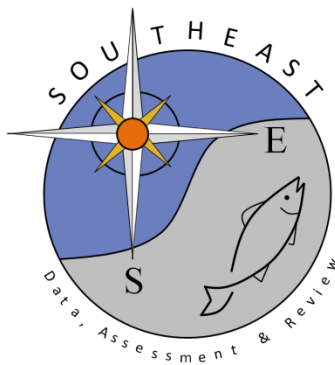


SEDAR 91 Commercial Landings of Caribbean Spiny Lobster (*Panulirus argus*, *Panulirus guttatus*) in Puerto Rico, US Caribbean, 1983-2023

M. Refik Orhun¹ *, Katherine Godwin³, Kim Johnson², and Stephanie Martínez Rivera¹

SEDAR91-DW-07

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SEDAR 91 Commercial Landings of Caribbean Spiny Lobster (*PANULIRUS ARGUS*, *PANULIRUS GUTTATUS*) in Puerto Rico, US Caribbean, 1983-2023

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November 19, 2024

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1. Introduction

Commercial fishery landings in Puerto Rico were obtained from self-reported fisher logbook data (Caribbean Commercial Logbook, CCL) the fishers mail or deliver monthly to the Puerto Rico Department of Natural and Environmental Resources. Commercial landings were reported by species, fishing gear, and fishing center where the catch was landed. Puerto Rico commercial landings have been incompletely reported throughout the available time series (Caribbean Fisheries Data Evaluation Final Report, 2009) and correction factors have been used to estimate total landings. Commercial fishery landings data for Caribbean Spiny Lobster in Puerto Rico were available for the years 1983-2023.

2. Methods

Commercial landings of Caribbean Spiny Lobster were compiled from 1983 to 2023. The commercial landings were compiled in pounds and number of trips reporting Spiny Lobster landings were summed by year, coast, and fishing gear.

2.1 Correction factors

Compilation of commercial fishery landings of 1983-2002 used a single, island-wide, correction factor to estimate total landings. For the years 2003 to 2023, correction factors were coast-specific (north, south, east, west). Reported landings were assigned to a coast based upon the fishing center reported for a trip.

Based on SEDAR 57 for Spiny Lobster, the correction factor for 2005 landings was replaced with the means of 2004 and 2006 correction factors (SEDAR 57, 2019).

The survey required to calculate correction factor for 2017 landings was not completed due to the hurricanes that affected Puerto Rico in 2017. Correction factors calculated during 2016 were also used to estimate 2017 commercial Spiny Lobster landings.

Based on methods used in SEDAR 80 for Queen Triggerfish, the coast specific correction factors for 2020-2023 were calculated as the means of 2014-2019 correction factors.

Spiny Lobster landings were estimated as the reported landings from the CCL database with the appropriate coast specific (after 2003) correction factor applied. The estimated total landings are labeled in tables and figures as “expanded pounds” or “expanded landings”. Discard data are not available for Spiny Lobsters in Puerto Rico.

2.2 Gear groups

In order to classify the landings into gear groups by the individual gears (or ERDMAN GEAR NAMES) with similar size selectivity, length composition data of Caribbean Spiny Lobster from the Fishery Dependent (FD) Trip Interview Program (TIP) database were analyzed using generalized linear models (GLMs). The statistical analysis conducted by Godwin et al. (2024) showed which gears had significantly different length distributions.

Based on the result of the GLMs and reported commercial landings, commercial landings of Caribbean Spiny Lobster were classified into 2 gear groups (Table 1).

Table 1: The classification of the commercial logbook gears into gear groups.

ERDMAN GEAR NAME	GEAR GROUP
FISH POT	POTS AND TRAPS ALL
SCUBA DIVING	DIVING ALL
LOBSTER POT	POTS AND TRAPS ALL
BEACH SEINE	DIVING ALL
GILL NET	DIVING ALL
OTHER GEAR	DIVING ALL
SPEAR FISHING	DIVING ALL
TRAMMEL NET	DIVING ALL
CAST NET	DIVING ALL
SILK HAUL	DIVING ALL
SKIN DIVING	DIVING ALL
BY HAND	DIVING ALL
SNARE	DIVING ALL
LAND CRAB TRAP	DIVING ALL
BOTTOM LINE	DIVING ALL
HAND LINE	DIVING ALL
LONG LINE	DIVING ALL
TROLL LINE	DIVING ALL
ROD AND REEL	DIVING ALL
FREE DIVING	DIVING ALL
LOBSTER TRAP	POTS AND TRAPS ALL
FISH TRAP	POTS AND TRAPS ALL
GILLNET	DIVING ALL

2.3 Outliers

Outlier removal was conducted by using a mean and standard deviation method. We calculated the values to define outliers by gear group and island (Table 2). In Puerto Rico, fishers reported landings from multiple trips on single forms in several years, therefore, we used reported

landings (not total landings estimated using correction factors) divided by the number of trips for the outlier analysis. If the landings of Caribbean Spiny Lobster reported on a trip were greater than three standard deviations from the mean (i.e., 99.73% quantile) they were removed from the dataset. Due to the outlier removal, the yearly commercial landings for Caribbean Spiny Lobster compiled may not match with previous SEDARs.

Table 2: Commercial landings of Caribbean Spiny Lobster in pounds equal to three standard deviations from the mean (i.e., 99.73% quantile) by gear group used for the outlier analysis. Trips with pounds landed greater than the indicated value were removed from the dataset.

GEAR NAMES	99.73% Quantile
SNARE	120
FISH POT	309
SCUBA DIVING	299
TRAMMEL NET	400
SKIN DIVING	102
LOBSTER POT	225
FISH TRAP	807
GILL NET	312
SPEAR FISHING	379
LOBSTER TRAP	293
BEACH SEINE	249
FREE DIVING	100
CAST NET	155
OTHER GEAR	141
BY HAND	108
HAND LINE	97
GILLNET	97
BOTTOM LINE	90
SILK HAUL	78
LAND CRAB TRAP	75

TROLL LINE	35
LONG LINE	28
ROD AND REEL	4

2.4 Confidentiality

Confidential data were determined based on the number of fishers that reported commercial landings by year and gear group. If the number of fishers reporting Spiny Lobster landings was less than 3 for any particular year and gear group, then those data were considered confidential and were not included in tables and figures in this working paper. The analysis found confidential data for Caribbean Spiny Lobster commercial landings in Puerto Rico only when landings were reported by coast.

3. Results

3.1 Commercial landings

Commercial landings of Caribbean Spiny Lobster in Puerto Rico from 1983 to 2023, were approximately 205,821-616,177 pounds per year (Table 3, Figure 1). Trips with reported Caribbean Spiny Lobster varied between approximately 7,158-24,475 (Table 3, Figure 2). The commercial landings by year and gear group are shown in Table 4 and Figure 3, and the number of trips with reported Caribbean Spiny Lobster are provided in Figure 4. Commercial landings by year and coast are shown in Figure 5 as pounds and in Figure 6 as number of trips with reported Caribbean Spiny Lobster landings..

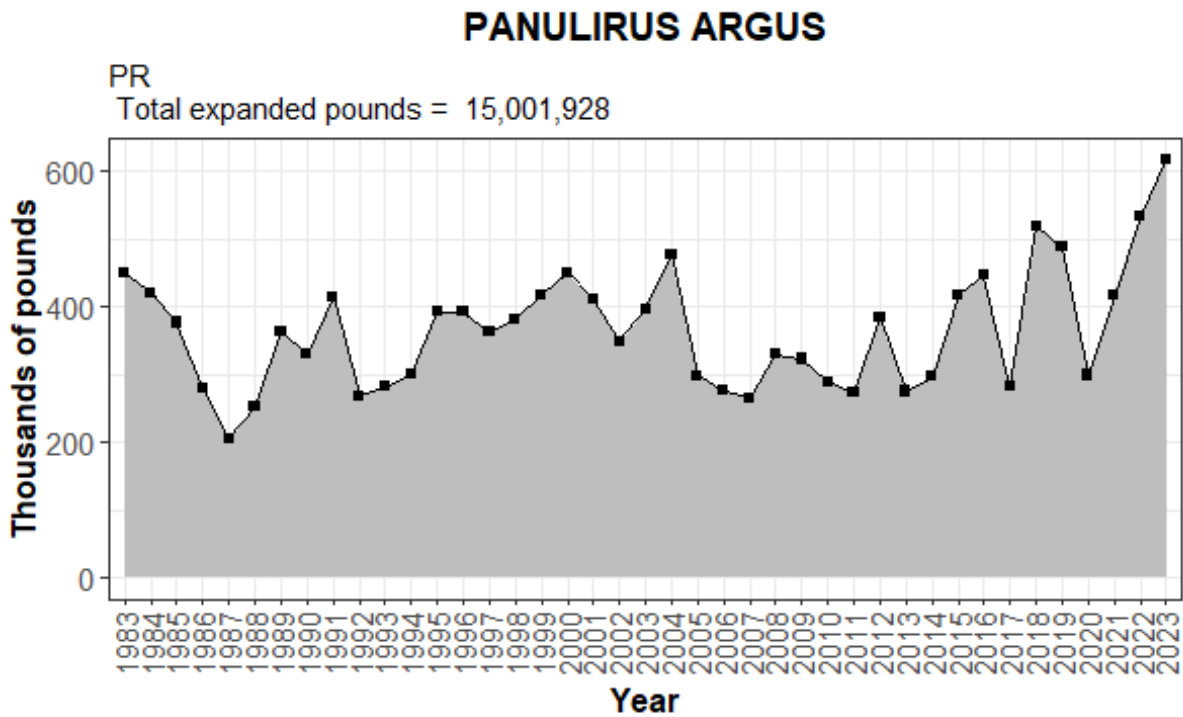
Table 3: Commercial landings of Caribbean Spiny Lobster in pounds and the number of trips that reported Caribbean Spiny Lobster landings in Puerto Rico .

Year	Expanded Landings (lbs)	Trips (n)
1983	448,508	24,432
1984	420,343	24,475
1985	376,525	19,187
1986	279,757	11,384
1987	205,821	8,070
1988	252,020	8,572
1989	363,939	10,102
1990	329,415	10,696
1991	414,945	14,982

1992	268,317	8,962
1993	281,659	11,515
1994	300,095	13,797
1995	392,427	21,371
1996	392,777	23,864
1997	363,096	19,968
1998	381,511	20,225
1999	417,854	23,631
2000	449,641	18,631
2001	411,429	18,888
2002	349,237	18,436
2003	395,962	10,678
2004	476,493	10,106
2005	298,688	8,651
2006	276,402	8,740
2007	265,615	8,013
2008	330,029	7,597
2009	323,143	8,370
2010	289,630	7,158
2011	273,018	9,177
2012	384,059	10,446
2013	275,421	11,182
2014	296,806	11,879
2015	417,579	12,158
2016	445,733	11,317
2017	281,905	7,635
2018	518,331	10,935
2019	488,196	12,349

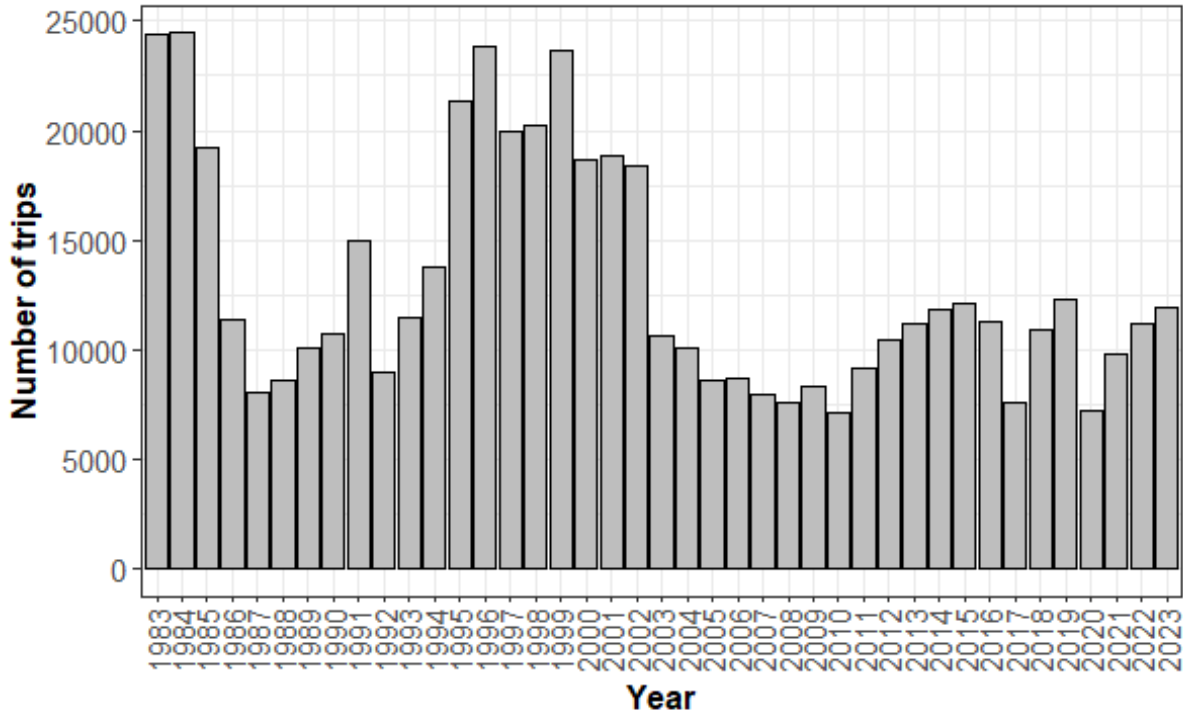
2020	298,750	7,254
2021	416,528	9,786
2022	534,147	11,189
2023	616,177	11,957
Total	15,001,928	537,765

^a Data are not confidential.



Data are not confidential.

Figure 1: The time series of commercial landings in expanded pounds of Caribbean Spiny Lobster in Puerto Rico .



Data are not confidential.

Figure 2: The time series of number of trips with reported landings of Caribbean Spiny Lobster in Puerto Rico .

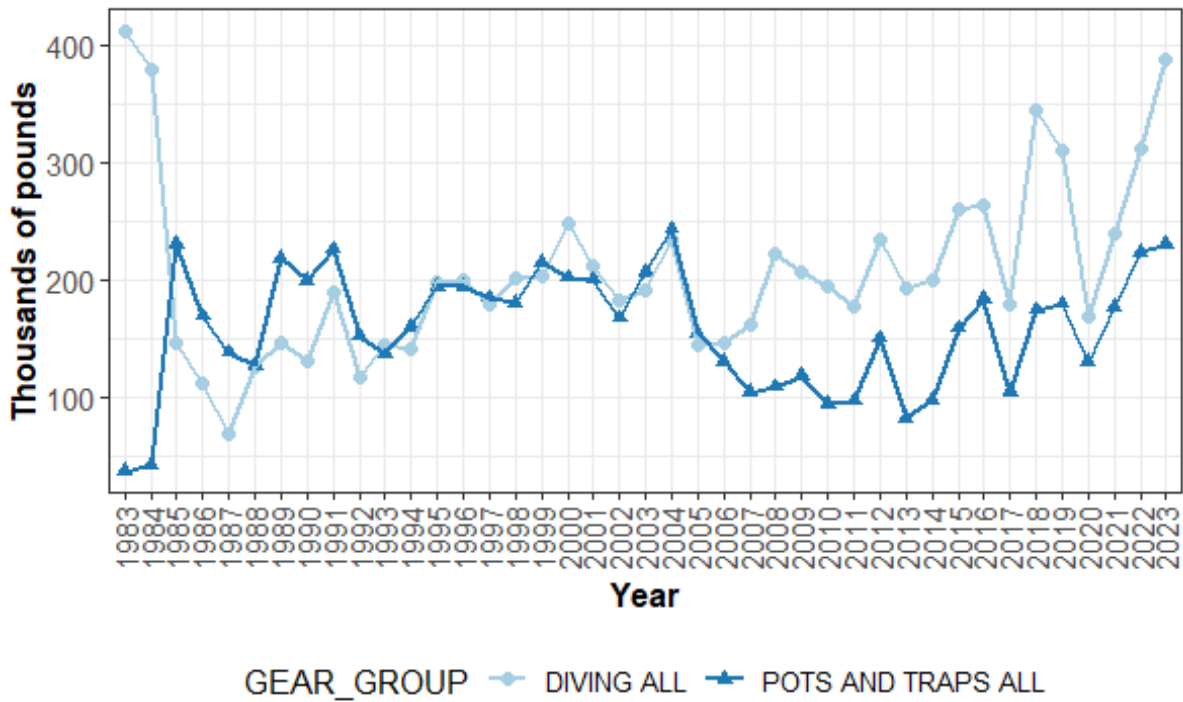
Table 4: Commercial landings of Caribbean Spiny Lobster in pounds by gear group that reported Caribbean Spiny Lobster landings in Puerto Rico . The number of trips reporting Caribbean Spiny Lobster by gear group are also included. ‘Expanded Lbs’ is the total landings of Caribbean Spiny Lobster estimated using the correction factors.

YEAR LANDED	EXPANDED LBS DIVING ALL	TRIPS DIVING ALL	EXPANDED LBS POTS AND TRAPS ALL	TRIPS POTS AND TRAPS ALL
1983	411,806	23,304	36,702	1,128
1984	378,041	22,824	42,302	1,651
1985	146,875	7,467	229,650	11,720
1986	110,905	5,546	168,852	5,838
1987	67,905	3,141	137,916	4,929
1988	124,760	4,121	127,260	4,451
1989	146,143	3,820	217,796	6,282

1990	130,510	3,849	198,905	6,847
1991	189,434	6,149	225,511	8,833
1992	116,871	4,251	151,446	4,711
1993	144,584	6,108	137,075	5,407
1994	140,176	7,057	159,919	6,740
1995	198,457	10,365	193,970	11,006
1996	198,761	11,532	194,016	12,332
1997	178,569	10,424	184,527	9,544
1998	200,913	10,839	180,598	9,386
1999	203,601	11,906	214,253	11,725
2000	247,922	9,698	201,719	8,933
2001	211,690	10,211	199,739	8,677
2002	182,345	9,825	166,892	8,611
2003	190,153	5,938	205,809	4,740
2004	233,655	6,341	242,838	3,765
2005	144,211	5,588	154,477	3,063
2006	146,060	6,070	130,342	2,670
2007	161,818	6,078	103,797	1,935
2008	221,684	5,881	108,345	1,716
2009	205,599	6,149	117,544	2,221
2010	195,105	5,128	94,525	2,030
2011	176,635	7,113	96,383	2,064
2012	234,339	7,901	149,720	2,545
2013	193,198	8,903	82,223	2,279
2014	199,292	9,349	97,514	2,530
2015	259,121	9,168	158,458	2,990
2016	262,896	8,307	182,837	3,010
2017	178,121	5,758	103,784	1,877

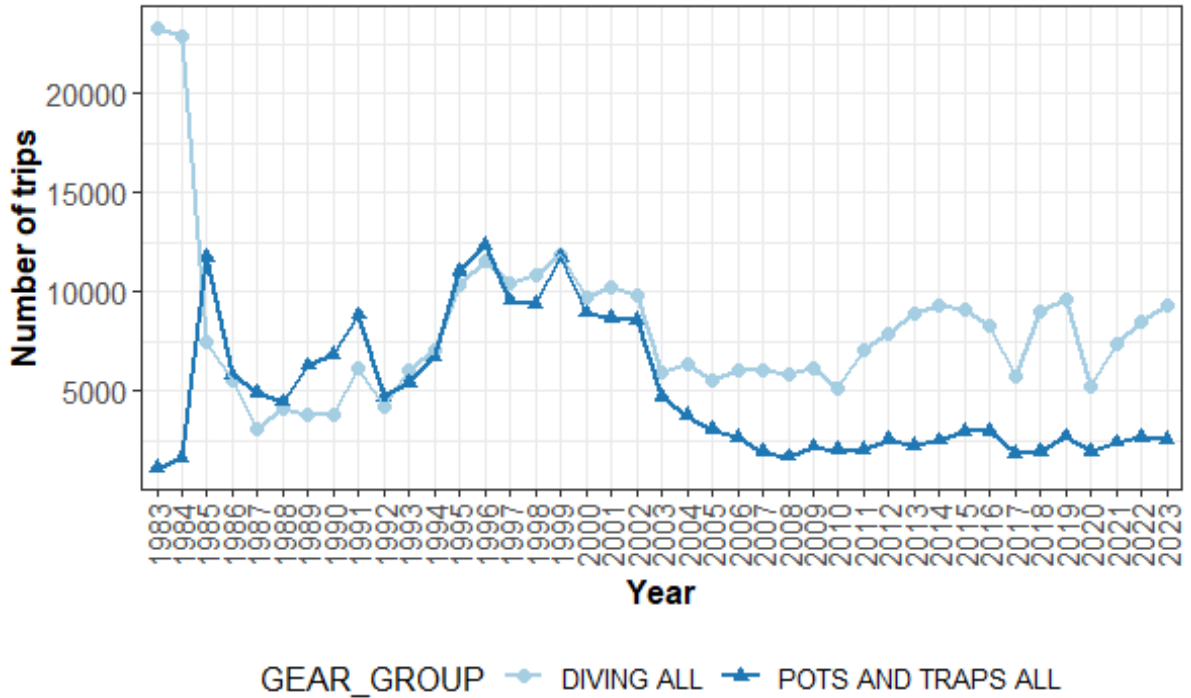
2018	344,497	8,975	173,834	1,960
2019	309,243	9,618	178,953	2,731
2020	169,054	5,269	129,696	1,985
2021	239,676	7,358	176,852	2,428
2022	310,715	8,491	223,432	2,698
2023	386,644	9,369	229,533	2,588
Total	8,491,984	335,189	6,509,944	202,576

^a Data are not confidential.



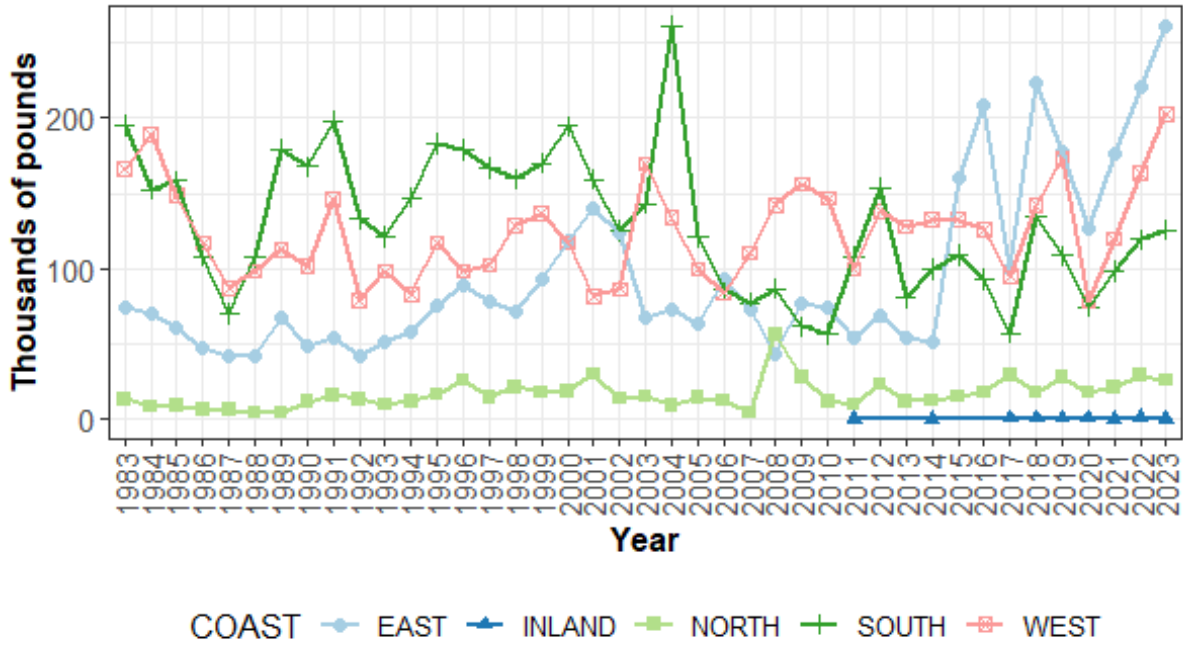
Data are not confidential.

Figure 3: Commercial landings in expanded pounds of Caribbean Spiny Lobster by year and gear group in Puerto Rico .



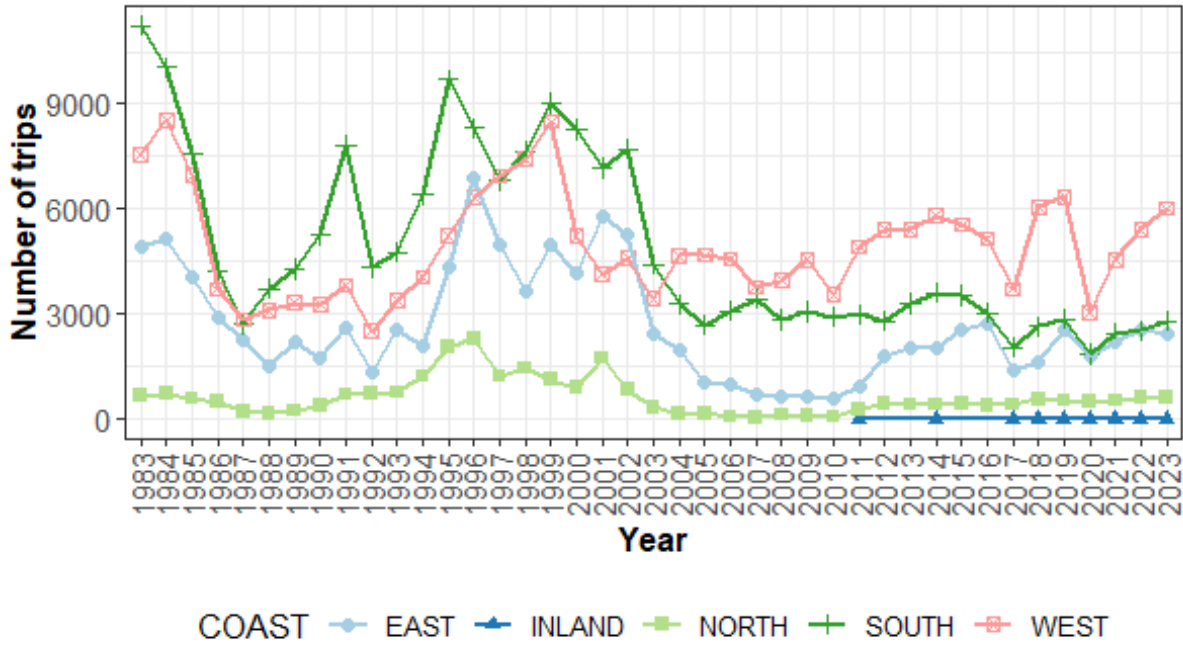
Data are not confidential.

Figure 4: Number of trips with reported landings of Caribbean Spiny Lobster by year and gear group in Puerto Rico .



Confidential data were removed.
 Total landings (lb) of confidential data is 204.
 Total number of trips of confidential data is 6.

Figure 5: Commercial landings in expanded pounds of Caribbean Spiny Lobster by year and coast in Puerto Rico .



Confidential data were removed.
 Total landings (lb) of confidential data is 204.
 Total number of trips of confidential data is 6.

Figure 6: Number of trips with reported landings of Caribbean Spiny Lobster by year and coast in Puerto Rico .

3.2 Commercial landings after outlier analysis by gears

Commercial landings of Caribbean Spiny Lobster in Puerto Rico from 1983 to 2023, were approximately 181,639-560,874 pounds per year (Table 5, Figure 7). Comparison of commercial landings after outlier analysis is shown in Table 7. Trips per year varied between approximately 7,142-24,473 (Table 5, Figure 8). The commercial landings by year and gear group are shown in Figure 9, and the number of trips in Figure 10. We also compiled commercial landings by year and coast and are shown in Figure 11 as pounds and in Figure 12 as number of trips.

Table 5: Commercial landings of Caribbean Spiny Lobster in pounds and the number of trips that reported Caribbean Spiny Lobster landings in Puerto Rico .

Year	Expanded Landings (lbs)	Trips (n)
1983	447,524	24,430
1984	418,530	24,473
1985	374,344	19,184
1986	260,191	11,349

1987	181,639	8,037
1988	240,642	8,560
1989	338,746	10,074
1990	302,116	10,658
1991	379,740	14,933
1992	237,424	8,930
1993	249,645	11,488
1994	286,801	13,781
1995	375,510	21,347
1996	371,898	23,847
1997	336,134	19,925
1998	339,054	20,161
1999	370,992	23,591
2000	415,172	18,612
2001	398,978	18,872
2002	313,213	18,381
2003	361,077	10,654
2004	471,092	10,100
2005	291,249	8,643
2006	271,272	8,730
2007	254,987	7,999
2008	294,887	7,577
2009	312,692	8,361
2010	264,583	7,142
2011	269,733	9,170
2012	378,357	10,432
2013	274,367	11,179
2014	293,023	11,865

2015	406,909	12,138
2016	434,089	11,299
2017	275,150	7,625
2018	496,520	10,899
2019	475,101	12,316
2020	292,654	7,237
2021	411,649	9,776
2022	499,588	11,122
2023	560,874	11,878
Total	14,228,146	536,775

^a Data are not confidential.

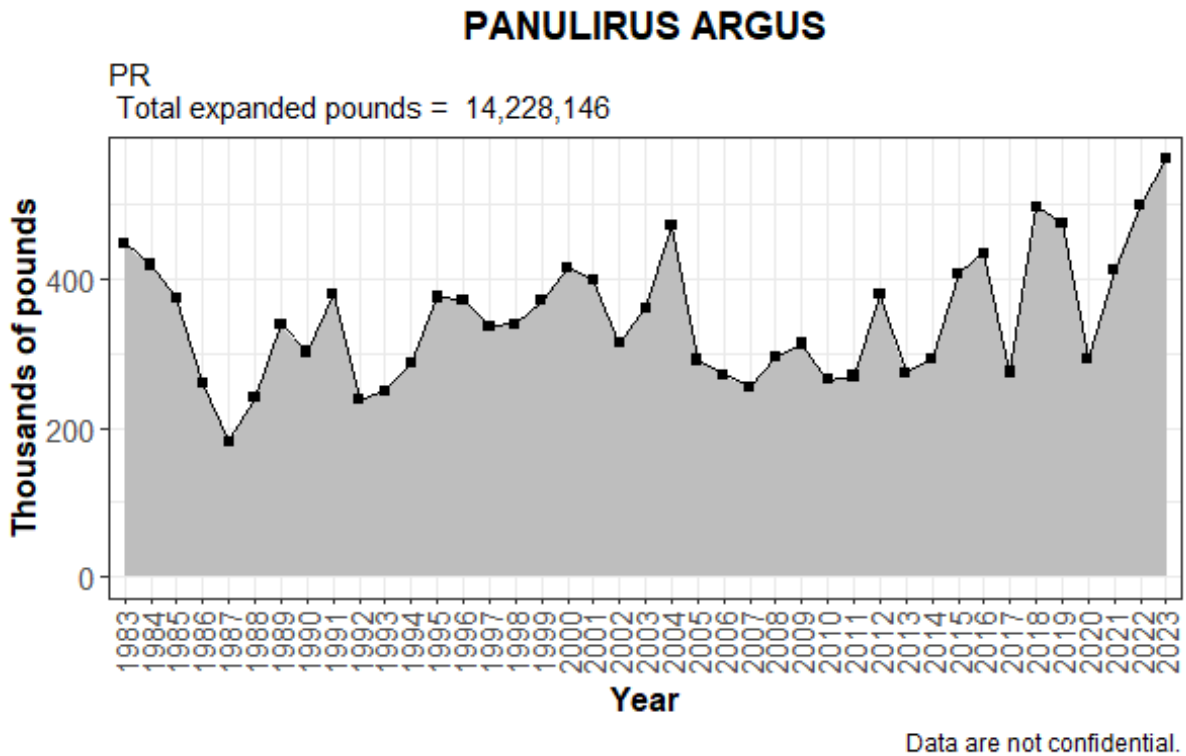
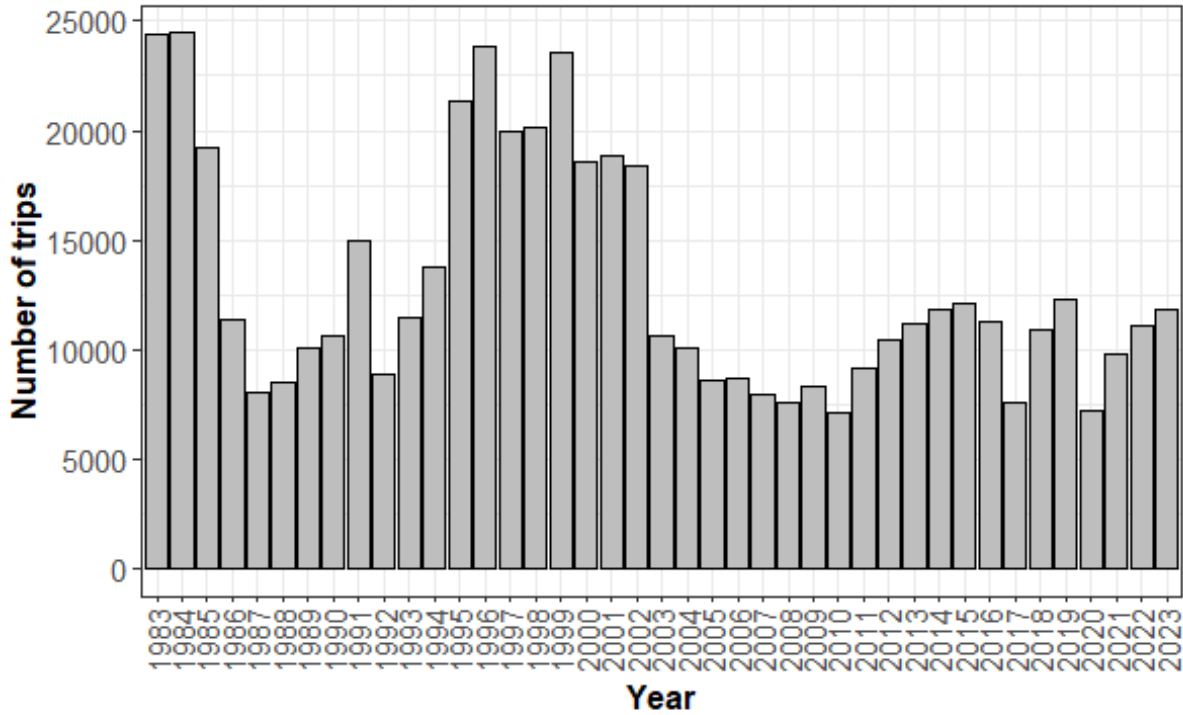


Figure 7: The time series of commercial landings in pounds of Caribbean Spiny Lobster in Puerto Rico after outlier removal.



Data are not confidential.

Figure 8: The time series of number of trips with reported landings of Caribbean Spiny Lobster in Puerto Rico after outlier removal.

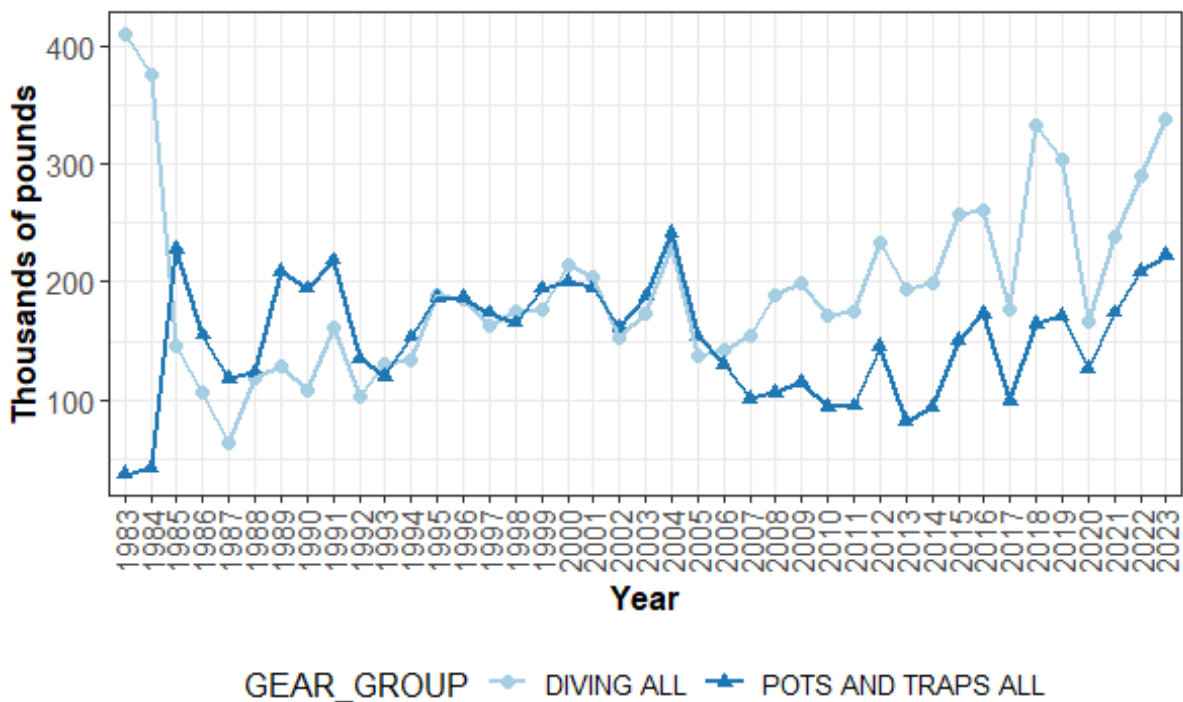
Table 6: Commercial landings of Caribbean Spiny Lobster in pounds by gear group that reported Caribbean Spiny Lobster landings in Puerto Rico after outlier removal.

YEAR LANDED	EXPANDED LBS DIVING ALL	TRIPS DIVING ALL	EXPANDED LBS POTS AND TRAPS ALL	TRIPS POTS AND TRAPS ALL
1983	410,822	23,302	36,702	1,128
1984	376,228	22,822	42,302	1,651
1985	146,009	7,466	228,335	11,718
1986	105,603	5,537	154,588	5,812
1987	64,005	3,139	117,634	4,898
1988	117,794	4,112	122,848	4,448
1989	129,287	3,801	209,459	6,273
1990	107,878	3,817	194,238	6,841

1991	161,338	6,109	218,402	8,824
1992	102,329	4,229	135,095	4,701
1993	130,014	6,088	119,631	5,400
1994	133,822	7,050	152,979	6,731
1995	188,561	10,351	186,949	10,996
1996	185,762	11,527	186,136	12,320
1997	162,534	10,403	173,600	9,522
1998	174,195	10,800	164,859	9,361
1999	176,732	11,883	194,260	11,708
2000	214,890	9,681	200,282	8,931
2001	203,548	10,200	195,430	8,672
2002	152,801	9,781	160,412	8,600
2003	173,534	5,922	187,543	4,732
2004	229,187	6,336	241,905	3,764
2005	136,772	5,580	154,477	3,063
2006	141,537	6,061	129,735	2,669
2007	154,568	6,065	100,419	1,934
2008	188,508	5,863	106,379	1,714
2009	198,579	6,143	114,113	2,218
2010	170,806	5,114	93,777	2,028
2011	175,101	7,108	94,632	2,062
2012	233,678	7,899	144,679	2,533
2013	193,198	8,903	81,169	2,276
2014	198,816	9,347	94,207	2,518
2015	256,656	9,162	150,253	2,976
2016	261,340	8,301	172,749	2,998
2017	176,096	5,753	99,054	1,872
2018	332,627	8,947	163,893	1,952

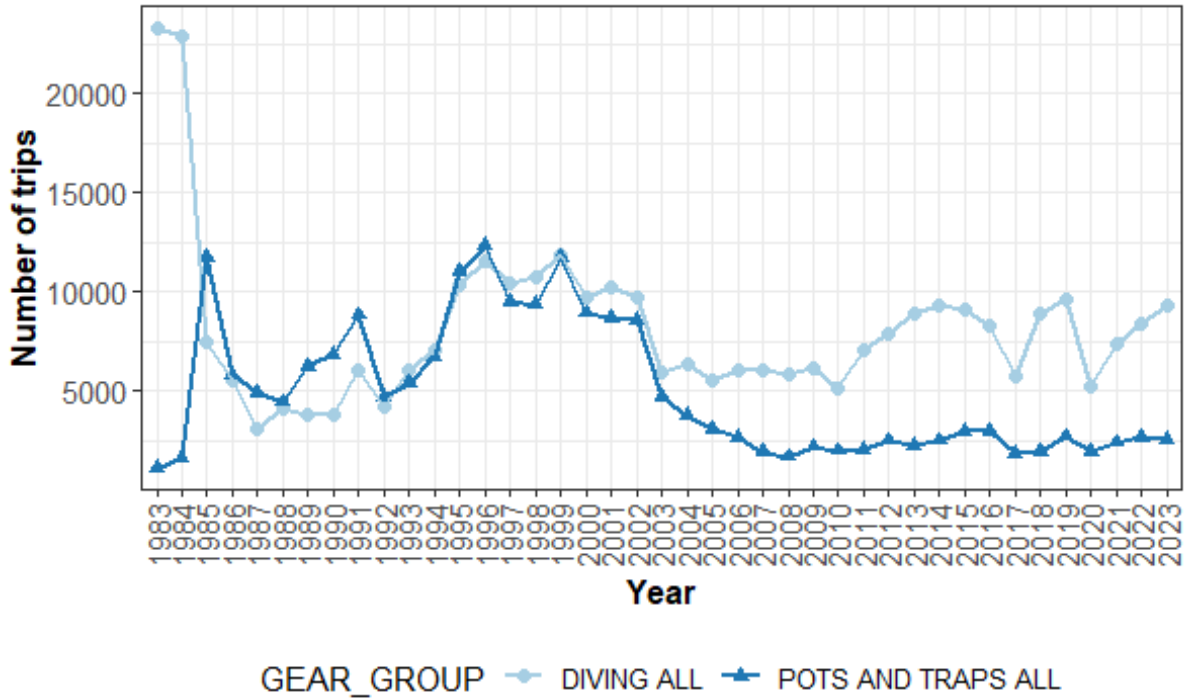
2019	303,939	9,598	171,162	2,718
2020	166,548	5,258	126,106	1,979
2021	237,972	7,351	173,677	2,425
2022	290,596	8,439	208,992	2,683
2023	338,796	9,303	222,078	2,575
Total	8,003,006	334,551	6,225,140	202,224

^a Data are not confidential.



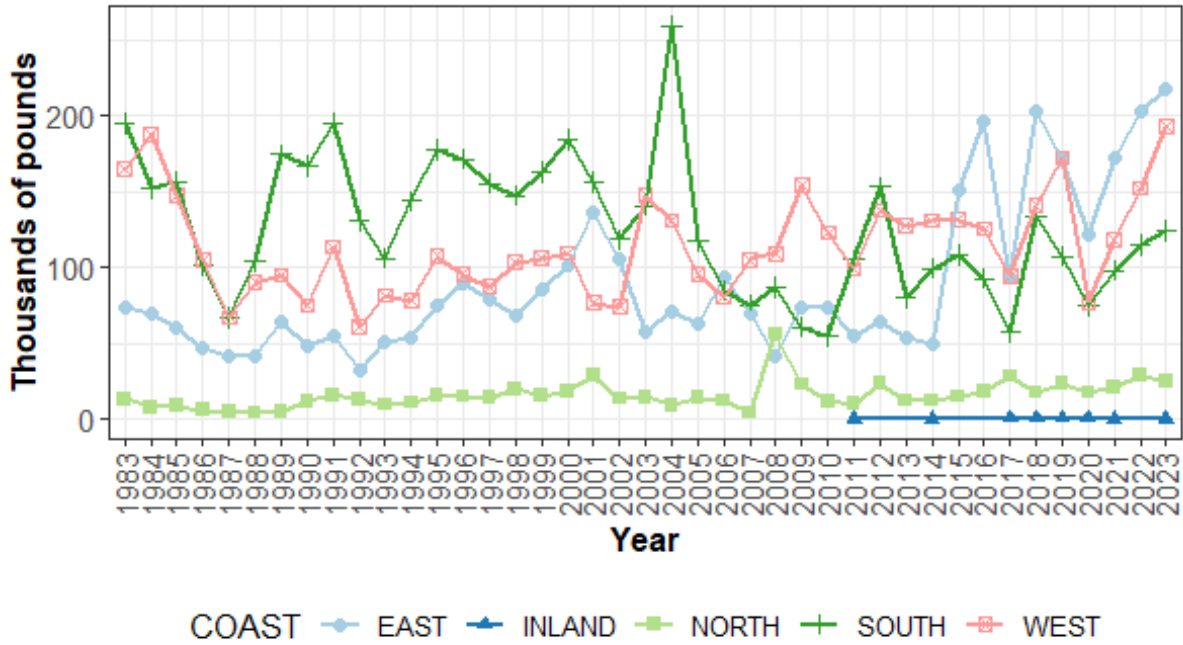
Data are not confidential.

Figure 9: Commercial landings in pounds of Caribbean Spiny Lobster by year and gear group in Puerto Rico after outlier removal.



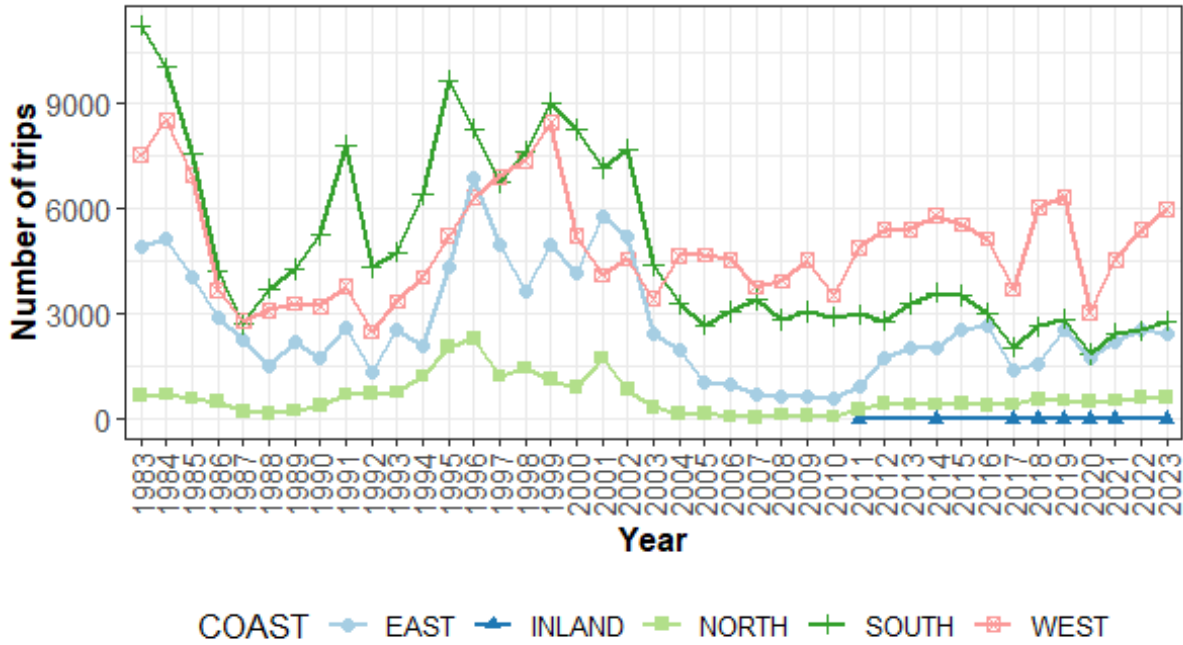
Data are not confidential.

Figure 10: Number of trips with reported landings of Caribbean Spiny Lobster by year and gear group in Puerto Rico after outlier removal.



Confidential data were removed.
 Total landings (lb) of confidential data is 313.
 Total number of trips of confidential data is 12.

Figure 11: Commercial landings in pounds of Caribbean Spiny Lobster by year and coast in Puerto Rico after outlier removal.



Confidential data were removed.
 Total landings (lb) of confidential data is 313.
 Total number of trips of confidential data is 12.

Figure 12: Number of trips with reported landings of Caribbean Spiny Lobster by year and coast in Puerto Rico after outlier removal.

Table 7: Comparison expanded landings before and after outlier removal of commercial landings of Caribbean Spiny Lobster in pounds for Puerto Rico .

Year	Expanded Landings (lbs)	Expanded Landings outlier analysis (lbs)	Difference (%)
1983	448,508	447,524	0.2
1984	420,343	418,530	0.4
1985	376,525	374,344	0.6
1986	279,757	260,191	7.0
1987	205,821	181,639	11.7
1988	252,020	240,642	4.5
1989	363,939	338,746	6.9
1990	329,415	302,116	8.3
1991	414,945	379,740	8.5

1992	268,317	237,424	11.5
1993	281,659	249,645	11.4
1994	300,095	286,801	4.4
1995	392,427	375,510	4.3
1996	392,777	371,898	5.3
1997	363,096	336,134	7.4
1998	381,511	339,054	11.1
1999	417,854	370,992	11.2
2000	449,641	415,172	7.7
2001	411,429	398,978	3.0
2002	349,237	313,213	10.3
2003	395,962	361,077	8.8
2004	476,493	471,092	1.1
2005	298,688	291,249	2.5
2006	276,402	271,272	1.9
2007	265,615	254,987	4.0
2008	330,029	294,887	10.6
2009	323,143	312,692	3.2
2010	289,630	264,583	8.6
2011	273,018	269,733	1.2
2012	384,059	378,357	1.5
2013	275,421	274,367	0.4
2014	296,806	293,023	1.3
2015	417,579	406,909	2.6
2016	445,733	434,089	2.6
2017	281,905	275,150	2.4
2018	518,331	496,520	4.2
2019	488,196	475,101	2.7

2020	298,750	292,654	2.0
2021	416,528	411,649	1.2
2022	534,147	499,588	6.5
2023	616,177	560,874	9.0
Total	15,001,928	14,228,146	5.2

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