

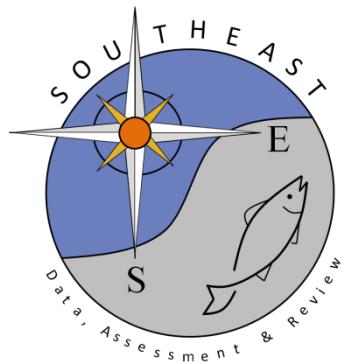
Summary of Fishery Independent Data from Puerto Rico and the U.S. Virgin Islands

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During the late 1970s and early 1980s several fishery independent surveys were undertaken to examine the deep-water stocks of snapper and grouper off of Puerto Rico and the U.S. Virgin Islands. The primary gears fished included bottom longlines, off-bottom longlines, handlines and fish traps. Other gears, such as shrimp trawls and pelagic longlines, were fished sporadically during the surveys, but excluded from summaries due to low sample number or for not targeting species of interest. In this case, the species of interest include all snappers and groupers. After an extended hiatus, in 2009, bottom longlines, fish traps and video gear was used to assess the relative abundance of reef fish along the insular shelves of Puerto Rico and the U.S. Virgin Islands. Only data from the bottom longlines and fish traps were summarized for the target species. Data from the following cruises are the data summarized in this paper:

04-097	06/13 - 08/03/1979	Reef Fish Habitat/Miami Swordfish
04-108	06/17 - 07/24/1980	Caribbean Reef Fish
04-119	07/13 - 07/28/1981	Caribbean Reef Fish
04-129	09/01 - 09/30/1982	Deep Water Snapper-Grouper
21-836	05/25 - 07/20/1983	Deepwater Snapper/Grouper
21-844	04/10 - 05/14/1984	Deepwater Snapper
28-857	10/01 - 10/23/1985	Caribbean Reef Fish
04-285	03/05 - 04/08/2009	Caribbean Reef Fish

The data from the old historical surveys (1979 - 1985) were summarized separately due to changes in sample design for the surveys. Distribution of the target species are shown for bottom longline (Figure 1 – Figure 23), off-bottom longline (Figure 24 – Figure 37), handlines (Figure 38 – Figure 45) and fish traps (Figure 46 – Figure 60). Distribution data from bottom longline and fish traps from 2009 are shown in Figure 61 – Figure 70. Catch rates and counts of fish for target species from the historic surveys are presented in Table 1 – Table 8. Catch rates and counts of fish for target species from 2009 are presented in Table 9 – Table 13. Where an appropriate of fish were present, length frequency histograms were created from the historic surveys (Figure 71 – Figure 78) and the 2009 survey (Figure 79 – Figure 80). Length distributions for all species are presented in Table 14 – Table 16 for the historic surveys and Tables 17 and 18 for the 2009 survey.

Table 1. Bottom longline catch rates (number of fish per 100 hook hour) for snappers and groupers caught off Puerto Rico and the U.S Virgin Islands on fishery independent surveys from 1979 – 1985.

Year	N	Coney (<i>Cephalopholis fulva</i>)	Graysby (<i>Cephalopholis cinctata</i>)	Snowy Grouper (<i>Epinephelus niveatus</i>)	Rock Hind (<i>Epinephelus adscensionis</i>)	Yellowedge Grouper (<i>Epinephelus flavolimatus</i>)	Red Hind (<i>Epinephelus guttatus</i>)	Red Grouper (<i>Epinephelus morio</i>)	Misty Grouper (<i>Epinephelus mystacinus</i>)	Nassau Grouper (<i>Epinephelus striatus</i>)	Yellowfin Grouper (<i>Mycteroperca venenosa</i>)	Black Snapper (<i>Apsilus dentatus</i>)	Queen Snapper (<i>Etelis oculatus</i>)	Mutton Snapper (<i>Lutjanus analis</i>)	Schoolmaster (<i>Lutjanus apodus</i>)	Blackfin Snapper (<i>Lutjanus buccanella</i>)	Dog Snapper (<i>Lutjanus jocu</i>)	Lane Snapper (<i>Lutjanus synagris</i>)	Silk Snapper (<i>Lutjanus vivanus</i>)	Yellowtail Snapper (<i>Ocyurus chrysurus</i>)	<i>Pristipomoides</i> sp.	Cardinal Snapper (<i>Pristipomoides macrourhampus</i>)	Wenchman (<i>Pristipomoides aquilonaris</i>)	Vermillion Snapper (<i>Rhomboplites aurorubens</i>)
1979	59	0	0.018	0	0.036	0.669	0.006	0.232	0.006	0.017	0	0.126	0.045	0	0.088	0.027	0.011	0.235	0.017	0.036	0.399	0.253	0.005	
1980	106	0.003	0	0.006	0	0.03	0.003	0	0.107	0	0	0.288	0	0.003	0	0.003	0	0.13	0.006	0	0.751	0.081	0.015	
1981	13	0	0	0	0	0.053	0	0	0.038	0	0	0.509	0	0	0	0.039	0	0	0	0	0.026	0.394	0	0
1982	111	0	0	0.016	0	0.027	0.009	0	0.117	0	0	0.154	0	0	0	0.035	0	0	0.081	0	0	0.618	0.222	0.055
1983	139	0	0	0.008	0	0.066	0.007	0	0.116	0	0	0.12	0	0	0	0.015	0	0	0.036	0	0	0.158	0	0
1984	88	0	0	0	0	0	0	0	0.061	0	0	0.172	0	0	0	0	0	0	0.037	0	0	0.294	0.074	0.025
1985	47	0	0	0	0.133	0.023	0.082	0	0.021	0	0	0.108	0.203	0.031	0	0.042	0	0	0.087	0	0	0.297	0	0.02

Table 2. Bottom longline counts (number of fish) for snappers and groupers caught off Puerto Rico and the U.S Virgin Islands on fishery independent surveys from 1979 – 1985.

Year	N	Coney (<i>Cephalopholis fulva</i>)	Graysby (<i>Cephalopholis cinctata</i>)	Snowy Grouper (<i>Epinephelus niveatus</i>)	Rock Hind (<i>Epinephelus adscensionis</i>)	Yellowedge Grouper (<i>Epinephelus flavolimbatus</i>)	Red Hind (<i>Epinephelus guttatus</i>)	Red Grouper (<i>Epinephelus morio</i>)	Misty Grouper (<i>Epinephelus mystacinus</i>)	Nassau Grouper (<i>Epinephelus striatus</i>)	Yellowfin Grouper (<i>Mycteroperca venenosa</i>)	Black Snapper (<i>Apsilus dentatus</i>)	Queen Snapper (<i>Etelis oculatus</i>)	Mutton Snapper (<i>Lutjanus analis</i>)	Schoolmaster (<i>Lutjanus apodus</i>)	Blackfin Snapper (<i>Lutjanus buccanella</i>)	Dog Snapper (<i>Lutjanus jocu</i>)	Lane Snapper (<i>Lutjanus synagris</i>)	Silk Snapper (<i>Lutjanus vivanus</i>)	Yellowtail Snapper (<i>Ocyurus chrysurus</i>)	Pristipomoides sp.	Cardinal Snapper (<i>Pristipomoides macrouralis</i>)	Wenchman (<i>Pristipomoides aquilonaris</i>)	Vermillion Snapper (<i>Rhomboplites aurorubens</i>)	
1979	59	0	3	0	0	7	46	1	41	1	0	0	21	8	0	16	5	2	42	3	6	21	45	1	
1980	106	1	0	2	0	9	1	0	25	0	0	0	75	0	1	0	1	0	34	2	0	190	17	5	
1981	13	0	0	0	0	2	0	0	1	0	0	0	13	0	0	0	1	0	0	0	0	10	0	0	
1982	111	0	0	2	0	3	1	0	13	0	0	0	17	0	0	0	4	0	9	0	0	68	24	6	
1983	139	0	0	1	0	9	1	0	16	0	0	0	17	0	0	0	2	0	5	0	0	22	0	0	
1984	88	0	0	0	0	0	0	0	5	0	0	0	14	0	0	0	0	0	3	0	0	25	9	2	
1985	47	0	0	0	0	6	1	4	0	1	0	0	5	8	2	0	2	0	4	0	0	0	13	0	1

Table 3. Off-bottom longline catch rates (number of fish per 100 hook hour) for snappers and groupers caught off Puerto Rico and the U.S Virgin Islands on fishery independent surveys from 1982 – 1985.

Year	N	Graysby (<i>Cephalopholis cinctata</i>)	<i>Epinephelus</i> sp.	Snowy Grouper (<i>Epinephelus niveatus</i>)	Rock Hind (<i>Epinephelus adscensionis</i>)	Yellowedge Grouper (<i>Epinephelus flavolimbatus</i>)	Red Hind (<i>Epinephelus guttatus</i>)	Misty Grouper (<i>Epinephelus mystacinus</i>)	Black Snapper (<i>Apsilus dentatus</i>)	Queen Snapper (<i>Etelis oculatus</i>)	Blackfin Snapper (<i>Lutjanus buccanella</i>)	Silk Snapper (<i>Lutjanus vivanus</i>)	Cardinal Snapper (<i>Pristipomoides macroura</i>)	Wenchman (<i>Pristipomoides aquilonaris</i>)	Vermillion Snapper (<i>Rhomboplites aurorubens</i>)
1982	111	0	0	0.007	0	0.015	0.004	0.026	0	0.03	0.008	0.048	0.19	0.071	0.022
1983	138	0	0	0.004	0	0.021	0	0.044	0	0.032	0.004	0.037	0.077	0.014	0.003
1984	90	0	0	0.006	0	0.022	0	0.039	0.006	0.083	0	0.028	0.139	0.011	0.022
1985	48	0.022	0.01	0	0.098	0	0.021	0.01	0.036	0.096	0.01	0	0.139	0.01	0

Table 4. Off-bottom longline counts (fish per hour) for snappers and groupers caught off Puerto Rico and the U.S Virgin Islands on fishery independent surveys from 1982 – 1985.

Year	N	Graysby (<i>Cephalopholis cinctata</i>)	<i>Epinephelus</i> sp.	Snowy Grouper (<i>Epinephelus niveatus</i>)	Rock Hind (<i>Epinephelus adscensionis</i>)	Yellowedge Grouper (<i>Epinephelus flavolimbatus</i>)	Red Hind (<i>Epinephelus guttatus</i>)	Misty Grouper (<i>Epinephelus mystacinus</i>)	Black Snapper (<i>Apsilus dentatus</i>)	Queen Snapper (<i>Etelis oculatus</i>)	Blackfin Snapper (<i>Lutjanus buccanella</i>)	Silk Snapper (<i>Lutjanus vivanus</i>)	Cardinal Snapper (<i>Pristipomoides macrophthalmus</i>)	Wenchman (<i>Pristipomoides aquillornaris</i>)	Vermillion Snapper (<i>Rhomboplites aurorubens</i>)
1982	111	0	0	2	0	4	1	7	0	8	2	13	51	19	6
1983	138	0	0	1	0	6	0	12	0	9	1	10	21	4	1
1984	90	0	0	1	0	4	0	7	1	15	0	5	25	2	4
1985	48	2	1	0	9	0	2	1	3	9	1	0	13	1	0

Table 5. Handline catch rates (number of fish per hook hour) for snappers and groupers caught off Puerto Rico and the U.S Virgin Islands on fishery independent surveys from 1979 – 1984.

Year	N	Coney (<i>Cephalopholis fulva</i>)	Red Hind (<i>Epinephelus guttatus</i>)	Red Grouper (<i>Epinephelus morio</i>)	Misty Grouper (<i>Epinephelus mystacinus</i>)	Queen Snapper (<i>Etelis oculatus</i>)	Blackfin Snapper (<i>Lutjanus buccanella</i>)	Silk Snapper (<i>Lutjanus vivanus</i>)	Vermilion Snapper (<i>Rhomboplites aurorubens</i>)
1979	29	0	0.017	0.034	0.034	0.008	0.011	0.094	0
1980	22	0.019	0.012	0	0	0	0	0	0.006
1981	1	0	0	0	0	0	0	0	0
1982	4	0.021	0.010	0	0	0	0	0	0
1983	0								
1984	1	0	0	0	0	0	0	0	0

Table 6. Handline counts (number of fish) for snappers and groupers caught off Puerto Rico and the U.S Virgin Islands on fishery independent surveys from 1979 – 1984.

Year	N	Coney (<i>Cephalopholis fulva</i>)	Red Hind (<i>Epinephelus guttatus</i>)	Red Grouper (<i>Epinephelus morio</i>)	Misty Grouper (<i>Epinephelus mystacinus</i>)	Queen Snapper (<i>Etelis oculatus</i>)	Blackfin Snapper (<i>Lutjanus buccanella</i>)	Silk Snapper (<i>Lutjanus vivanus</i>)	Vermilion Snapper (<i>Rhomboplites aurorubens</i>)
1979	29	0	3	1	1	1	1	11	0
1980	22	2	3	0	0	0	0	0	1
1981	1	0	0	0	0	0	0	0	0
1982	4	2	1	0	0	0	0	0	0
1983	0								
1984	1	0	0	0	0	0	0	0	0

Table 7. Fish trap catch rates (number of fish per trap) for snappers and groupers caught off Puerto Rico and the U.S Virgin Islands on fishery independent surveys from 1979 – 1985.

Year	N	Graysby (<i>Cephalopholis cinctata</i>)	Rock Hind (<i>Epinephelus adscensionis</i>)	Red Hind (<i>Epinephelus guttatus</i>)	Red Grouper (<i>Epinephelus morio</i>)	Misty Grouper (<i>Epinephelus mystacinus</i>)	Nassau Grouper (<i>Epinephelus striatus</i>)	Yellowfin Grouper (<i>Mycteroperca venenosa</i>)	Mutton Snapper (<i>Lutjanus analis</i>)	Blackfin Snapper (<i>Lutjanus buccanella</i>)	Lane Snapper (<i>Lutjanus synagris</i>)	Silk Snapper (<i>Lutjanus vivanus</i>)	Mahogany Snapper (<i>Lutjanus mahagoni</i>)	Cardinal Snapper (<i>Pristipomoides macroura</i>)	Wenchman (<i>Pristipomoides aquilonaris</i>)	Vermillion Snapper (<i>Rhomboplites aurorubens</i>)
1979	4	0.500	0	0.500	0.500	0	0.750	0	0.250	1.500	1.250	0.250	0	0	0	0.250
1980	11	0	0	0.636	0.182	0.091	0	0	0	4.727	0	9.091	0	0	0	2.545
1981	1	6	0	8.000	0	0	0	0	0	2.000	0	0	0	0	0	0
1982	17	0	0	0	0	0	0.059	0.059	0	0.706	0	3.059	0	0	0	2.706
1983	11	0	0	0	0	0	0	0	0	0.545	0	0.727	0.091	0	0	0
1984	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	51	0	0.059	0	0	0.020	0	0	0	0.059	0	0.882	0	0.529	0.020	1.078

Table 8. Fish trap counts (number of fish) for snappers and groupers caught off Puerto Rico and the U.S Virgin Islands on fishery independent surveys from 1979 – 1985.

Year	N	Graysby (<i>Cephalopholis cinctata</i>)	Rock Hind (<i>Epinephelus adscensionis</i>)	Red Hind (<i>Epinephelus guttatus</i>)	Red Grouper (<i>Epinephelus morio</i>)	Misty Grouper (<i>Epinephelus mystacinus</i>)	Nassau Grouper (<i>Epinephelus striatus</i>)	Yellowfin Grouper (<i>Mycteroperca venenosa</i>)	Mutton Snapper (<i>Lutjanus analis</i>)	Blackfin Snapper (<i>Lutjanus buccanella</i>)	Lane Snapper (<i>Lutjanus synagris</i>)	Silk Snapper (<i>Lutjanus vivanus</i>)	Mahogany Snapper (<i>Lutjanus mahagoni</i>)	Cardinal Snapper (<i>Pristipomoides macroura/mus</i>)	Wenchman (<i>Pristipomoides aquilonaris</i>)	Vermillion Snapper (<i>Rhomboplites aurorubens</i>)
1979	4	2	0	2	2	0	3	0	1	6	5	1	0	0	0	1
1980	11	0	0	7	2	1	0	0	0	52	0	100	0	0	0	28
1981	1	6	0	8	0	0	0	0	0	2	0	0	0	0	0	0
1982	17	0	0	0	0	0	1	1	0	12	0	52	0	0	0	46
1983	11	0	0	0	0	0	0	0	0	6	0	8	1	0	0	0
1984	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	51	0	3	0	0	1	0	0	0	3	0	45	0	27	1	55

Table 9. Bottom longline catch rates (number of fish per 100 hook hour) for snappers and groupers caught off Puerto Rico and the U.S Virgin Islands on a fishery independent survey in 2009.

Year	N	Red Hind (<i>Epinephelus guttatus</i>)	Red Grouper (<i>Epinephelus morio</i>)	Mutton Snapper (<i>Lutjanus analis</i>)	Blackfin Snapper (<i>Lutjanus buccanella</i>)	Dog Snapper (<i>Lutjanus jocu</i>)	Lane Snapper (<i>Lutjanus synagris</i>)	Silk Snapper (<i>Lutjanus vivanus</i>)
2009	55	0.023	0.015	0.042	0.050	0.048	0.026	0.025

Table 10. Bottom longline count (number of fish) for snappers and groupers caught off Puerto Rico and the U.S Virgin Islands on a fishery independent survey in 2009.

Year	N	Red Hind (<i>Epinephelus guttatus</i>)	Red Grouper (<i>Epinephelus morio</i>)	Mutton Snapper (<i>Lutjanus analis</i>)	Blackfin Snapper (<i>Lutjanus buccanella</i>)	Dog Snapper (<i>Lutjanus jocu</i>)	Lane Snapper (<i>Lutjanus synagris</i>)	Silk Snapper (<i>Lutjanus vivanus</i>)
2009	55	2	1	3	4	4	2	2

Table 11. Fish trap catch rate (number of fish per trap) for snappers and groupers caught off Puerto Rico and the U.S Virgin Islands on a fishery independent survey in 2009.

Year	N	Coney (<i>Cephalopholis fulva</i>)	Red Hind (<i>Epinephelus guttatus</i>)	Blackfin Snapper (<i>Lutjanus buccanella</i>)	Lane Snapper (<i>Lutjanus synagris</i>)	Creolefish (<i>Paranthias furcifer</i>)	Vermillion Snapper (<i>Rhomboptilus aurorubens</i>)
2009	57	0.650	0.250	5.450	3.850	0.050	0.100

Table 12. Fish trap catch rate (number of fish per trap hour) for snappers and groupers caught off Puerto Rico and the U.S Virgin Islands on a fishery independent survey in 2009.

Year	N	Coney (<i>Cephalopholis fulva</i>)	Red Hind (<i>Epinephelus guttatus</i>)	Blackfin Snapper (<i>Lutjanus buccanella</i>)	Lane Snapper (<i>Lutjanus synagris</i>)	Creolefish (<i>Paranthias furcifer</i>)	Vermillion Snapper (<i>Rhomboplites aurorubens</i>)
2009	57	0.638	0.249	5.264	3.696	0.043	0.099

Table 13. Fish trap count (number of fish) for snappers and groupers caught off Puerto Rico and the U.S Virgin Islands on a fishery independent survey in 2009.

Year	N	Coney (<i>Cephalopholis fulva</i>)	Red Hind (<i>Epinephelus guttatus</i>)	Blackfin Snapper (<i>Lutjanus buccanella</i>)	Lane Snapper (<i>Lutjanus synagris</i>)	Creolefish (<i>Paranthias furcifer</i>)	Vermillion Snapper (<i>Rhomboplites aurorubens</i>)
2009	57	13	5	109	77	1	2

Table 14. Size distribution of snappers and groupers caught on bottom longlines off Puerto Rico and the U.S Virgin Islands on fishery independent surveys from 1979 – 1985.

Common Name	Scientific Name	N	Mean Size	Minimum Size	Maximum Size	Length Measurement
Coney	<i>Cephalopholis fulva</i>	2	247	235	258	Total
Snowy Grouper	<i>Epinephelus niveatus</i>	2	414	387	440	Total
Yellowedge Grouper	<i>Epinephelus flavolimbatus</i>	14	918	727	1070	Total
Red Hind	<i>Epinephelus guttatus</i>	46	361	267	478	Total
Red Grouper	<i>Epinephelus morio</i>	1	645	645	645	Total
Misty Grouper	<i>Epinephelus mystacinus</i>	60	880	297	2230	Total
Nassau Grouper	<i>Epinephelus striatus</i>	1	806	806	806	Total
Yellowfin Grouper	<i>Mycteroperca venenosa</i>	1	997	997	997	Fork
Queen Snapper	<i>Etelis oculatus</i>	85	604	324	865	Fork
Mutton Snapper	<i>Lutjanus analis</i>	3	588	580	600	Fork
Schoolmaster	<i>Lutjanus apodus</i>	1	384	384	384	Fork
Blackfin Snapper	<i>Lutjanus buccanella</i>	17	410	275	550	Fork
Dog Snapper	<i>Lutjanus jocu</i>	4	679	574	775	Fork
Lane Snapper	<i>Lutjanus synagris</i>	2	304	251	356	Fork
Silk Snapper	<i>Lutjanus vivanus</i>	70	472	278	730	Fork
Yellowtail Snapper	<i>Ocyurus chrysurus</i>	5	325	212	390	Fork
Cardinal Snapper	<i>Pristipomoides macrophthalmus</i>	195	278	167	512	Fork
Wenchman	<i>Pristipomoides aquilonaris</i>	46	365	186	557	Fork
Vermillion Snapper	<i>Rhomboplites aurorubens</i>	6	385	256	484	Fork

Table 15. Size distribution of snappers and groupers caught on handlines off Puerto Rico and the U.S Virgin Islands on fishery independent surveys from 1979 – 1984.

Common Name	Scientific Name	N	Mean Size	Minimum Size	Maximum Size	Length Measurement
Coney	<i>Cephalopholis fulva</i>	2	245	225	264	Total
Red Hind	<i>Epinephelus guttatus</i>	4	395	372	435	Total
Queen Snapper	<i>Etelis oculatus</i>	1	560	560	560	Fork
Silk Snapper	<i>Lutjanus vivanus</i>	5	363	220	512	Fork
Vermillion Snapper	<i>Rhomboplites aurorubens</i>	2	289	213	365	Fork

Table 16. Size distribution of snappers and groupers caught in fish traps off Puerto Rico and the U.S Virgin Islands on fishery independent surveys from 1979 – 1985.

Common Name	Scientific Name	N	Mean Size	Minimum Size	Maximum Size	Length Measurement
Coney	<i>Cephalopholis fulva</i>	2	248	225	270	Total
Red Hind	<i>Epinephelus guttatus</i>	7	366	225	434	Total
Red Grouper	<i>Epinephelus morio</i>	3	676	650	708	Total
Misty Grouper	<i>Epinephelus mystacinus</i>	1	860	860	860	Total
Nassau Grouper	<i>Epinephelus striatus</i>	1	725	725	725	Total
Blackfin Snapper	<i>Lutjanus buccanella</i>	18	285	181	395	Fork
Lane Snapper	<i>Lutjanus synagris</i>	5	228	214	238	Fork
Silk Snapper	<i>Lutjanus vivanus</i>	79	253	168	498	Fork
Vermillion Snapper	<i>Rhomboplites aurorubens</i>	29	232	177	291	Fork

Table 17. Size distribution of snappers and groupers caught on bottom longlines off Puerto Rico and the U.S Virgin Islands on a fishery independent survey in 2009.

Common Name	Scientific Name	N	Mean Size	Minimum Size	Maximum Size	Length Measurement
Red Hind	<i>Epinephelus guttatus</i>	2	411	355	466	Total
Red Grouper	<i>Epinephelus morio</i>	1	737	737	737	Fork
Mutton Snapper	<i>Lutjanus analis</i>	3	596	550	654	Fork
Blackfin Snapper	<i>Lutjanus buccanella</i>	4	420	311	492	Fork
Dog Snapper	<i>Lutjanus jocu</i>	4	650	595	687	Fork
Lane Snapper	<i>Lutjanus synagris</i>	2	392	259	524	Fork
Silk Snapper	<i>Lutjanus vivanus</i>	2	532	363	700	Fork

Table 18. Size distribution of snappers and groupers caught in fish traps off Puerto Rico and the U.S Virgin Islands on a fishery independent survey in 2009.

Common Name	Scientific Name	N	Mean Size	Minimum Size	Maximum Size	Length Measurement
Coney	<i>Cephalopholis fulva</i>	13	261	232	287	Total
Red Hind	<i>Epinephelus guttatus</i>	5	317	288	367	Total
Blackfin Snapper	<i>Lutjanus buccanella</i>	109	235	177	305	Fork
Lane Snapper	<i>Lutjanus synagris</i>	77	267	163	354	Fork
Creolefish	<i>Paranthias furcifer</i>	1	219	219	219	Fork
Vermillion Snapper	<i>Rhomboplites aurorubens</i>	2	201	200	202	Fork

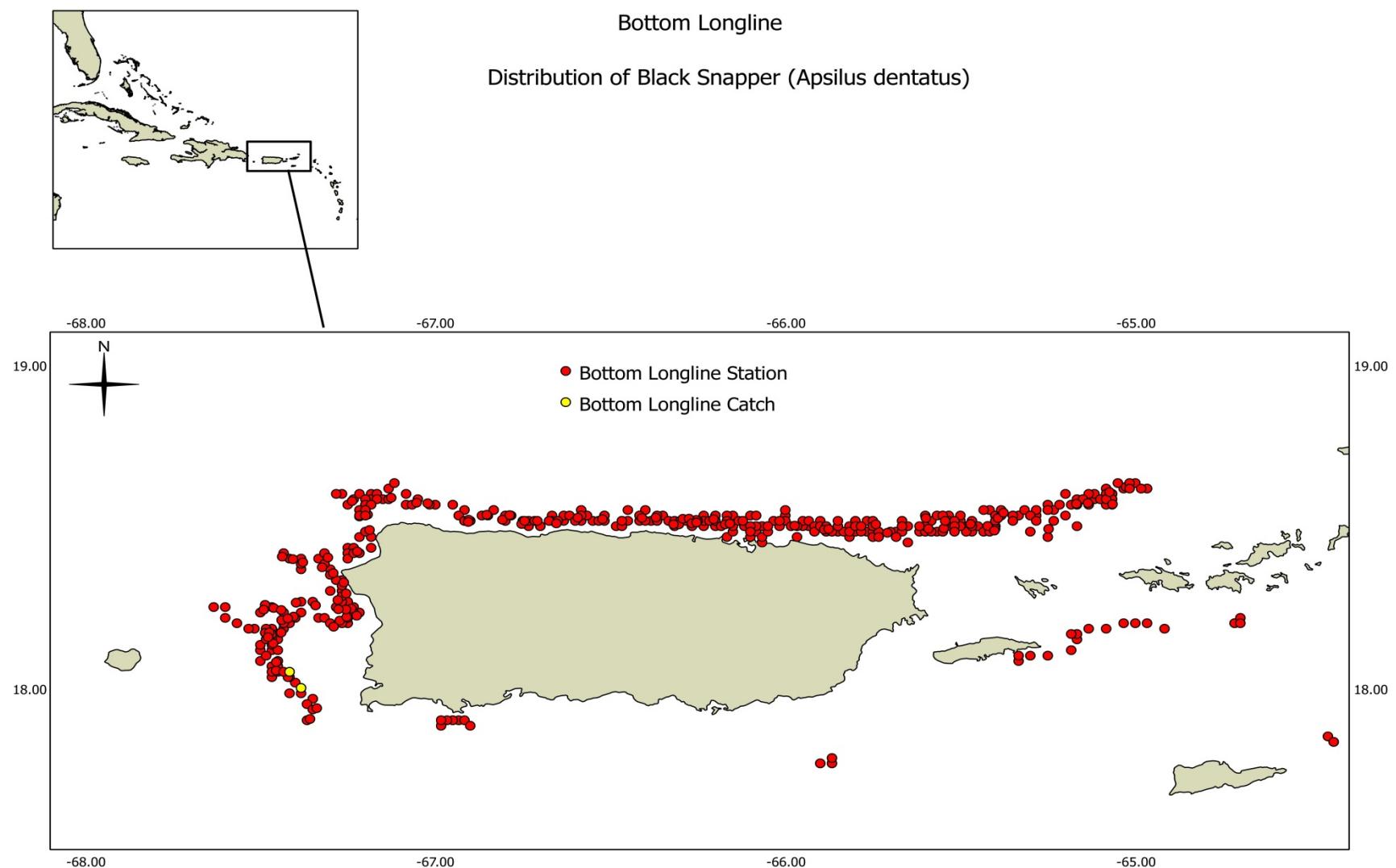


Figure 1. Distribution of black snapper (*Apsilus dentatus*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

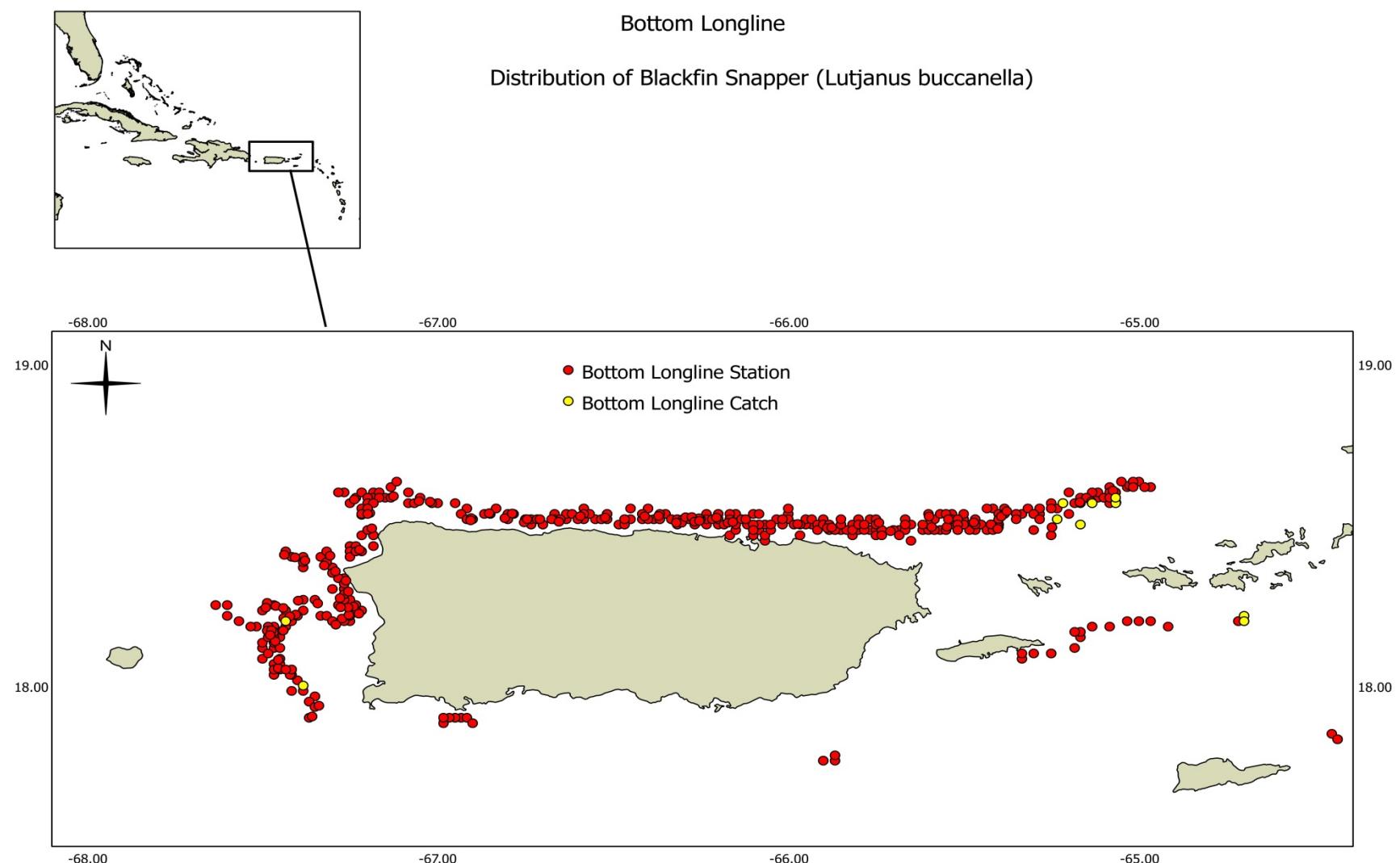


Figure 2. Distribution of blackfin snapper (*Lutjanus buccanella*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

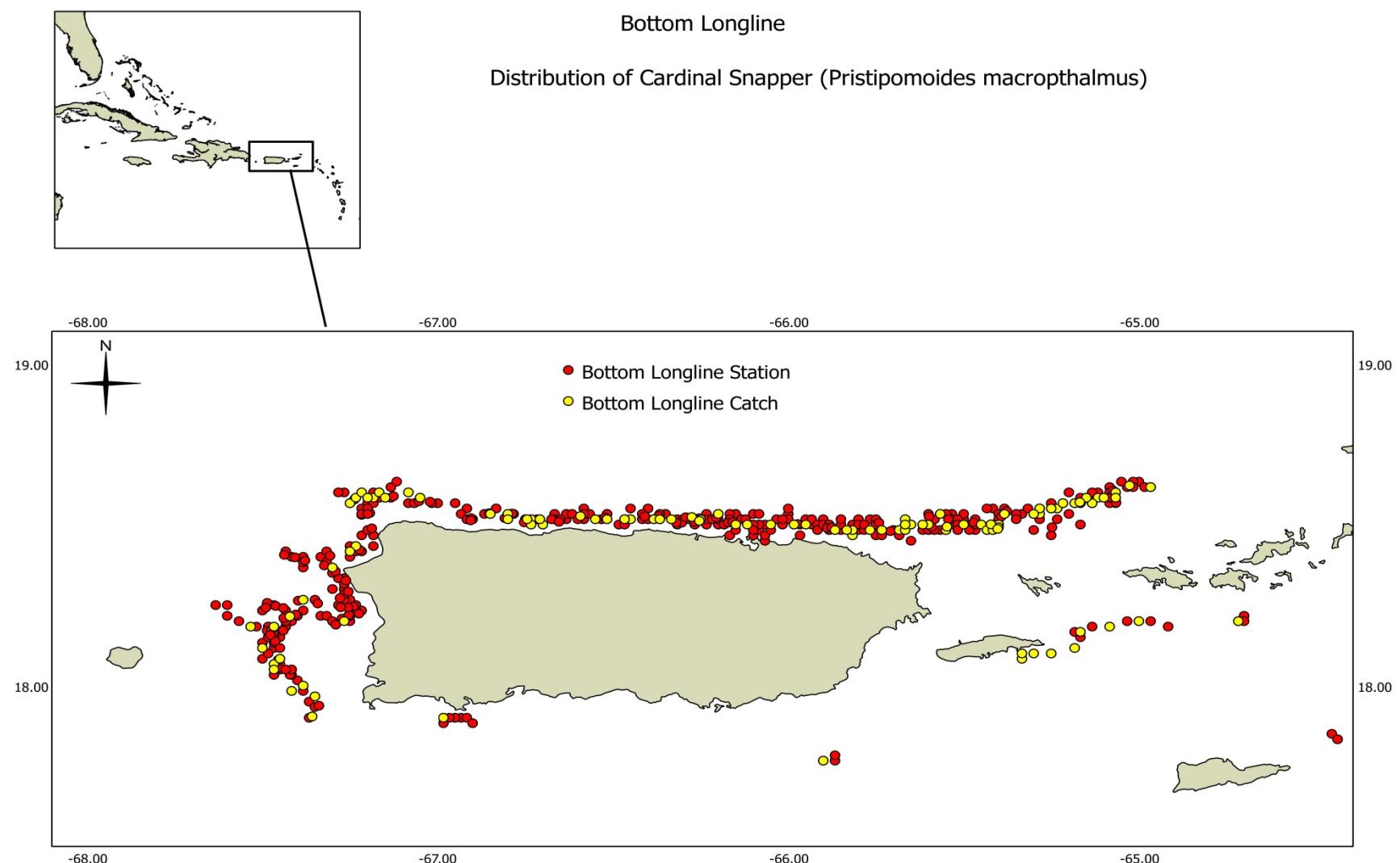


Figure 3. Distribution of cardinal snapper (*Pristipomoides macrophthalmus*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

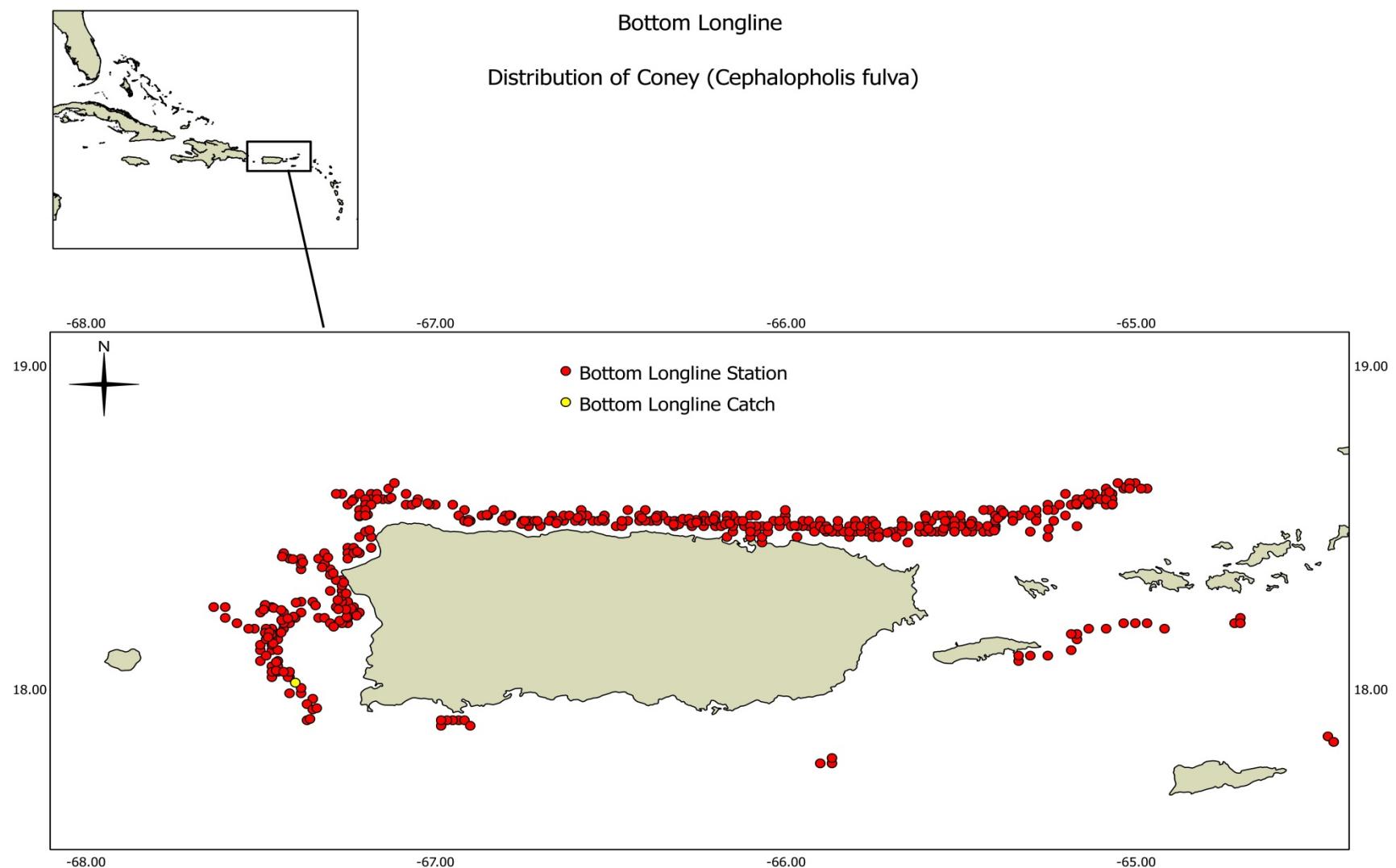


Figure 4. Distribution of coney (*Cephalopholis fulva*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

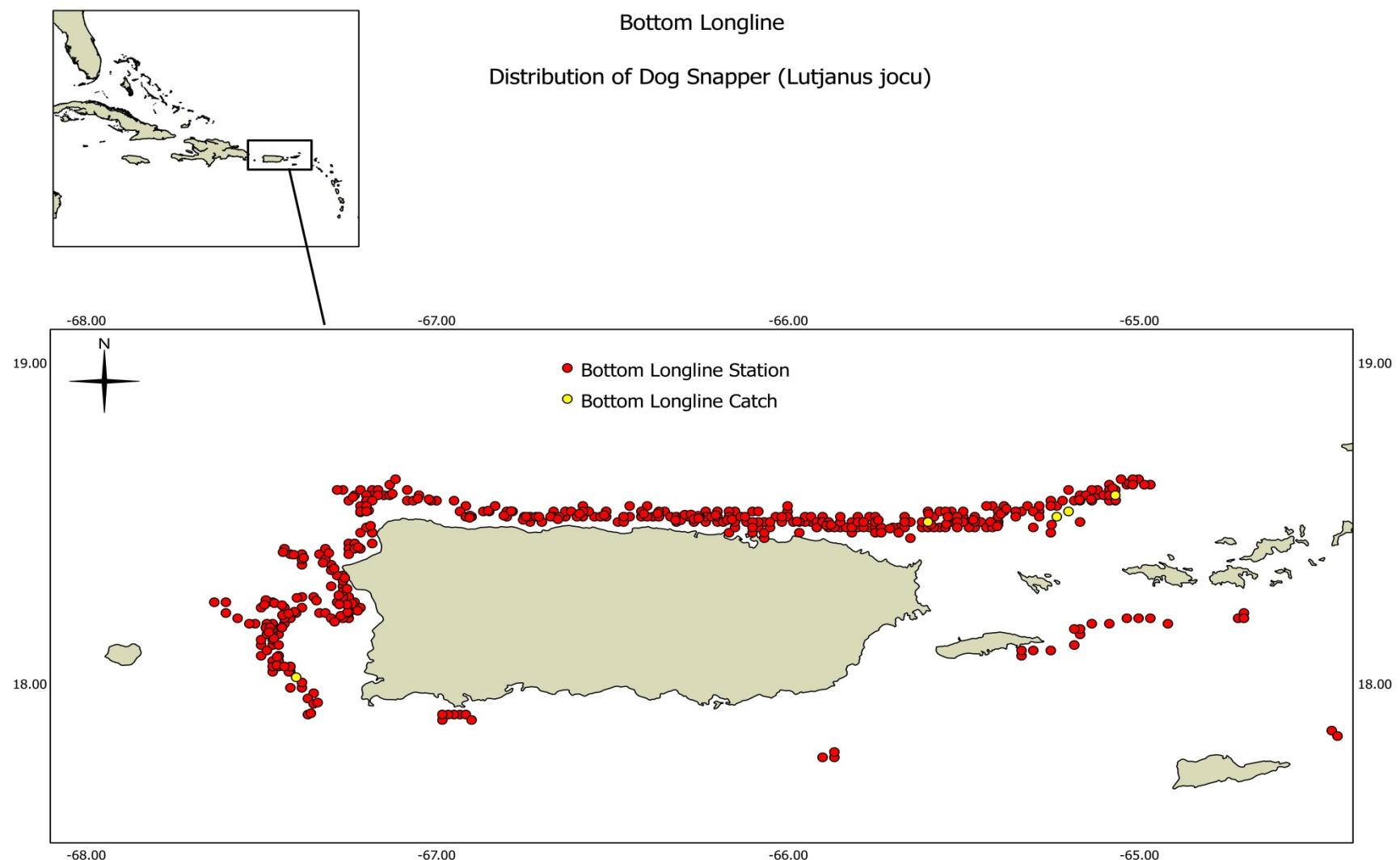


Figure 5. Distribution of dog snapper (*Lutjanus jocu*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

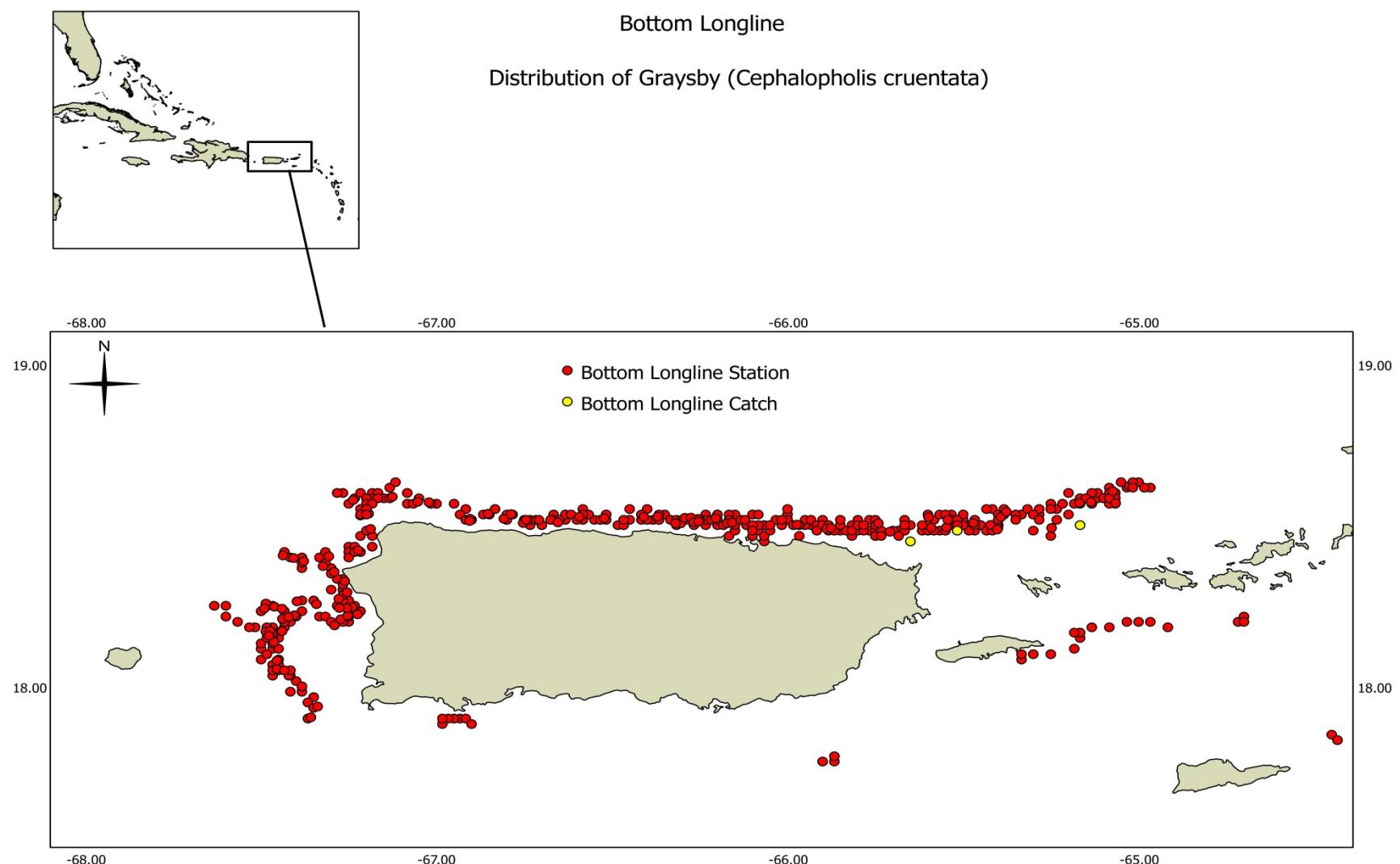


Figure 6. Distribution of graysby (*Cephalopholis cruentata*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

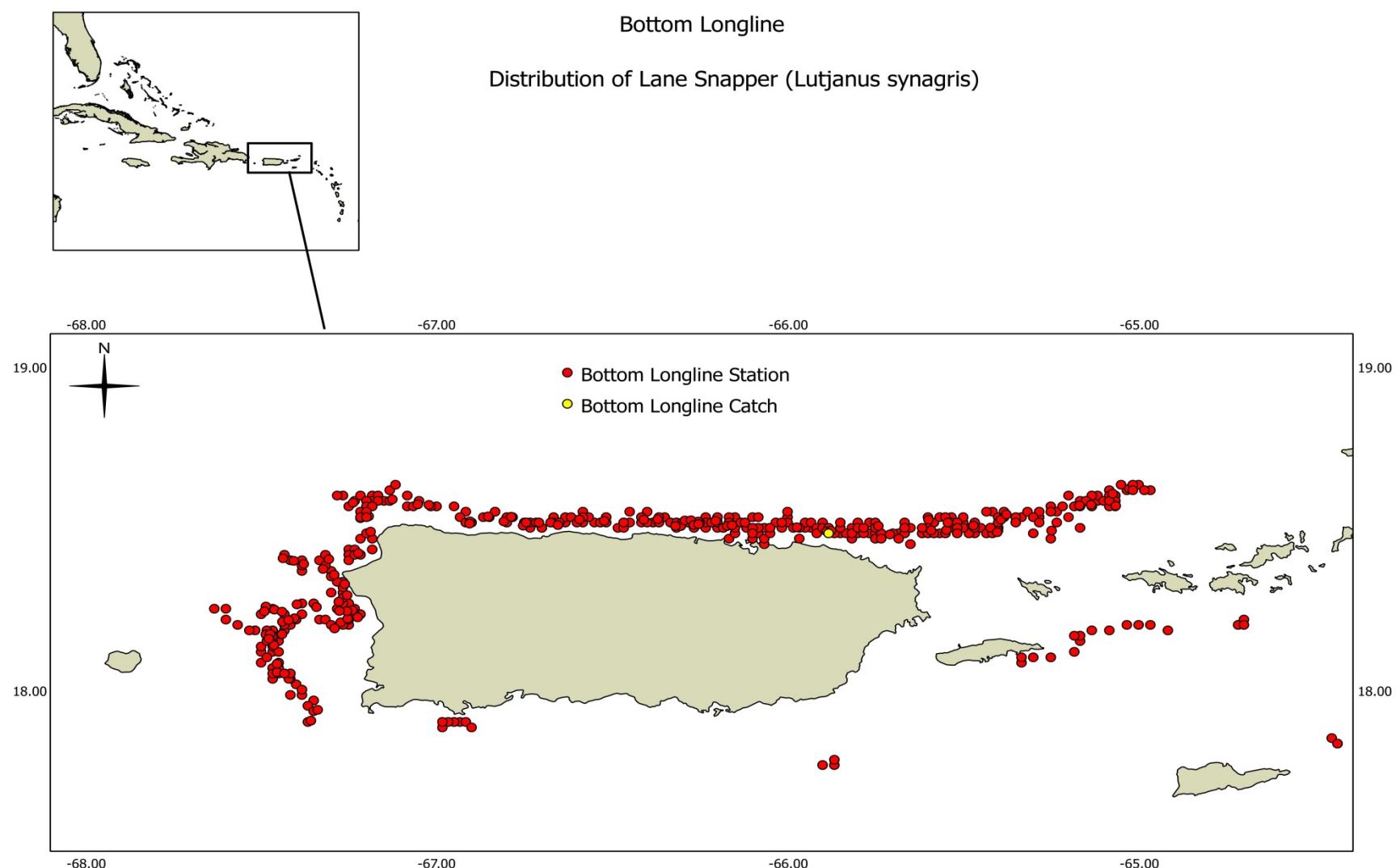


Figure 7. Distribution of lane snapper (*Lutjanus synagris*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

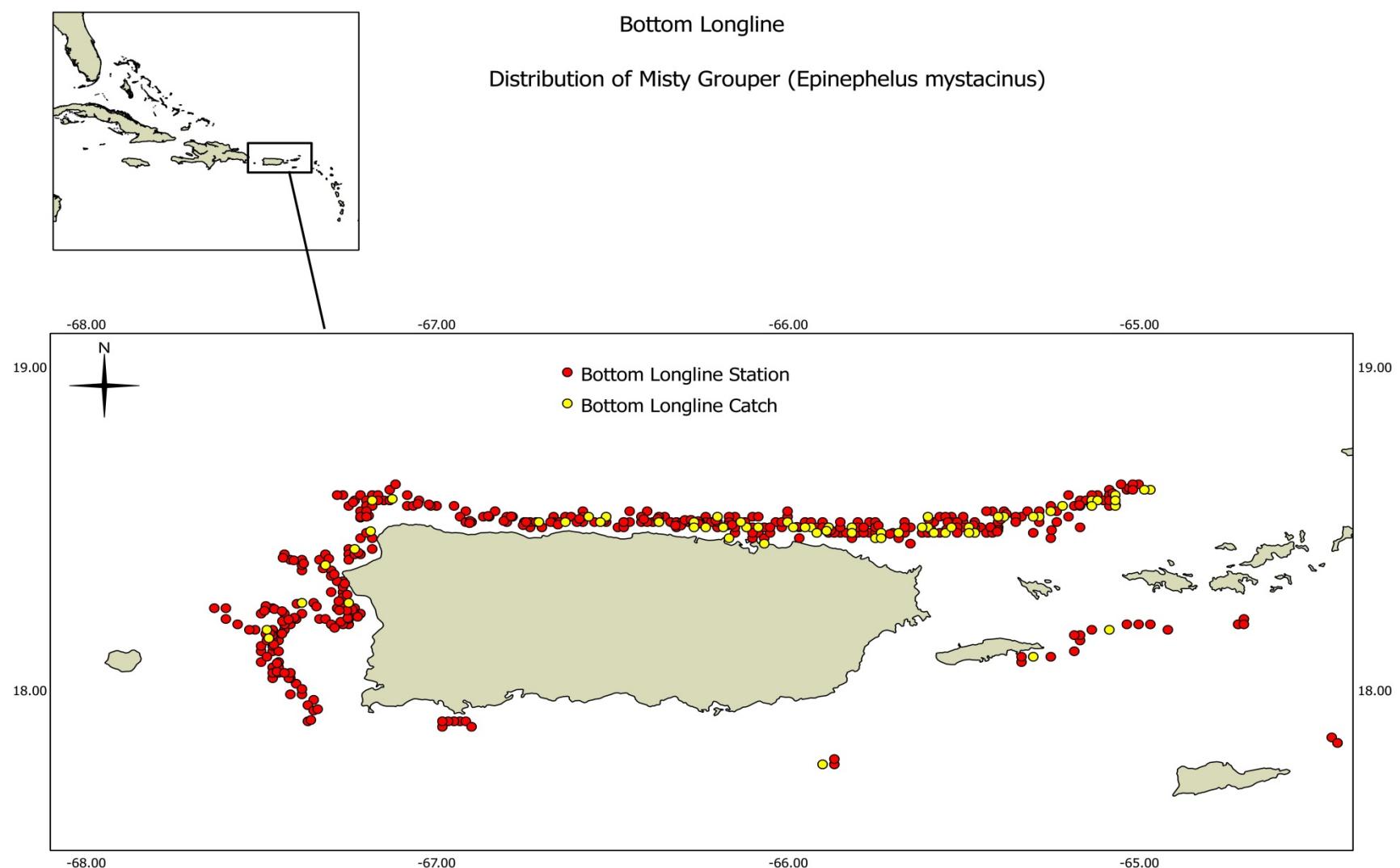


Figure 8. Distribution of misty grouper (*Epinephelus mystacinus*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

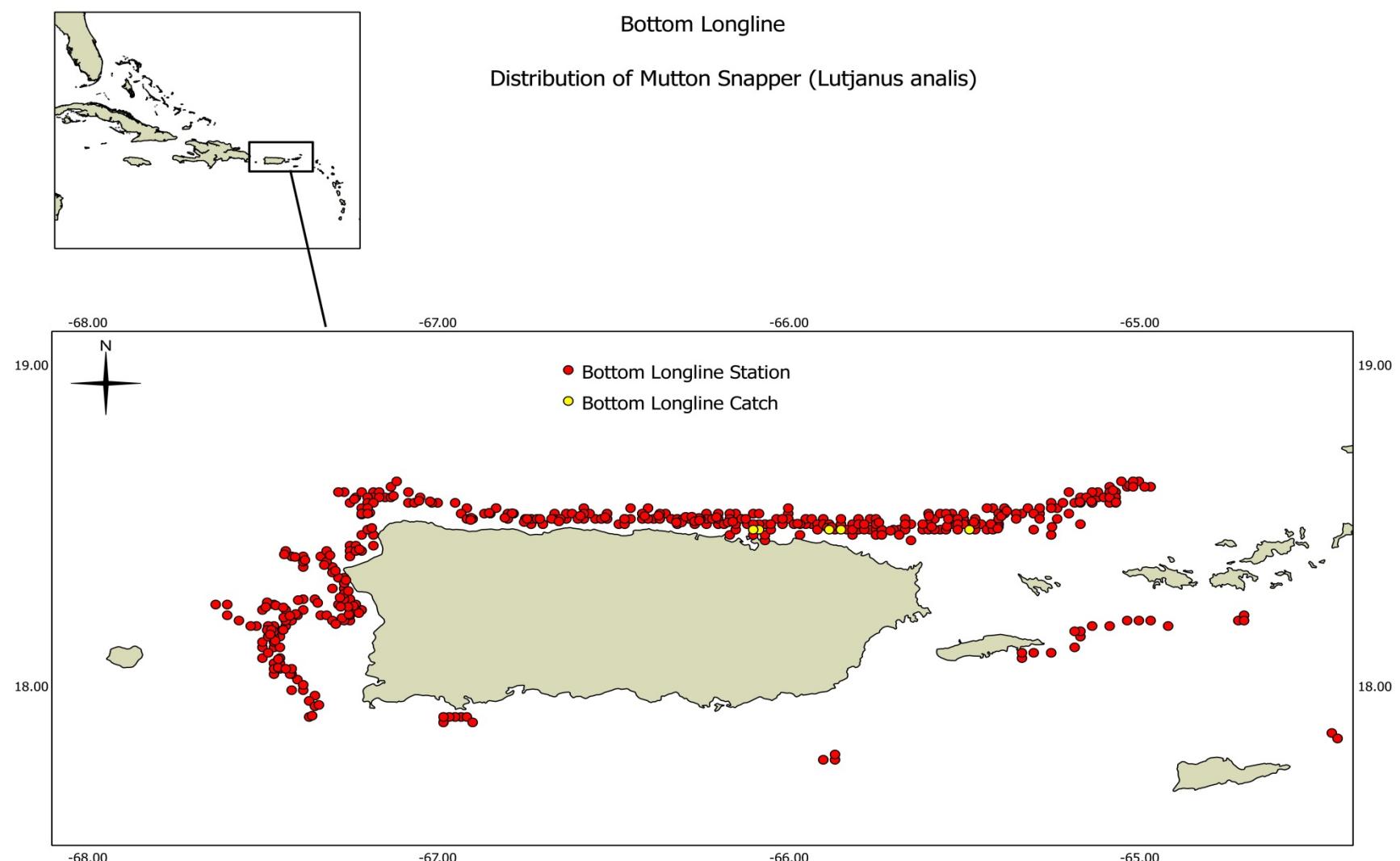


Figure 9. Distribution of mutton snapper (*Lutjanus analis*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

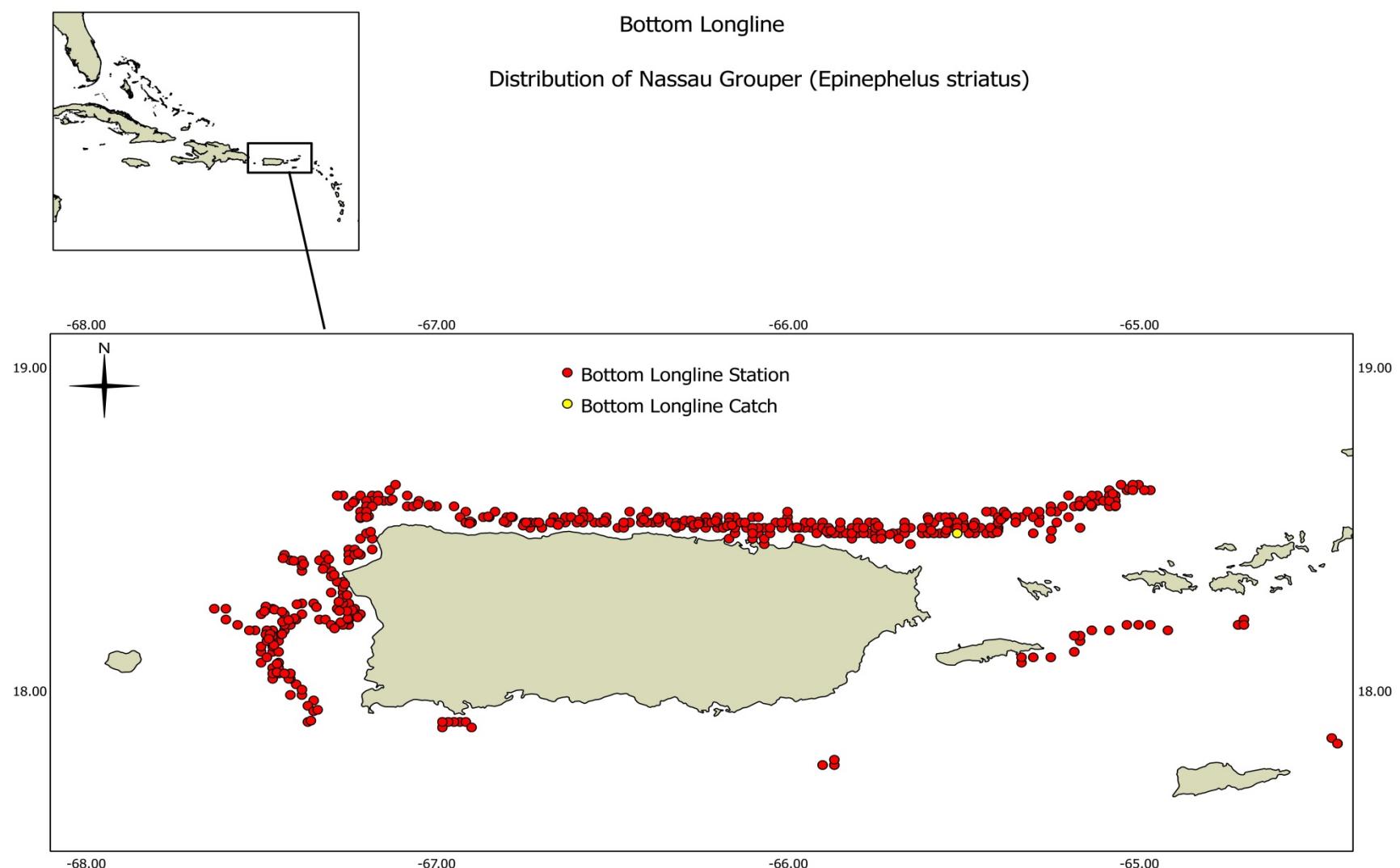


Figure 10. Distribution of Nassau grouper (*Epinephelus striatus*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

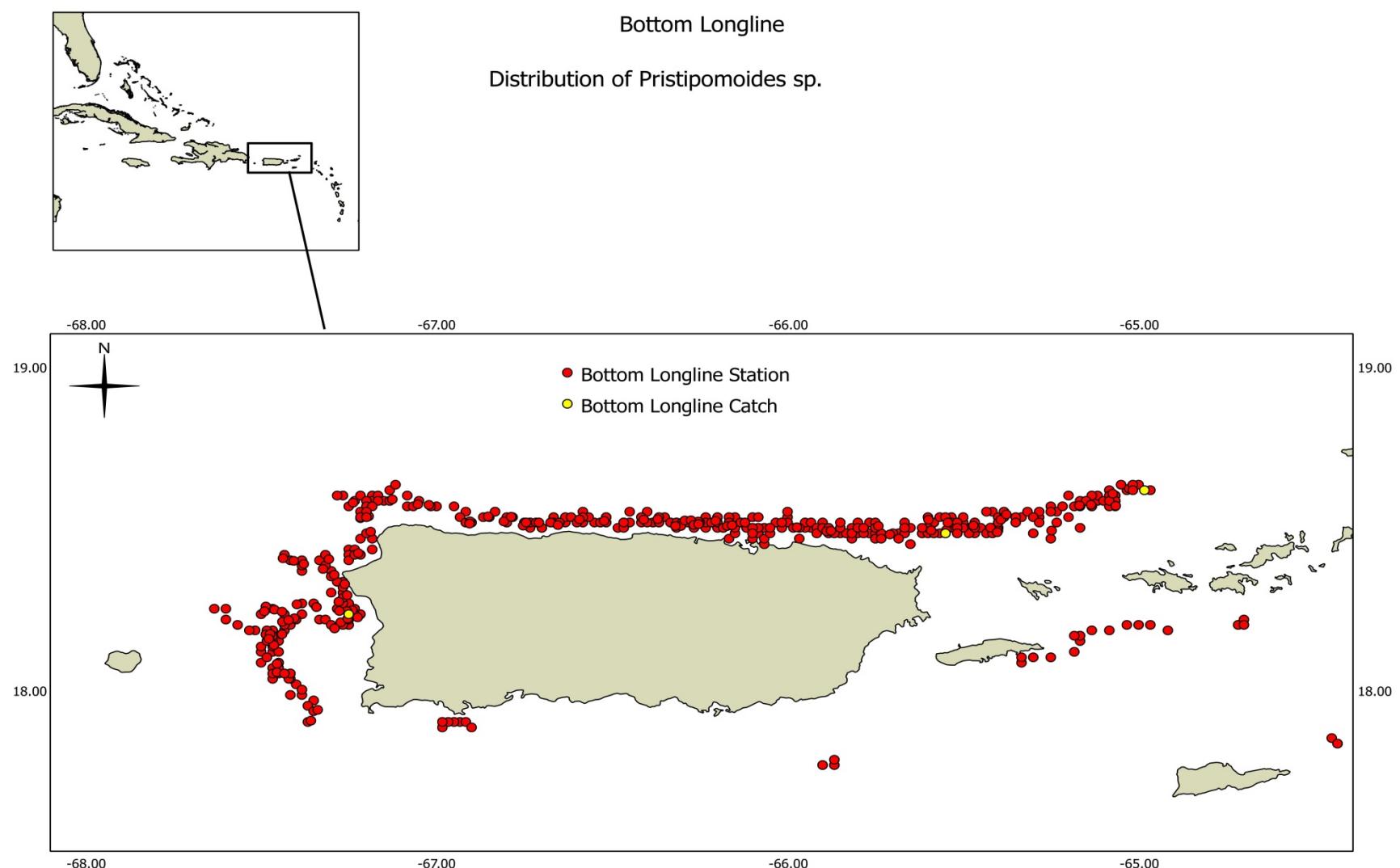


Figure 11. Distribution of *Pristipomoides* sp. captured on bottom longlines during fishery independent surveys from 1979 - 1985.

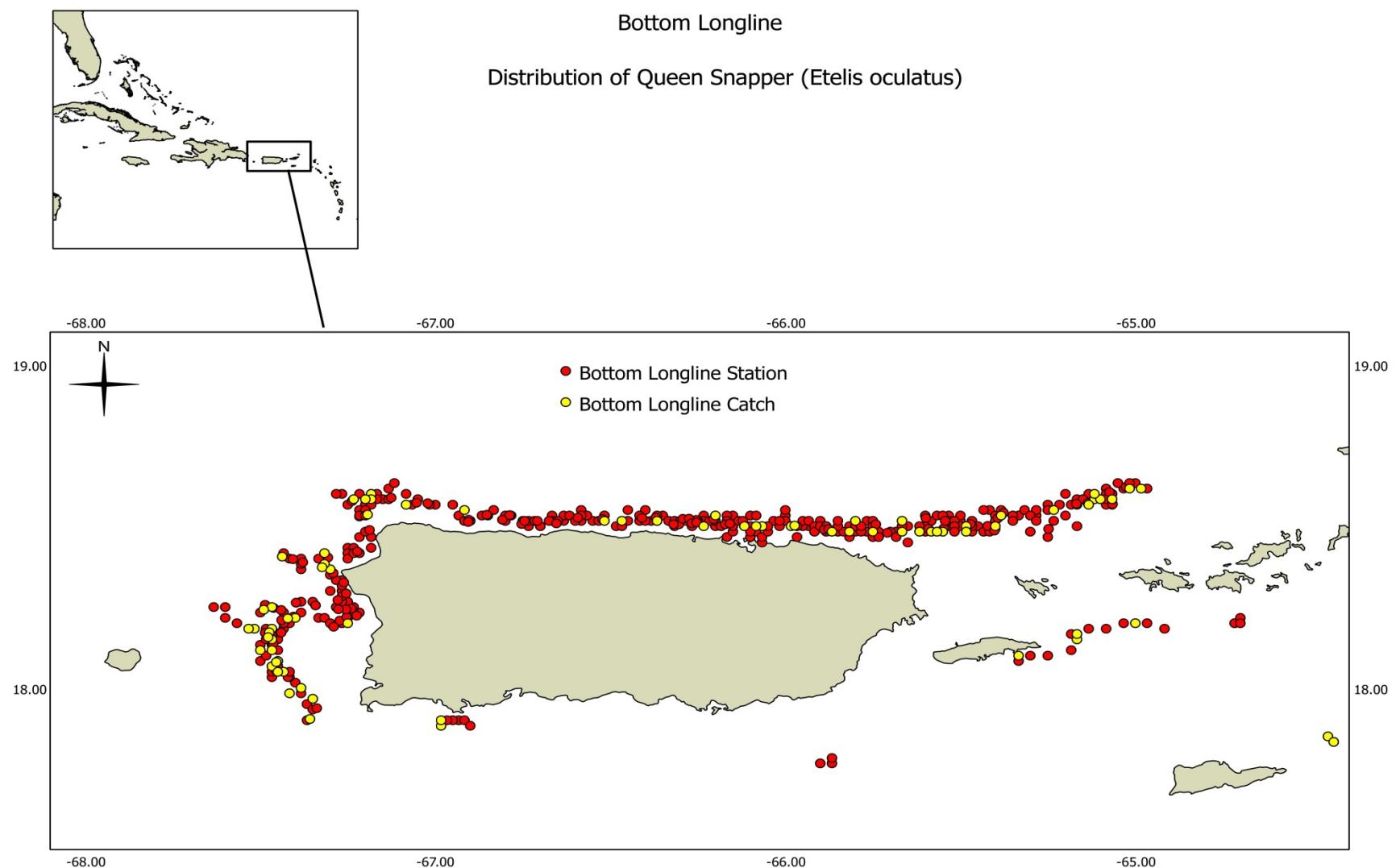


Figure 12. Distribution of queen snapper (*Etelis oculatus*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

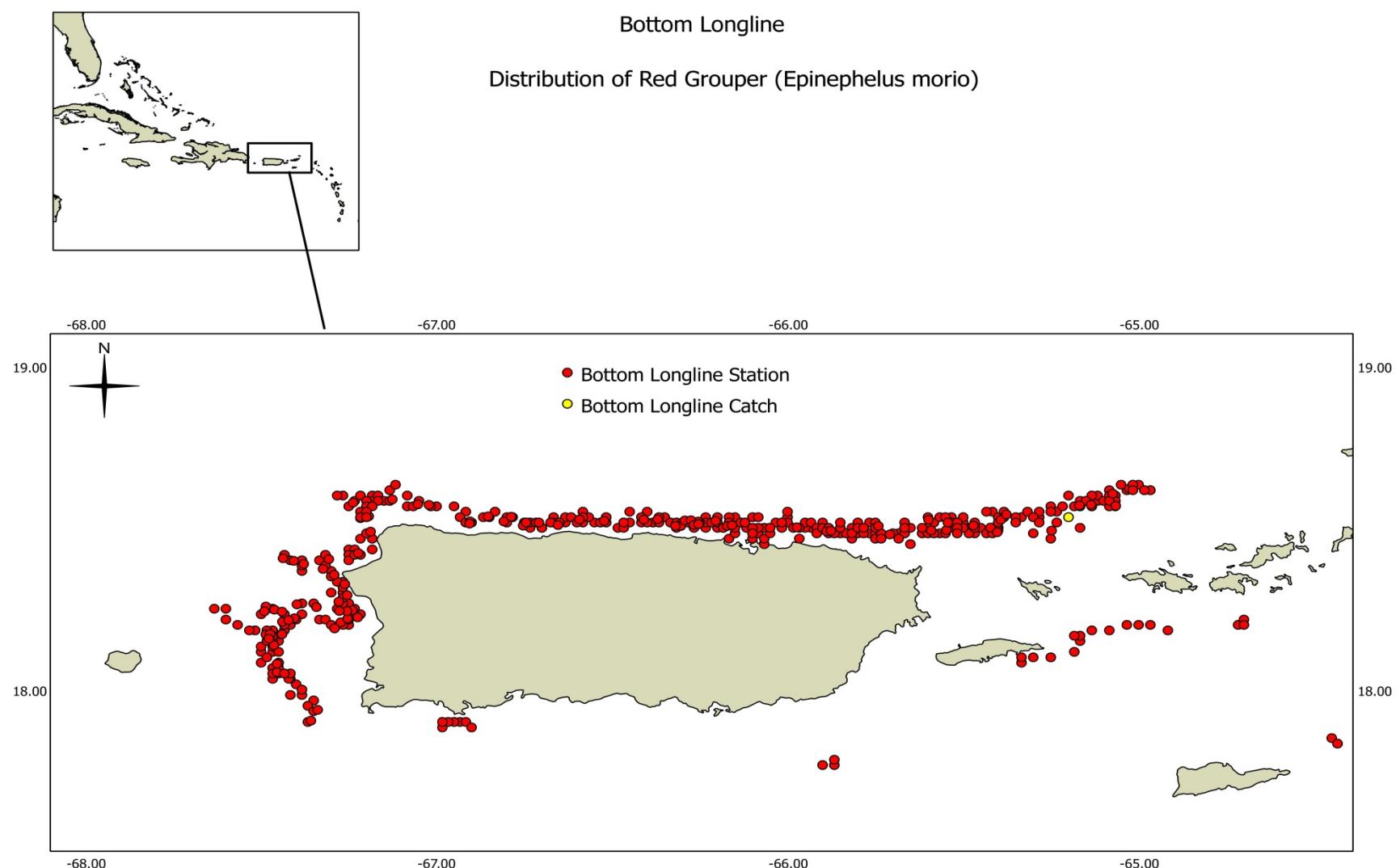


Figure 13. Distribution of red grouper (*Epinephelus morio*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

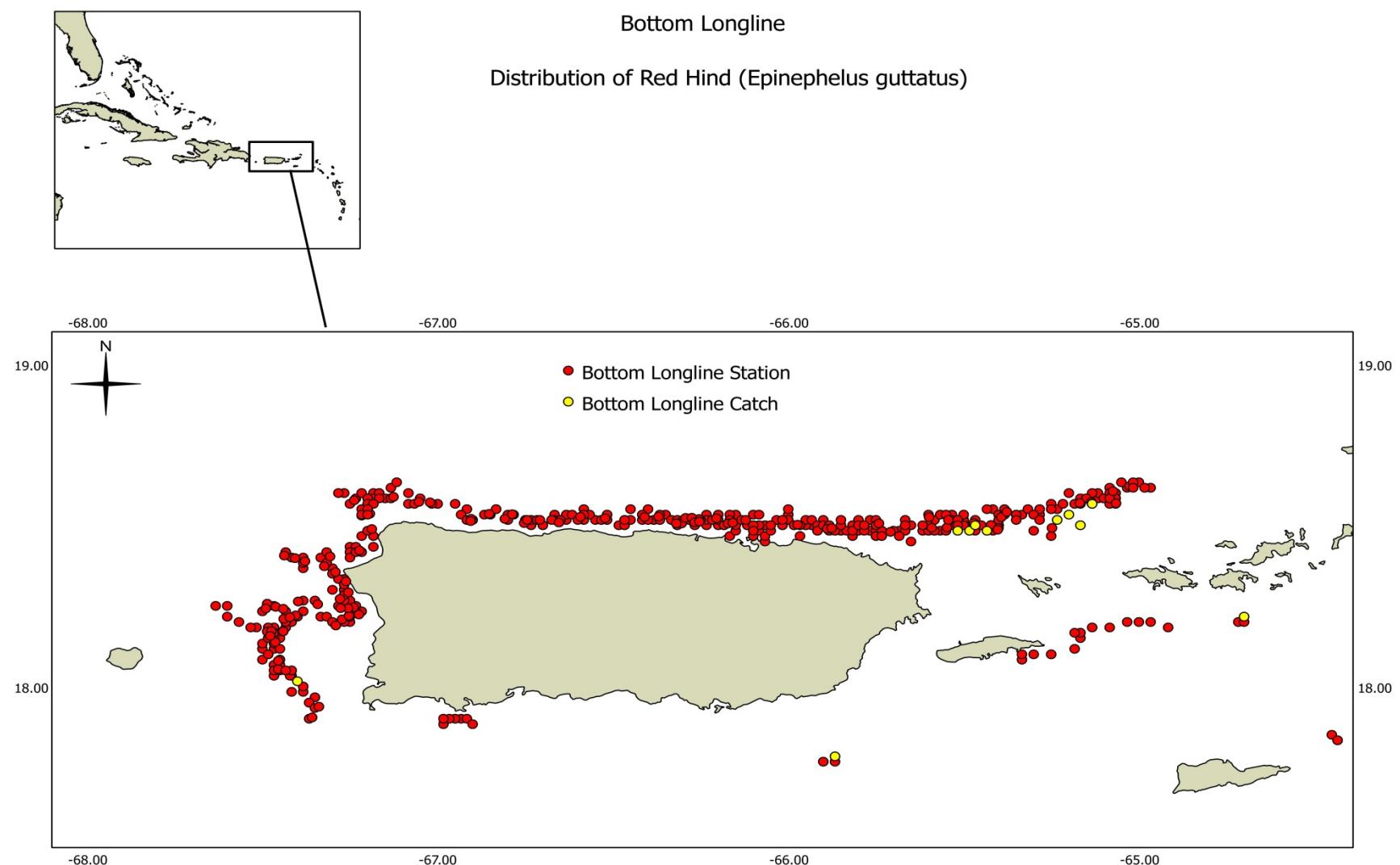


Figure 14. Distribution of red hind (*Epinephelus guttatus*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

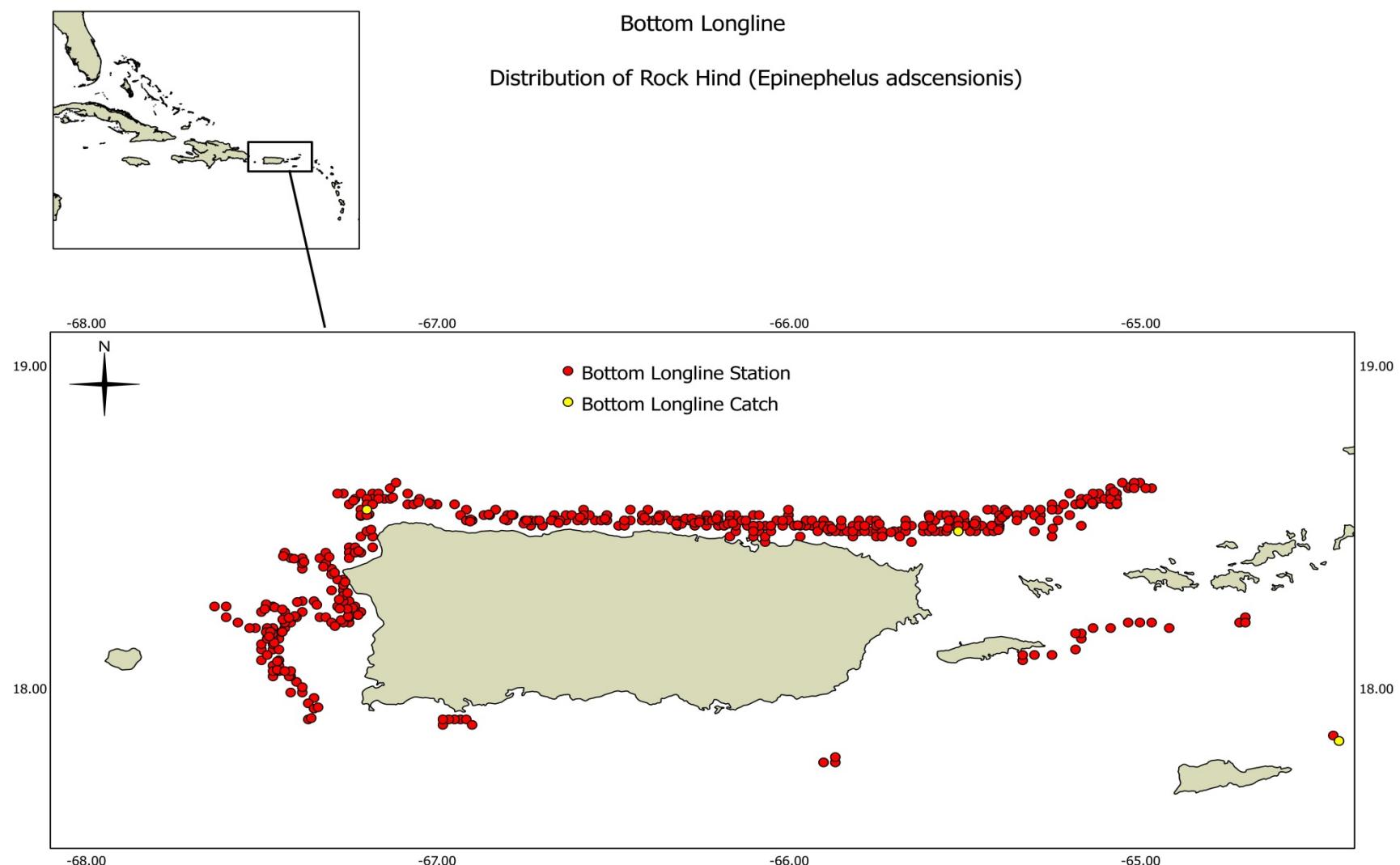


Figure 15. Distribution of rock hind (*Epinephelus adscensionis*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

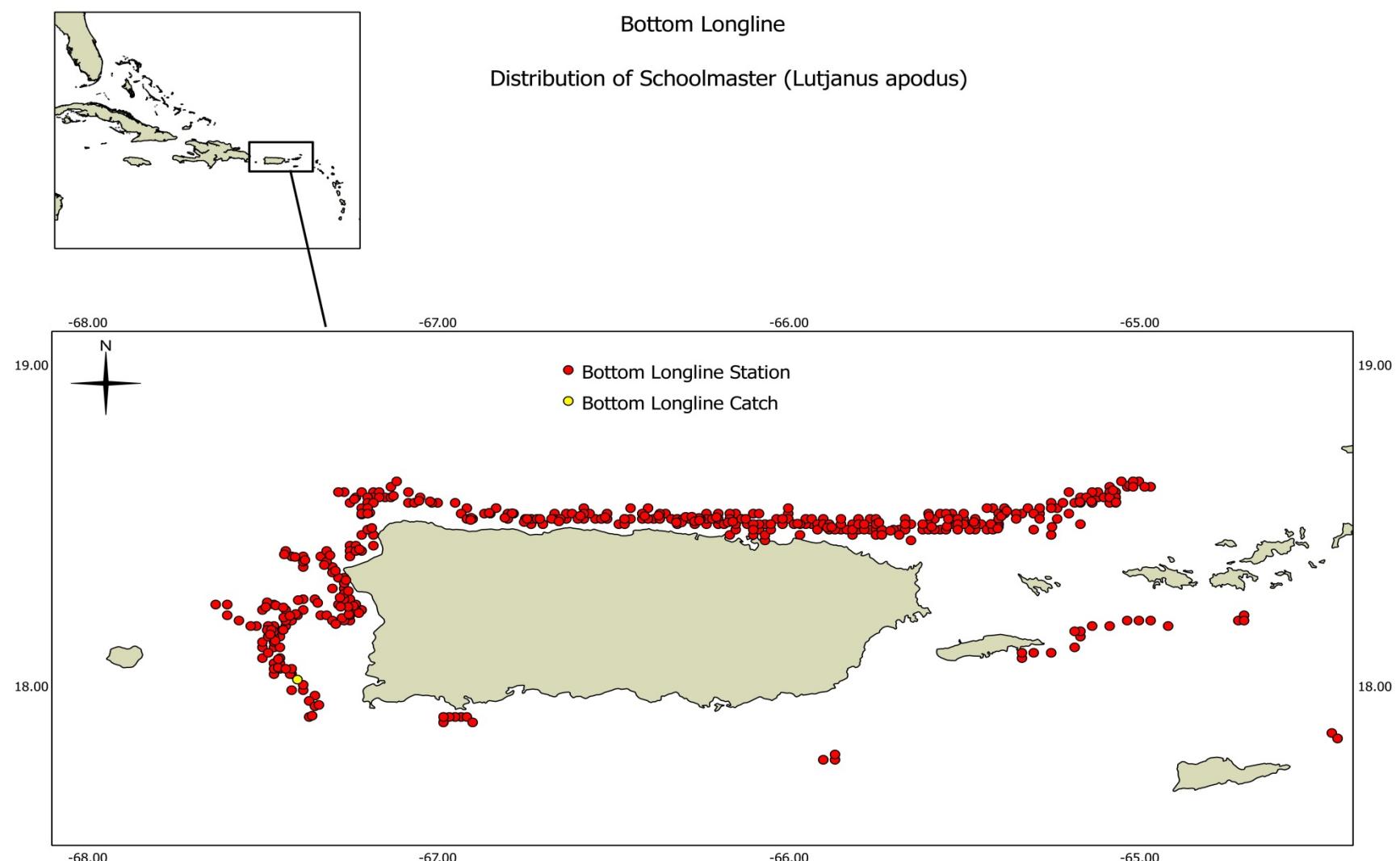


Figure 16. Distribution of schoolmaster (*Lutjanus apodus*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

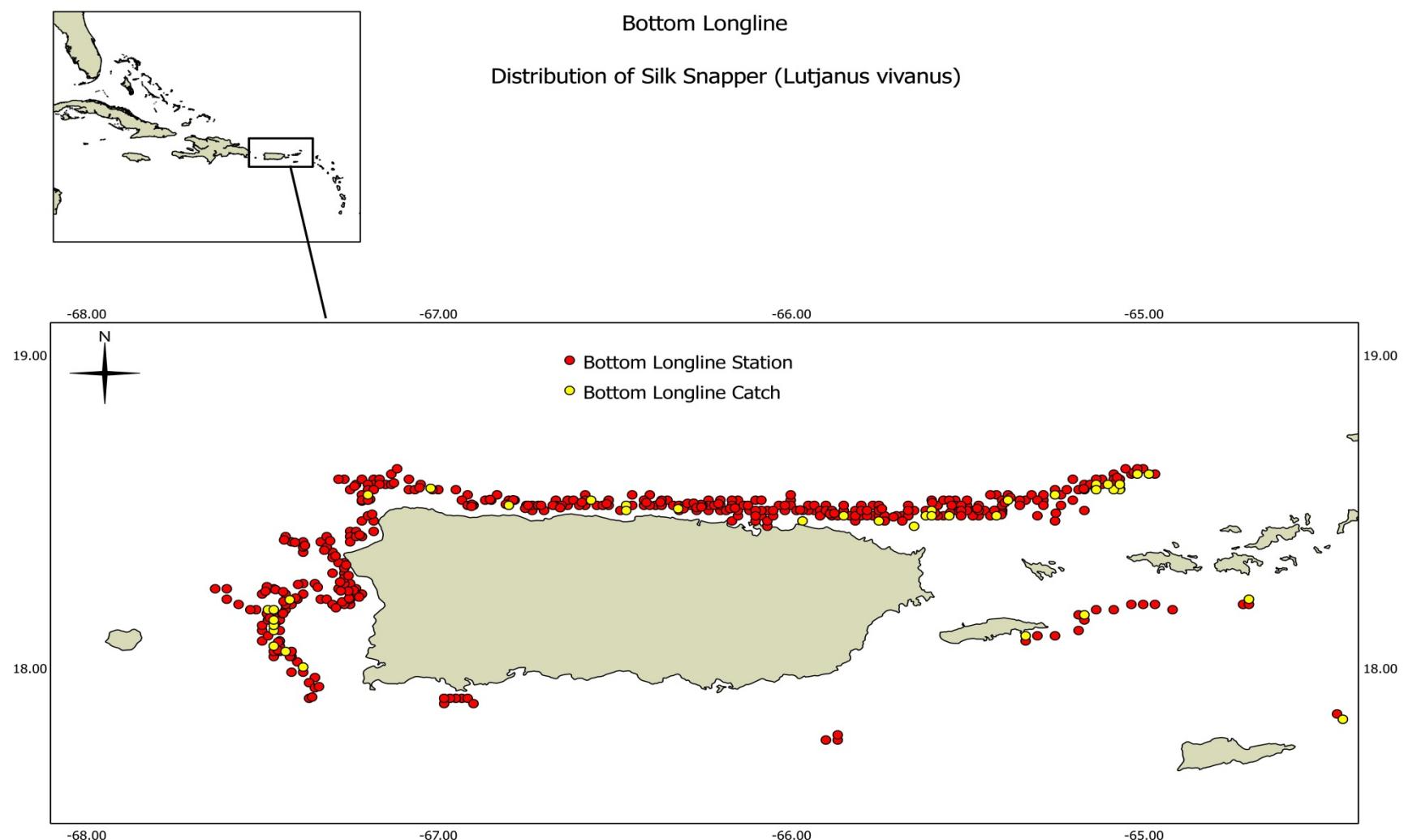


Figure 17. Distribution of silk snapper (*Lutjanus vivanus*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

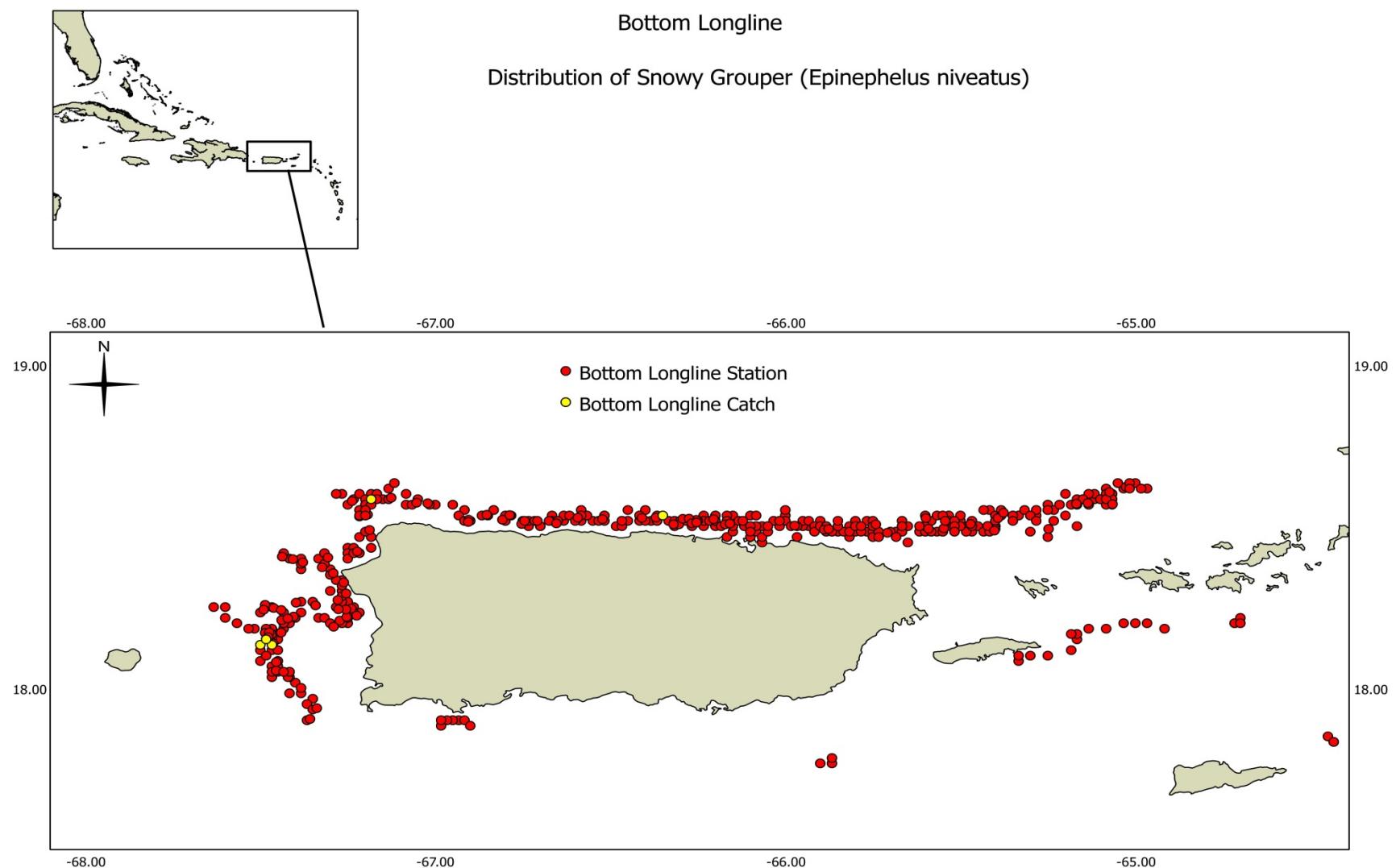


Figure 18. Distribution of snowy grouper (*Epinephelus niveatus*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

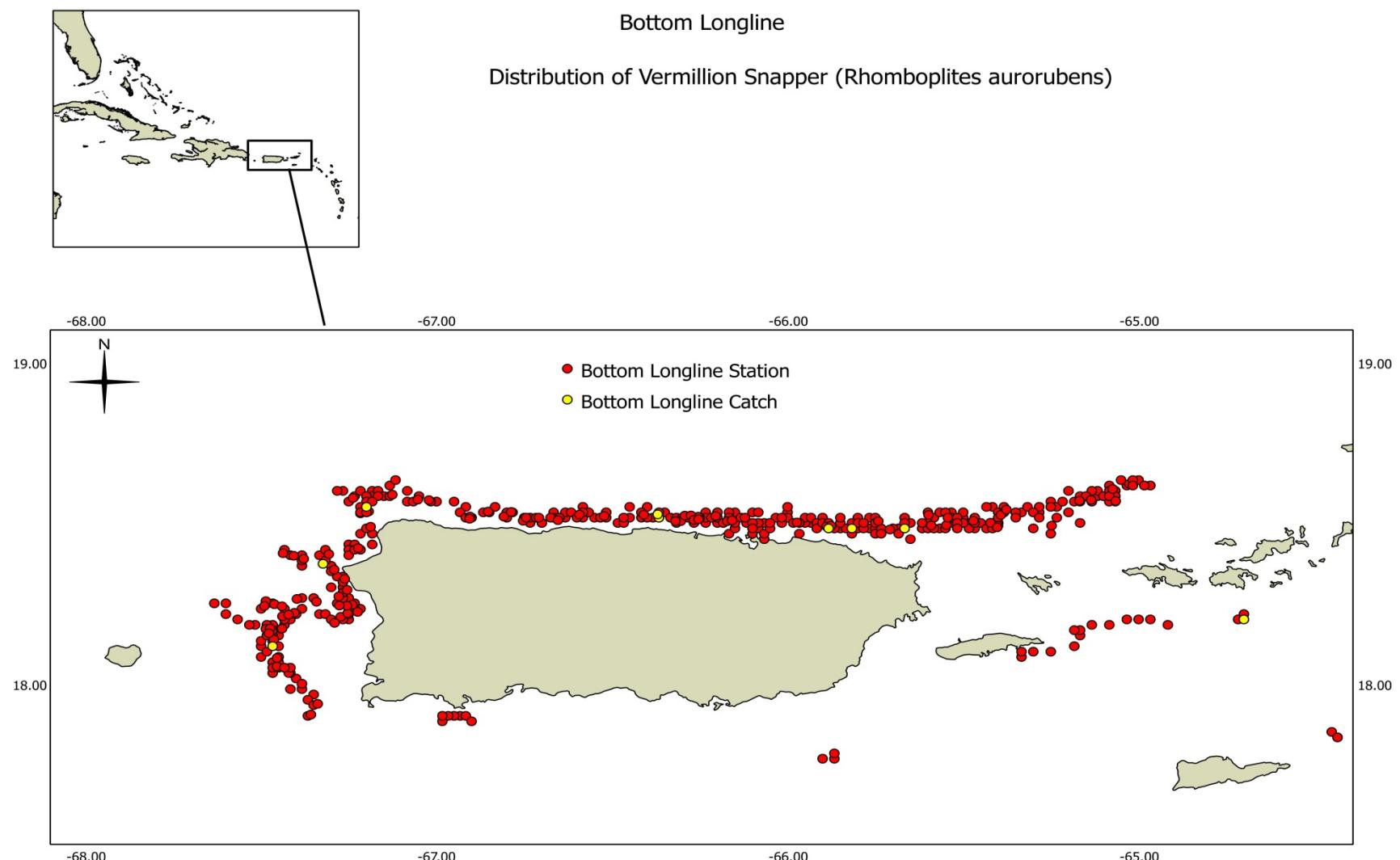


Figure 19. Distribution of vermillion snapper (*Rhomboplites aurorubens*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

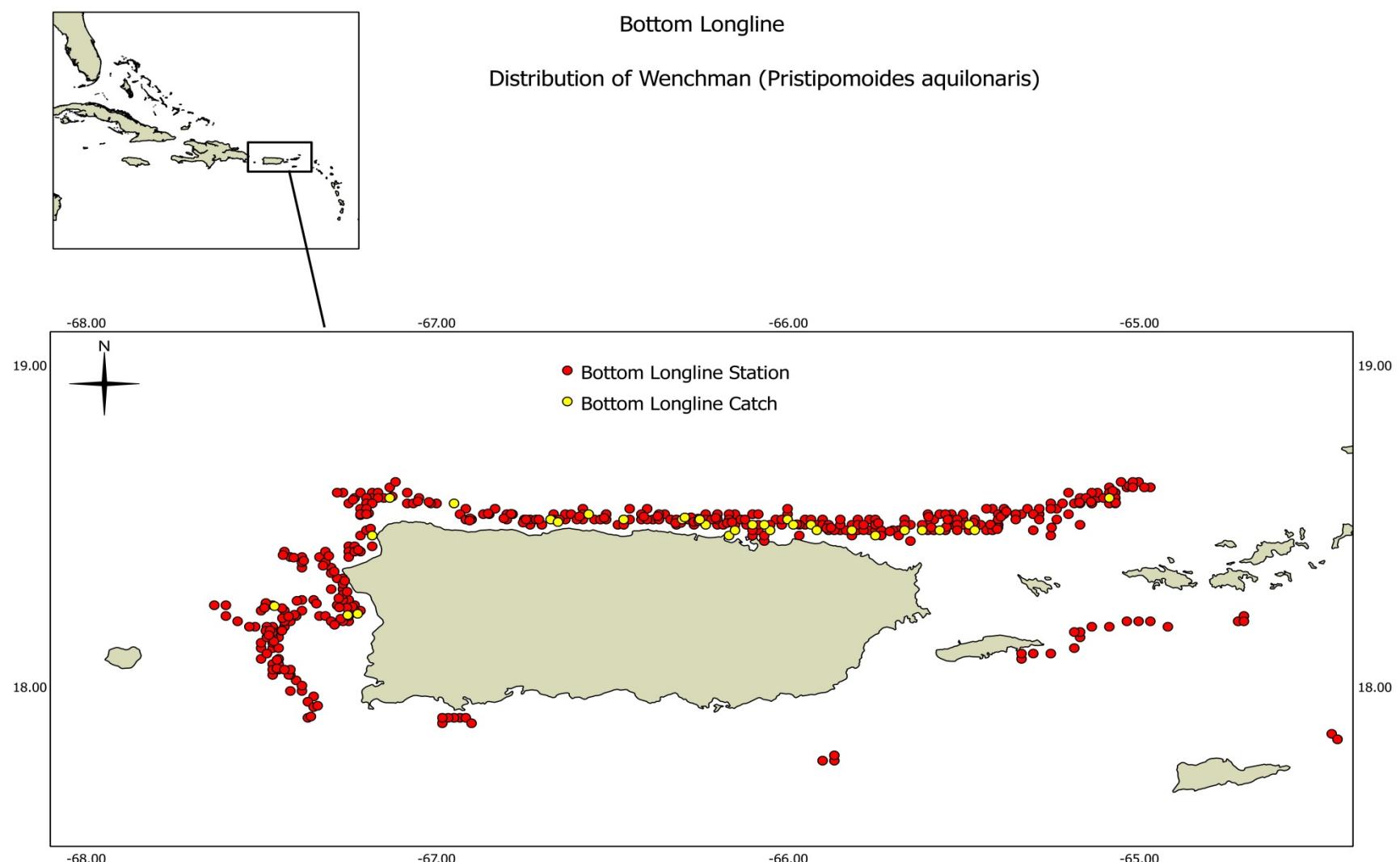


Figure 20. Distribution of wenchman (*Pristipomoides aquilonaris*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

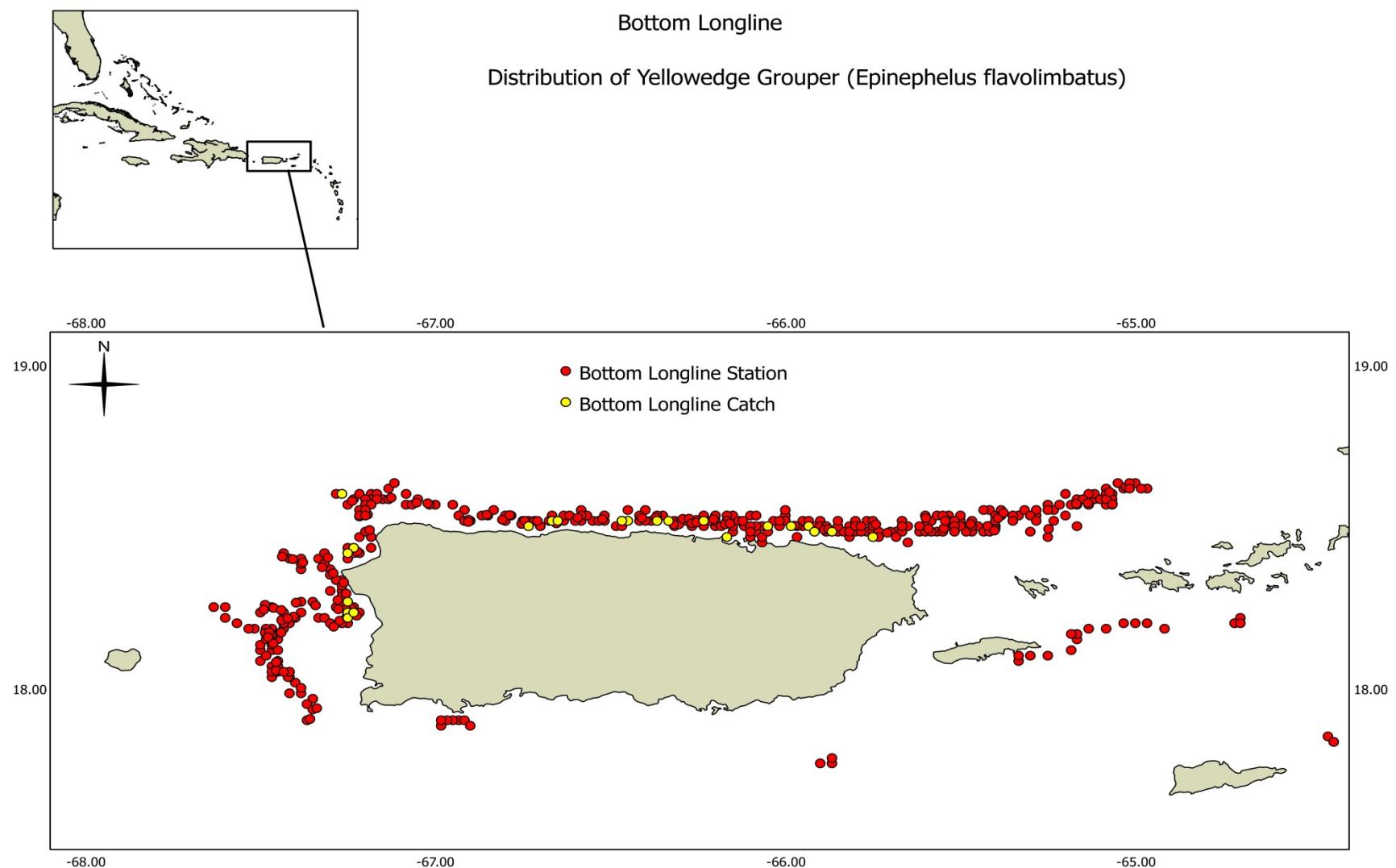


Figure 21. Distribution of yellowedge grouper (*Epinephelus flavolimbatus*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

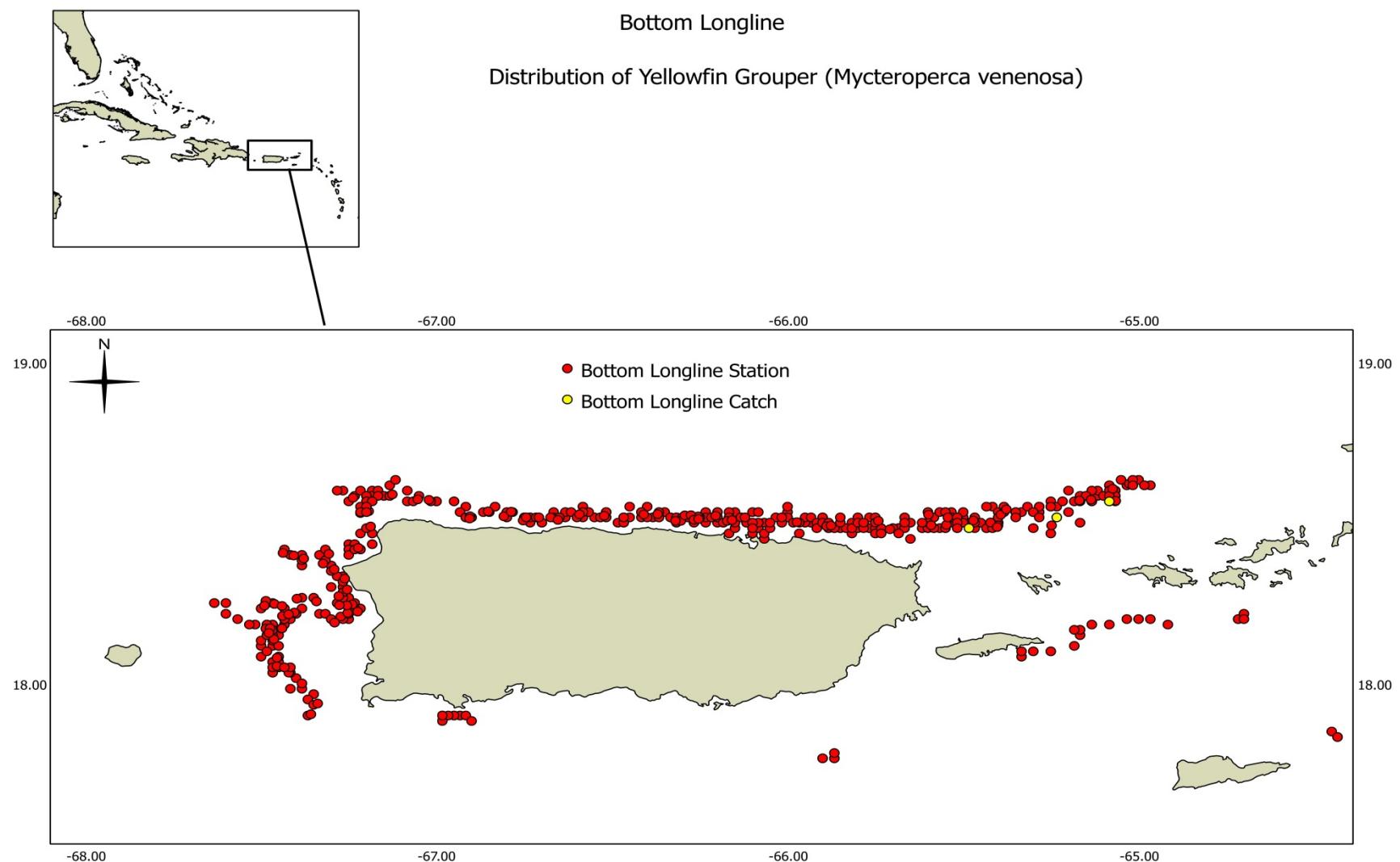


Figure 22. Distribution of yellowfin grouper (*Mycteroperca venenosa*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

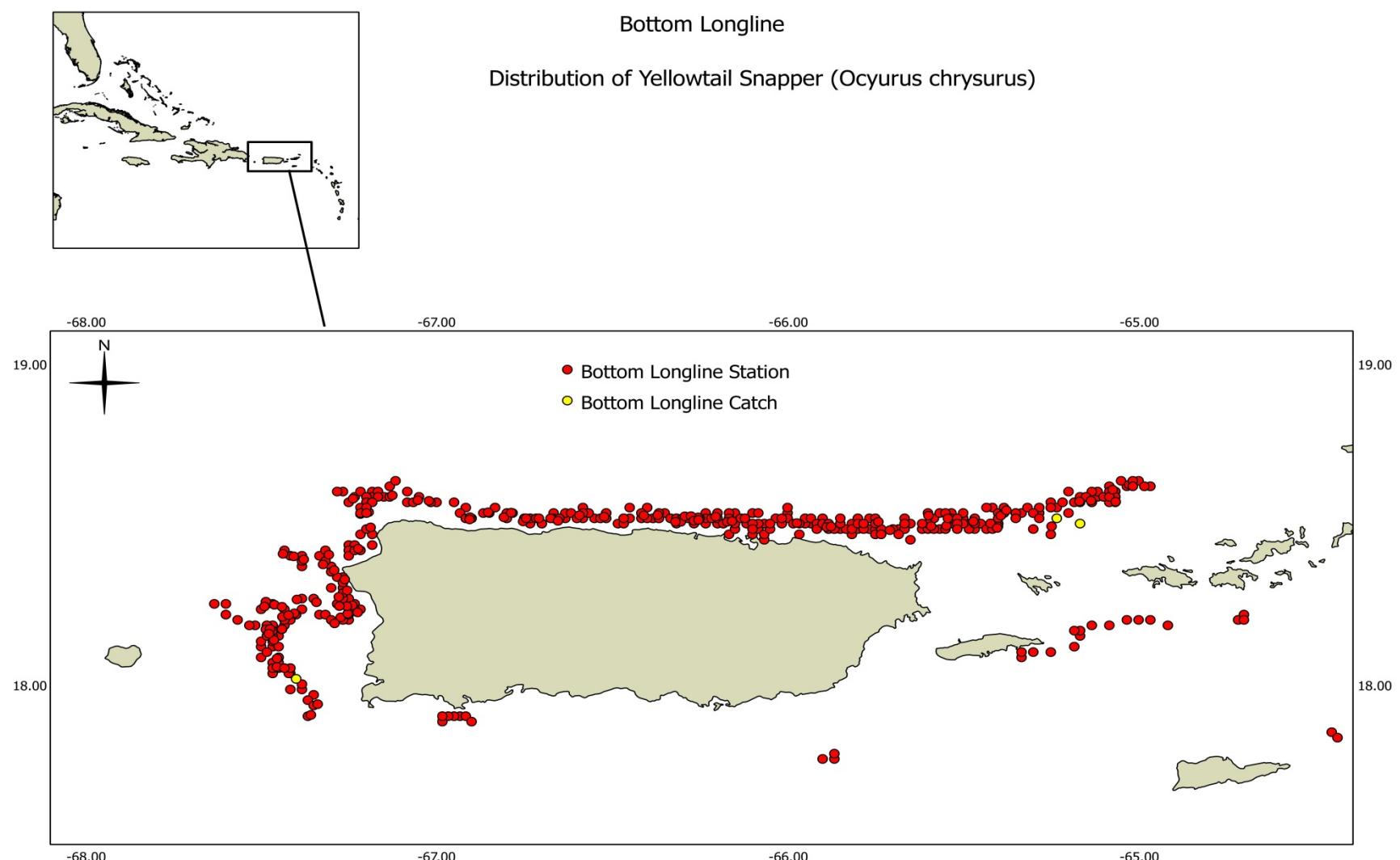


Figure 23. Distribution of yellowtail snapper (*Ocyurus chrysurus*) captured on bottom longlines during fishery independent surveys from 1979 - 1985.

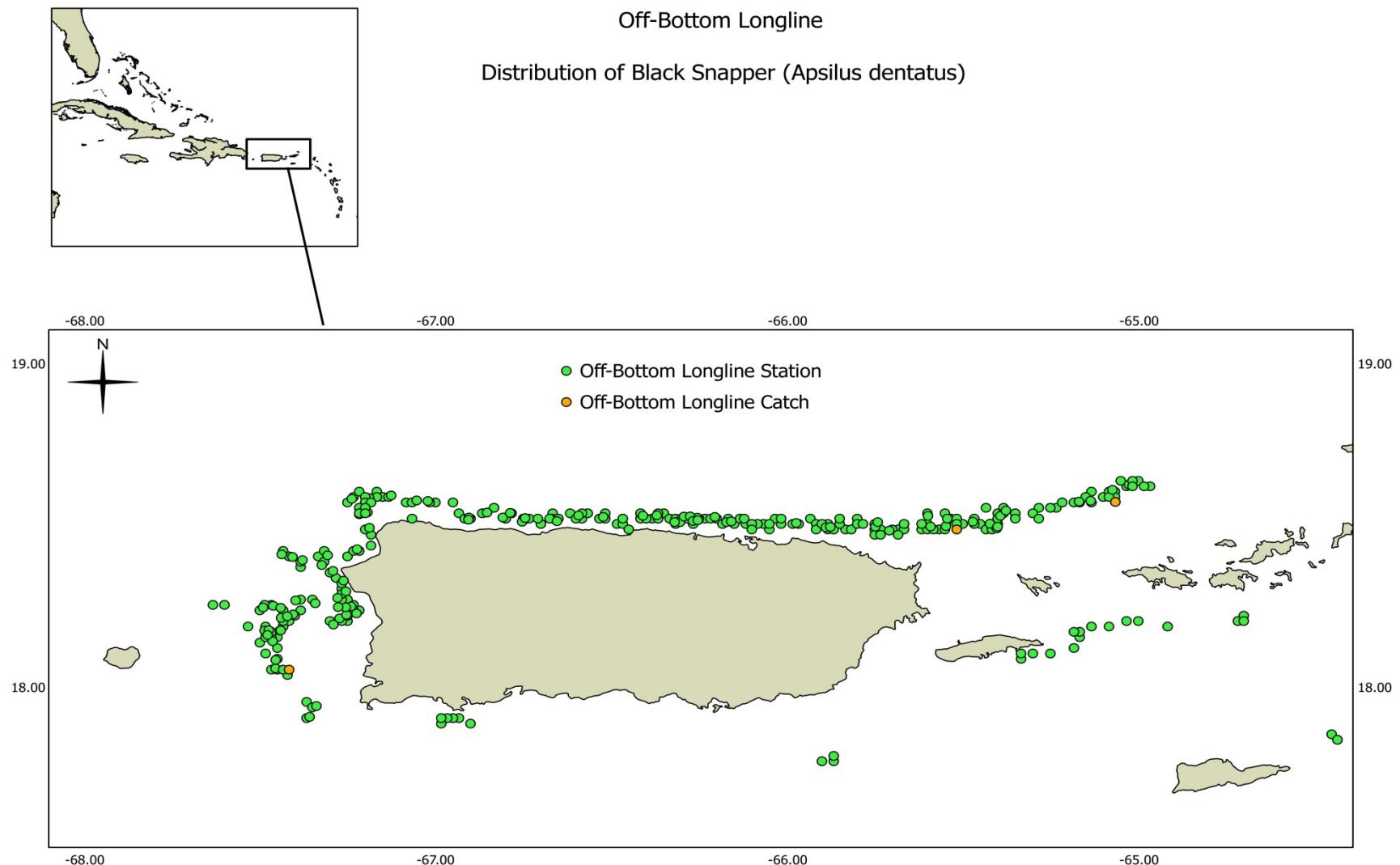


Figure 24. Distribution of black snapper (*Apsilus dentatus*) captured on off-bottom longlines during fishery independent surveys from 1982 - 1985.

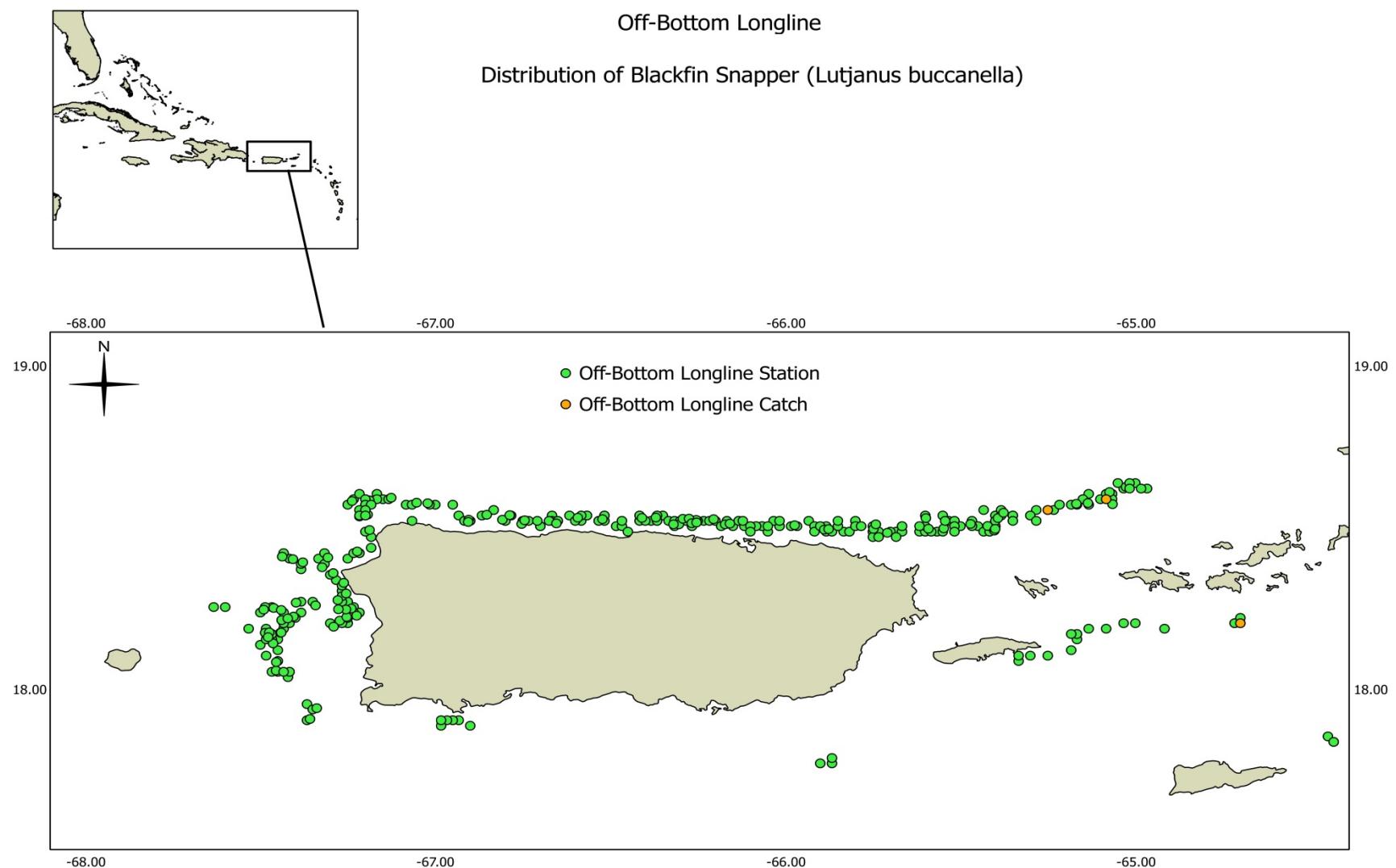


Figure 25. Distribution of blackfin snapper (*Lutjanus buccanella*) captured on off-bottom longlines during fishery independent surveys from 1982 - 1985.

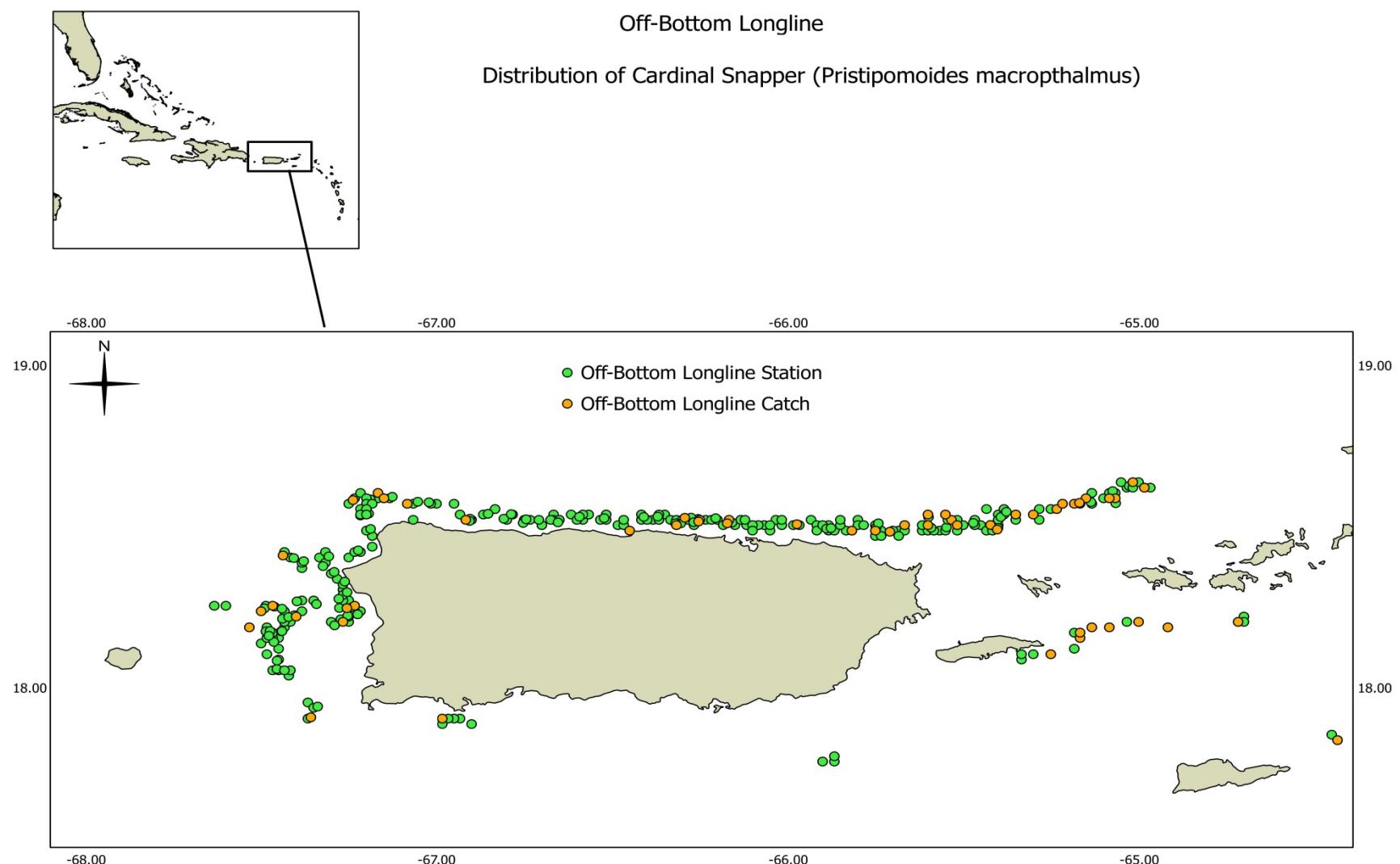


Figure 26. Distribution of cardinal snapper (*Pristipomoides macrourus*) captured on off-bottom longlines during fishery independent surveys from 1982 - 1985.

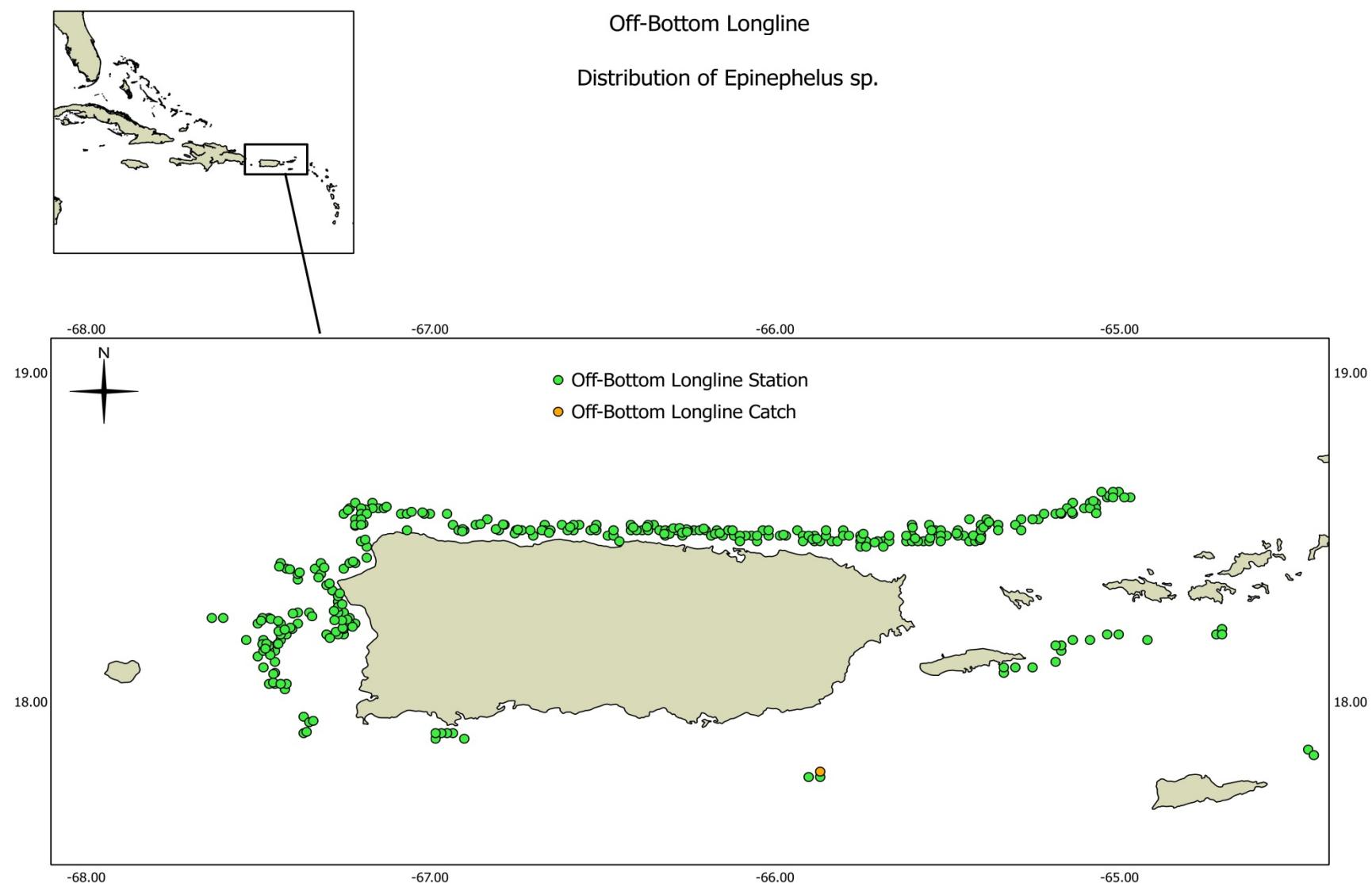


Figure 27. Distribution of *Epinephelus* sp. captured on off-bottom longlines during fishery independent surveys from 1982 - 1985.

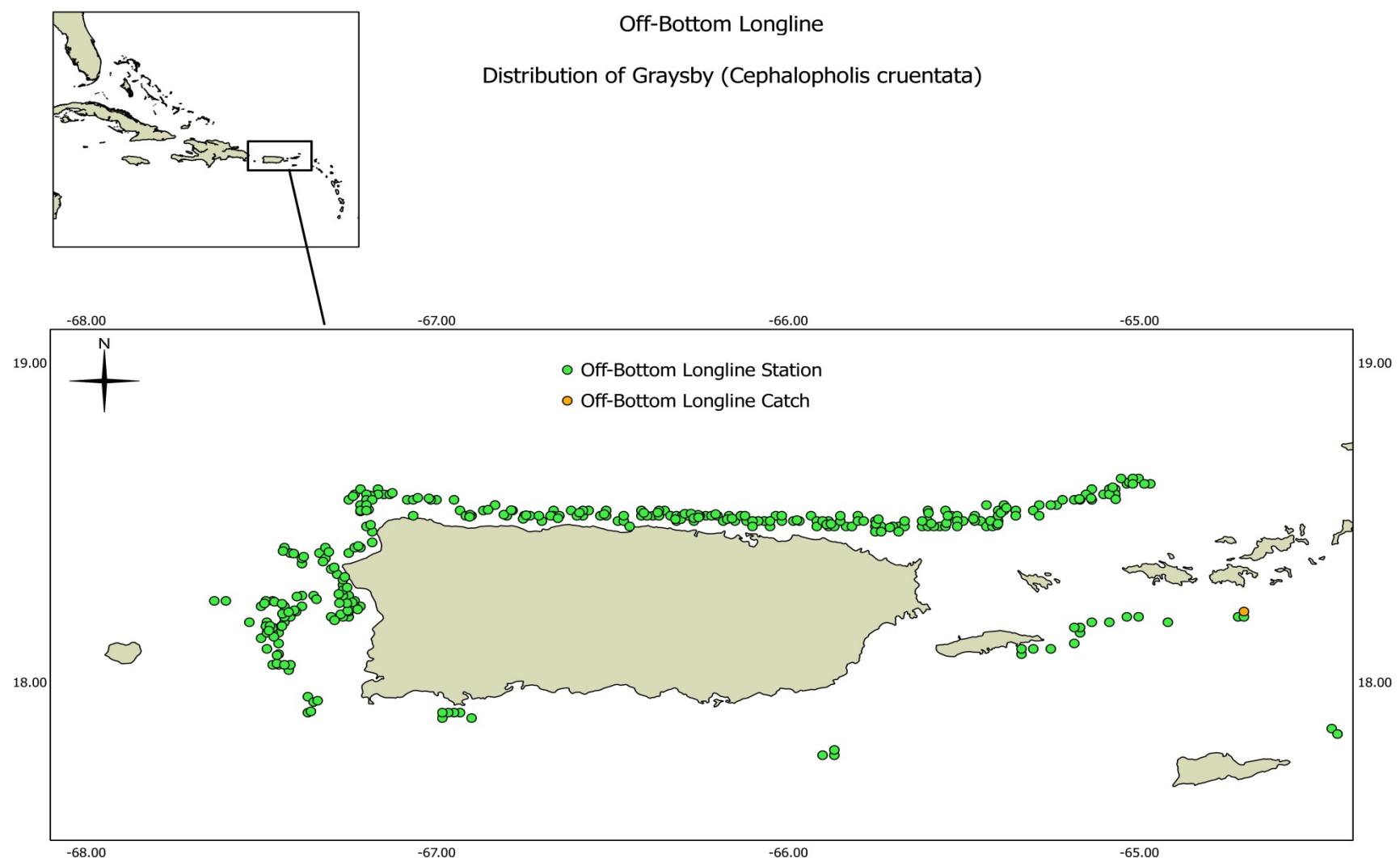


Figure 28. Distribution of graysby (*Cephalopholis cincta*) captured on off-bottom longlines during fishery independent surveys from 1982 - 1985.

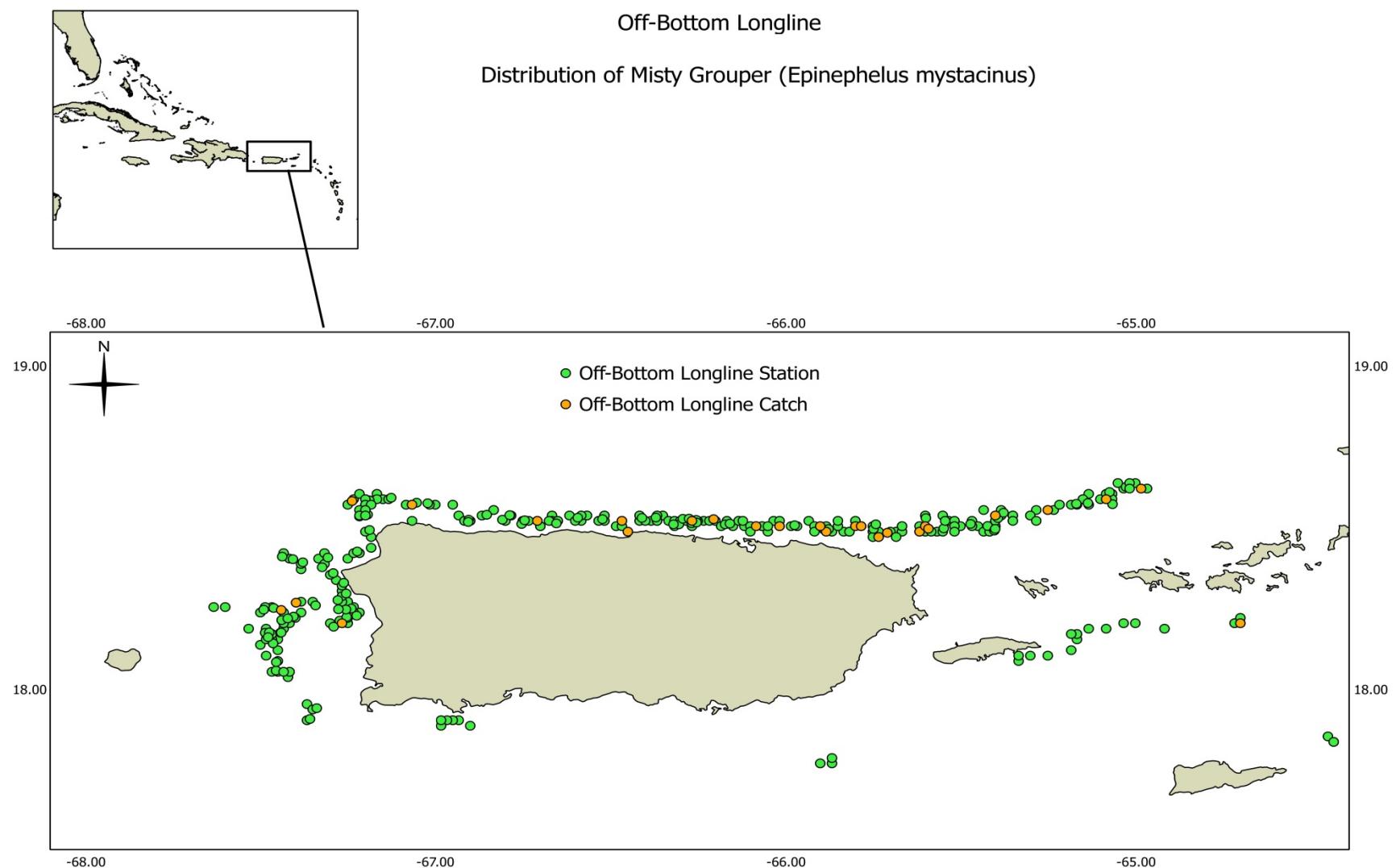


Figure 29. Distribution of misty grouper (*Epinephelus mystacinus*) captured on off-bottom longlines during fishery independent surveys from 1982 - 1985.

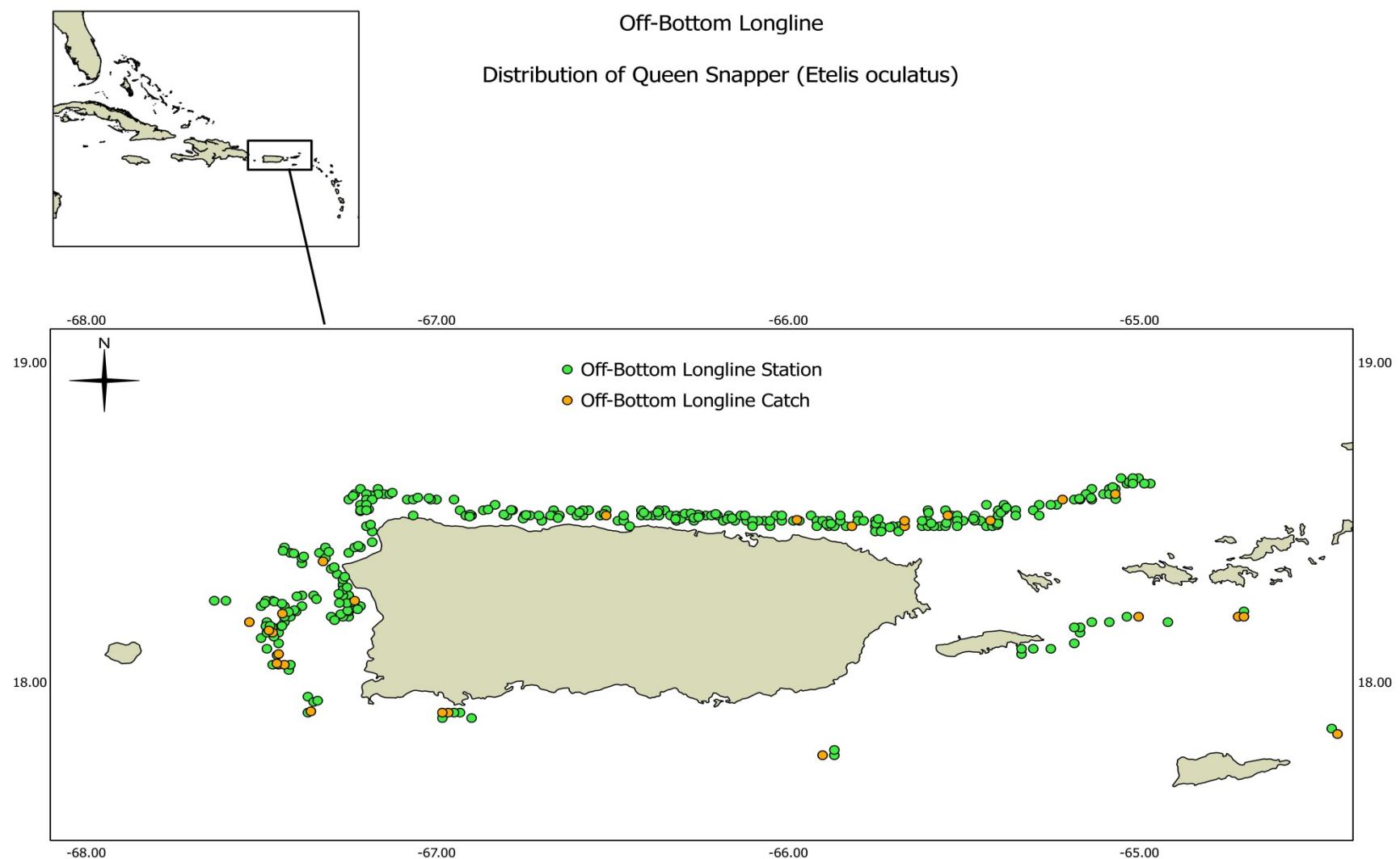


Figure 30. Distribution of queen snapper (*Etelis oculatus*) captured on off-bottom longlines during fishery independent surveys from 1982 - 1985.

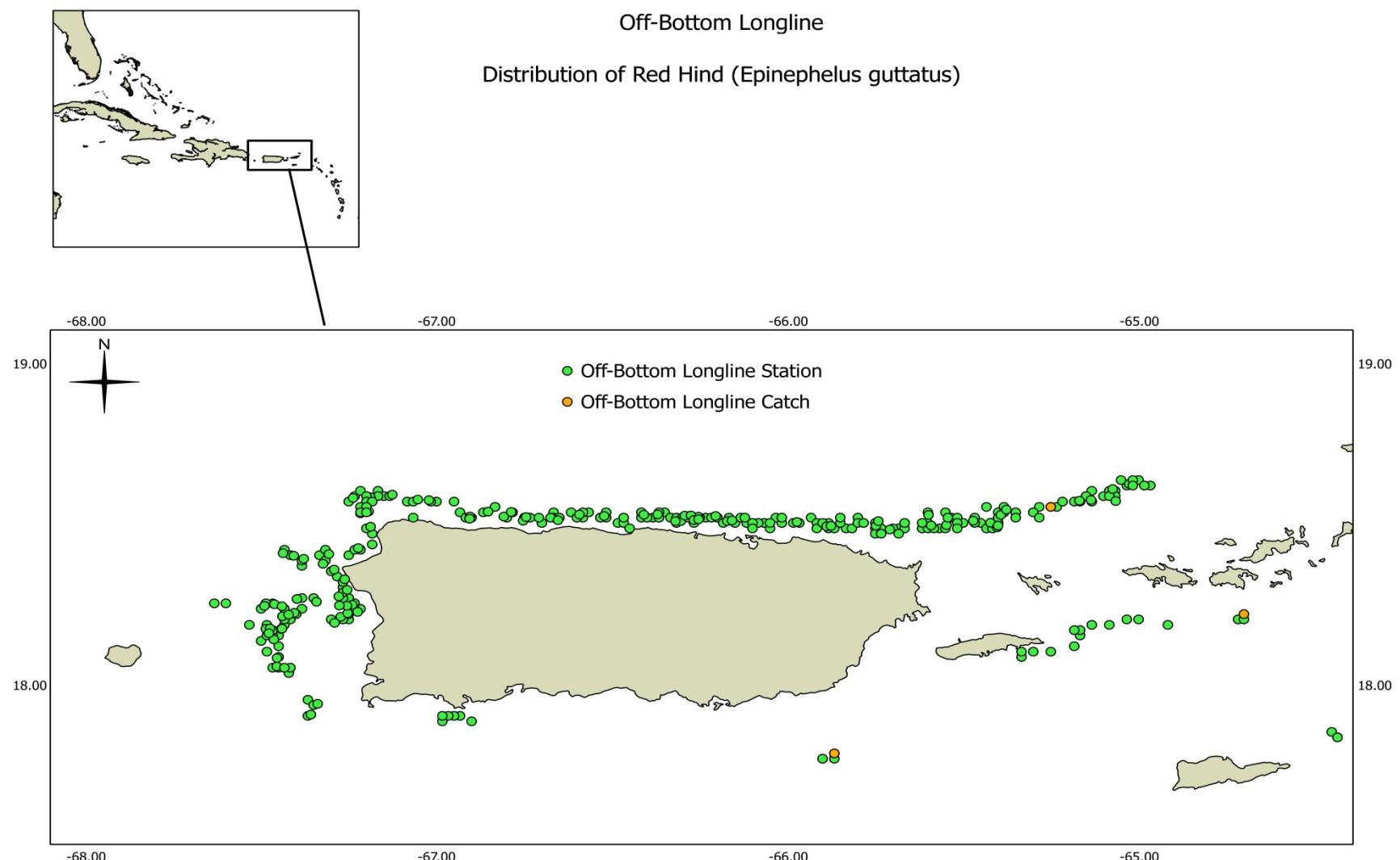


Figure 31. Distribution of red hind (*Epinephelus guttatus*) captured on off-bottom longlines during fishery independent surveys from 1982 - 1985.

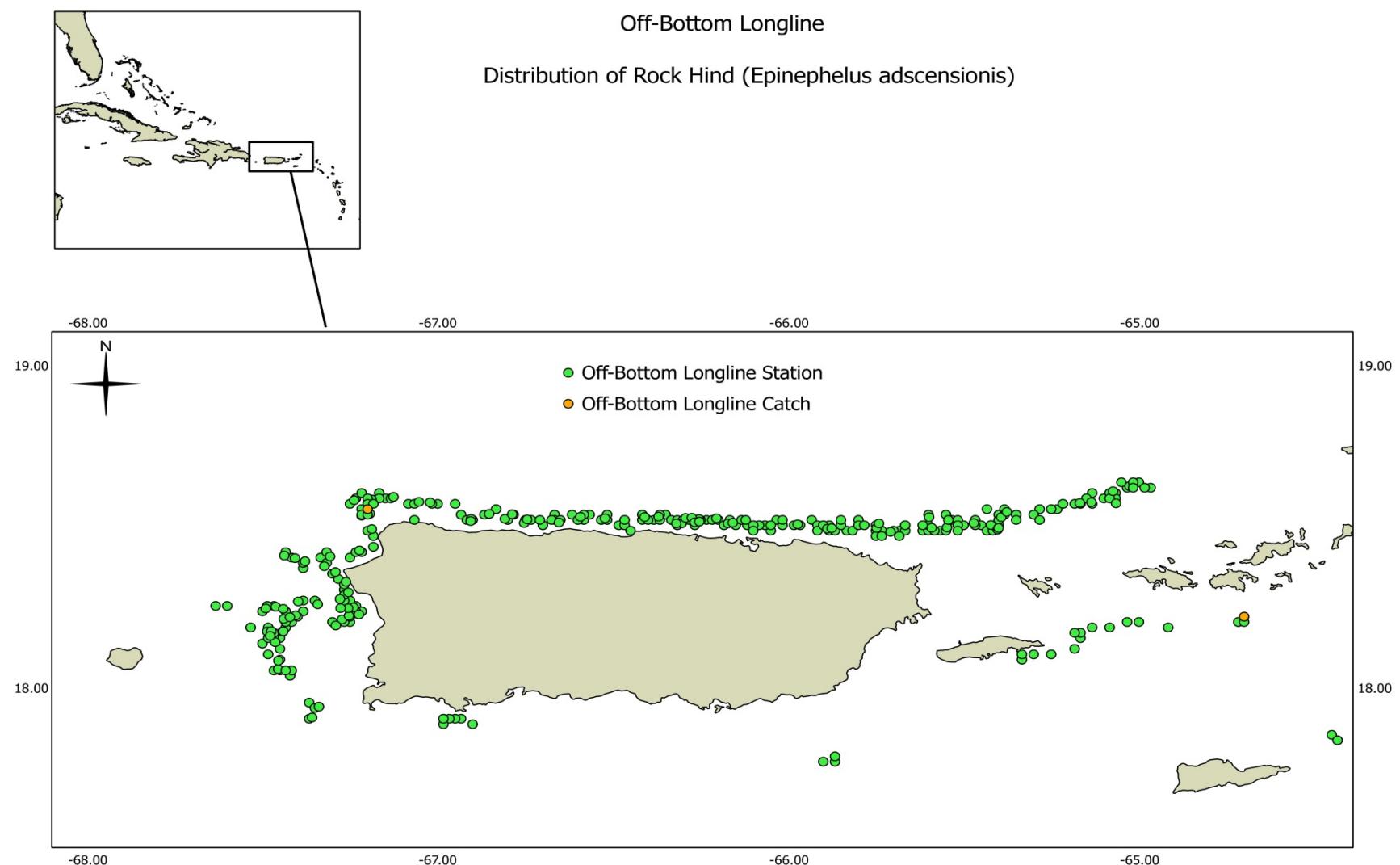


Figure 32. Distribution of rock hind (*Epinephelus adscensionis*) captured on off-bottom longlines during fishery independent surveys from 1982 - 1985.

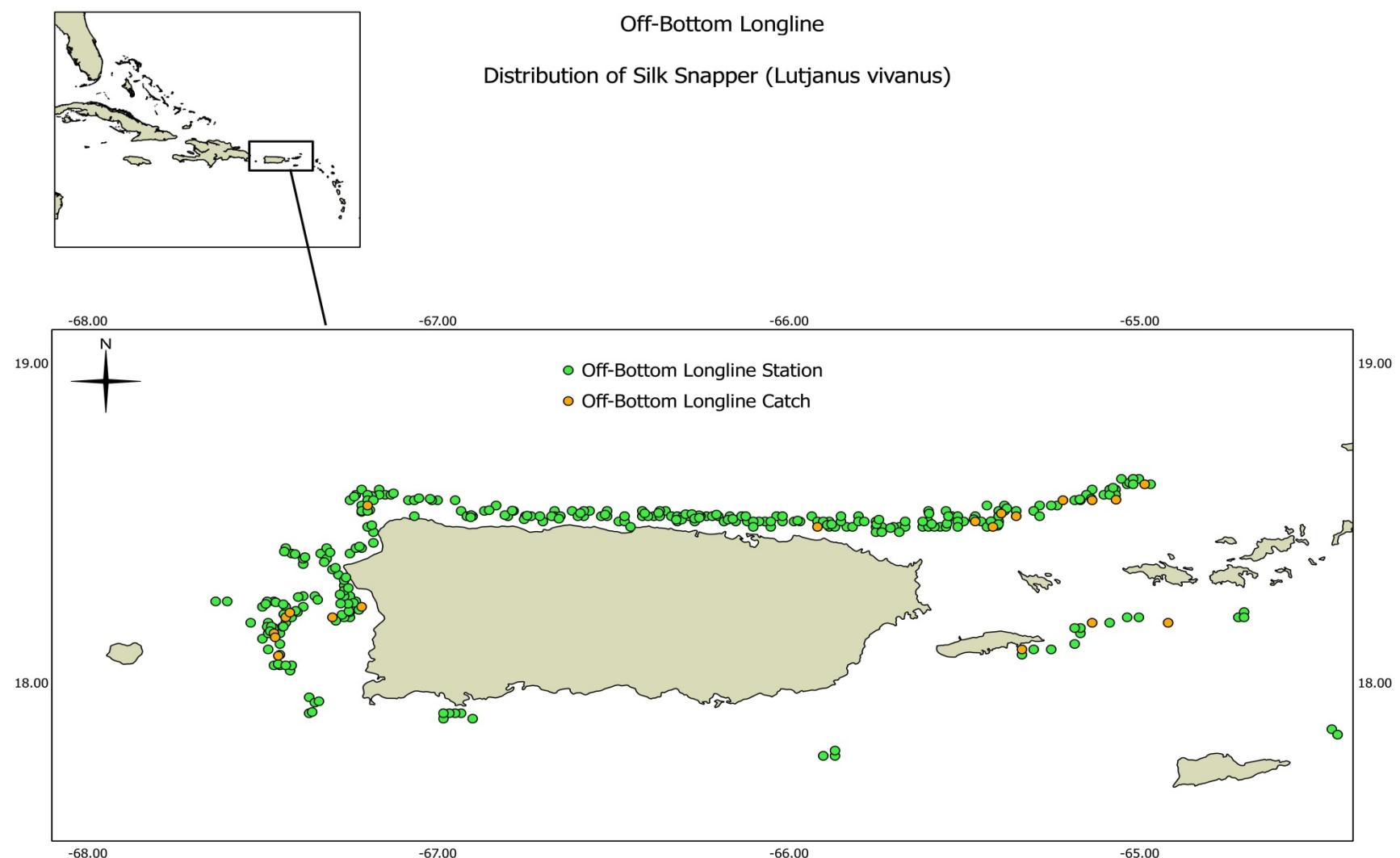


Figure 33. Distribution of silk snapper (*Lutjanus vivanus*) captured on off-bottom longlines during fishery independent surveys from 1982 - 1985.

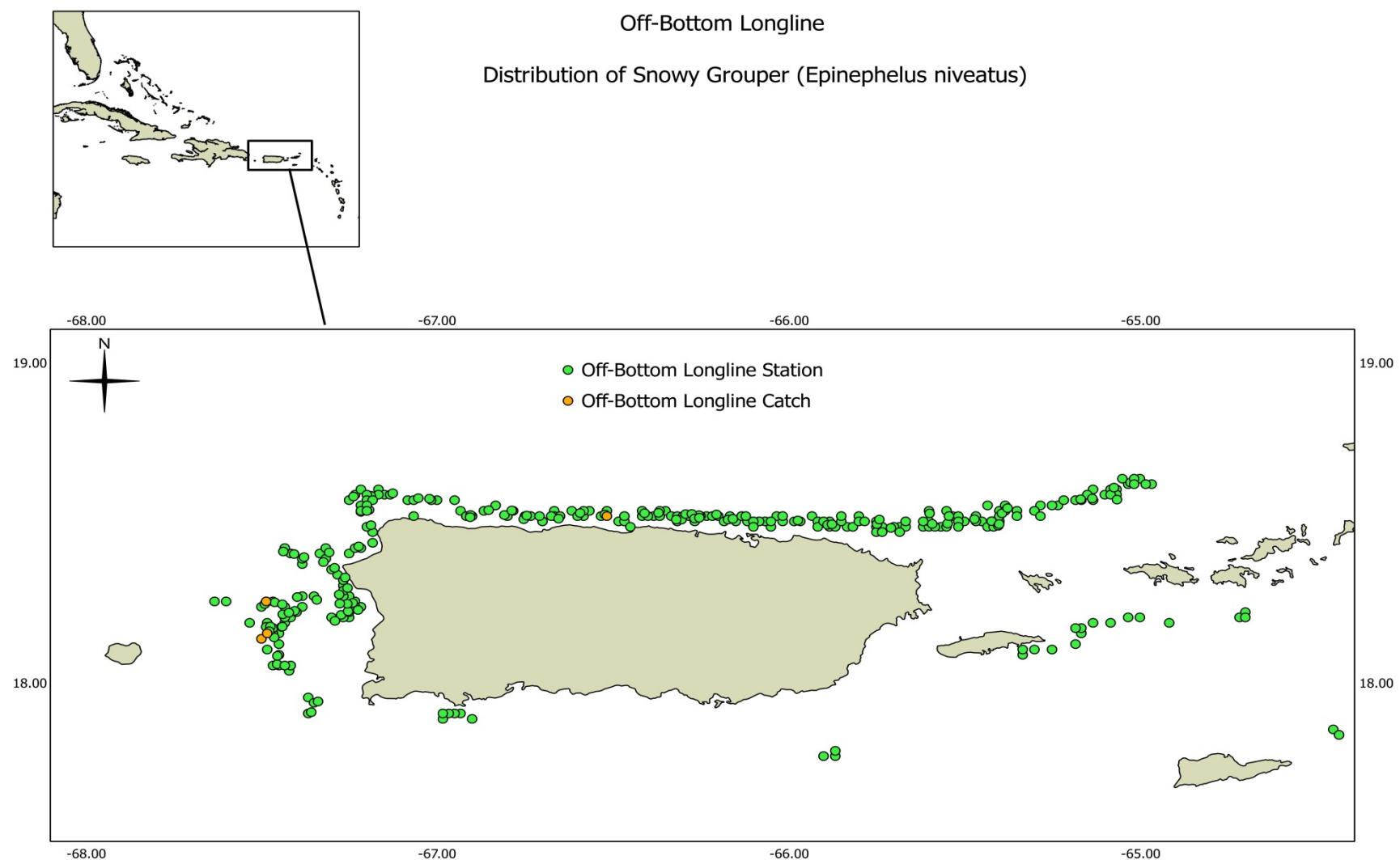


Figure 34. Distribution of snowy grouper (*Epinephelus niveatus*) captured on off-bottom longlines during fishery independent surveys from 1982 - 1985.

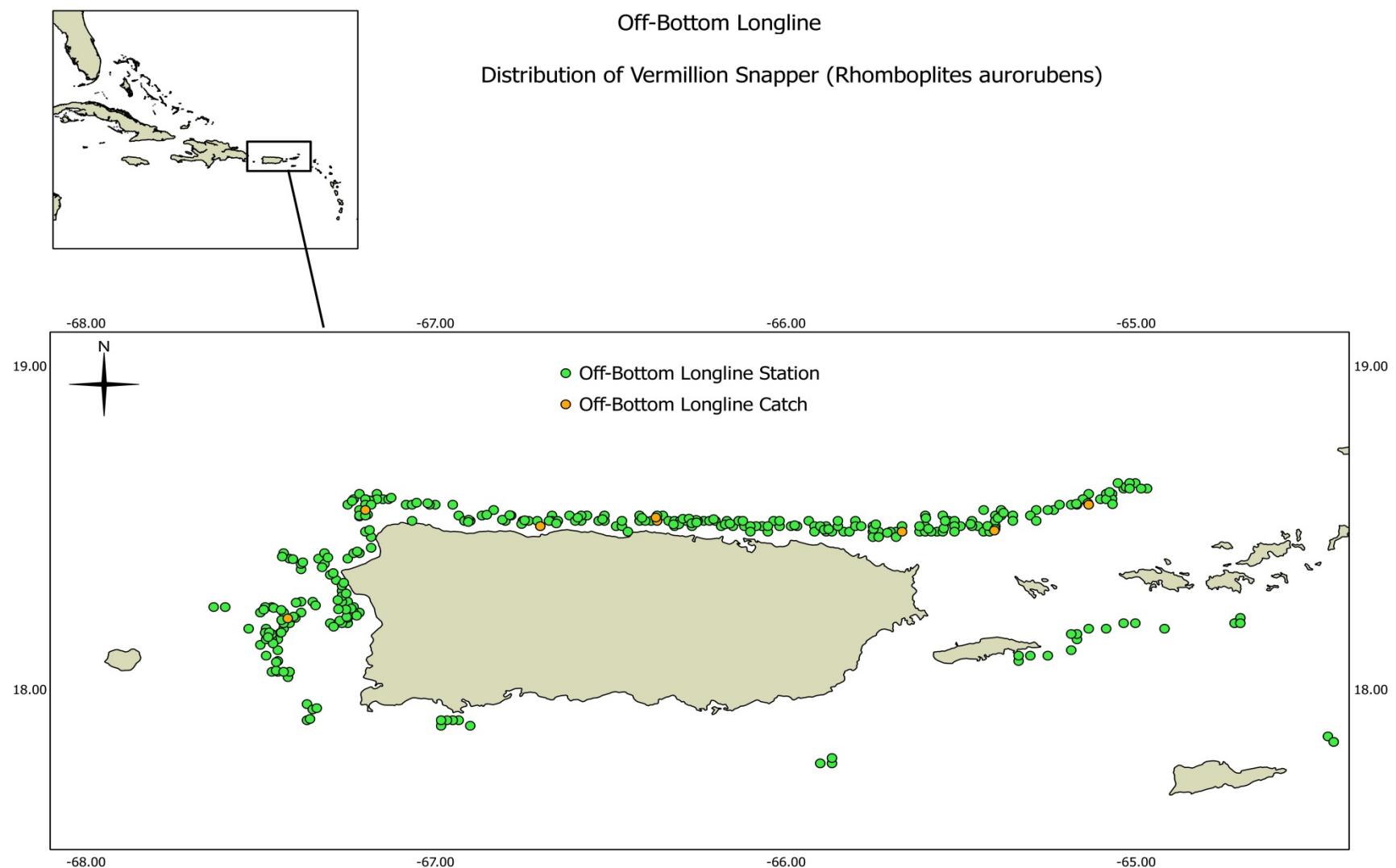


Figure 35. Distribution of vermillion snapper (*Rhomboplites aurorubens*) captured on off-bottom longlines during fishery independent surveys from 1982 - 1985.

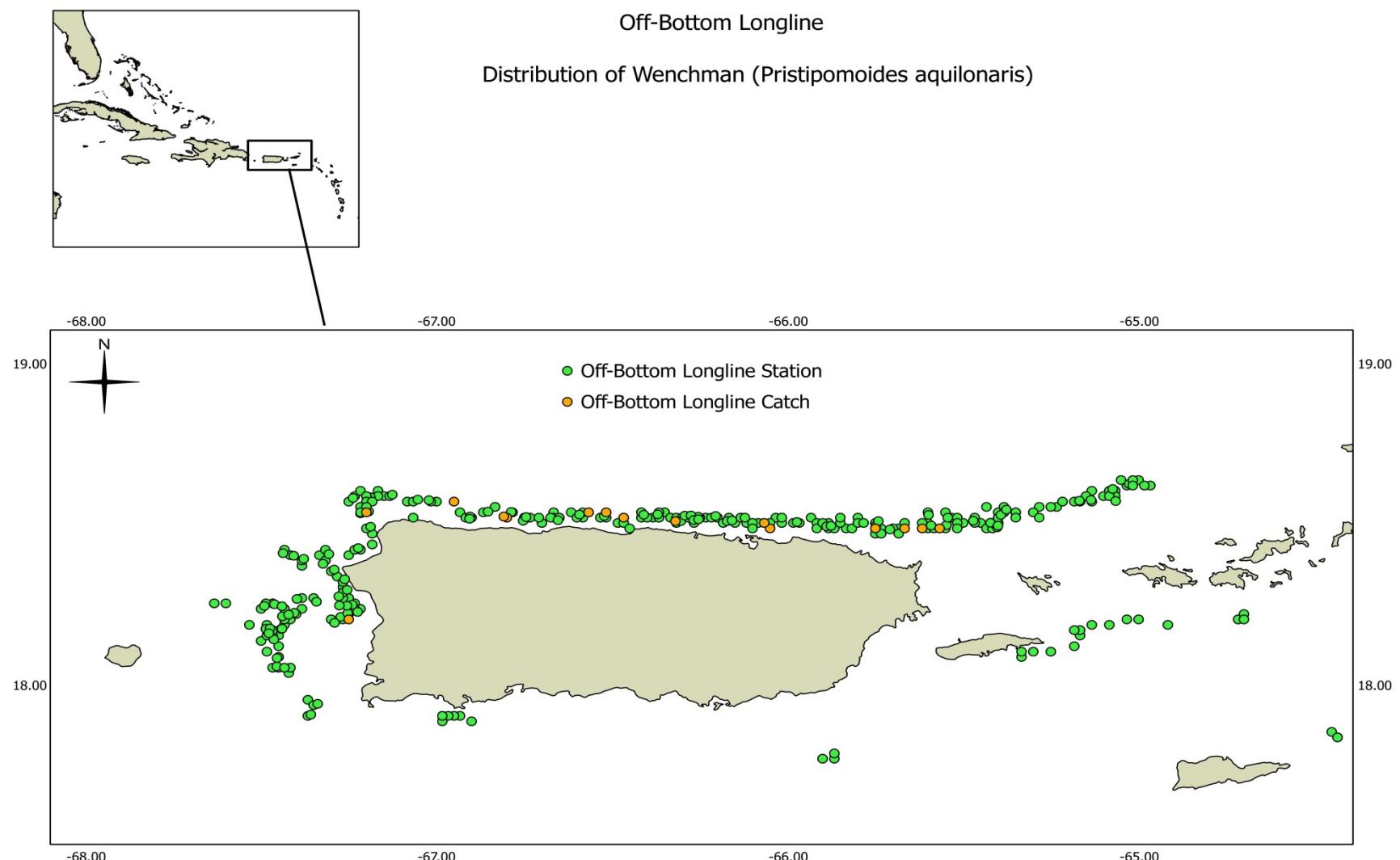


Figure 36. Distribution of wenchman (*Pristipomoides aquilonaris*) captured on off-bottom longlines during fishery independent surveys from 1982 - 1985.

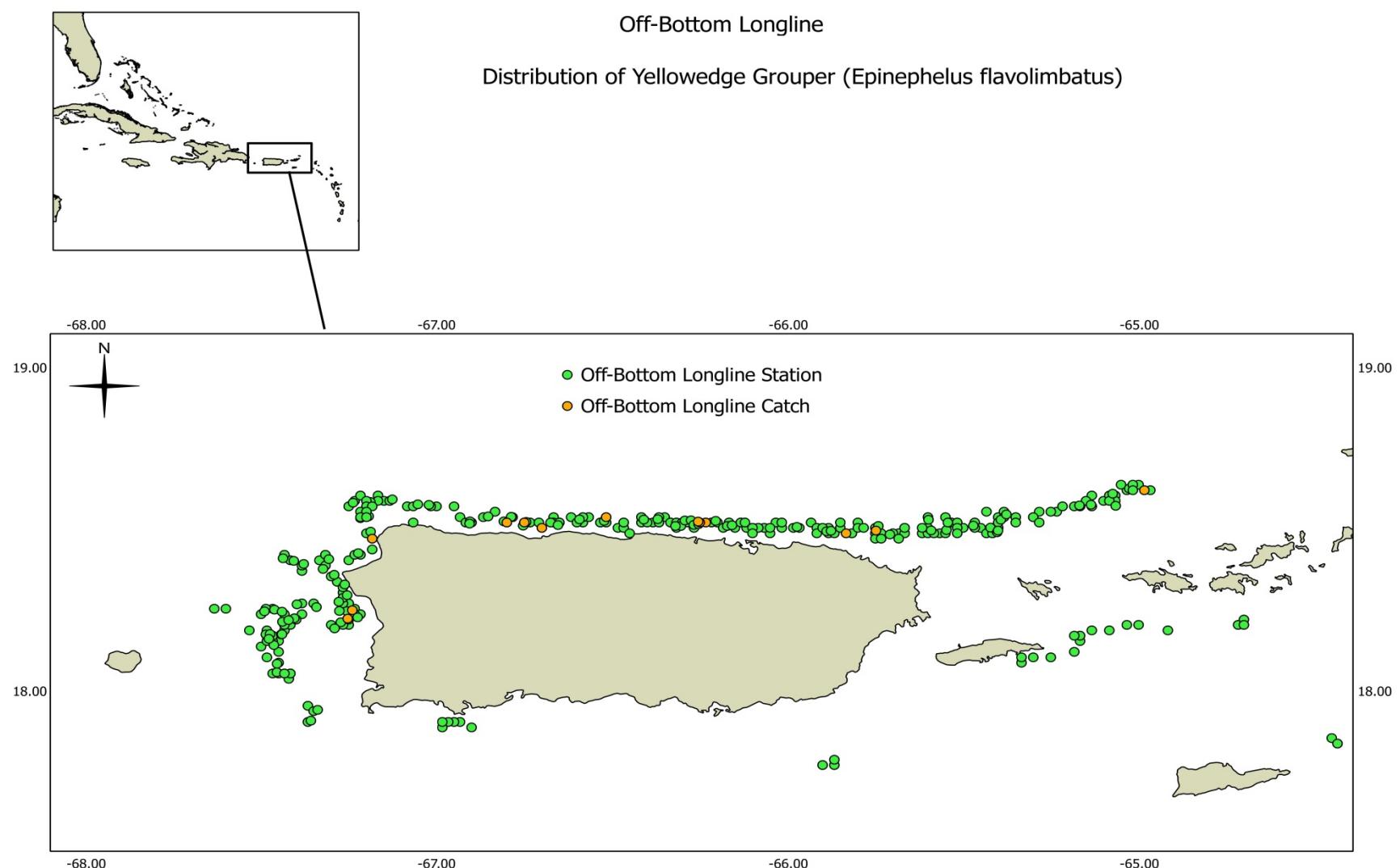


Figure 37. Distribution of yellowedge grouper (*Epinephelus flavolimbatus*) captured on off-bottom longlines during fishery independent surveys from 1982 - 1985.

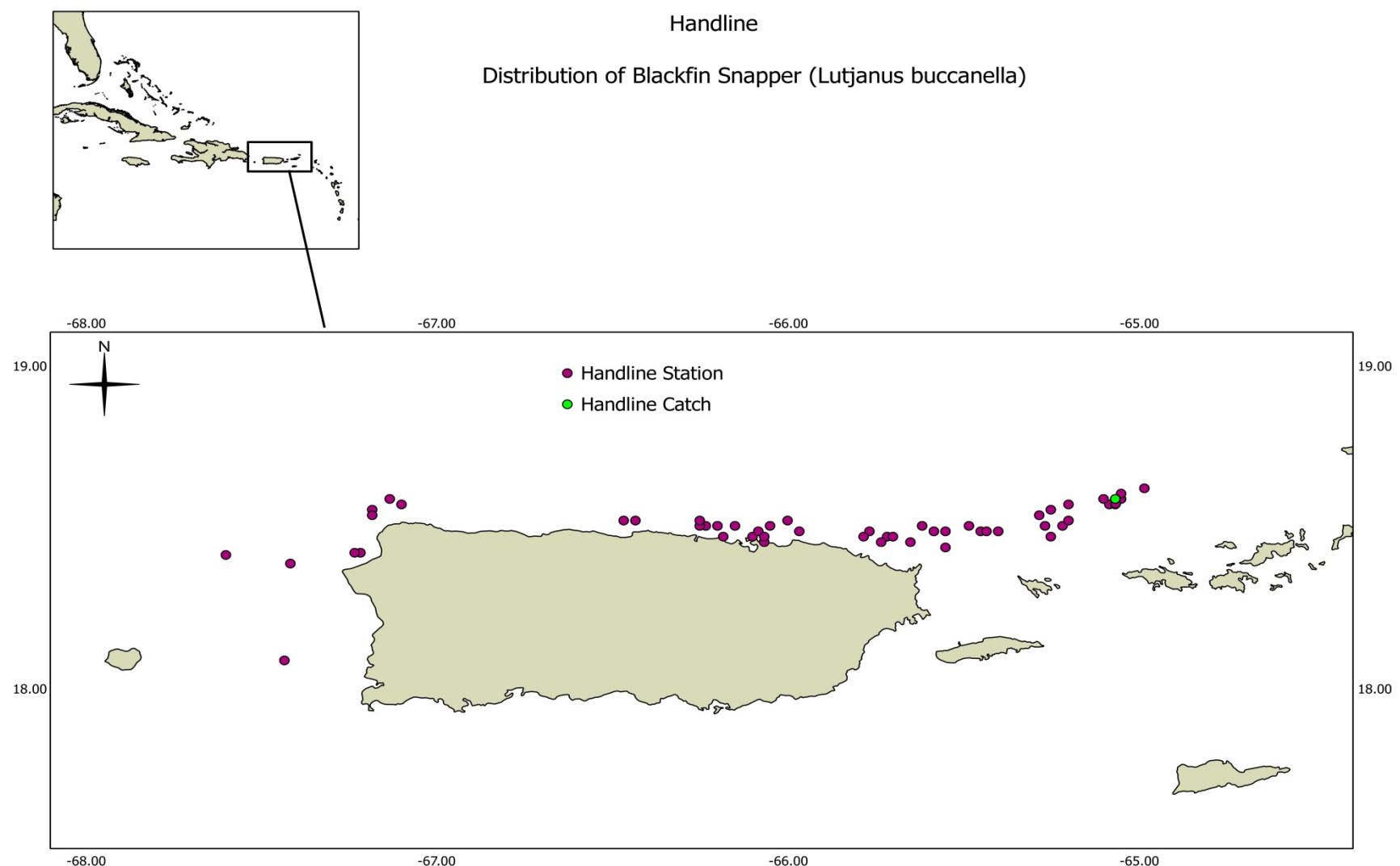


Figure 38. Distribution of blackfin snapper (*Lutjanus buccanella*) captured on handlines during fishery independent surveys from 1979 - 1984.

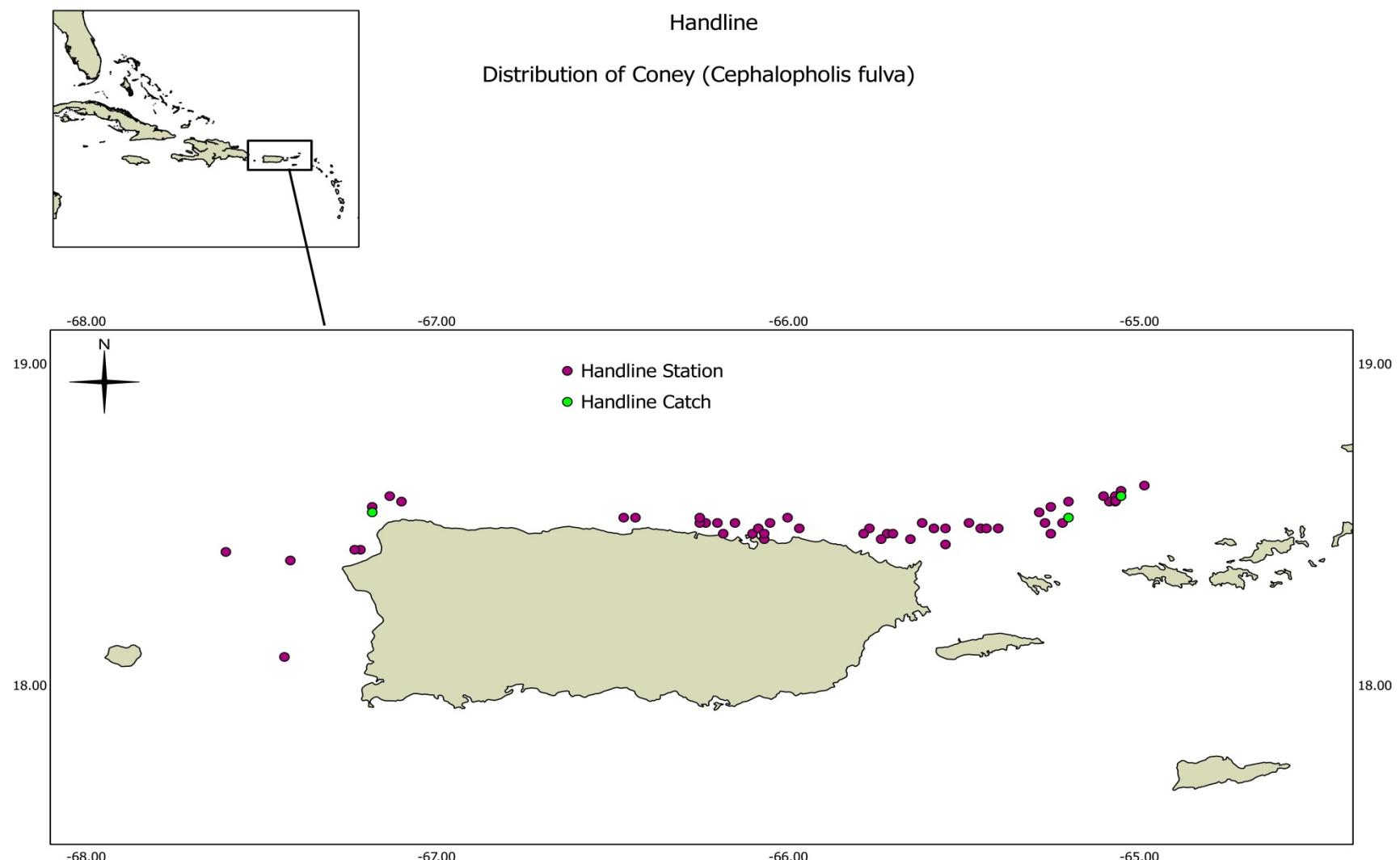


Figure 39. Distribution of coney (*Cephalopholis fulva*) captured on handlines during fishery independent surveys from 1979 - 1984.

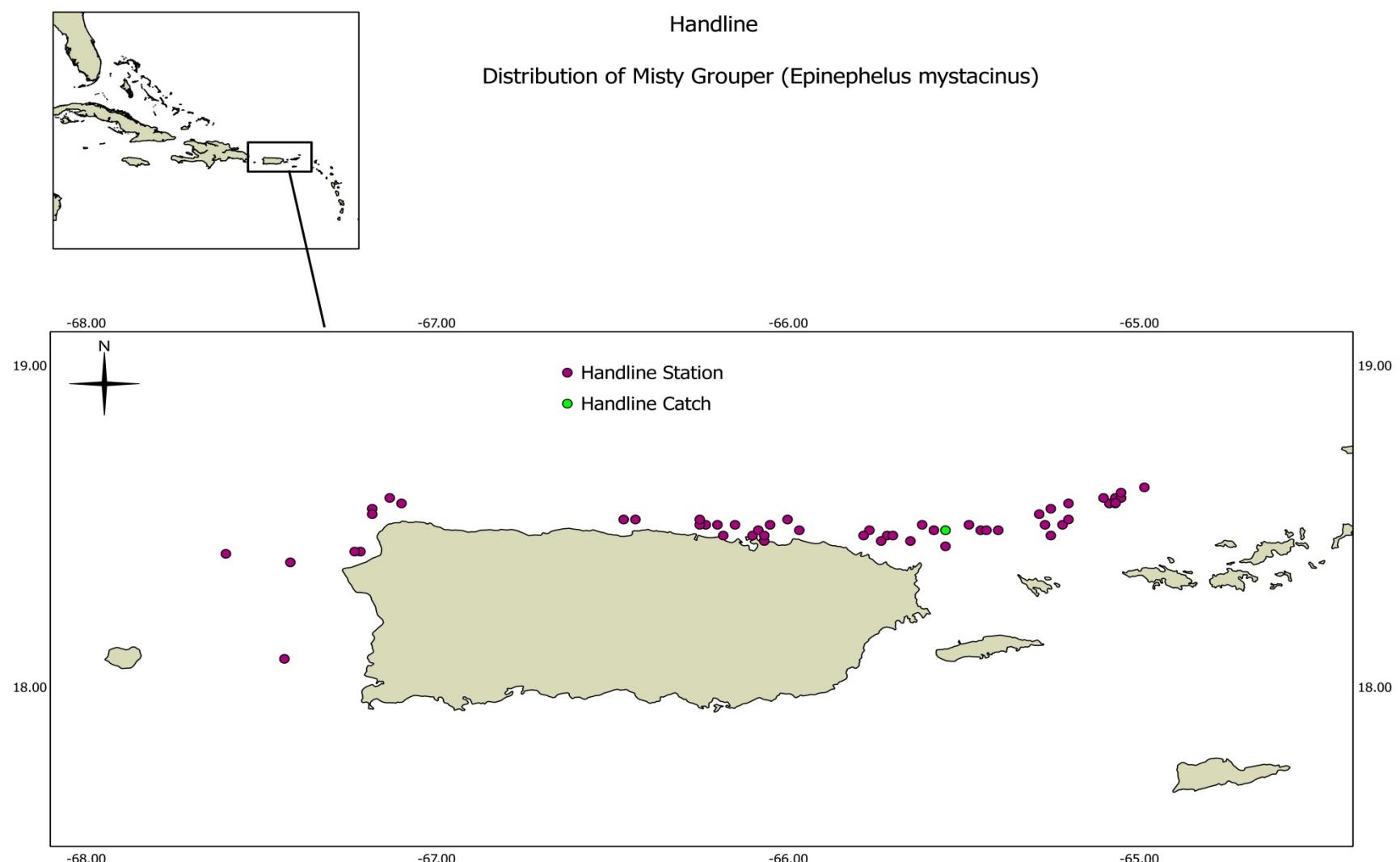


Figure 40. Distribution of misty grouper (*Epinephelus mystacinus*) captured on handlines during fishery independent surveys from 1979 - 1984.

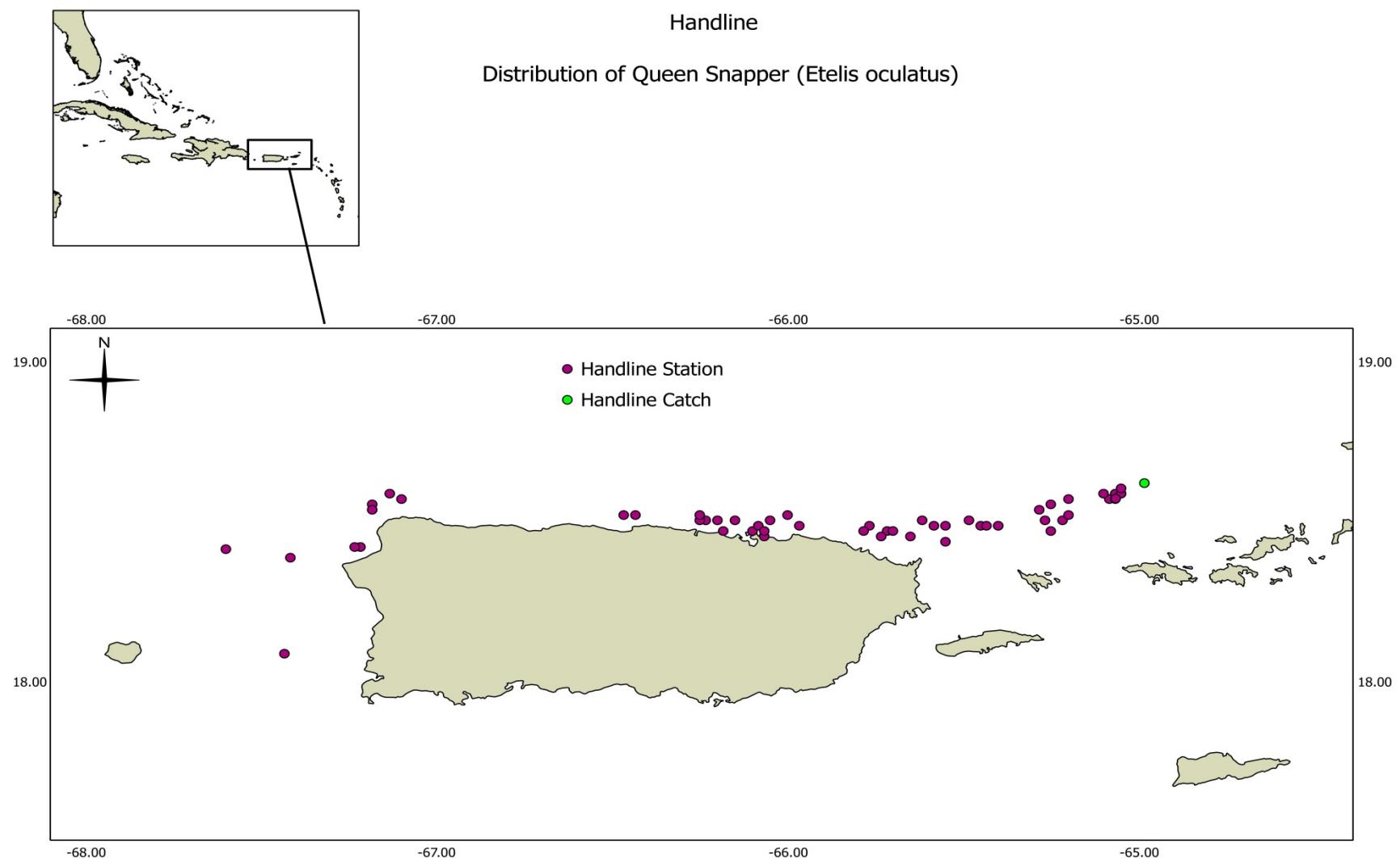


Figure 41. Distribution of queen snapper (*Etelis oculatus*) captured on handlines during fishery independent surveys from 1979 - 1984.

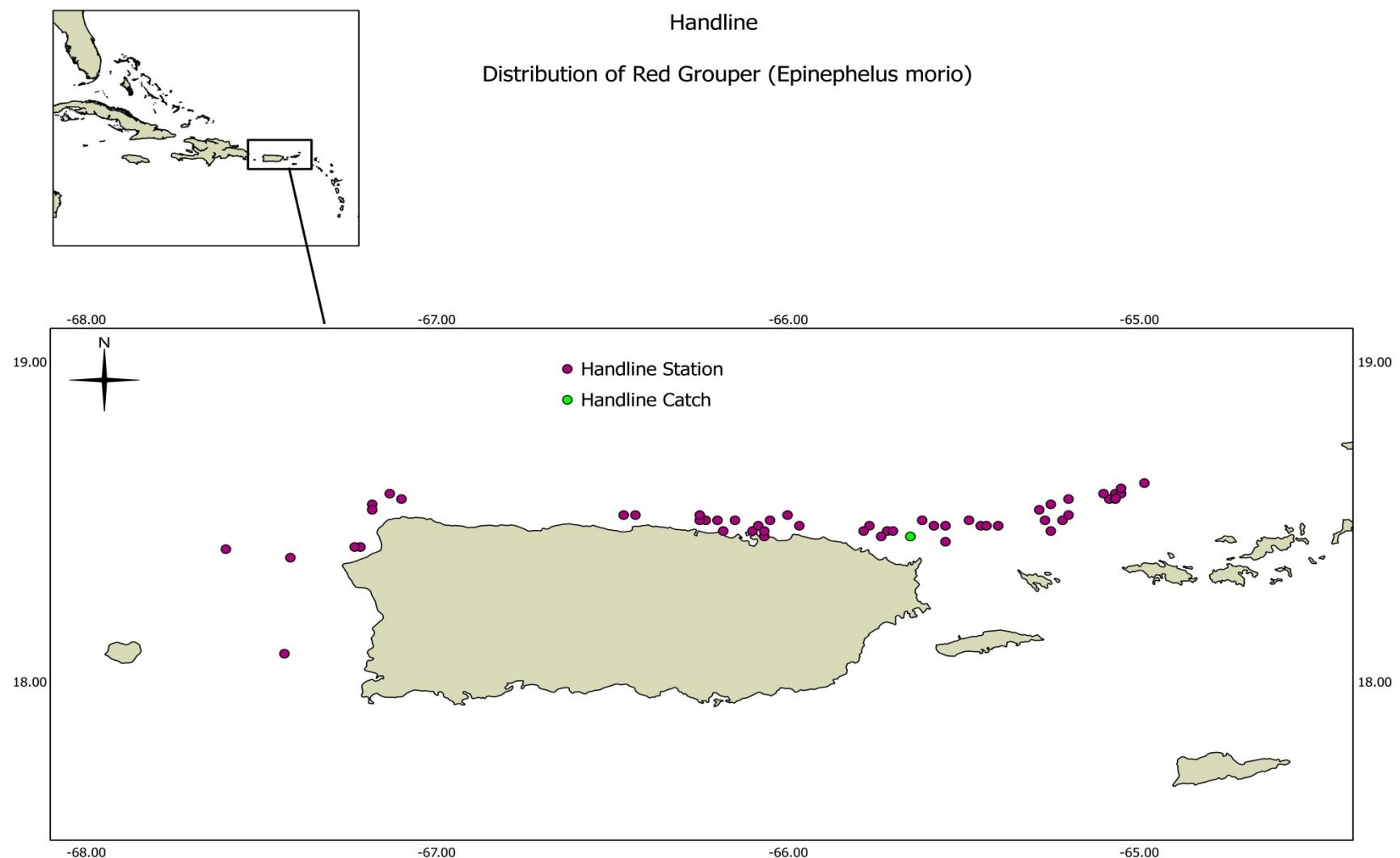


Figure 42. Distribution of red grouper (*Epinephelus morio*) captured on handlines during fishery independent surveys from 1979 - 1984.

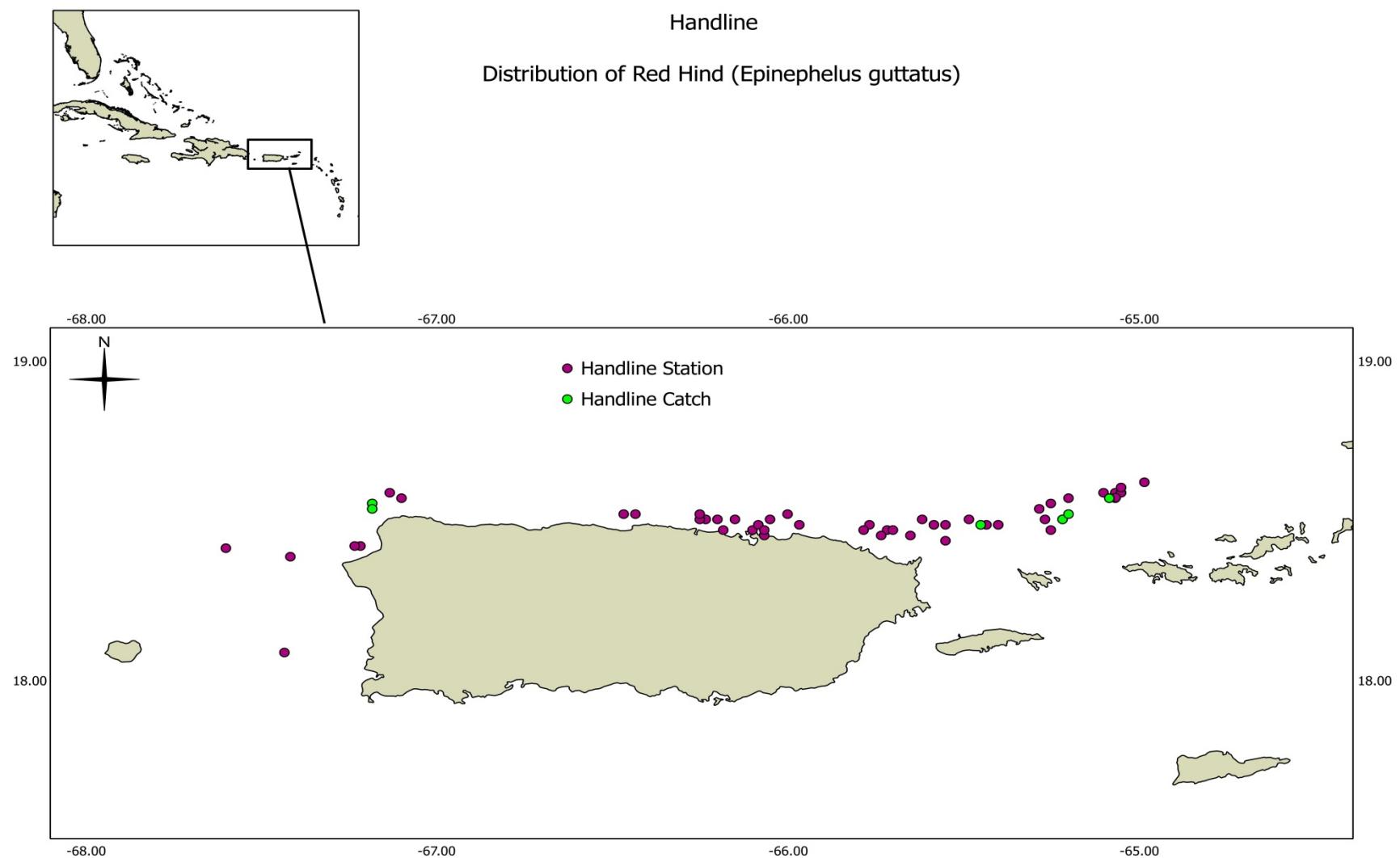


Figure 43. Distribution of red hind (*Epinephelus guttatus*) captured on handlines during fishery independent surveys from 1979 - 1984.

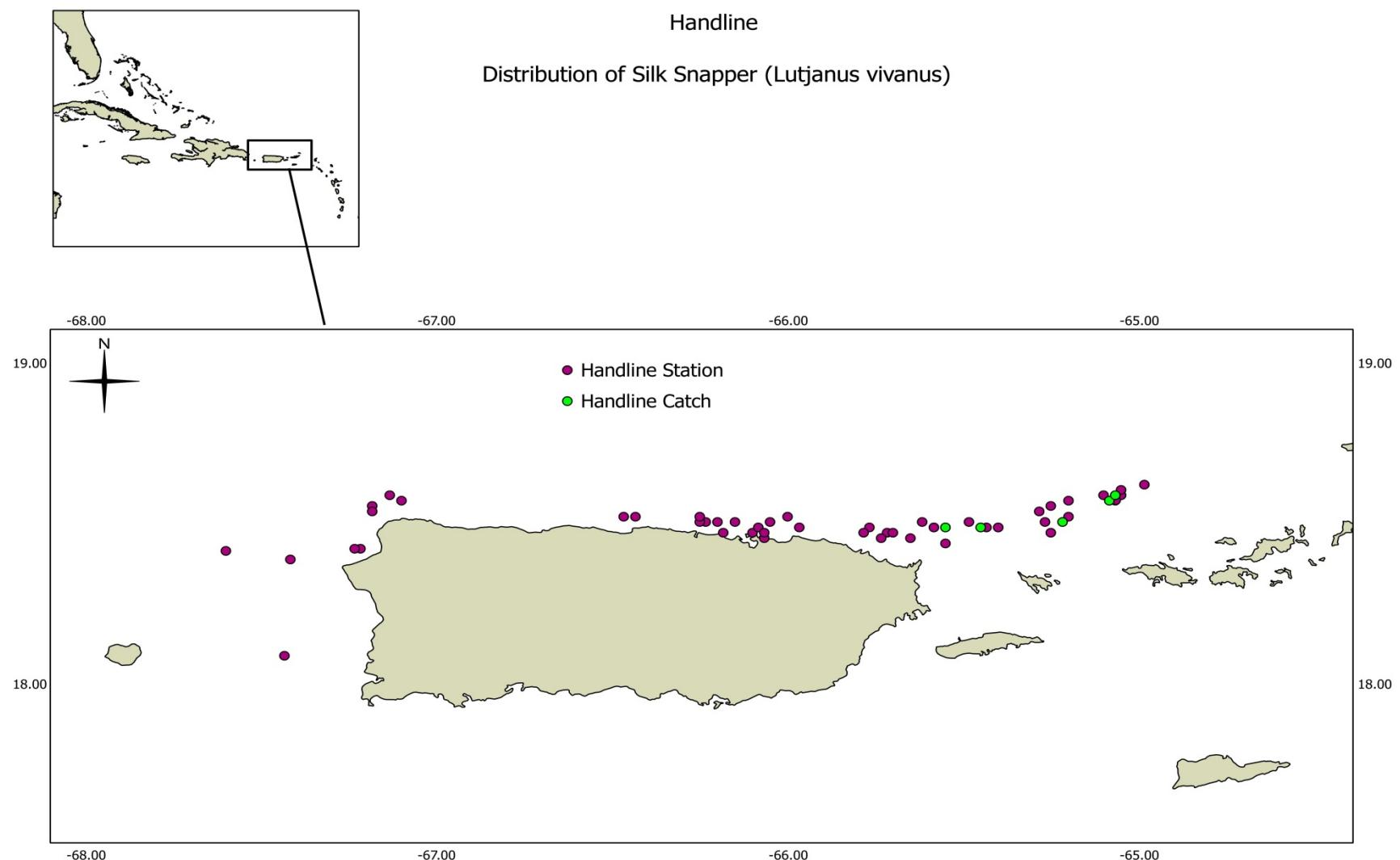


Figure 44. Distribution of silk snapper (*Lutjanus vivanus*) captured on handlines during fishery independent surveys from 1979 - 1984.

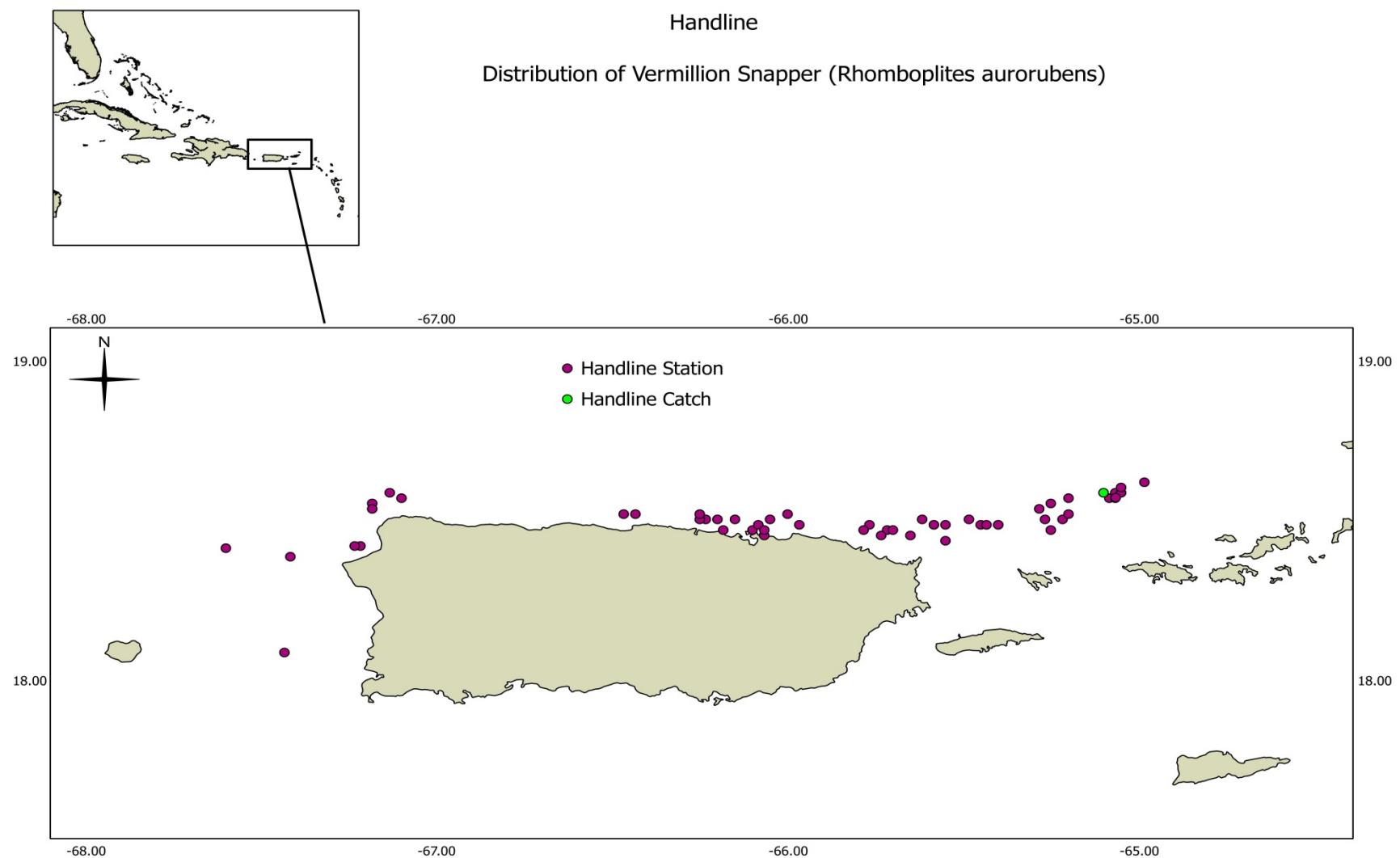


Figure 45. Distribution of vermillion snapper (*Rhomboplites aurorubens*) captured on handlines during fishery independent surveys from 1979 - 1984.

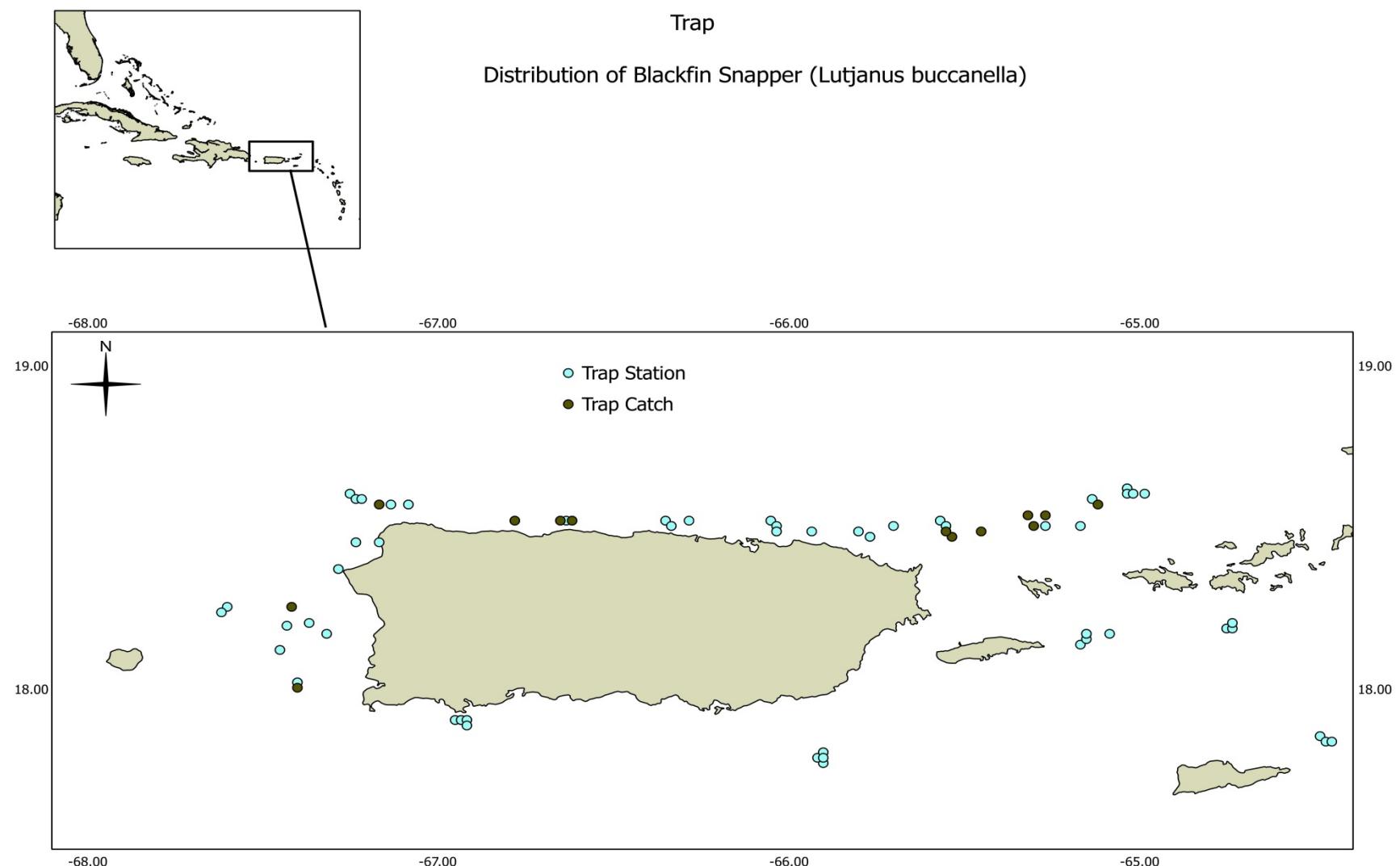


Figure 46. Distribution of blackfin snapper (*Lutjanus buccanella*) captured in fish traps during fishery independent surveys from 1979 - 1985.

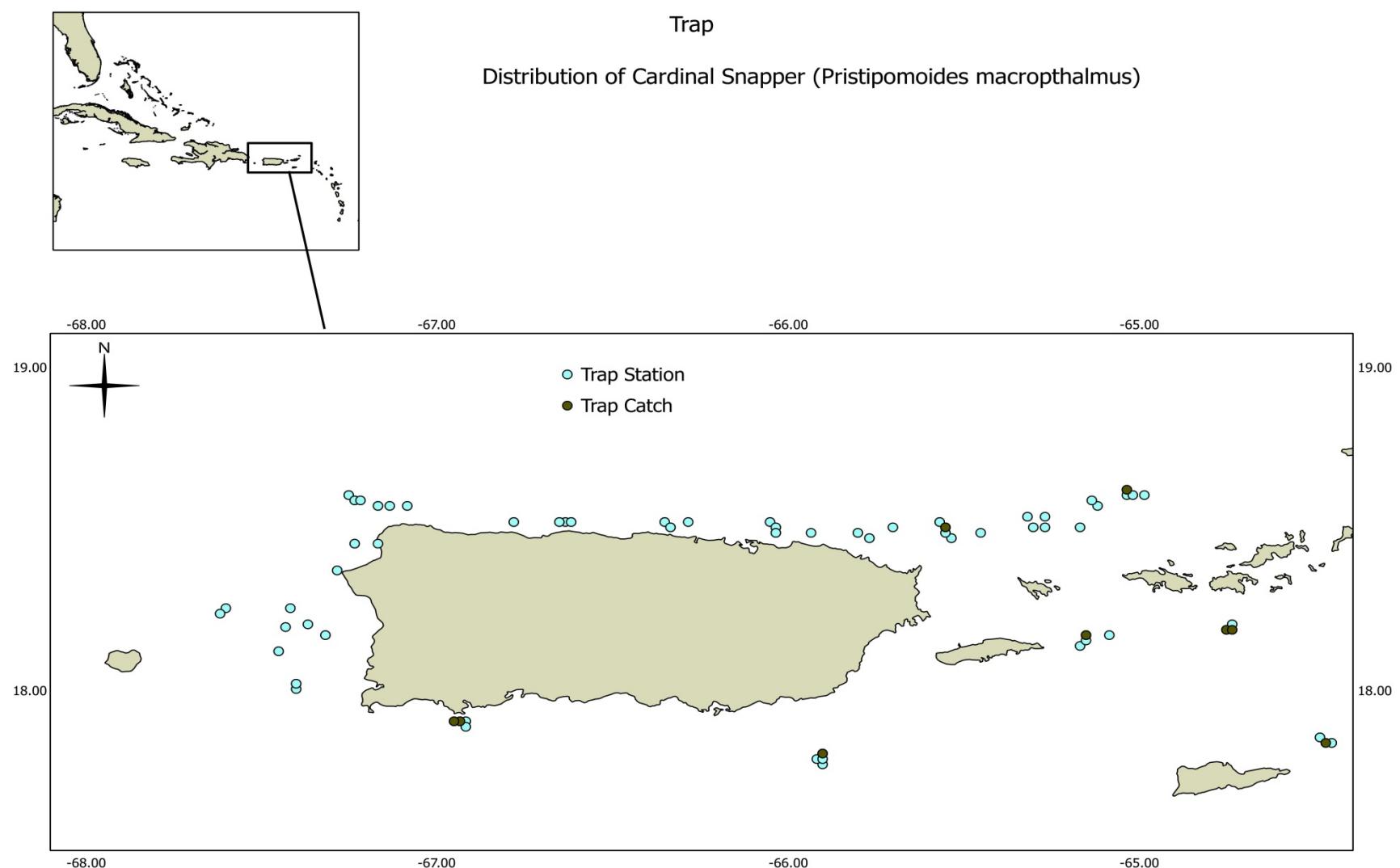


Figure 47. Distribution of cardinal snapper (*Pristipomoides macrourus*) captured in fish traps during fishery independent surveys from 1979 - 1985.

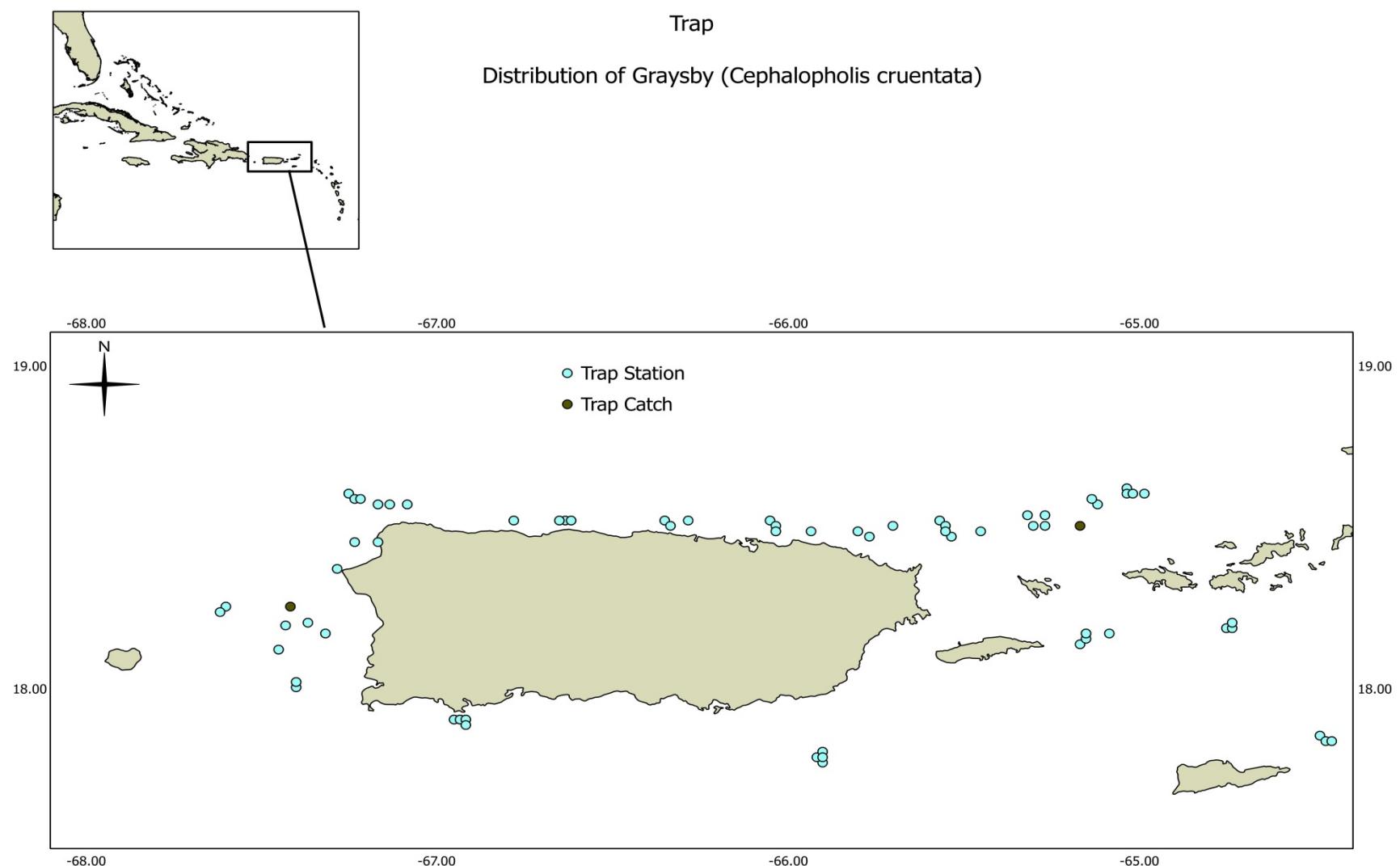


Figure 48. Distribution of graysby (*Cephalopholis cincta*) captured in fish traps during fishery independent surveys from 1979 - 1985.

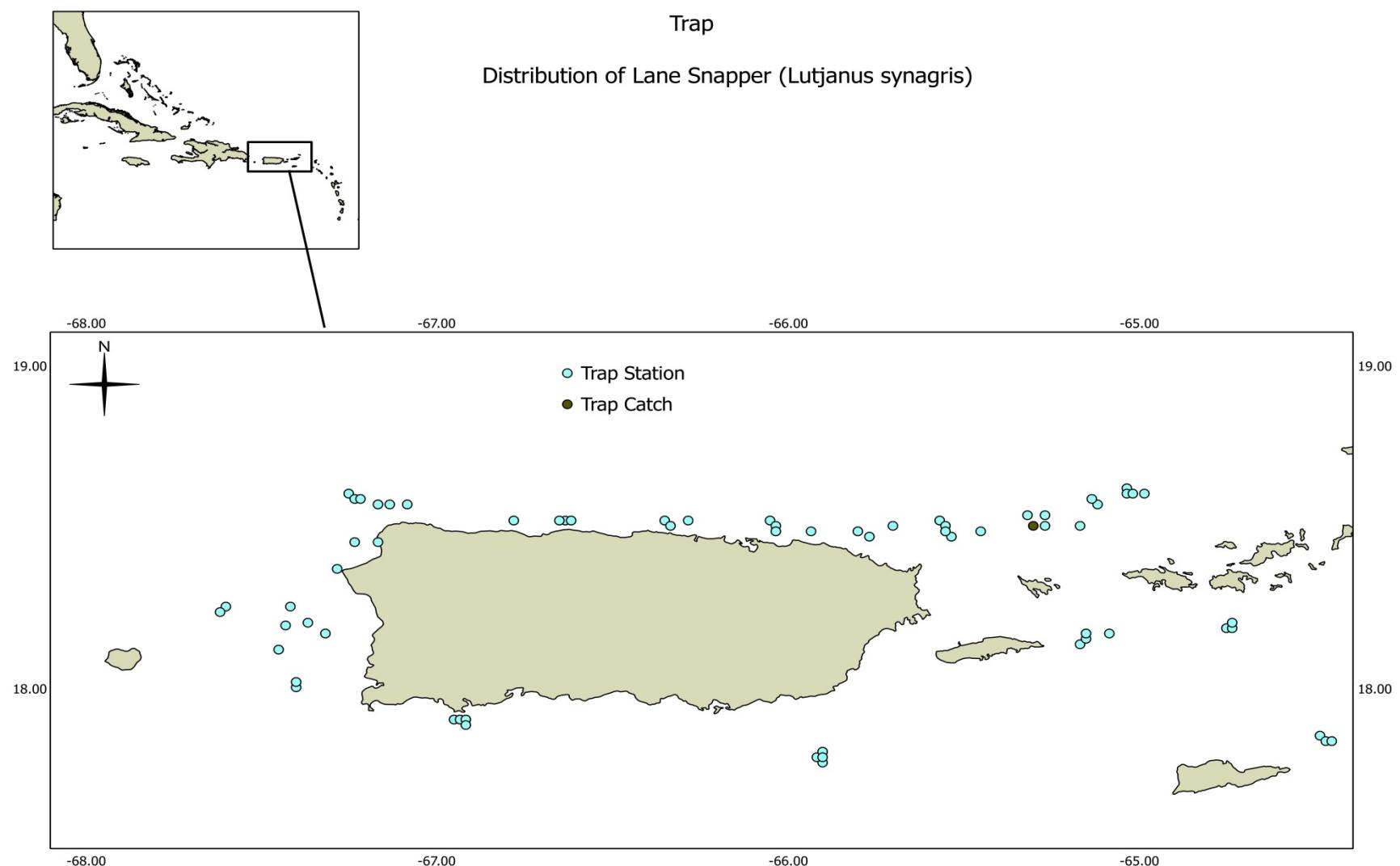


Figure 49. Distribution of lane snapper (*Lutjanus synagris*) captured in fish traps during fishery independent surveys from 1979 - 1985.

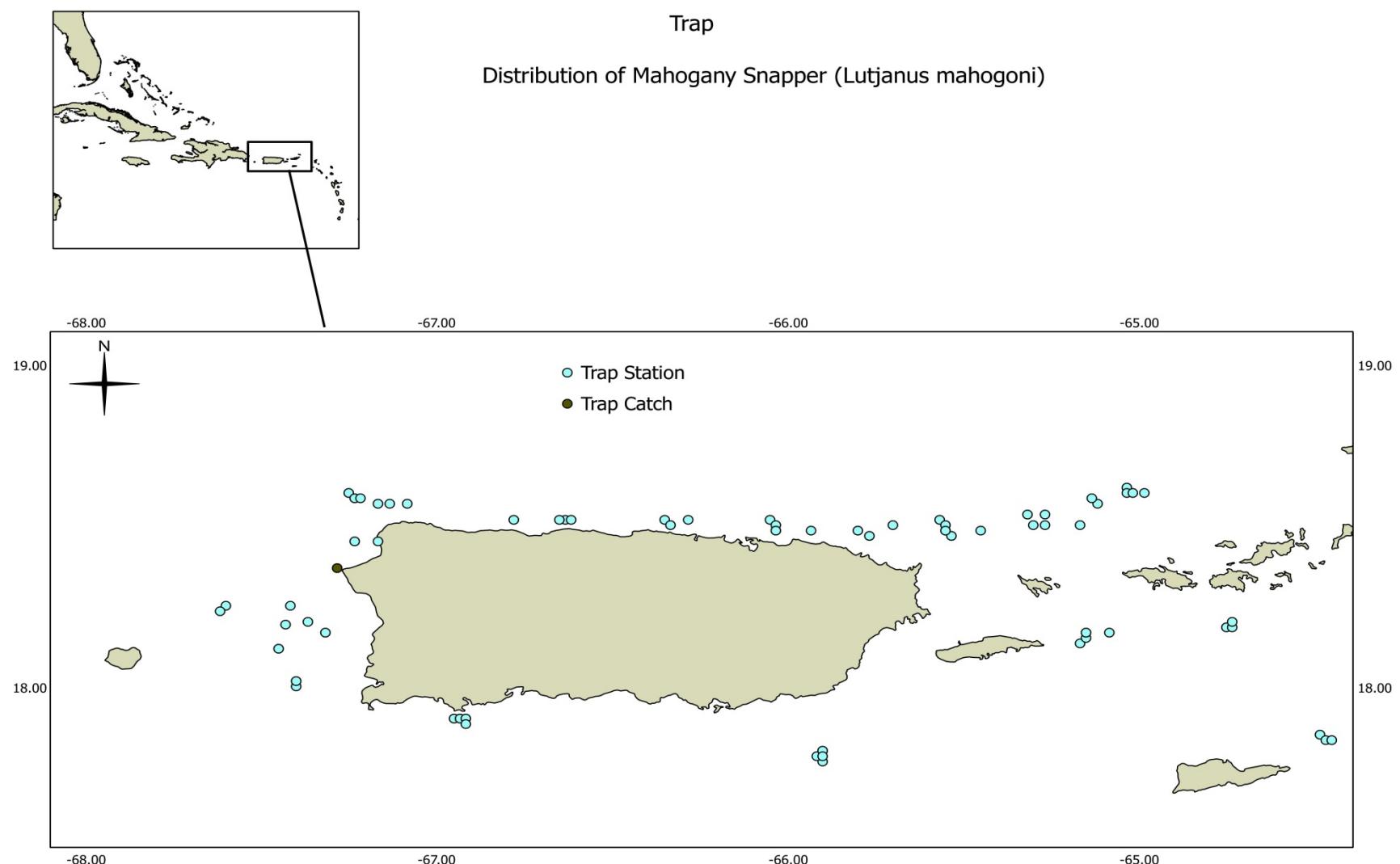


Figure 50. Distribution of mahogany snapper (*Lutjanus mahogoni*) captured in fish traps during fishery independent surveys from 1979 - 1985.

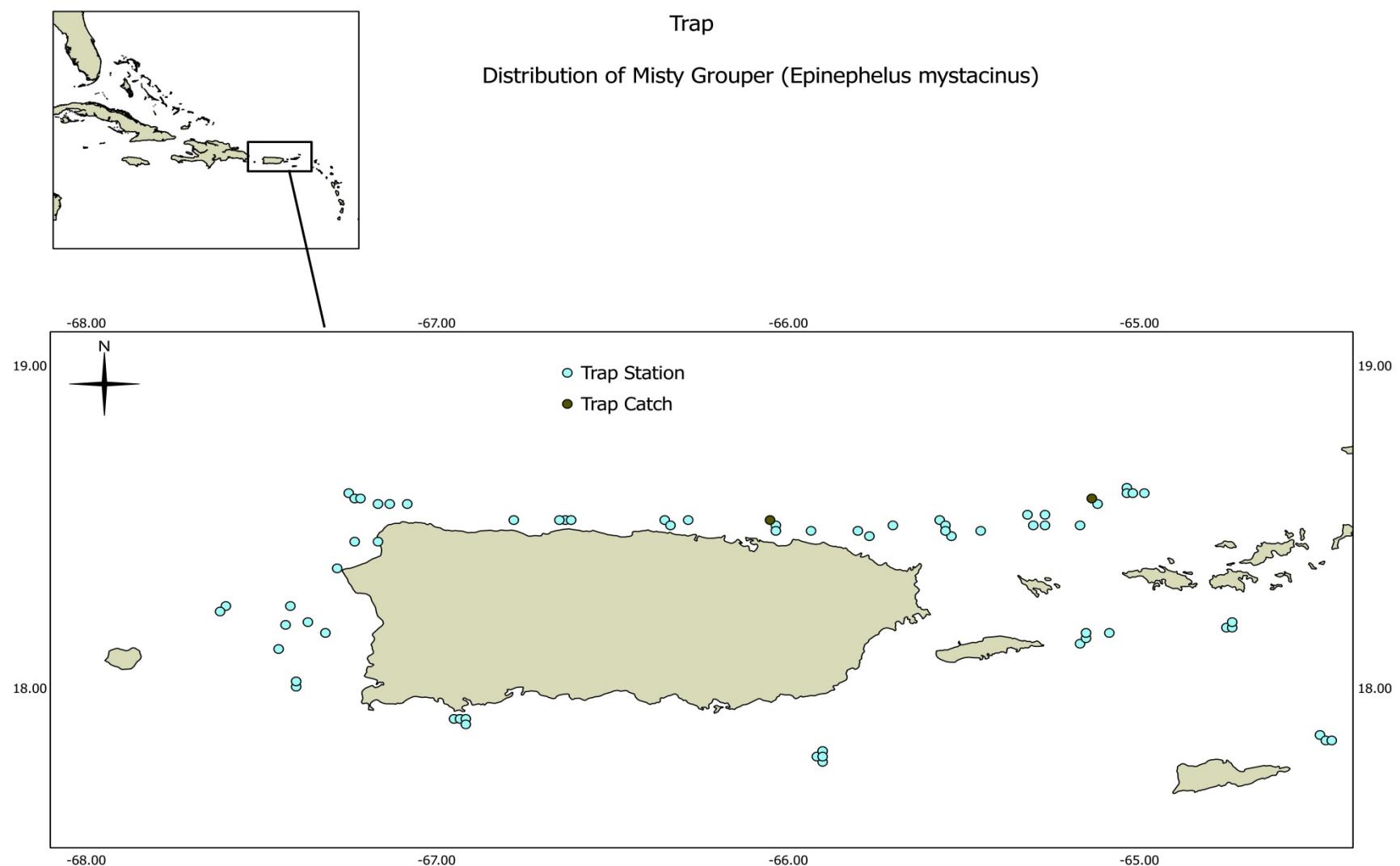


Figure 51. Distribution of misty grouper (*Epinephelus mystacinus*) captured in fish traps during fishery independent surveys from 1979 - 1985.

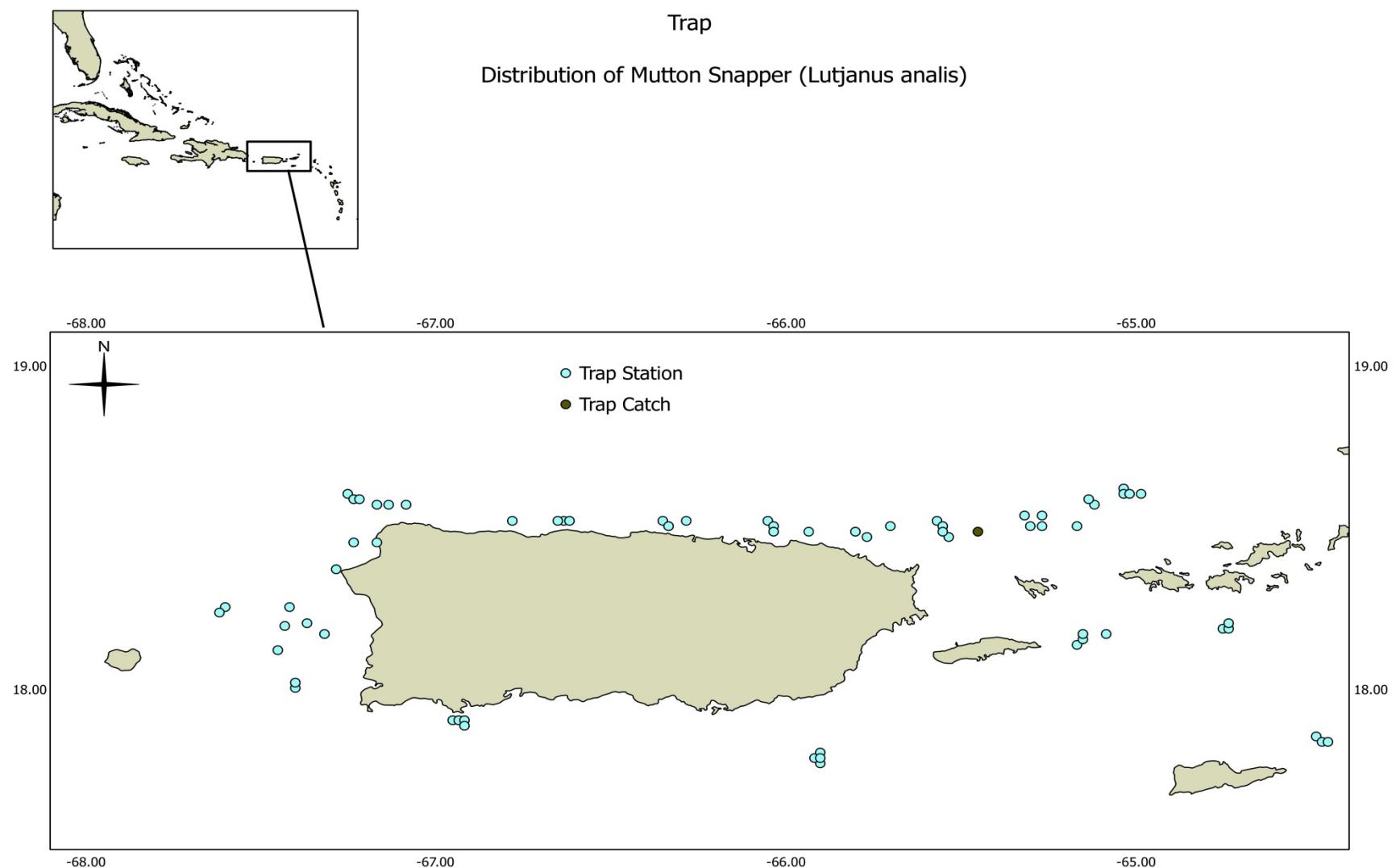


Figure 52. Distribution of mutton snapper (*Lutjanus analis*) captured in fish traps during fishery independent surveys from 1979 - 1985.

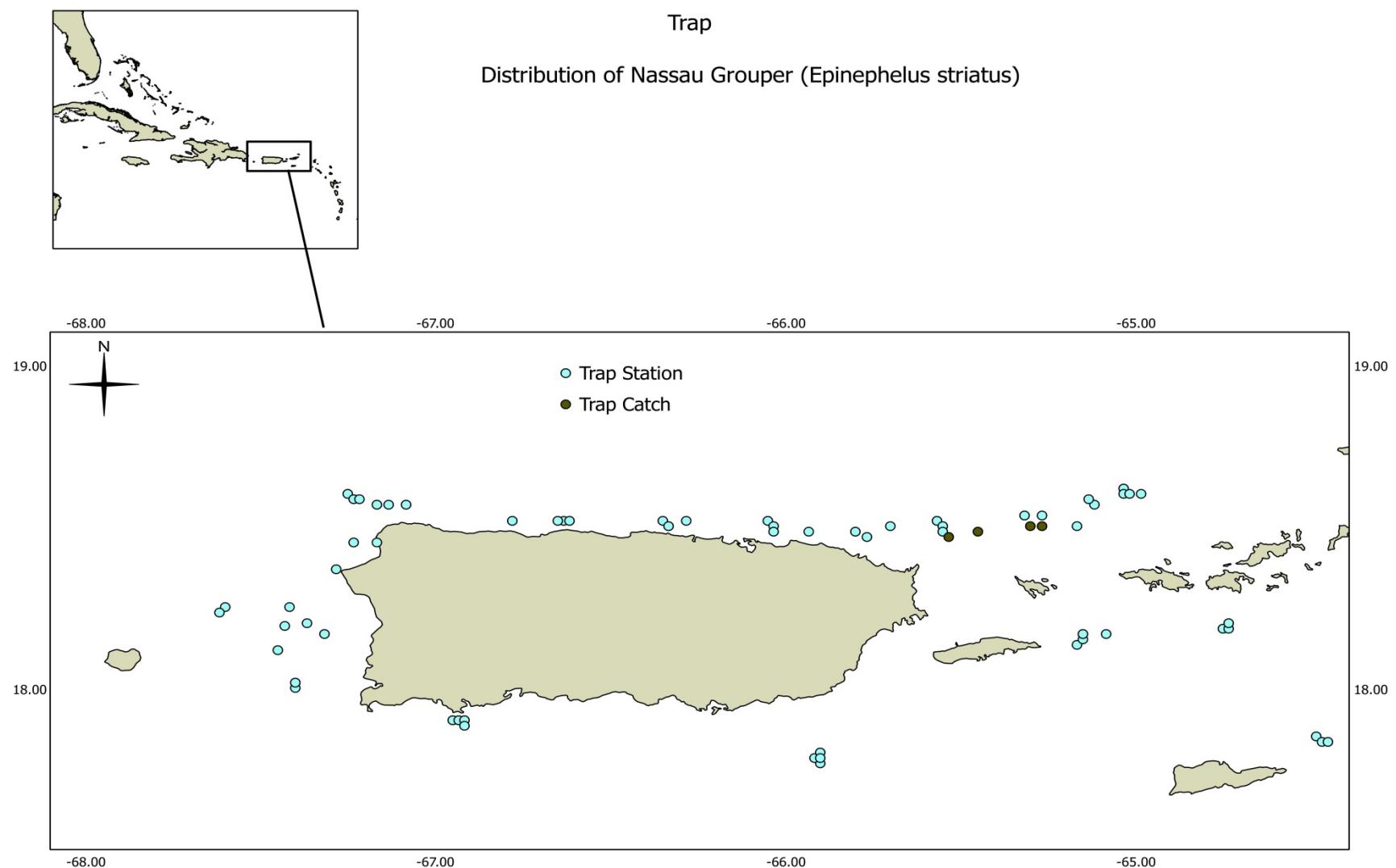


Figure 53. Distribution of nassau grouper (*Epinephelus striatus*) captured in fish traps during fishery independent surveys from 1979 - 1985.

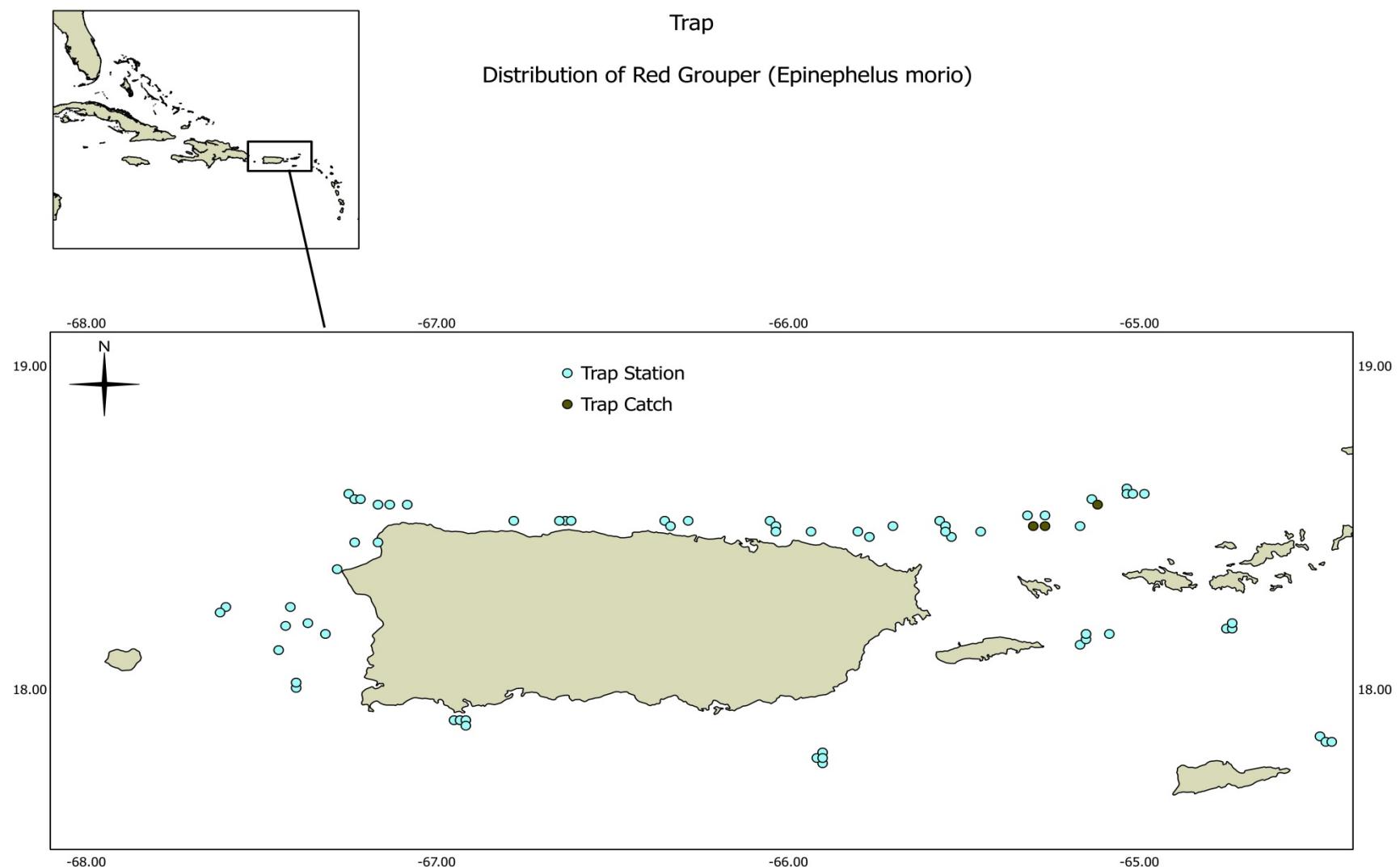


Figure 54. Distribution of red grouper (*Epinephelus morio*) captured in fish traps during fishery independent surveys from 1979 - 1985.

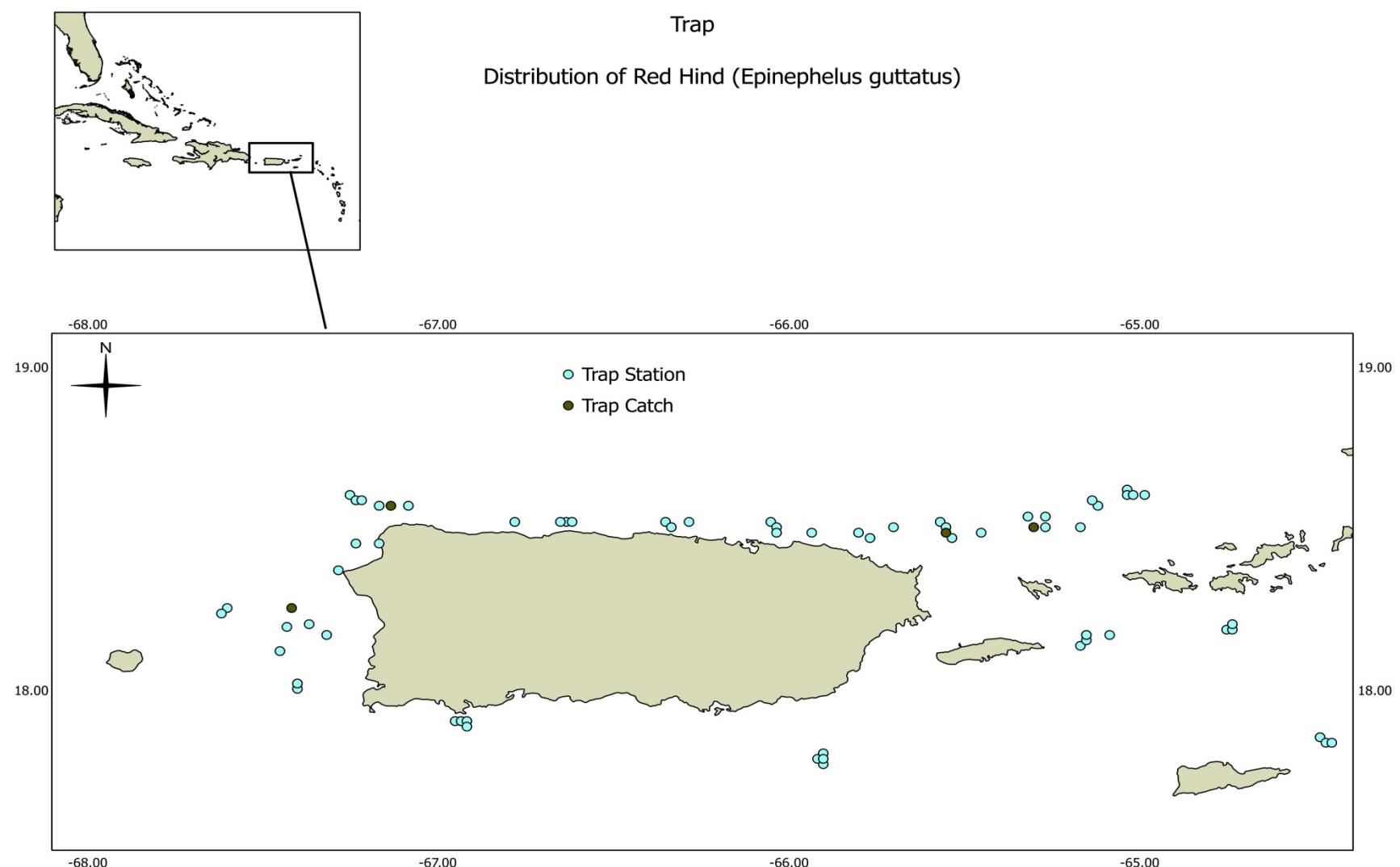


Figure 55. Distribution of red hind (*Epinephelus guttatus*) captured in fish traps during fishery independent surveys from 1979 - 1985.

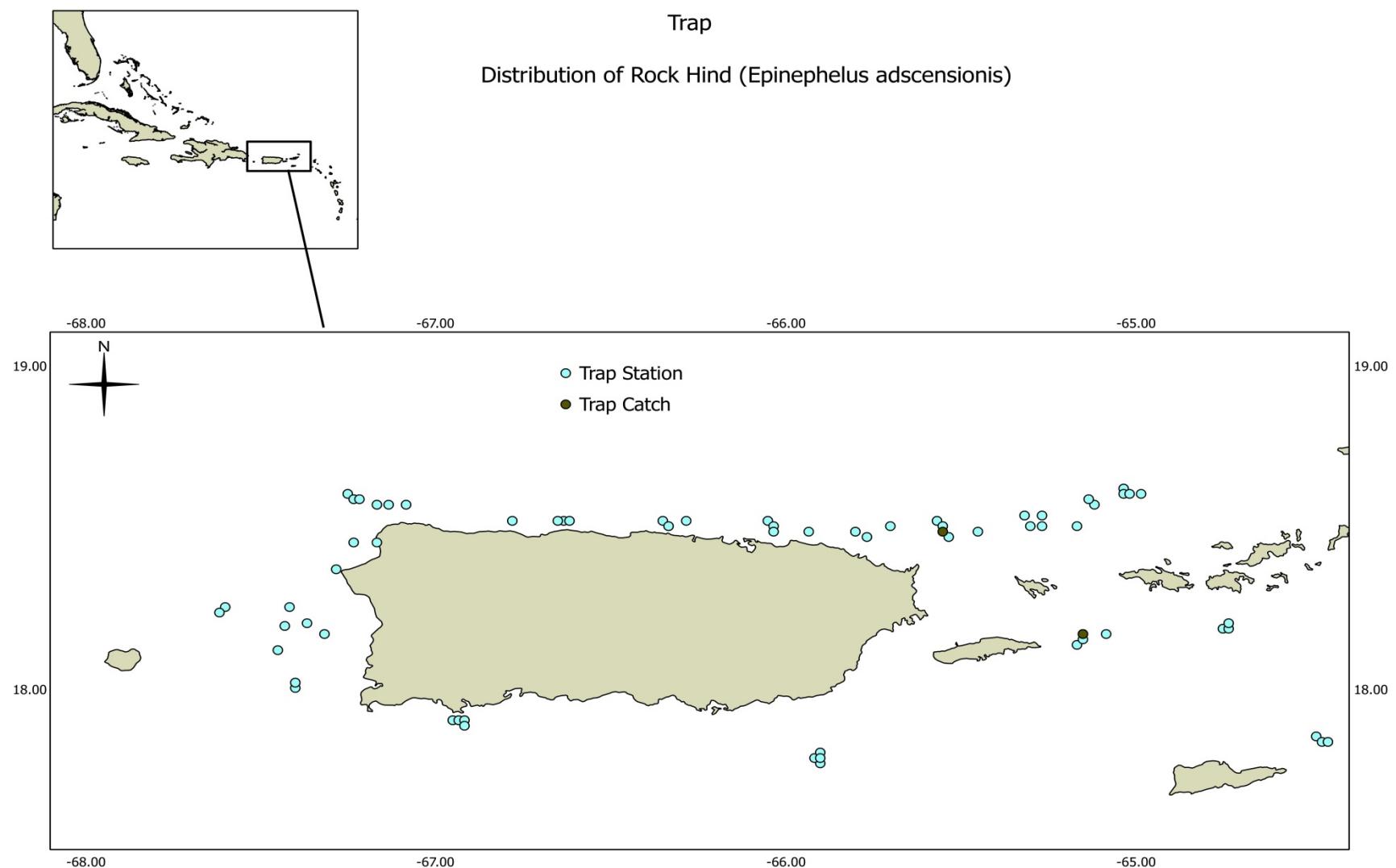


Figure 56. Distribution of rock hind (*Epinephelus adscensionis*) captured in fish traps during fishery independent surveys from 1979 - 1985.

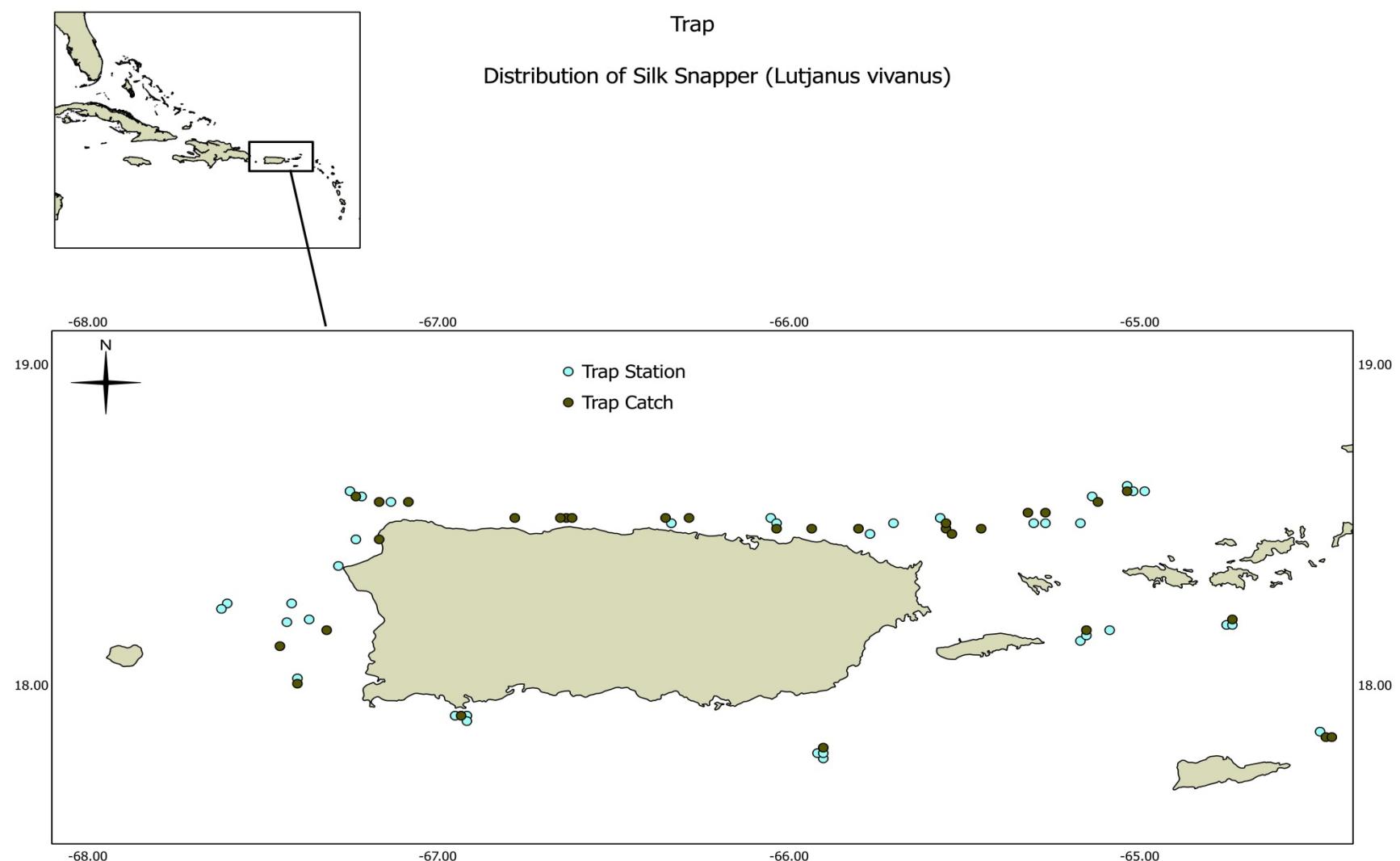


Figure 57. Distribution of silk snapper (*Lutjanus vivanus*) captured in fish traps during fishery independent surveys from 1979 - 1985.

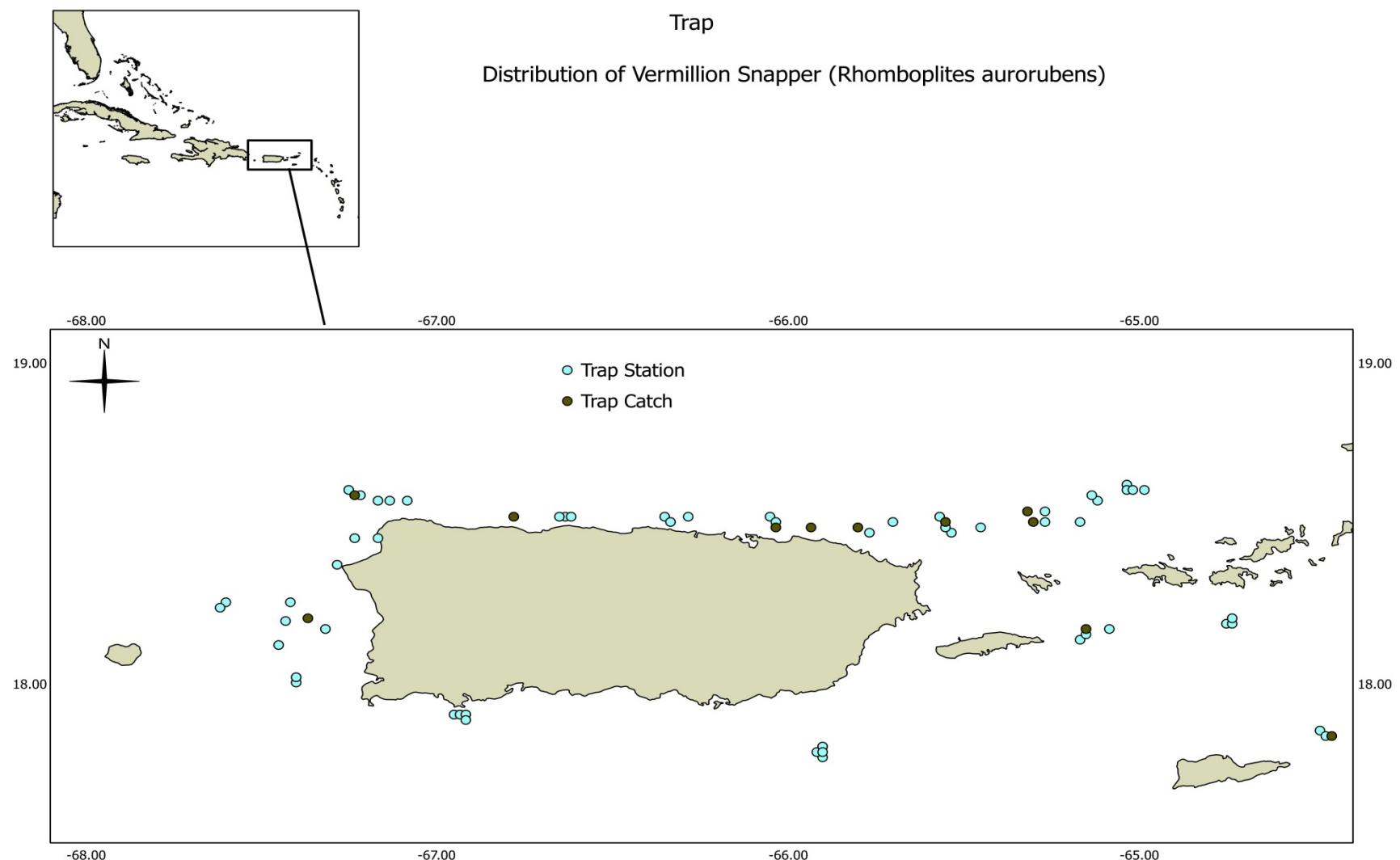


Figure 58. Distribution of vermillion snapper (*Rhomboplites aurorubens*) captured in fish traps during fishery independent surveys from 1979 - 1985.

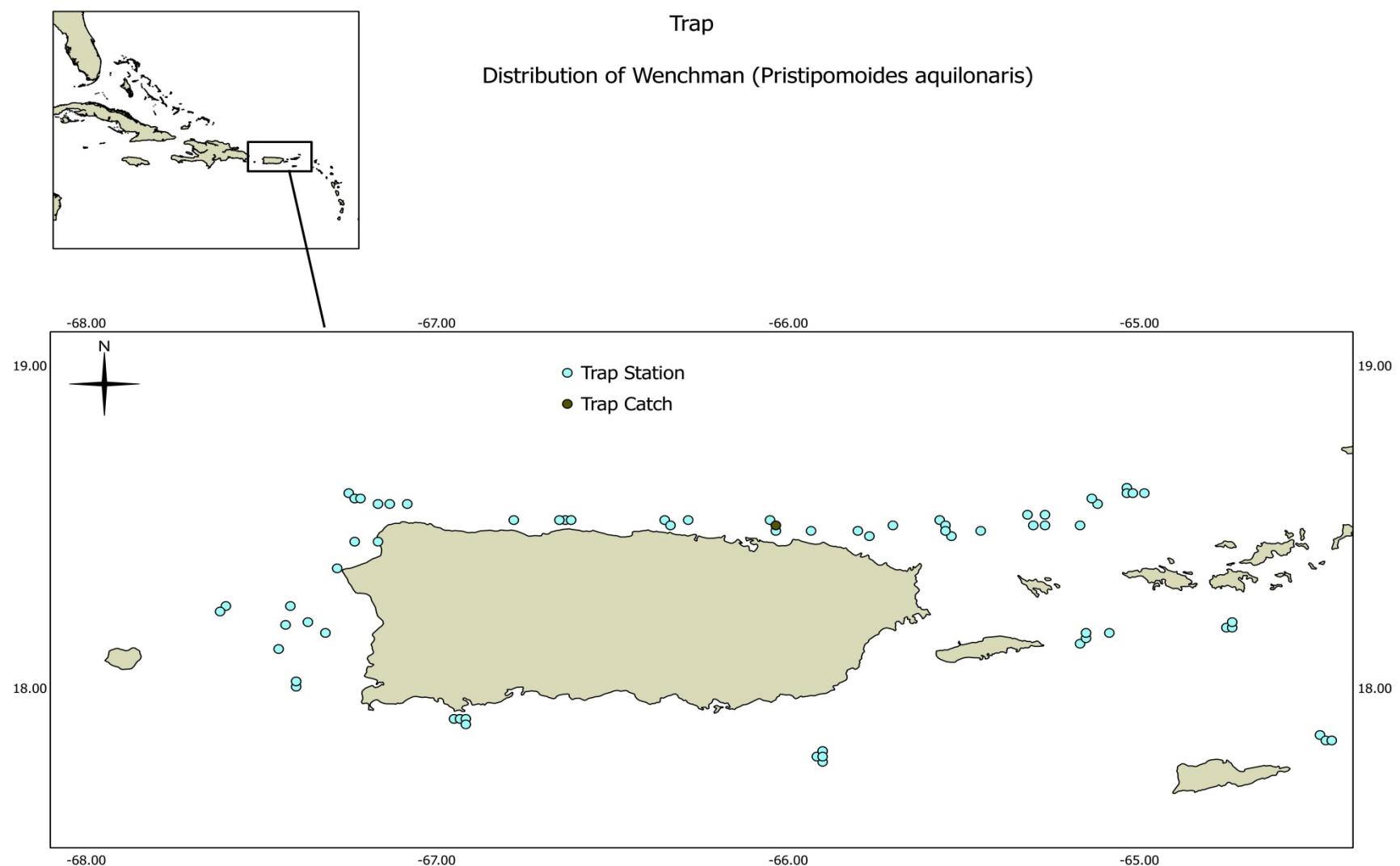


Figure 59. Distribution of wenchman (*Pristipomoides aquilonaris*) captured in fish traps during fishery independent surveys from 1979 - 1985.

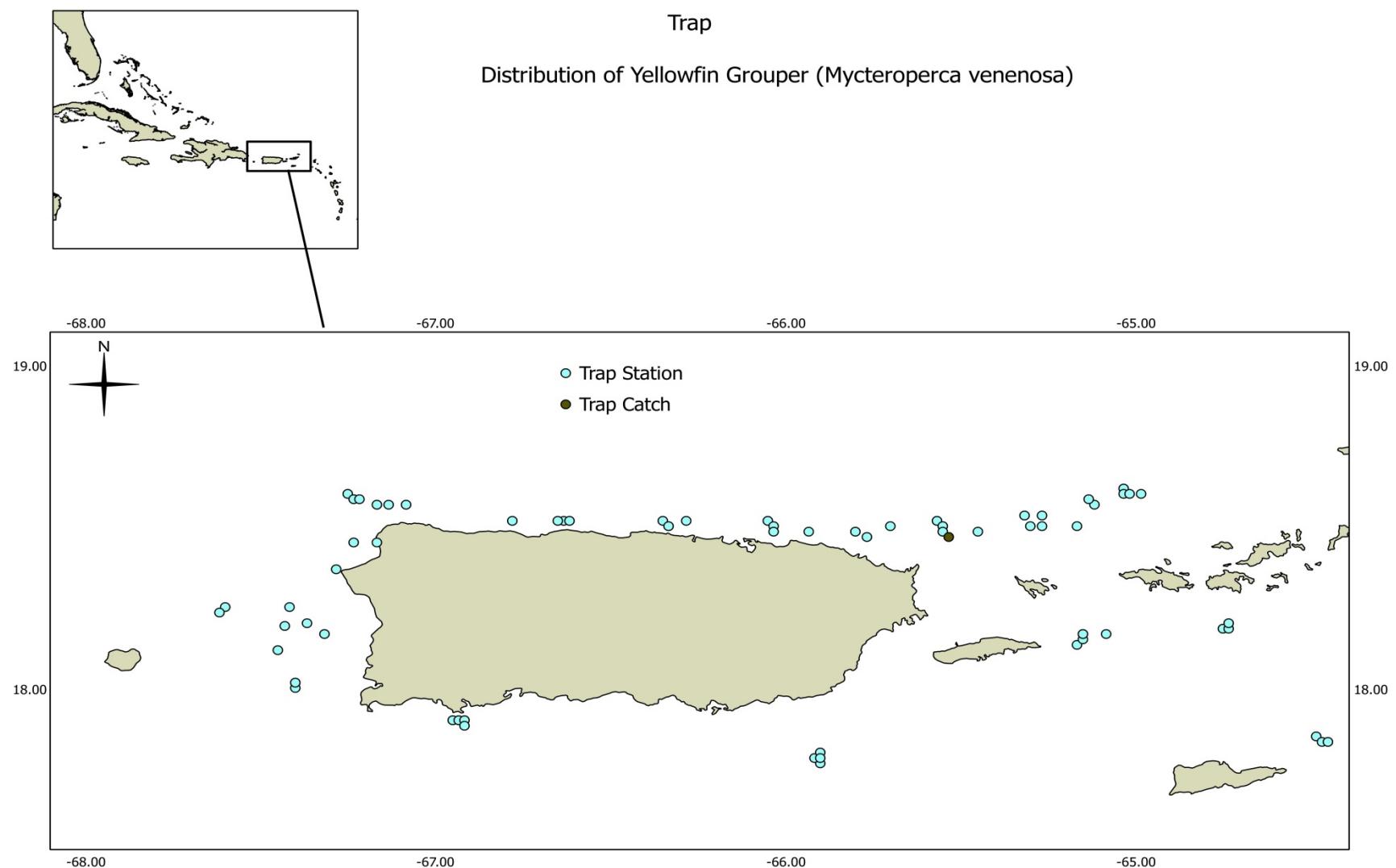


Figure 60. Distribution of yellowfin grouper (*Mycteroperca venenosa*) captured in fish traps during fishery independent surveys from 1979 - 1985.

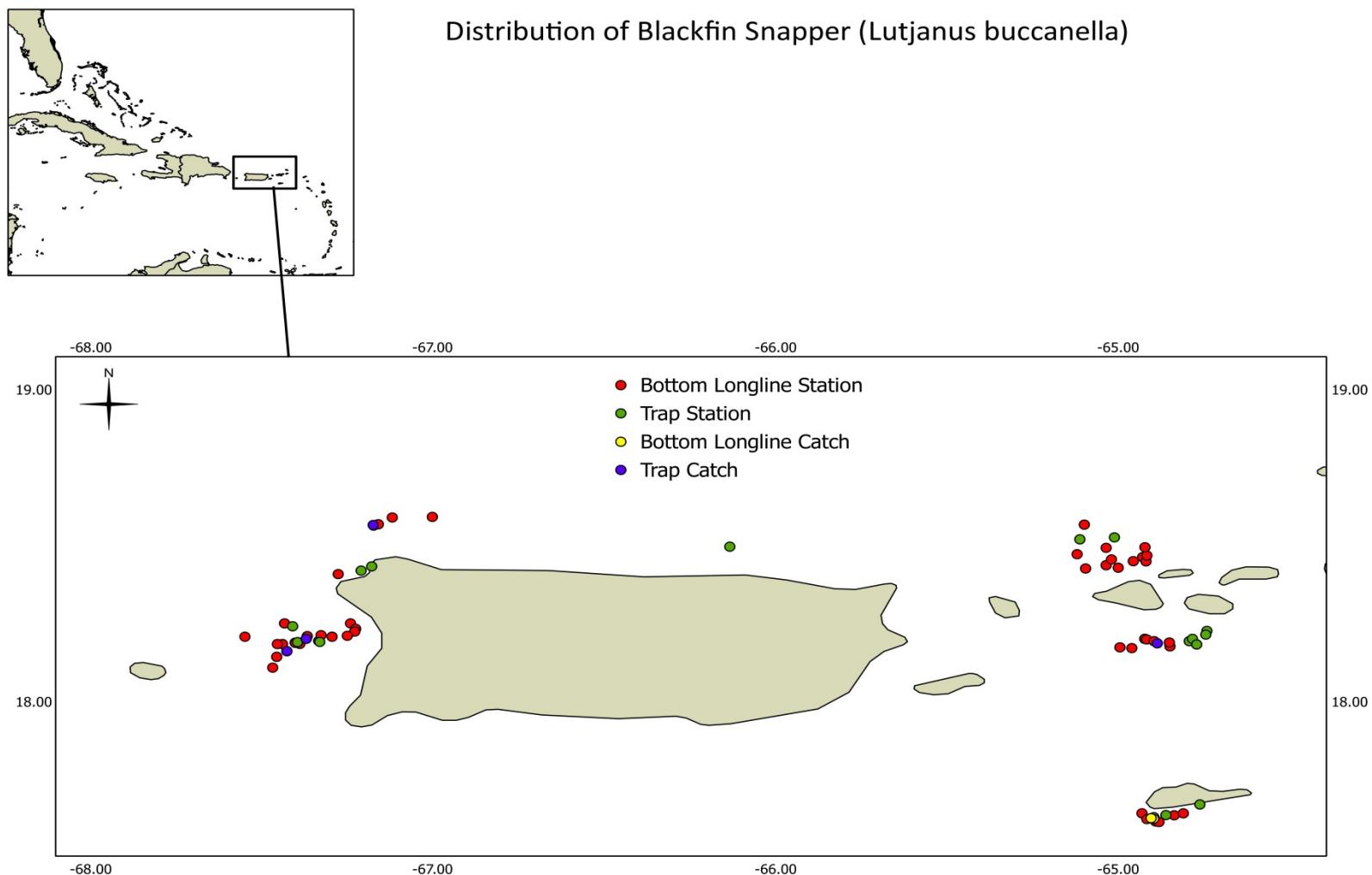


Figure 61. Distribution of blackfin snapper (*Lutjanus buccanella*) captured on bottom longline and fish traps during a fishery independent survey in 2009.

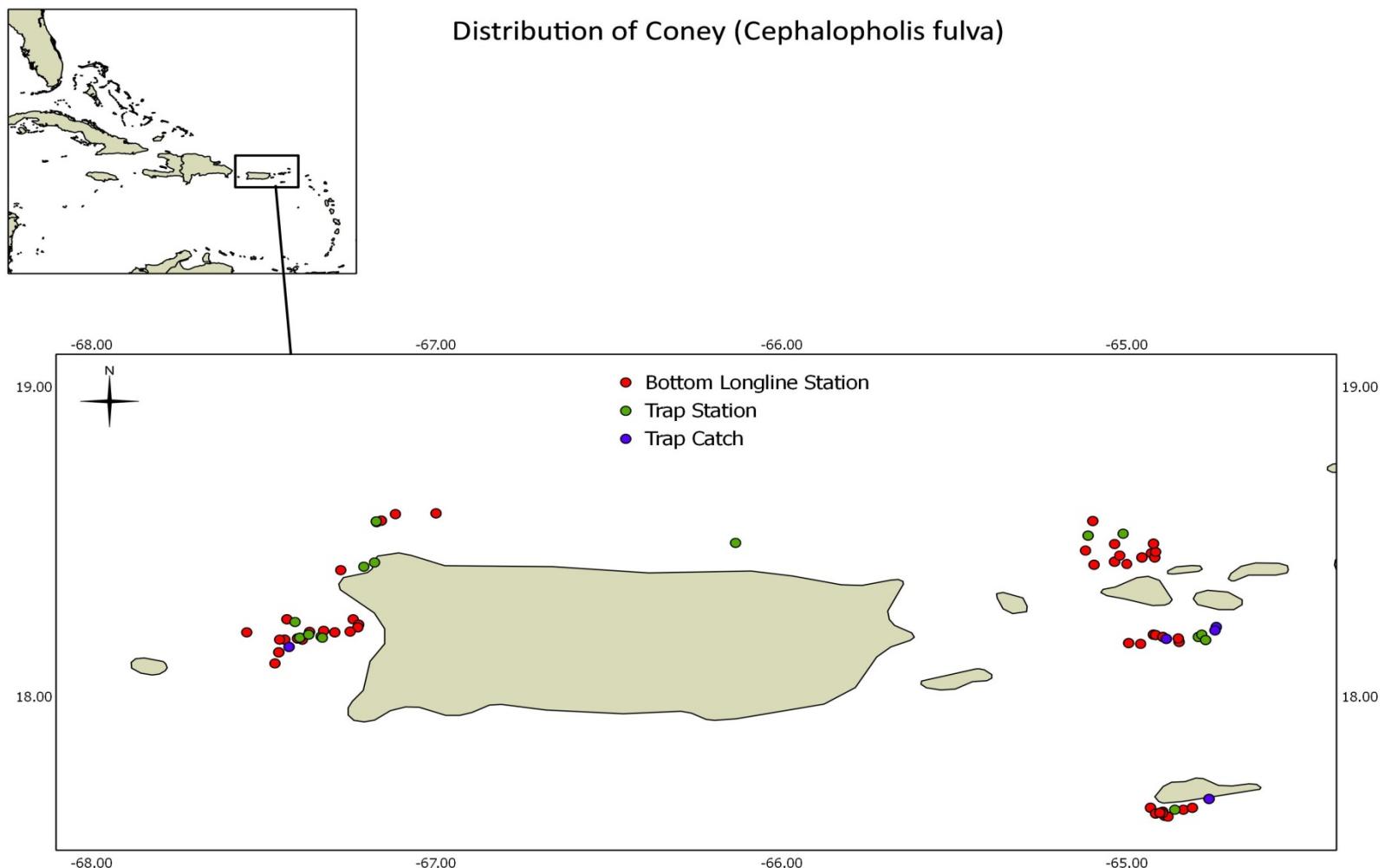


Figure 62. Distribution of coney (*Cephalopholis fulva*) captured on bottom longline and fish traps during a fishery independent survey in 2009.

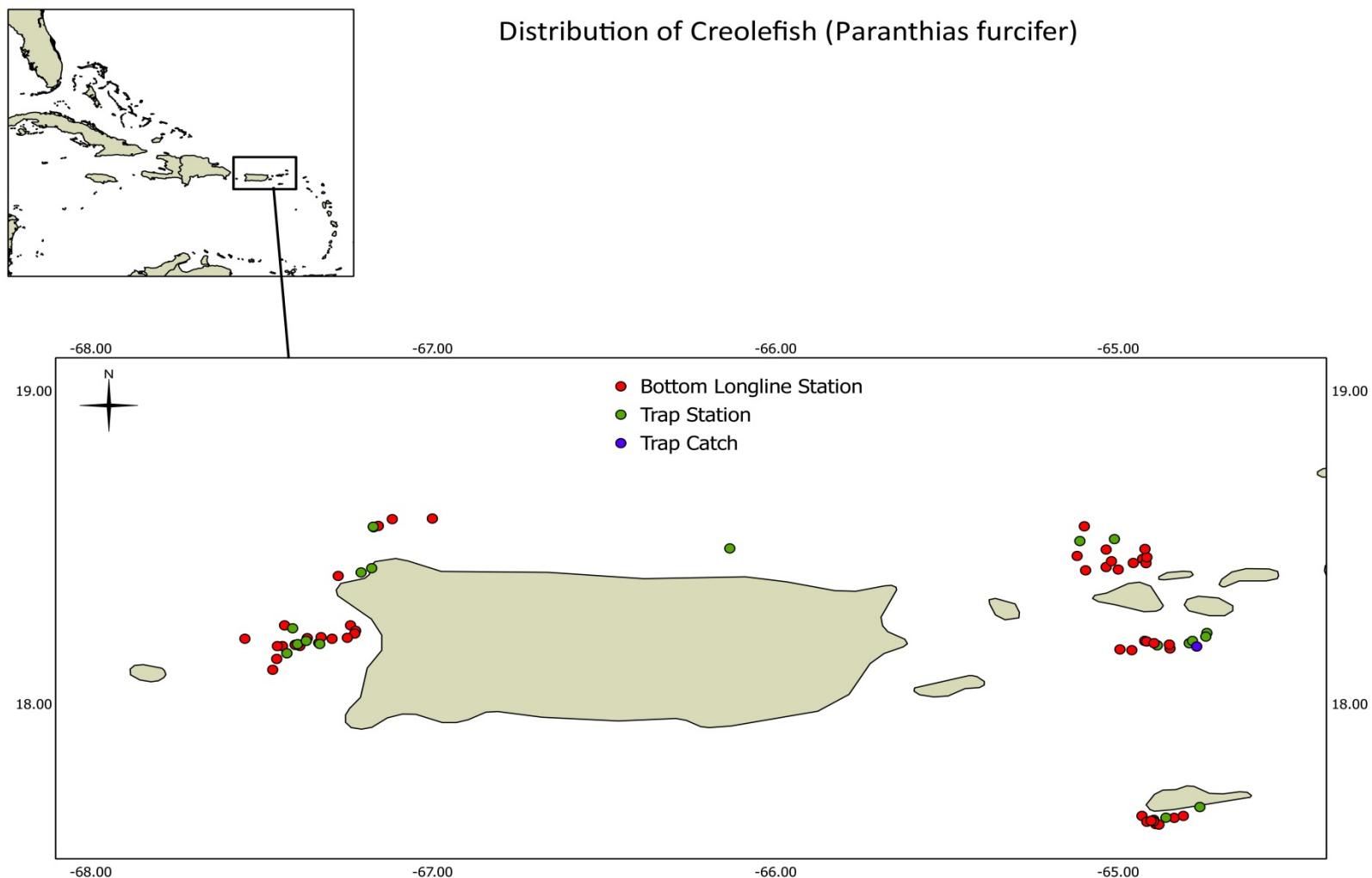


Figure 63. Distribution of creolefish (*Paranthias furcifer*) captured on bottom longline and fish traps during a fishery independent survey in 2009.

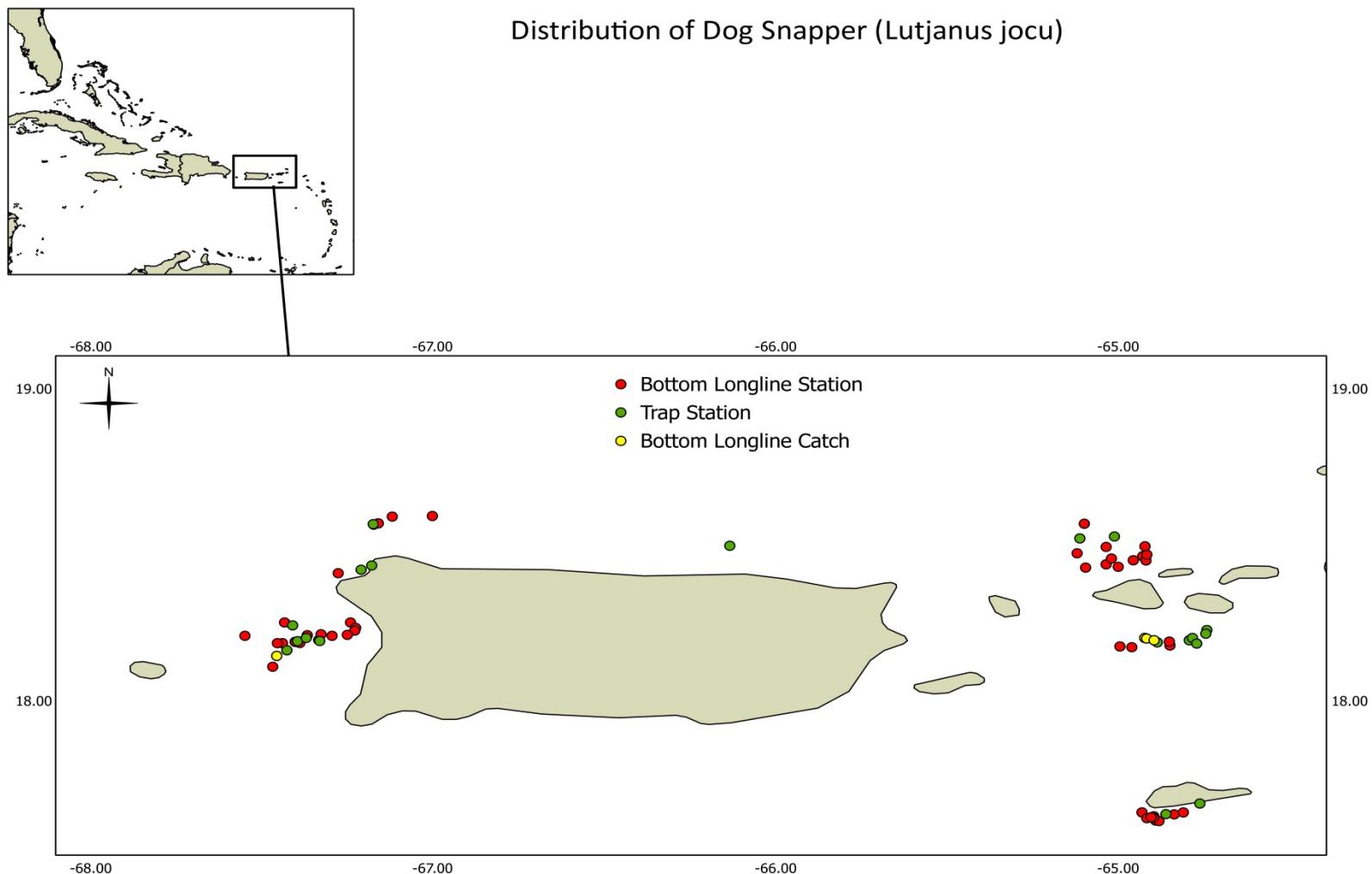


Figure 64. Distribution of dog snapper (*Lutjanus jocu*) captured on bottom longline and fish traps during a fishery independent survey in 2009.

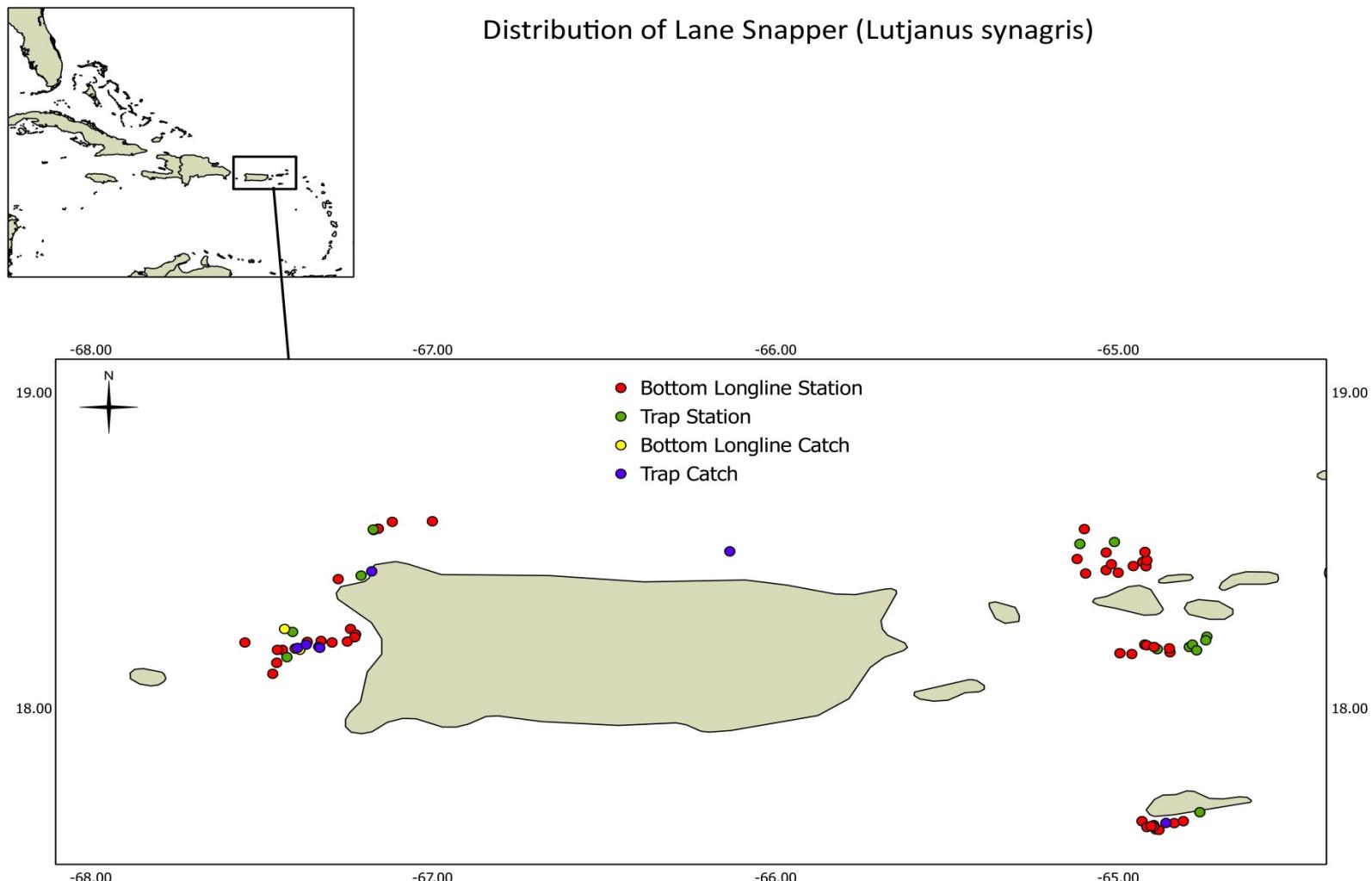


Figure 65. Distribution of lane snapper (*Lutjanus synagris*) captured on bottom longline and fish traps during a fishery independent survey in 2009.

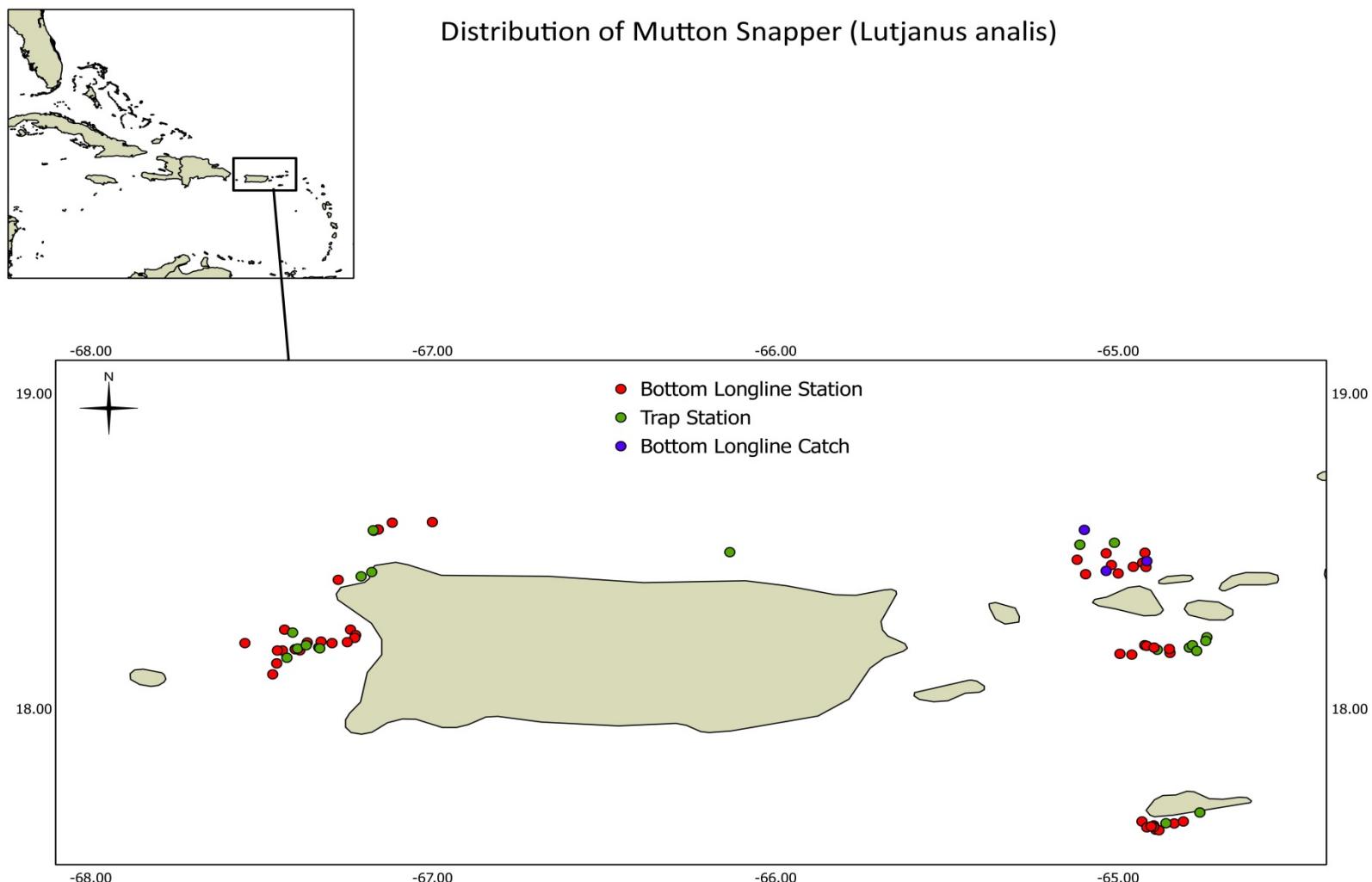


Figure 66. Distribution of mutton snapper (*Lutjanus analis*) captured on bottom longline and fish traps during a fishery independent survey in 2009.

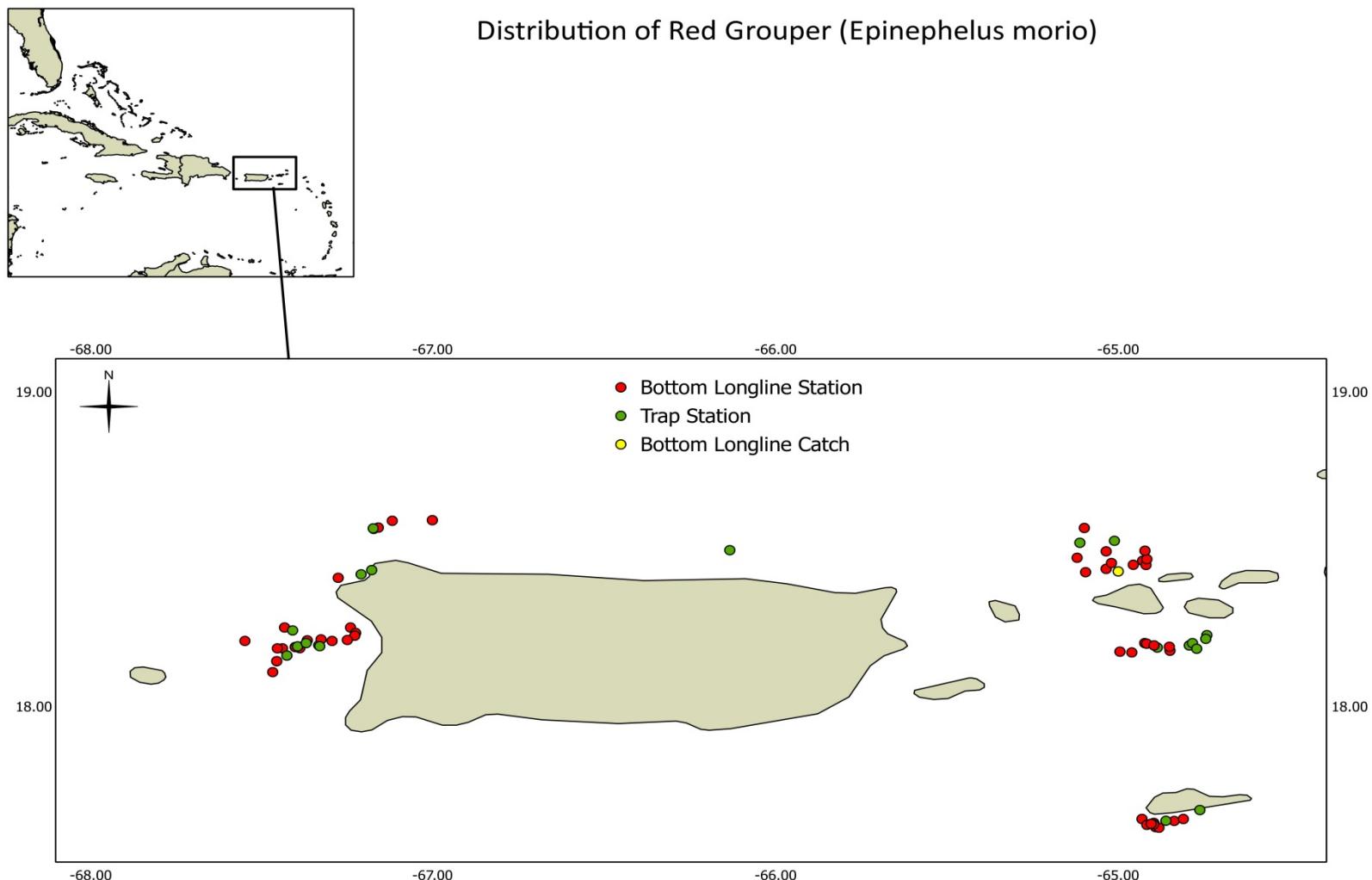


Figure 67. Distribution of red grouper (*Epinephelus morio*) captured on bottom longline and fish traps during a fishery independent survey in 2009.

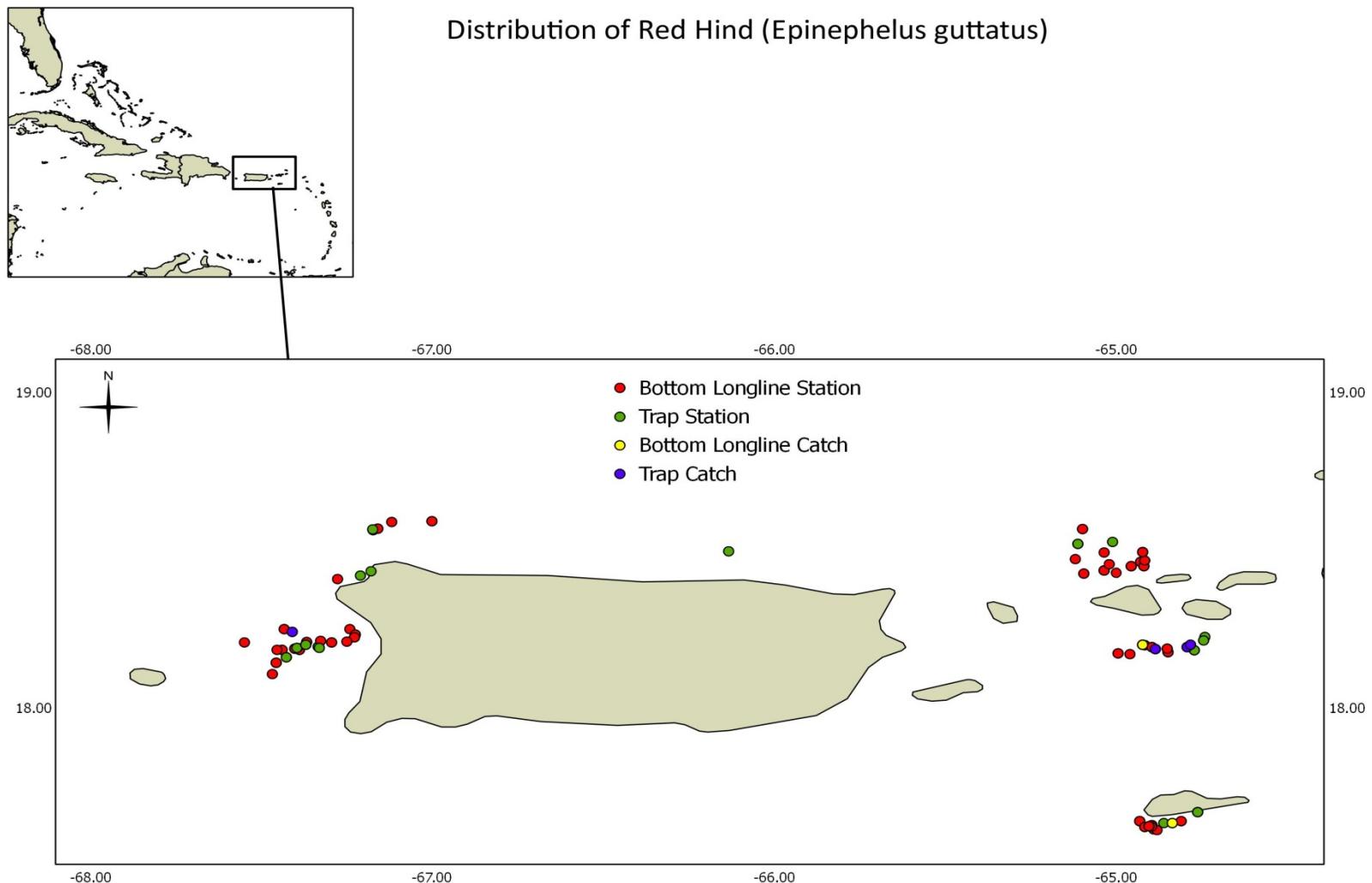


Figure 68. Distribution of red hind (*Epinephelus guttatus*) captured on bottom longline and fish traps during a fishery independent survey in 2009.

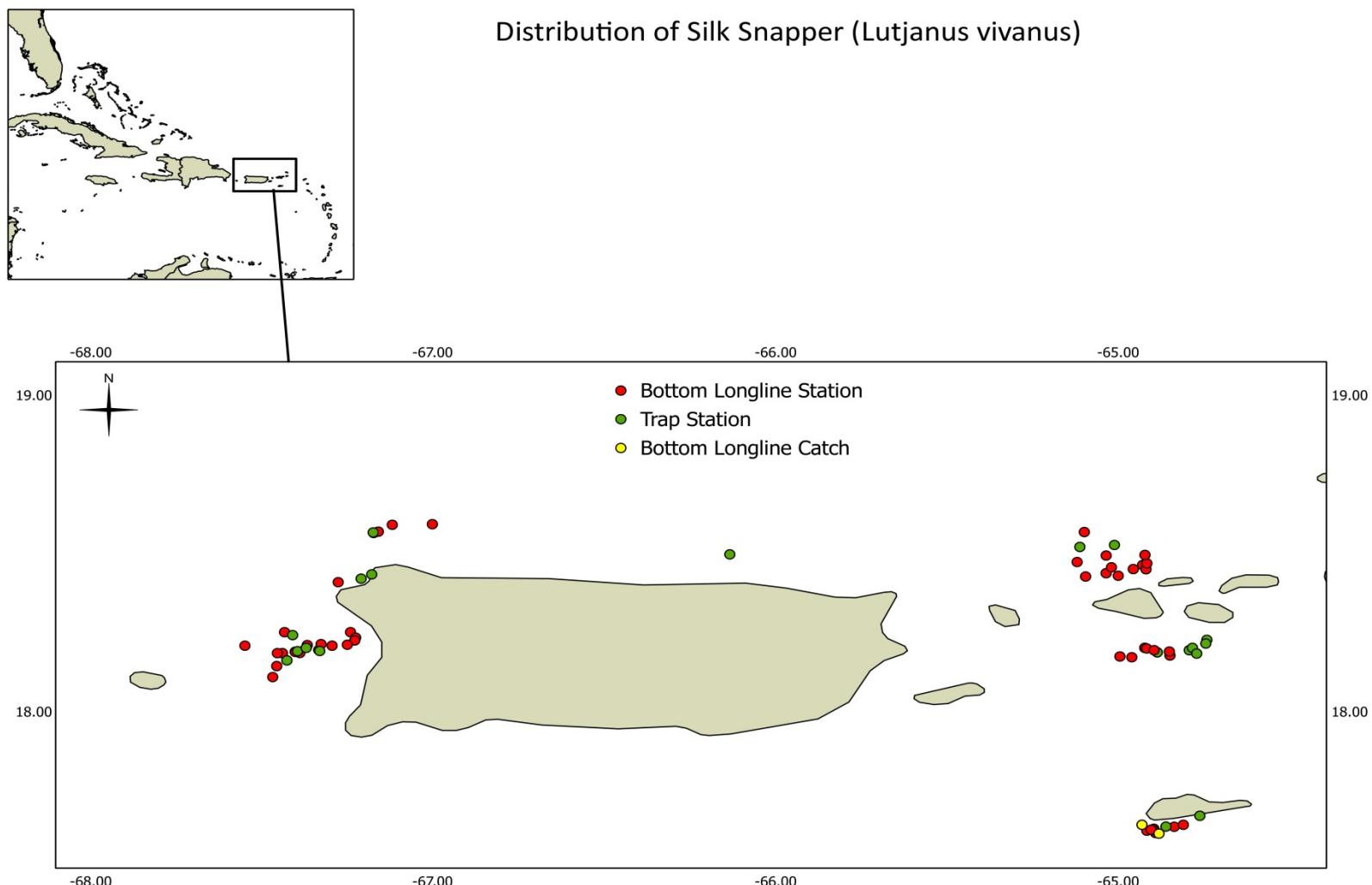


Figure 69. Distribution of silk snapper (*Lutjanus vivanus*) captured on bottom longline and fish traps during a fishery independent survey in 2009.

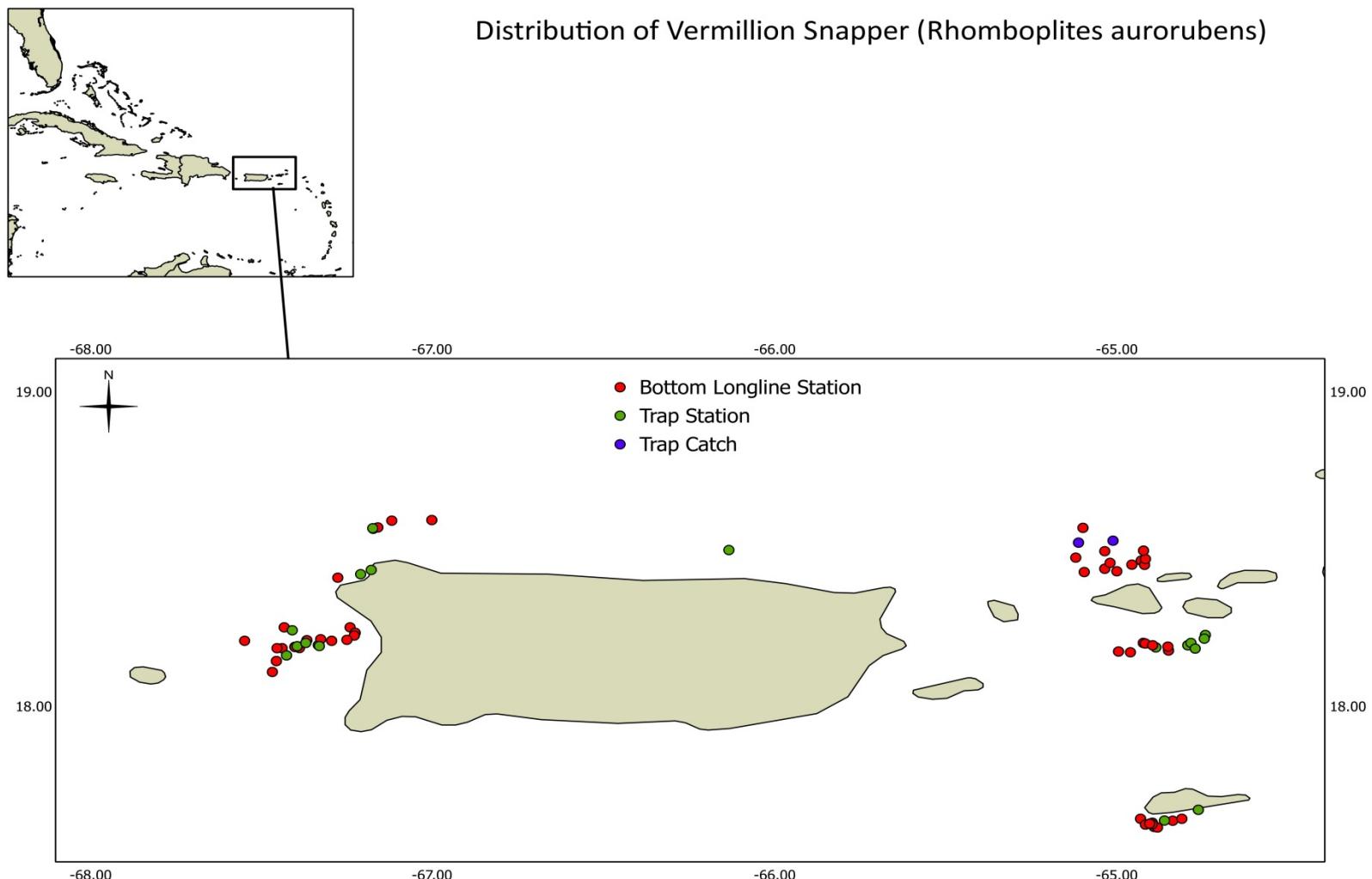


Figure 70. Distribution of vermillion snapper (*Rhomboplites aurorubens*) captured on bottom longline and fish traps during a fishery independent survey in 2009.

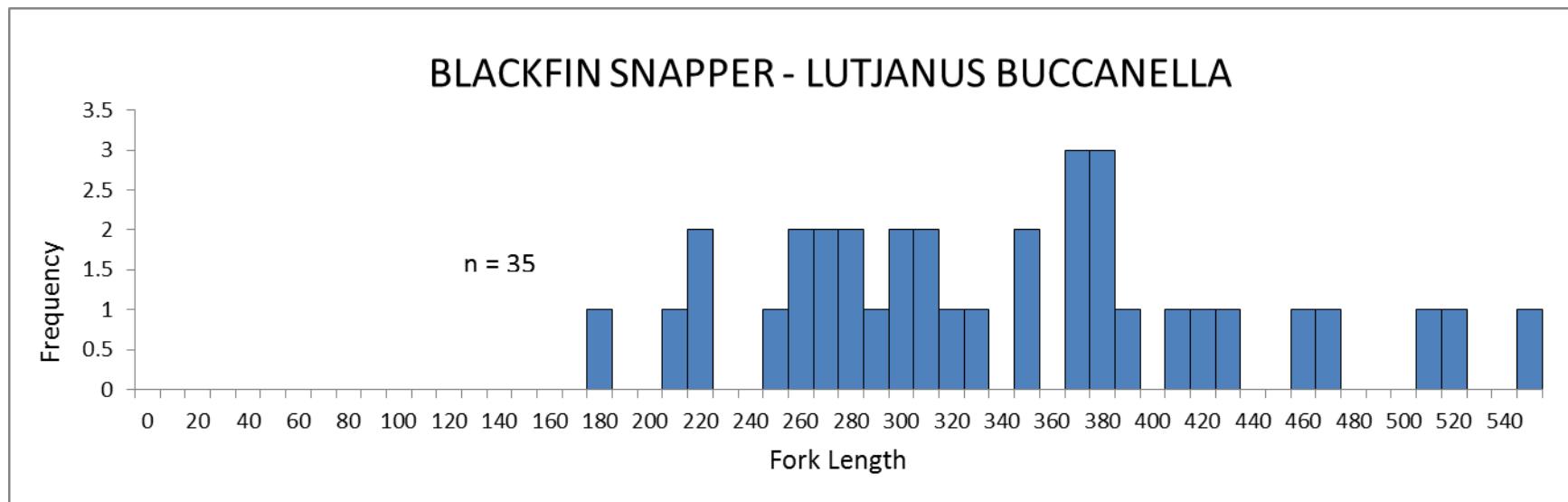


Figure 71. Length frequency distribution of blackfin snapper (*Lutjanus buccanella*) captured on bottom and off-bottom longlines, handlines and fish traps during fishery independent surveys from 1979-1985.

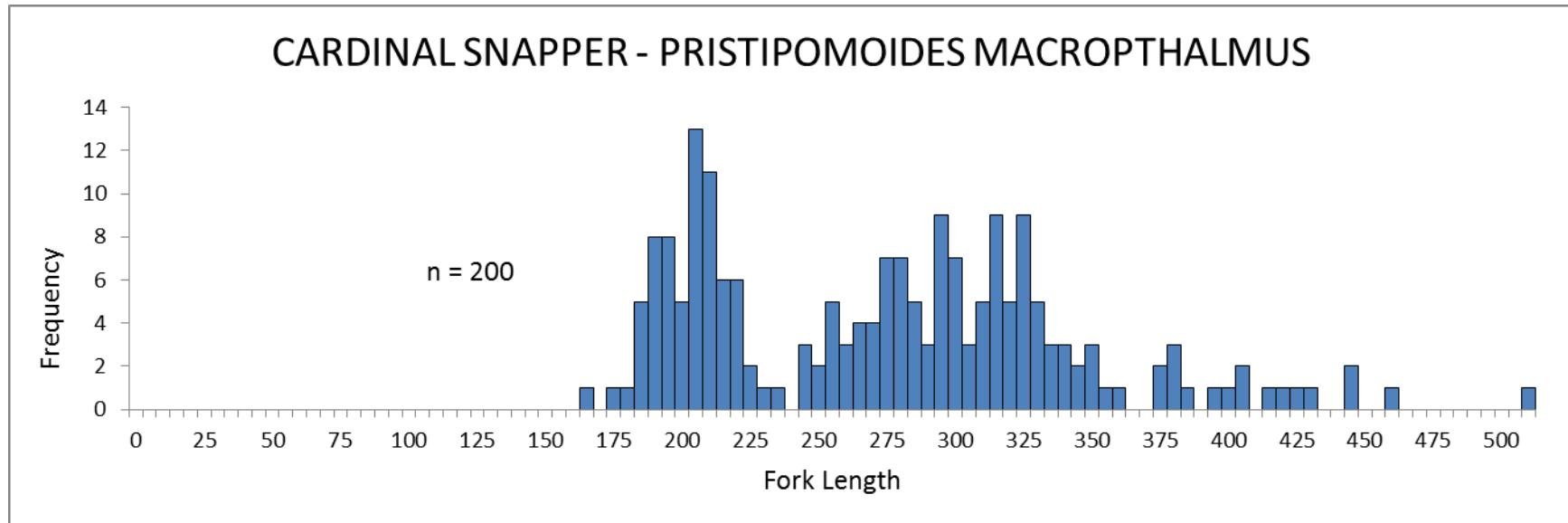


Figure 72. Length frequency distribution of cardinal snapper (*Pristipomoides macrophthalmus*) captured on bottom and off-bottom longlines, handlines and fish traps during fishery independent surveys from 1979-1985.

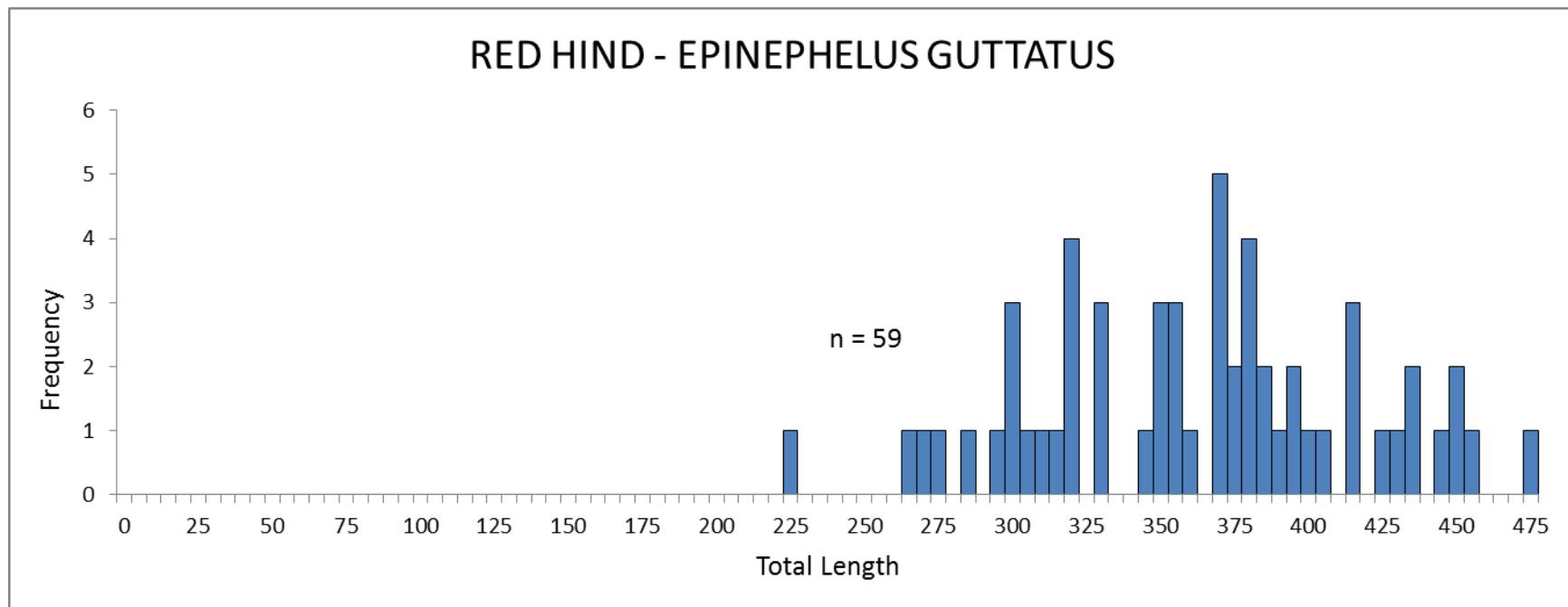


Figure 73. Length frequency distribution of red hind (*Epinephelus guttatus*) captured on bottom and off-bottom longlines, handlines and fish traps during fishery independent surveys from 1979-1985.

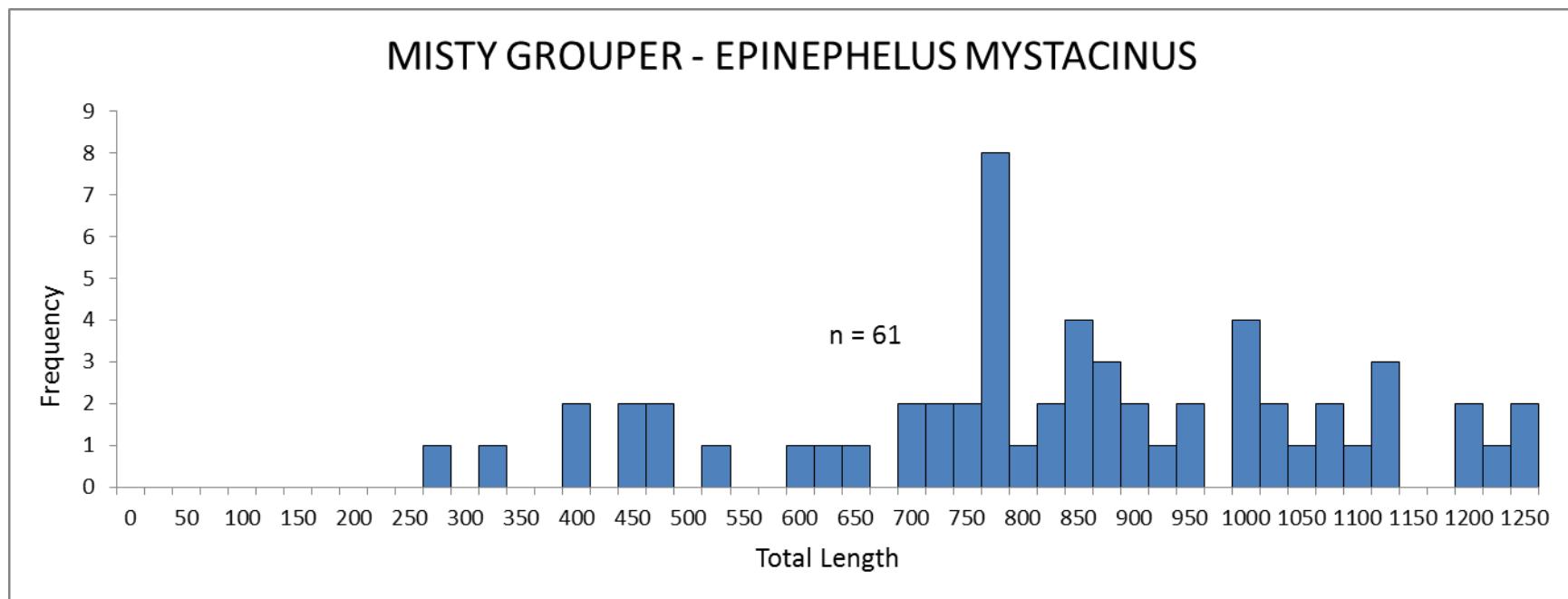


Figure 74. Length frequency distribution of misty grouper (*Epinephelus mystacinus*) captured on bottom and off-bottom longlines, handlines and fish traps during fishery independent surveys from 1979-1985.

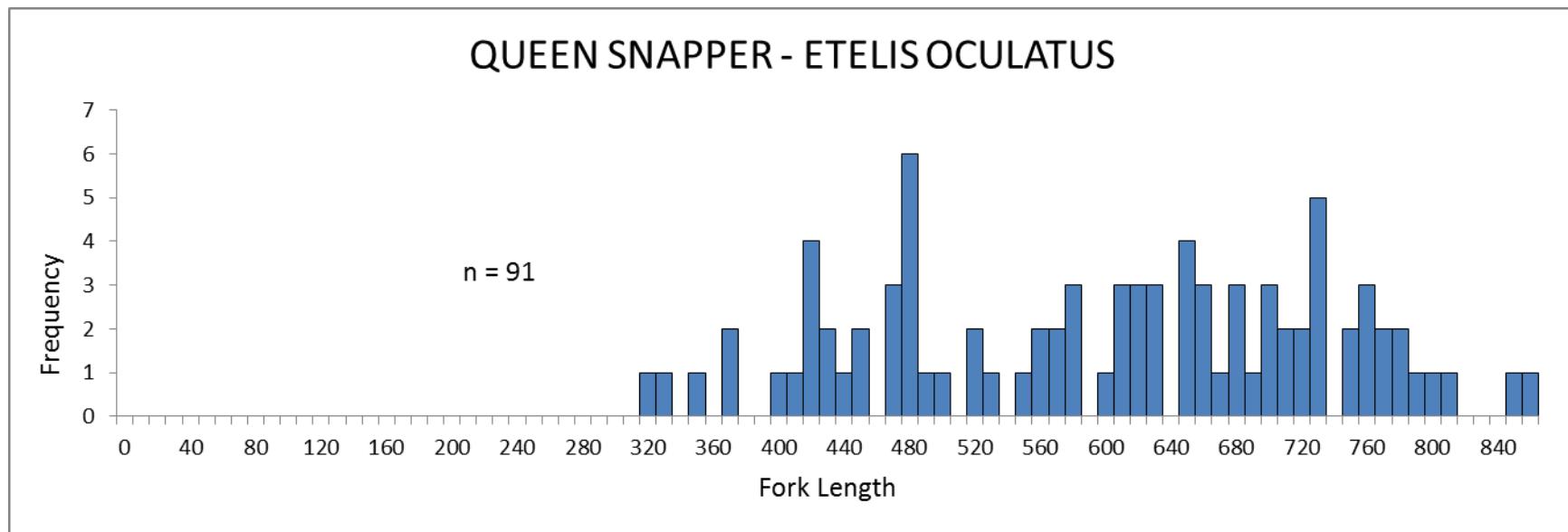


Figure 75. Length frequency distribution of queen snapper (*Etelis oculatus*) captured on bottom and off-bottom longlines, handlines and fish traps during fishery independent surveys from 1979-1985.

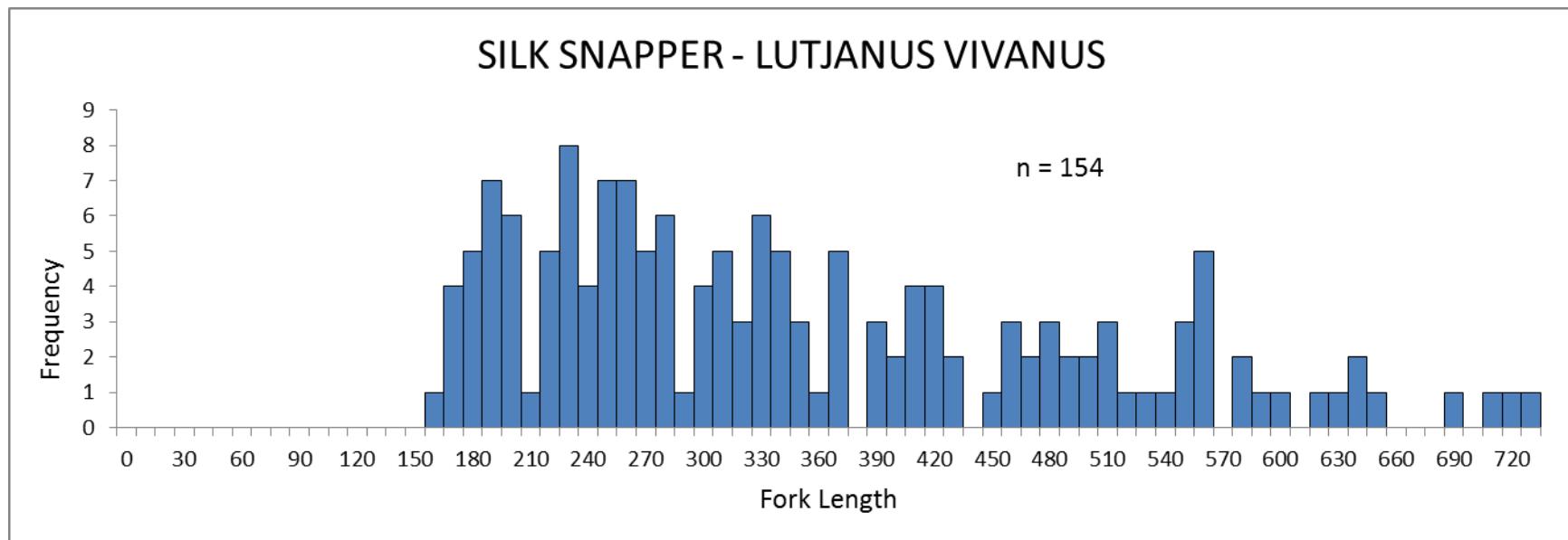


Figure 76. Length frequency distribution of silk snapper (*Lutjanus vivanus*) captured on bottom and off-bottom longlines, handlines and fish traps during fishery independent surveys from 1979-1985.

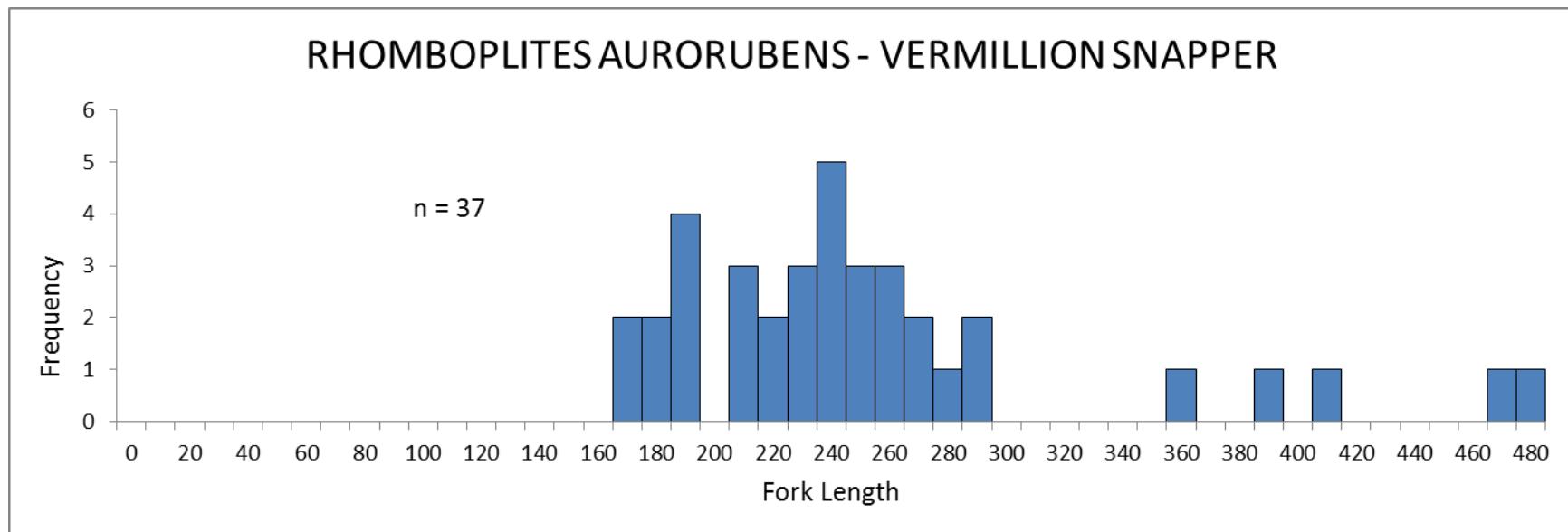


Figure 77. Length frequency distribution of vermilion snapper (*Rhomboplites aurorubens*) captured on bottom and off-bottom longlines, handlines and fish traps during fishery independent surveys from 1979-1985.

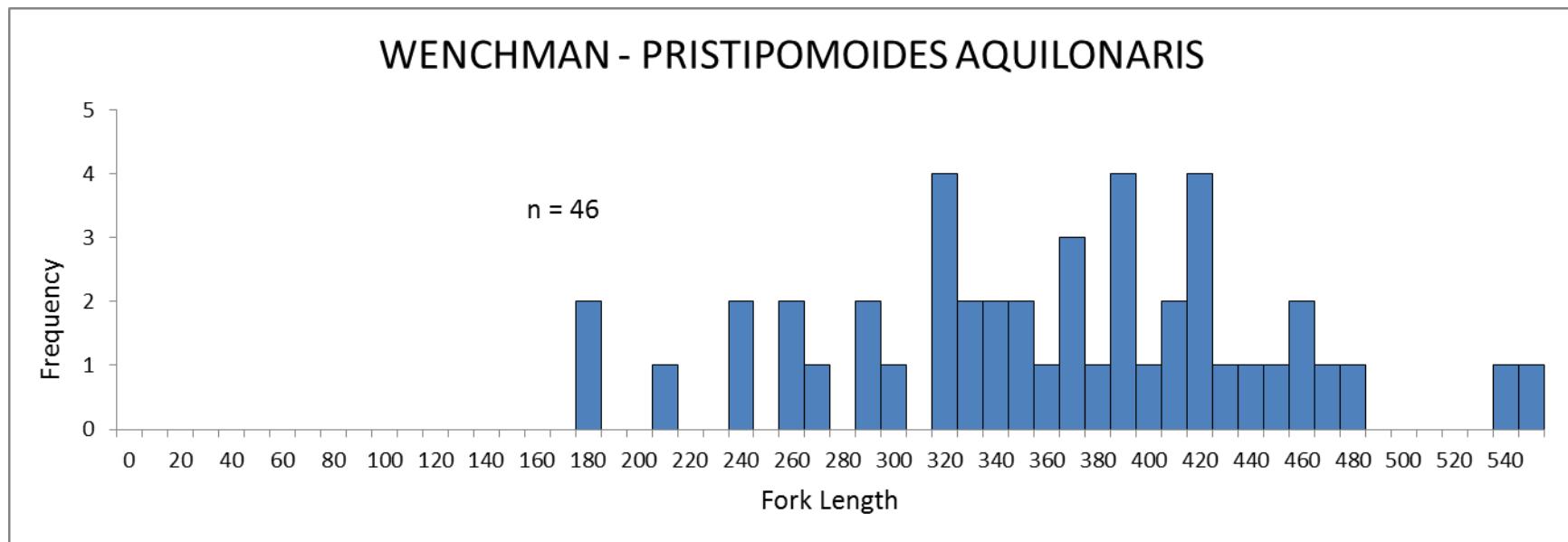


Figure 78. Length frequency distribution of wenchman (*Pristipomoides aquilonaris*) captured on bottom and off-bottom longlines, handlines and fish traps during fishery independent surveys from 1979-1985.

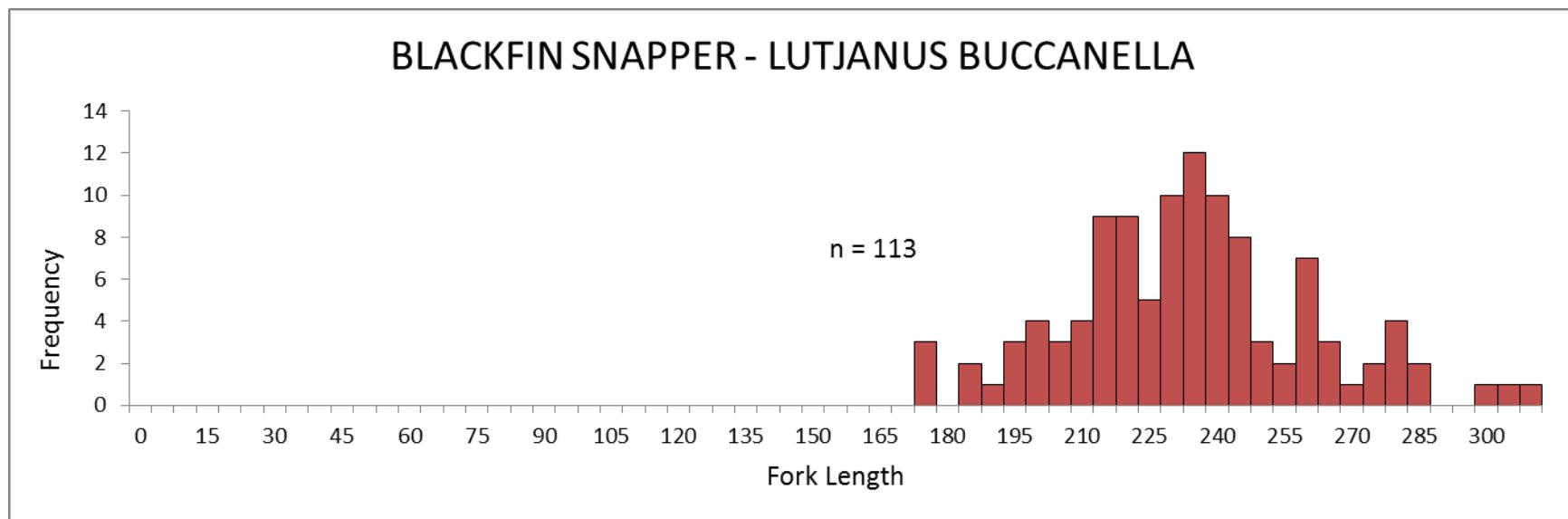


Figure 79. Length frequency distribution of blackfin snapper (*Lutjanus buccanella*) captured on bottom longlines and fish traps during a fishery independent survey in 2009.

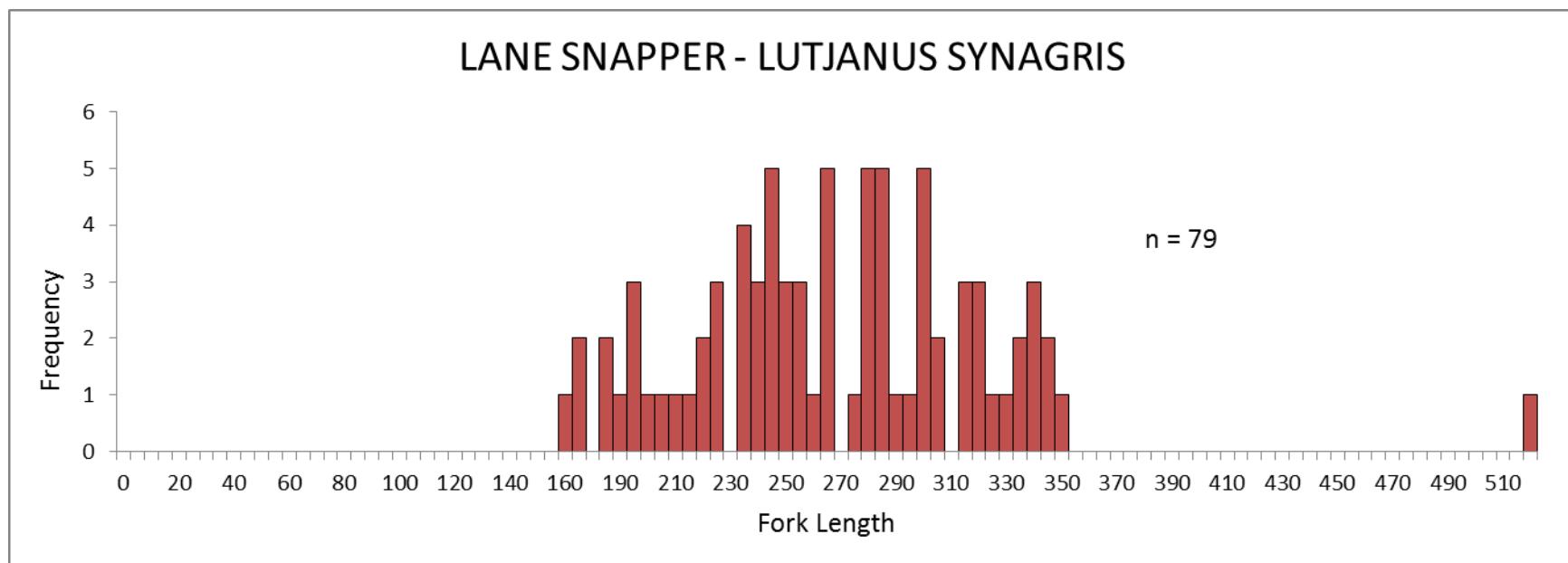


Figure 80. Length frequency distribution of lane snapper (*Lutjanus synagris*) captured on bottom longlines and fish traps during a fishery independent survey in 2009.

Addendum for SEDAR26-DW-10

Following the Data Workshop, we were asked to produce index values for queen snapper and silk snapper for all available gear types off Puerto Rico and the U.S. Virgin Islands (USVI). Due to low sample numbers (Addendum Table 1), no indices were produced for queen and silk snapper from data off the USVI. In addition, no handline index was produced for queen or silk snapper and no off bottom longline index for silk snapper off Puerto Rico. When an index was not able to be produced, nominal CPUE was reported (Addendum Tables 2 - 4).

When enough data was present to produce an index, a delta-lognormal modeling approach was used to estimate a yearly relative abundance index (I_y), as described by Lo *et al.* (1992):

$$I_y = c_y p_y,$$

where c_y is the estimate of mean CPUE for positive catches only for year y and p_y is the estimate of mean probability of occurrence during year y . The main advantage of using this method is allowance for the probability of zero catch (Ortiz *et al.* 2000). Both c_y and p_y were estimated using GLMs. Data used to estimate abundance for positive catches (c) and probability of occurrence (p) were assumed to have a lognormal distribution and a binomial distribution, respectively, and modeled using the following equations:

$$\ln(c) = X\beta + \varepsilon$$

and

$$p = \frac{e^{X\beta + \varepsilon}}{1 + e^{X\beta + \varepsilon}}, \text{ respectively,}$$

where c is a vector of the positive catch data, p is a vector of the presence/absence data, X is the design matrix for main effects, β is the parameter vector for main effects, and ϵ is a vector of independent normally distributed errors with expectation zero and variance σ^2 . Therefore, c_y and p_y were estimated as least-squares means for each year along with their corresponding standard errors, $SE(c_y)$ and $SE(p_y)$, respectively. From these estimates, I_y was calculated, as in equation, and its variance calculated as:

$$V(I_y) \approx V(c_y)p_y^2 + c_y^2V(p_y) + 2c_y p_y C_{(c,p)}$$

where:

$$\text{Cov}(c, p) \approx \rho_{c,p} [SE(c_y)SE(p_y)],$$

and $\rho_{c,p}$ denotes correlation of c and p among years.

The submodels of the delta-lognormal model were built using a backward selection procedure based on type 3 analyses with an inclusion level of significance of $\alpha = 0.05$. If year was not significant, it was forced into the model so an annual abundance index would be calculated. Binomial submodel performance was evaluated using AIC, while the performance of the lognormal submodel was evaluated based on analyses of residual scatter and QQ plots in addition to AIC. Factors included in the submodels were year and depth. An attempt was made to include season in the submodels, but due to the inconsistent nature of the sampling, the submodels were unable to converge when season was included.

For the delta-lognormal model built for the queen snapper caught with bottom longlines off Puerto Rico, both variables were significant in the positive catch submodel, however, depth

was not significant in the proportion positive submodel. The annual abundance index is presented in Addendum Table 5. The model tables are in Addendum Table 6 and show the significance of each factor in the model. Diagnostic plots are presented in Addendum Figure 1.

For the delta-lognormal model built for the queen snapper caught on off bottom longlines off Puerto Rico, no factors were significant in either submodel. The annual abundance index is presented in Addendum Table 7. The model tables are in Addendum Table 8 and show the significance of each factor in the model. Diagnostic plots are presented in Addendum Figure 2.

For the delta-lognormal model built for the silk snapper caught on bottom longlines off Puerto Rico, both variables were significant in the proportion positive submodel, however depth was not significant in the positive catch submodel. The annual abundance index is presented in Addendum Table 9. The model tables are in Addendum Table 10 and show the significance of each factor in the model. Diagnostic plots are presented in Addendum Figure 3.

For the delta-lognormal model built for the silk snapper fish trap caught off Puerto Rico, both variables were significant in each submodel, therefore no additional model runs were necessary. The annual abundance index is presented in Addendum Table 11. The model tables are in Addendum Table 12 and show the significance of each factor in the model. Diagnostic plots are presented in Addendum Figure 4.

References

- Lo, N.C.H., L.D. Jacobson, and J.L. Squire. 1992. Indices of relative abundance from fish spotter data based on delta-lognormal models. *Canadian Journal of Fisheries and Aquatic Science* 49:2515-2526.
- Ortiz, M. 2006. Standardized catch rates for gag grouper (*Mycteroperca microlepis*) from the marine recreational fisheries statistical survey (MRFSS). Southeast Data Assessment and Review (SEDAR) Working Document SEDAR10-DW-09.

Addendum Table 1. Number of stations completed off Puerto Rico and the U.S. Virgin Islands (USVI) with various gear types during fisheries independent surveys conducted between 1979 and 1985.

Year	Bottom Longline		Off Bottom Longline		Handline		Trap	
	Puerto Rico	U.S.V.I.	Puerto Rico	U.S.V.I.	Puerto Rico	U.S.V.I.	Puerto Rico	U.S.V.I.
1979	48	11			26	3	3	1
1980	96	9			18	5	10	2
1981	13				1		1	
1982	98	13	98	13	4		16	2
1983	130	10	128	10			12	
1984	83	5	85	5		1	1	
1985	34	15	33	15			40	20

Addendum Table 2. Nominal CPUE for queen snapper caught on various gears off the U.S. Virgin Islands during fisheries independent surveys.

Year	Bottom Longline	Off Bottom Longline	Handline
1979	0.337		0.0740
1980	1.479		0
1981			
1982	0.0762	0.0334	
1983	0.100	0.150	0
1984	0	0	0.0740
1985	0.517	0.185	

Addendum Table 3. Nominal CPUE for silk snapper caught on various gears off the U.S. Virgin Islands during fisheries independent surveys.

Year	Off Bottom Longline	Handline
1979		0.0689
1980		0
1981		0
1982	0.0133	0
1983	0.0393	
1984	0.0235	
1985	0	

Addendum Table 4. Nominal CPUE for silk snapper caught on various gears off the U.S. Virgin Islands during fisheries independent surveys.

Year	Bottom Longline	Off Bottom Longline	Handline	Fish Trap
1979	0.878		0.311	0
1980	0.653		0	10.000
1981				
1982	0.231	0.308		0
1983	0	0	0	
1984	0	0.100	0.311	
1985	0.294	0		0.750

Addendum Table 5. Indices of abundance for queen snapper caught off Puerto Rico on bottom longlines developed using the delta-lognormal model for 1979-1985. The nominal frequency of occurrence, the number of samples (N), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	N	DL Index	Scaled Index	CV	LCL	UCL
1979	0.16667	48	0.07675	0.45697	0.64096	0.14136	1.4773
1980	0.17708	95	0.17112	1.01879	0.44348	0.43655	2.3776
1981	0.30769	13	0.40738	2.42545	0.81451	0.58234	10.1019
1982	0.14286	98	0.16534	0.98440	0.33776	0.51013	1.8996
1983	0.06923	130	0.11723	0.69794	0.59070	0.23368	2.0846
1984	0.12048	77	0.17655	1.05113	0.45036	0.44503	2.4827
1985	0.05882	33	0.06136	0.36534	0.79572	0.09002	1.4826

Addendum Table 6. Summary of backward selection procedure for building delta-lognormal index of relative abundance submodels for queen snapper that were captured off Puerto Rico with bottom longlines from 1979 to 1985.

Model Run #1		Binomial Submodel Type 3 Tests (AIC 2598.0)					Lognormal Submodel Type 3 Tests (AIC 116.4)				
Effect		Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F	Num DF	Den DF	F Value	Pr > F
Year		6	106	11.09	1.79	0.0855	0.1072	6	56	7.74	<.0001
Depth		1	395	0.37	0.37	0.5443	0.5446	1	56	6.41	0.0142
Model Run #2		Binomial Submodel Type 3 Tests (AIC 2585.4)					Lognormal Submodel Type 3 Tests (AIC 116.4)				
Effect		Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F	Num DF	Den DF	F Value	Pr > F
Year		6	105	10.92	1.76	0.0909	0.1135	6	56	7.74	<.0001
Depth		dropped						1	56	6.41	0.0142

Addendum Table 7. Indices of abundance for queen snapper off Puerto Rico caught on off bottom longlines developed using the delta-lognormal model for 1982-1985. The nominal frequency of occurrence, the number of samples (N), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	N	DL Index	Scaled Index	CV	LCL	UCL
1982	0.061224	98	0.029652	0.62732	0.83229	0.14701	2.67693
1983	0.031250	128	0.022428	0.47449	1.26190	0.06737	3.34171
1984	0.094118	85	0.085791	1.81499	0.67922	0.52954	6.22090
1985	0.090909	30	0.051201	1.08320	1.15271	0.17223	6.81245

Addendum Table 8. Summary of backward selection procedure for building delta-lognormal index of relative abundance submodels for queen snapper off Puerto Rico with off bottom longlines from 1982 to 1985.

Model Run #1		Binomial Submodel Type 3 Tests (AIC 2011.2)					Lognormal Submodel Type 3 Tests (AIC 44.2)				
<i>Effect</i>		Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F	Num DF	Den DF	F Value	Pr > F
Year		3	131	3.76	1.24	0.2884	0.2974	3	16	1.58	0.2324
Depth		1	228	0.00	0.00	0.9883	0.9883	1	16	0.04	0.8498
Model Run #2		Binomial Submodel Type 3 Tests (AIC 2002.1)					Lognormal Submodel Type 3 Tests (AIC 34.5)				
<i>Effect</i>		Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F	Num DF	Den DF	F Value	Pr > F
Year		3	130	3.78	1.25	0.2862	0.2953	3	17	1.84	0.1778
Depth		dropped					dropped				

Addendum Table 9. Indices of abundance for silk snapper caught off Puerto Rico on bottom longlines developed using the delta-lognormal model for 1979-1985. The nominal frequency of occurrence, the number of samples (N), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	N	DL Index	Scaled Index	CV	LCL	UCL
1979	0.12500	48	0.012456	0.36474	2.24545	0.02495	5.33227
1980	0.11458	95	0.080798	2.36596	0.58922	0.79404	7.04979
1981	0.00000	13	0				
1982	0.05102	98	0.038255	1.12020	1.19723	0.16991	7.38559
1983	0.03077	130	0.018285	0.53544	1.84123	0.04702	6.09768
1984	0.03614	77	0.020956	0.61365	1.91438	0.05129	7.34233
1985	0.00000	33	0				

Addendum Table 10. Summary of backward selection procedure for building delta-lognormal index of relative abundance submodels for silk snapper caught off Puerto Rico with bottom longlines from 1979 to 1985.

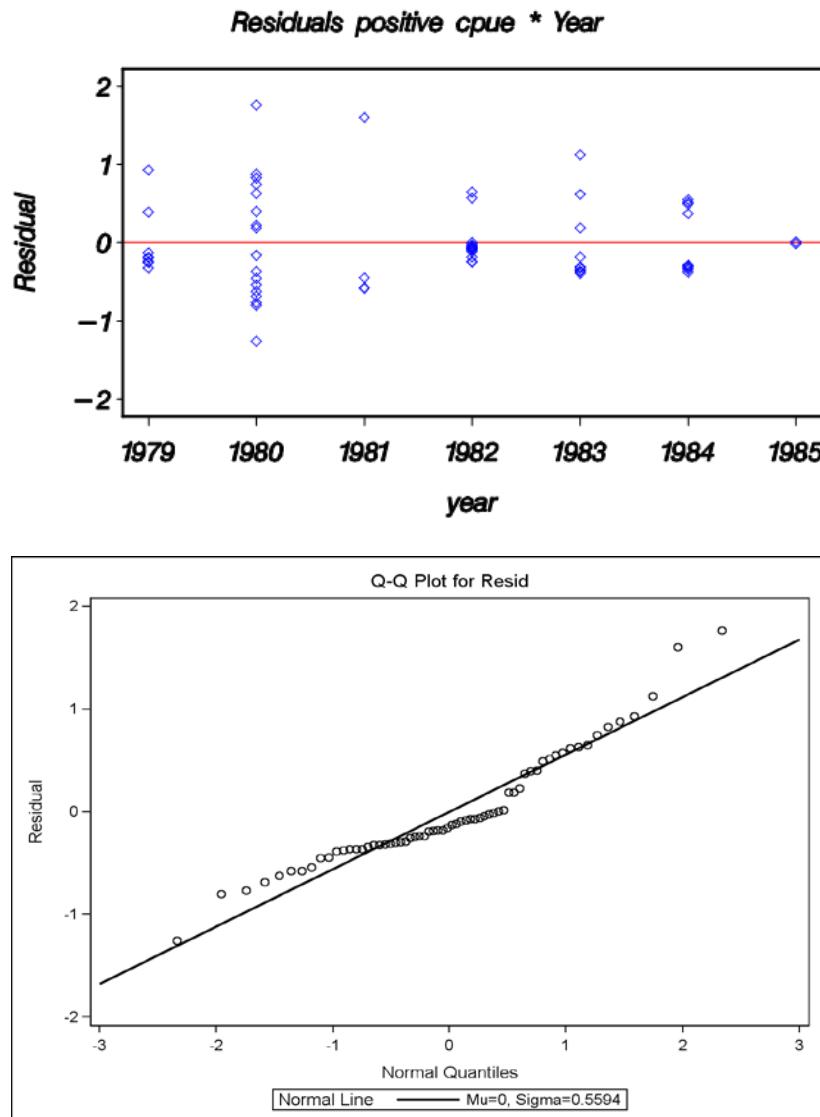
Model Run #1		Binomial Submodel Type 3 Tests (AIC 2933.8)					Lognormal Submodel Type 3 Tests (AIC 53.5)				
Effect		Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F	Num DF	Den DF	F Value	Pr > F
Year		4	449	17.99	4.50	0.0012	0.0014	4	23	2.73	0.0537
Depth		1	449	23.71	23.71	<.0001	<.0001	1	23	0.67	0.4212
Model Run #2		Binomial Submodel Type 3 Tests (AIC 2933.8)					Lognormal Submodel Type 3 Tests (AIC 44.7)				
Effect		Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F	Num DF	Den DF	F Value	Pr > F
Year		4	449	17.99	4.50	0.0012	0.0014	4	24	2.76	0.0510
Depth		1	449	23.71	23.71	<.0001	<.0001				

Addendum Table 11. Indices of abundance for silk snapper caught off Puerto Rico in fish traps developed using the delta-lognormal model for 1979-1985. The nominal frequency of occurrence, the number of samples (N), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

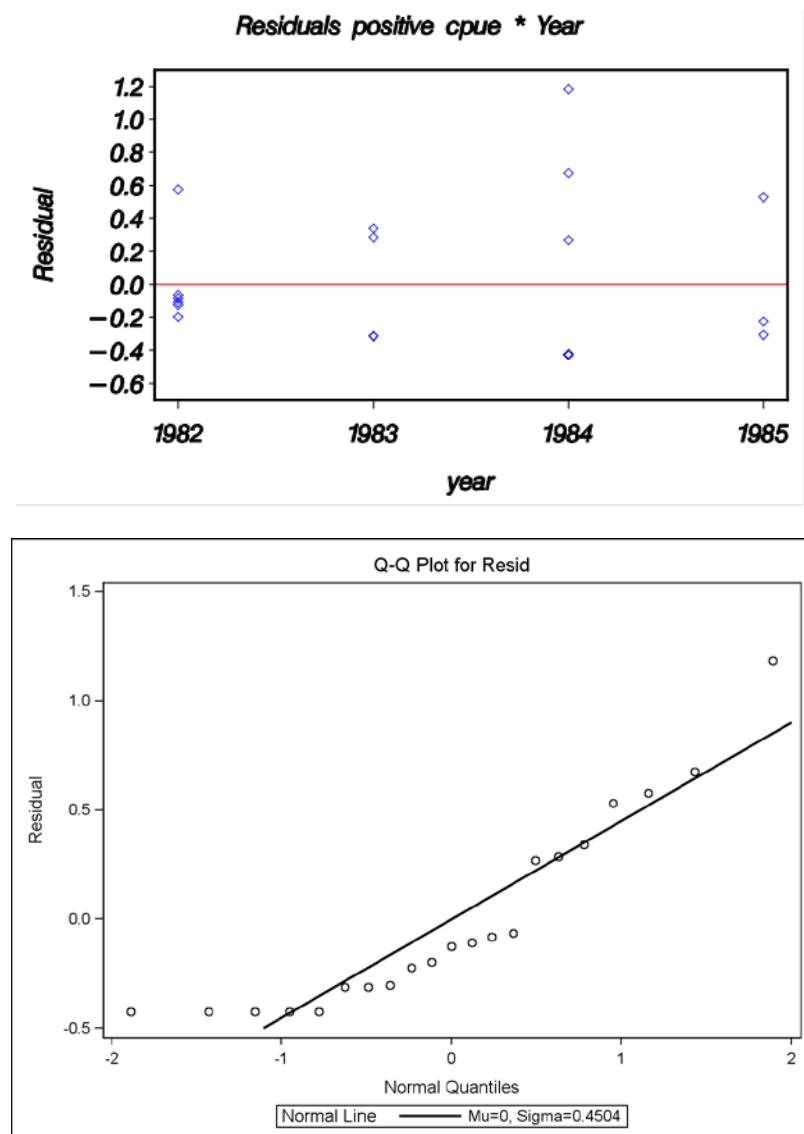
Survey Year	Frequency	N	DL Index	Scaled Index	CV	LCL	UCL
1979	0.33333	3	0.10699	0.05710	2.33662	0.00372	0.87699
1980	0.70000	10	4.80192	2.56254	0.46574	1.05638	6.21617
1981	0.00000	1	0				
1982	0.81250	16	2.58043	1.37704	0.30411	0.75966	2.49619
1983	0.41667	12	0.29771	0.15887	0.88316	0.03479	0.72543
1984	0.00000	1	0				
1985	0.20000	40	1.58241	0.84445	0.49121	0.33324	2.13992

Addendum Table 12. Summary of backward selection procedure for building delta-lognormal index of relative abundance submodels for silk snapper caught off Puerto Rico with fish traps from 1979 to 1985.

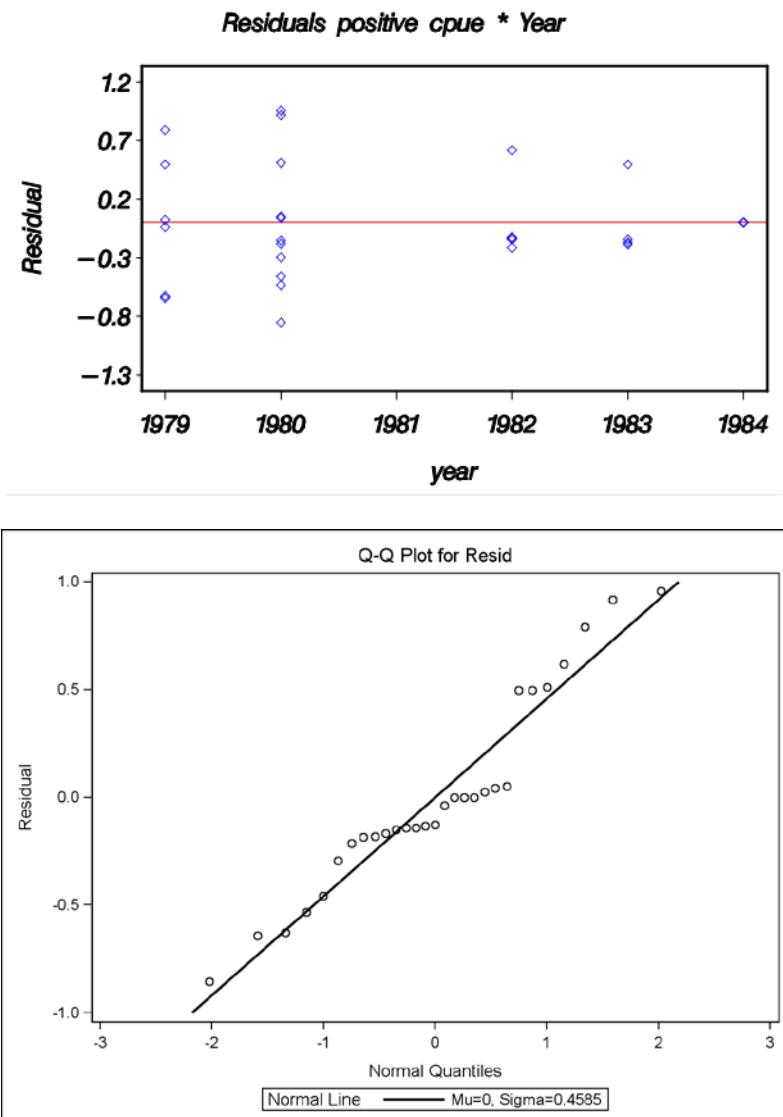
Model Run #1		Binomial Submodel Type 3 Tests (AIC 383.7)					Lognormal Submodel Type 3 Tests (AIC 77.8)				
<i>Effect</i>		Num DF	Den DF	Chi- Square	F Value	Pr > ChiSq	Pr > F	Num DF	Den DF	F Value	Pr > F
<i>Year</i>		4	75	9.30	2.32	0.0541	0.0642	4	28	6.55	0.0007
<i>Depth</i>		1	75	5.61	5.61	0.0179	0.0204	1	28	4.32	0.0471



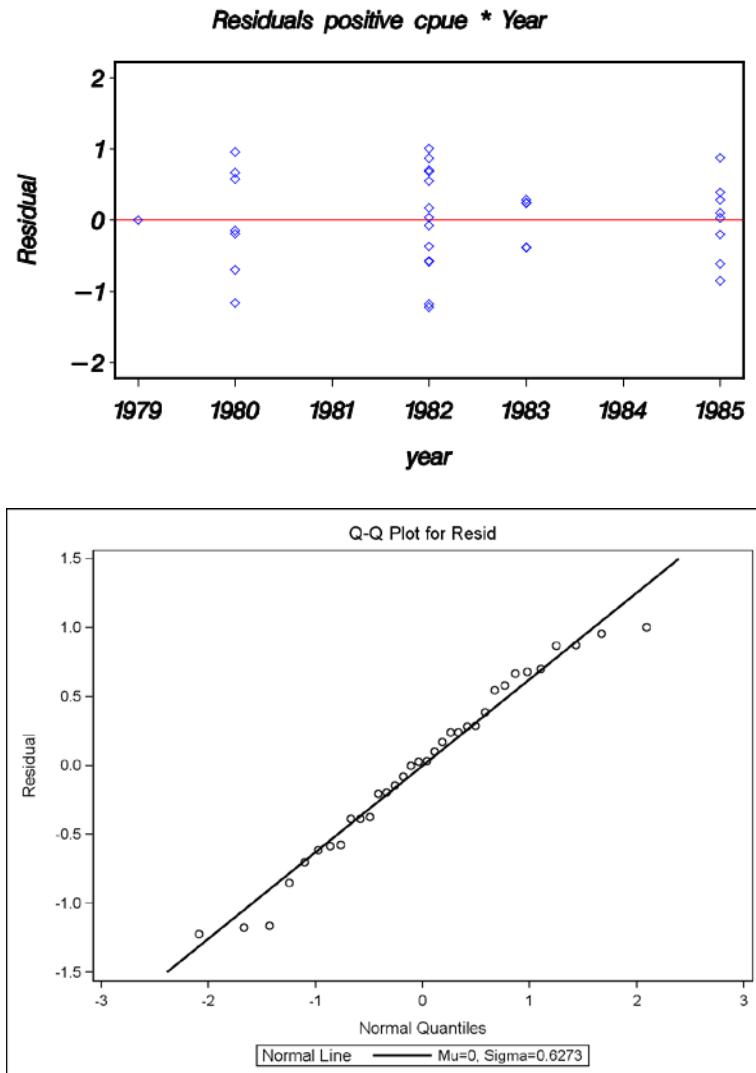
Addendum Figure 1. Diagnostic plots for queen snapper caught off Puerto Rico with bottom longlines.



Addendum Figure 2. Diagnostic plots for queen snapper caught off Puerto Rico with off bottom longlines.



Addendum Figure 3. Diagnostic plots for silk snapper caught off Puerto Rico with bottom longlines.



Addendum Figure 4. Diagnostic plots for silk snapper caught off Puerto Rico with fish traps.