	Pots and traps	255mm FL	325mm FL
	Gill nets	265mm FL	330mm FL
	Dive/by hand/spear	285mm FL	350mm FL
St. Thomas	Pots and traps	285mm FL	360mm FL
St. Croix	Pots and traps	270mm FL	330mm FL
	Gill nets	280mm FL	350mm FL
	Dive/By hand/spear	275mm FL	340mm FL

Recommendations

The length data needed for non-equilibrium mean length estimator seems adequate for the following combinations; St. Croix and pots and traps and Puerto Rico trammel nets. Equilibrium mean length estimators could also be applied. All other island-gear combinations have small sample sizes in more recent years, application of mean length estimators could yield mis-leading estimates of mortality.

Queen triggerfish

Prevalence in gear types and islands

A similar numbers of Queen triggerfish were measured in Puerto Rico (8924 lengths), St. Croix (8790 lengths), and St. Thomas/St. John (8394 lengths). There were four predominant gear types with Queen triggerfish lengths in Puerto Rico; pots and traps (5170 lengths), dive/by hand/spears (1498 lengths), trammel nets (1051 lengths), and handlines (930 lengths). The majority of Queen triggerfish lengths were associated with pots and traps (7790 lengths) in St. Croix, followed by dive/by hand/spears (648 lengths). The majority of lengths in St. Thomas were from pots and trap intercepts (8051 lengths).

Length frequency and critical length (L_c)

Figure 101a - Figure 106a summarize the length frequency data for the dominant island and gear combinations for Queen triggerfish. The annual numbers of measured lengths from the pot and trap intercepts in Puerto Rico were greatest between 1983 and 1993 (Figure 101a). After 1993 there was a general reduction in the number of Queen triggerfish lengths collected , exceptions include 1999 (157 lengths), 2004 (141 lengths), and 2011 (280 lengths). The majority of measured lengths from the dive/by hand/spear intercepts were collected after 1996; however,

annual sample size is marginal in most years (Figure 102a). Annual sample sizes from the trammel net intercepts and the handline intercepts are marginal over time (Figure 103a - Figure 104a).

Annual sample size was acceptable between 1983 and 2002 and declined after 2002 (Figure 105a). The time-series of lengths from the dive/by hand/spear intercepts was very short with large gaps between years with data (Figure 106a). The majority of length data is from between 2008 and 2010. The time-series of lengths from the dive/by hand/spear intercepts was very short with large gaps between years with data (Figure 106a). The majority of length data is from between 2008 and 2010.

The annual sample size from the pot and trap intercepts collected in St. Thomas and St. John was generally good in the years when data were collected (Figure 107).

Assuming a logistic relationship the length at 50% and full selection by island and gear type are as follows (Figure 101b - Figure 106b):

Island	Gear type	L50%	Lfull
Puerto Rico	Pots and traps	275mm FL	395mm FL
	Dive/By hand/Spears	310mm FL	410mm FL
	Trammel nets	255mm FL	320mm FL
	Handlines	315mm FL	455mm FL
St. Thomas	Pots and traps	310mm FL	395mm FL
St. Croix	Pots and traps	265mm FL	345mm FL
	Dive/By hand/spear	285mm FL	355mm FL

Recommendation

The sample size from the pot and trap intercepts collected in Puerto Rico seem adequate for application to the mean length estimators. Annual sample size declined after 1996, estimates of total mortality for the time period after 1996 should be interpreted with caution. The annual sample sizes are marginal for the other three predominant gear types in Puerto Rico.

The sample size from the pot and trap intercepts collected in St. Croix seem adequate for application to the mean length estimators. Annual sample size declined after 2002, estimates of total mortality for the time period after 2002 should be interpreted with caution. Given the short time-series of length data associated with the dive/by hand/spear intercepts, an equilibrium mean length estimator could be applied to the more recent years of data to get a mortality estimate that reflects more recent years (2008-2010).

The annual sample sizes from the pot and trap intercepts from St. Thomas seem adequate for application to the mean length estimation approaches.

Blackfin tuna

Prevalence in gear types and islands

Blackfin tuna intercepts were greatest in Puerto Rico (2639 length) followed by St. Croix (594 lengths) and St. Thomas/ St. John (11). The predominant gear type capturing Blackfin tuna in Puerto Rico was trolling gear (2204 lengths) followed by handlines (360 lengths). Blackfin were also caught by haul seines (13 lengths) and trammel nets (62 lengths). In St. Croix, Blackfin tuna were observed in handline (254 lengths), pots and traps (150 lengths), and trolling gear (190 lengths) intercepts.

Length frequency and critical length (L_c)

The majority of Blackfin tuna length samples from trolling gear intercepts were collected in Puerto Rico between 1999 and 2013 (Figure 108a). The Blackfin tuna length samples from handlines intercepts collected in Puerto Rico are relatively small on an annual basis (Figure 109a). The time-series of lengths collected form handline intercepts in St. Croix wass short (1983-1991, 1994, 2010-2011) and the number of measured lengths was generally less than 50 per year (Figure 110a). There were only two years of length measurements for Blackfin tuna from pot and trap intercepts, 1984 and 1985 (Figure 111a). The time-series of measured lengths from the troll intercepts in St. Croix was also short, 1984-1994, with few lengths (Figure 112a).

Recommendation

The number of Blackfin tuna lengths measured annually for the majority of the island-gear combinations are small and it is inappropriate to apply these data to mean length estimation approaches. The length data collected from trolling gear intercepts has samples from the 2000s are of adequate sample size, but in most recent years, 2010-2013, the sample sizes are quite small. These data could be applied to mean length estimation approaches, but the interpretation of the mortality estimates would not likely reflect the most recent years accurately.

King mackerel

Prevalence in gear types and islands

King mackerel length observations were relatively few in St. Croix (88 lengths) and St. Thomas/ St. John (159 lengths). A total of 8997 lengths were measured in Puerto Rico. The predominant gear types were handlines (7032 lengths) and trolling gear (1310 lengths).

Length frequency and critical length (L_c)

Figure 113 and Figure 114 summarize the length data from the handline and trolling intercepts collected in Puerto Rico. The length at 50% selectivity for handline is ~750mm FL and the length at full selectivity is 1140mm FL (Figure 113a). The length at 50% selectivity for trolling gear is ~675mm FL and the length at full selectivity is 1130mm FL (Figure 114a).

Recommendation

The time-series and annual sample sizes from the handline intercepts from Puerto Rico seem adequate for application to non-equilibrium or equilibrium mean length estimators.

Cero mackerel

Prevalence in gear types and islands

There were relatively few Cero mackerel length measurements from St. Thomas (75 lengths) and St. Croix (39 lengths). A total of 5223 Cero mackerel length measurements were collected by TIP in Puerto Rico. The predominant gear types were handlines (2537 lengths), troll (1256 lengths), and haul seines (862 lengths).

Length frequency and critical length (L_c)

Figure 115 - Figure 117 summarize the annual length data for the predominant island-gear combinations. The time-series of measured lengths from the handline intercepts in Puerto Rico shows that sample size has fluctuated over time with the majority of lengths being measured between 1998 and 2006 (Figure 115). The number of length measured annually from tolling gear intercepts was generally small (less than 50 lengths) except in 1991 (129 lengths), 1991 (194 lengths), 1994 (116 lengths), 1999 (102 lengths) and 2005 (255 lengths) (Figure 116a). The number of lengths collected annually from haul seine intercepts in Puerto Rico was generally small, except in 1989 and 1990 when 269 and 280 lengths were measured, respectively (Figure 117a).

The length at 50% selectivity for handline is ~530mm FL and the length at full selectivity is ~825mm FL (Figure 115b). The length at 50% selectivity for trolling gear is ~580mm FL and the length at full selectivity is ~980mm FL (Figure 116b). The length at 50% selectivity for haul seines is ~215mm FL and the length at full selectivity is ~520mm FL (Figure 117b).

Recommendations

The data from the handline and trolling gear intercepts in Puerto Rico could be applied to mean length estimation approaches; however, the data from the haul seine intercepts are inadequate.

Wahoo

Prevalence in gear types and islands

Wahoo intercepts were greatest in Puerto Rico (675 length) followed by St. Croix (434 lengths) and St. Thomas/ St. John (16). The predominant gear types in Puerto Rico and St. Croix were handlines and trolling gear. A total of 106 and 555 Wahoo lengths were intercepted from handline and trolling trips, respectively, in Puerto Rico. A total of 219 and 139 Wahoo lengths were intercepted from handline and trolling trips in St. Croix.

Length frequency and critical length (L_c)

The annual length frequency distributions for wahoo caught in Puerto Rico by handlines and trolling gear are shown in Figure 118 and Figure 119. The annual length frequency distributions for wahoo caught in St. Croix by handlines and trolling gear are shown in Figure 120 and Figure 121. Samples are intermittent from the 1980s to 2013 and annual sample sizes are generally small in Puerto Rico (Figure 118, Figure 119). The same is generally true for St. Croix (Figure 120 and Figure 121). There is an absence of wahoo intercepts from trolling gear in St. Croix since 1994 (Figure 121).

Recommendations

Given the small annual sample sizes these data are not recommended for application to the mean length estimator approaches.

Dolphin

Prevalence in gear types and islands

A total of 3571 and 930 Dolphin length measurements were collected by TIP in Puerto Rico and St. Croix, respectively. Very few Dolphin length measurements (30 lengths) were collected by TIP in St. Thomas. The majority of lengths (3236 lengths) were collected from trolling gear intercepts in Puerto Rico. In St. Croix, a total of 506, 242, and 168 Dolphin length measurements were collected from handline, pots and traps, and trolling gear intercepts.

Length frequency and critical length (L_c)

The length data from the trolling gear intercepts in Puerto Rico are shown in Figure 116a. The majority of the lengths were collected from 1999 to 2013 (Figure 122a). The length at 50% selectivity and length at full selection, assuming a logistic relationship, are approximately 890mm FL and 1240mm FL (Figure 122b).

Recommendation

The annual sample sizes between 1999 and 2013 seem adequate for application to the mean length estimation approaches.

Crevalle jack

Prevalence in gear types and islands

Very few Crevalle jack length measurements were collect by TIP in any of the islands. A total of 242, 19, and 3 Crevalle jack length measurements were collected in Puerto Rico, St. Thomas/St. John, and St. Croix, respectively. Given the small, overall sample sizes these data are not recommended for use.

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Tables

Table 1. The number and percentage of length types as reported in the TIP database by island.

	Island					
	Number of lengths			Percentage		
Length type	Puerto Rico	St. Thomas and St. John	St. Croix	Puerto Rico	St. Thomas and St. John	St. Croix
FORK LENGTH	495947	77076	262169	91.454%	84.365%	90.035%
CARAPACE LENGTH	44266	11648	20317	8.163%	12.750%	6.977%
TOTAL LENGTH	1693	1003	8624	0.312%	1.098%	2.962%
SHELL LENGTH	240	43	6	0.044%	0.047%	0.002%
CARAPACE WIDTH	106	25	64	0.020%	0.027%	0.022%
LOG LENGTH	33			0.006%	0.000%	0.000%
STANDARD LENGTH	5	1559		0.001%	1.706%	0.000%
CLAW LENGTH	1			0.000%	0.000%	0.000%
CURVED FORK LENGTH		1	3	0.000%	0.001%	0.001%
LIP THICKNESS,CONCH		5		0.000%	0.005%	0.000%
NO LENGTH			2	0.000%	0.000%	0.001%
Grand Total	542291	91360	291185			

Table 2. The number and percentage of length types used when measuring finfish as reported in the TIP database by island.

	Island					
	Number of lengths			Percentage		
Length type	Puerto Rico	St. Thomas and St. John	St. Croix	Puerto Rico	St. Thomas and St. John	St. Croix
FORK LENGTH	495947	77076	262169	99.659%	96.782%	96.814%
TOTAL LENGTH	1693	1003	8624	0.340%	1.259%	3.185%
STANDARD LENGTH	5	1559		0.001%	1.958%	0.000%
CURVED FORK LENGTH		1	3	0.000%	0.001%	0.001%
Grand Total	497645	79639	270796			

Table 3. Gear names found in TIP and the gear groupings used in previous assessments.

gear_name	new_gearname
BY HAND	dive_byhand_spear
BY HAND, DIVING GEAR	dive_byhand_spear
SKIN DIVING	dive_byhand_spear
SPEARS	dive_byhand_spear
SPEARS, DIVING	dive_byhand_spear
SPEARS, TONGS, GRABS	dive_byhand_spear
LINES HAND	hook_line
LINES POWER TROLL OTHER	hook_line
REEL, ELECTRIC OR HYDRAULIC	hook_line
REEL, MANUAL	hook_line
ROD AND REEL	hook_line
ROD AND REEL, ELECTRIC (HAND)	hook_line
TROLL LINE, MANUAL	hook_line
GRABS, HOOKS	hook_other
HOOKS, SPONGE	hook_other
BUOY GEAR, VERTICAL	longline
LINES LONG DRIFT WITH HOOKS	longline
LINES LONG SET WITH HOOKS	longline
LINES LONG, REEF FISH	longline
FYKE AND HOOP NETS	nets
GILL NETS, DRIFT, RUNAROUND	nets
GILL NETS, OTHER	nets
LAMPARA & RING NETS	nets
TRAMMEL NETS	nets
BAG NETS	nets
CAST NETS	nets
DIP NETS	nets
ENCIRCLING NETS (PURSE)	nets
ENTANGLING NETS (GILL) UNSPC	nets
HAUL SEINES	nets
POTS & TRAPS, LOBSTER INSHORE	pots_traps
POTS AND TRAPS, BOX TRAP	pots_traps
POTS AND TRAPS, CMB	pots_traps
POTS AND TRAPS, FISH	pots_traps
POTS AND TRAPS, OCTOPUS	pots_traps
POTS AND TRAPS, SHRIMP	pots_traps
POTS AND TRAPS, SPINY LOBSTER	pots_traps
FLOATING TRAPS (SHALLOW)	pots_traps
	unspecified
NOT CODED	unspecified
UNSPECIFIED GEAR	unspecified

Table 4. Gear names found in US Caribbean TIP database and the gear groupings recommended for SEDAR 46.

gear_name	new_gearname
BY HAND	dive_byhand_spear
BY HAND, DIVING GEAR	dive_byhand_spear
SKIN DIVING	dive_byhand_spear
SPEARS	dive_byhand_spear
SPEARS, DIVING	dive_byhand_spear
POTS AND TRAPS, CMB	pots_traps
POTS AND TRAPS, FISH	pots_traps
POTS AND TRAPS, SPINY LOBSTER	pots_traps
FLOATING TRAPS (SHALLOW)	pots_traps
LINES HAND	Handline
REEL, ELECTRIC OR HYDRAULIC	Handline
ROD AND REEL, ELECTRIC (HAND)	Handline
LINES POWER TROLL OTHER	Troll
REEL, MANUAL	Troll
ROD AND REEL	Troll
TROLL LINE, MANUAL	Troll
GRABS, HOOKS	hook_other
HOOKS, SPONGE	hook_other
BUOY GEAR, VERTICAL	longline
LINES LONG DRIFT WITH HOOKS	longline
LINES LONG SET WITH HOOKS	longline
LINES LONG, REEF FISH	longline
GILL NETS, DRIFT, RUNAROUND	Gill_net
GILL NETS, OTHER	Gill_net
ENTANGLING NETS (GILL) UNSPC	Gill_net
FYKE AND HOOP NETS	FYKE AND HOOP NETS
TRAMMEL NETS	TRAMMEL NETS
CAST NETS	CAST NETS
DIP NETS	DIP NETS
ENCIRCLING NETS (PURSE)	ENCIRCLING NETS (PURSE)
HAUL SEINES	HAUL SEINES

Table 5. Percentage of TIP interviews reporting secondary gear type. Percentages are shown for each island and gear type. These numbers reflect the assumption that if a secondary gear type was unspecified or recorded as NA, a single gear type was used.

Island	Primary gear	Total number of interviews	Percentage of interviews reporting secondary gear
PUERTO RICO	cast_nets	849	0.000%
	dive_byhand_spear	51102	0.391%
	gill_net	26719	2.305%
	handline	190375	0.781%
	haul_seines	27512	0.000%
	longline	7988	0.901%
	pots_traps	168921	3.759%
	trammel_nets	52552	0.590%
	troll	15862	1.576%
STT_STJ	dive_byhand_spear	899	0.000%
	encircling_nets_purse	1627	1.537%
	handline	16421	1.614%
	haul_seines	2414	1.243%
	longline	510	5.882%
	pots_traps	77384	2.648%
	troll	1374	2.984%
STX	dive_byhand_spear	22898	0.611%
	gill_net	18637	2.704%
	handline	30234	2.451%
	pots_traps	231463	3.039%
	troll	2615	12.772%
	trammel_nets	4394	0.000%
	longline	5571	6.570%

Table 6. Number of interviews and lengths reported by fishing area from vessels intercepted by the TIP in St. Croix, USVI from 1981 to 2012. Lengths have not been collected in St. Croix since 2012.

AREA_1	AREANAME_1	% Total Interviews	% Total lengths
51100	St. Croix - Unknown	24.58%	27.28%
51100.1	St. Croix - North West	0.14%	0.04%
51100.2	St. Croix - North East	20.58%	19.58%
51100.3	St. Croix - South East	1.57%	2.14%
51100.4	St. Croix - South West	4.31%	2.62%
51101	St. Croix - North	0.55%	0.48%
51102	St. Croix - East	8.87%	2.36%
51103	St. Croix - South	1.33%	0.22%
51104	St. Croix - West	0.05%	0.01%
51203	St. John - South	0.02%	0.00%
51300.4	St. Thomas - South West	0.07%	0.06%
52100.1	St. Croix C1	2.77%	1.45%
52100.2	St. Croix C2	2.99%	2.07%
52100.3	St. Croix C3	4.41%	4.16%
52100.4	St. Croix C4	23.57%	34.85%
52100.5	St. Croix C5	3.33%	2.31%
52100.6	St. Croix C6	0.84%	0.36%
	Total		

Table 7. Number of interviews and lengths reported by fishing area from vessels intercepted by the TIP in St. Thomas and St. John, USVI from 1980 to 2013. TIP data were not collected in 1982, 1989-1990, 1997-2001, and 2007.

AREA_1	AREANAME_1	% Total Interviews	% Total lengths
51100	St. Croix - Unknown	0.05%	0.07%
51101	St. Croix - North	0.10%	0.05%
51200	St. John - Unknown	1.73%	0.47%
51200.2	St. John - Southeast	1.41%	2.58%
51200.3	St. John - Southwest	0.89%	1.41%
51201	St. John - North	0.52%	0.41%
51202	St. John - East	0.63%	0.87%
51203	St. John - South	3.24%	3.83%
51300	St. Thomas - Unknown	34.92%	27.49%
51300.1	St. Thomas - North West	6.85%	7.74%
51300.2	St. Thomas - North East	8.31%	8.11%
51300.3	St. Thomas - South East	6.33%	9.65%
51300.4	St. Thomas - South West	12.13%	21.35%
51301	St. Thomas - North	12.49%	6.27%
51302	St. Thomas - East	1.57%	0.54%
51303	St. Thomas - South	7.21%	5.77%
51304	St. Thomas - West	0.42%	0.46%
51400.1	British Virgin Islands	0.99%	2.65%
51500	Puerto Rico	0.16%	0.28%
52100.2	St. Croix C2	0.05%	0.02%
	Total		

Table 8. Reef fish species in the TIP database from the USVI

ITIS code	Species name	Scientific name	Classification
166170	squirrelfishes, holocentridae	holocentridae	reef
166172	squirrelfish	holocentrus adscensionis	reef
166173	longspine squirrelfish,holocen	holocentrus rufus	reef
166175	longjaw squirrelfish	holocentrus marianus	reef
166211	blackbar soldierfish	myripristis jacobus	reef
166409	cornetfishes	aulostomidae	reef
167674	groupers and sea basses, serra	serranidae	reef
167694	groupers, epinephelus	epinephelus	reef
167695	goliath grouper, e. itajara	epinephelus itajara	reef
167696	rock hind	epinephelus adscensionis	reef
167699	yellowedge grouper	epinephelus flavolimbatus	reef
167700	red hind	epinephelus guttatus	reef
167702	red grouper	epinephelus morio	reef
167703	misty grouper	epinephelus mystacinus	reef
167706	nassau grouper	epinephelus striatus	reef
167740	coney	cephalopholis fulva	reef
167741	graysby	epinephelus cruentatus	reef
167743	marbled grouper	epinephelus inermis	reef
167758	groupers, mycteroperca	mycteroperca spp.	reef
167759	gag	mycteroperca microlepis	reef
167760	black grouper	mycteroperca bonaci	reef
167762	yellowmouth grouper	mycteroperca interstitialis	reef
167764	yellowfin grouper	mycteroperca venenosa	reef
167767	tiger grouper	mycteroperca tigris	reef
167838	creole-fish	paranthias furcifer	reef
167857	tattler	serranus phoebe	reef
167859	tobaccofish	serranus tabacarius	reef
167861	chalk bass	serranus tortugarum	reef
167990	greater soapfish	rypticus saponaceus	reef
168178	bigeye,priacanthus arenatus	priacanthus arenatus	reef
168181	glasseye snapper	heteropriacanthus cruentatus	reef
168845	snappers, lutjanidae	lutjanidae	reef
168847	cubera snapper	lutjanus cyanopterus	reef
168848	gray snapper	lutjanus griseus	reef
168849	mutton snapper	lutjanus analis	reef
168850	schoolmaster	lutjanus apodus	reef

Table 8 continued

ITIS code	Species name	Scientific name	Classification
168852	blackfin snapper	lutjanus buccanella	reef
168853	red snapper,lutjanus campechan	lutjanus campechanus	reef
168857	dog snapper,lutjanus jocu	lutjanus jocu	reef
168858	mahogany snapper	lutjanus mahogoni	reef
168859	caribbean red snapper	lutjanus purpureus	reef
168860	lane snapper	lutjanus synagris	reef
168861	silk snapper	lutjanus vivanus	reef
168899	black snapper	apsilus dentatus	reef
168902	queen snapper,etelis oculatus	etelis oculatus	reef
168907	yellowtail snapper,ocyurus chr	ocyurus chrysurus	reef
168909	vermilion snapper	rhomboplites aurorubens	reef
168913	wenchman	pristipomoides aquilonaris	reef
168915	cardinal snapper	pristipomoides macrophthalmus	reef
169055	grunts, haemulidae	haemulidae	reef
169058	tomtate,haemulon aurolineatu	haemulon aurolineatum	reef
169059	white grunt	haemulon plumieri	reef
169060	margate	haemulon album	reef
169061	black grunt	haemulon bonariense	reef
169063	caesar grunt	haemulon carbonarium	reef
169064	smallmouth grunt	haemulon chrysargyreum	reef
169065	french grunt	haemulon flavolineatum	reef
169066	spanish grunt	haemulon macrostomum	reef
169067	cottonwick	haemulon melanurum	reef
169069	bluestriped grunt	haemulon sciurus	reef
169073	striped grunt	haemulon striatum	reef
169074	sailors choice	haemulon parra	reef
169077	pigfish	orthopristis chrysoptera	reef
169079	orthopristis ruber	orthopristis ruber	reef
169084	black margate	anisotremus surinamensis	reef
169314	jackknife-fish	equetus lanceolatus	reef
169317	spotted drum	equetus punctatus	reef
169325	reef croaker	odontoscion dentex	reef
169406	goat fishes, mullidae	mullidae	reef
169408	yellow goatfish	mulloidichthys martinicus	reef
169417	red goatfish,mullus auratus	mullus auratus	reef
169421	spotted goatfish	pseudupeneus maculatus	reef
169554	butterflyfishes, chaetodontida	chaetodontidae	reef
169556	spotfin butterflyfish	chaetodon ocellatus	reef
169558	foureye butterflyfish	chaetodon capistratus	reef

Table 8 continued

ITIS code	Species name	Scientific name	Classification
169563	banded butterflyfish	chaetodon striatus	reef
169623	queen angelfish	holacanthus ciliaris	reef
169625	rock beauty	holacanthus tricolor	reef
169626	blue angelfish	holacanthus bermudensis	reef
169632	gray angelfish	pomacanthus arcuatus	reef
169633	french angelfish	pomacanthus paru	reef
170044	damselfishes, pomacentridae	pomacentridae	reef
170046	sergeant major	abudefduf saxatilis	reef
170084	brown chromis,chromis multilin	chromis multilineata	reef
170178	dusky damselfish	pomacentrus fuscus	reef
170445	threadfins, polynemidae	polynemidae	reef
170477	wrasses, labridae	labridae	reef
170484	spanish hogfish	bodianus rufus	reef
170503	slippery dick	halichoeres bivittatus	reef
170506	yellowhead wrasse	halichoeres garnoti	reef
170507	clown wrasse	halichoeres maculipinna	reef
170510	puddingwife	halichoeres radiatus	reef
170566	hogfish	lachnolaimus maximus	reef
170809	parrotfishes, scaridae	scaridae	reef
170811	blue parrotfish	scarus coeruleus	reef
170812	midnight parrotfish	scarus coelestinus	reef
170813	striped parrotfish	scarus croicensis	reef
170814	rainbow parrotfish	scarus guacamaia	reef
170815	princess parrotfish	scarus taeniopterus	reef
170816	queen parrotfish	scarus vetula	reef
170863	redband parrotfish	sparisoma aurofrenatum	reef
170864	redtail parrotfish	sparisoma chrysopterum	reef
170866	redfin parrotfish	sparisoma rubripinne	reef
170867	stoplight parrotfish	sparisoma viride	reef
172250	tangs, acanthuridae	acanthuridae	reef
172252	ocean surgeon	acanthurus bahianus	reef
172253	doctorfish,acanthurus chirurgu	acanthurus chirurgus	reef
172254	blue tang	acanthurus coeruleus	reef
173128	triggerfishes and filefishes,b	balistidae	reef
173131	orange filefish	aluterus schoepfi	reef
173133	unicorn filefish	aluterus monoceros	reef
173134	scrawled filefish	aluterus scriptus	reef
173138	gray triggerfish	balistes capriscus	reef

Table 8 continued

ITIS code	Species name	Scientific name	Classification
173139	queen triggerfish	balistes vetula	reef
173157	whitespotted filefish,canthe.m	cantherhines macrocerus	reef
173158	orangespotted filefish	cantherhines pullus	reef
173170	ocean triggerfish	canthidermis sufflamen	reef
173174	black durgon	melichthys niger	reef
173184	pygmy filefish	monacanthus setifer	reef
173187	sargassum triggerfish	xanthichthys ringens	reef
173235	trunkfishes, ostraciidae	ostraciidae	reef
173237	trunkfish	lactophrys trigonus	reef
173238	spotted trunkfish	lactophrys bicaudalis	reef
173239	smooth trunkfish	lactophrys triqueter	reef
173240	scrawled cowfish, acanthostrac	acanthostracion quadricornis	reef
173246	honeycomb cowfish	acanthostracion polygonius	reef
173382	porcupinefishes, diodontidae	diodontidae	reef
173391	porcupinefish,diodon hystrix	diodon hystrix	reef
173392	balloonfish	diodon holocanthus	reef

Table 9 Reef-associated species in the TIP database from the USVI

ITIS code	Species name	Scientific name	Classification
97646	spiny lobsters, palinuridae	palinuridae	reef-associate
97648	caribbean spiny lobster	panulirus argus	reef-associate
97651	spotted spiny lobster	panulirus guttatus	reef-associate
97652	smoothtail spiny lobster	panulirus laevicauda	reef-associate
97676	spanish slipper lobster	scyllarides aequinoctialis	reef-associate
160433	lemon shark	negaprion brevirostris	reef-associate
161160	morays, muraenidae	muraenidae	reef-associate
161180	viper moray	enchelycore nigricans	reef-associate
161186	green moray	gymnothorax funebris	reef-associate
161188	spotted moray,gymnothorax mori	gymnothorax moringa	reef-associate
166416	tobacco trumpetfish	fistularia tabacaria	reef-associate
166704	scorpionfishes, scorpaenidae	scorpaenidae	reef-associate
166825	spotted scorpionfish	scorpaena plumieri	reef-associate
166862	reef scorpionfish	scorpaenodes caribbaeus	reef-associate
167746	mutton hamlet	cephalopholis afer	reef-associate

Table 9 continued

ITIS code	Species name	Scientific name	Classification
168196	cardinalfishes, apogonidae	apogonidae	reef-associate
168204	flamefish	apogon maculatus	reef-associate
168548	sand tilefish	malacanthus plumieri	reef-associate
168584	jacks, carangidae	carangidae	reef-associate
168606	yellow jack,caranx bartholomae	caranx bartholomaei	reef-associate
168609	crevalle jack	caranx hippos	reef-associate
168610	horse-eye jack	caranx latus	reef-associate
168612	blue runner,caranx crysos	caranx crysos	reef-associate
168613	black jack	caranx lugubris	reef-associate
168614	bar jack	caranx ruber	reef-associate
168684	atlantic moonfish	selene setapinnis	reef-associate
168688	amberjacks	seriola	reef-associate
168689	greater amberjack	seriola dumerili	reef-associate
168709	permit	trachinotus falcatus	reef-associate
168710	palometa,trachinotus goodei	trachinotus goodei	reef-associate
169028	striped mojarra	diapterus plumieri	reef-associate
169032	yellowfin mojarra	gerres cinereus	reef-associate
169086	porkfish	anisotremus virginicus	reef-associate
169090	barred grunt,conodon nobilis	conodon nobilis	reef-associate
169180	scups or porgies, sparidae	sparidae	reef-associate
169189	sheepshead	archosargus probatocephalus	reef-associate
169190	sea bream	archosargus rhomboidalis	reef-associate
169195	porgies, calamus	calamus	reef-associate
169197	jolthead porgy	calamus bajonado	reef-associate
169198	saucereye porgy	calamus calamus	reef-associate
169202	porgy, calamus pennatula	calamus pennatula	reef-associate
169203	littlehead porgy	calamus proridens	reef-associate
169205	sheepshead porgy	calamus penna	reef-associate
169206	red porgies,pagrus	pagrus	reef-associate
169207	red porgy	pagrus pagrus	reef-associate
169503	sea chubs, kyphosidae	kyphosidae	reef-associate
169505	yellow chub	kyphosus incisor	reef-associate
169506	bermuda chub	kyphosus sectatrix	reef-associate
170424	barracudas, sphyraenidae	sphyraenidae	reef-associate
170428	guaguanche	sphyraena guachancho	reef-associate
170429	great barracuda	sphyraena barracuda	reef-associate
170430	southern sennet	sphyraena picudilla	reef-associate
172564	butterfish and harvestfish	peprilus	reef-associate
172570	harvestfish,peprilus alepidotu	peprilus paru	reef-associate

Table 9 continued

ITIS code	Species name	Scientific name	Classification
173285	smooth puffer	lagocephalus laevigatus	reef-associate
173300	bandtail puffer	sphoeroides spengleri	reef-associate
173386	web burrfish	chilomycterus antillarum	reef-associate

Table 10. Species classified as other or not classified in the TIP database from the USVI

ITIS code	Species name	Scientific name	Classification
72558	pink or queen conch	strombus gigas	other
73006	king helment	cassis tuberosa	other
79118	mollusks, two shell,bivalvia	bivalvia	other
79881	mangrove oyster	crassostrea rhizophorae	other
159785	sharks and rays, chondrichthye	chondrichthyes	other
159814	sixgill sharks, hexanchidae	hexanchidae	other
159826	bigeyed sixgill shark	hexanchus vitulus	other
159844	bigeyed sevengill shark	heptranchias perlo	other
159854	rhincodontidae	rhincodontidae	other
159859	wobbegongs, orectolobidae	orectolobidae	other
159901	mackerel sharks, lamnidae	lamnidae	other
159924	shortfin mako	isurus oxyrinchus	other
159977	nurse shark	ginglymostoma cirratum	other
160178	requiem sharks, carcharhinidae	carcharhinidae	other
160189	tiger shark	galeocerdo cuvier	other
160206	caribbean sharpnose shark	rhizoprionodon porosus	other
160230	smooth dogfish	mustelus canis	other
160234	florida smoothhound	mustelus norrisi	other
160268	dusky shark	carcharhinus obscurus	other
160275	bull shark	carcharhinus leucas	other
160318	blacktip shark	carcharhinus limbatus	other
160336	reef shark	carcharhinus perezii	other
160424	blue shark	prionace glauca	other
160497	hammerhead sharks, sphyrnidae	sphyrnidae	other
160508	scalloped hammerhead	sphyrna lewini	other

Table 10 continued

ITIS code	Species name	Scientific name	Classification
160515	great hammerhead	sphyrna mokarran	other
160806	skates and rays,rajiformes	rajiformes	other
160946	stingrays, dasyatidae	dasyatidae	other
160951	southern stingray	dasyatis americana	other
160978	spotted eagle ray,aetobatus na	aetobatus narinari	other
160992	manta ray	manta birostris	other
161030	finfish, unclassified	osteichthyes	other
161094	longnose gar	lepisosteus osseus	other
161111	ladyfish	elops saurus	other
161116	tarpon	megalops atlanticus	other
161119	bonefishes, albulidae	albulidae	other
161121	bonefish	albula vulpes	other
161748	atlantic thread herring	opisthonema oglinum	other
161753	false pilchard	harengula clupeola	other
161754	redear sardine	harengula humeralis	other
161755	scaled sardine,harengula jagua	harengula jaguana	other
161762	herrings,sardinella	sardinella	other
161838	striped anchovy	anchoa hepsetus	other
161848	slough anchovy	anchoa delicatissima	other
161861	bocon	cetengraulis edentulus	other
163350	goldfish	carassius auratus	other
163995	north american freshwater catf	ictaluridae	other
163998	graceful catfish	ictalurus punctatus	other
164037	white catfish	ameiurus catus	other
164518	frogfishes, antennariidae	antennariidae	other
164520	sargassumfish	histrio histrio	other
165460	ballyhoo	hemiramphus brasiliensis	other
165461	balao	hemiramphus balao	other
167642	snooks, centropomidae	centropomidae	other
167645	swordspine snook	centropomus ensiferus	other
167646	fat snook	centropomus parallelus	other
167647	tarpon snook	centropomus pectinatus	other
167648	snook	centropomus undecimalis	other
167914	wreckfish	polyprion americanus	other

Table 10 continued

ITIS code	Species name	Scientific name	Classification
168141	bluegill	lepomis macrochirus	other
168160	largemouth bass	micropterus salmoides	other
168163	redeye bass	micropterus coosae	other
168176	bigeyes, priacanthidae	priacanthidae	other
168195	longfin bulleye	cookeolus japonicus	other
168541	blackline tilefish	caulolatilus cyanops	other
168544	goldface tilefish	caulolatilus chrysops	other
168546	tilefish	lopholatilus chamaeleonticeps	other
168559	bluefish,pomatomus saltatrix	pomatomus saltatrix	other
168564	cobias, rachycentridae	rachycentridae	other
168566	cobia	rachycentron canadum	other
168567	sharksuckers, echeneididae	echeneidae	other
168571	remora	remora remora	other
168575	sharksucker	echeneis naucrates	other
168602	african pompano	alectis ciliaris	other
168670	atlantic bumper	chloroscombrus chrysurus	other
168677	bigeye scad	selar crumenophthalmus	other
168691	almaco jack	seriola rivoliana	other
168738	rainbow runner	elagatis bipinnulata	other
168789	dolphins, coryphaenidae	coryphaenidae	other
168790	dolphins,coryphaena	coryphaena	other
168791	dolphin	coryphaena hippurus	other
168792	pompano dolphin	coryphaena equisetis	other
169007	tripletail	lobotes surinamensis	other
169093	burro grunt	pomadasys crocro	other
169810	blue tilapia	tilapia aurea	other
169857	peacock cichlid	cichla ocellaris	other
170333	mullets, mugilidae	mugilidae	other
170338	liza,mugil liza	mugil liza	other
170341	mullet, mugil dussumieri	mugil dussumieri	other
172364	oilfish	ruvettus pretiosus	other
172374	purple snake mackerel	promethichthys prometheus	other
172378	ribbonfishes, trichiuridae	trichiuridae	other
172385	atlantic cutlassfish	trichiurus lepturus	other
172398	mackerels and tunas, scombrida	scombridae	other
172399	little tunas	euthynnus	other
172401	skipjack tuna	katsuwonus pelamis	other
172402	little tunny	euthynnus alletteratus	other

Table 10 continued

ITIS code	Species name	Scientific name	Classification
172409	atlantic bonito	sarda sarda	other
172419	longfinned albacore	thunnus alalunga	other
172421	bluefin tuna	thunnus thynnus	other
172423	yellowfin tuna	thunnus albacares	other
172427	blackfin tuna	thunnus atlanticus	other
172428	bigeye tuna	thunnus obesus	other
172434	king,spanish,cero mackerels,sc	scomberomorus	other
172435	king mackerel	scomberomorus cavalla	other
172436	spanish mackerel,scomberomor.m	scomberomorus maculatus	other
172437	cero mackerel	scomberomorus regalis	other
172451	wahoo	acanthocybium solandri	other
172455	bullet mackerel	auxis rochei	other
172482	swordfish	xiphias gladius	other
172486	marlin,sailfish,spearfish - is	istiophoridae	other
172488	sailfish	istiophorus platypterus	other
172491	blue marlin,makaira nigricans	makaira nigricans	other
172499	white marlin	tetrapturus albidus	other
172554	man-of-war fish	nomeus gronovii	other
82595	octopuses,octopus	octopus	
82610	caribbean reef octopus	octopus briareus	
83677	crustacea	crustacea	
95599	crustaceans,decapoda	decapoda	
95603	penaeid shrimp,penaeus	penaeus	
97322	african lobster	metanephrops	
98417	spider crabs, majidae	majidae	
98524	channel clinging crab	mithrax spinosissimus	
98691	speckled swimming crab	arenaeus cribrarius	
98695	swimming crabs	callinectes	
98897	batwing coral crab	carpilius corallinus	
99128	blue land crab	cardisoma guanhumi	
161127	american eel	anguilla rostrata	
161299	sapphire eel	cynoponticus savanna	
161700	herrings, clupeidae	clupeidae	
161932	chubs, coregonus	coregonus	
162374	lizardfishes, synodontidae	synodontidae	
162377	sand diver,synodus intermedius	synodus intermedius	
164576	shortnose batfish	ogcocephalus nasutus	
164807	cusk eels, ophidiidae	ophidiidae	
164818	bearded brotula,brotula barbat	brotula barbata	

Table 10 continued

ITIS code	Species name	Scientific name	Classification
165431	flyingfishes and halfbeaks, ex	exocoetidae	
165447	atlantic flyingfish,cypselur.m	cypselurus melanurus	
165474	silverstripe halfbeak	hyporhamphus unifasciatus	
165546	needlefishes, belonidae	belonidae	
165548	flat needlefish	ablennes hians	
165577	houndfish	tylosurus crocodilus	
165585	keeltail needlefish	platybelone argalus	
165903	rainbowfish,poecilia reticulat	poecilia reticulata	
165920	green swordtail	xiphophorus helleri	
166006	hardhead silverside	atherinomorus stipes	
166124	beardfishes	polymixiidae	
166126	beardfish	polymixia lowei	
166127	stout beardfish	polymixia nobilis	
166443	seahorses, syngnathidae	syngnathidae	
166883	firefish	pterois volitans	
167624	flying gurnard,dactylopterus v	dactylopterus volitans	
167793	sand perch	diplectrum formosum	
167798	spanish flag	gonioplectrus hispanus	
167813	hypoplectrus puella	hypoplectrus puella	
167870	neoscombrops	neoscombrops	
168138	warmouth	lepomis gulosus	
168154	redear sunfish	lepomis microlophus	
168537	tilefishes, malacanthidae	malacanthidae	
168562	scombrops	scombrops	
168673	leatherjacket,oligoplites saur	oligoplites saurus	
168680	lookdown	selene vomer	
168724	mackerel scad	decapterus macarellus	
168725	round scad	decapterus punctatus	
168746	cottonmouth jack	uraspis secunda	
169013	mojarras, gerreidae	gerreidae	
169016	silver jenny	eucinostomus gula	
169027	mojarra, diapterus rhombeus	diapterus rhombeus	
169192	spottail pinfish	diplodus holbrooki	
169237	drums, sciaenidae	sciaenidae	
169244	mongolar drummer	cynoscion jamaicensis	
169265	ronco	bairdiella ronchus	
169285	whitemouth drummer	micropogonias furnieri	
169298	sand drum	umbrina coroides	
169537	spadefishes, ephippididae	ephippididae	

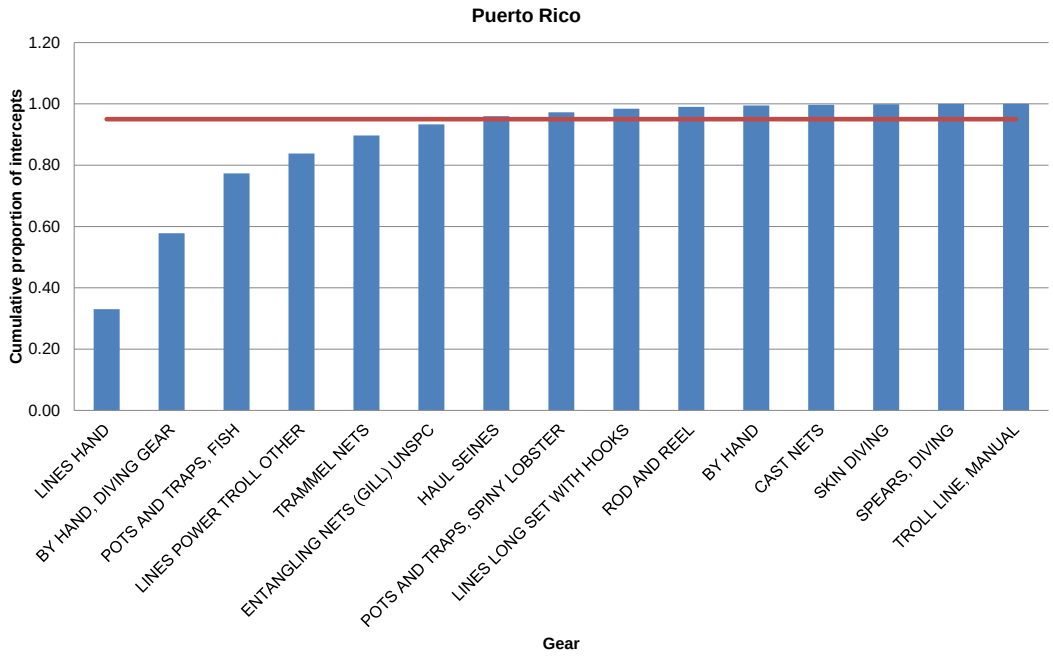
Table 10 continued

ITIS code	Species name	Scientific name	Classification
169539	atlantic spadefish	chaetodipterus faber	
170287	pomfrets, bramidae	bramidae	
170305	eumegistus	eumegistus	
170311	bigscale pomfret,taractichthys	taractichthys longipinnis	
170355	mountain mullet	agonostomus monticola	
170399	bobo jotur	joturus pichardi	
170448	barbu	polydactylus virginicus	
170537	pearly razorfish	hemipteronotus novacula	
171832	violet goby	gobioides broussonnetii	
171919	fat sleeper	dormitator maculatus	
171932	spinycheek sleeper	eleotris pisonis	
171959	sirajo	sicydium plumieri	
172707	flatfishes,pleuronectoidei	pleuronectoidei	
172714	lefteyed flounders, bothidae	bothidae	
172759	peacock flounder	bothus lunatus	
173062	blackcheek tonguefish	symphurus plagiusa	
641870	neoscombrops atlanticus	neoscombrops atlanticus	
645459	red rover	emmelichthys ruber	

Figures

Figure 1. The cumulative proportion of total TIP intercepts in Puerto Rico over time (1980-2013) by a) gear type as reported in the database and b) aggregated gear type. Red line shows the cumulative proportion of 0.95. N = 17513.

a)



b)

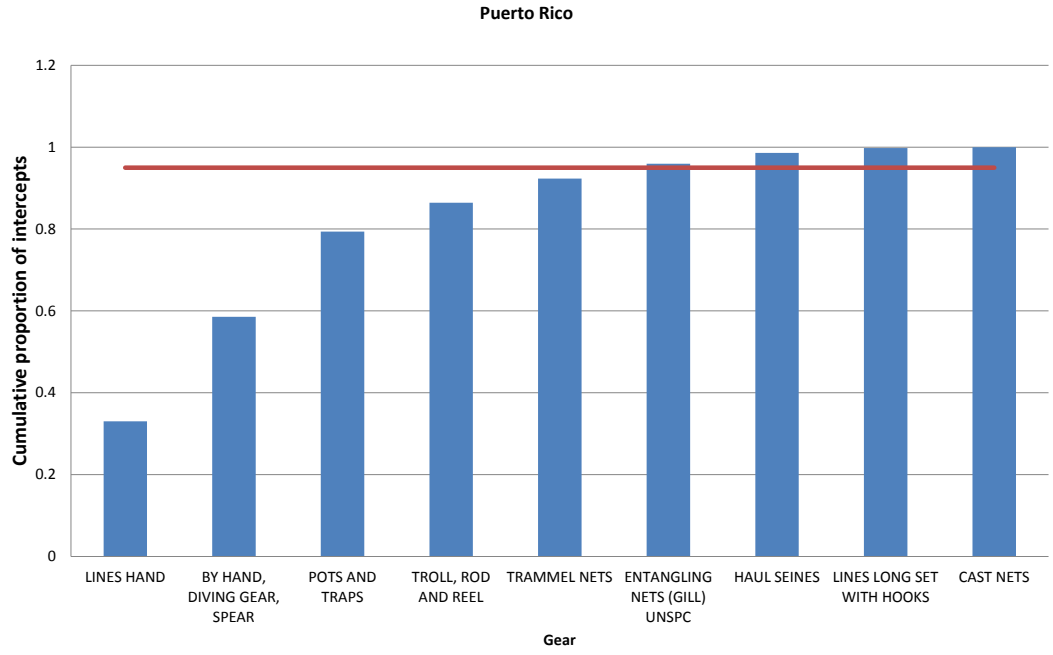
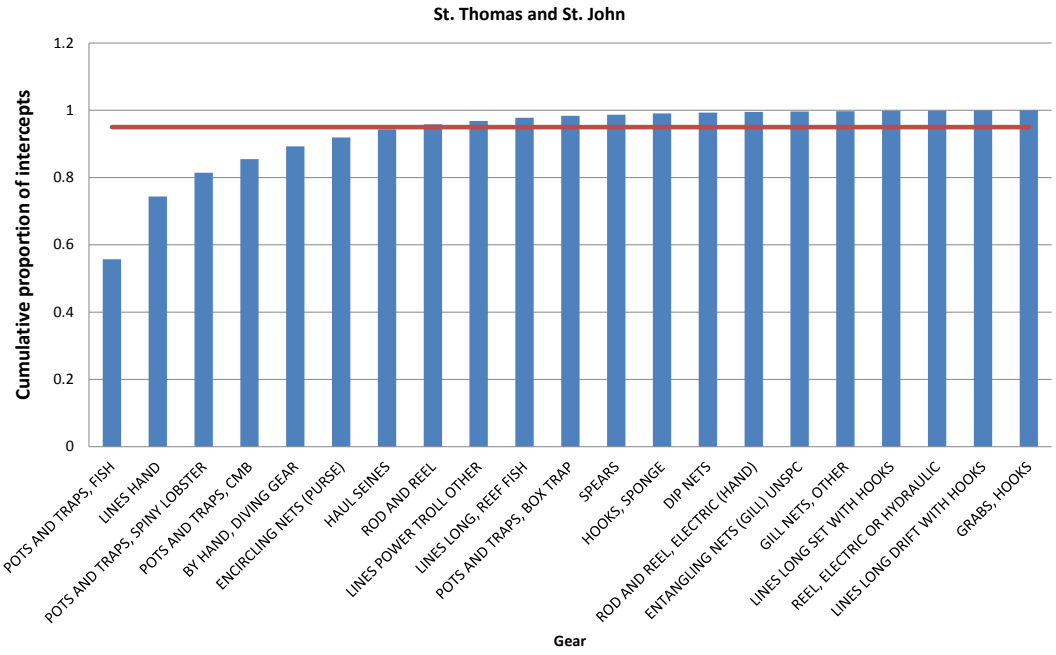


Figure 2. The cumulative proportion of total TIP intercepts in St. Thomas and St. John over time (1980-2013) by a) gear type as reported in the database and b) aggregated gear type. Red line shows the cumulative proportion of 0.95. N = 1929.

a)



b)

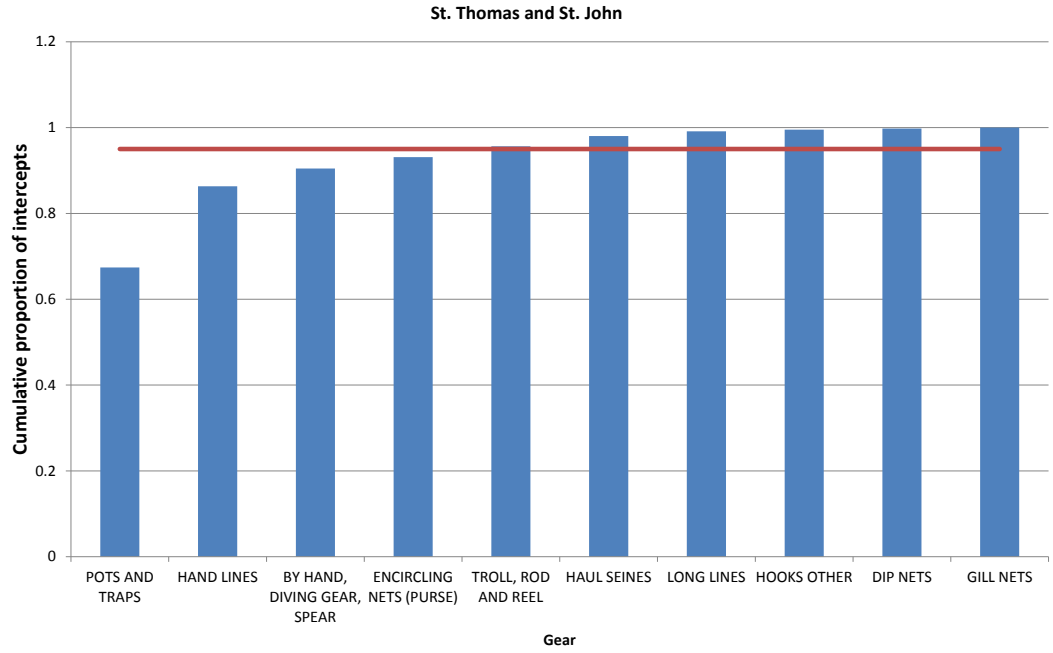
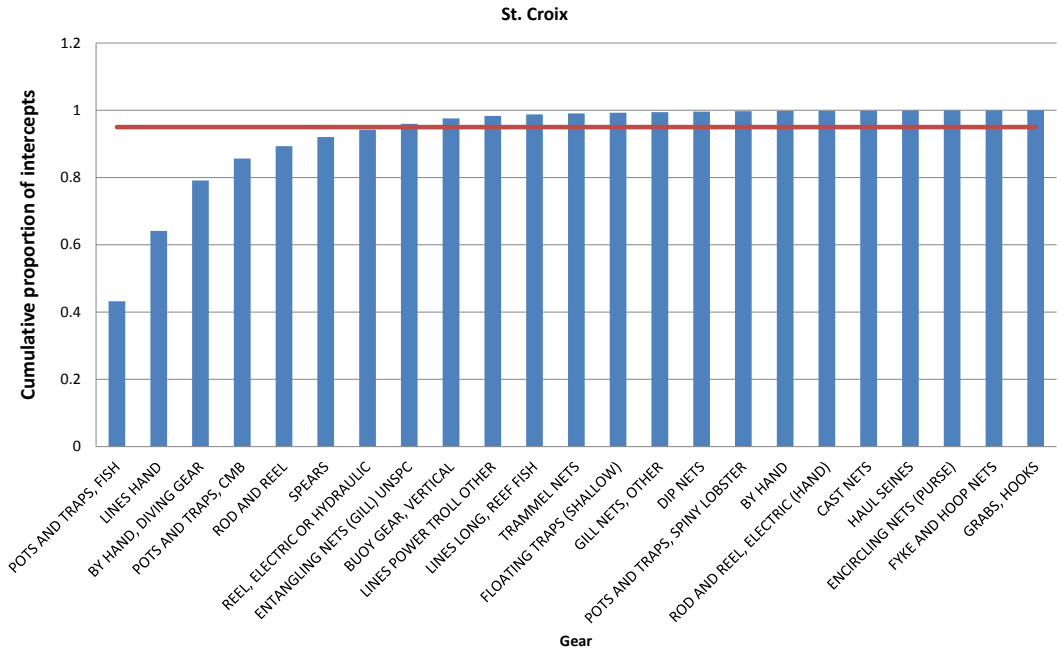


Figure 3. The cumulative proportion of total TIP intercepts in St. Croix over time (1980-2013) by a) gear type as reported in the database and b) aggregated gear type. Red line shows the cumulative proportion of 0.95. N = 4151.

a)



b)

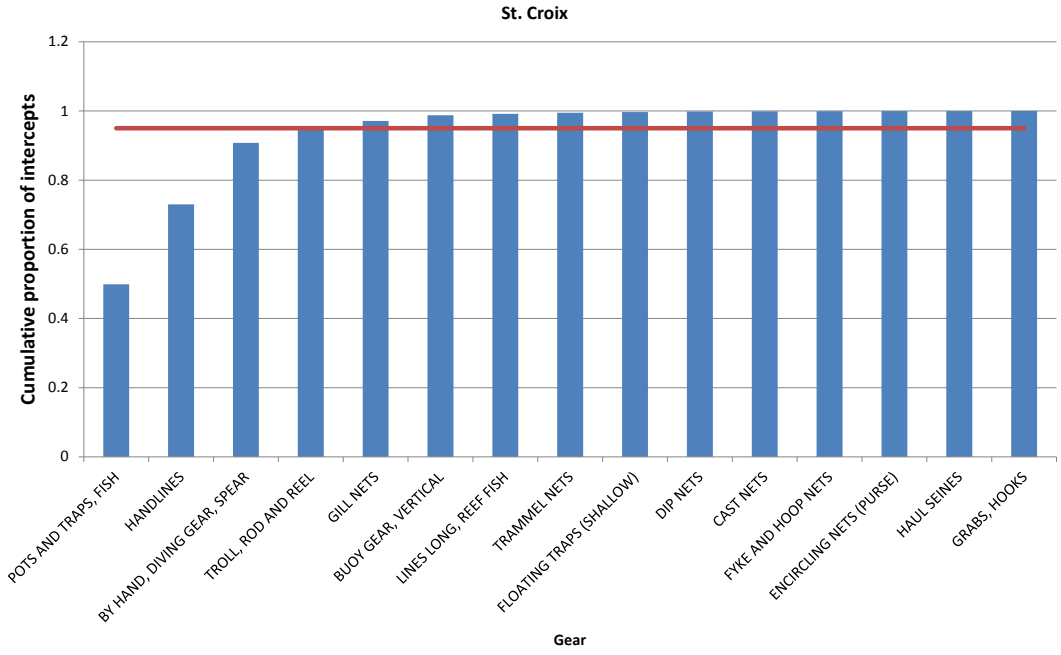


Figure 4. Time-series of the number of TIP intercepts by predominant gear types and island.

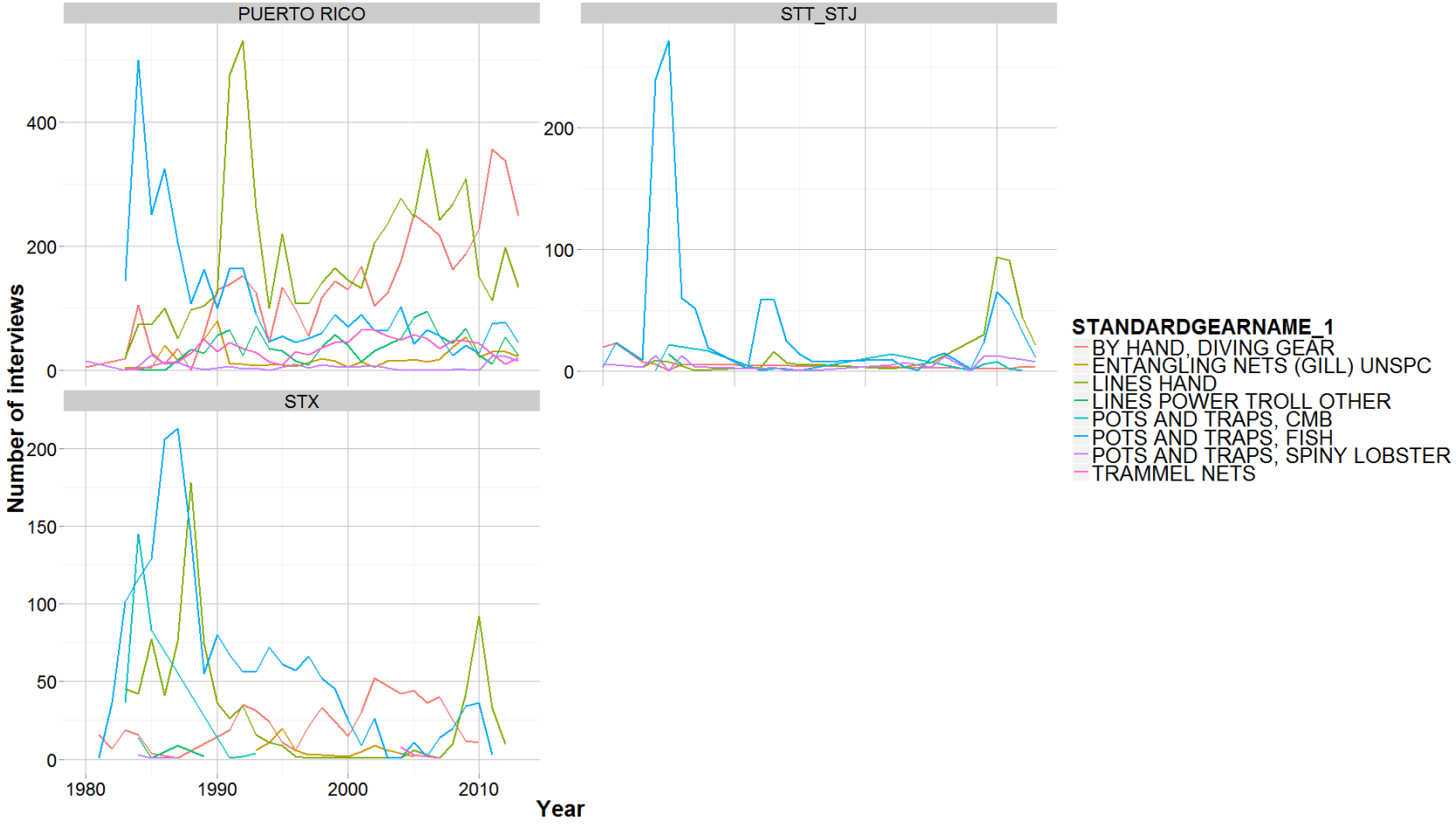


Figure 5. St. Croix fishing area map (1974-1989, 1990-1992, 1994-2005).

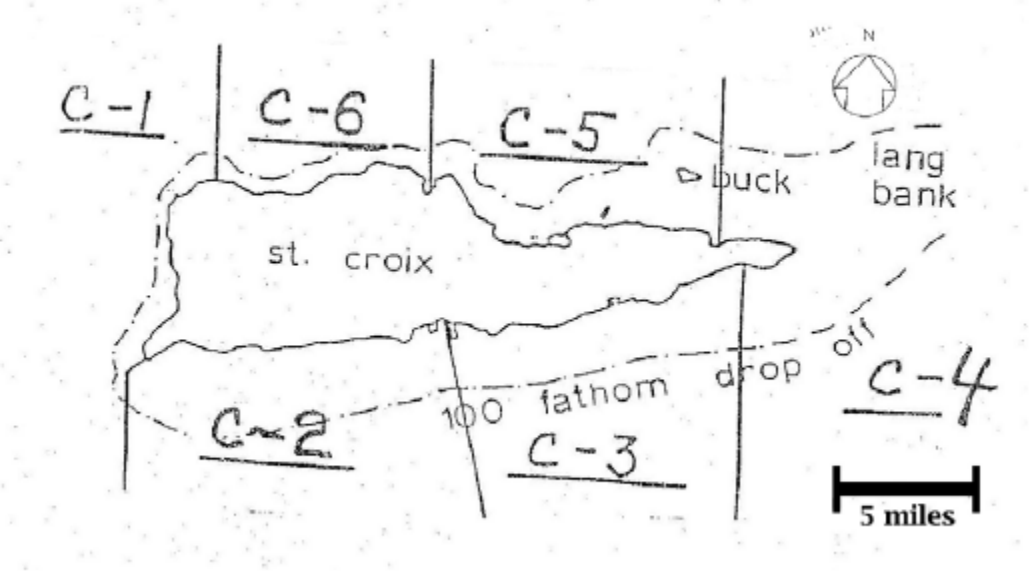


Figure 6. St. Croix fishing area map (1987-1988, 1989-1990, 1992-1994).

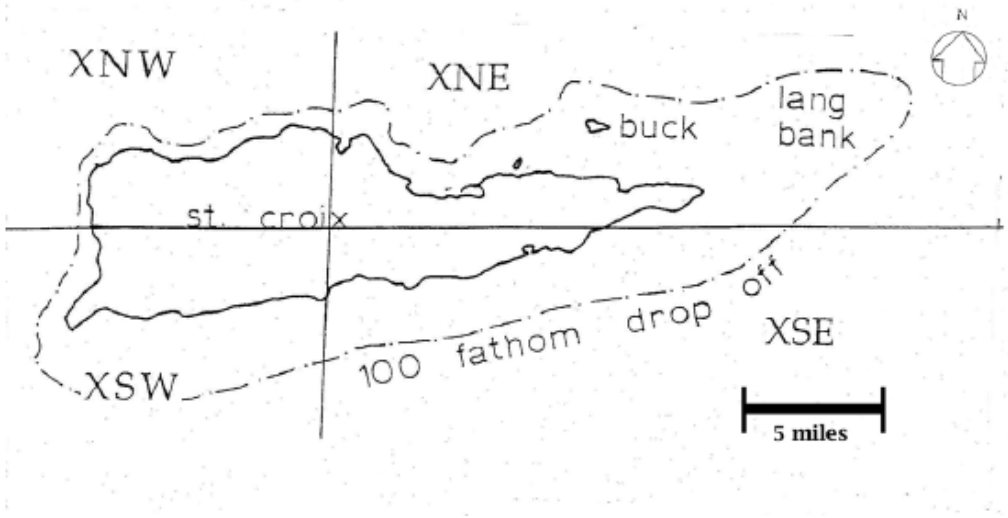


Figure 7. St. Croix biological grid map created as part of the US Caribbean data improvement project (Implemented in 2012). Each grid represents a 2.5 x 2.5 minute area.

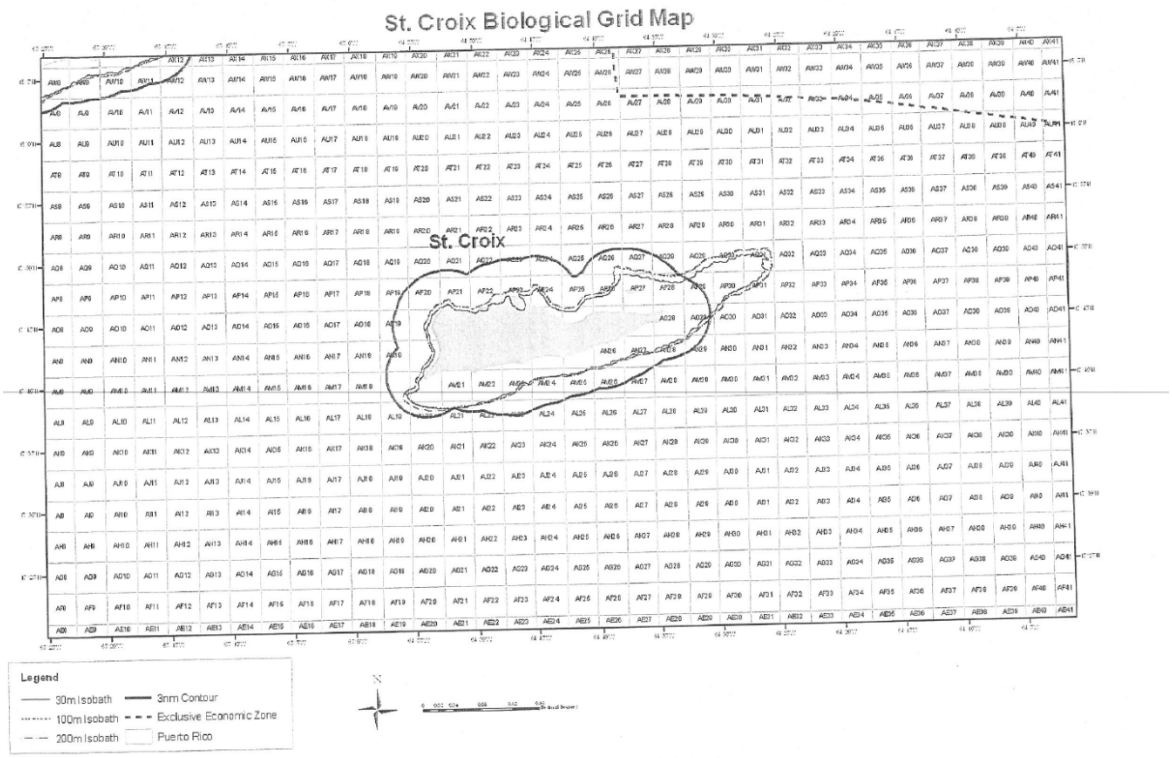


Figure 8. The number of TIP interviews in St. Croix and the fishing areas recorded over time.

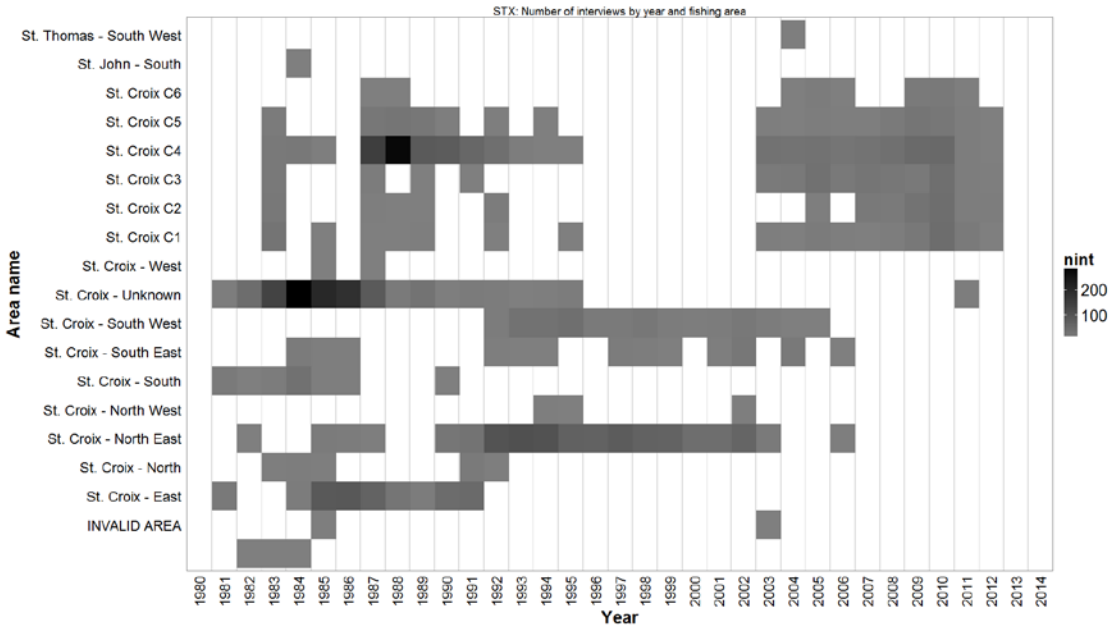


Figure 9. St. Thomas and St. John fishing area map (1974-1989, 1990-1992, 1997-1998).

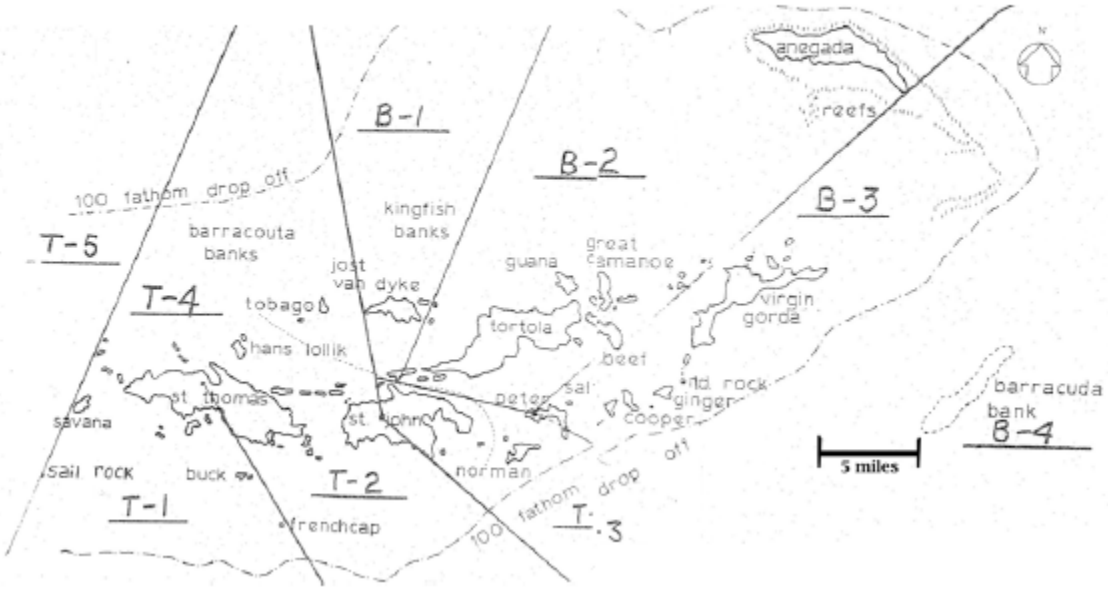


Figure 10. St. Thomas and St. John fishing area map (1987-1990).

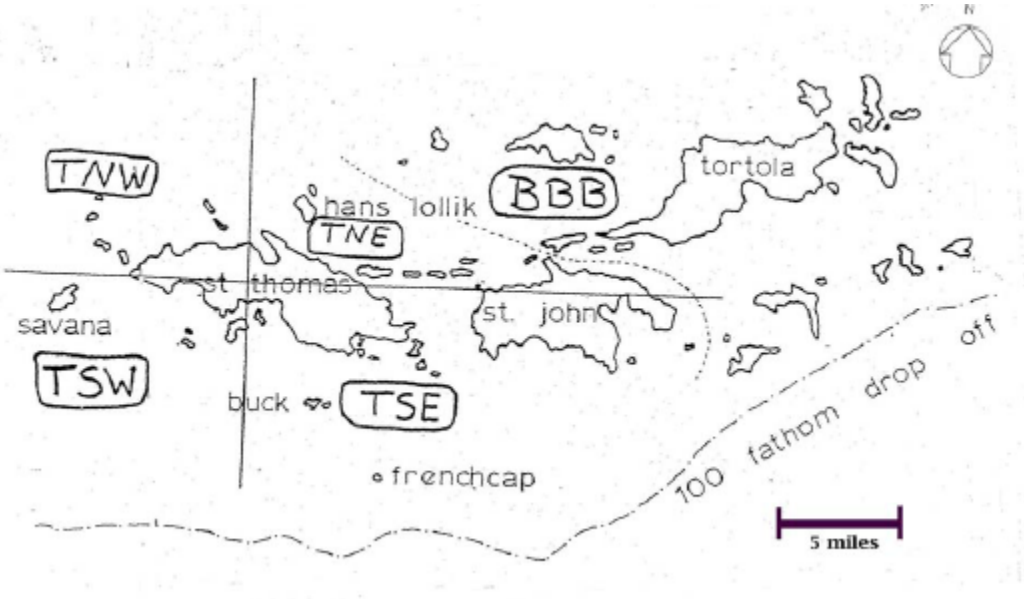


Figure 11. St. Thomas and St. John fishing area map (1992-1994).

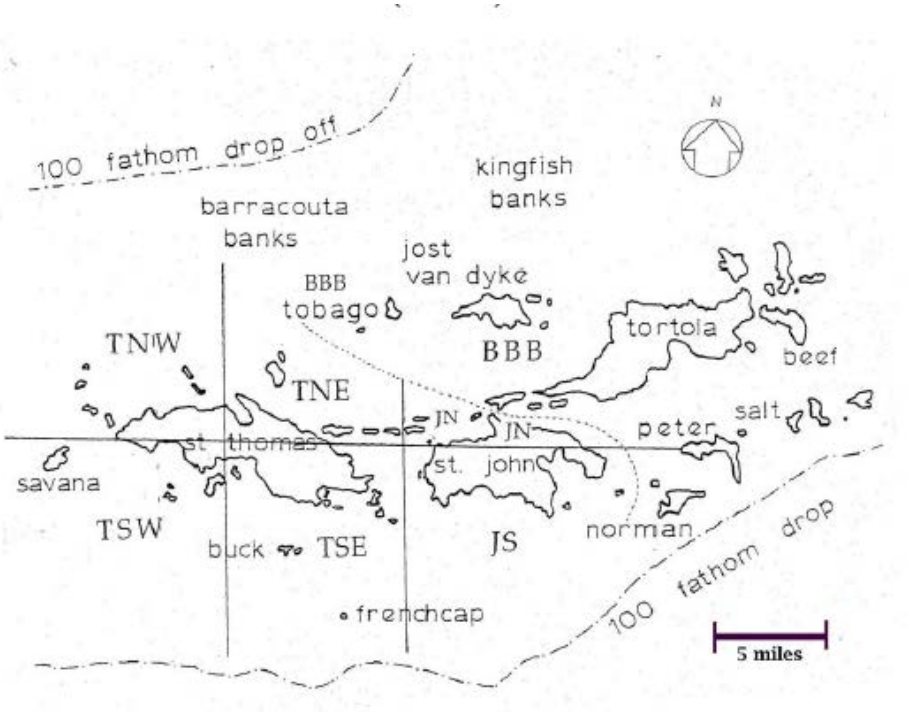


Figure 12. St. Thomas and St. John fishing area map (1994 - 2005).

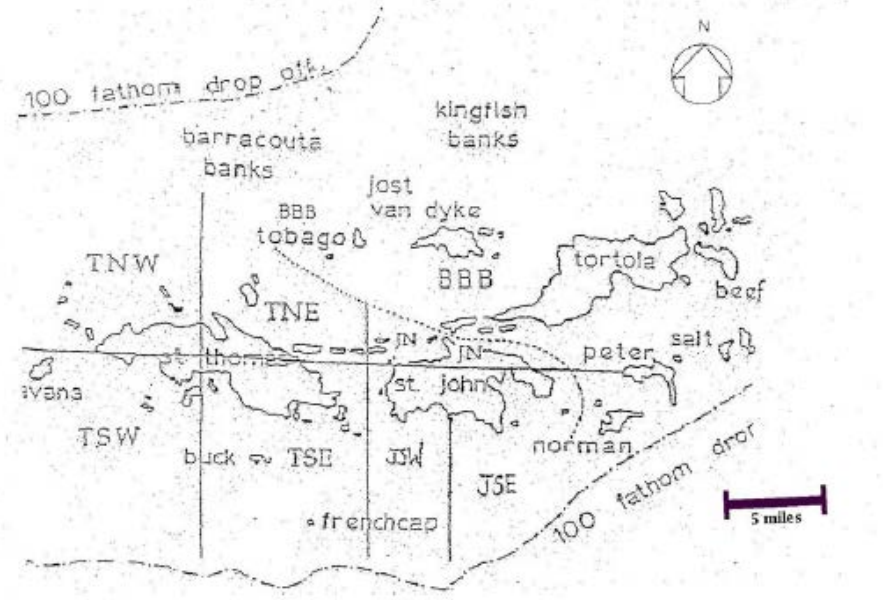


Figure 13. St. Thomas and St. John biological grid map created as part of the US Caribbean data improvement project (Implemented in 2012). Each grid represents a 2.5 x 2.5 minute area.

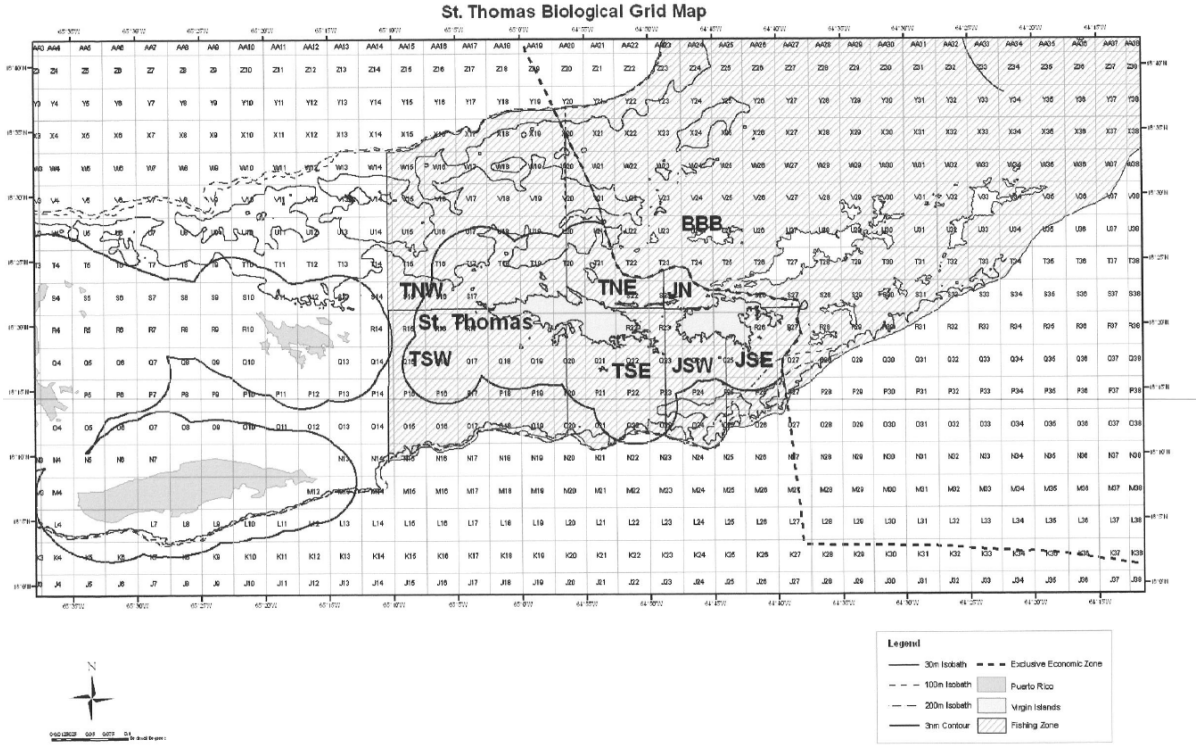


Figure 14. The number of TIP interviews in St. Thomas and St. John and the fishing areas recorded over time.

Figure 15. Total number of TIP intercepts by island (STX = St. Croix and STT_STJ = St. Thomas and St. John). White indicates zero intercepts.

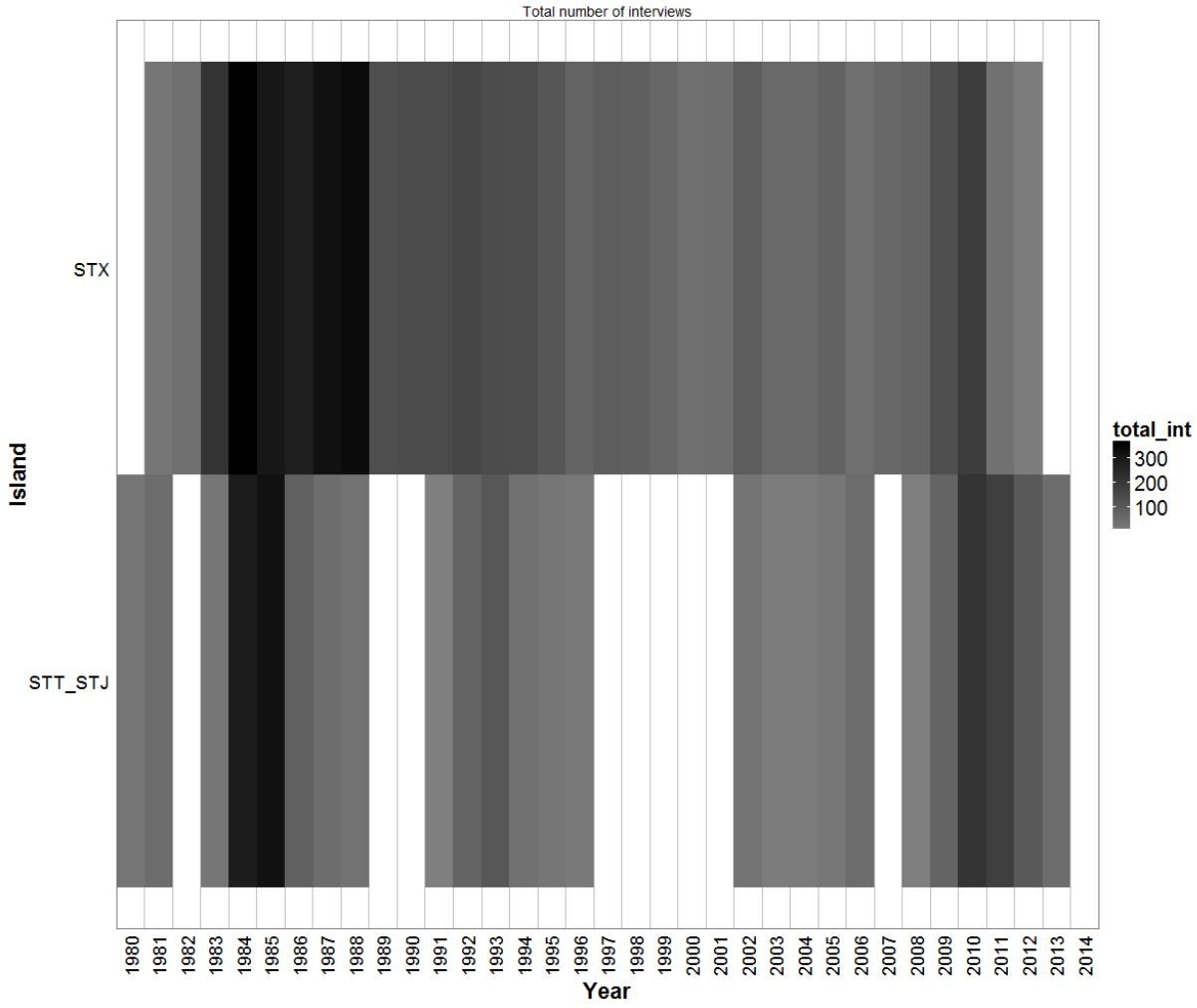
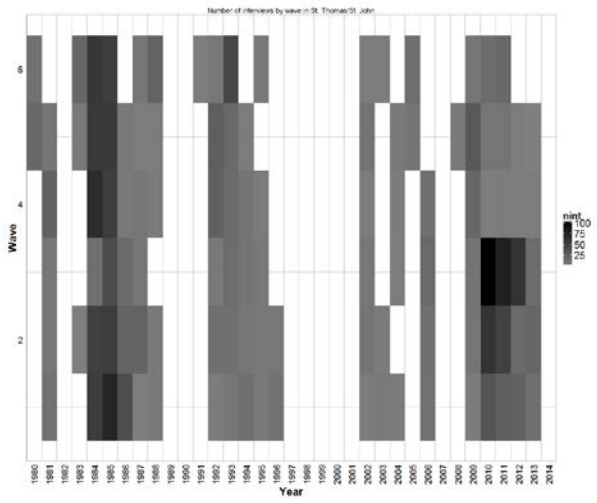


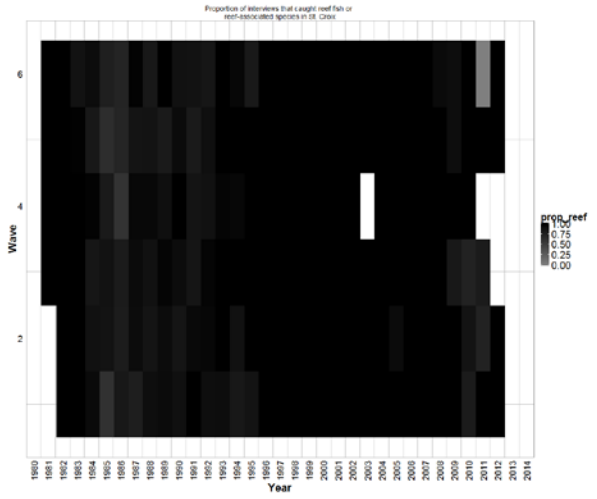
Figure 16. The number of TIP intercepts over time and by wave for a) St.Croix and b) St. Thomas and St. Thomas. The proportion of reef and reef-associated trips over time and by wave for c) St. Croix and d) St. Thomas and St. Thomas.

a)

b)



c)



d)

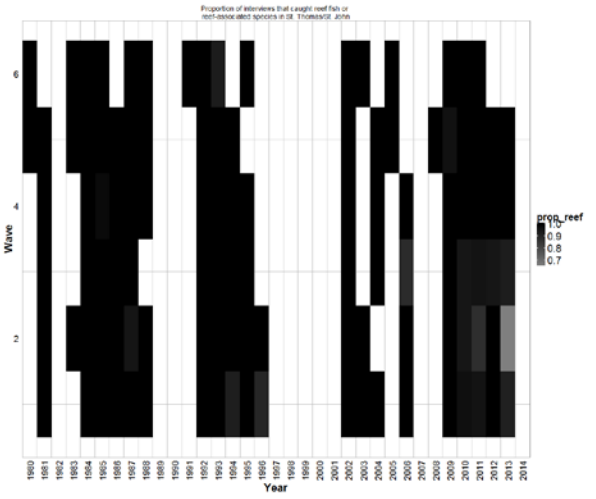


Figure 17 The total number of TIP intercepts by gear type for St. Croix (STX) and St. Thomas and St. John (STT_STJ).

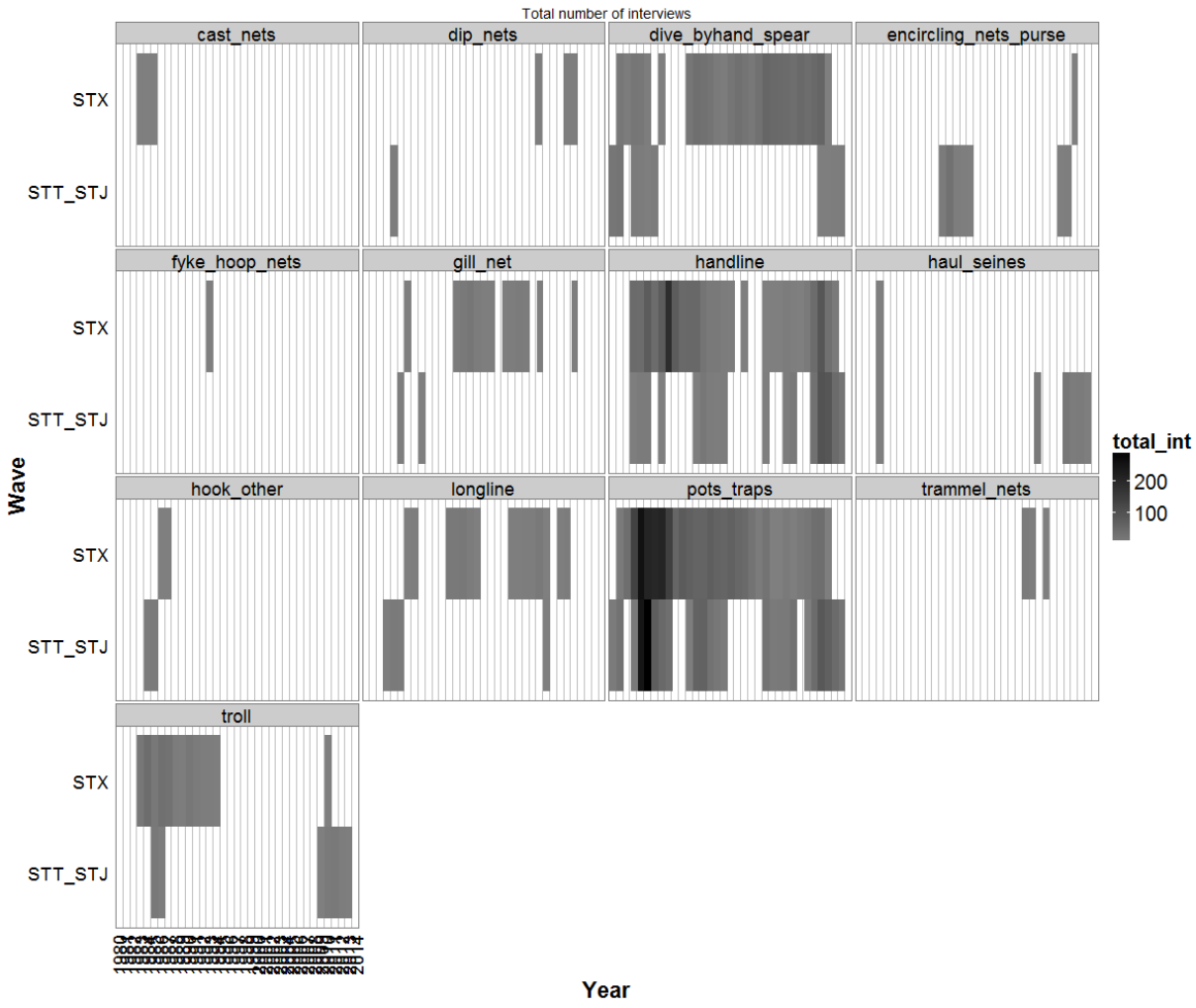
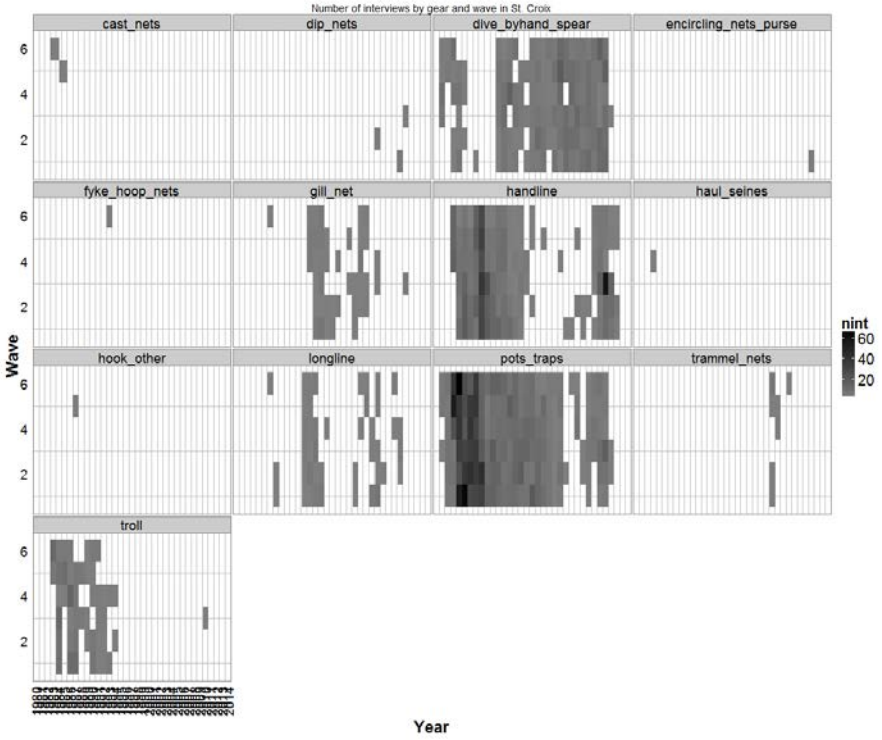


Figure 18 The number of TIP intercepts by gear type and wave over time for a) St. Croix and b) St. Thomas and St. John

a)



b)

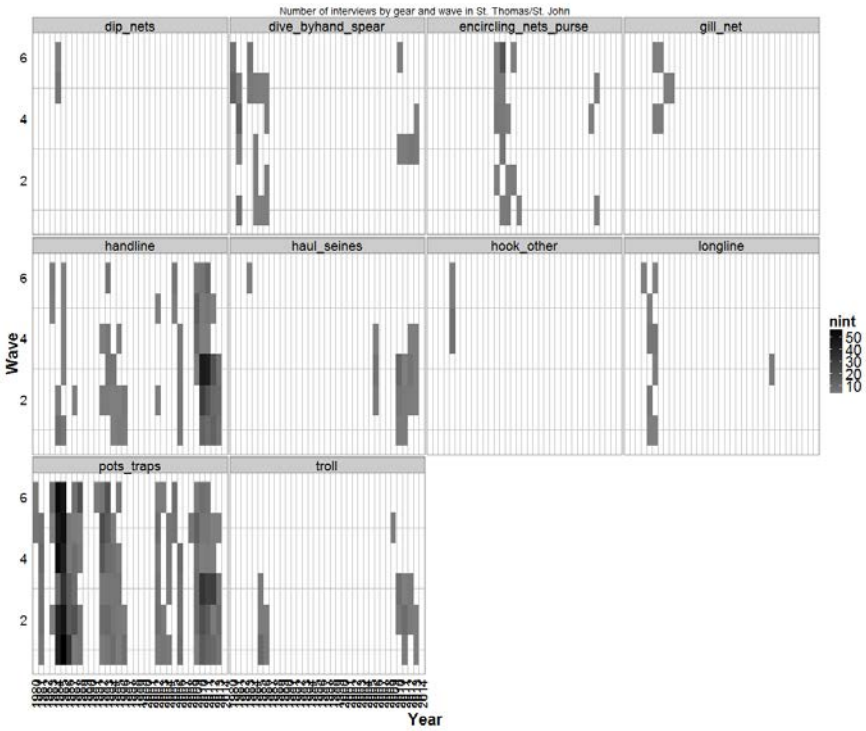
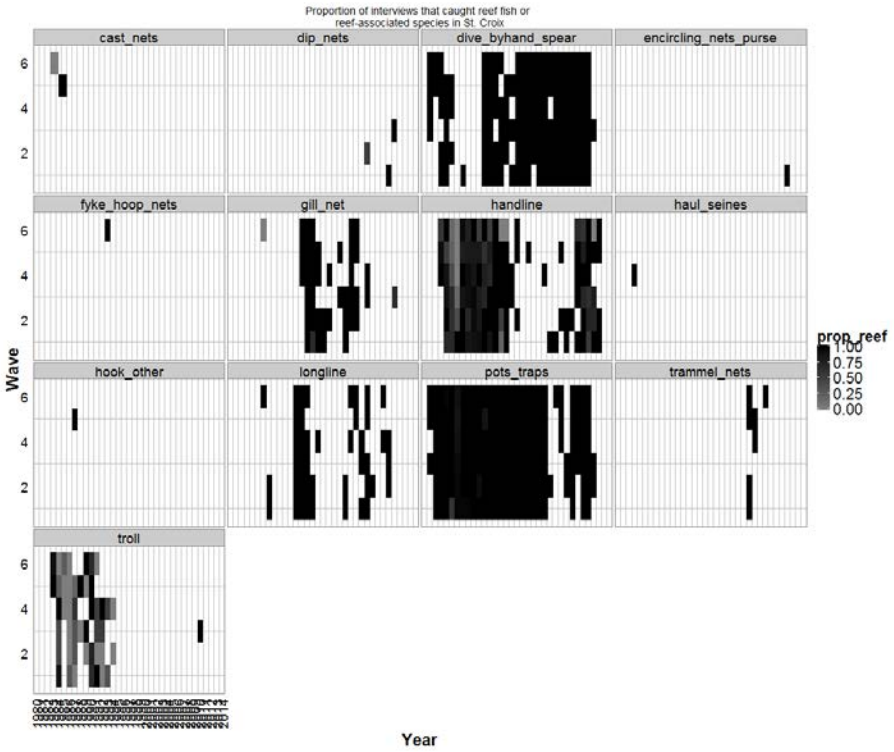


Figure 19 The proportion of reef fish and reef-associated trips by gear type and wave over time for a) St. Croix and b) St. Thomas and St. John

a)



b)

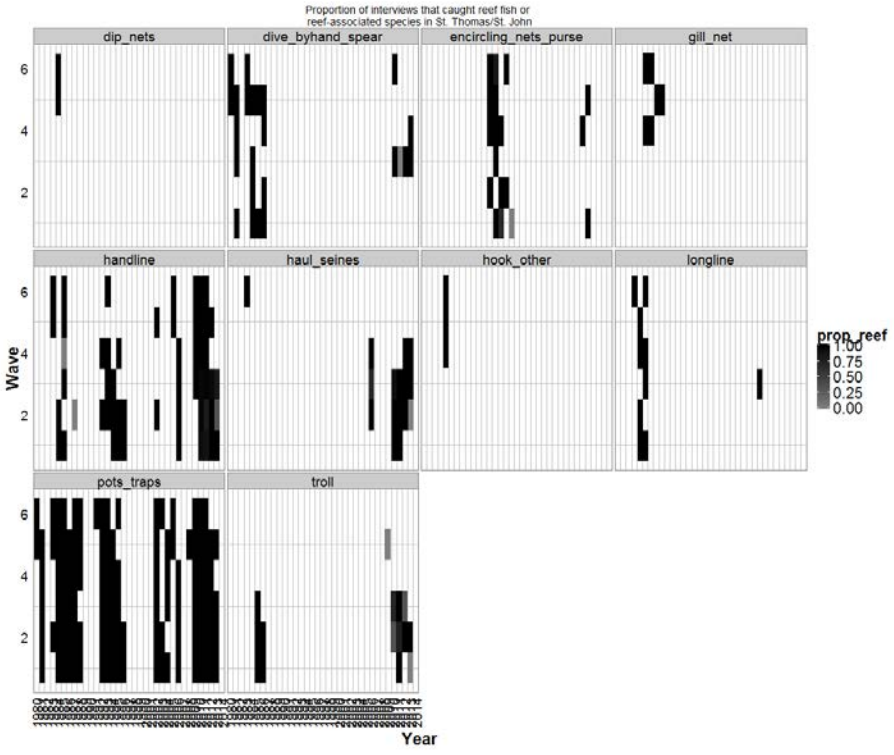


Figure 20 Distribution of lengths from all gears by island. Outlier is highlighted by the red circle.

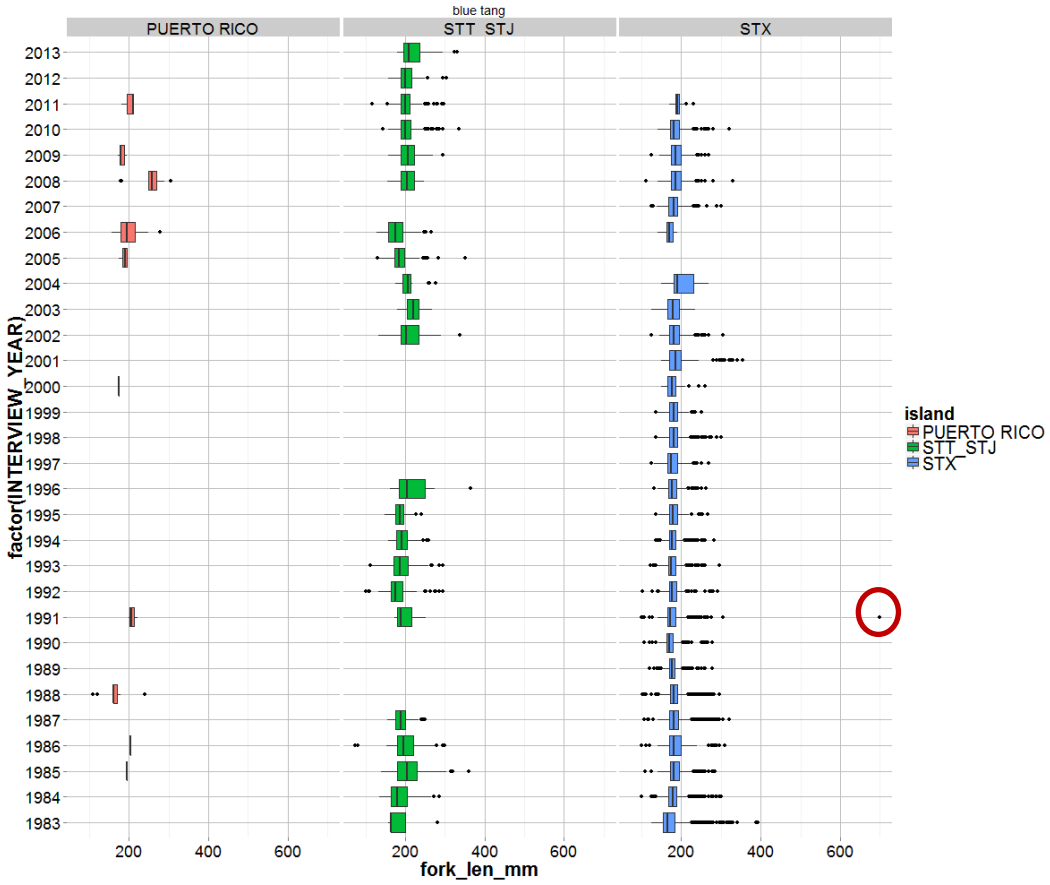
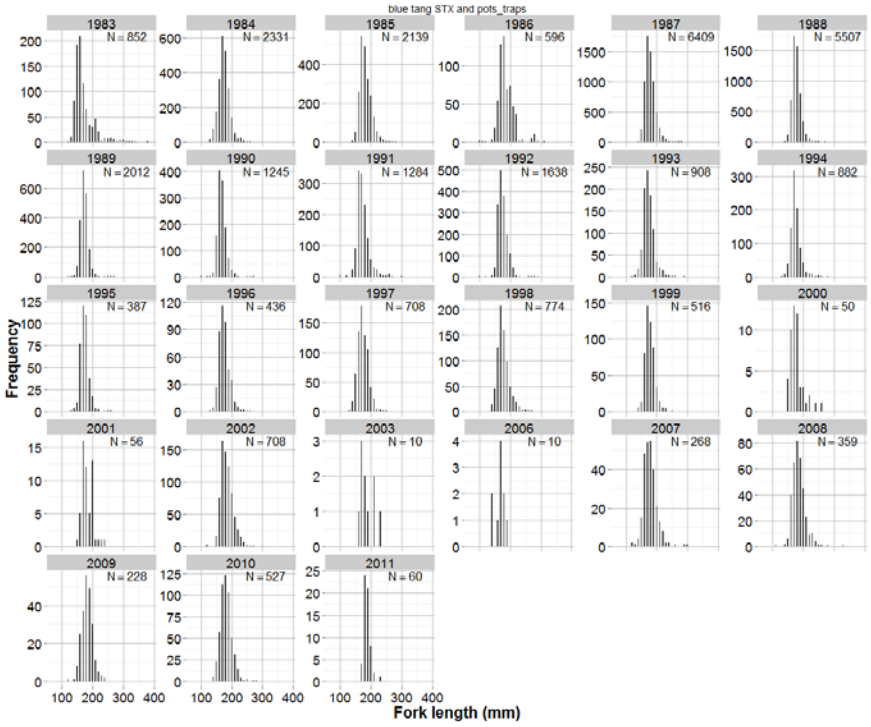


Figure 21. a) Blue Tang length frequency associated with pots and traps in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

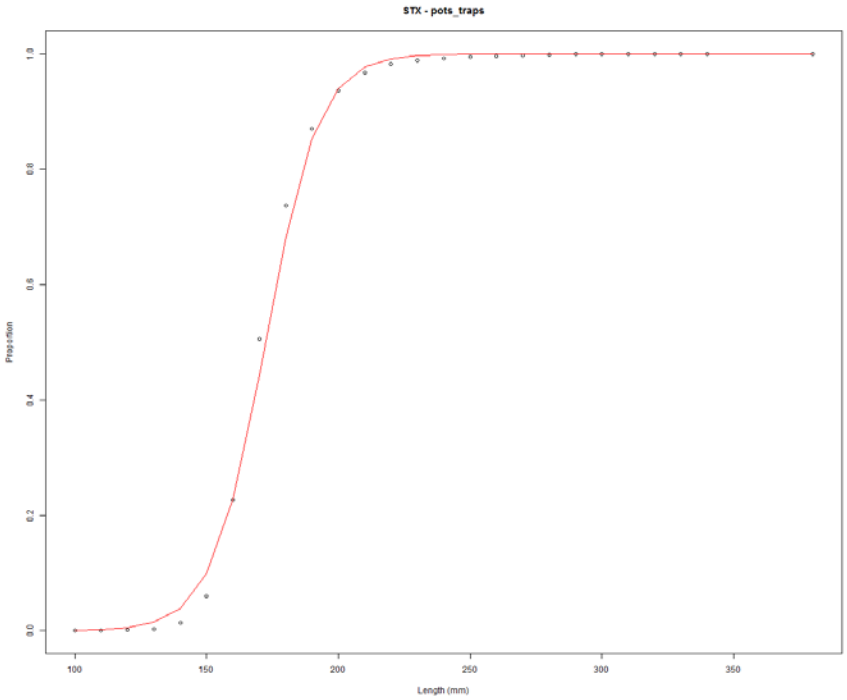
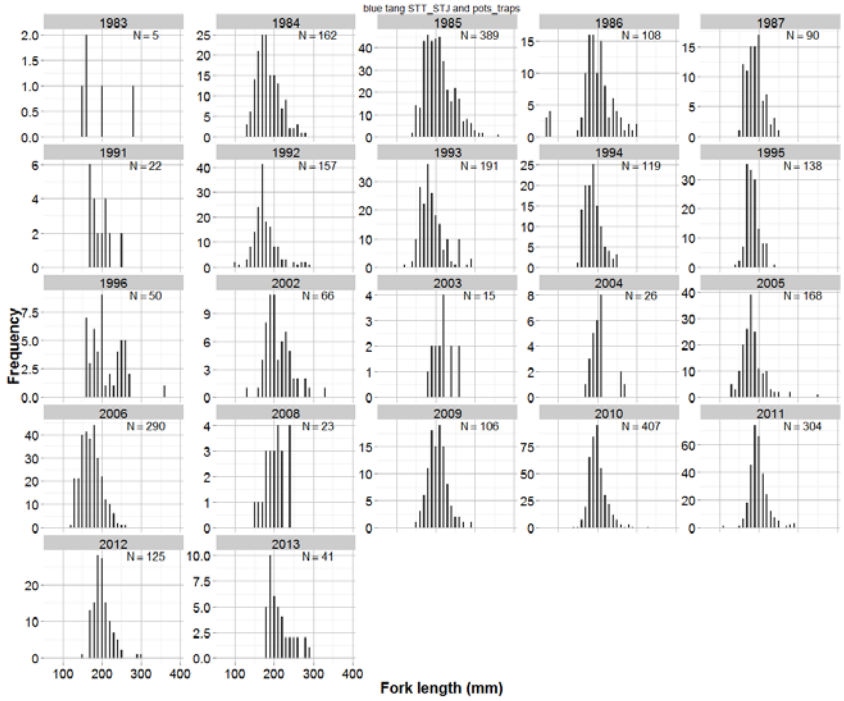


Figure 22. a) Blue Tang length frequency associated with pots and traps in St. Thomas and St. John and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

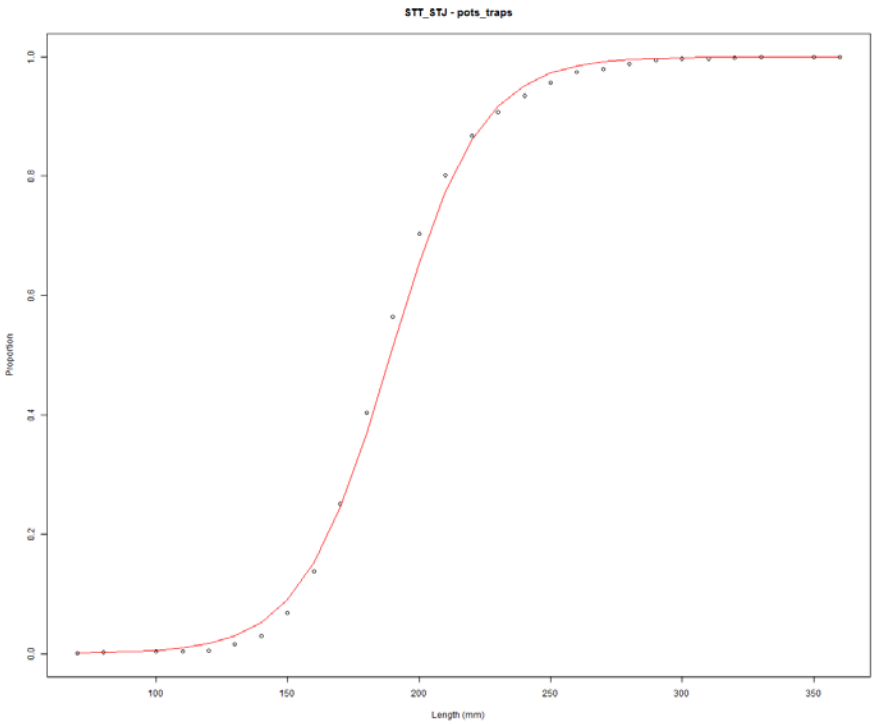
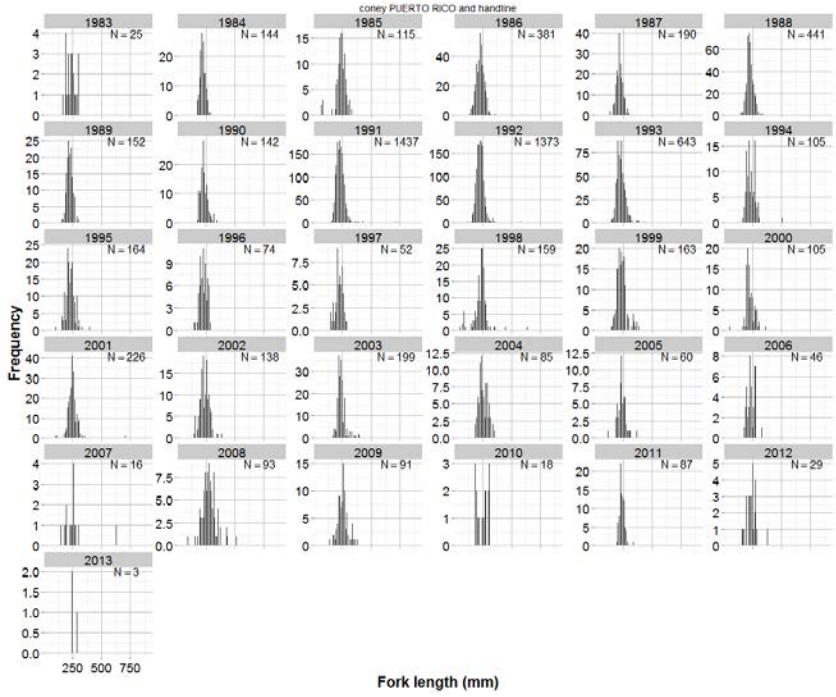


Figure 23 a) Coney length frequency associated with handlines in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

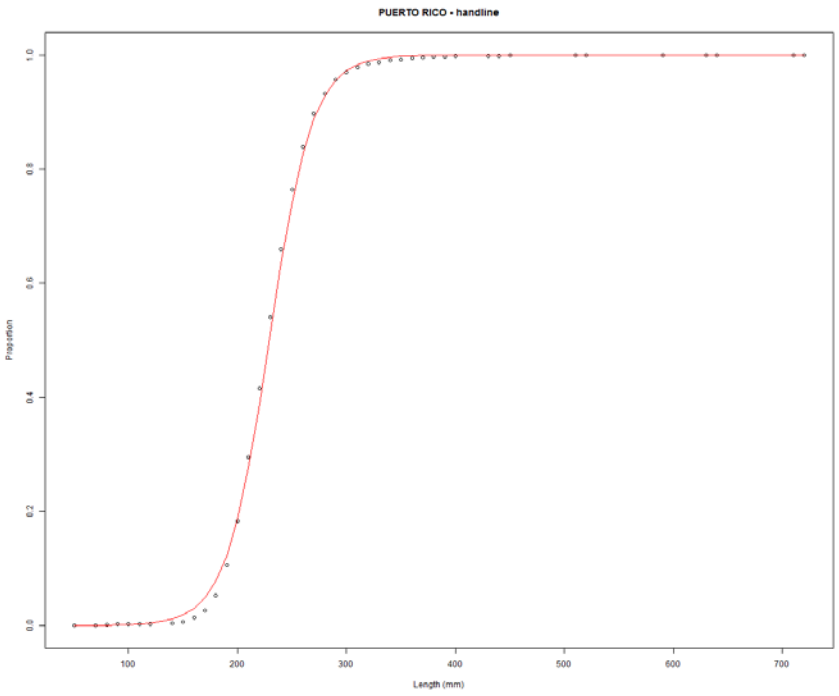
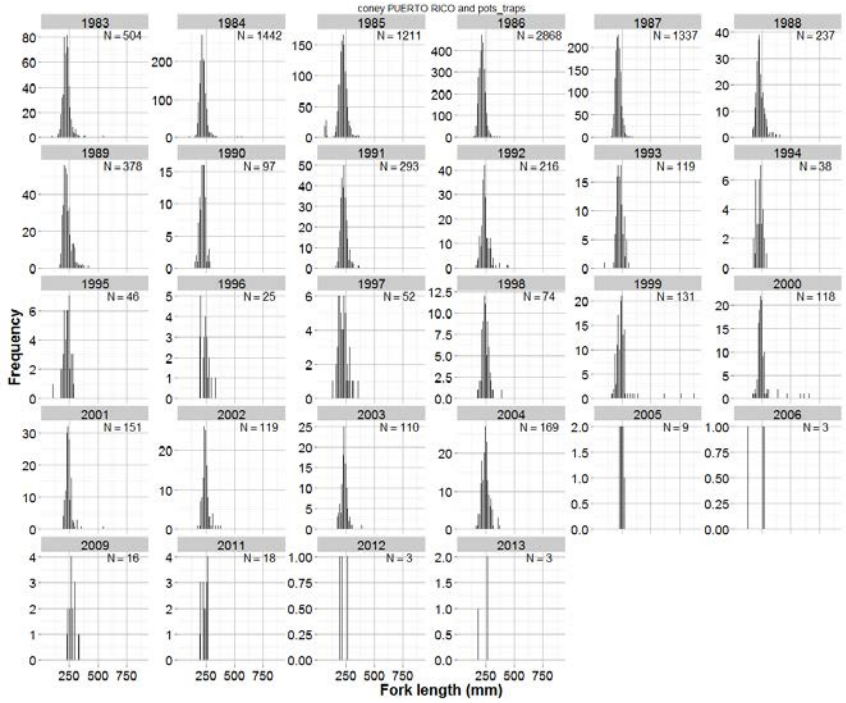


Figure 24 Coney length frequency associated with pots and traps in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

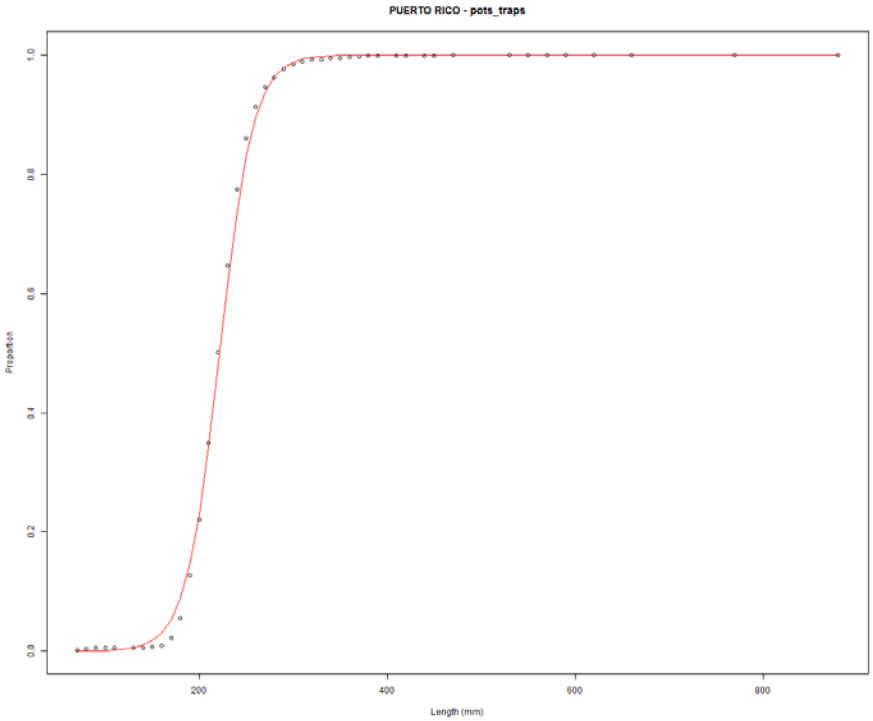
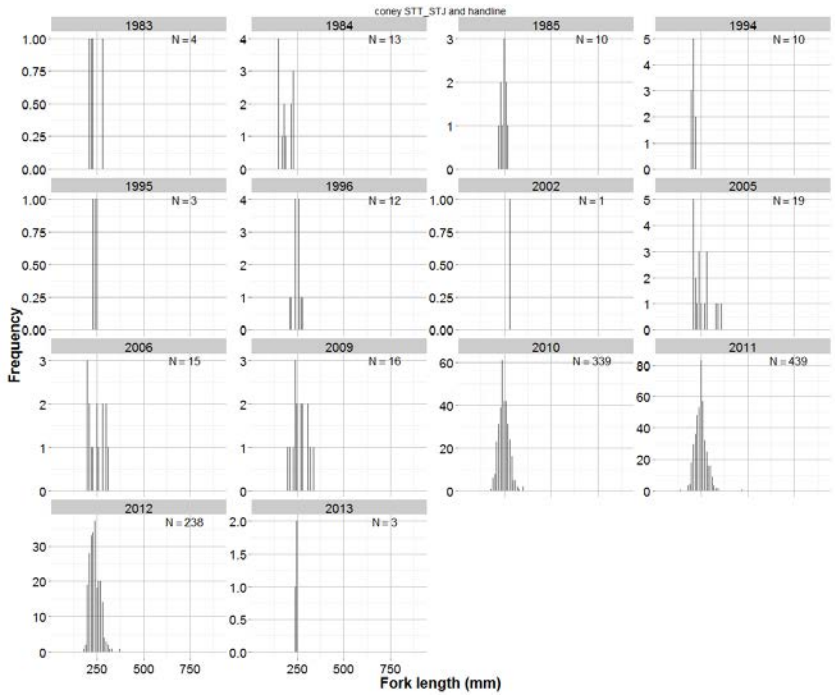


Figure 25 a) Coney length frequency associated with handlines in St. Thomas/St. John and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

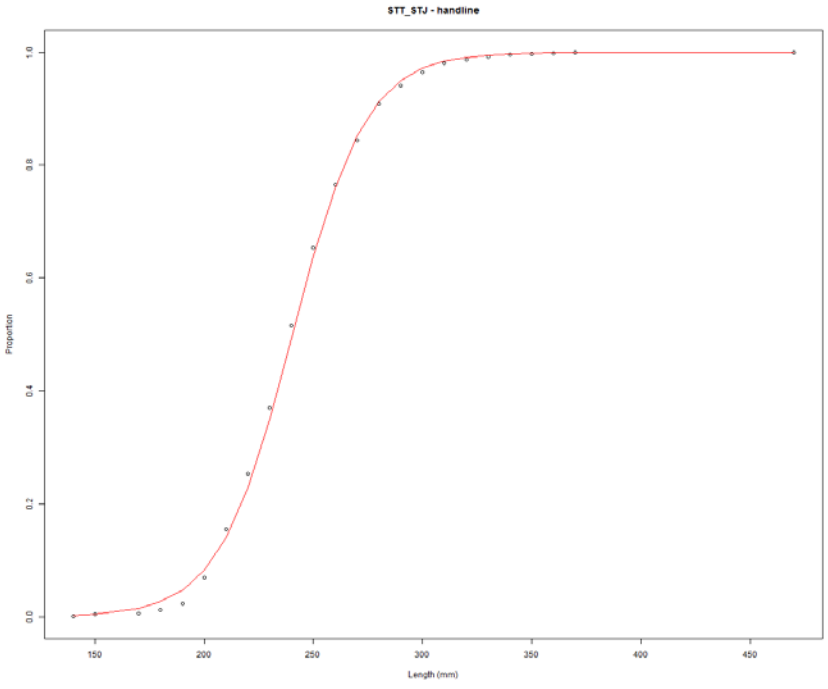
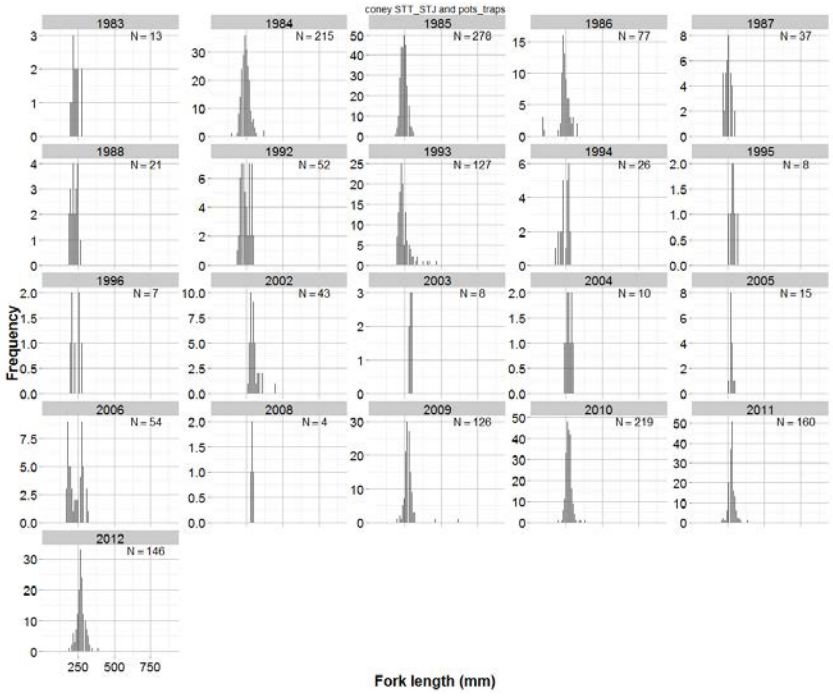


Figure 26 Coney length frequency associated with pots and traps in St. Thomas/St. John and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

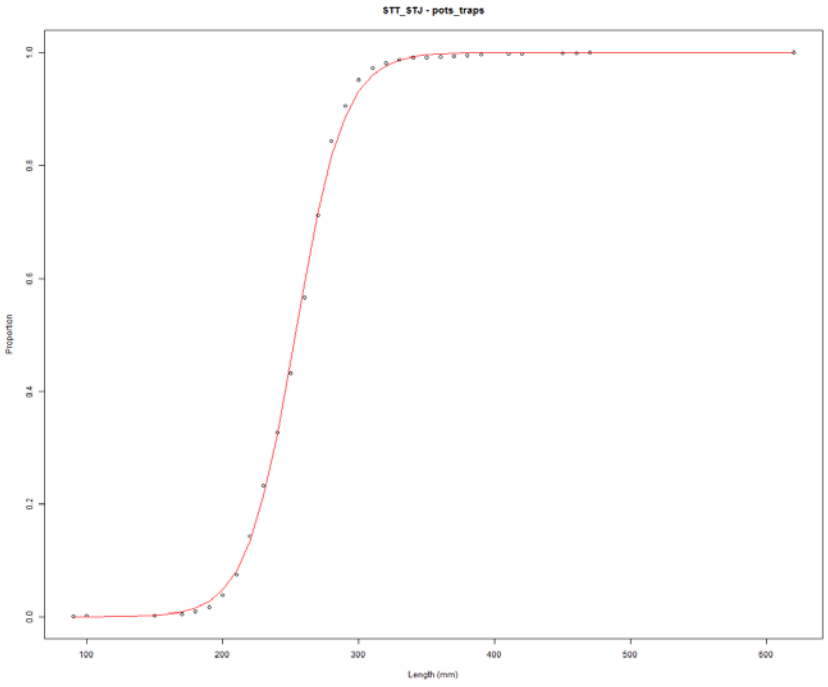
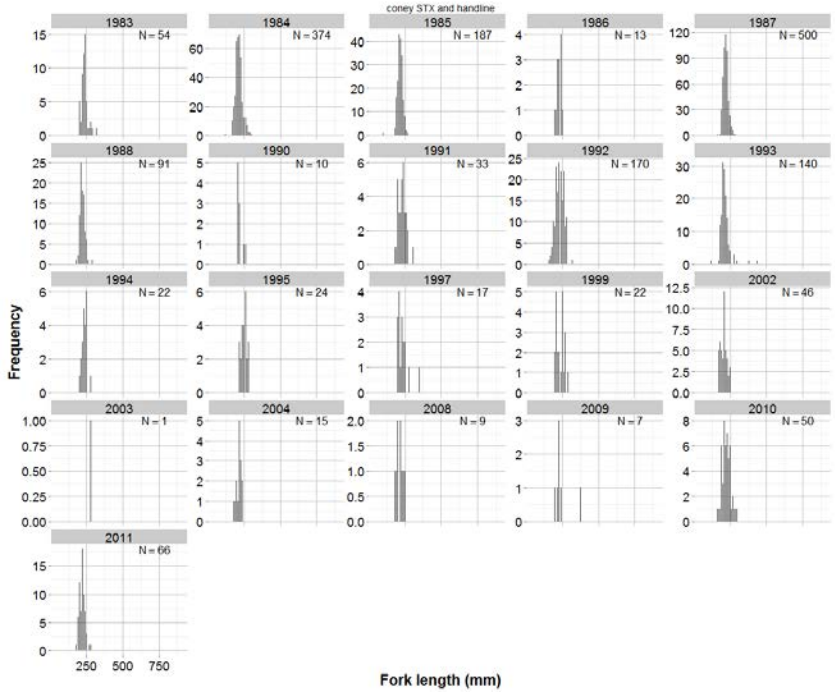


Figure 27 Coney length frequency associated with handlines in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

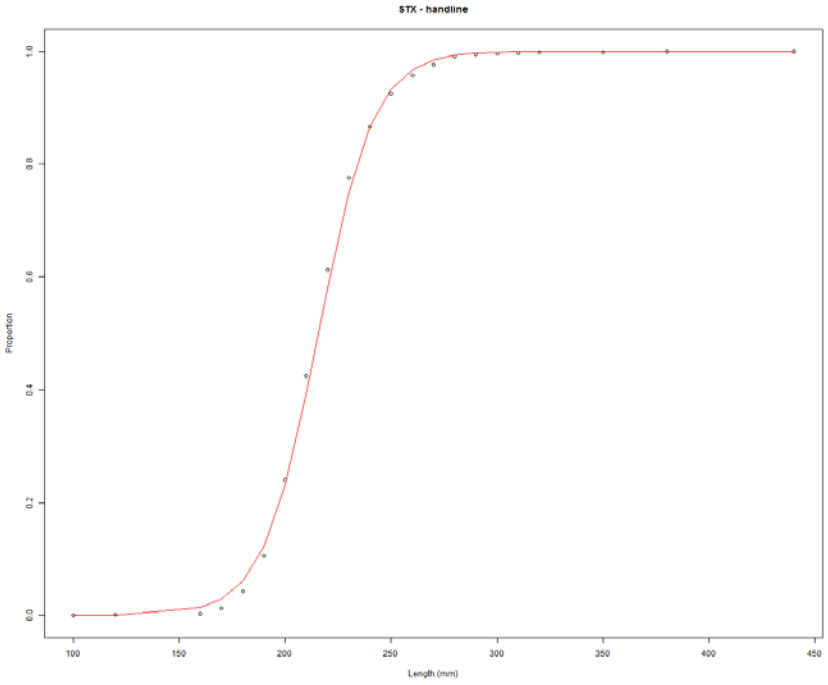
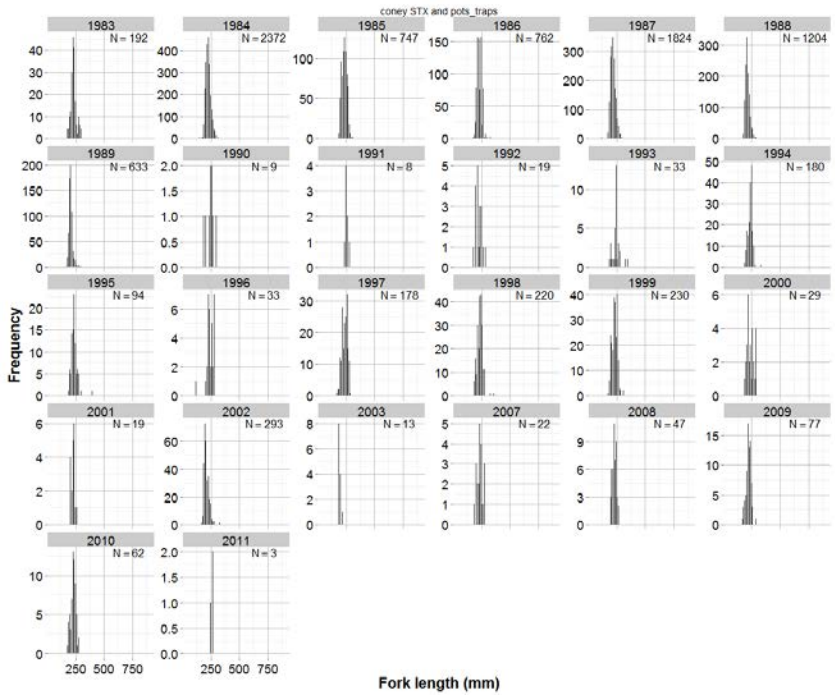


Figure 28 Coney length frequency associated with pots and traps in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

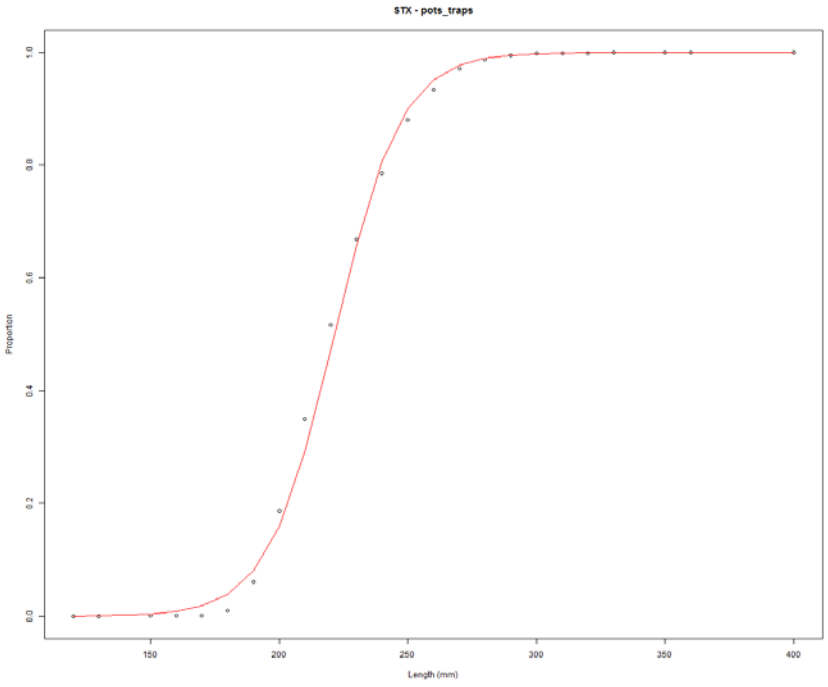
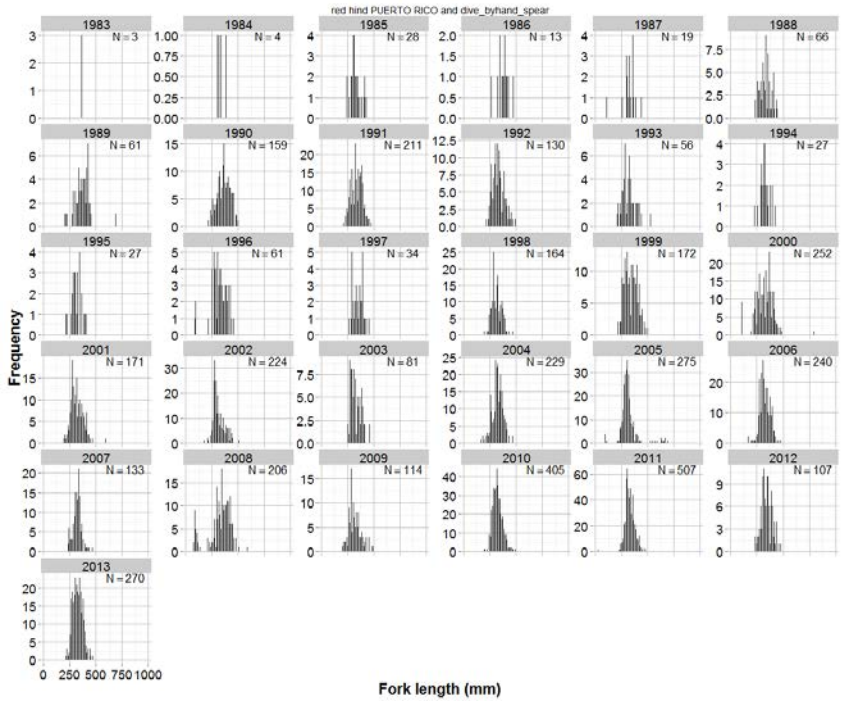


Figure 29 a) Annual length frequency histograms for Red hind caught by dive/by hand/spears in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

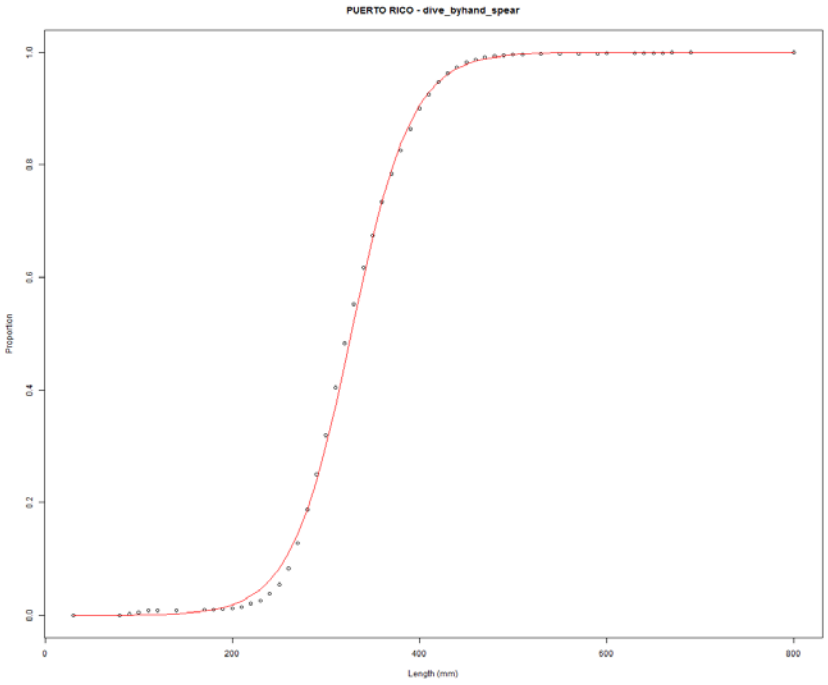
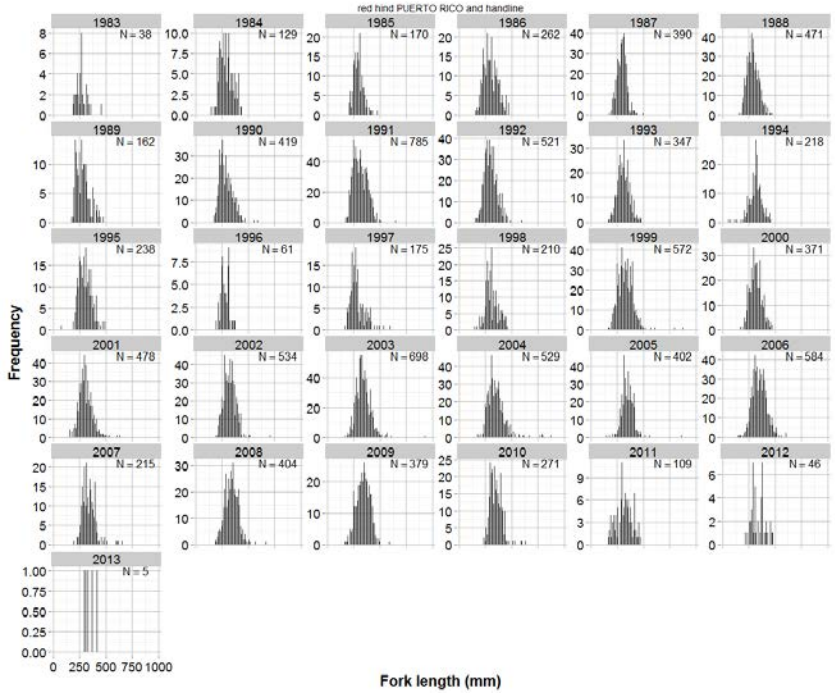


Figure 30 a) Annual length frequency histograms for Red hind caught by handlines in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

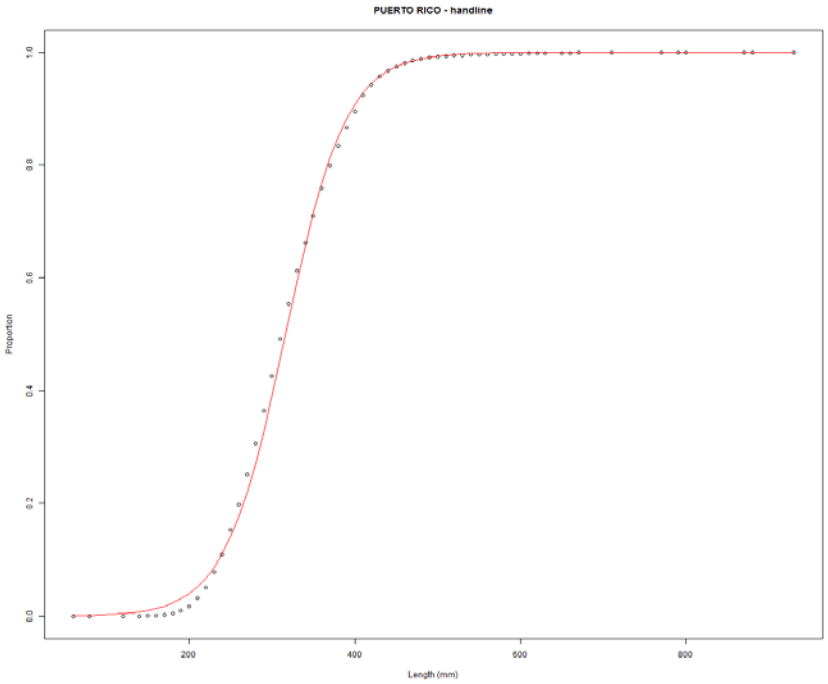
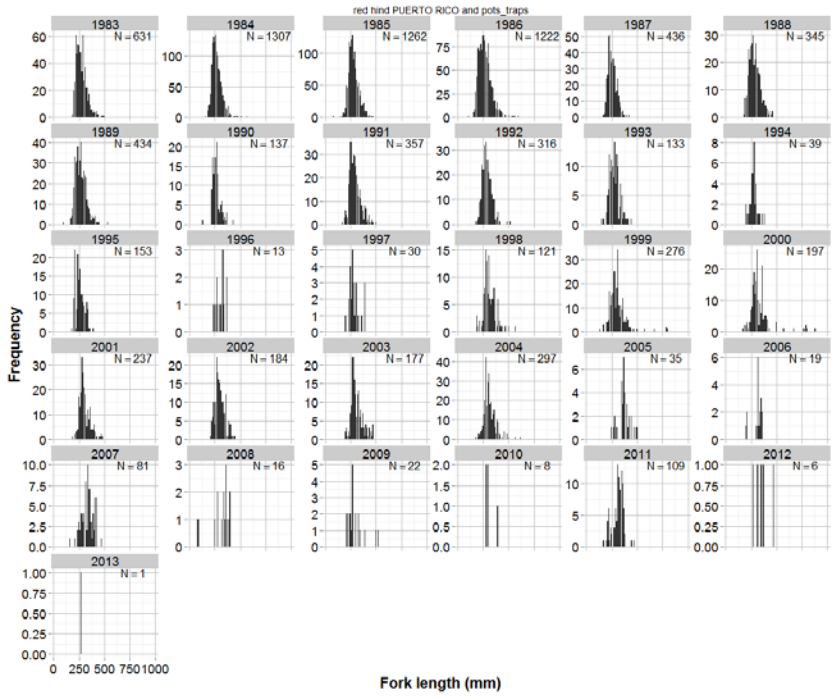


Figure 31 a) Annual length frequency histograms for Red hind caught by pots and traps in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

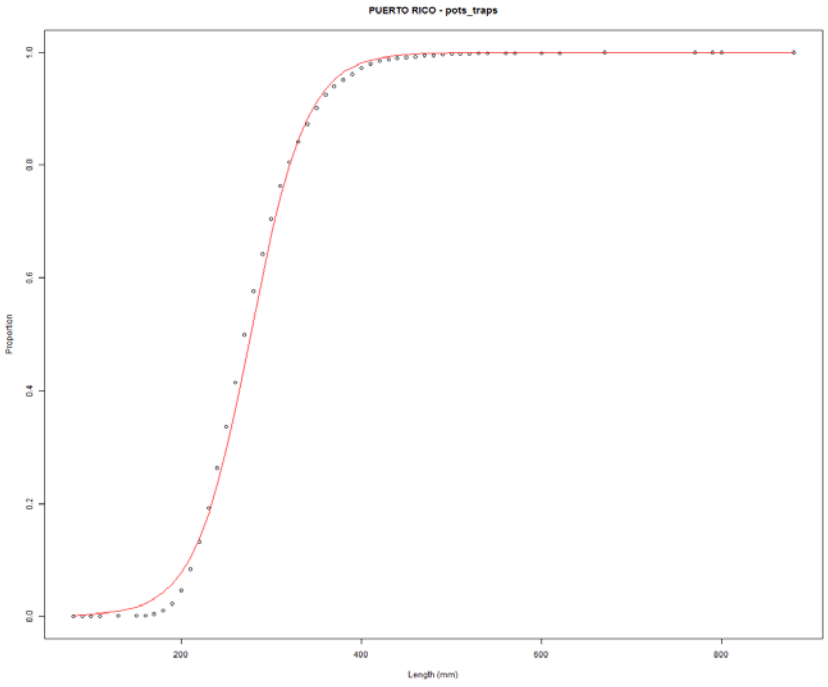
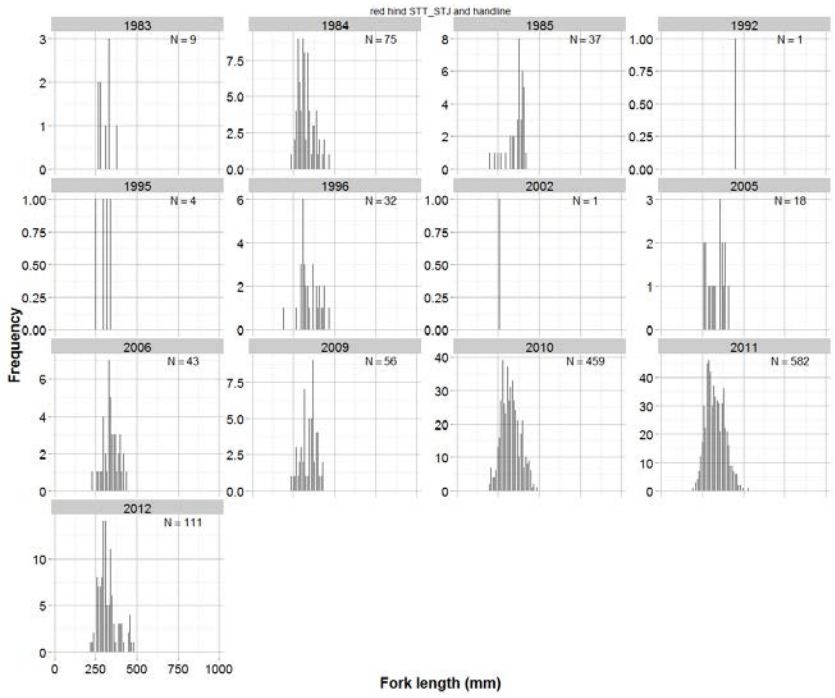


Figure 32 a) Annual length frequency histograms for Red hind caught by handlines in St. Thomas and St. John and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

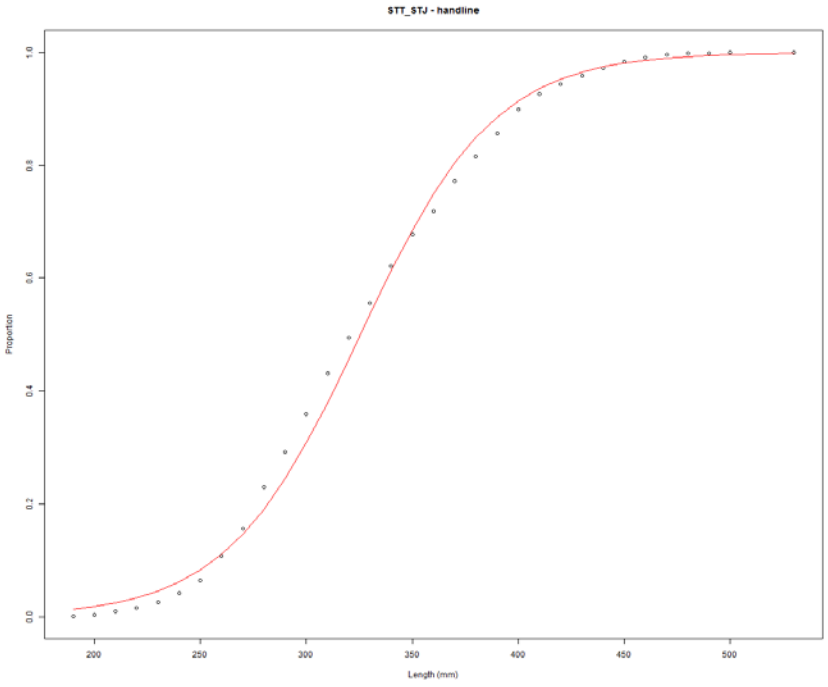
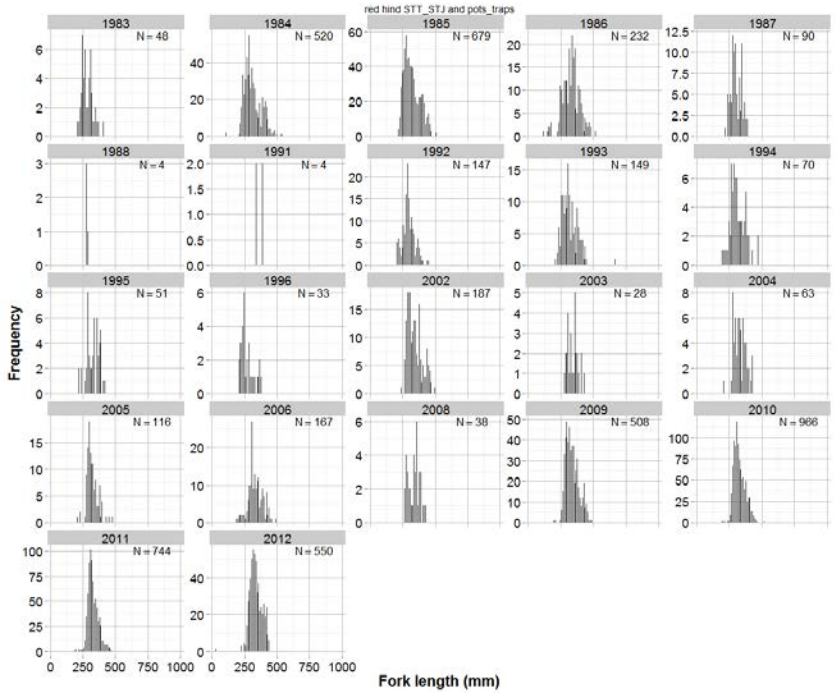


Figure 33 a) Annual length frequency histograms for Red hind caught by pots and traps in St. Thomas and St. John and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

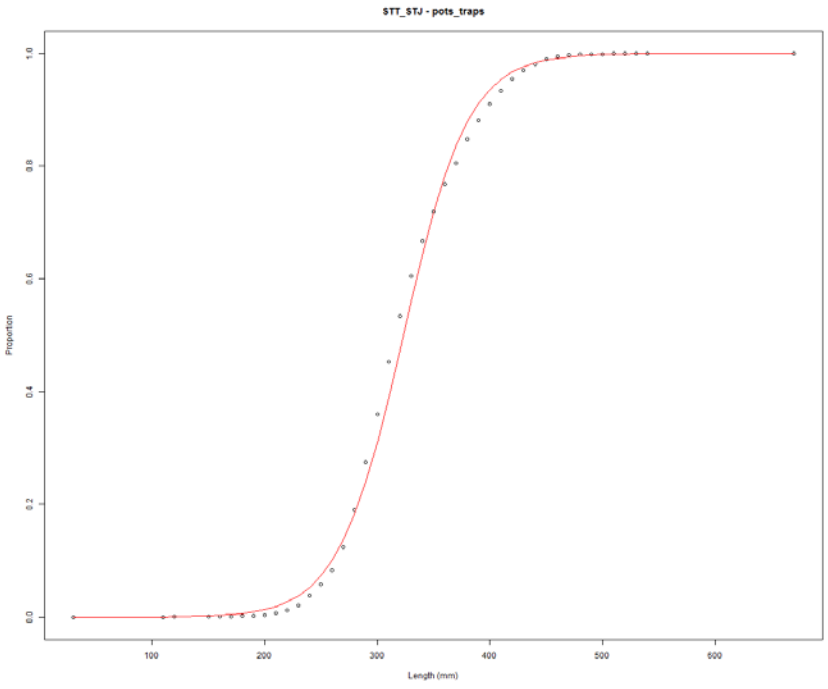
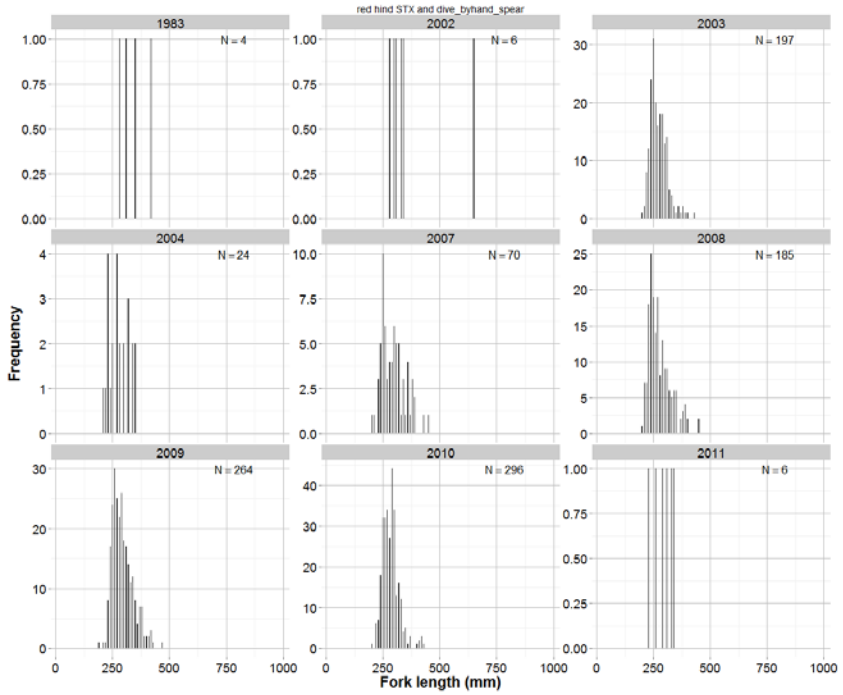


Figure 34 a) Annual length frequency histograms for Red hind caught by dive/by hand/spears in St. Thomas and St. John and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

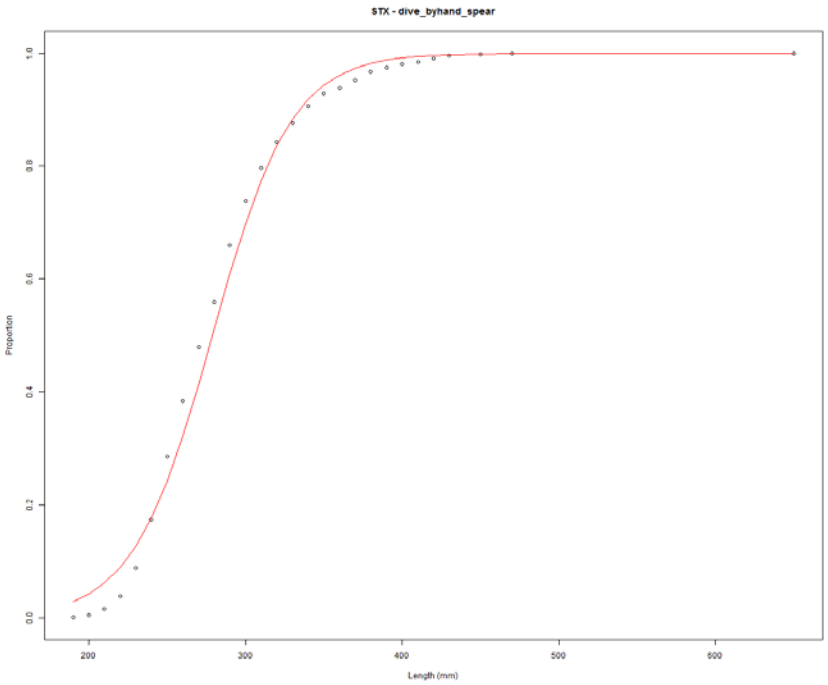
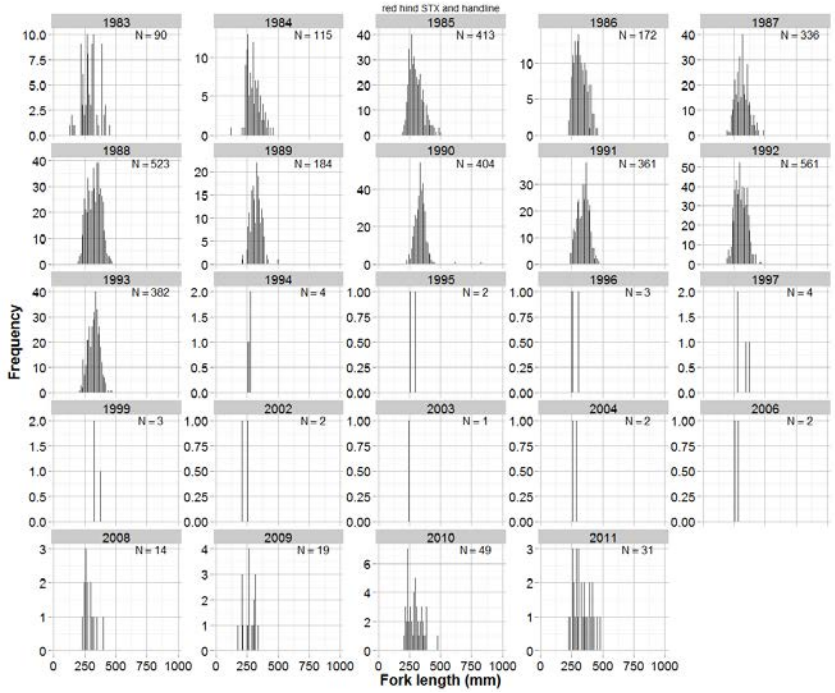


Figure 35 a) Annual length frequency histograms for Red hind caught by handlines in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

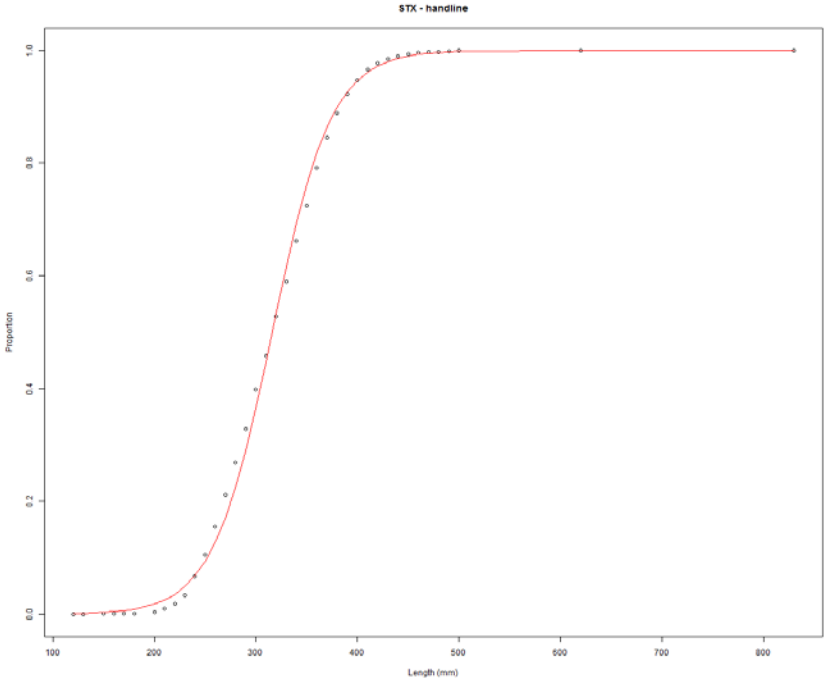
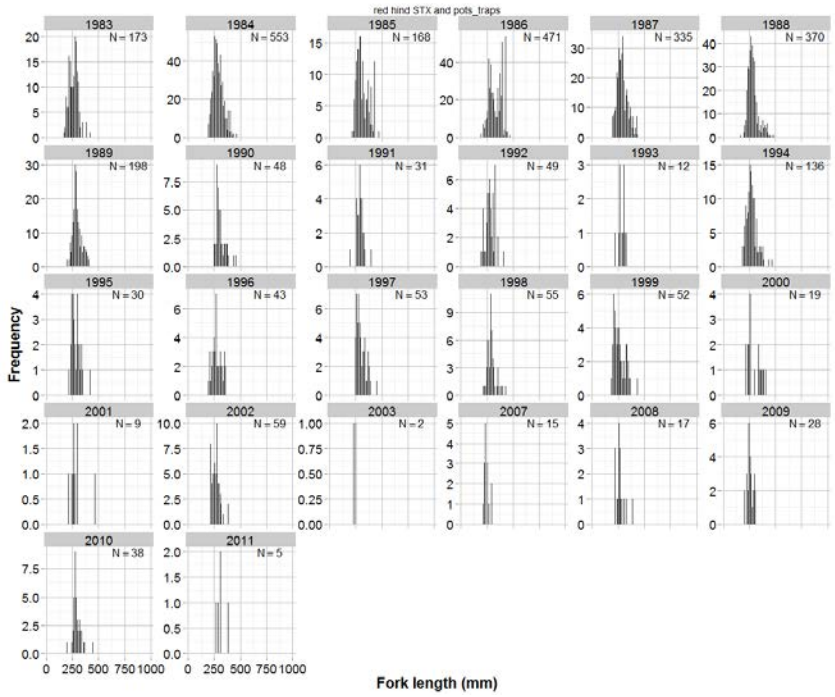


Figure 36 a) Annual length frequency histograms for Red hind caught by pots and traps in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

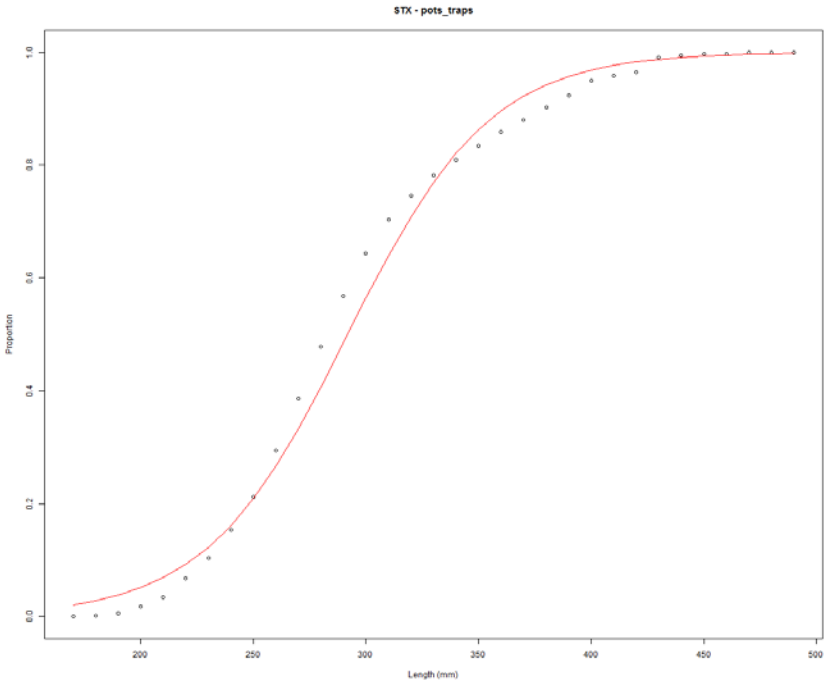
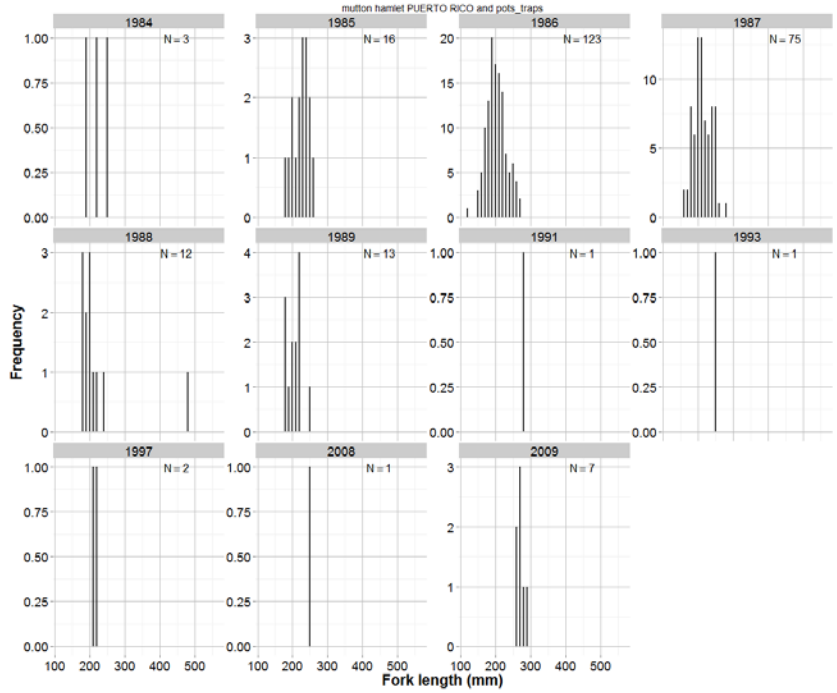


Figure 37 a) Annual length frequency histograms for Mutton hamlet caught by pots and traps in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

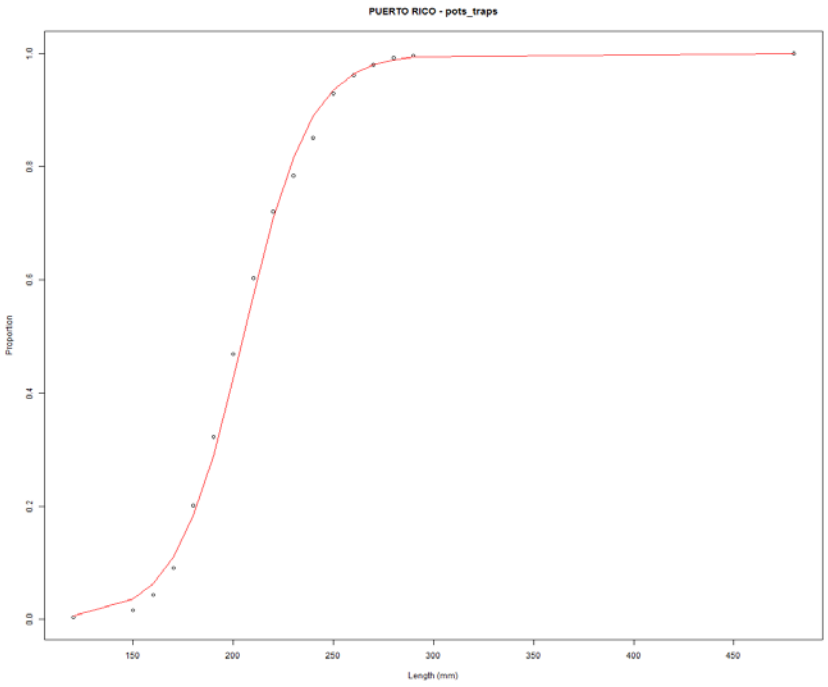
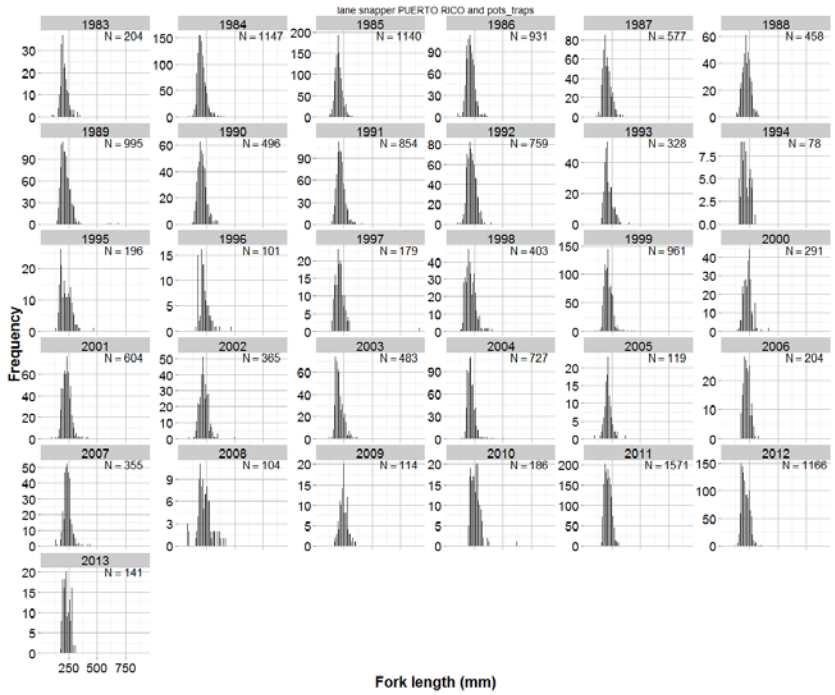


Figure 38 a) Annual length frequency histograms for Lane snapper caught by pots and traps in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

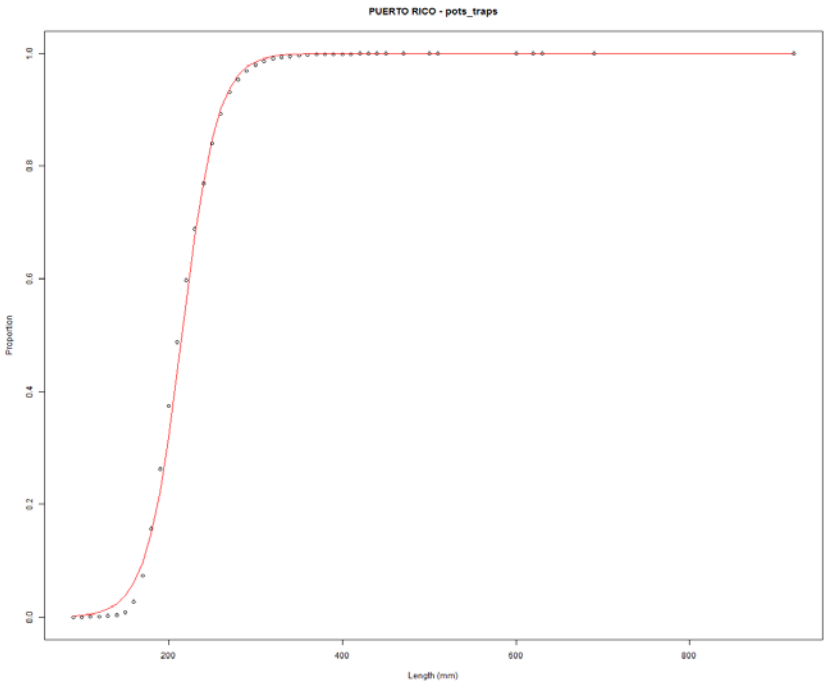
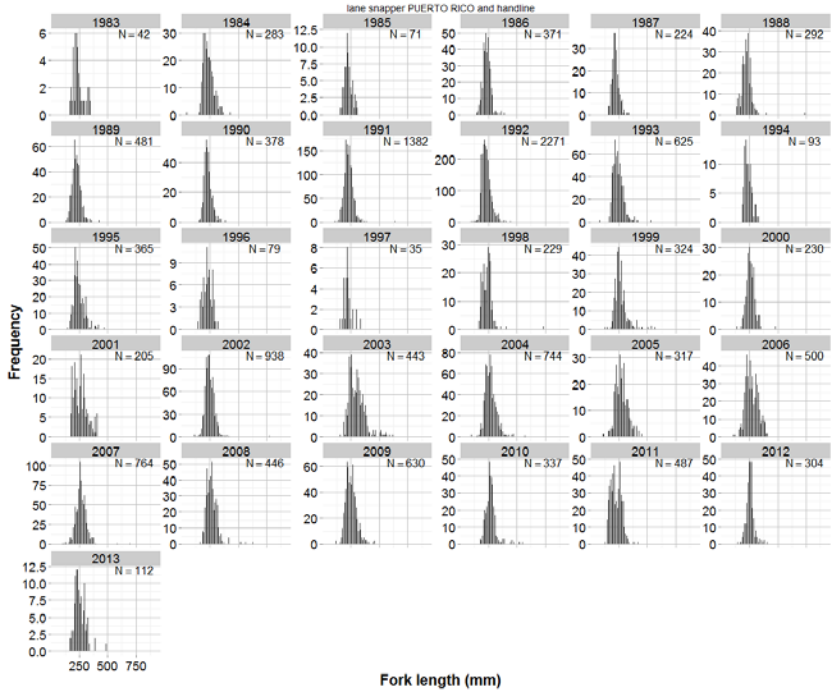


Figure 39 a) Annual length frequency histograms for Lane snapper caught by handlines in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

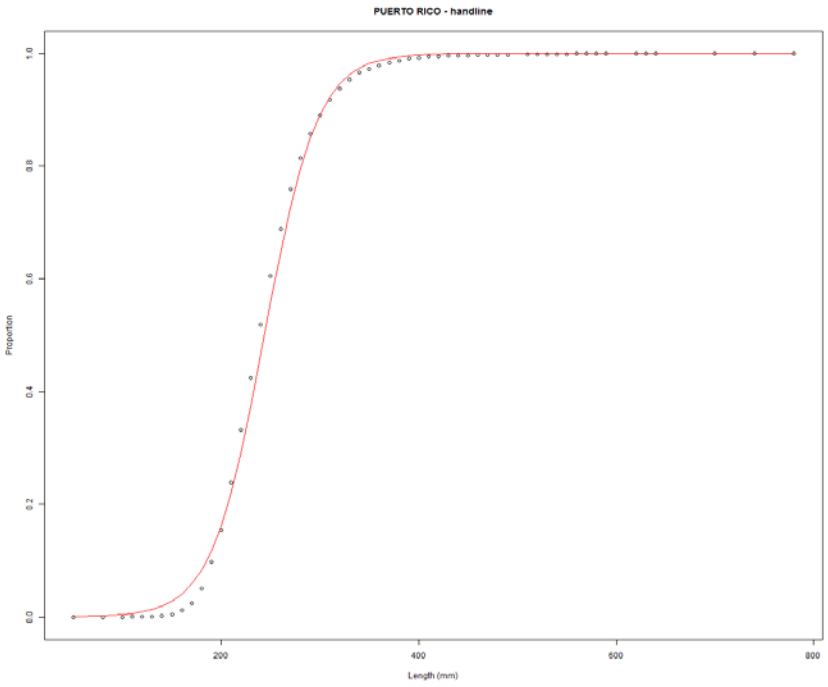
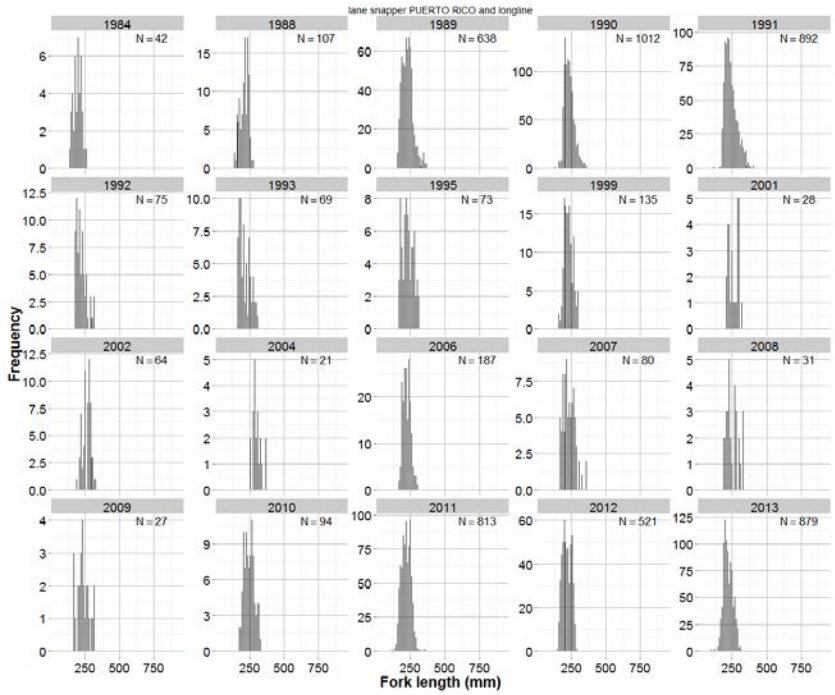


Figure 40 a) Annual length frequency histograms for Lane snapper caught by longlines in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

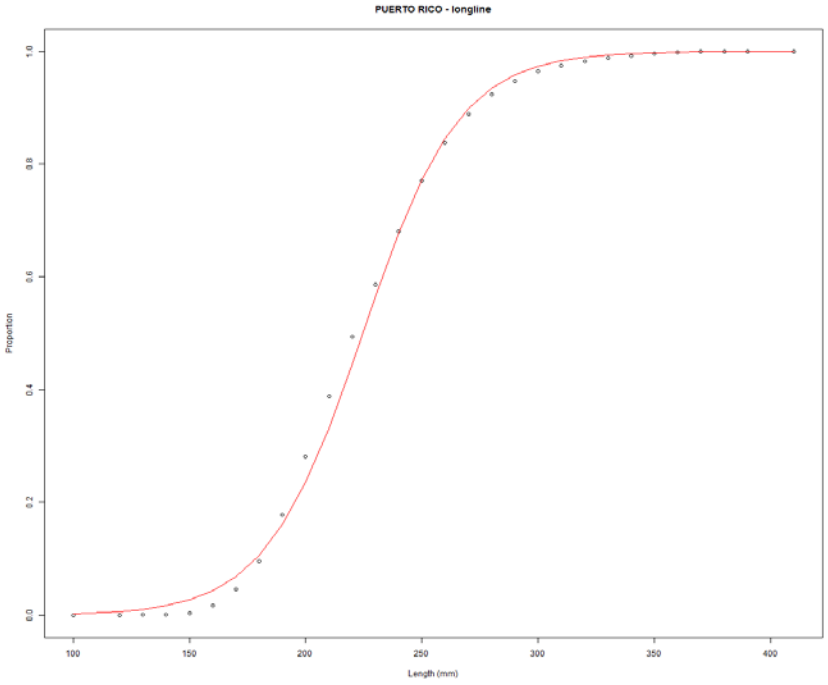
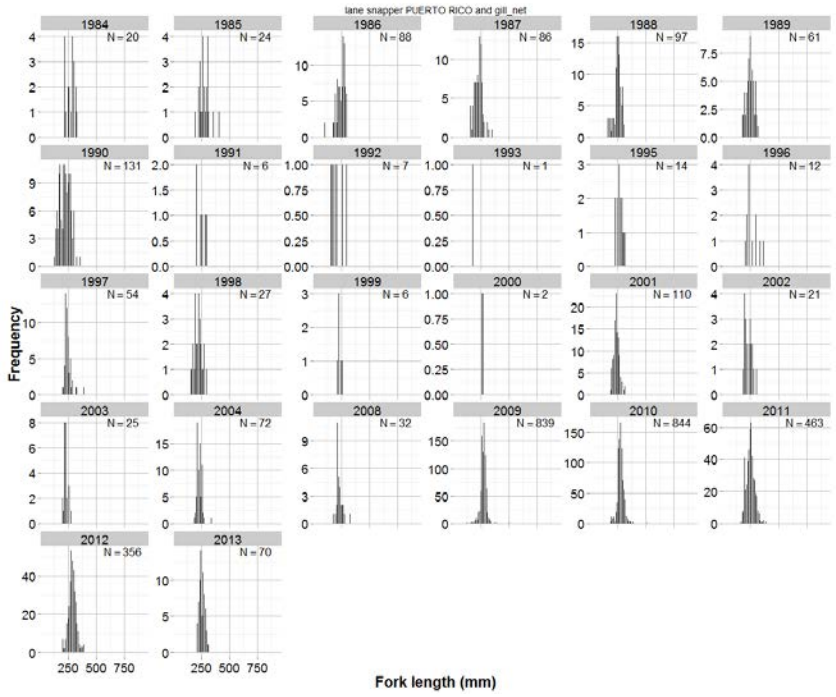


Figure 41 a) Annual length frequency histograms for Lane snapper caught by gill nets in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

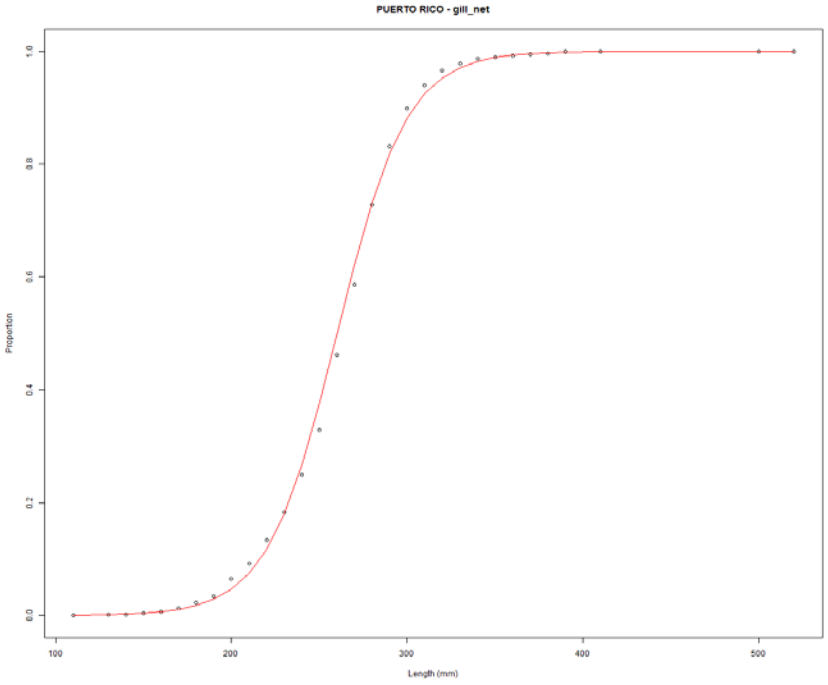
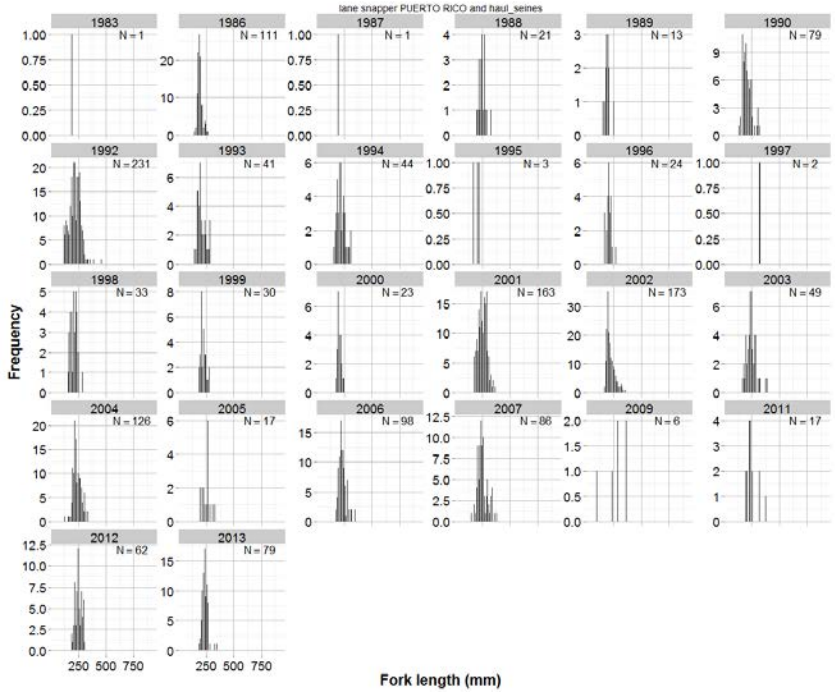


Figure 42 a) Annual length frequency histograms for Lane snapper caught by haul seines in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

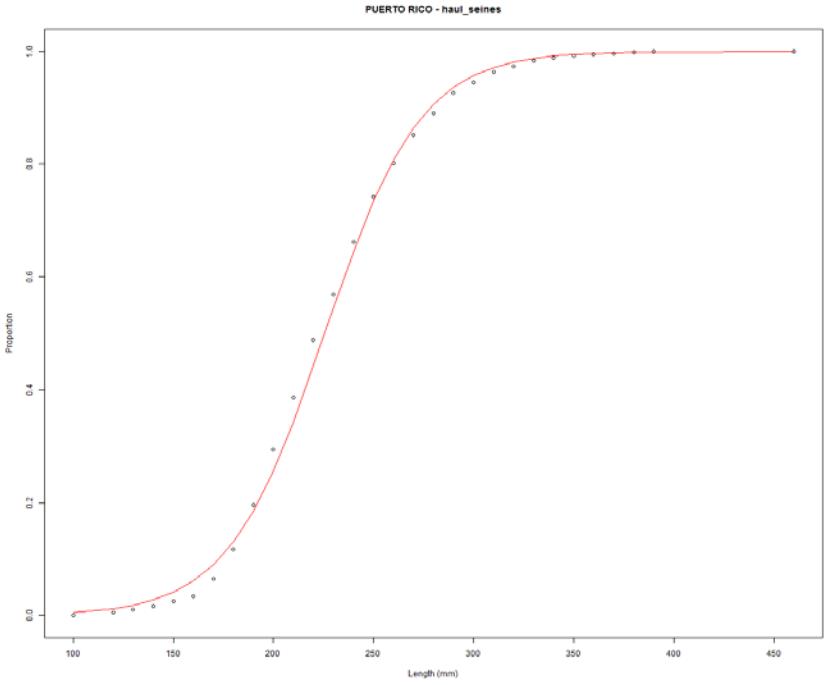
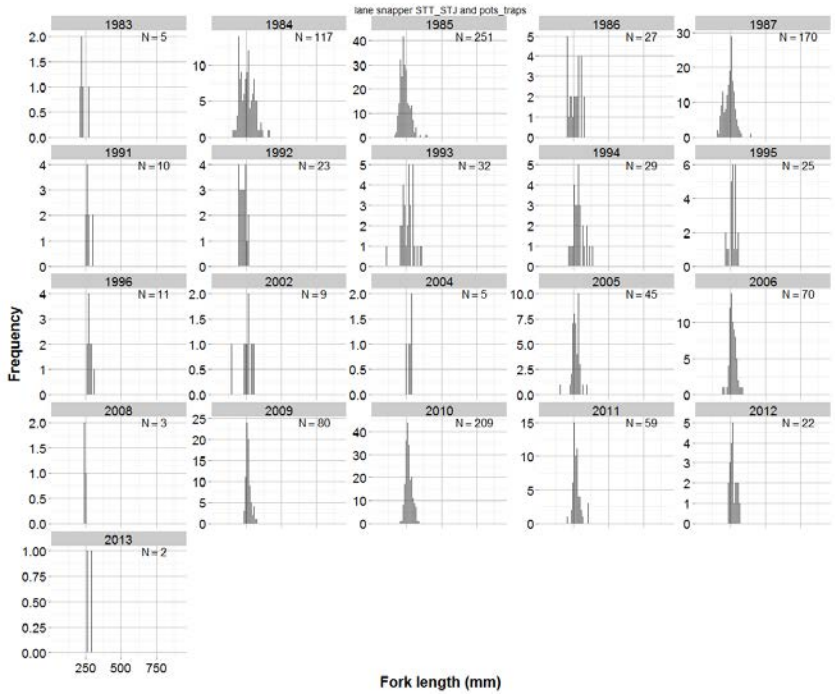


Figure 43 a) Annual length frequency histograms for Lane snapper caught by pots and traps in St. Thomas/St. John and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

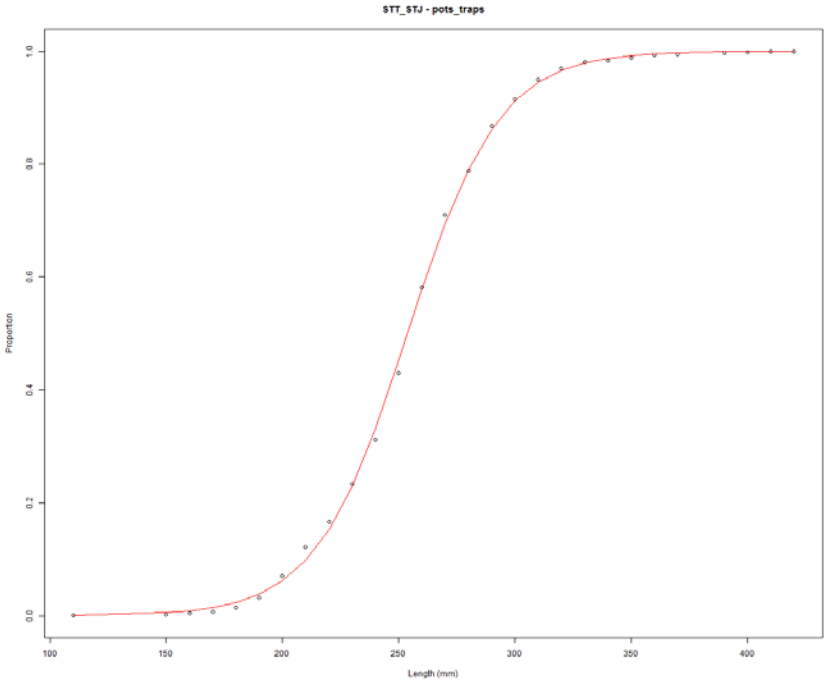
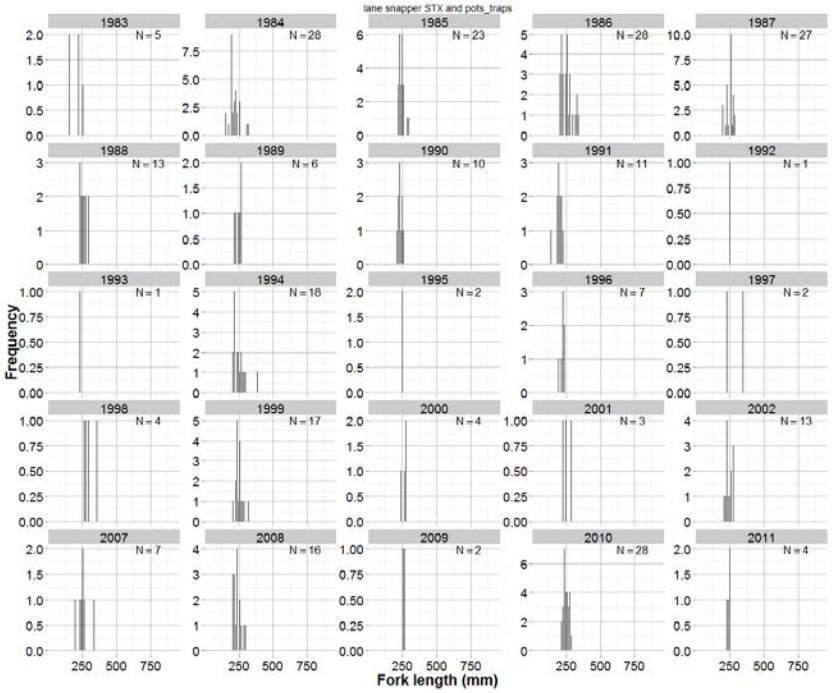


Figure 44 a) Annual length frequency histograms for Lane snapper caught by pots and traps in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

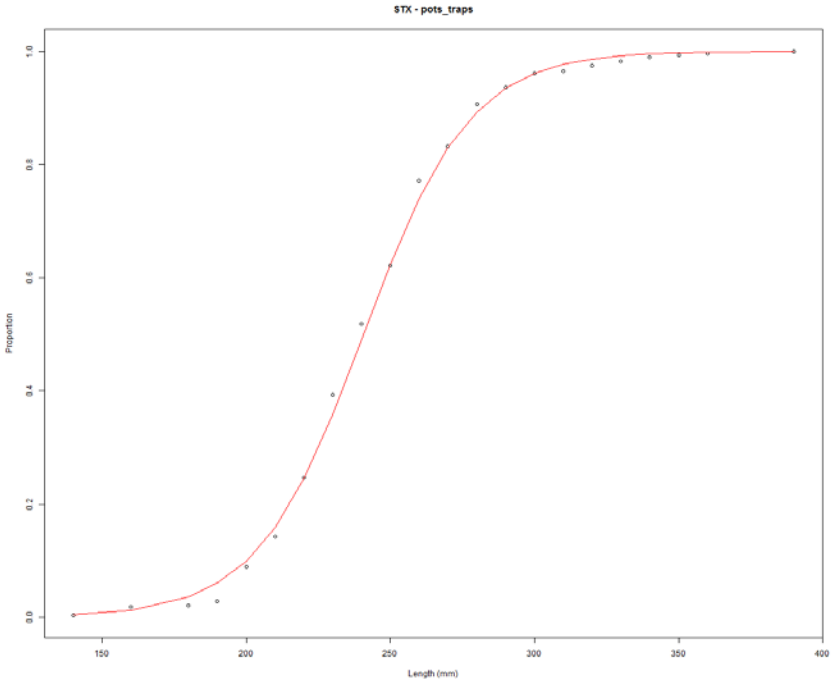


Figure 45 a) Annual length frequency histograms for Silk snapper caught by handlines in Puerto Rico. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

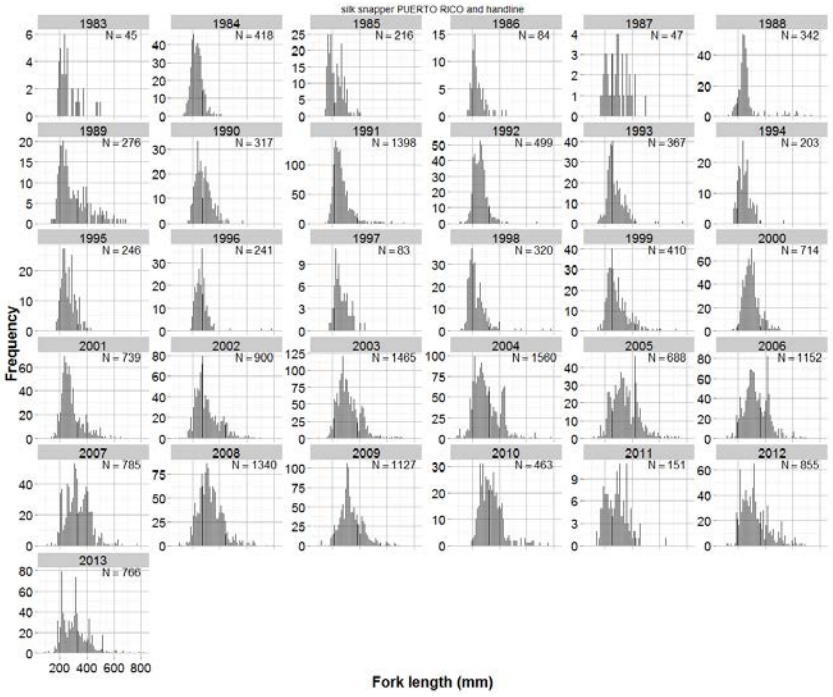


Figure 46 Annual length frequency histograms for Silk snapper caught by pots and traps in Puerto Rico. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

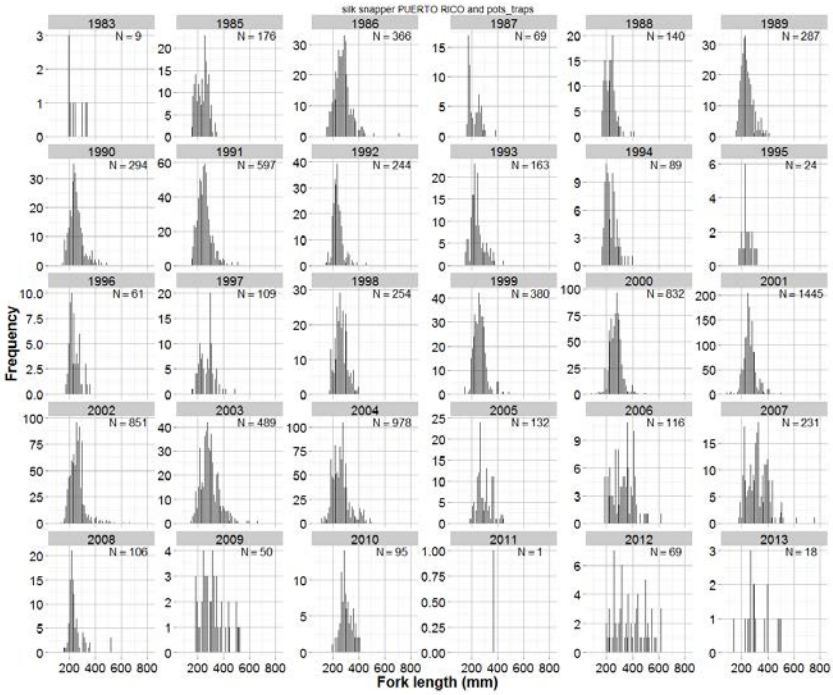


Figure 47 Annual length frequency histograms for Silk snapper caught by trolling gear in Puerto Rico. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

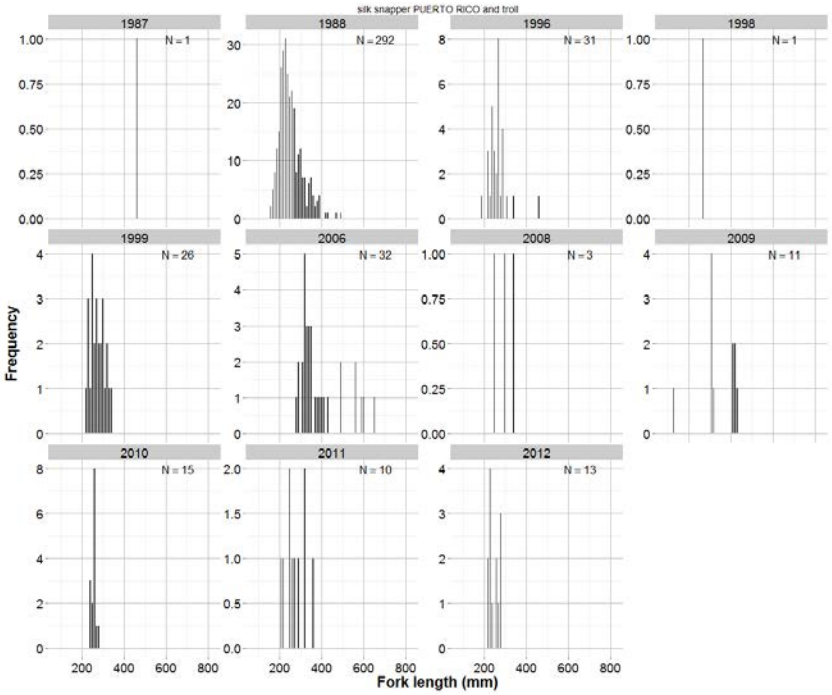


Figure 48 Annual length frequency histograms for Silk snapper caught by longlines in Puerto Rico. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

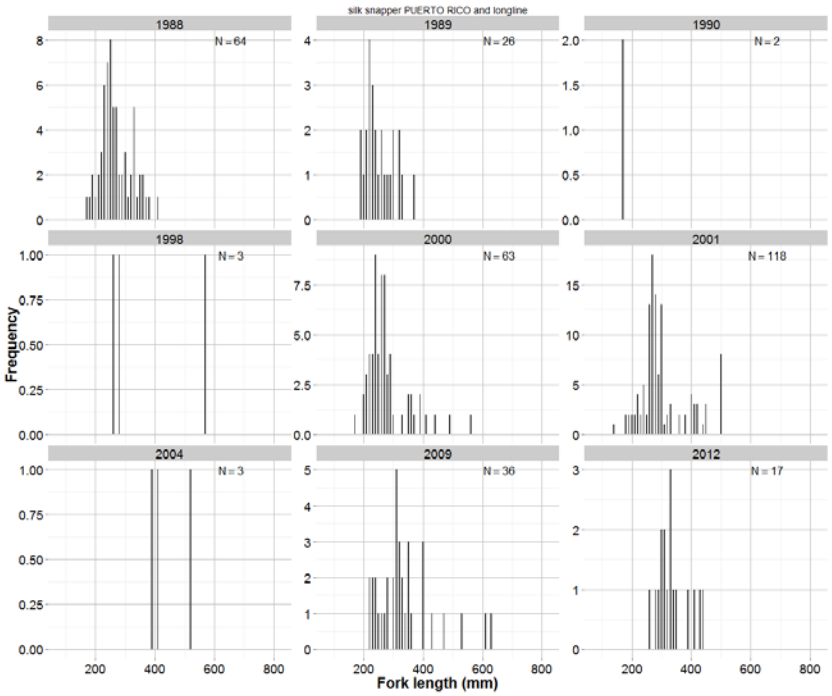


Figure 49 Annual length frequency histograms for Silk snapper caught by handlines in St. Croix. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

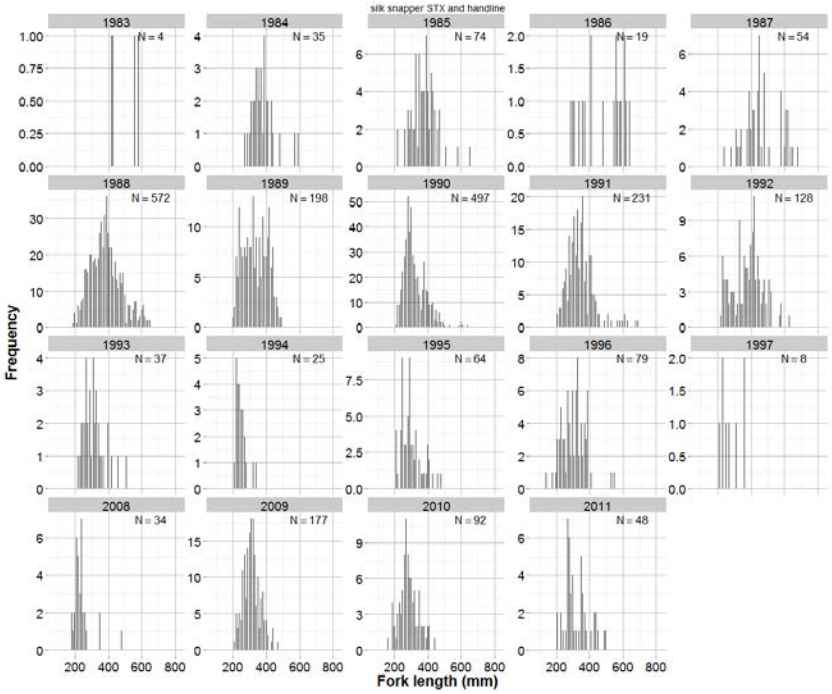


Figure 50 Annual length frequency histograms for Silk snapper caught by longlines in St. Croix. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

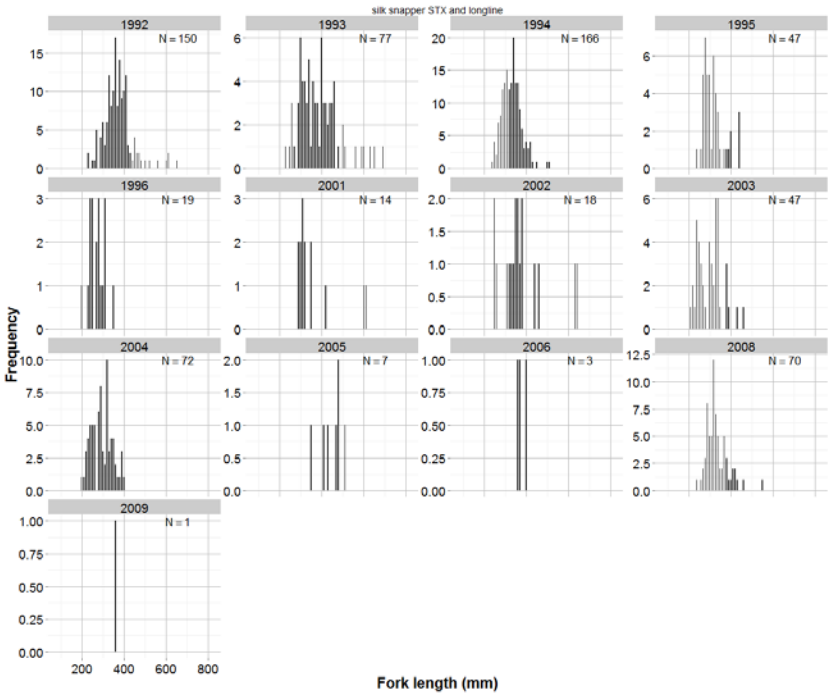


Figure 51 Annual length frequency histograms for Silk snapper caught by pots and traps in St. Thomas/St. John. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

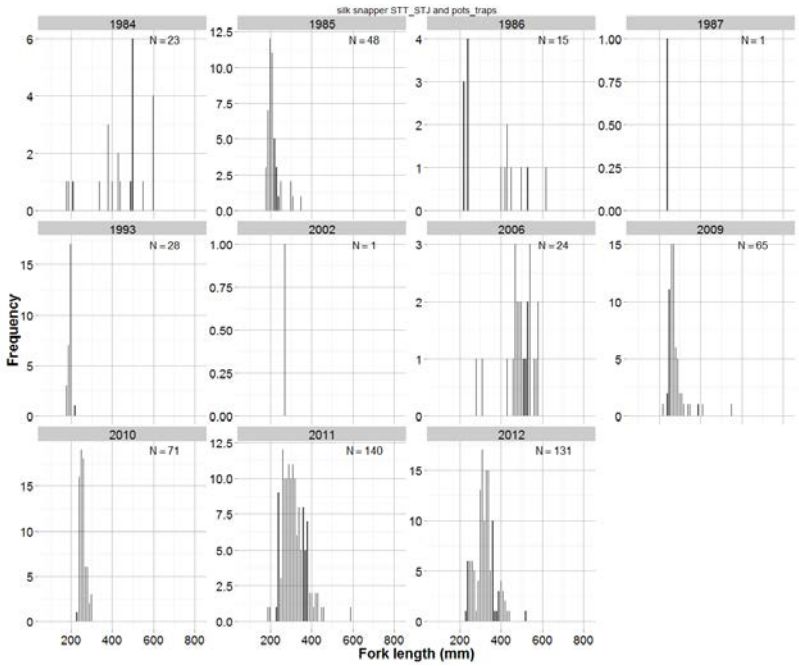


Figure 52 Annual length frequency histograms for Silk snapper caught by handlines in St. Thomas/St. John. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

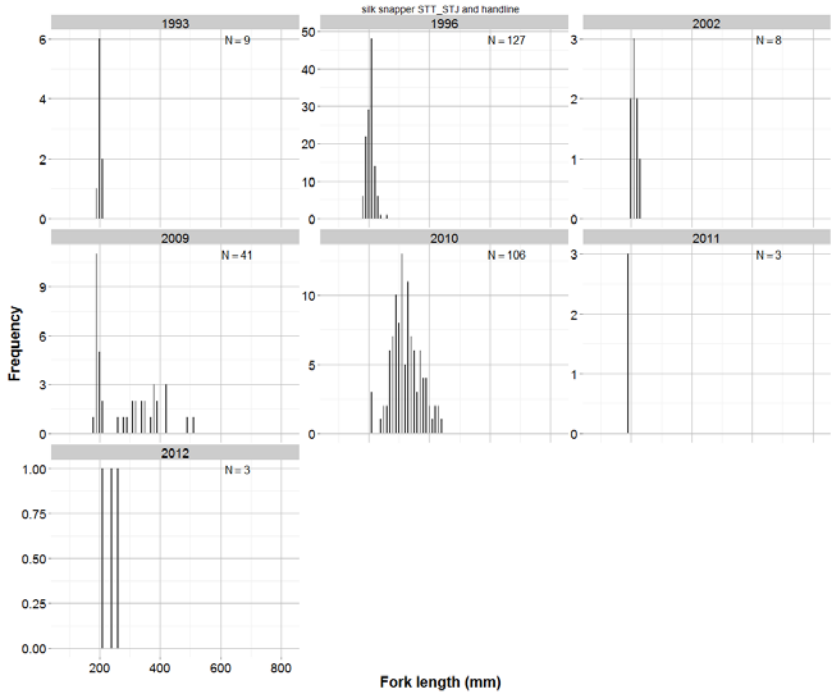
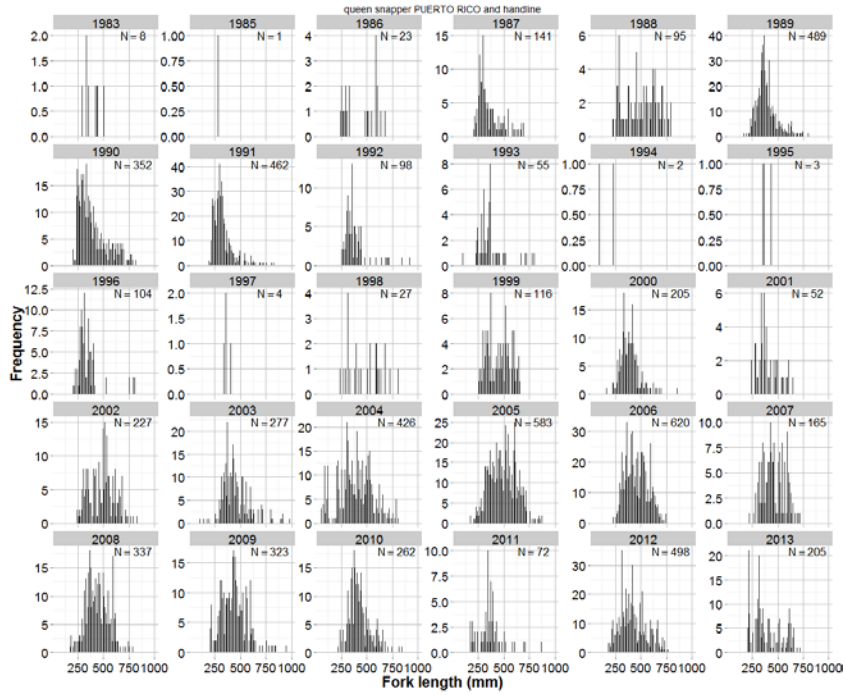


Figure 53 a) Annual length frequency histograms for Queen snapper caught by handlines in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.



b)

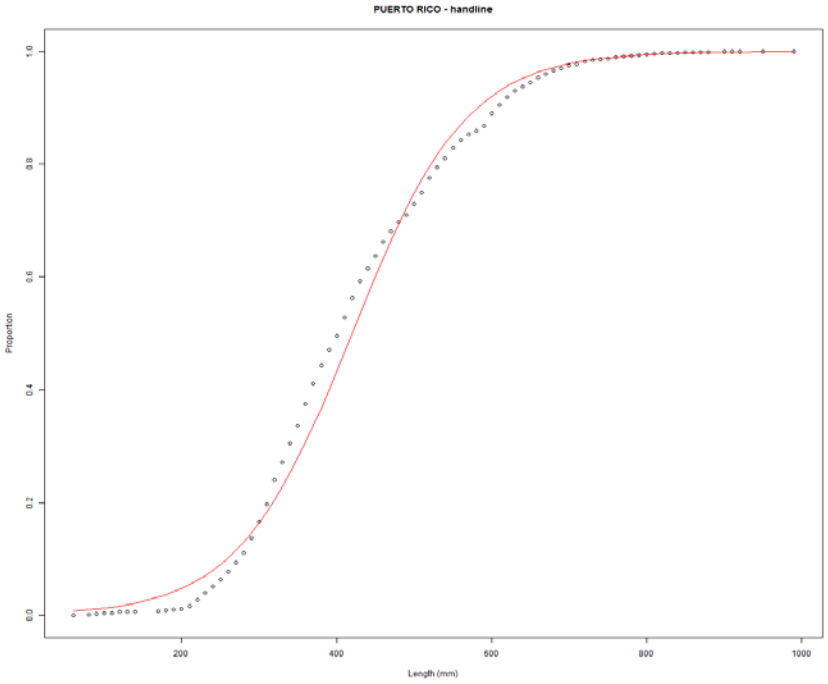
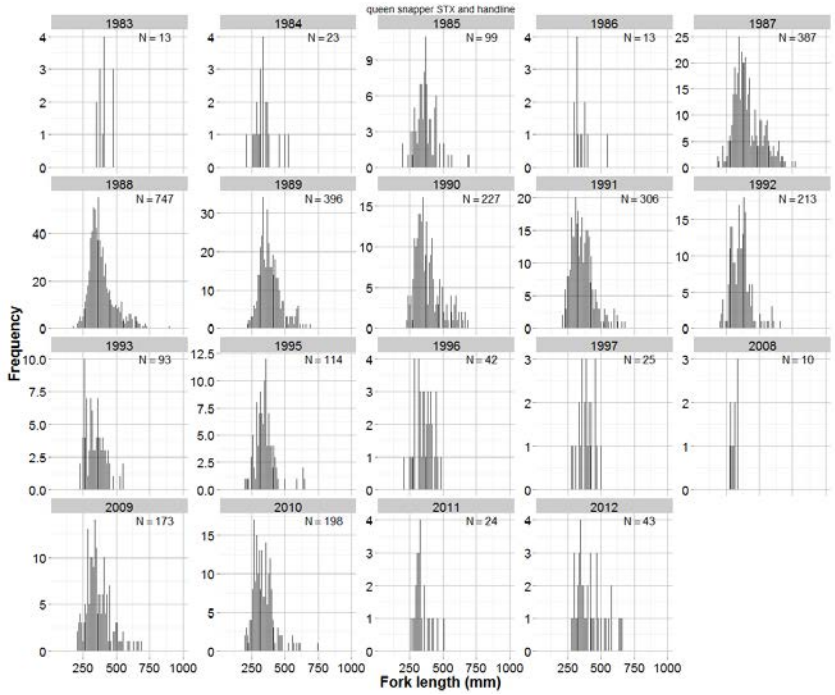


Figure 54 Annual length frequency histograms for Queen snapper caught by handlines in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.



b)

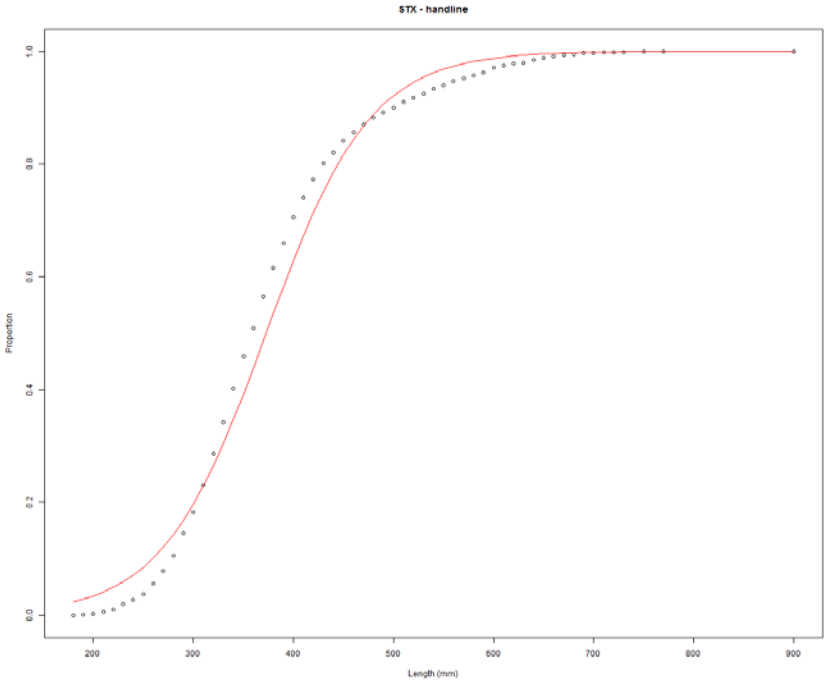
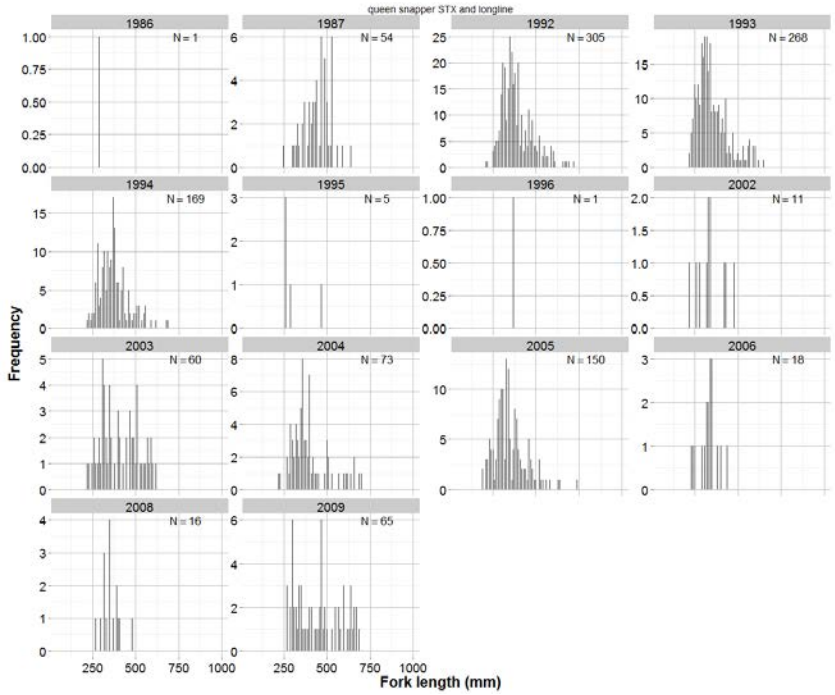


Figure 55 Annual length frequency histograms for Queen snapper caught by longlines in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.



b)

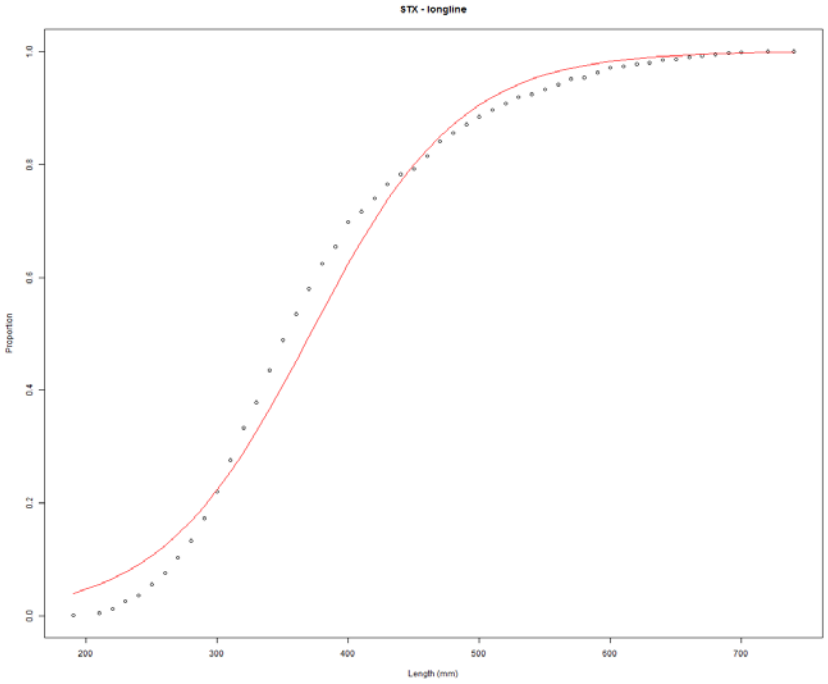
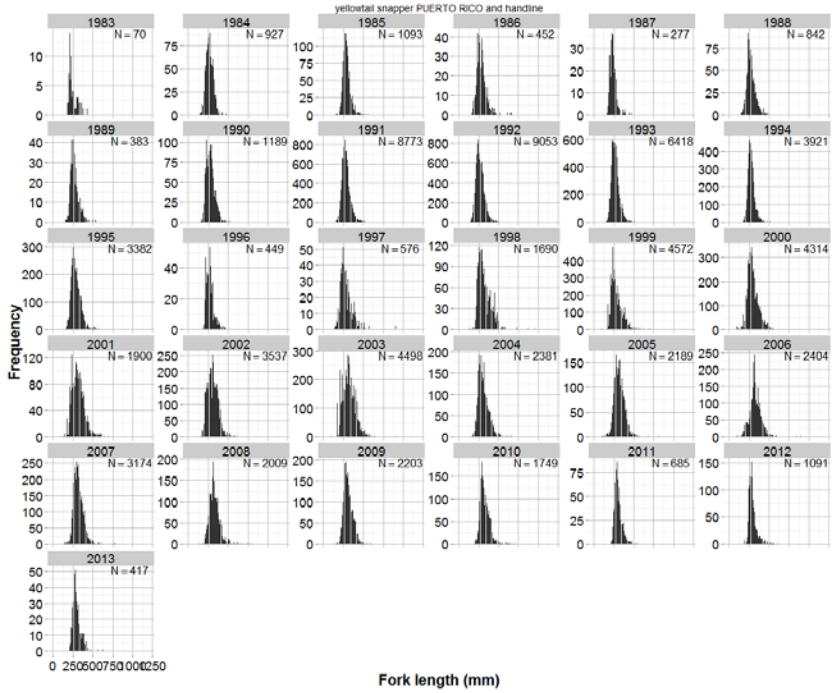


Figure 56 a) Annual length frequency histograms for Yellowtail snapper caught by handlines in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

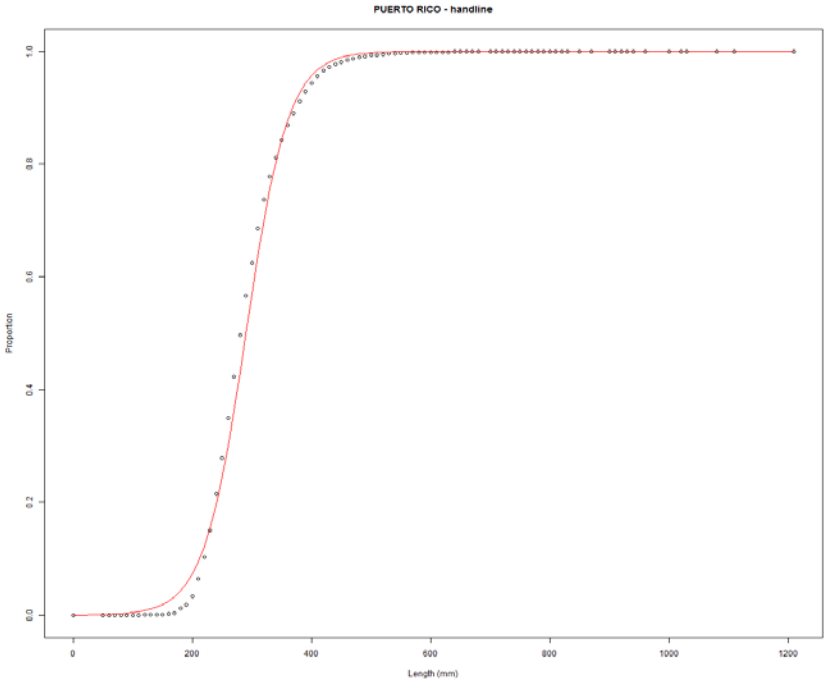
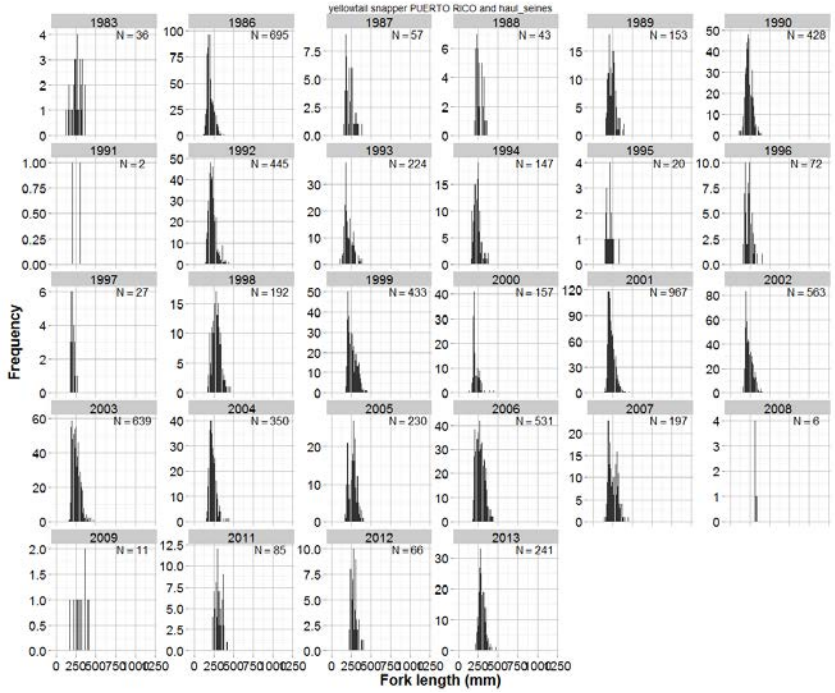


Figure 57 a) Annual length frequency histograms for Yellowtail snapper caught by haul seines in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

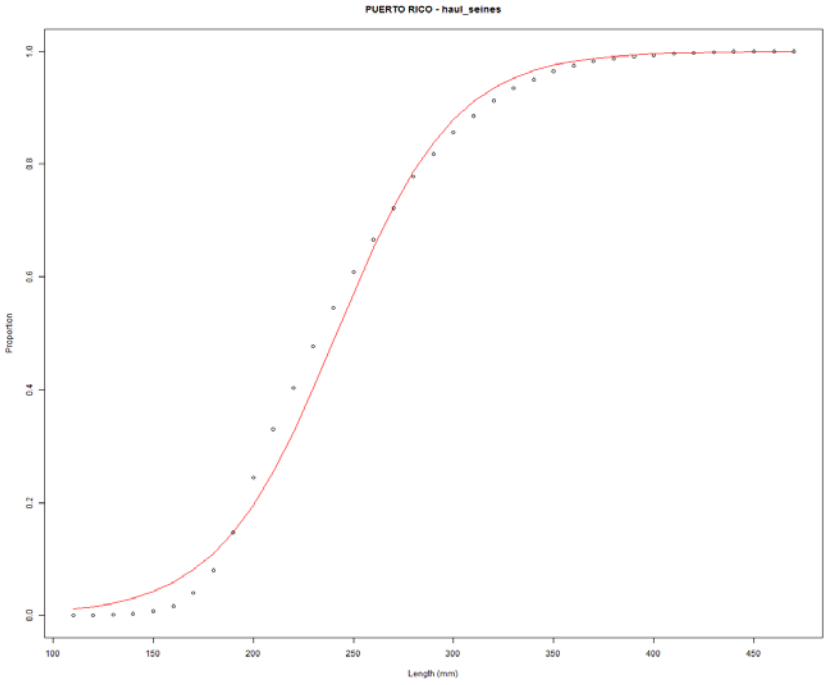
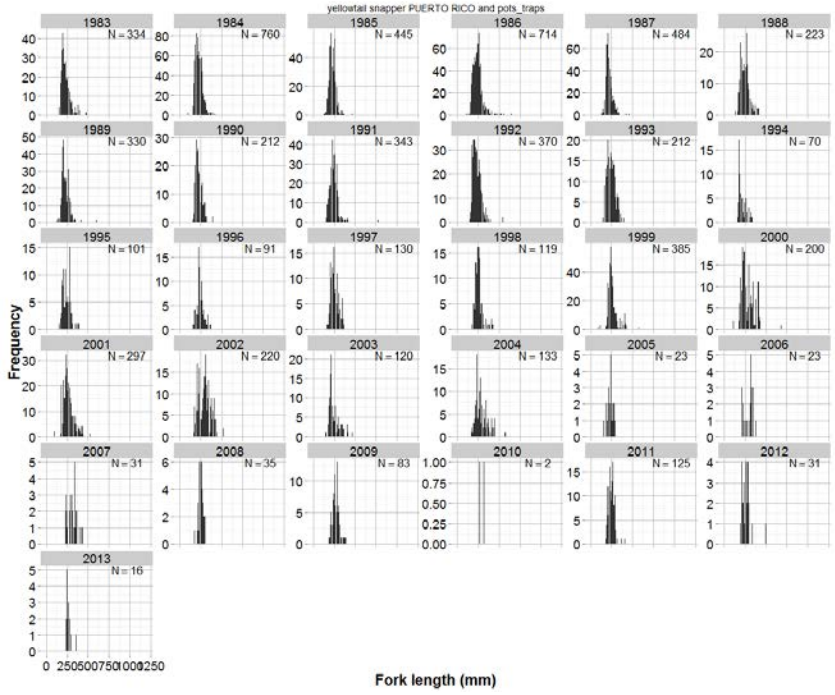


Figure 58 a) Annual length frequency histograms for Yellowtail snapper caught by pots and traps in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

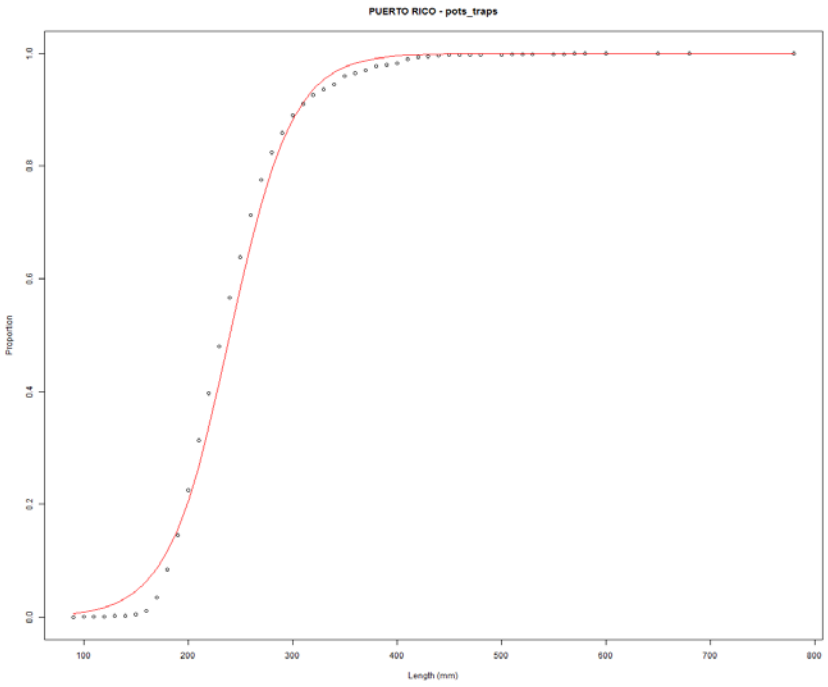
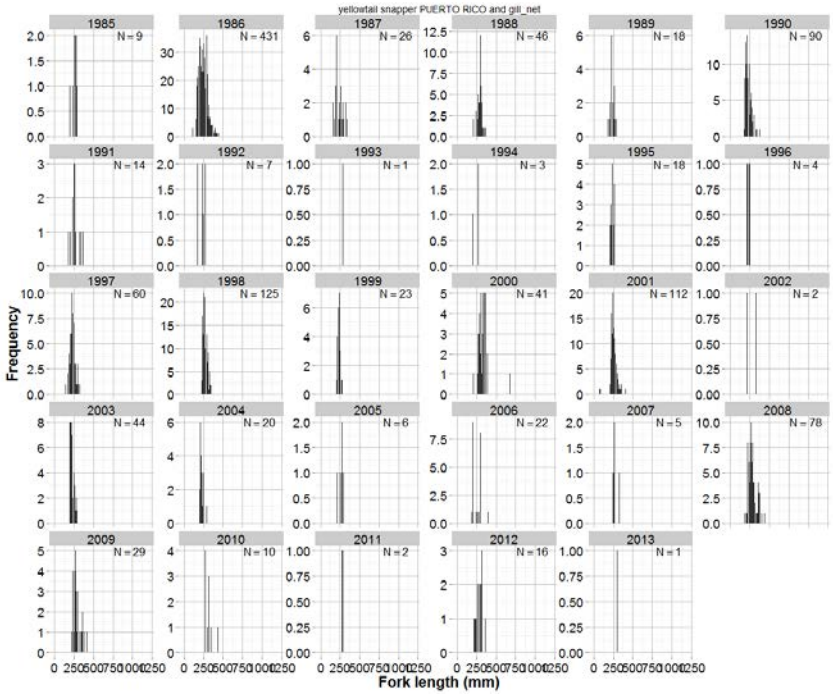


Figure 59 a) Annual length frequency histograms for Yellowtail snapper caught by gill nets in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.



a)

b)

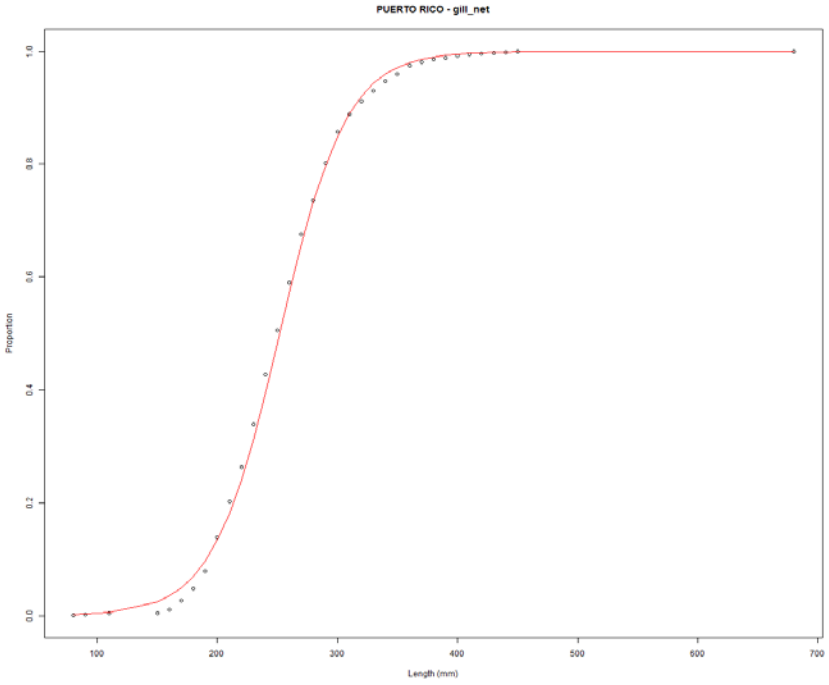
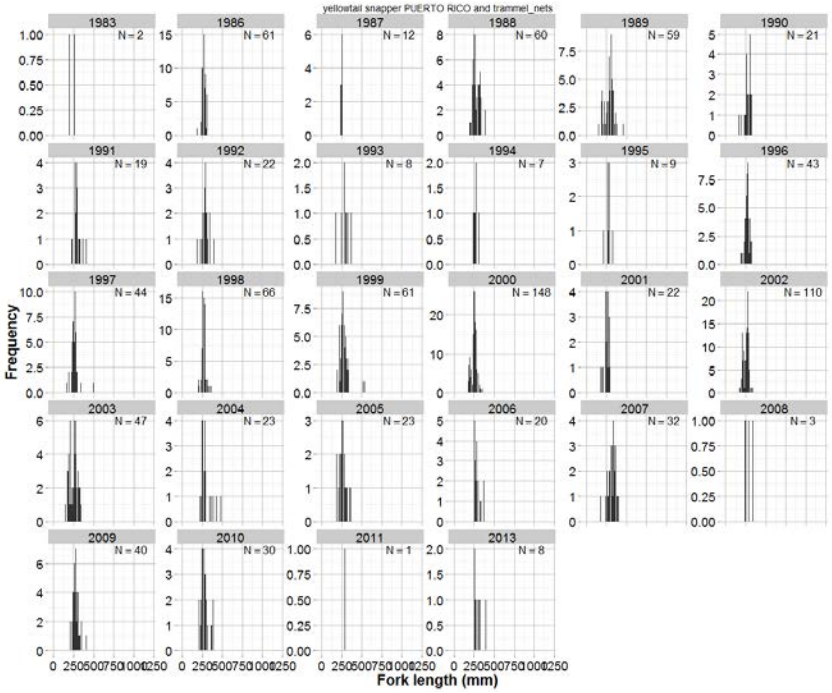


Figure 60 a) Annual length frequency histograms for Yellowtail snapper caught by trammel nets in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

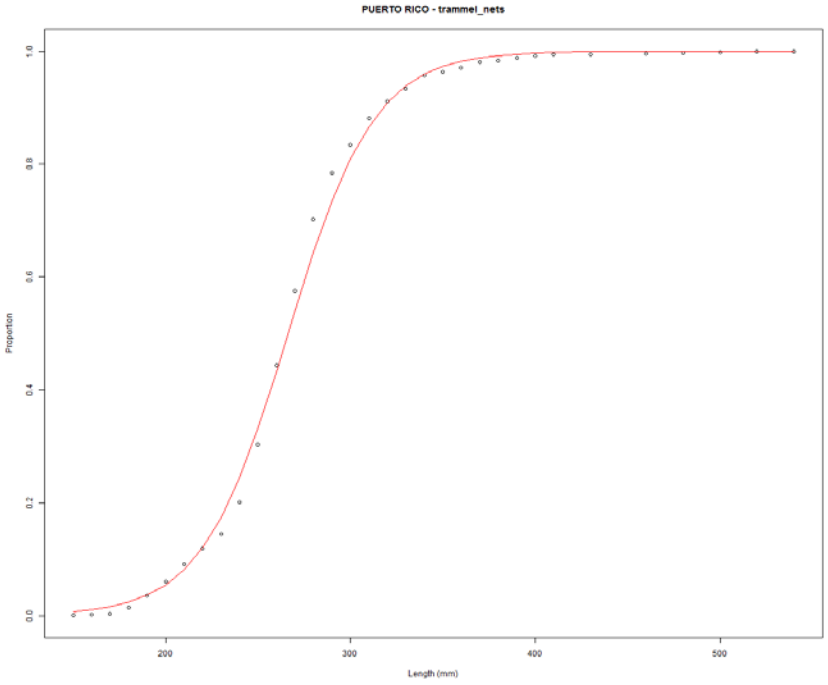
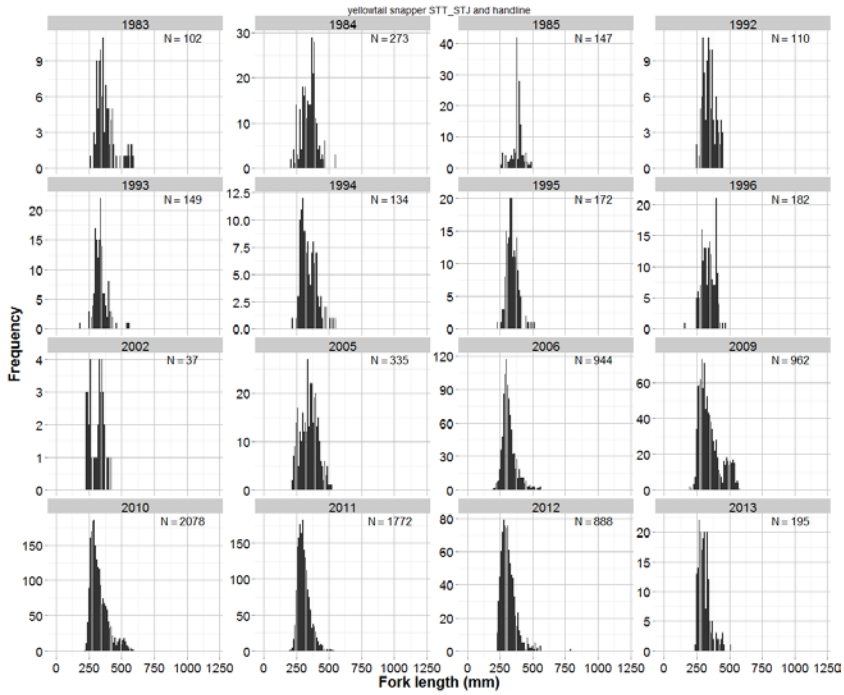


Figure 61 a) Annual length frequency histograms for Yellowtail snapper caught by handlines in St. Thomas/St. John and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

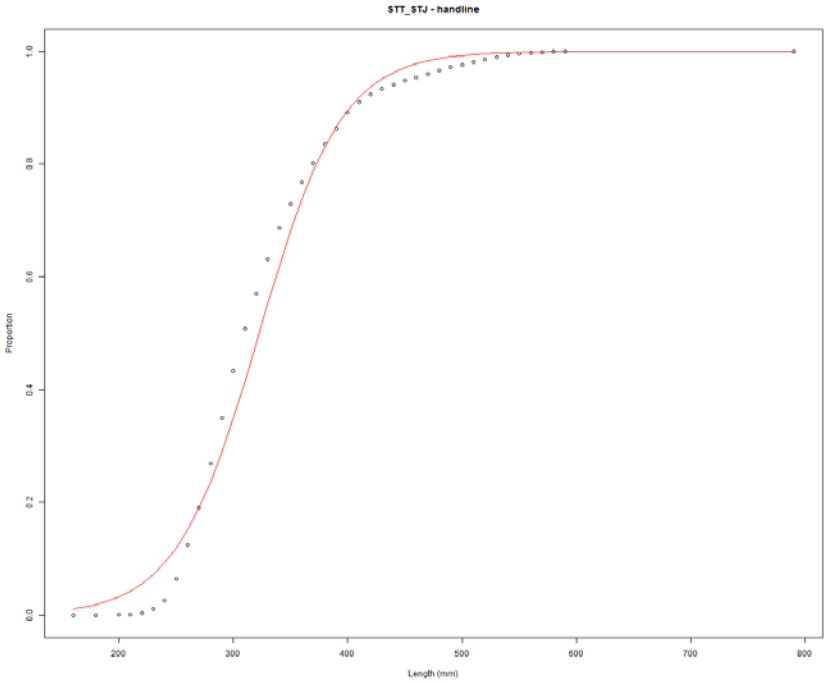
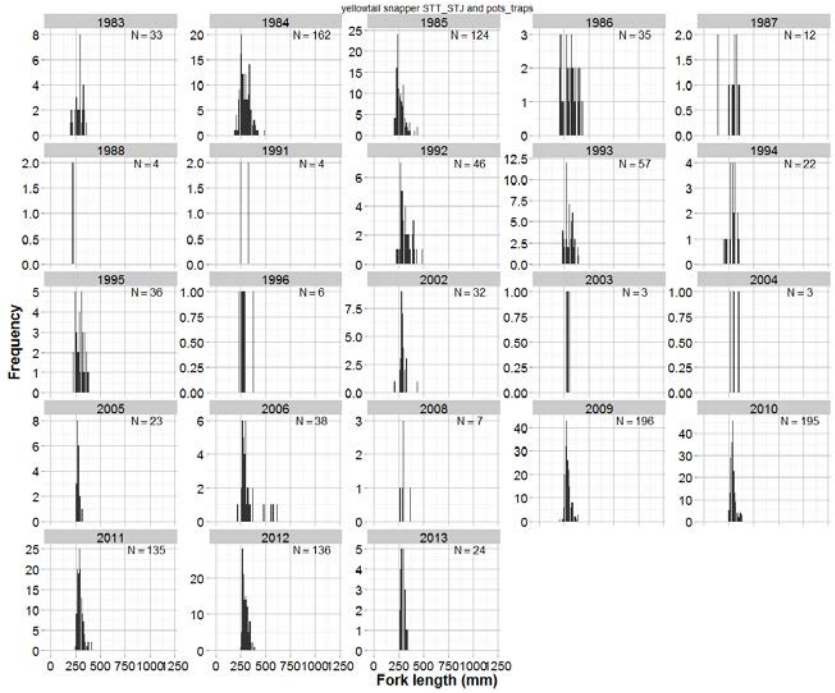


Figure 62 a) Annual length frequency histograms for Yellowtail snapper caught by pots and traps in St. Thomas/St. John and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

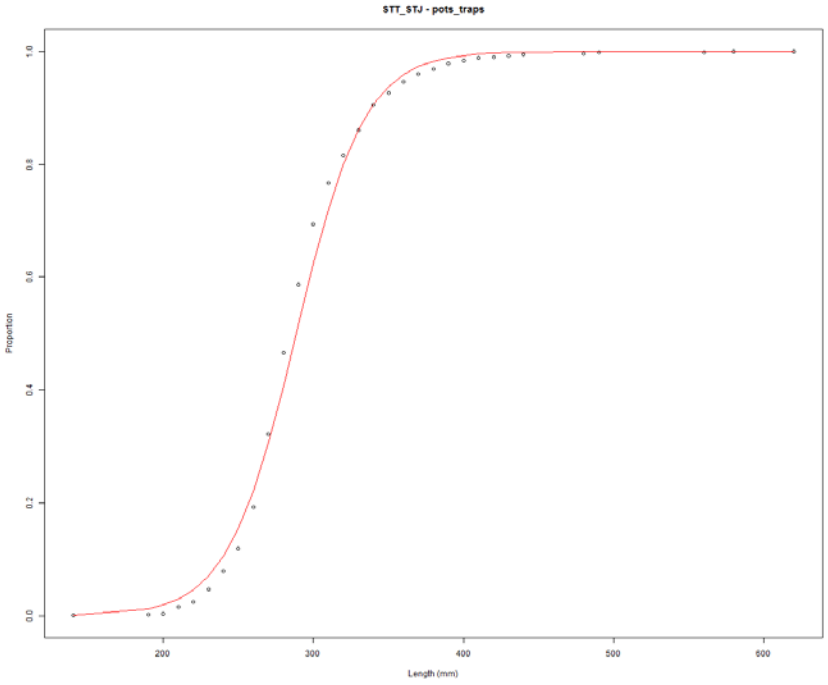
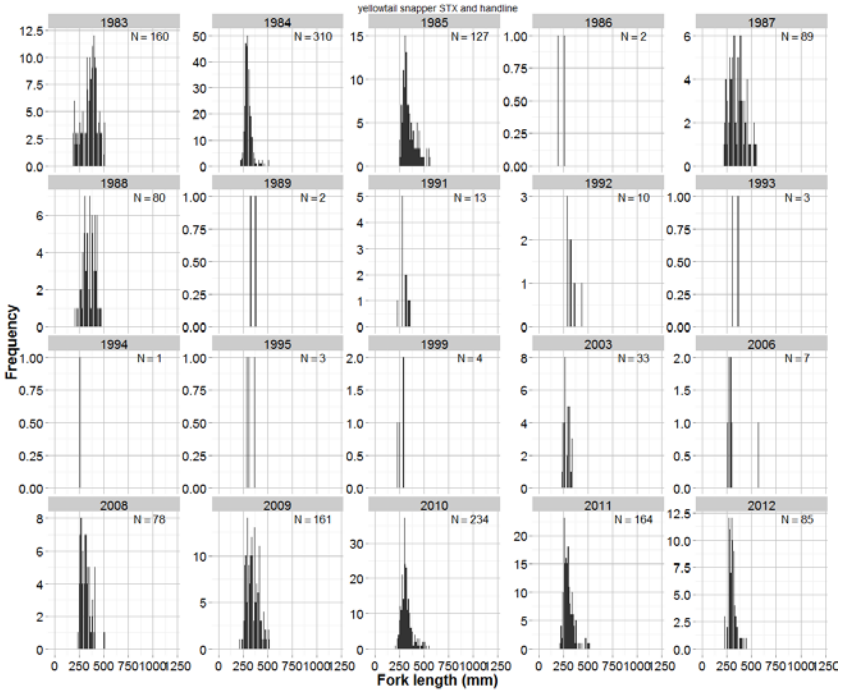


Figure 63 a) Annual length frequency histograms for Yellowtail snapper caught by handlines in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

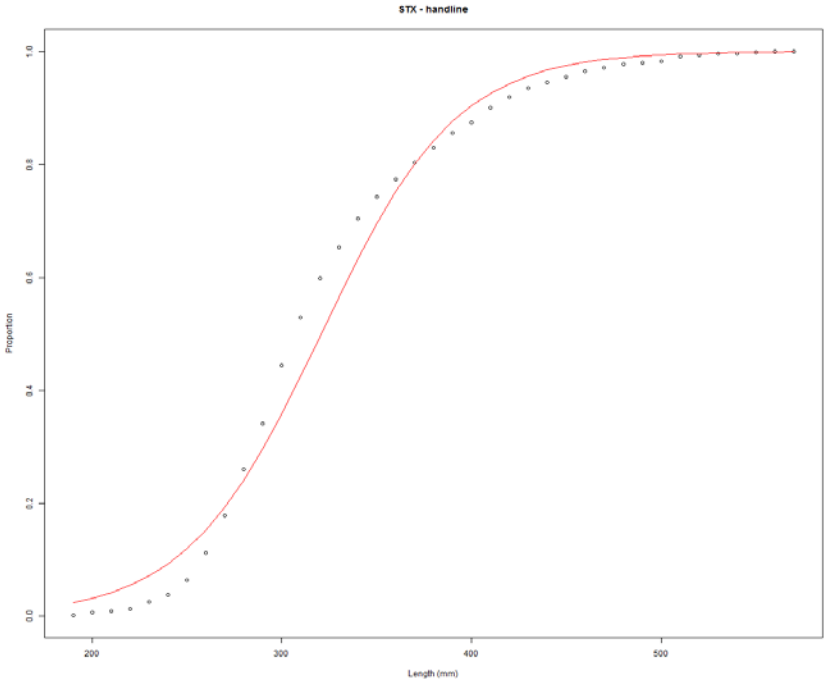
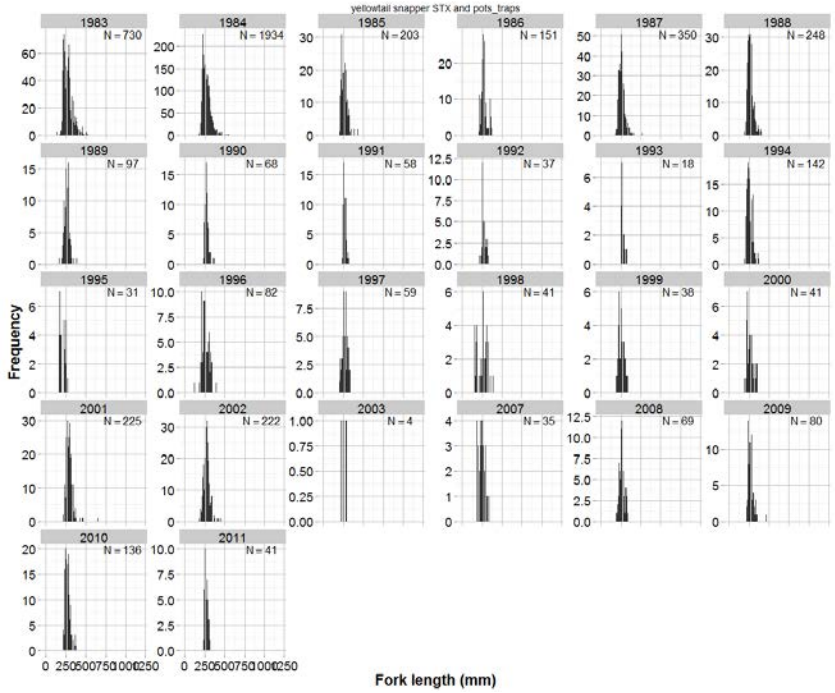


Figure 64 a) Annual length frequency histograms for Yellowtail snapper caught by pots and traps in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

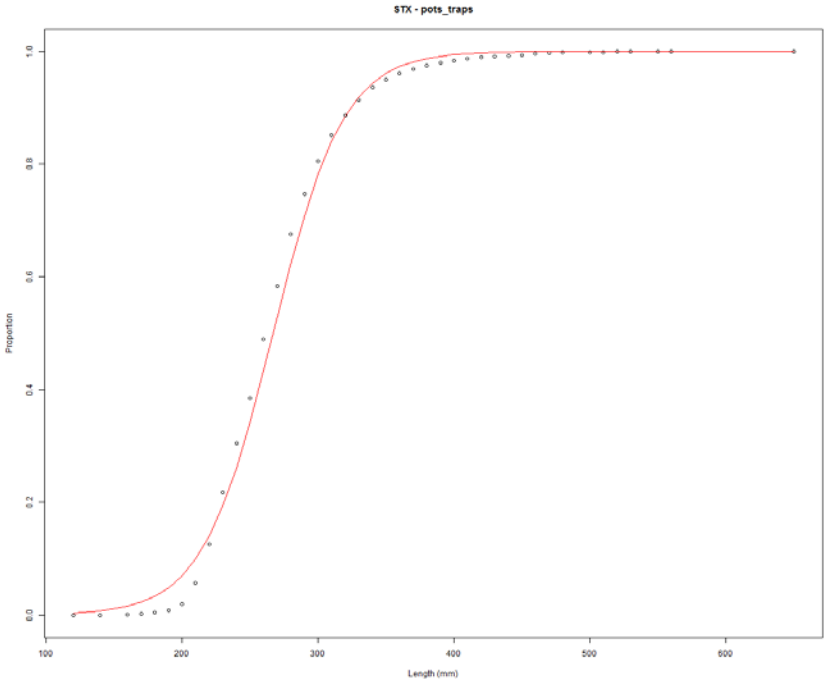
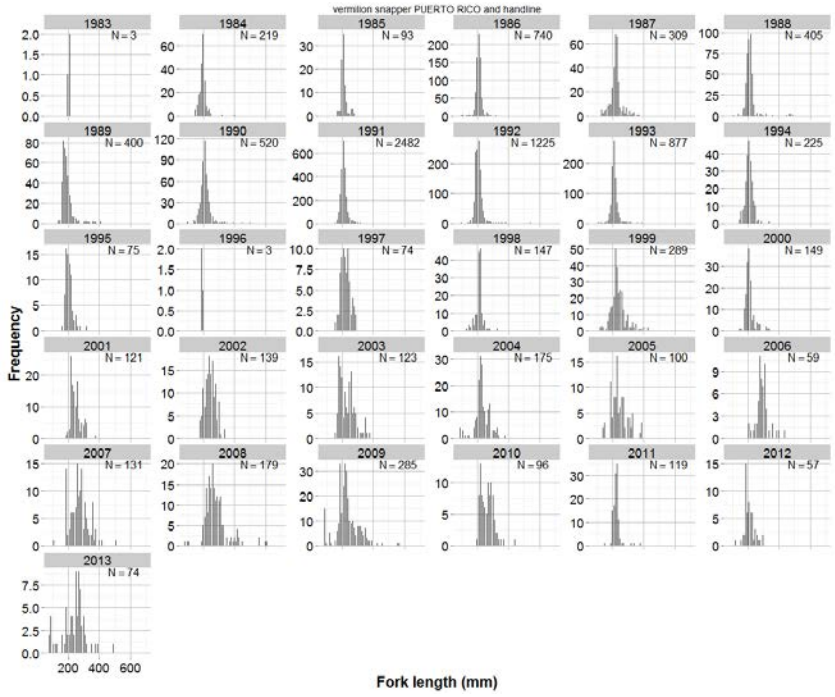


Figure 65 a) Annual length frequency histograms for Vermilion snapper caught by handlines in Puerto Rico b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.



b)

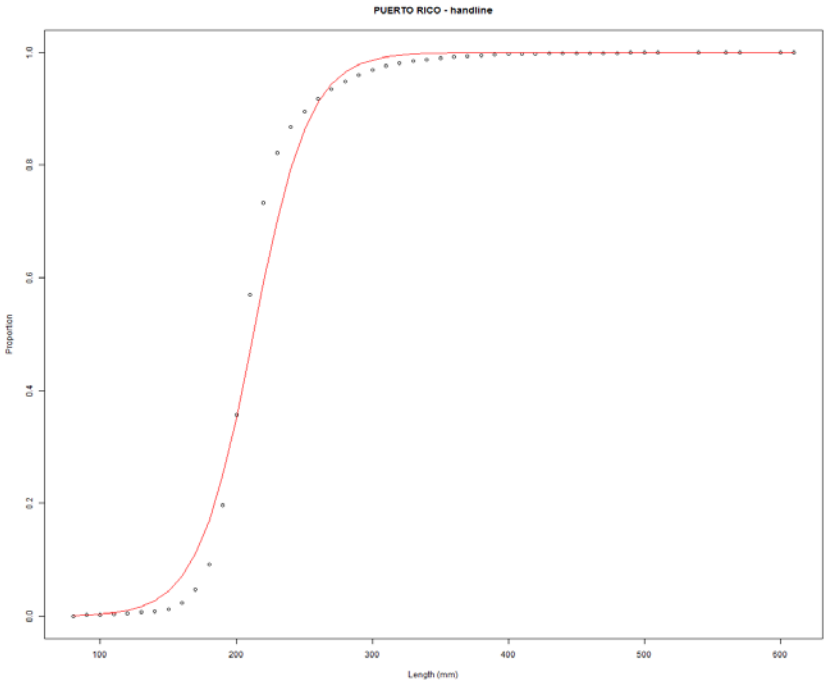
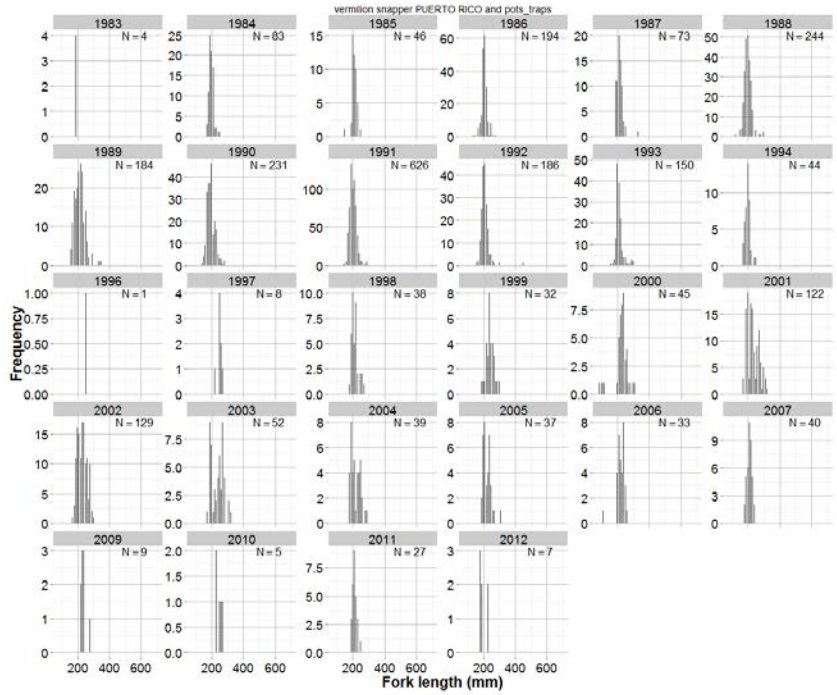


Figure 66 a) Annual length frequency histograms for Vermilion snapper caught by pots and traps in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.



b)

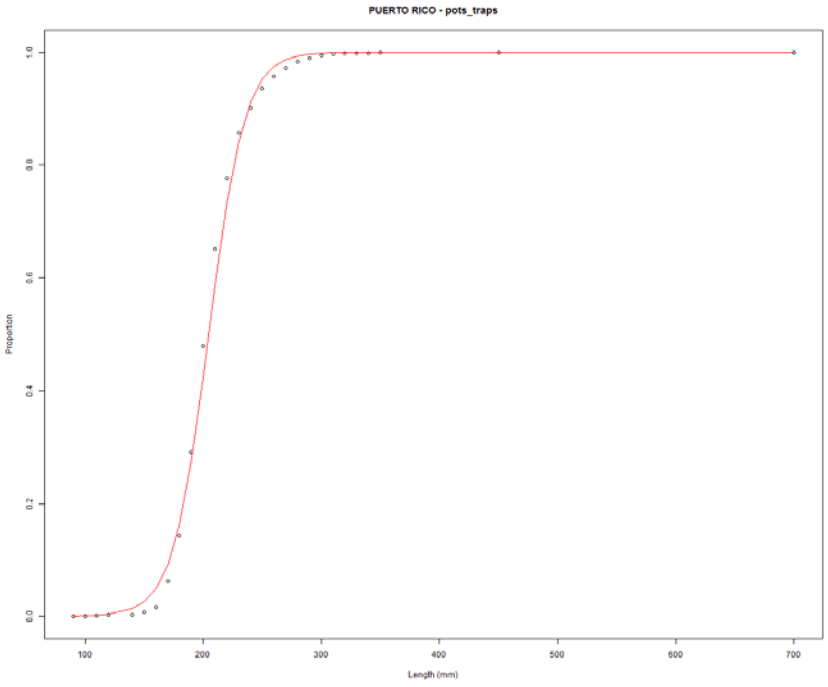
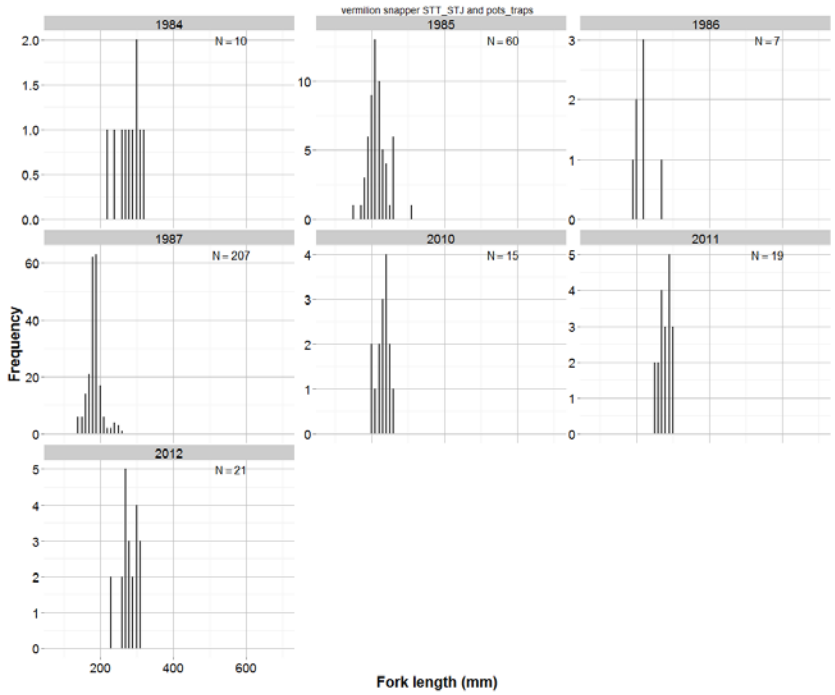


Figure 67 a)Annual length frequency histograms for Vermilion snapper caught by pots and traps in St. Thomas/St. John and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

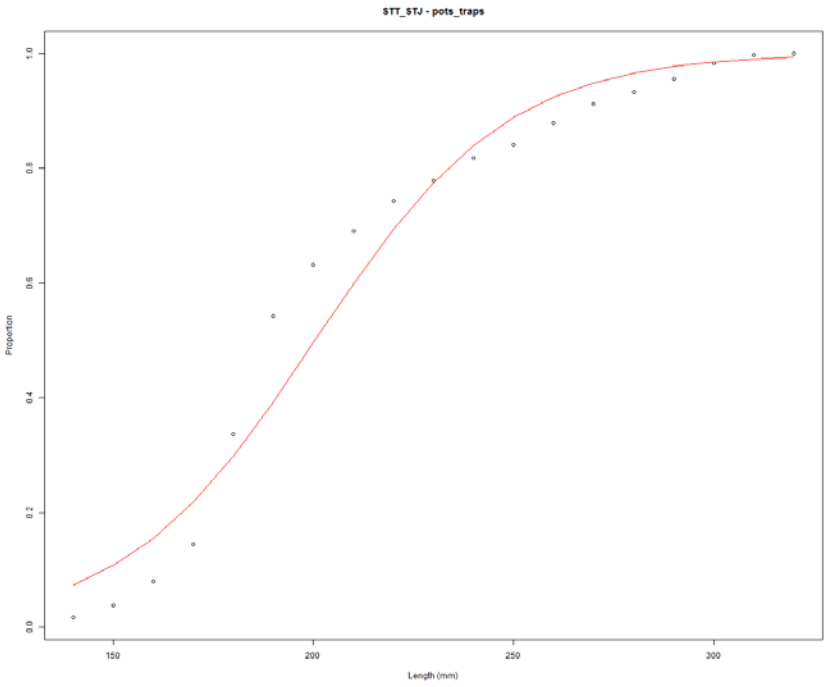
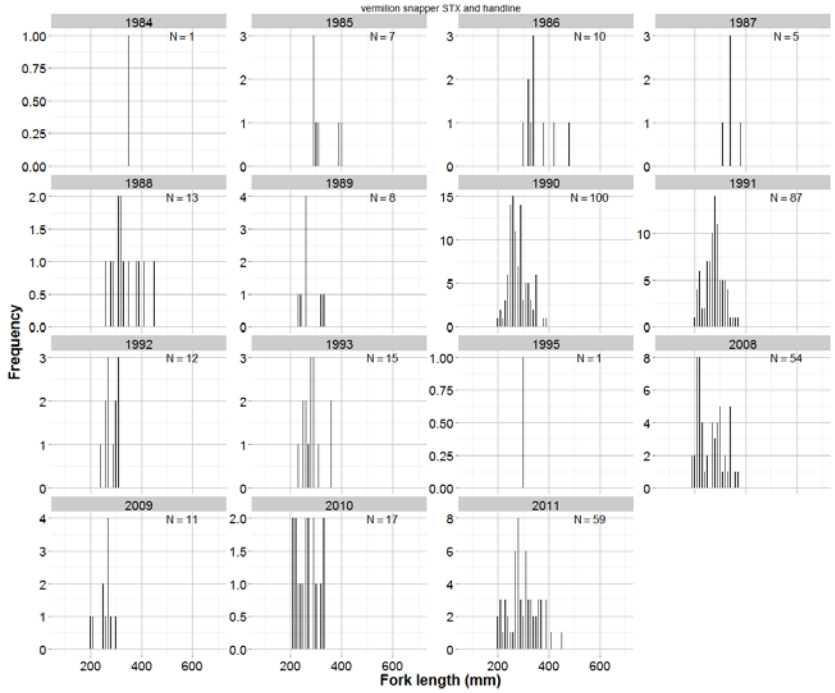


Figure 68 a) Annual length frequency histograms for Vermilion snapper caught by handlines in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

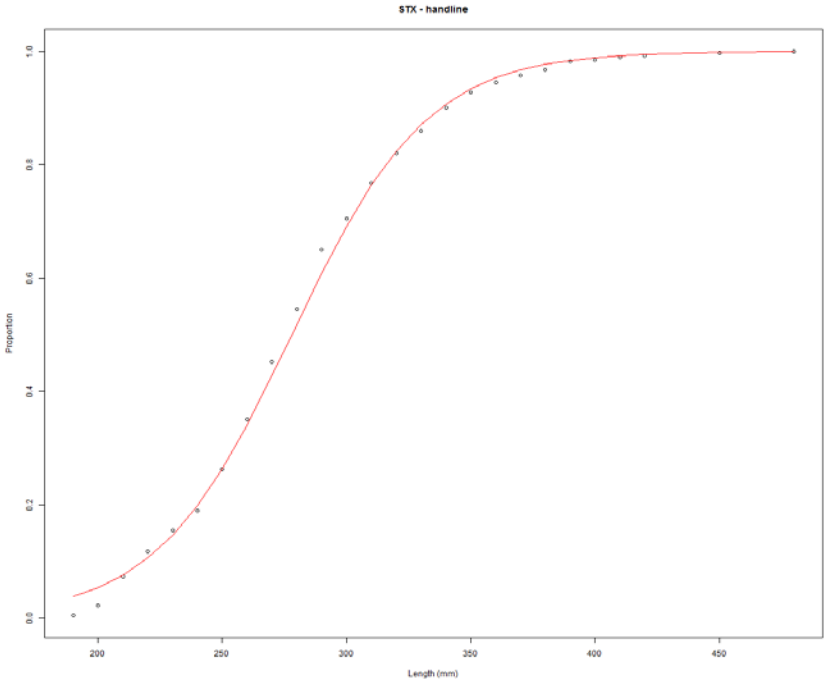


Figure 69 Annual length frequency histograms for Tripletail caught by handlines in Puerto Rico. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

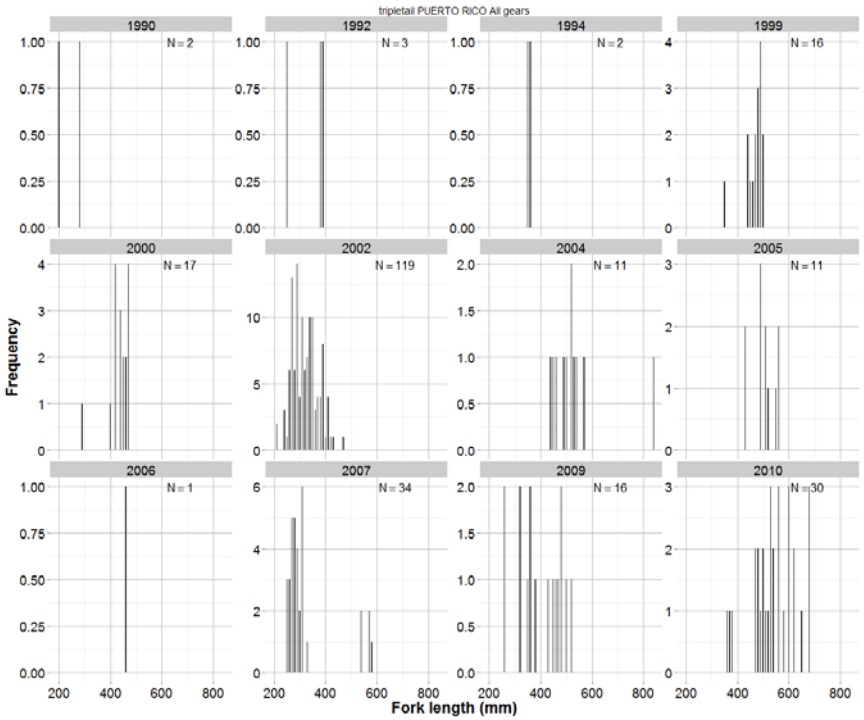
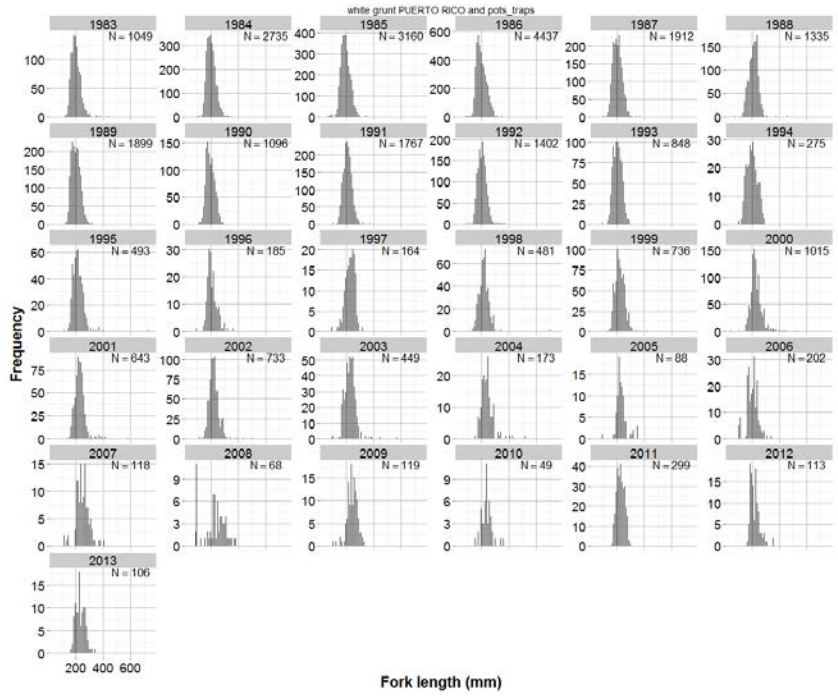


Figure 70 a) Annual length frequency histograms for White grunt caught by pots and traps in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

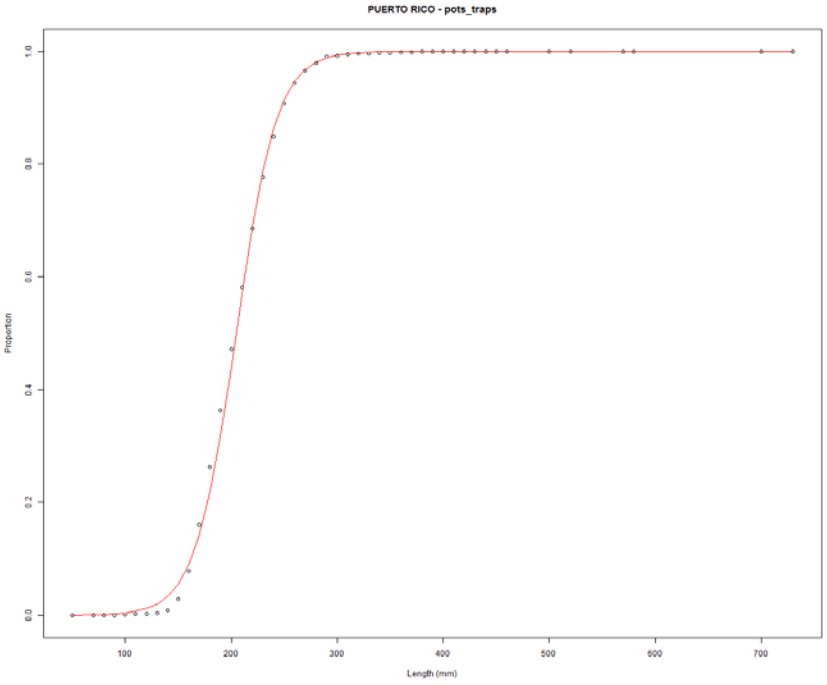
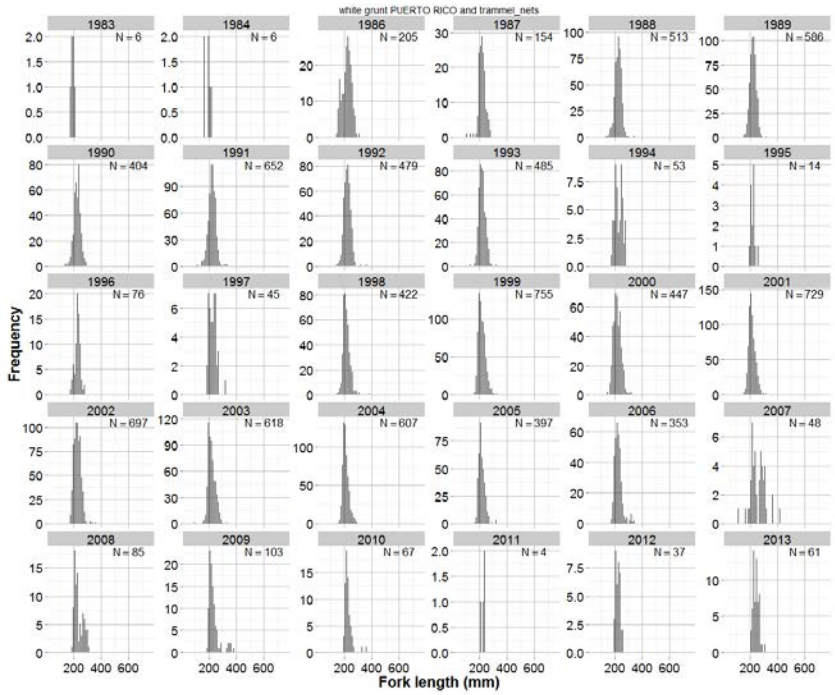


Figure 71 a) Annual length frequency histograms for White grunt caught by trammel nets in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

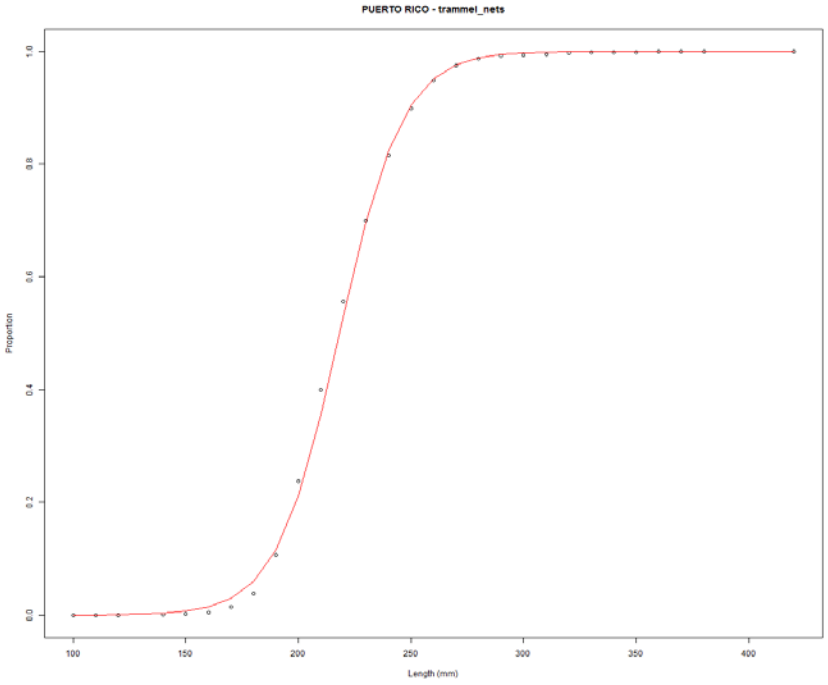
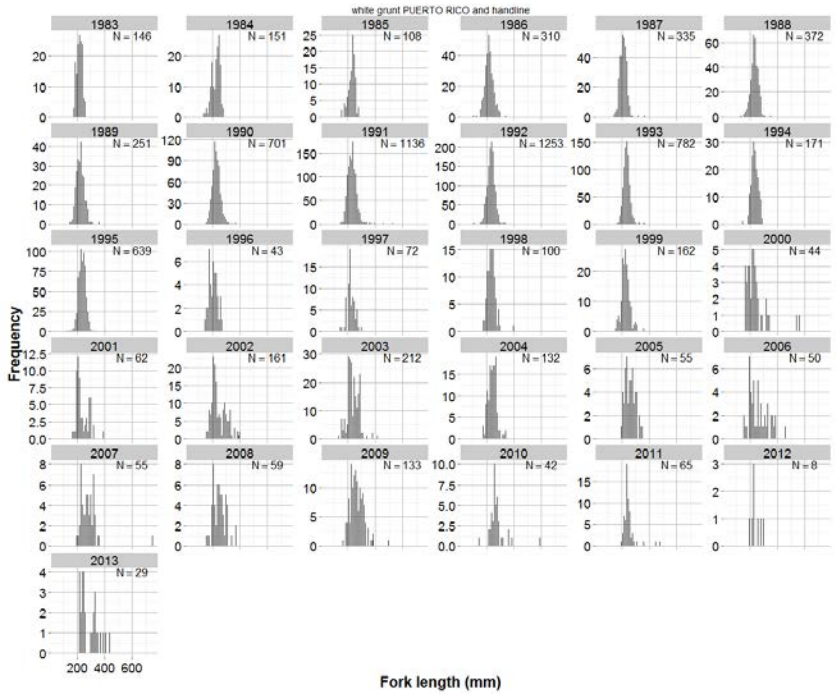


Figure 72 a) Annual length frequency histograms for White grunt caught by handlines in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

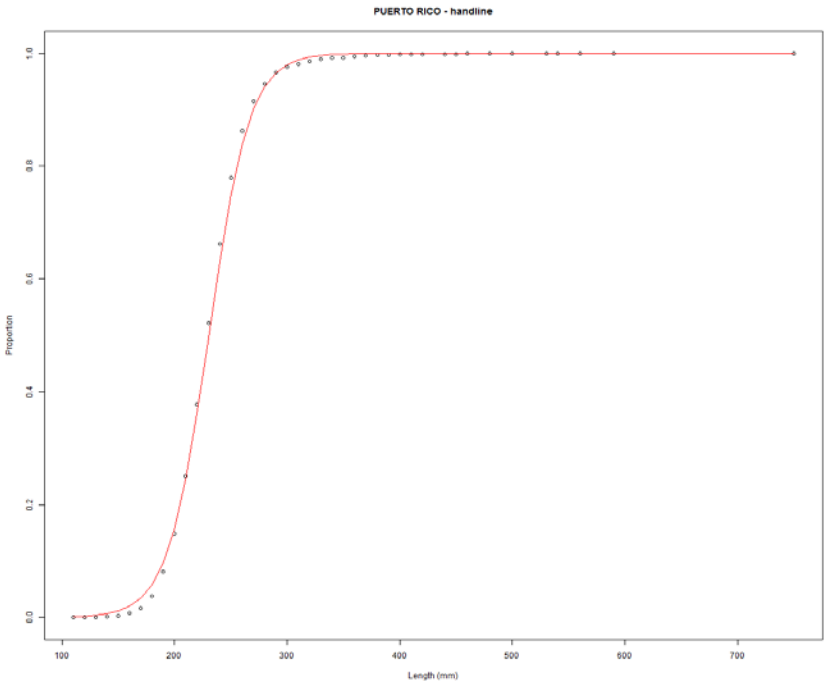
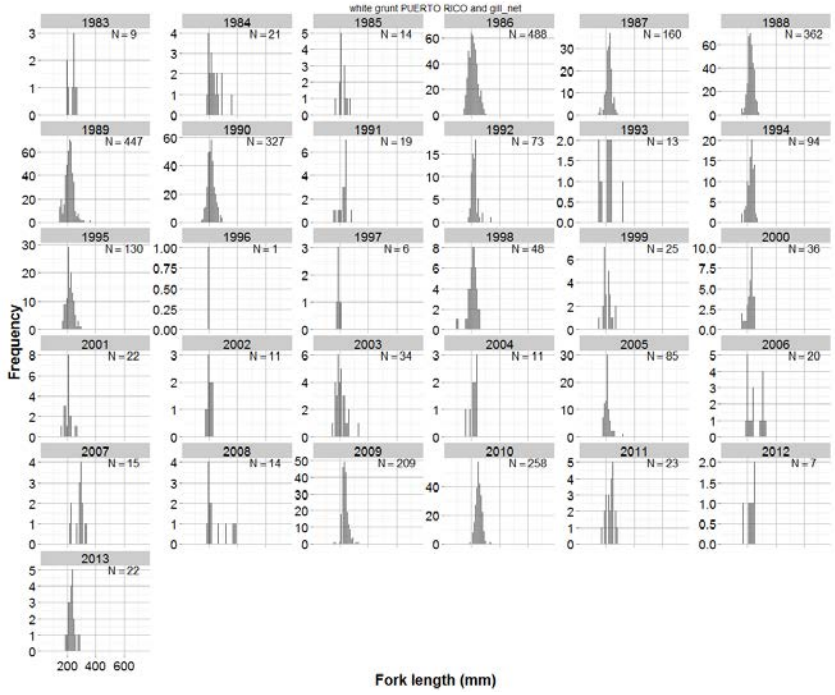


Figure 73 a) Annual length frequency histograms for White grunt caught by gill nets in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

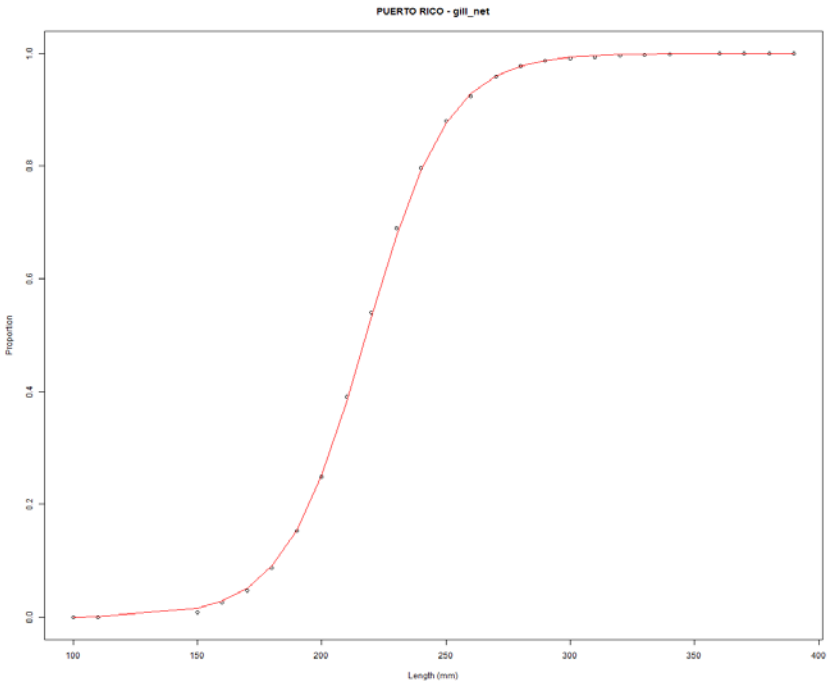
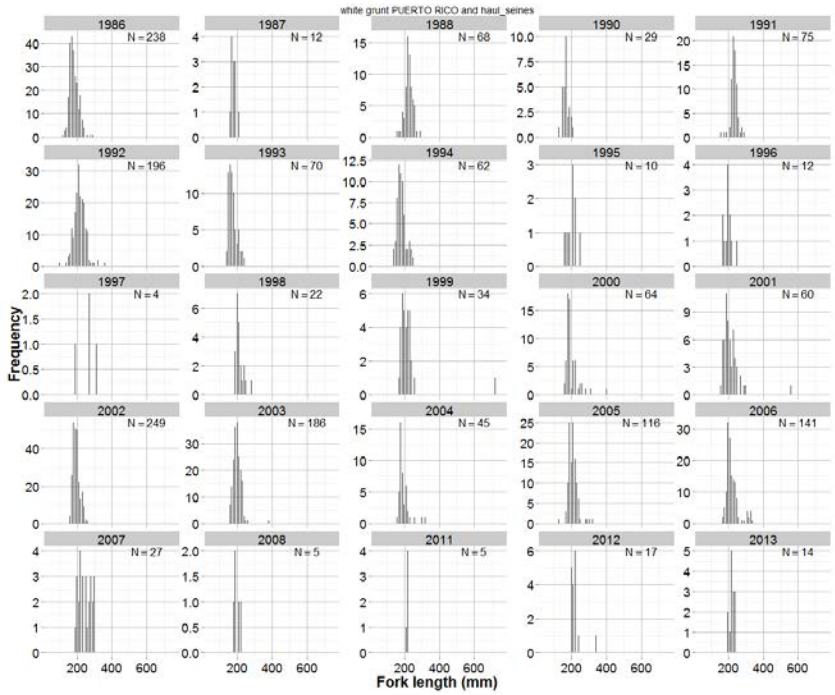


Figure 74 a) Annual length frequency histograms for White grunt caught by haul seines in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

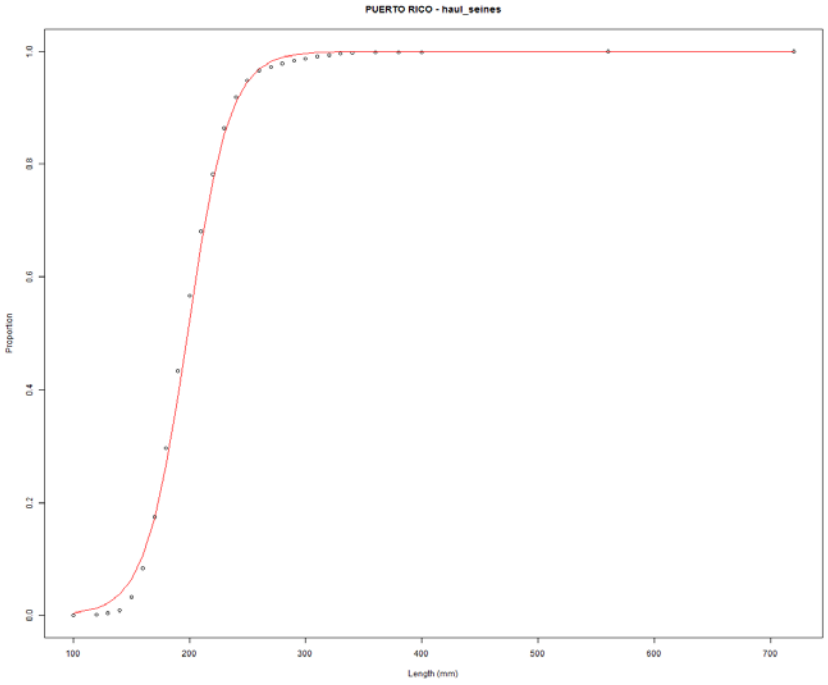
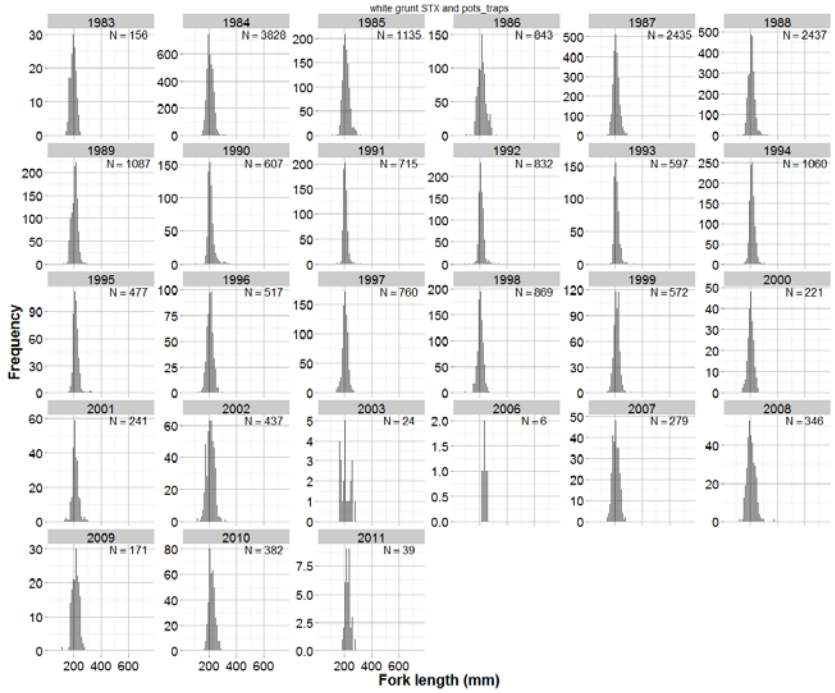


Figure 75 a) Annual length frequency histograms for White grunt caught by pots and traps in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

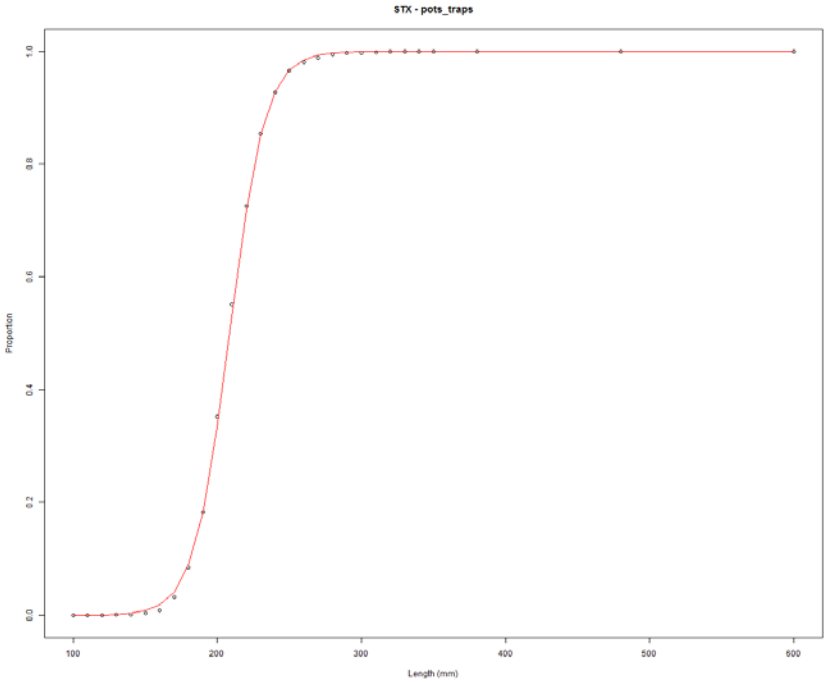
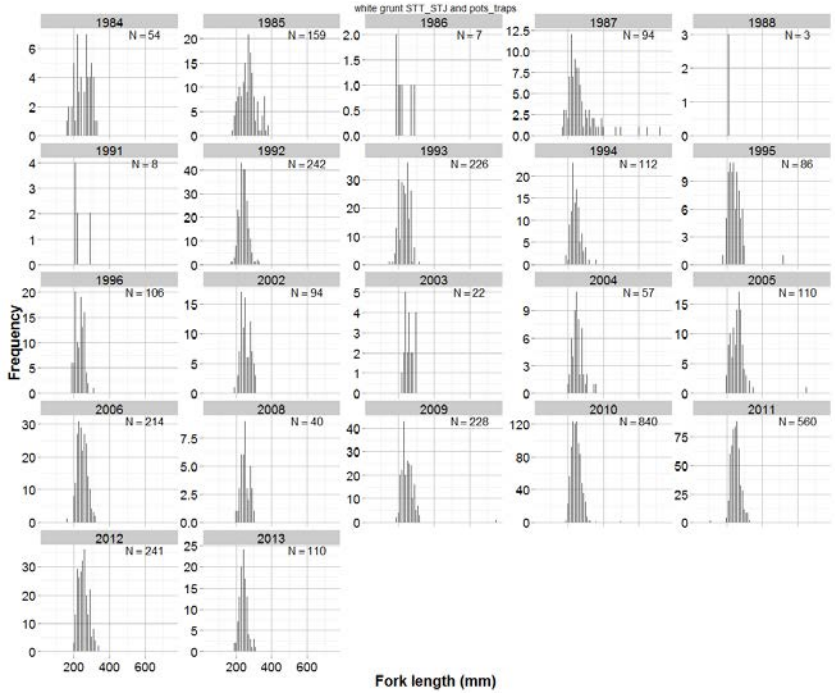


Figure 76 a) Annual length frequency histograms for White grunt caught by pots and traps in St. Thomas/St. John and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

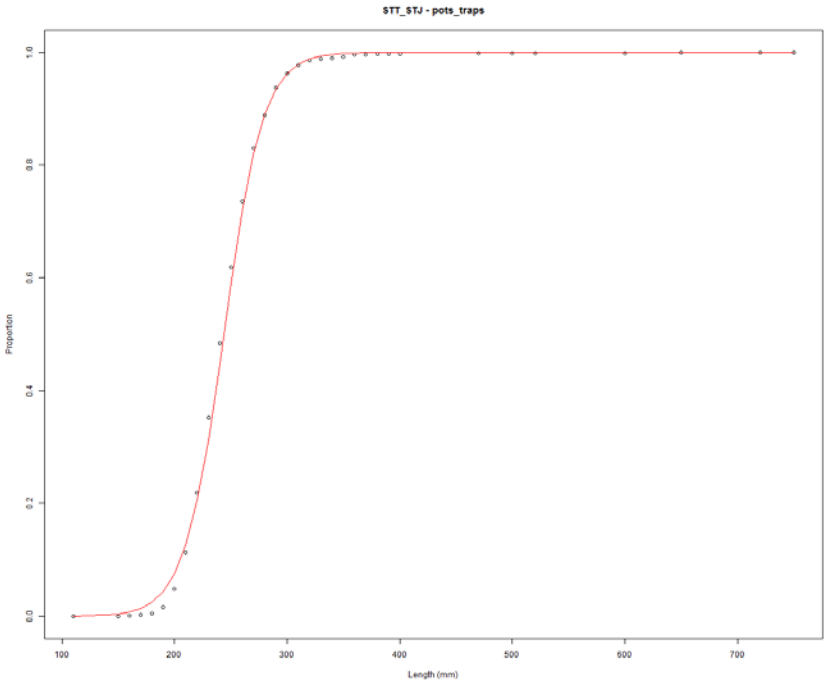


Figure 77. Annual length frequency histograms for Great barracuda caught by handlines in St. Croix. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

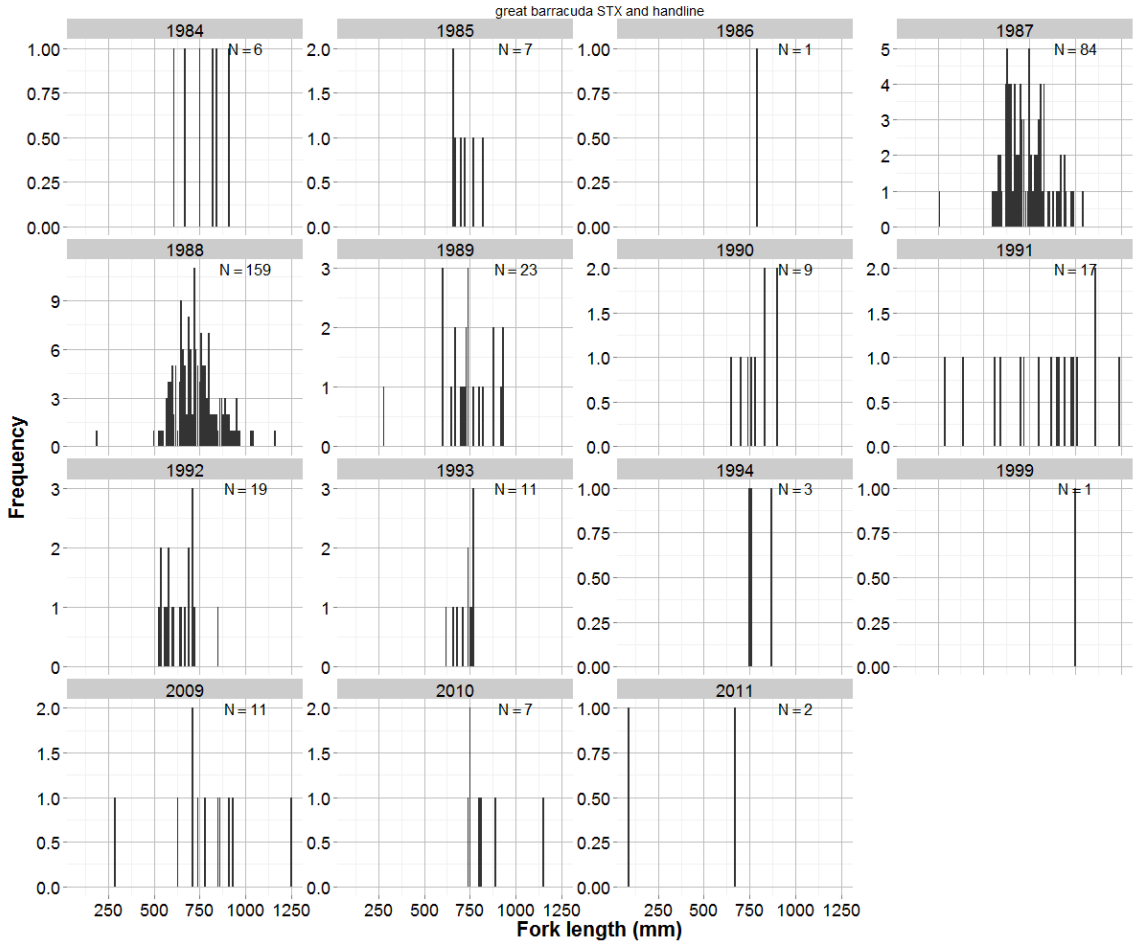
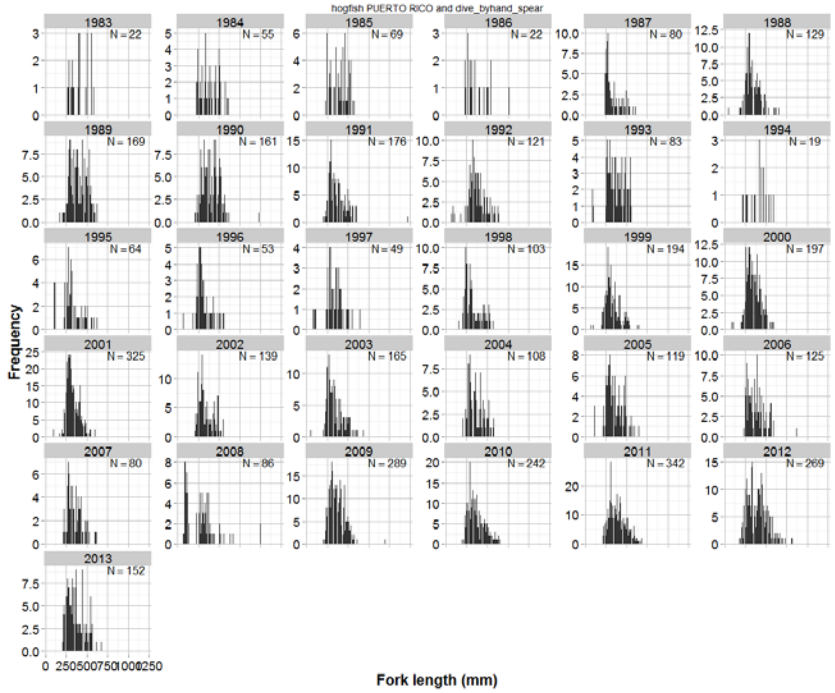


Figure 78 a) Annual length frequency histograms for Hogfish caught by diving/by hand/spears in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

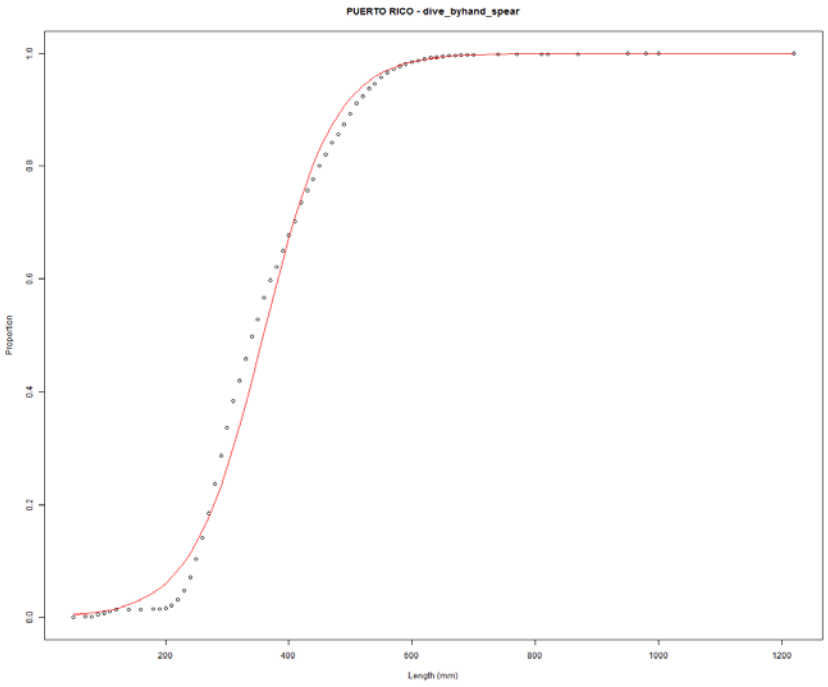
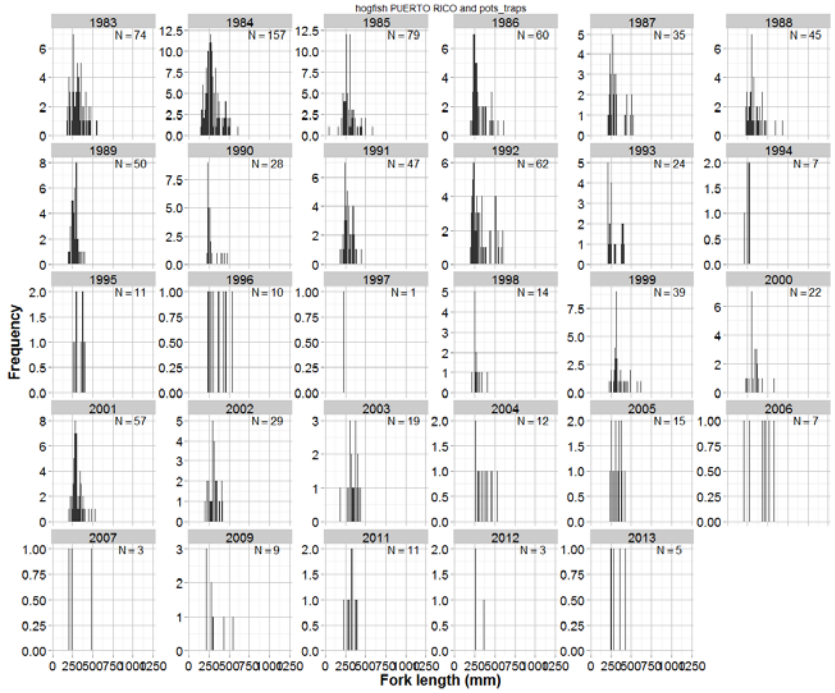


Figure 79 a) Annual length frequency histograms for Hogfish caught by pots and traps in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

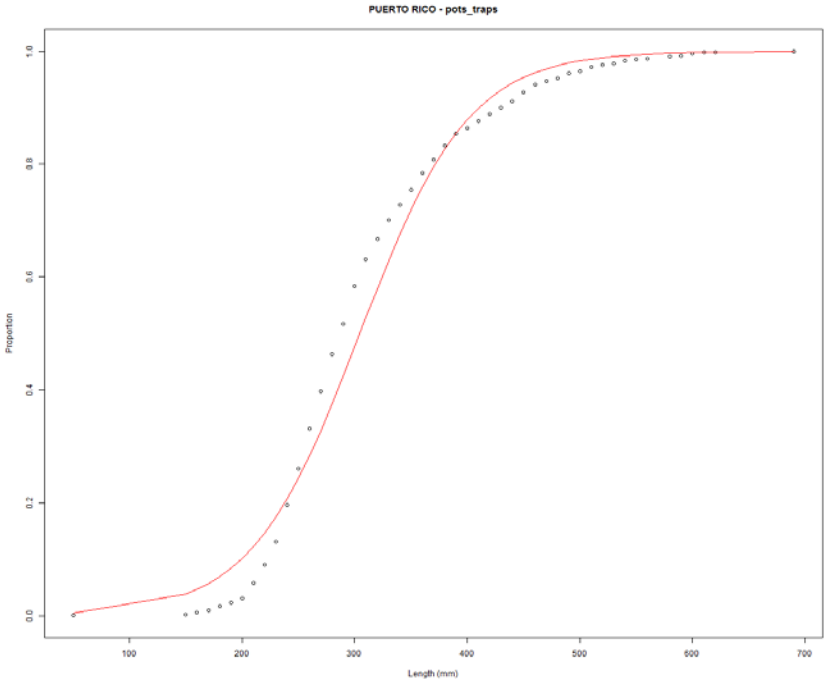
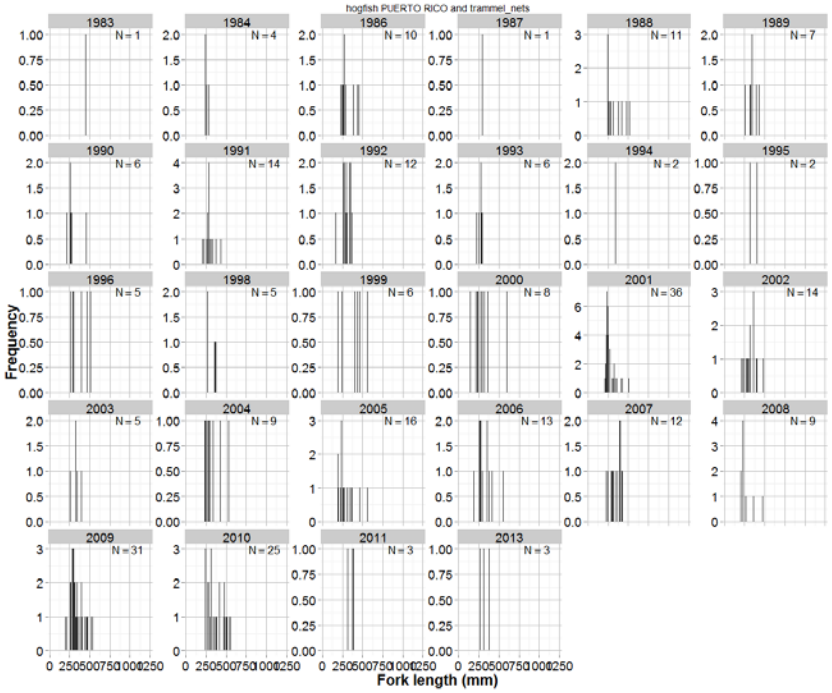


Figure 80 a) Annual length frequency histograms for Hogfish caught by trammel nets in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

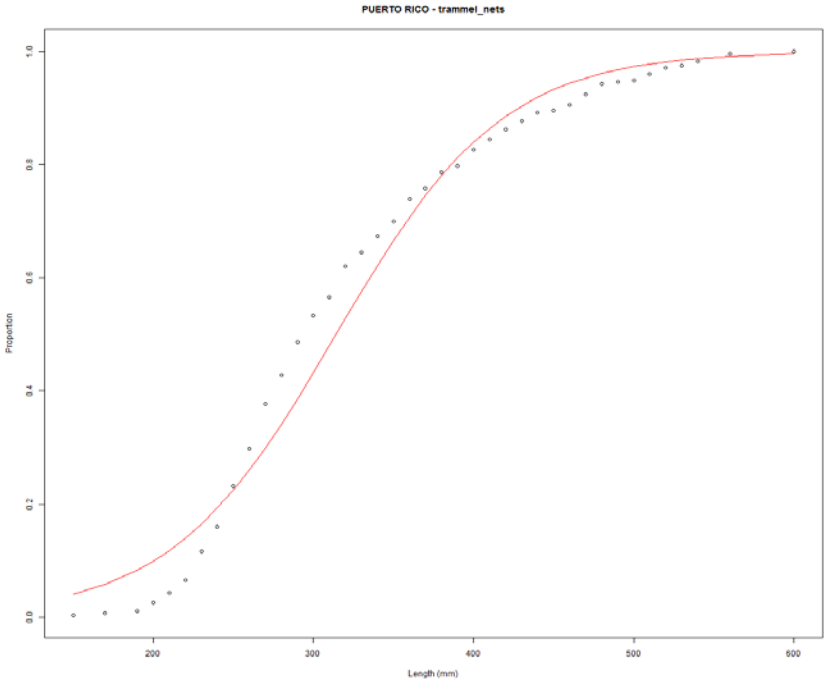
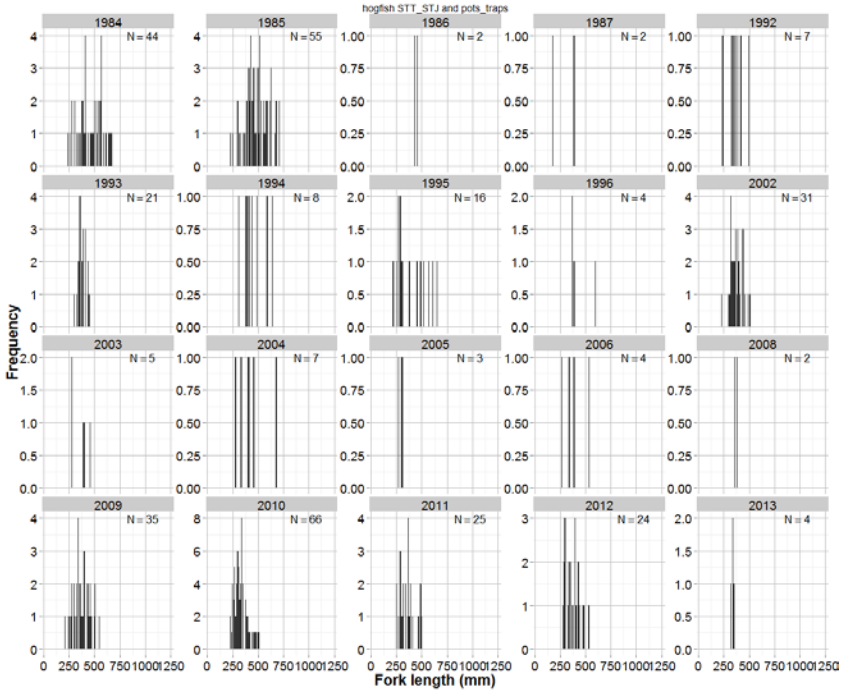


Figure 81 a) Annual length frequency histograms for Hogfish caught by pots and traps in St. Thomas/St. John and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

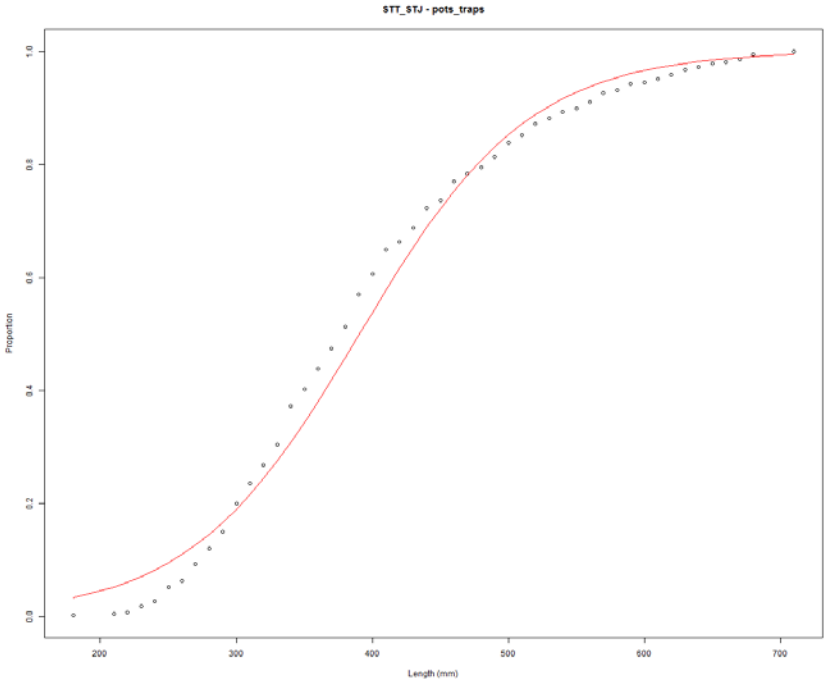
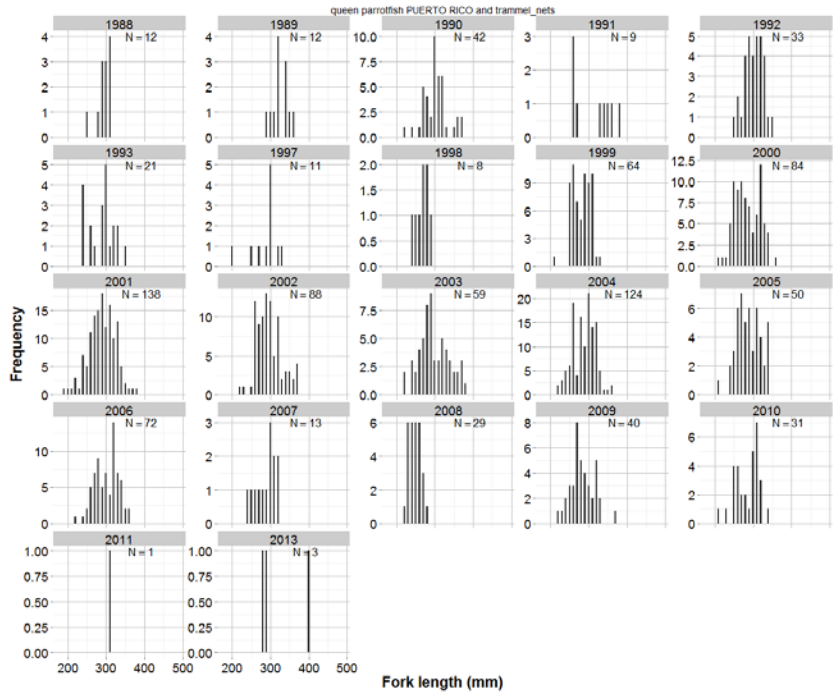


Figure 82 a) Annual length frequency histograms for Queen parrotfish caught by trammel nets in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

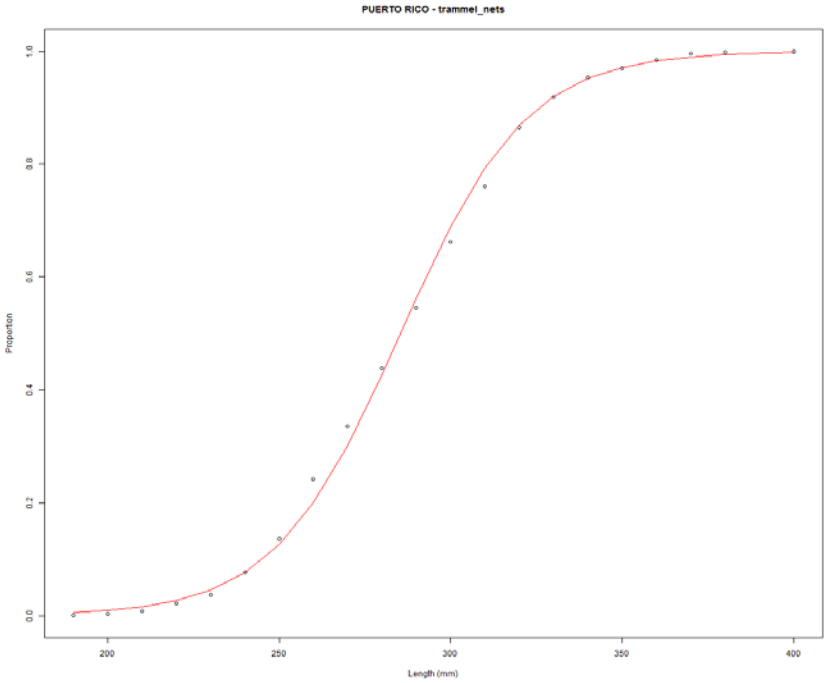
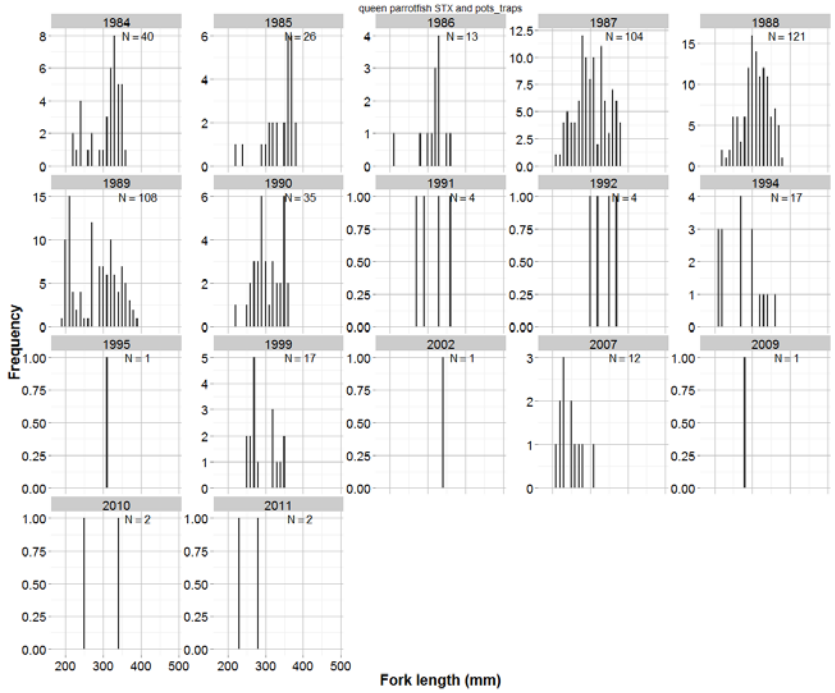


Figure 83 a) Annual length frequency histograms for Queen parrotfish caught by pots and traps in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

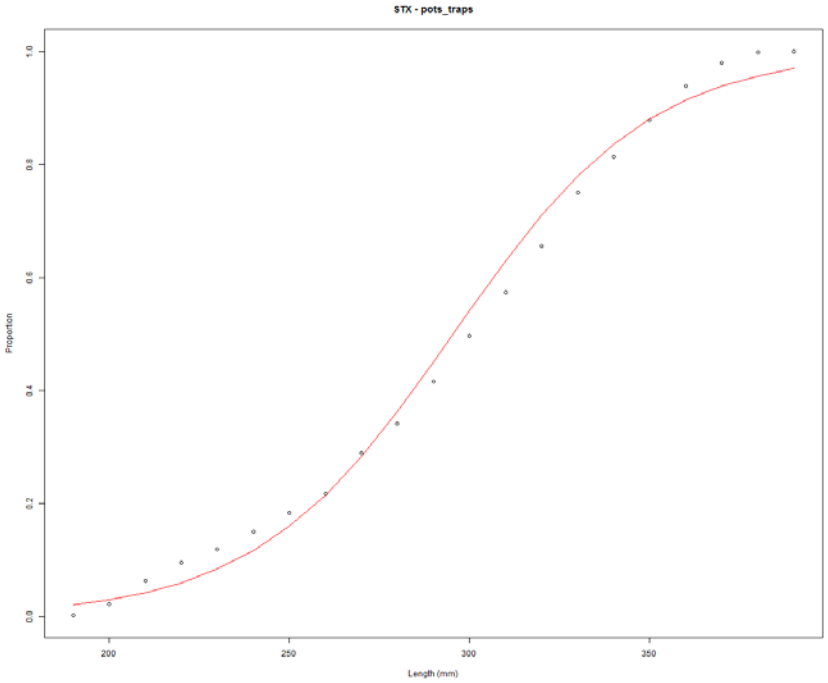
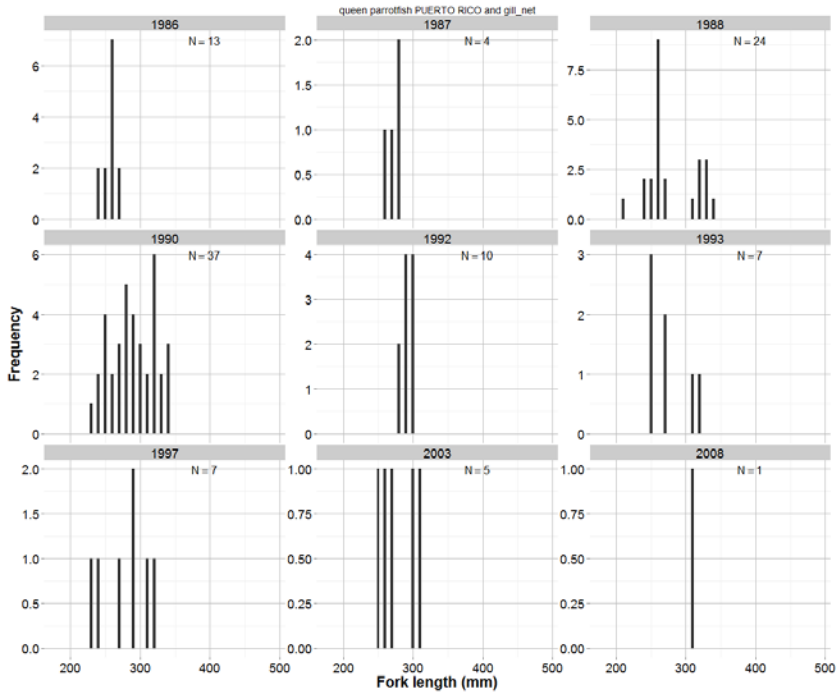


Figure 84 a) Annual length frequency histograms for Queen parrotfish caught by gill nets in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

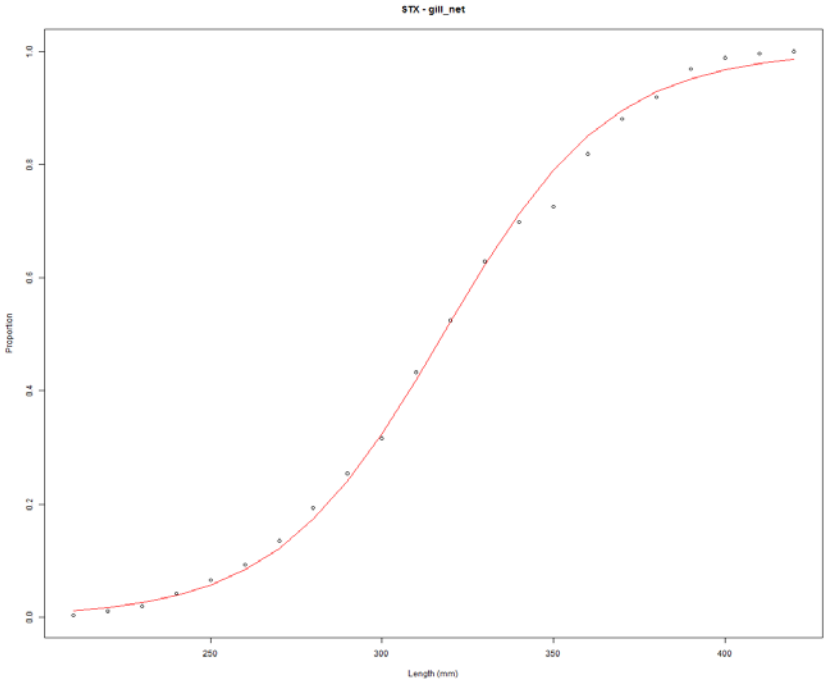
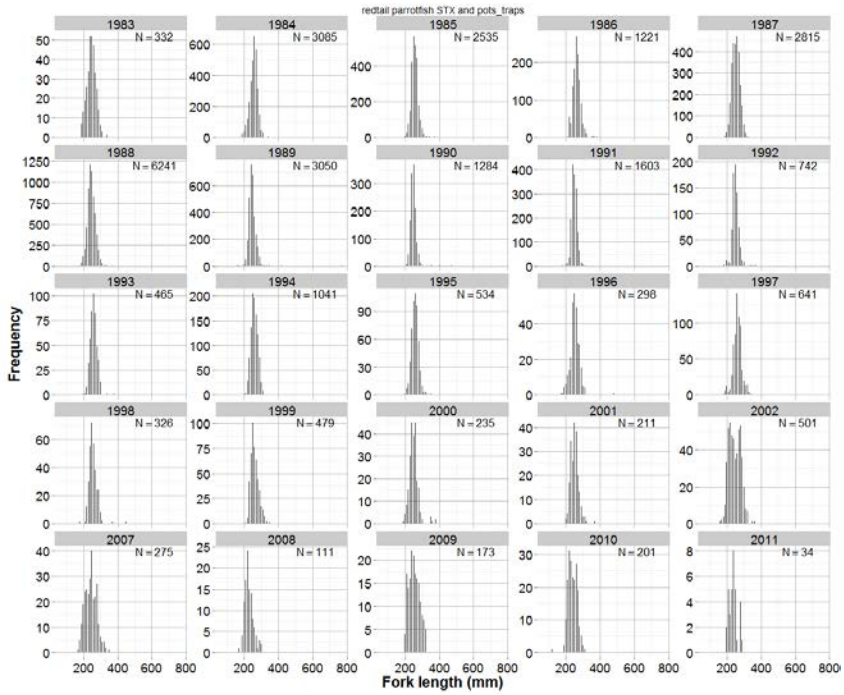


Figure 85 a) Annual length frequency histograms for Redtail parrotfish caught by pots and traps in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

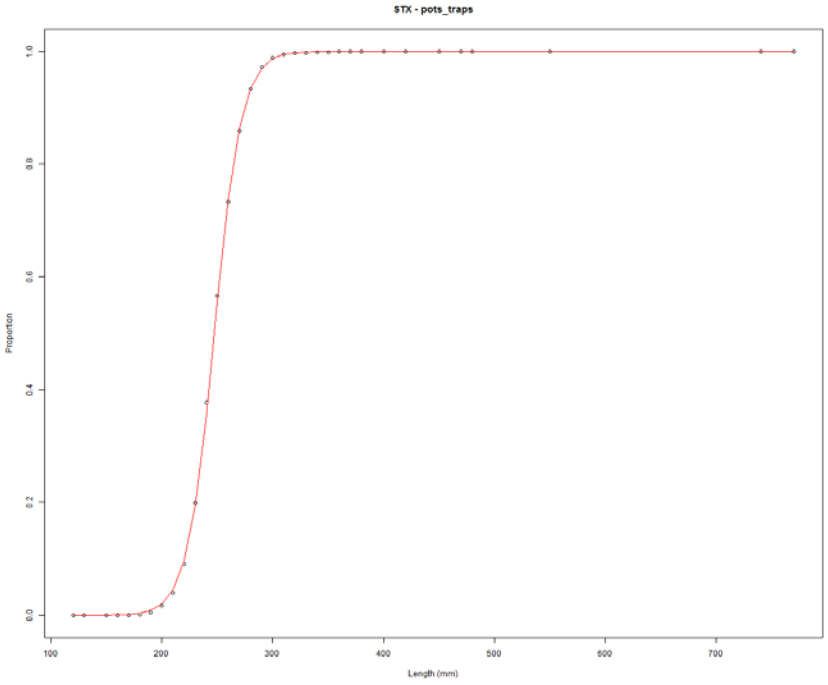
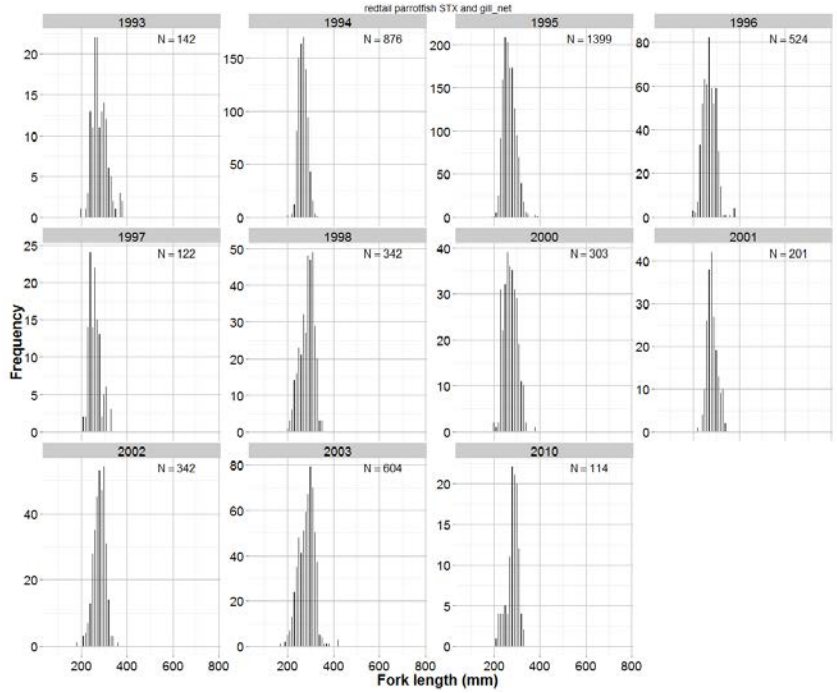


Figure 86 a) Annual length frequency histograms for Redtail parrotfish caught by gill nets in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

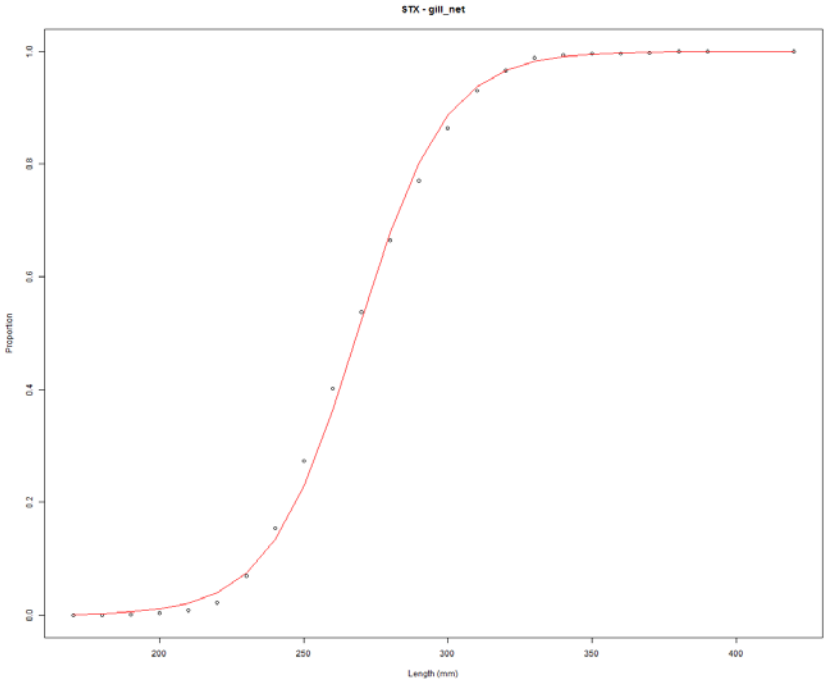
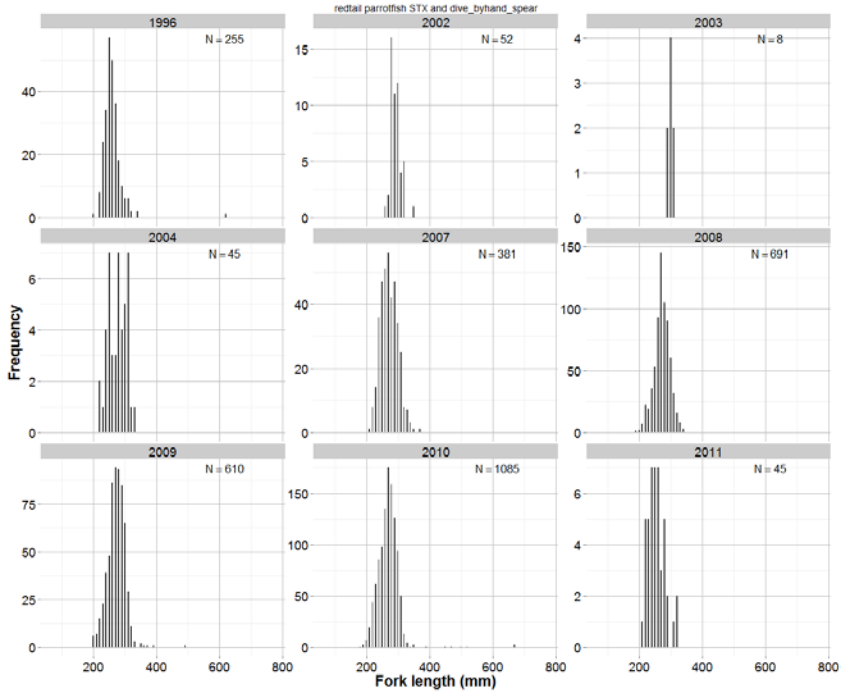


Figure 87 a) Annual length frequency histograms for Redtail parrotfish caught by diving/by hand/spears in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

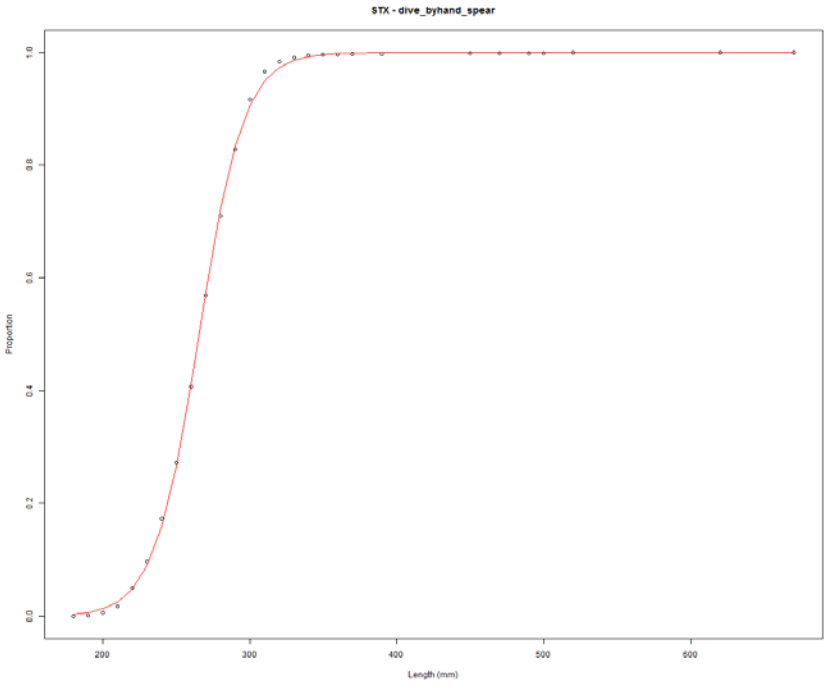
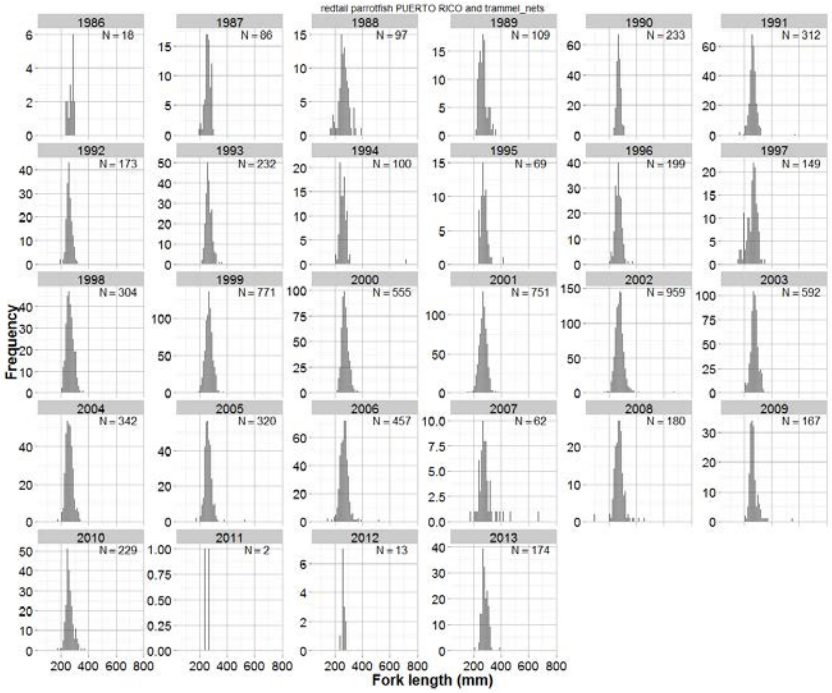


Figure 88 a) Annual length frequency histograms for Redtail parrotfish caught by trammel nets in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

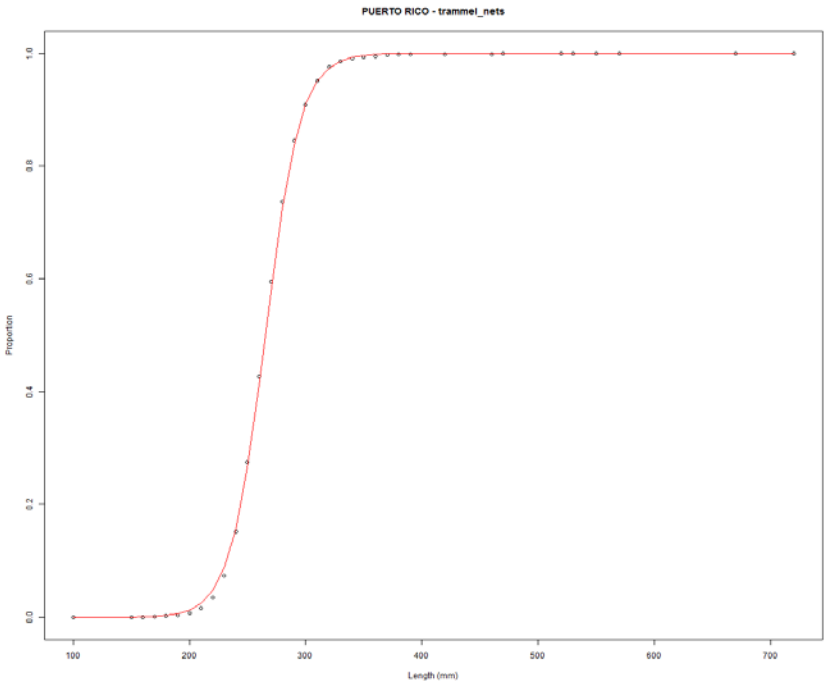
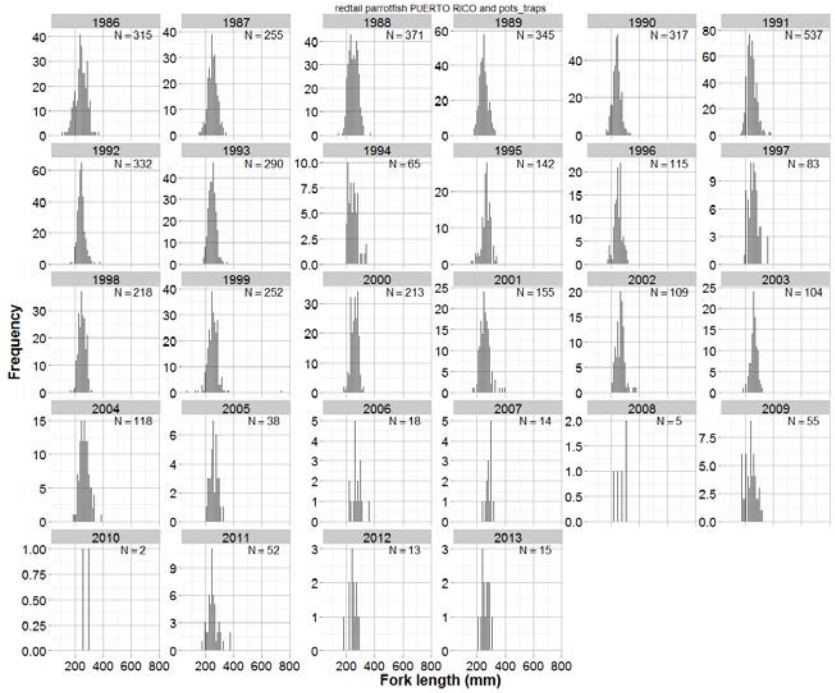


Figure 89 a) Annual length frequency histograms for Redtail parrotfish caught by pots and trasps in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

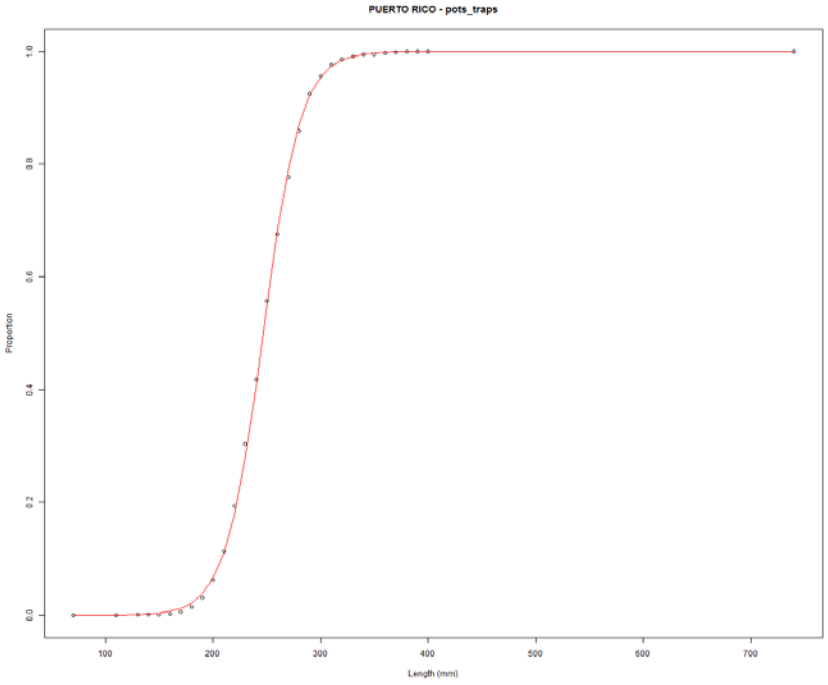
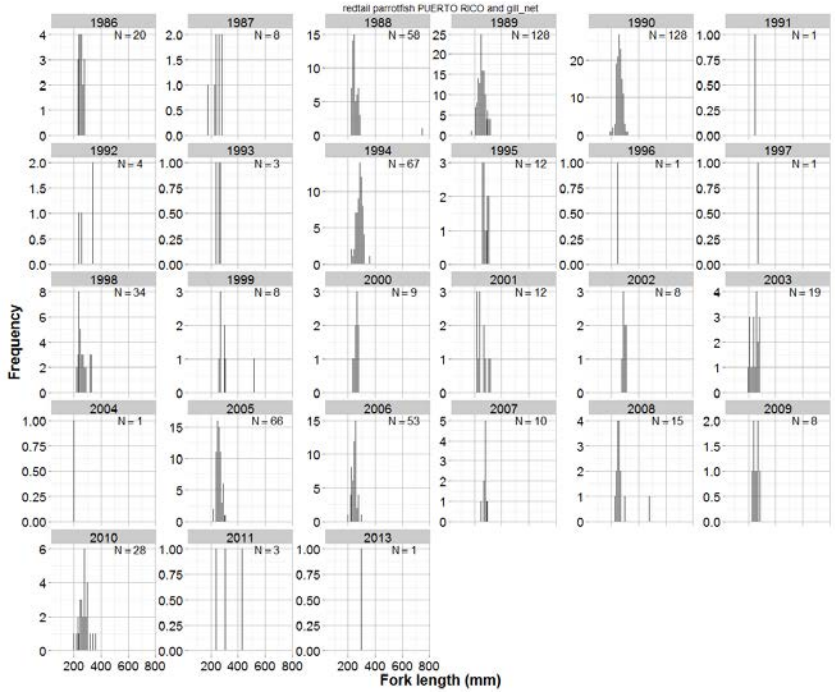


Figure 90 a) Annual length frequency histograms for Redtail parrotfish caught by gill nets in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

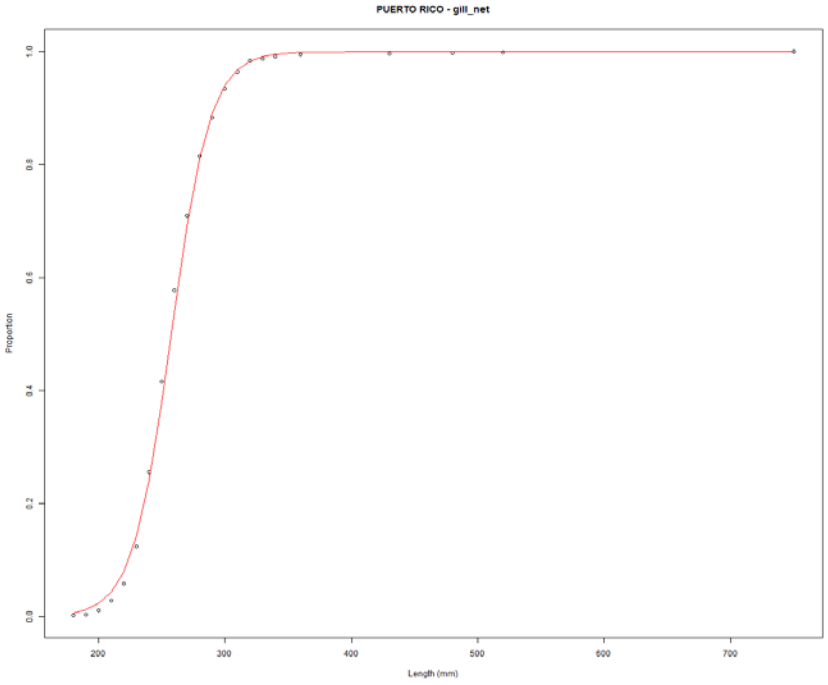
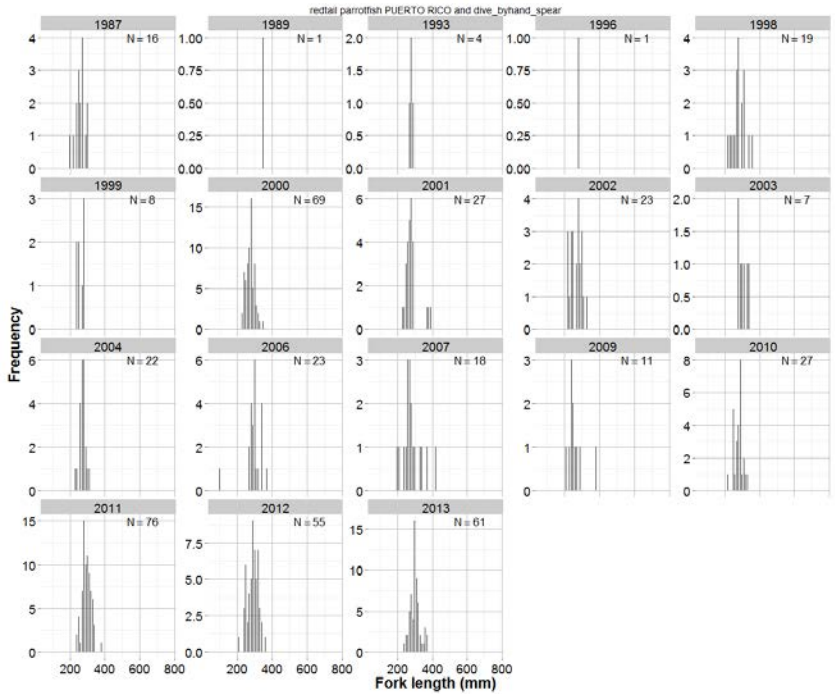


Figure 91 a) Annual length frequency histograms for Redtail parrotfish caught by dive/by hand/spears in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

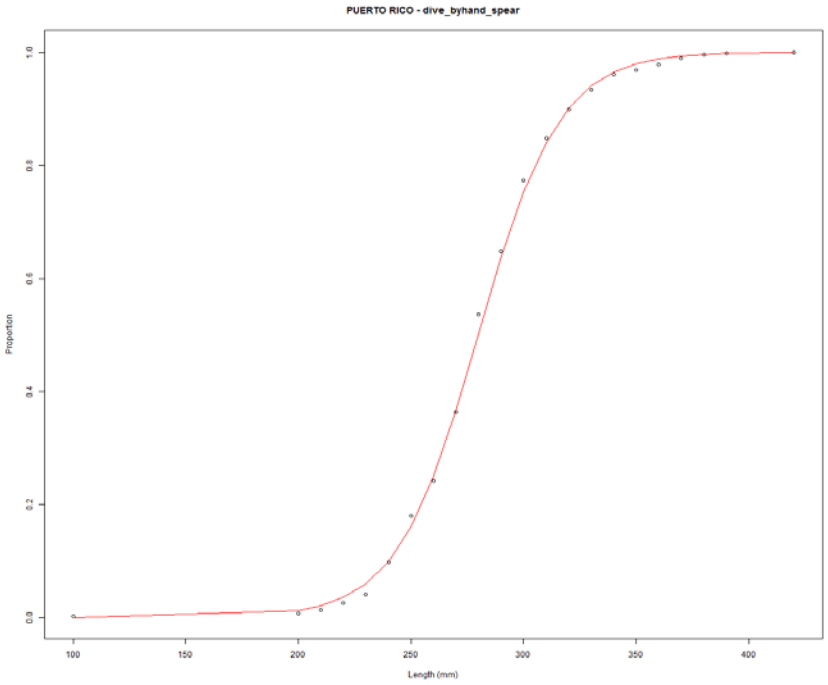
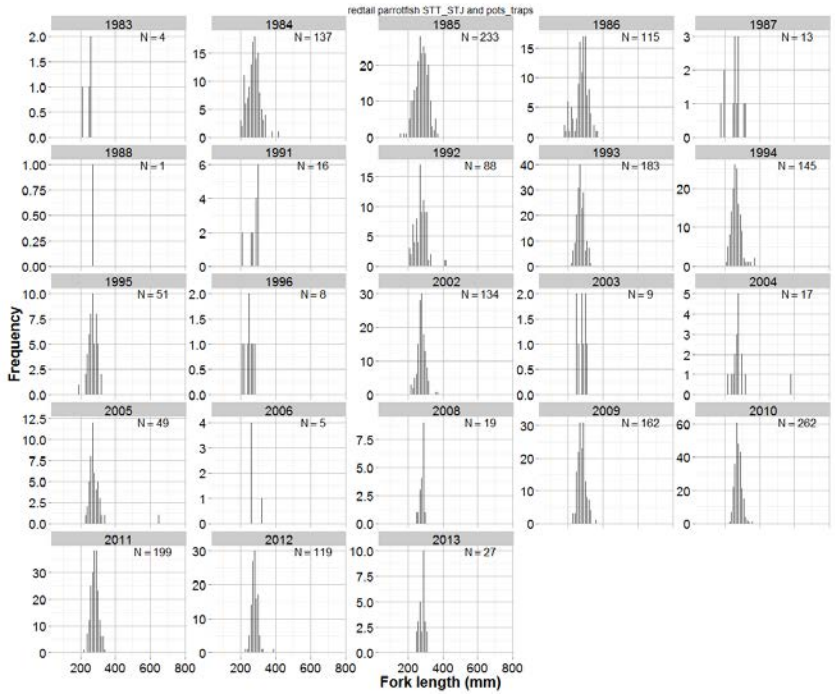


Figure 92 a) Annual length frequency histograms for Redtail parrotfish caught by pots and trasps in St. Thomas/St. John and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

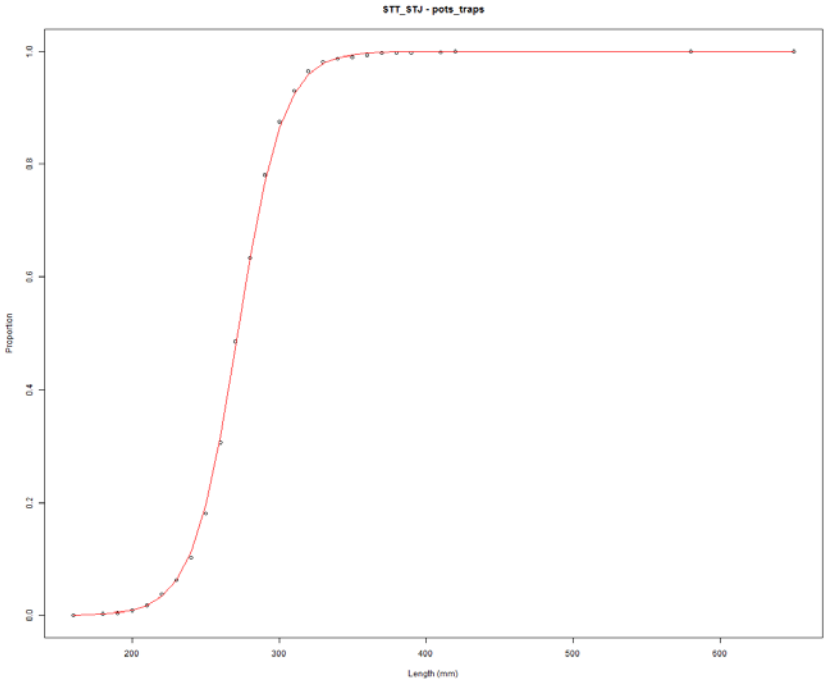
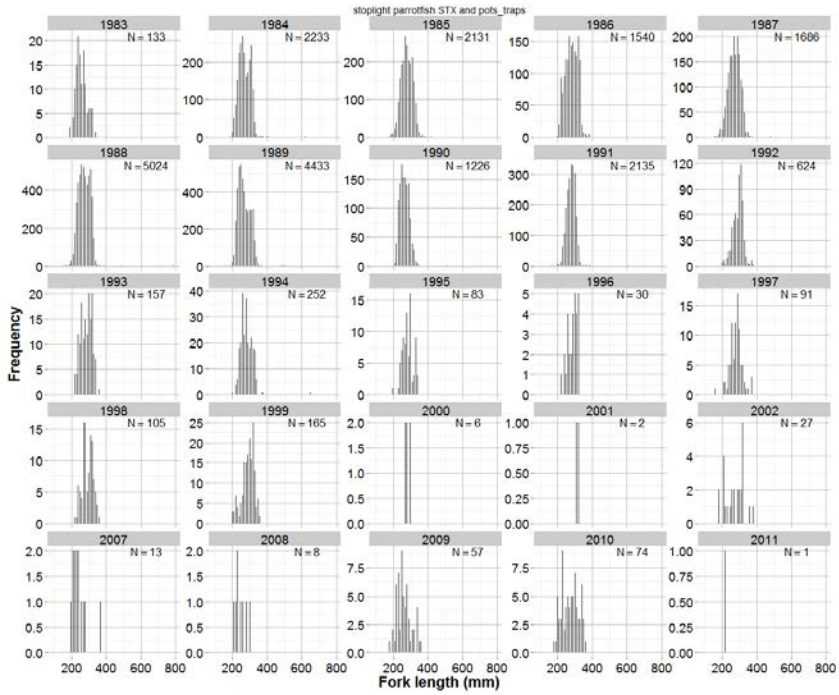


Figure 93 a) Annual length frequency histograms for Stoplight parrotfish caught by pots and traps in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

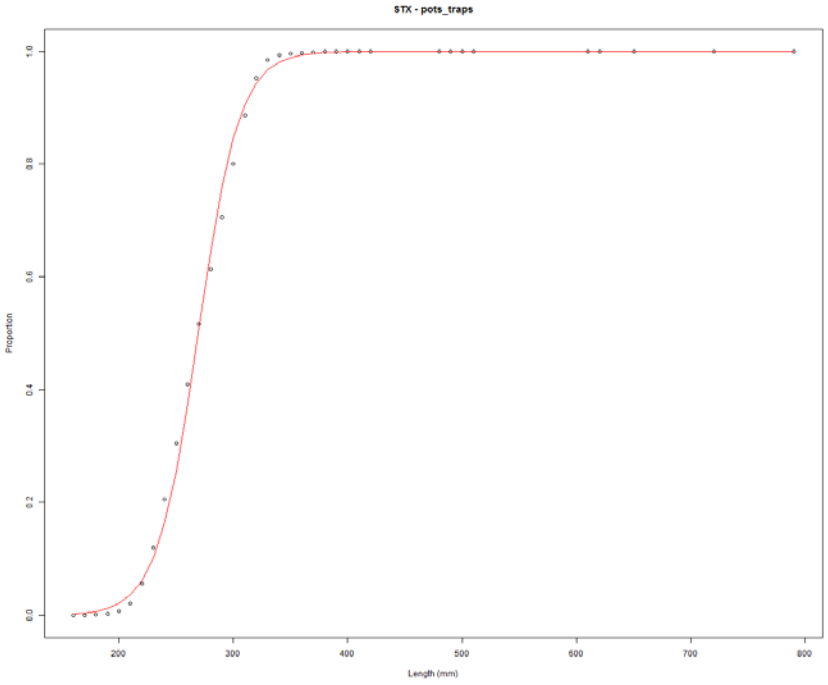
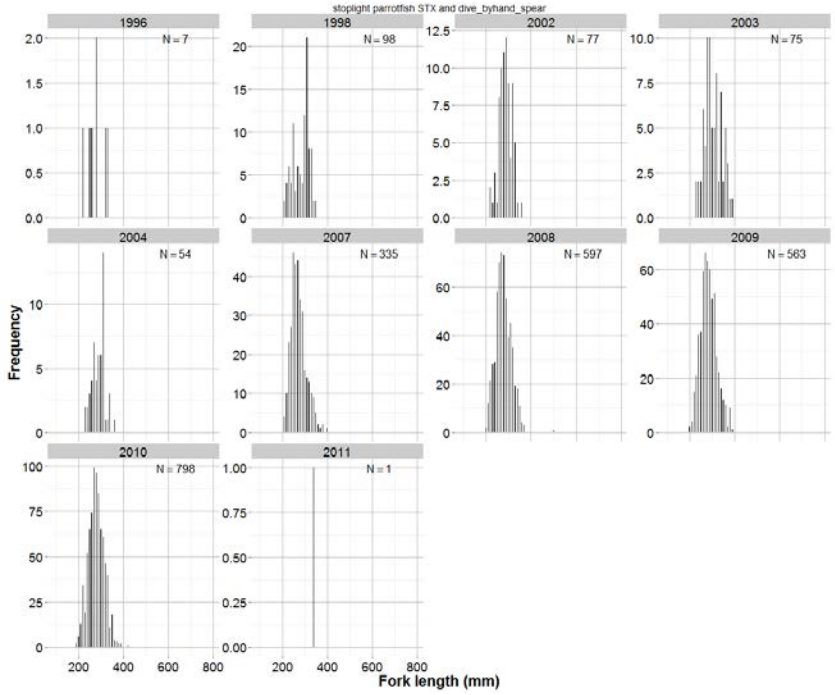


Figure 94 a) Annual length frequency histograms for Stoplight parrotfish caught by diving/by hand/spears in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

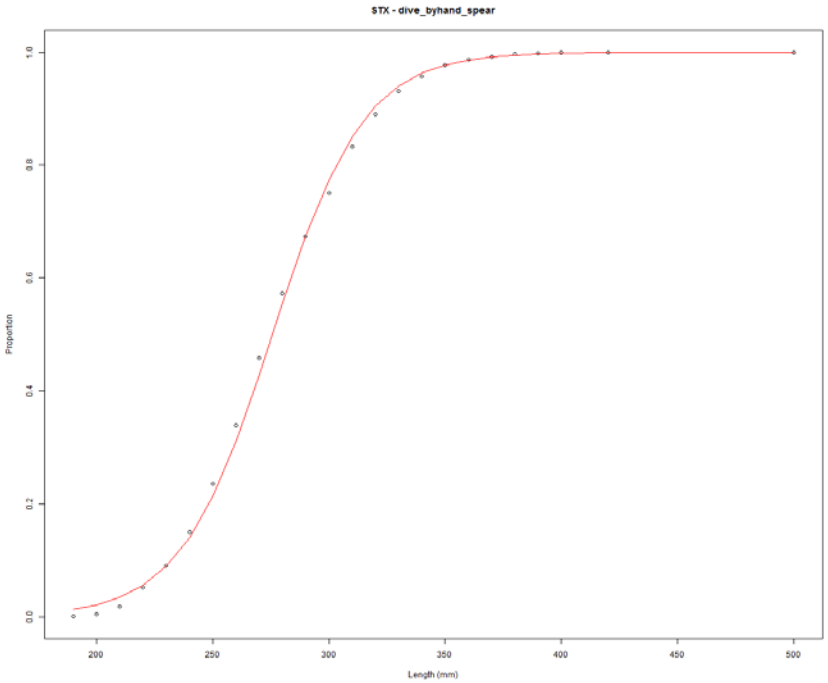
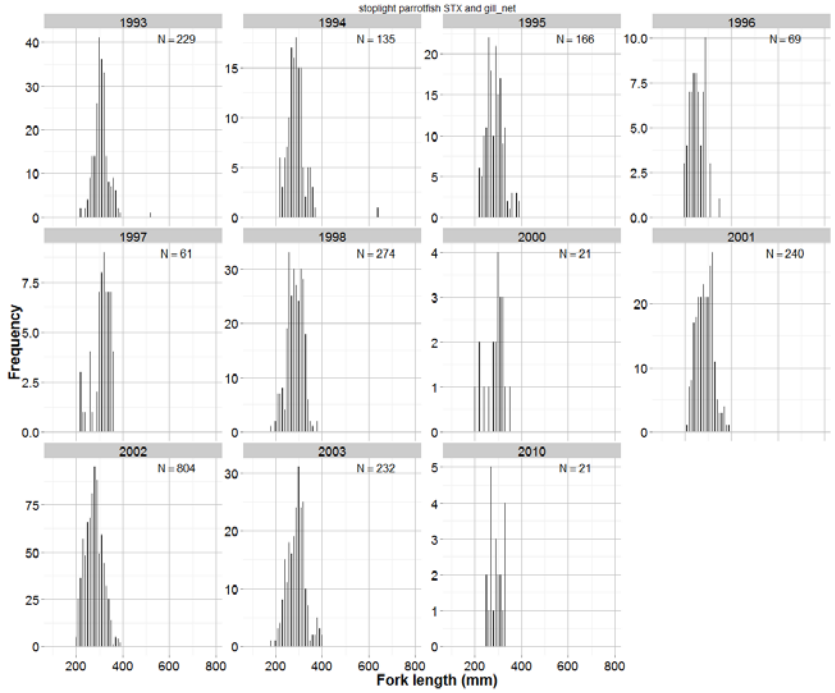


Figure 95 a) Annual length frequency histograms for Stoplight parrotfish caught by gill nets in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

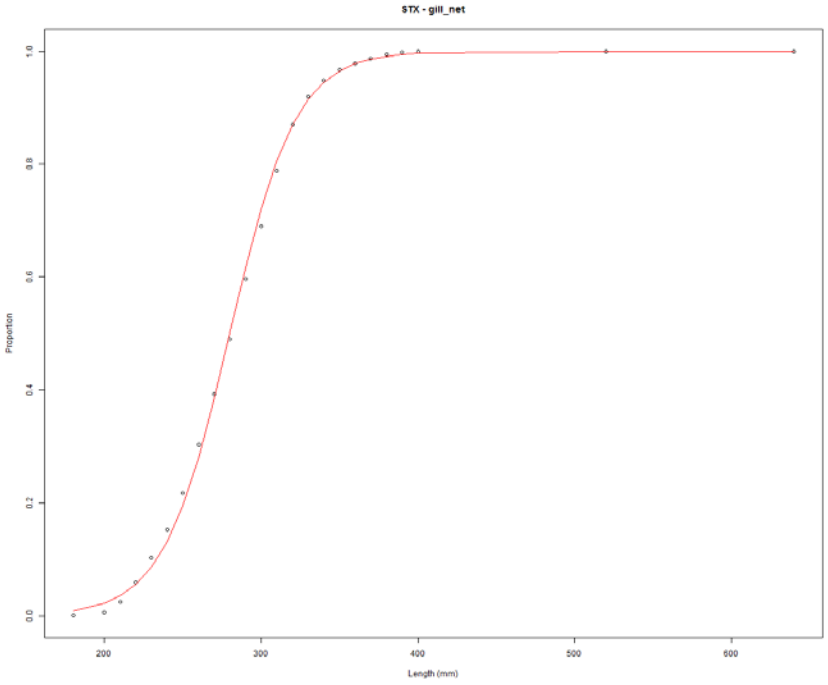
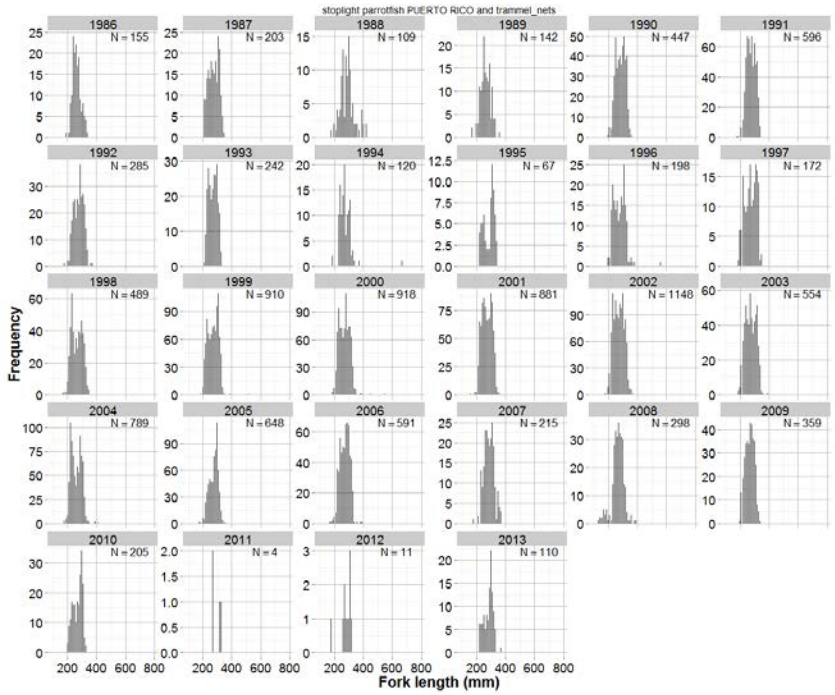


Figure 96 a) Annual length frequency histograms for Stoplight parrotfish caught by trammel nets in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

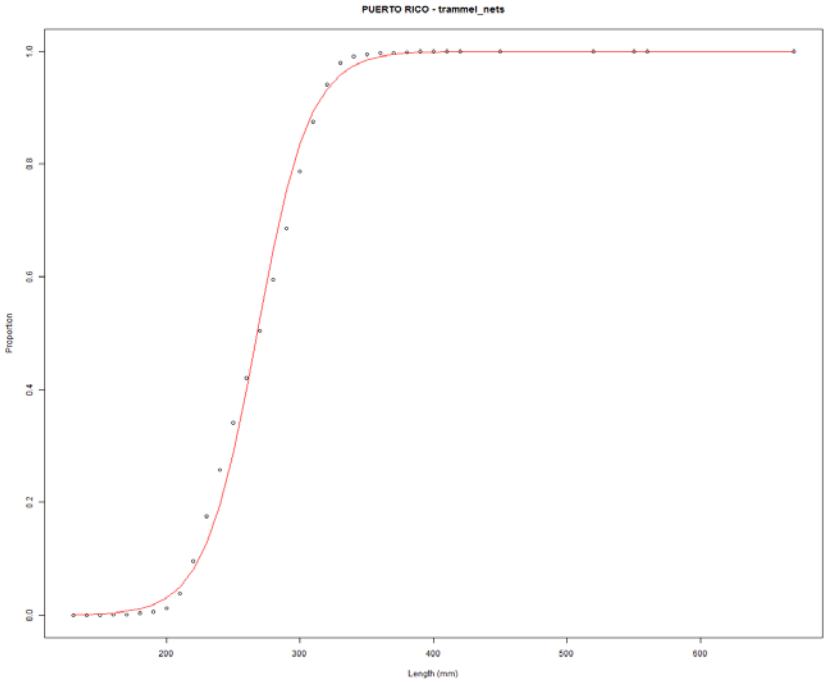
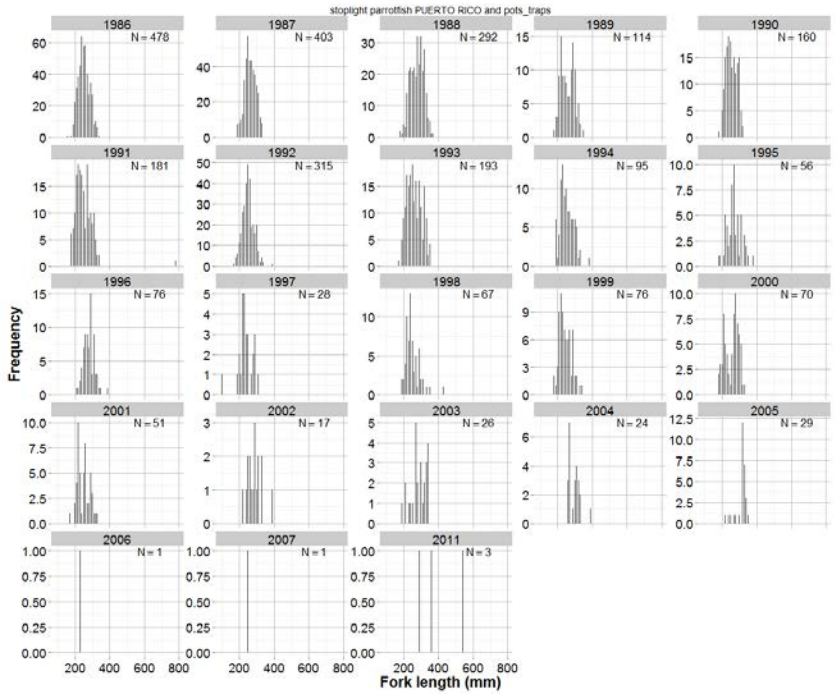


Figure 97 a) Annual length frequency histograms for Stoplight parrotfish caught by pots and traps in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

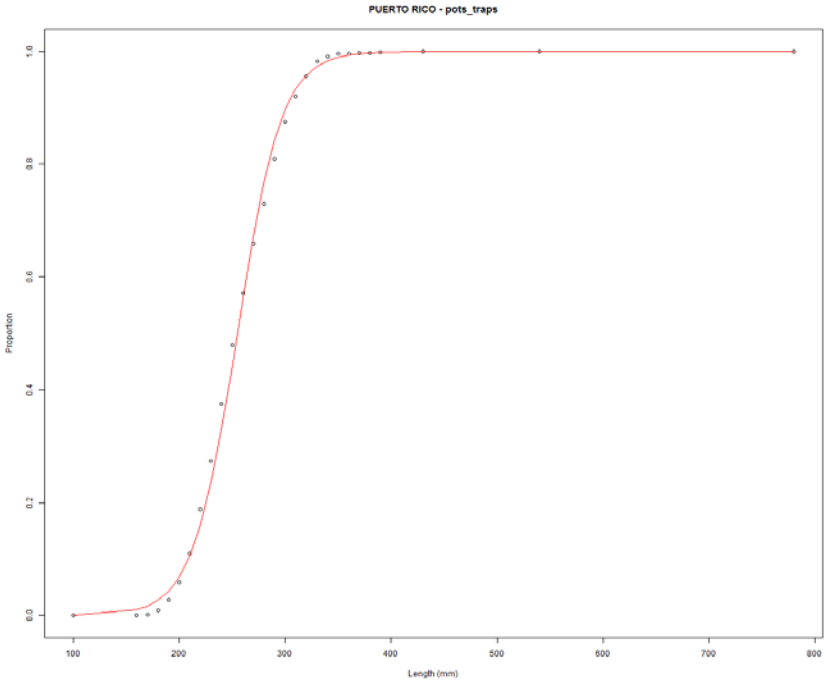
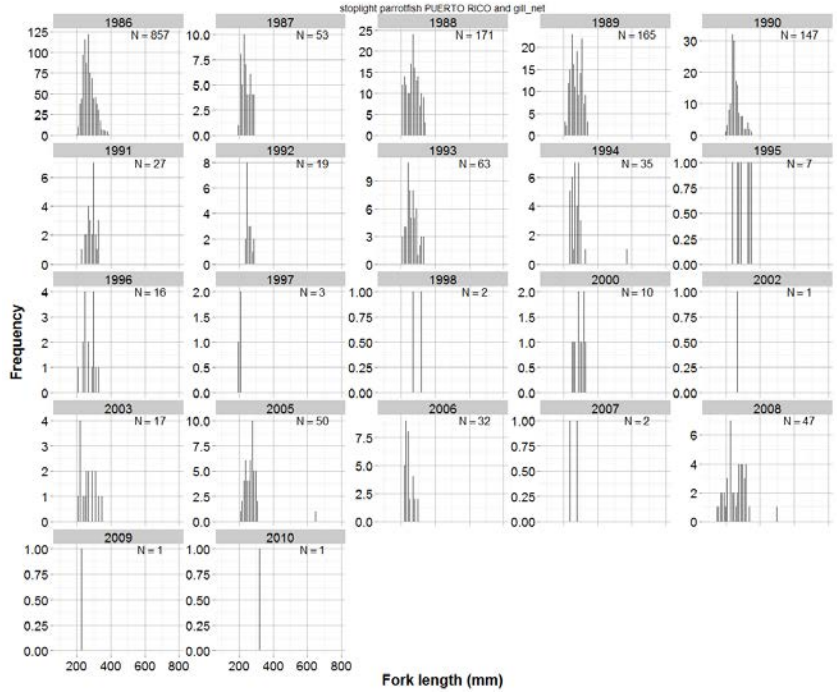


Figure 98 a) Annual length frequency histograms for Stoplight parrotfish caught by gill nets in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

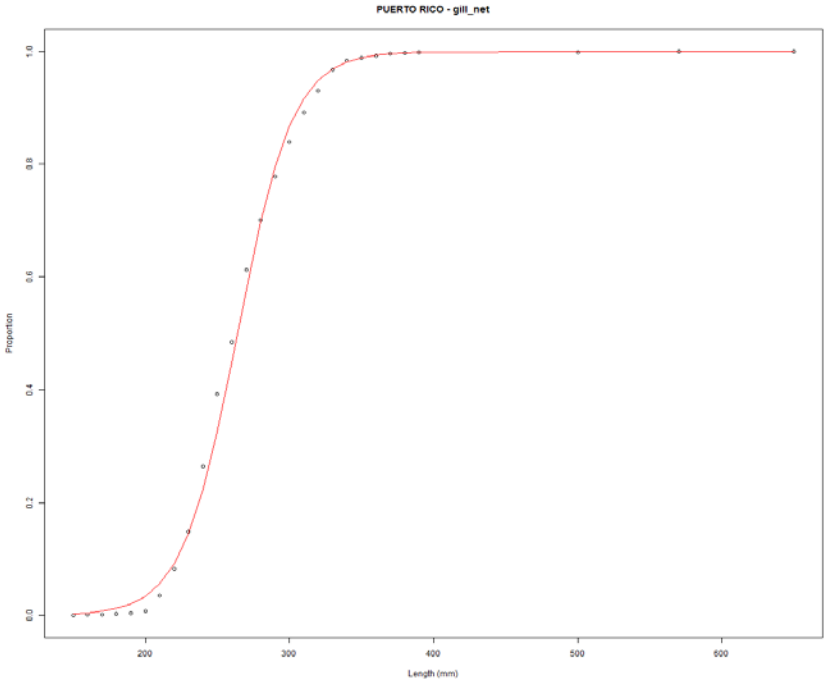
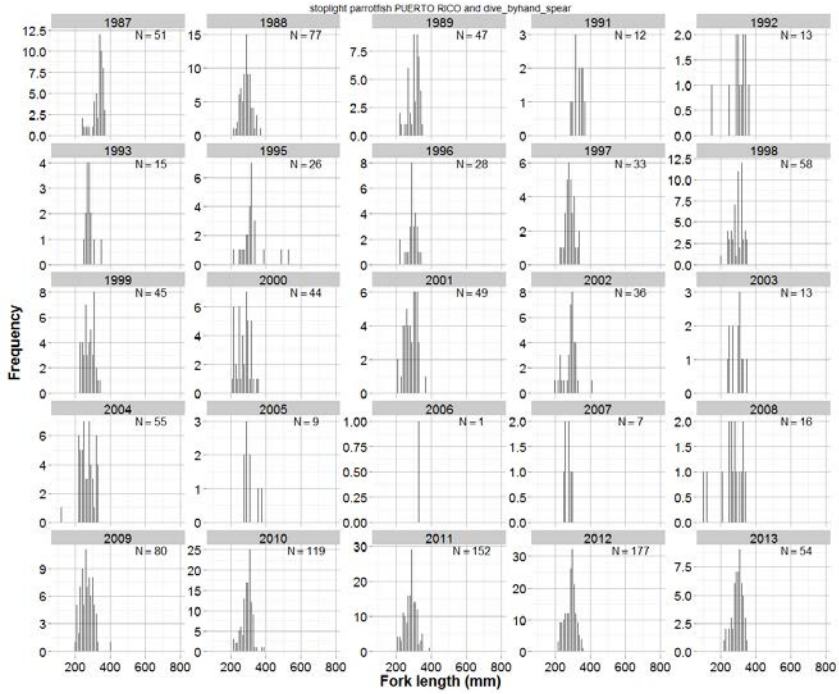


Figure 99 a) Annual length frequency histograms for Stoplight parrotfish caught by dive/by hand/spears in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

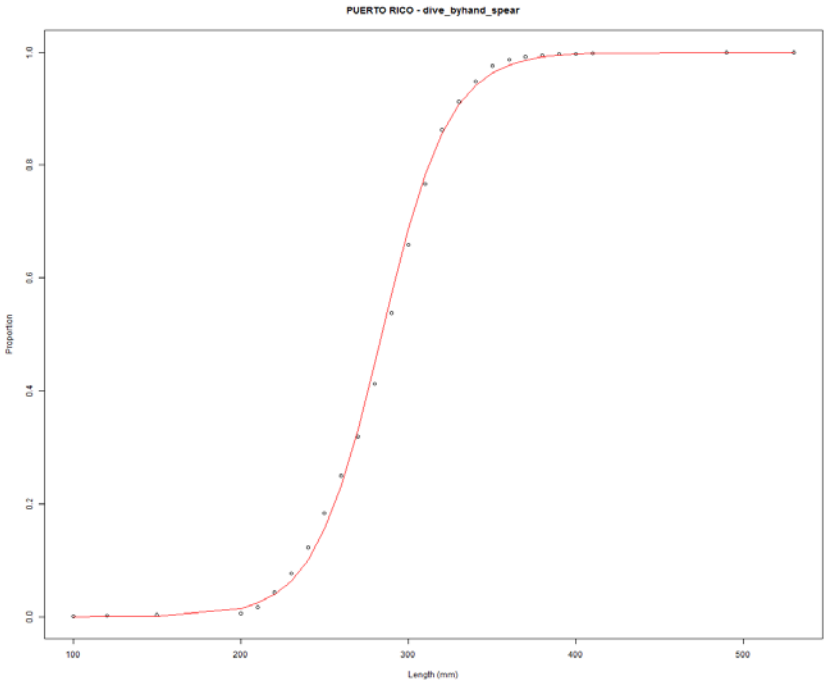
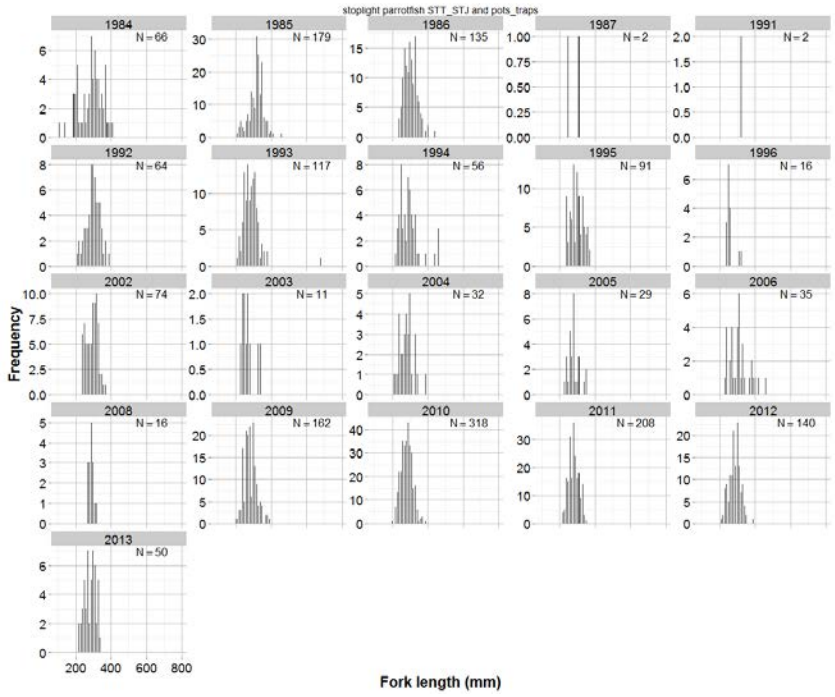


Figure 100 a) Annual length frequency histograms for Stoplight parrotfish caught by pots and traps in St. Thomas and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

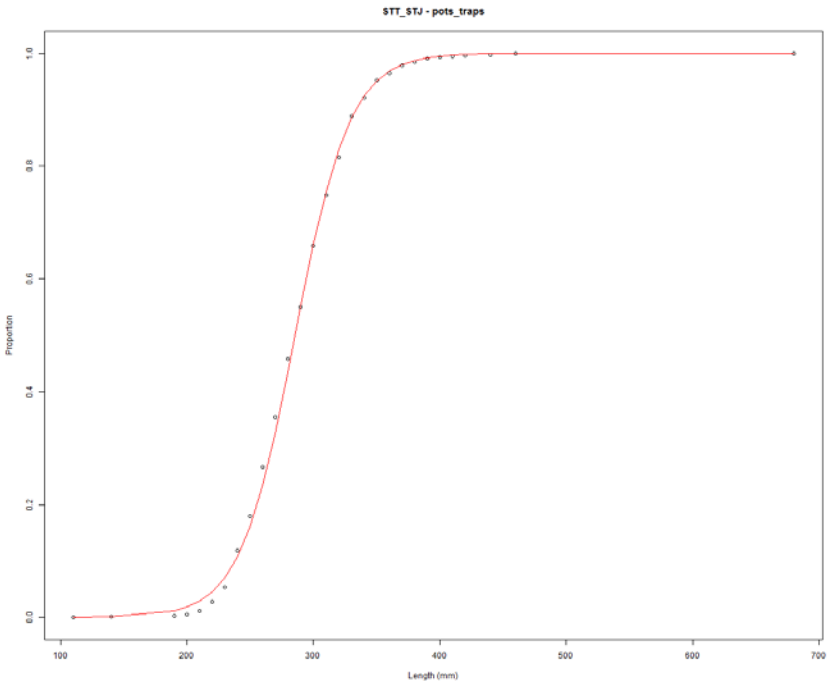
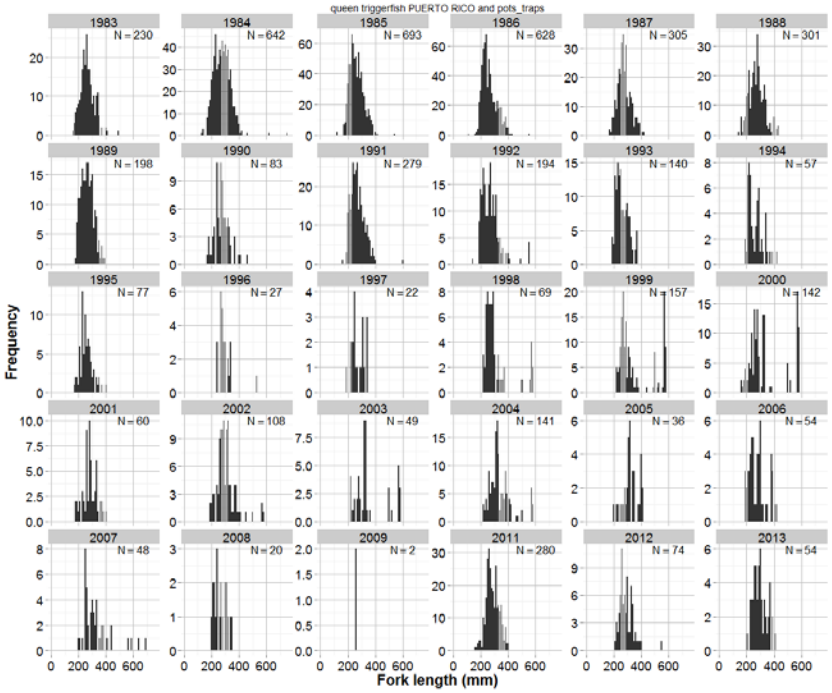


Figure 101) Annual length frequency histograms for Queen triggerfish caught by pots and traps in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

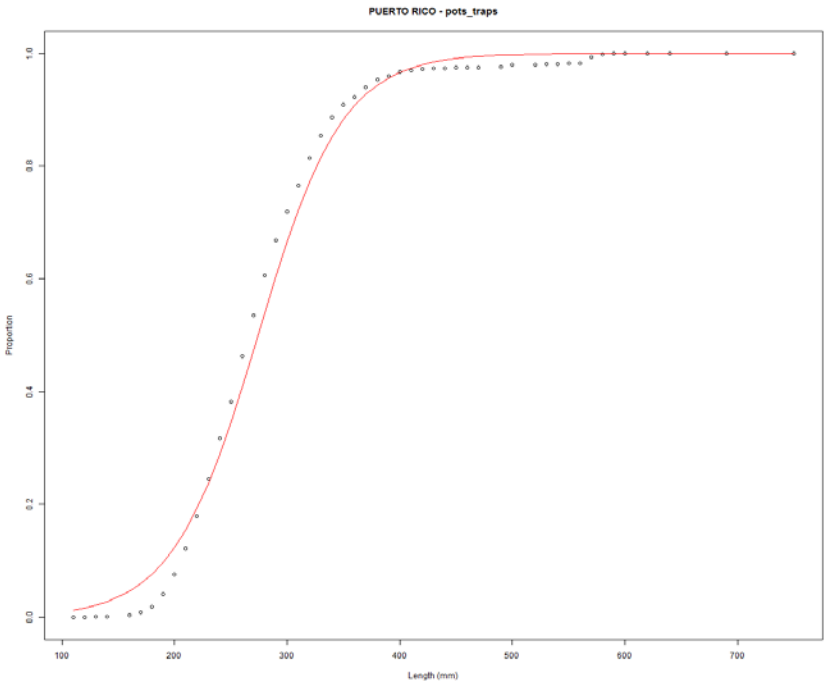
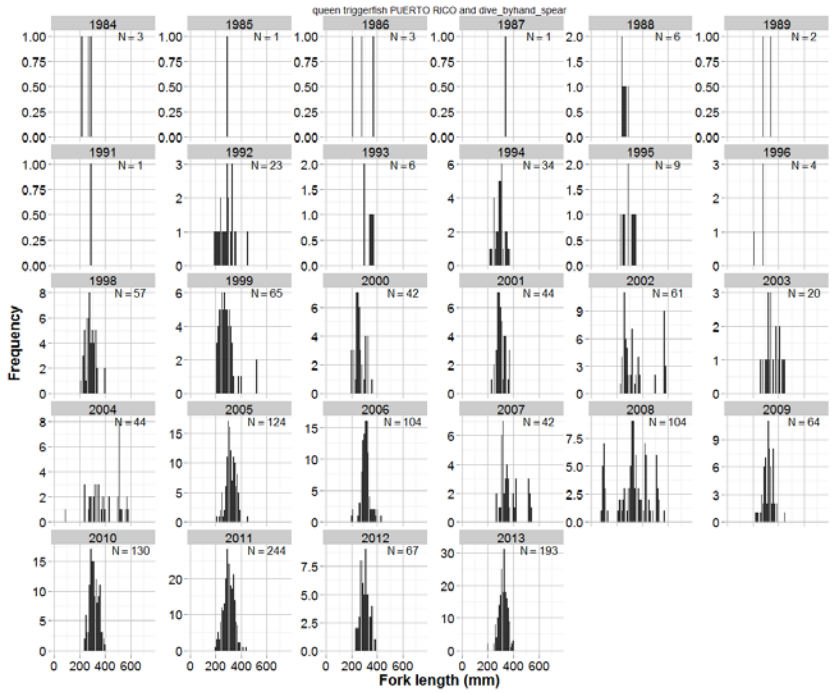


Figure 102 Annual length frequency histograms for Queen triggerfish caught by dive/by hand/spear in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

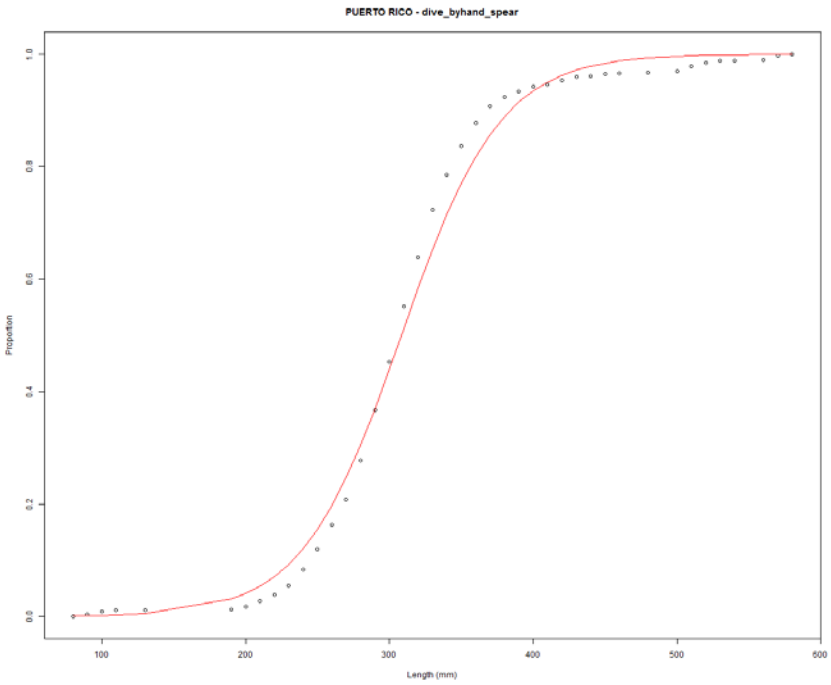
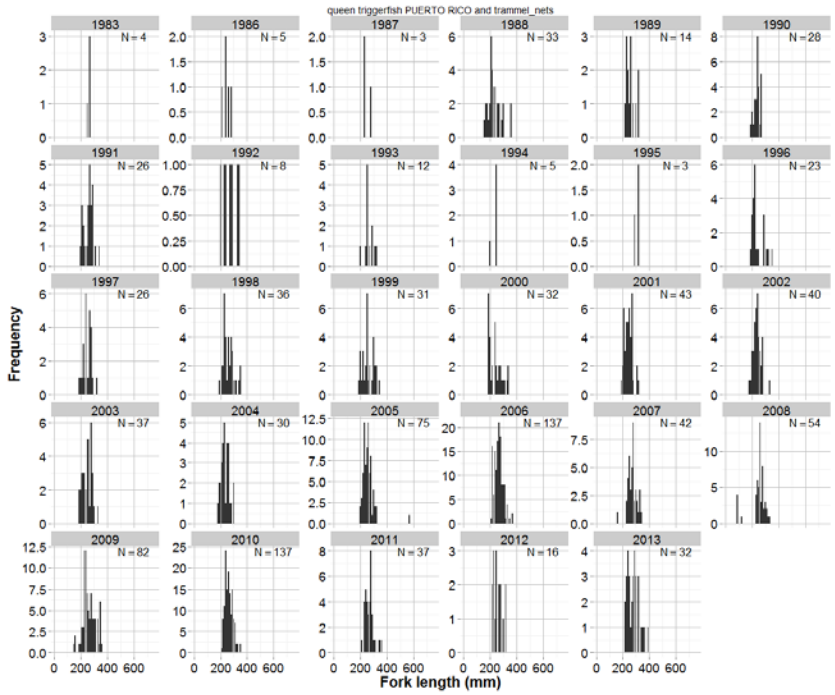


Figure 103 Annual length frequency histograms for Queen triggerfish caught by trammel nets in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

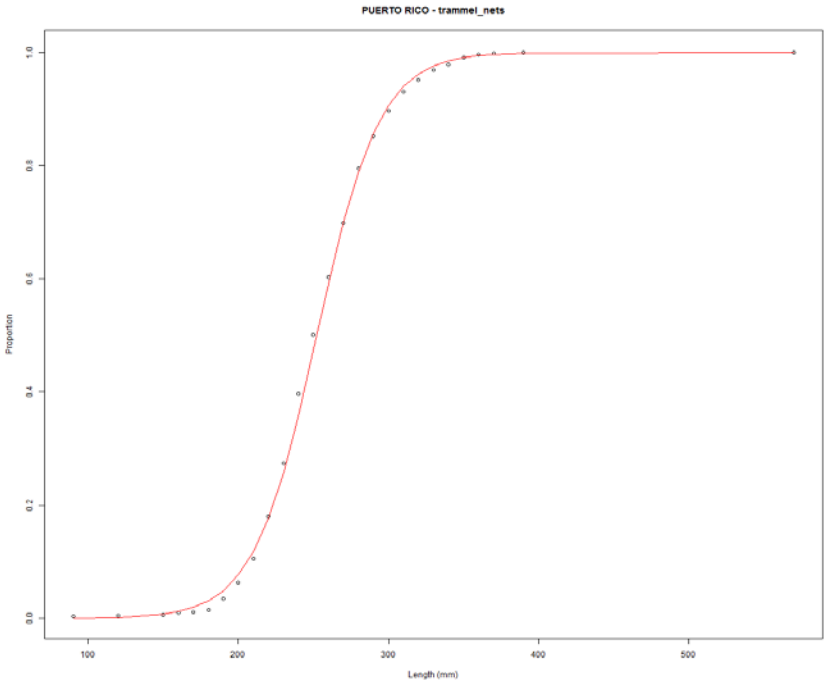
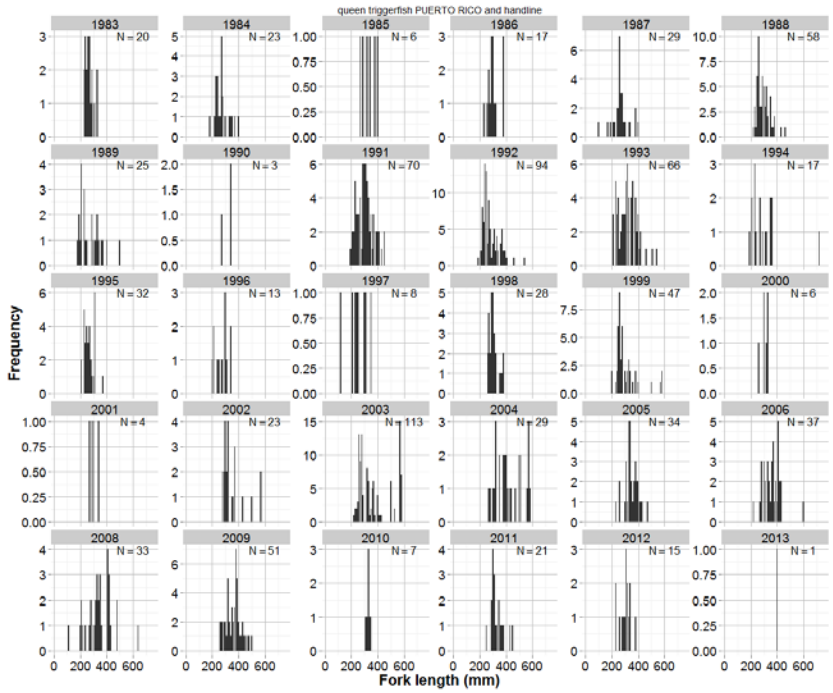


Figure 104 Annual length frequency histograms for Queen triggerfish caught by handlines in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

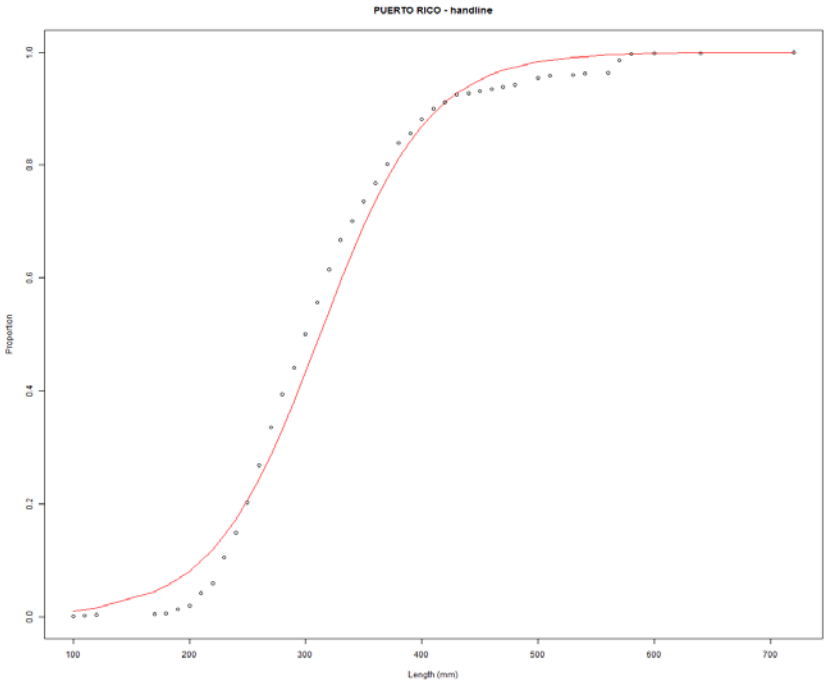
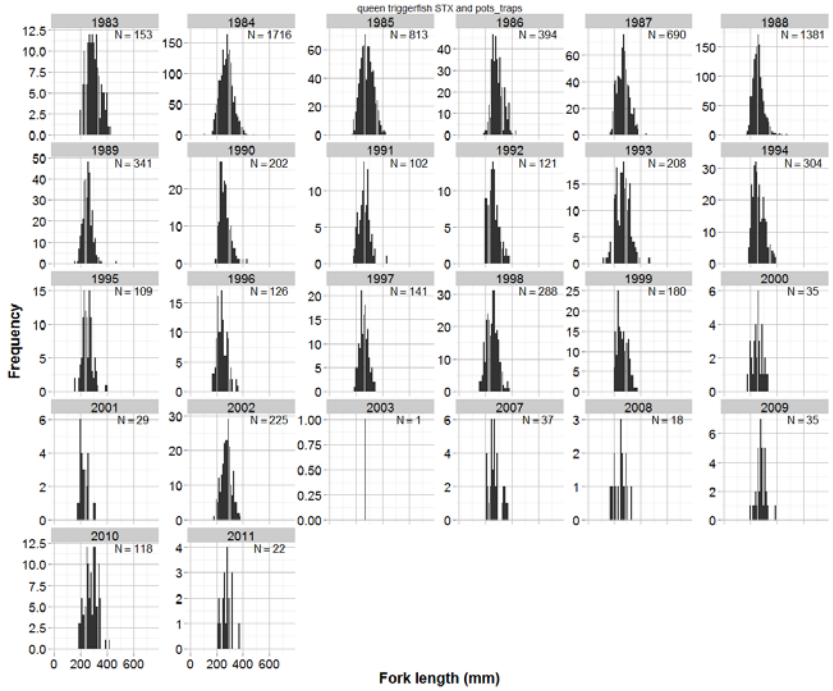


Figure 105 Annual length frequency histograms for Queen triggerfish caught by pots and traps in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

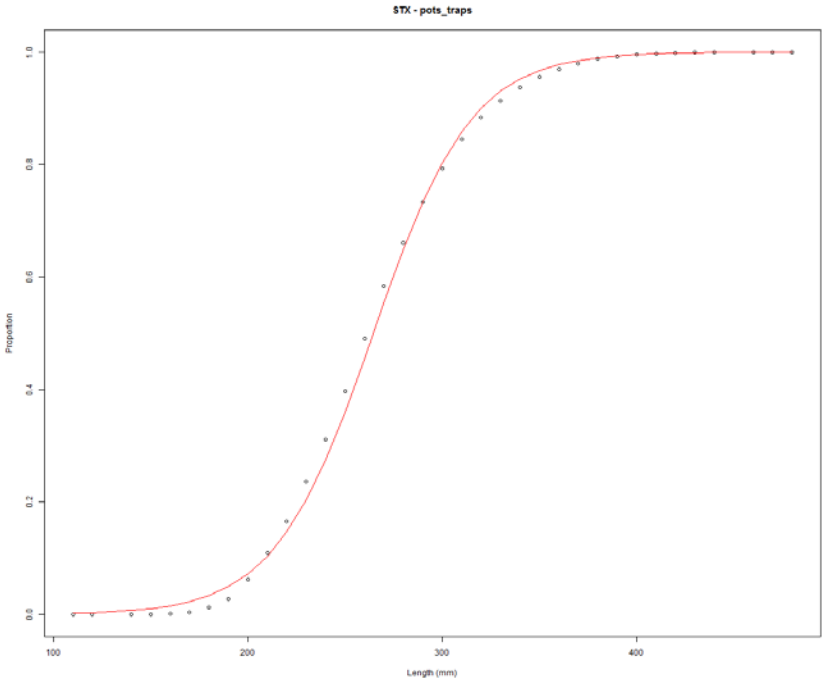
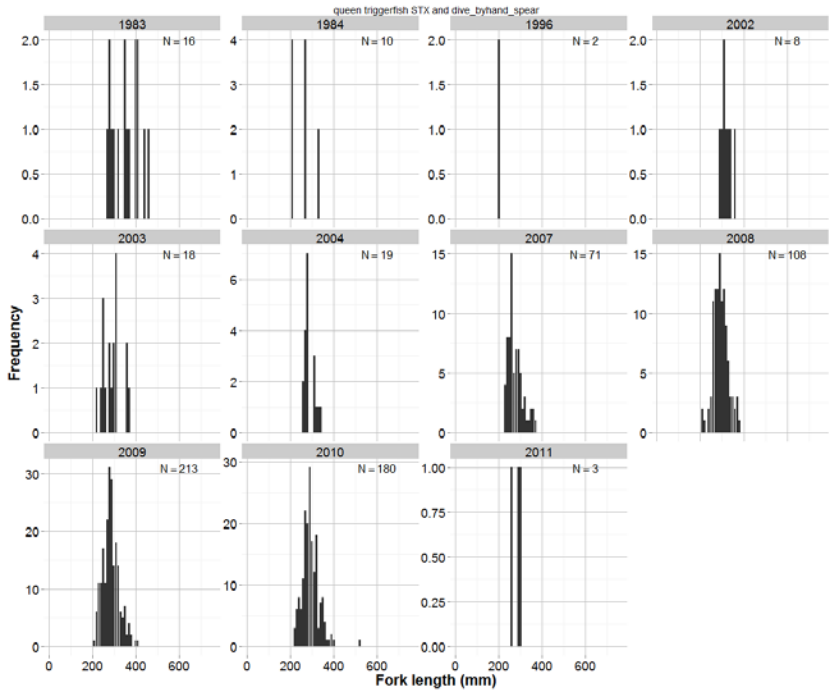


Figure 106 Annual length frequency histograms for Queen triggerfish caught by dive/by hand/spear in St. Croix and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

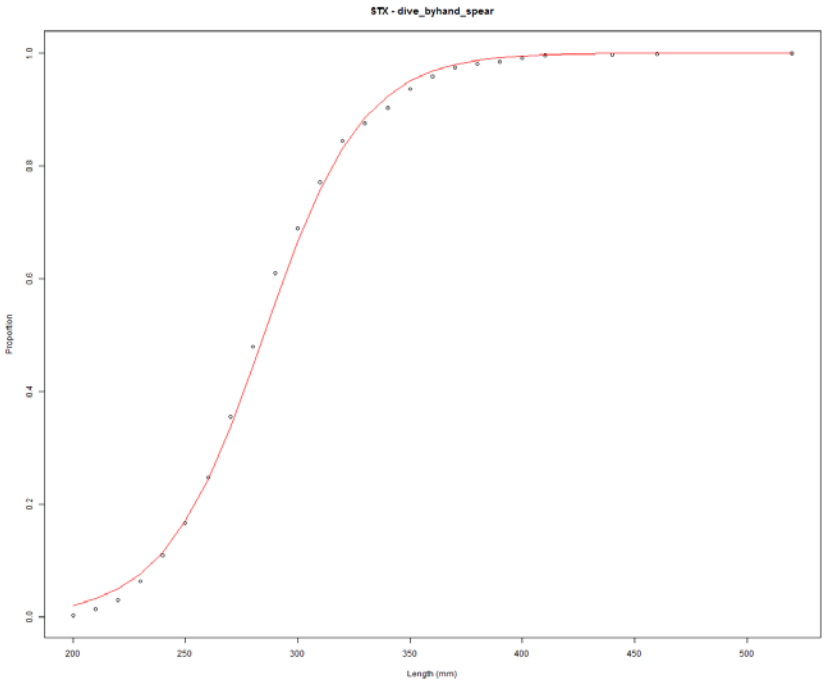
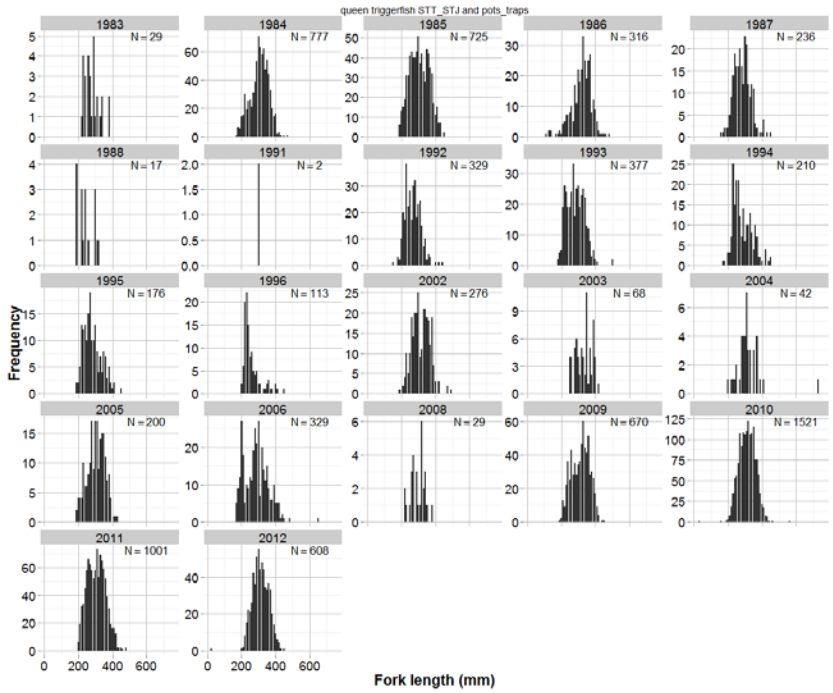


Figure 107 Annual length frequency histograms for Queen triggerfish caught by pots and traps in St. Thomas and St. John and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

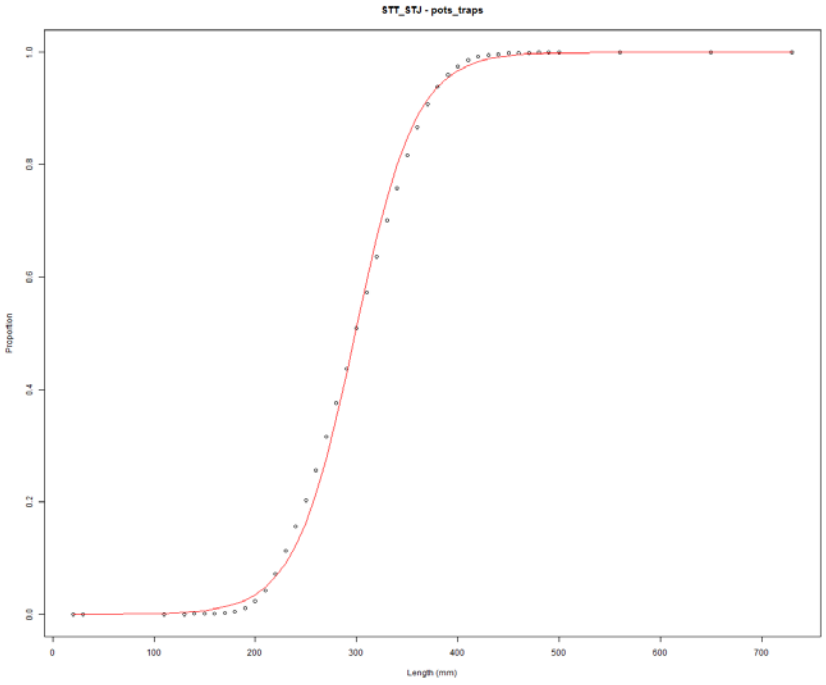


Figure 108 Annual length frequency histograms for Blackfin tuna caught by trolling gear in Puerto Rico. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

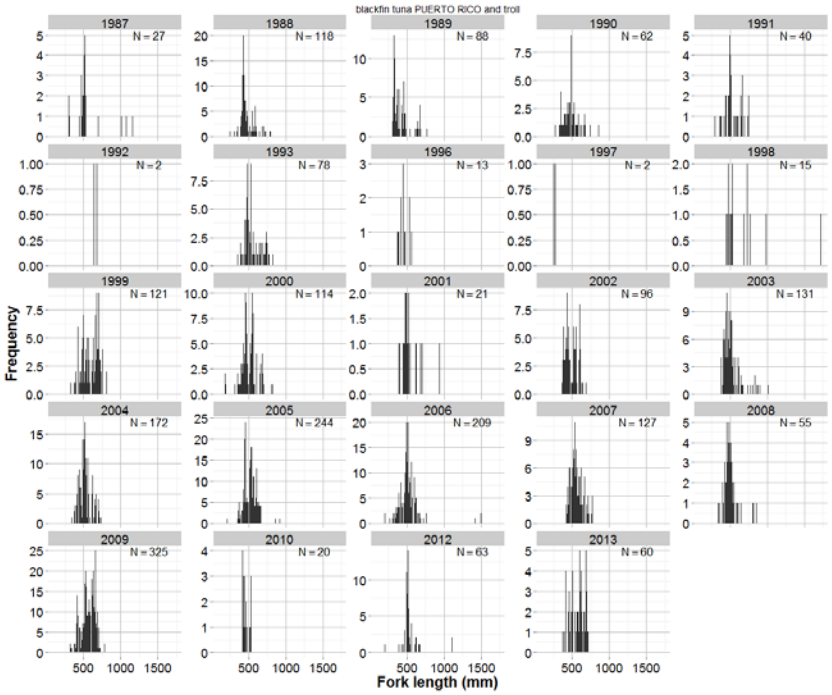


Figure 109 Annual length frequency histograms for Blackfin tuna caught by handlines in Puerto Rico. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

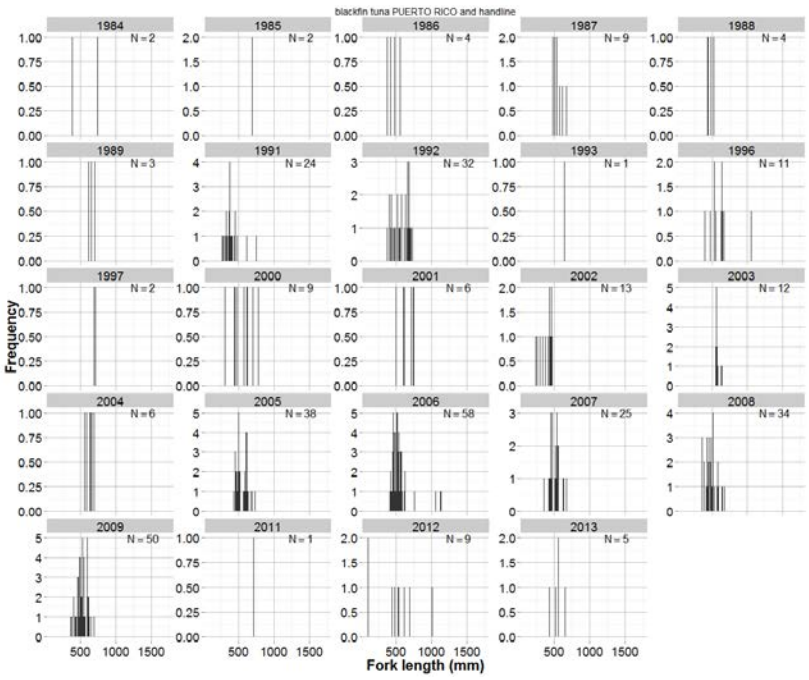


Figure 110 Annual length frequency histograms for Blackfin tuna caught by handlines in St. Croix. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

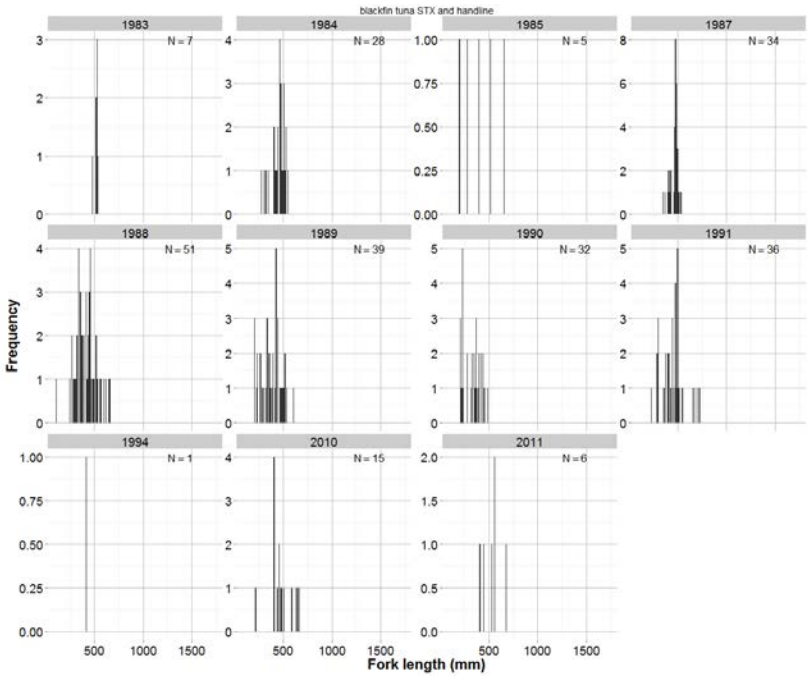


Figure 111 Annual length frequency histograms for Blackfin tuna caught by pots and traps in St. Croix. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

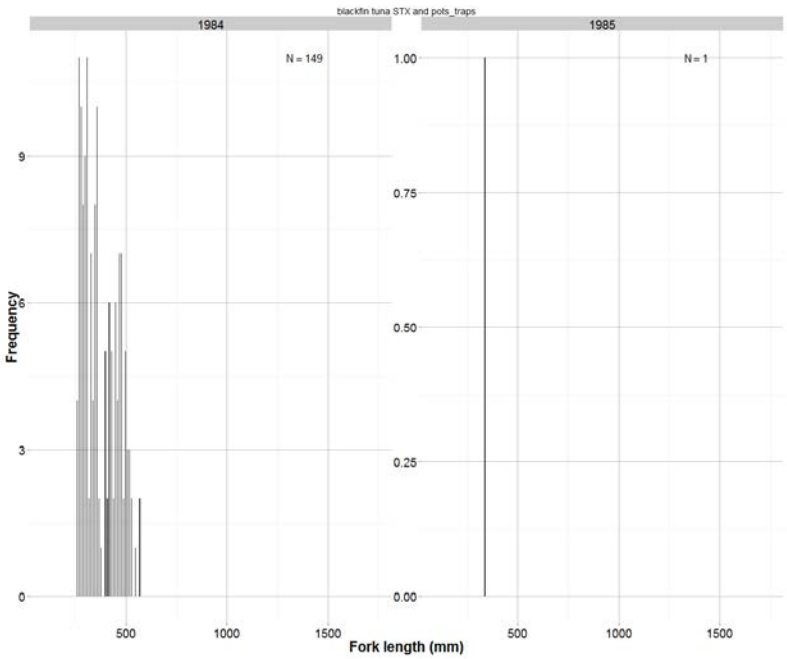


Figure 112 Annual length frequency histograms for Blackfin tuna caught by trolling gear in St. Croix. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

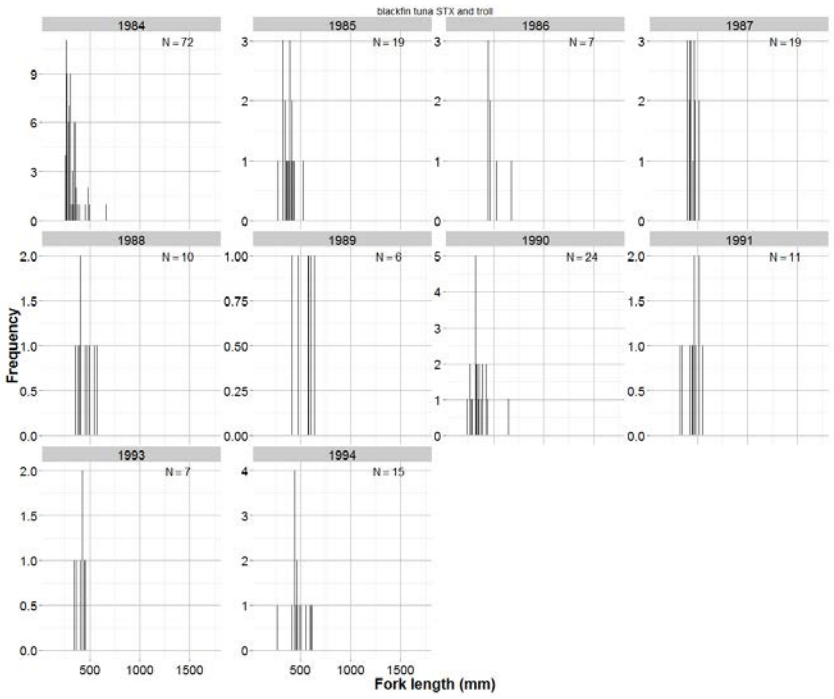
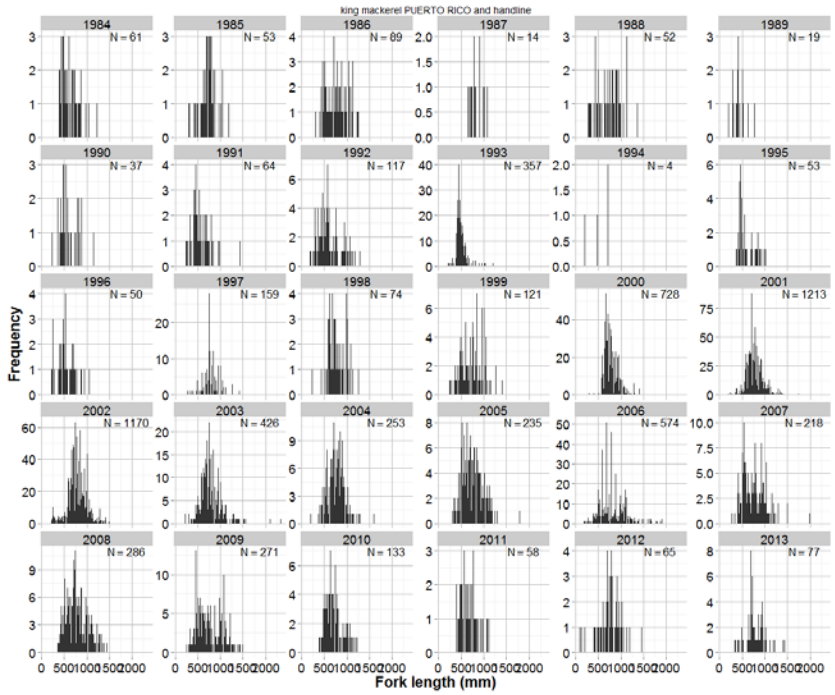


Figure 113 a) Annual length frequency histograms for King mackerel caught by handlines in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

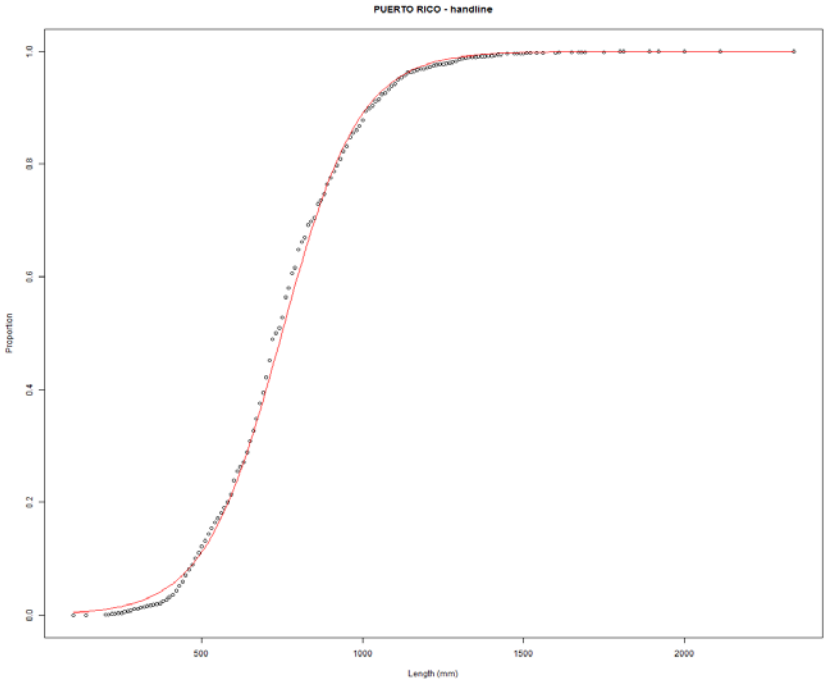
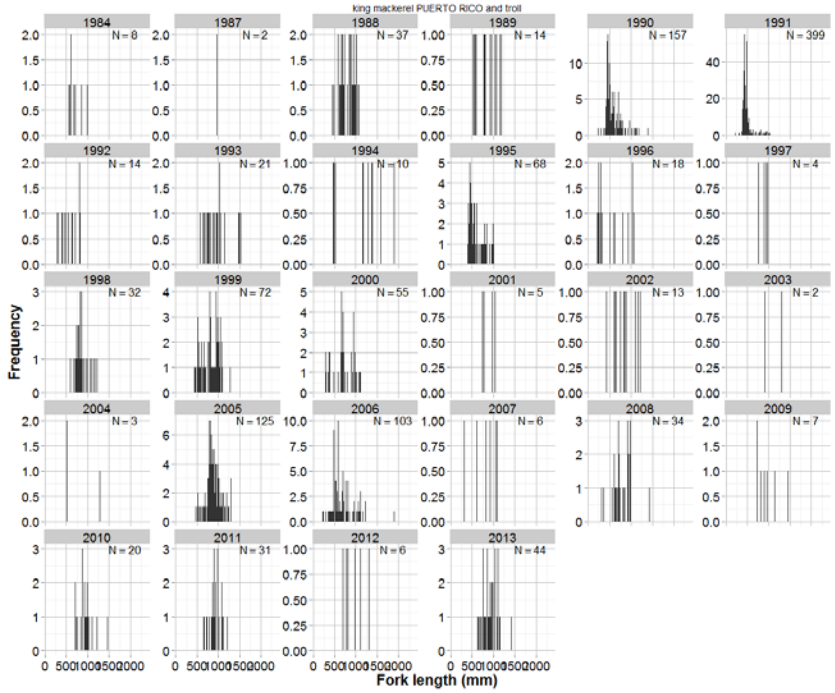


Figure 114 a) Annual length frequency histograms for King mackerel caught by trolling gear in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

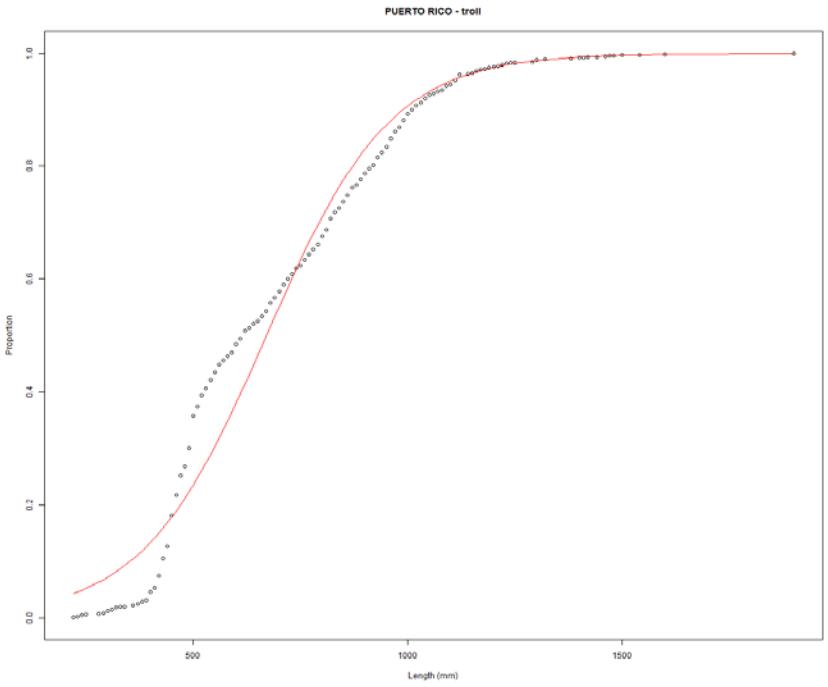
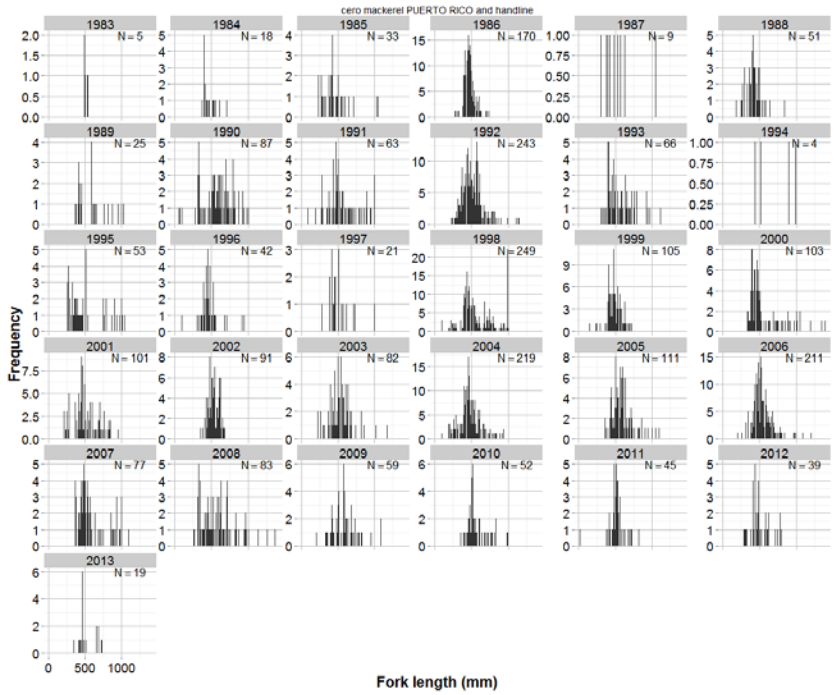


Figure 115 a) Annual length frequency histograms for Cero mackerel caught by handlines in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

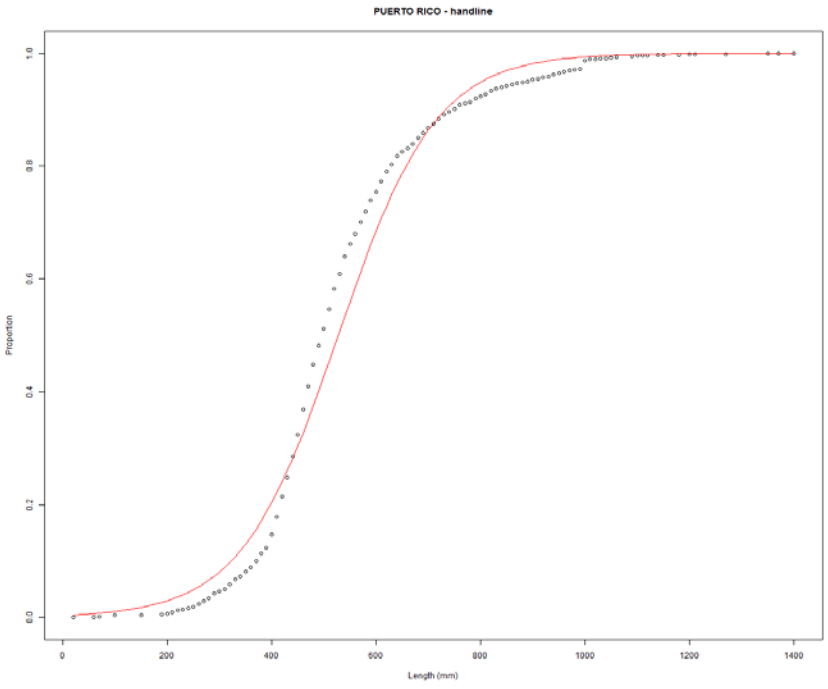
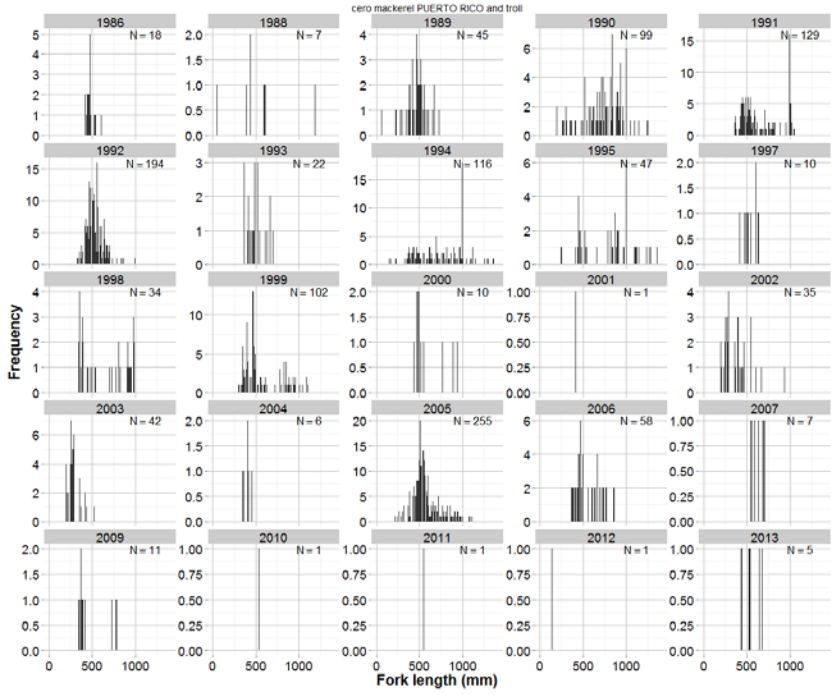


Figure 116a) Annual length frequency histograms for Cero mackerel caught by trolling gear in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

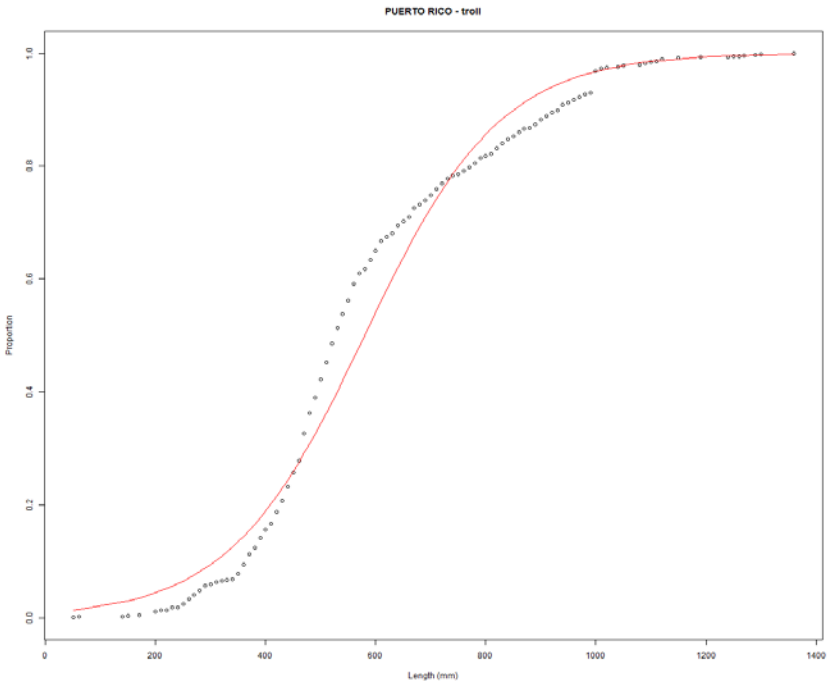
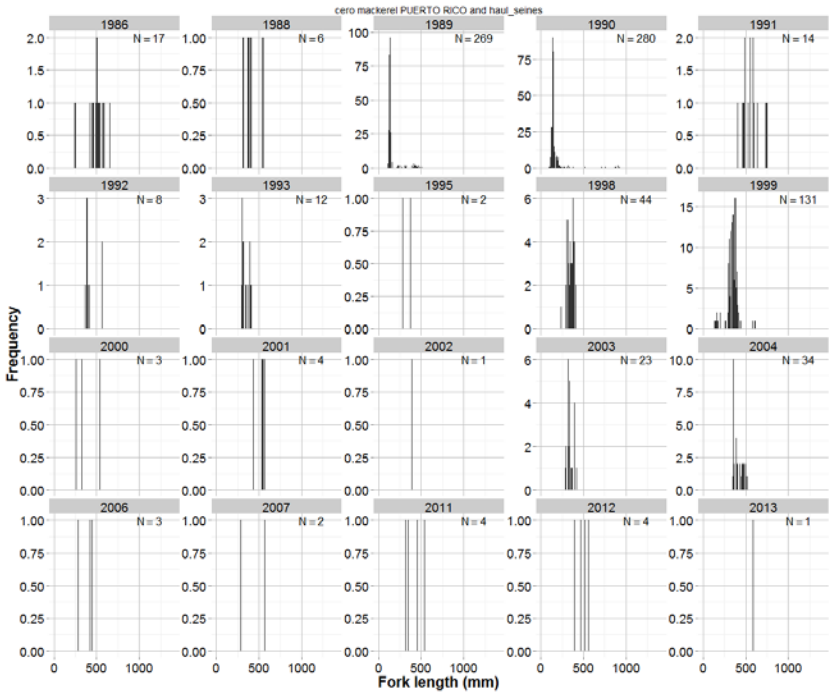


Figure 117 a) Annual length frequency histograms for Cero mackerel caught by haul seines in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)

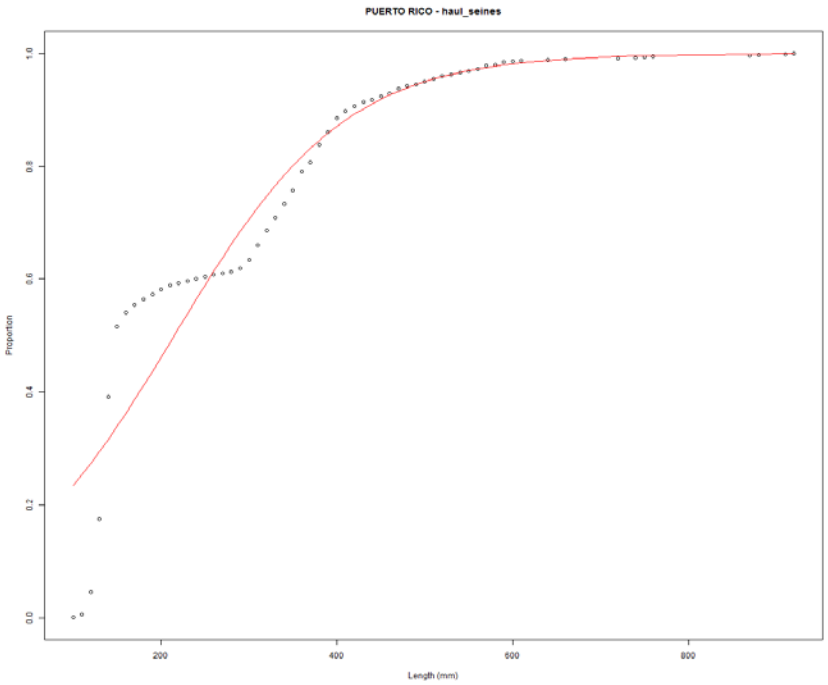


Figure 118 Annual length frequency histograms for Wahoo caught by handlines in Puerto Rico. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

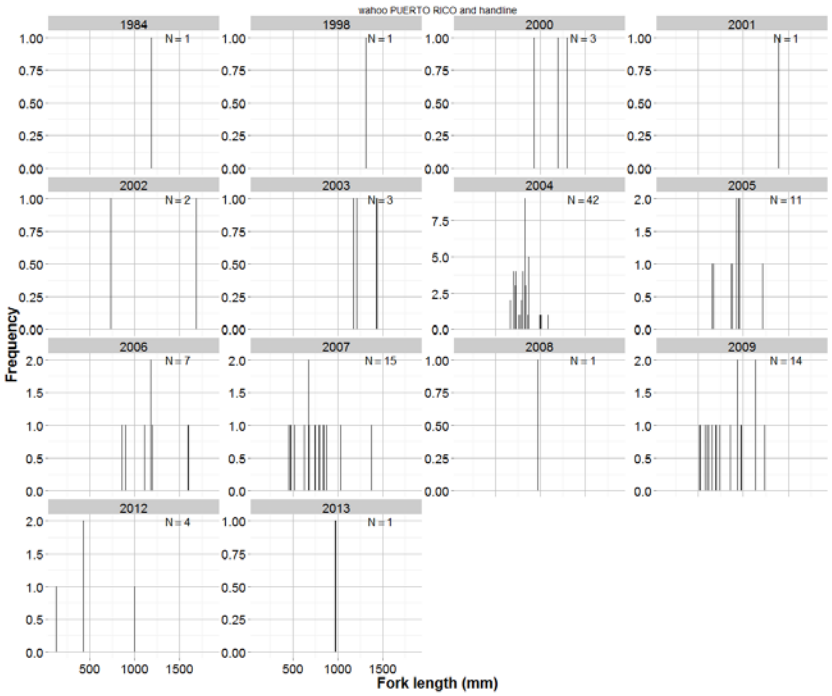


Figure 119 Annual length frequency histograms for Wahoo caught by trolling gear in Puerto Rico. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

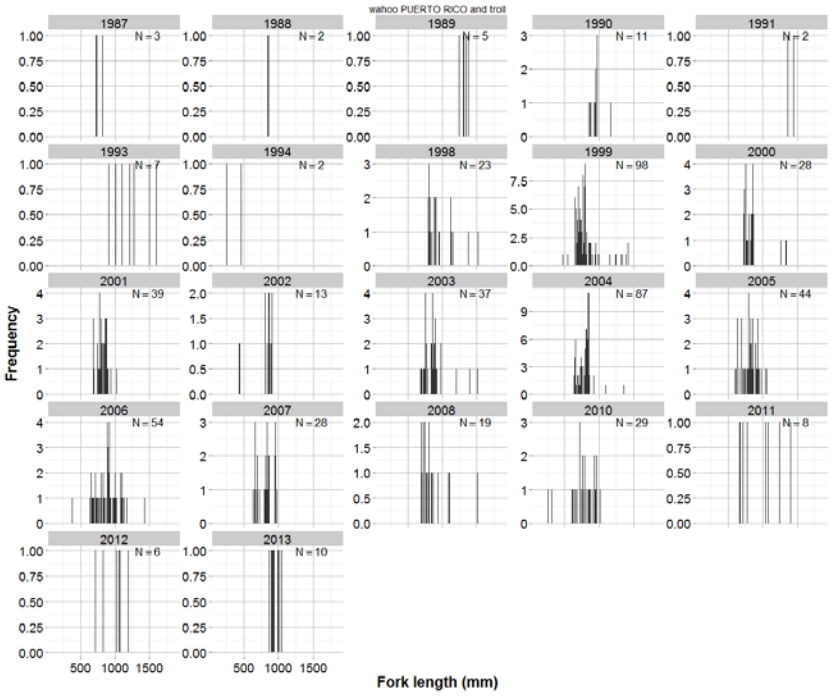


Figure 120 Annual length frequency histograms for Wahoo caught by handlines in St. Croix. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

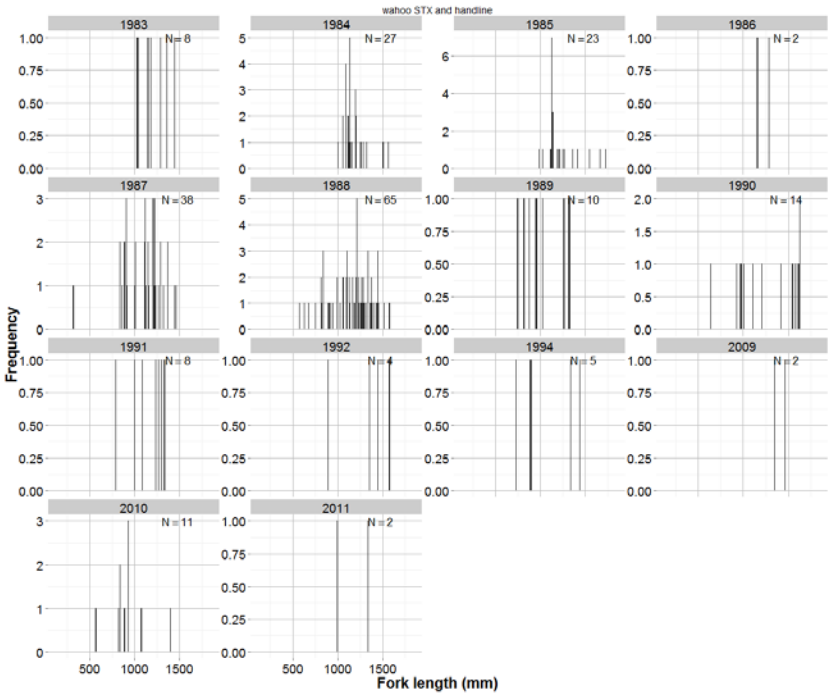


Figure 121 Annual length frequency histograms for Wahoo caught by trolling gear in St. Croix. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

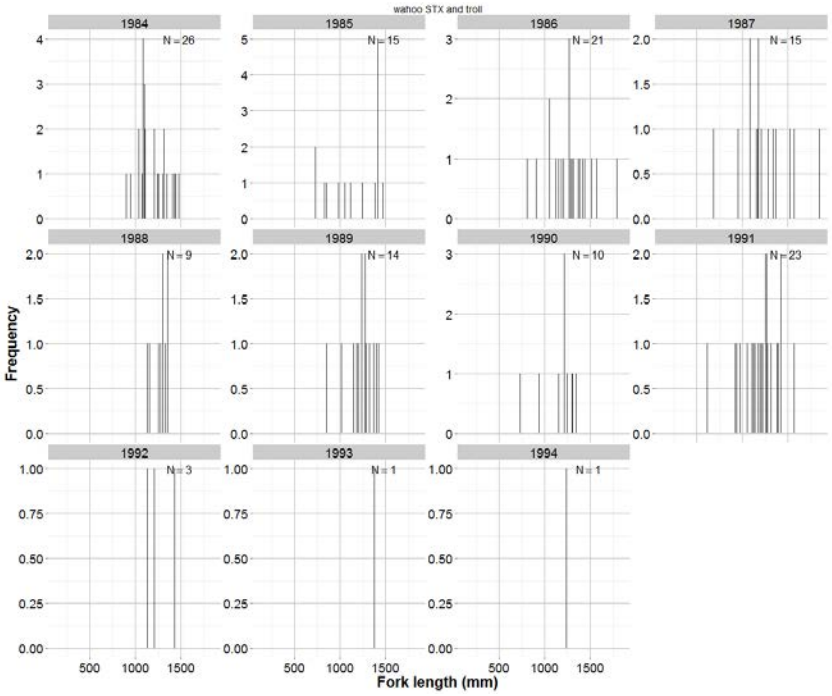
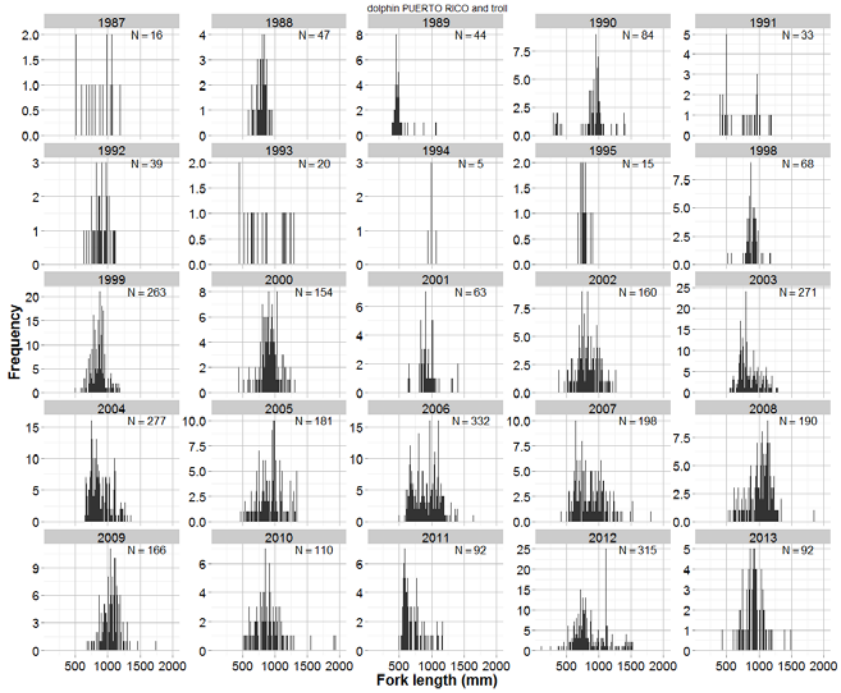


Figure 122 a) Annual length frequency histograms for Dolphin caught by trolling gear in Puerto Rico and b) logistic fit to the observed cumulative proportions. N indicates the number of lengths per year. Each bar represents a 10mm length bin.

a)



b)