Supplement to

Atlantic Marine Assessment Program for Protected Species: 2019-2025

Appendix C

Small Cetacean
Generalize Additive Density-Habitat Models and Maps, by Species

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C.1 Study Area

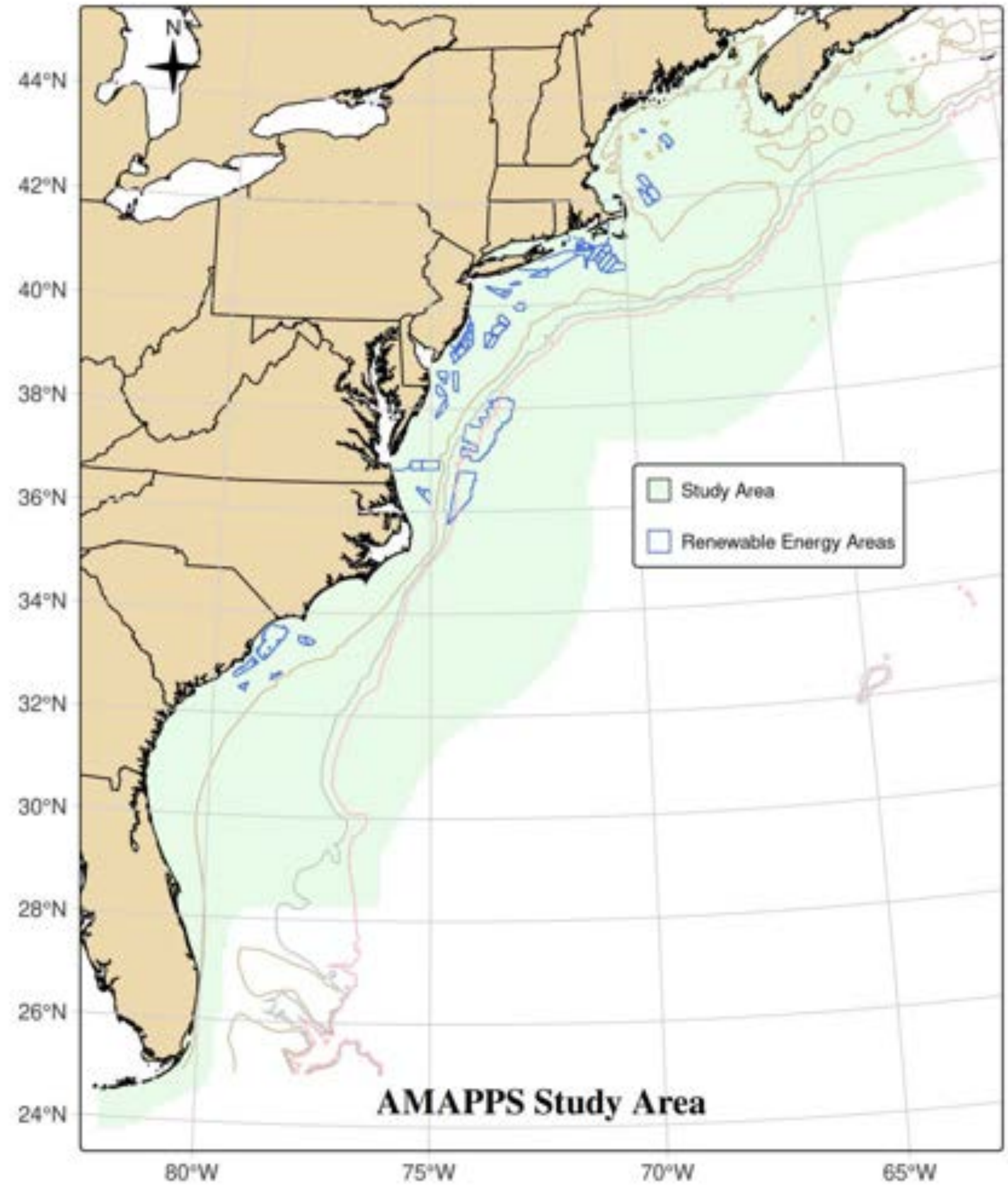

Figure C.1-1. AMAPPS study area and Massachusetts to North Carolina wind-energy study areas
We identified the locations of the offshore wind energy areas (blue line) in relationship to the AMAPPS study area (green shaded). Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

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C.2 Short-finned Pilot Whale (*Globicephala macrorhynchus*)

Figure C.2-1. Short-finned pilot whales
Image collected under MMPA research permit #779-1633. Credit: NOAA/SEFSC

C.2.1 Data Collection

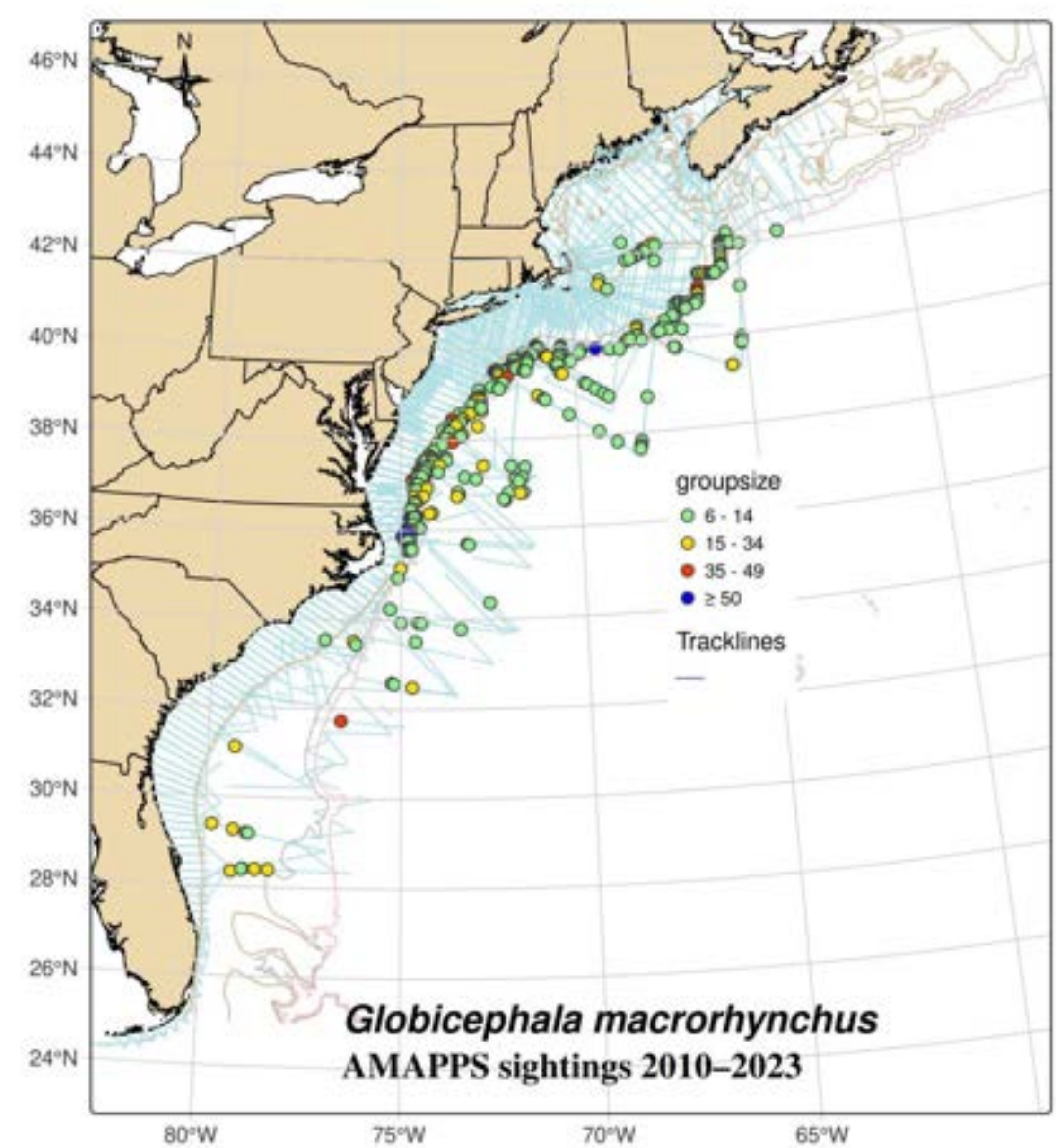

Figure C.2-2. Distribution of track lines and short-finned pilot whale sightings 2010 to 2023
Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

Table C.2-1. AMAPPS research effort 2010 to 2023 and short-finned pilot whale sightings

Survey Region and Platform	Season	Effort (km)	Number of Groups	Number of Animals
NE Shipboard	Spring	8,883	5	42
NE Shipboard	Summer	49,064	260	2510
NE Aerial	Spring	38,839	6	21
NE Aerial	Summer	52,003	30	269
NE Aerial	Fall	87,311	35	245
NE Aerial	Winter	24,747	0	0
SE Shipboard	Spring	2,604	0	0
SE Shipboard	Summer	18,331	88	1,489
SE Shipboard	Fall	2,673	15	467
SE Shipboard	Winter	302	0	0
SE Aerial	Spring	48,634	10	269
SE Aerial	Summer	43,285	26	712
SE Aerial	Fall	21,153	31	485
SE Aerial	Winter	19,152	5	38

C.2.2 Mark-Recapture Distance Sampling Analysis

Table C.2-2. Intermediate parameters in short-finned pilot whale mark-recapture distance sampling (MRDS) models

Analysis Set	MR Model	MR Truncation (m)	DS Model	DS Truncation (m)	Key function	p(0)	p(0) CV	Chi-square p-value	CvM p-value
SE–aerial group 5	distance + observer + glare	400	distance	400	HN + Hermite Poly Adjustment 4	0.76	0.09	0.22	0.83
NE–aerial group 7	distance + observer + log(group size)	460	Distance + glare	460	HR	0.66	0.12	0.68	0.95
NE–shipboard group 7	distance * observer + log(group size) + sea state + glare	4000	distance + time of day	4000	HR	0.67	0.09	0.20	0.92
SE–shipboard group 3	distance * observer + log(group size)	5000	Distance + log(group size)	5000	HR	0.60	0.13	0.15	0.66

MR=Mark-Recapture, DS=Distance Sampling, HR=Hazard Rate, HN= Half Normal, CV=Coefficient of variation. Values of p>0.5 for Chi-square and Cramer-von Mises test (CvM) indicate good fit. The definition of p(0) is the probability of detecting a group on the track line. Species included in the analysis sets are explained in main text Tables 4-20 and 4-21.

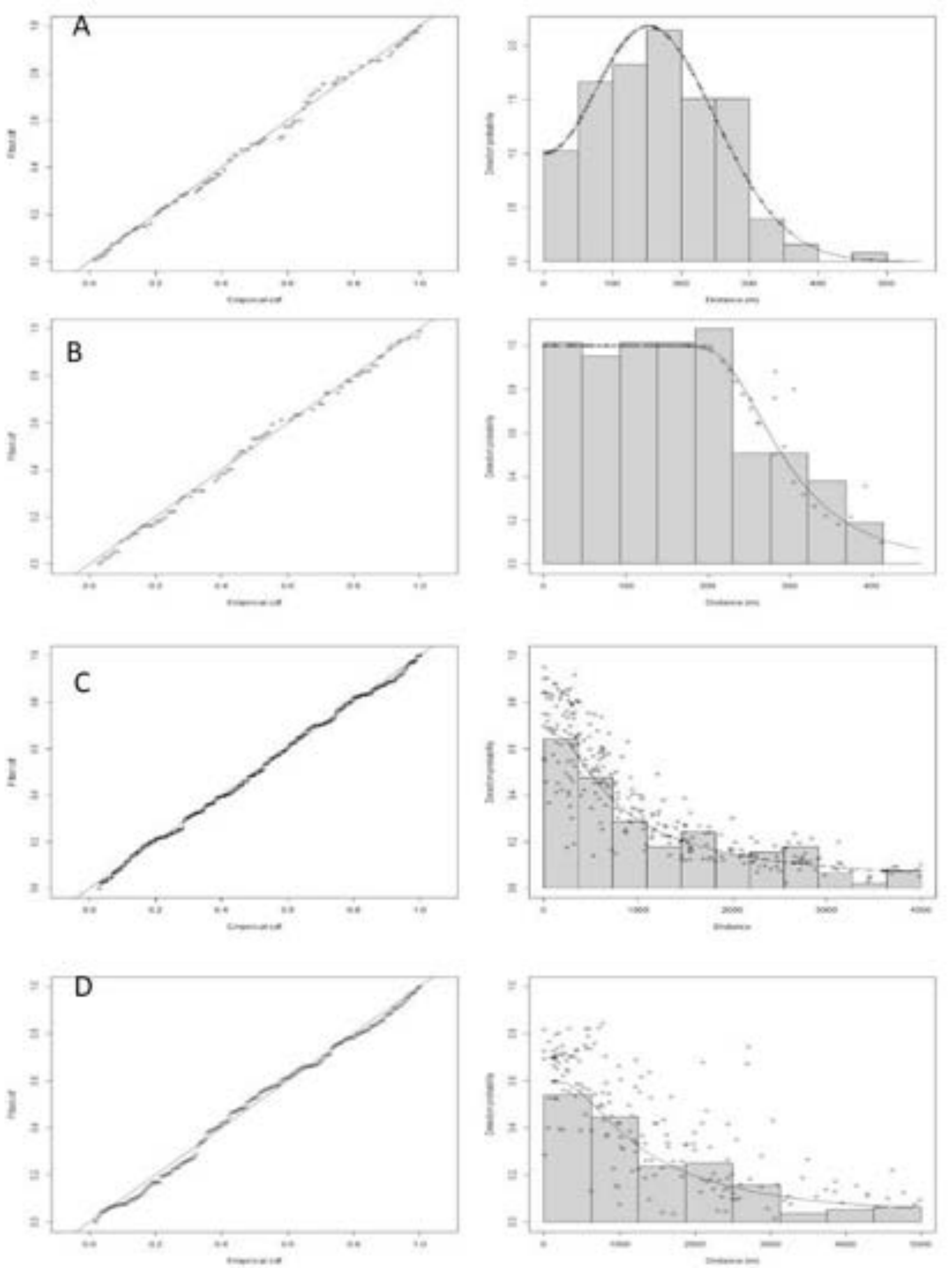

Figure C.2-3. Q-Q plots and detection functions from the short-finned pilot whale MRDS analyses
A) SE-aerial analysis set 5; B) NE-aerial analysis set 7; C) NE-shipboard analysis set 7;) SE-shipboard analysis set 3.

C.2.3 Generalized Additive Model Analysis

Table C.2-3. 2010 to 2023 density-habitat model output for short-finned pilot whales

Covariates	Edf	Ref.df	F	C.dev	p-value
s(sstmur)	2.62	5	14.45	10.92	<0.0001
s(mlp)	0.77	5	0.64	0.79	0.04000
s(btemp)	4.09	5	14.13	9.11	<0.0001
s(dist2GSNw)	3.97	5	9.39	9.15	<0.0001
s(dist2shore)	3.90	5	21.14	7.52	<0.0001
s(slope)	3.35	5	22.71	19.10	<0.0001
s(latdd)	3.17	5	4.79	3.93	<0.0001

Adjusted R^2 = 0.0193. Deviance explained = 60.5%.
Includes the estimated degrees of freedom (Edf), reference degrees of freedom (Ref.df), contribution to the deviance (C.dev) explained for each habitat covariate and its associated p-value. Covariate abbreviations explained in main text in Table 4-2.

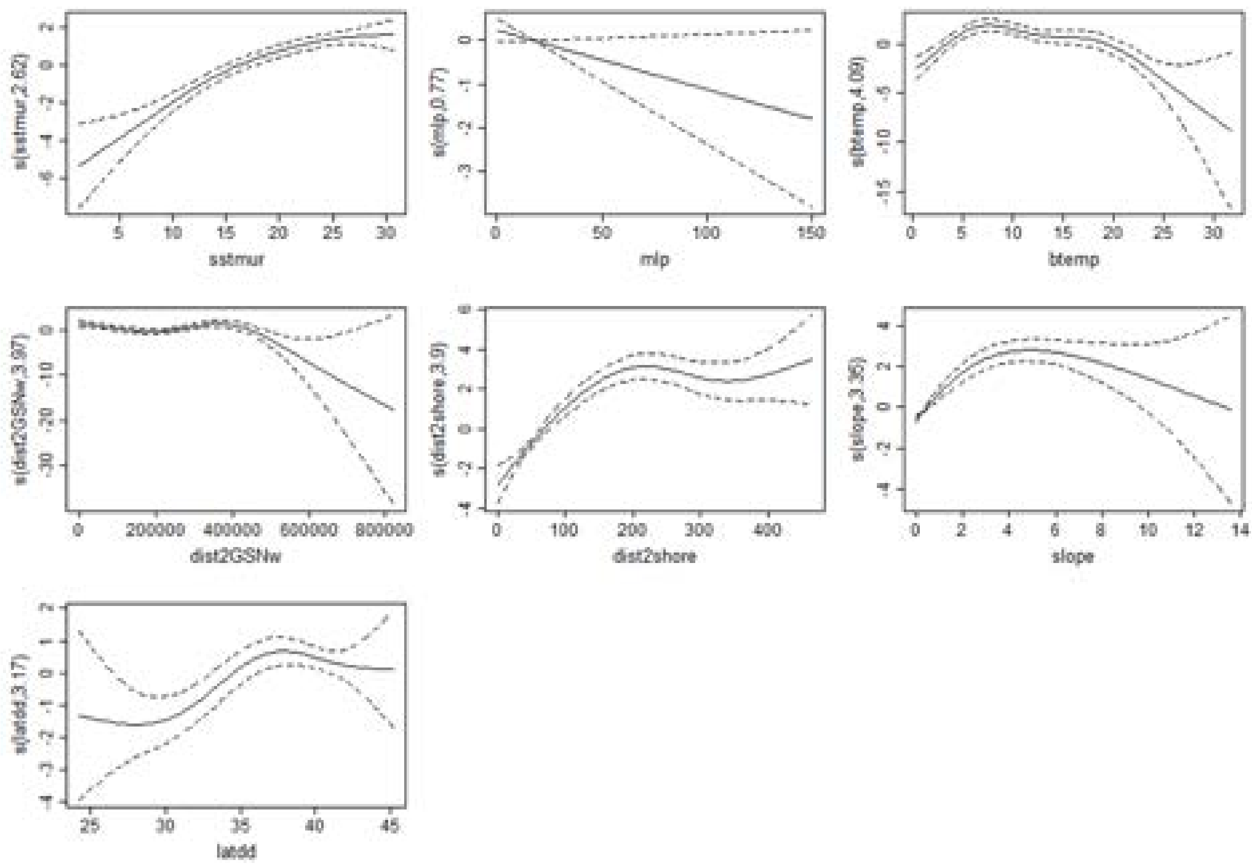

Figure C.2-4. Short-finned pilot whale density relative to significant habitat covariates
Plots represent the partial smooths and interaction terms of the density-habitat model. Covariate abbreviations explained in main text in Tables 6-1 and 6-2.

C.2.4 Model Cross-Validation

Table C.2-4. Diagnostic statistics from the short-finned pilot whale density-habitat model

Diagnostic Statistic	Description	Calculated with	Model Values (x)	Score
MAPE	Mean absolute percentage error	Non-zero density	81.035	Fair to good
RHO	Spearman rank correlation	Non-zero density	0.296	Fair to good
MAPE	Mean absolute percentage error	All data divided in 25 random samples	85.498	Fair to good
RHO	Spearman rank correlation	All data divided in 25 random samples	0.130	Excellent
MAE	Mean absolute error	All data divided in 25 random samples	0.024	Excellent

RHO: Poor= x<0.05; Fair to good =0.05<=x<0.3; Excellent= x>0.3
MAPE: Poor= x>150%; Fair to good= 150%>=x>50%; Excellent= x<=50%
MAE: Poor= x>1; Fair to good = 1>=x>0.25; Excellent= x<=0.25

C.2.5 Abundance Estimates for AMAPPS Study Area

Table C.2-5. Short-finned pilot whale average abundance estimates for the AMAPPS study area

Season	Average Abundance	CV	95% Confidence Interval
Spring (March–May)	3,740	0.47	1,558 – 8,978
Summer (June–August)	13,831	0.37	6,854 – 27,910
Fall (September–November)	8,744	0.40	4,109 – 18,606
Winter (December–February)	2,527	0.53	953 – 6,701
Summer 2011 U.S. surveys[1]	21,515	0.37	13,546 − 34,172
Summer 2016 U.S. surveys[1]	28,924	0.24	21,218 − 39,434
Summer 2021 U.S. surveys[1]	18,726	0.33	9,972 – 35,166

[1]Hayes et al. 2024

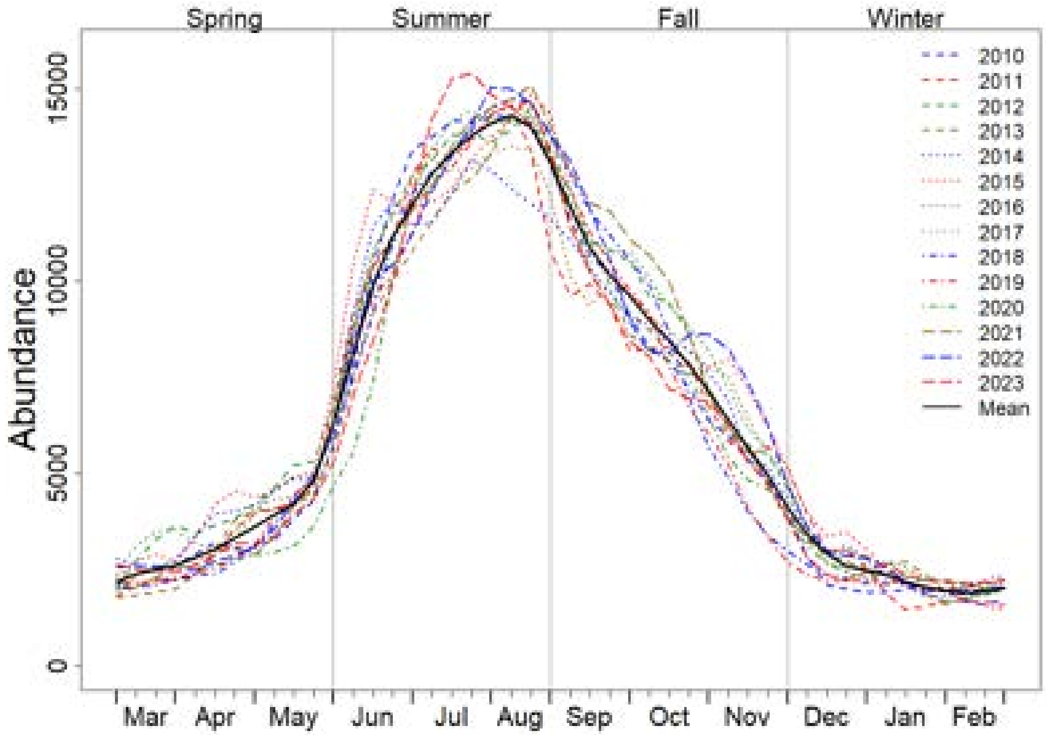

Figure C.2-5. Annual abundance trends for short-finned pilot whales in the AMAPPS study area

C.2.6 Seasonal Prediction Maps

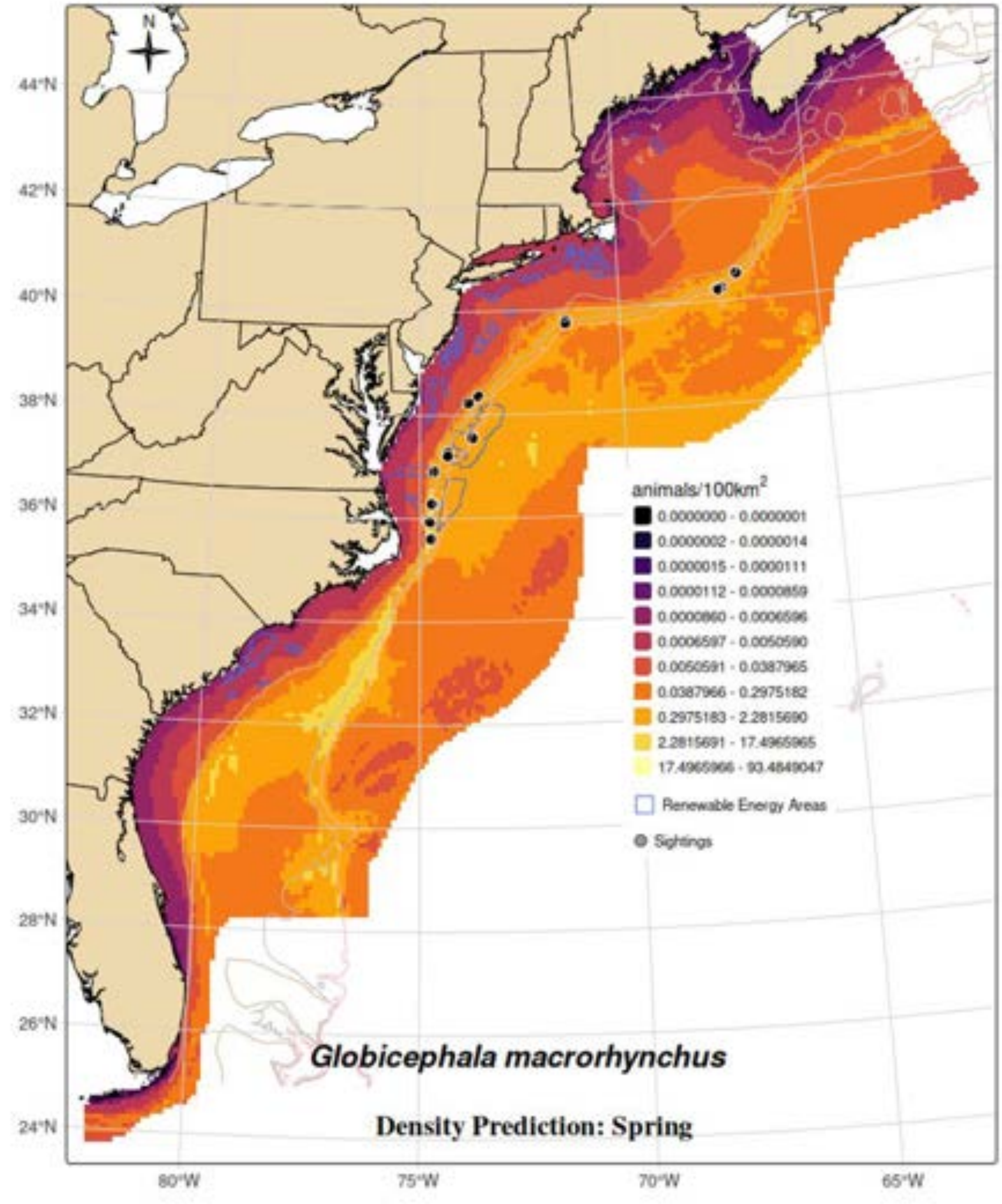

Figure C.2-6. Short-finned pilot whale spring average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

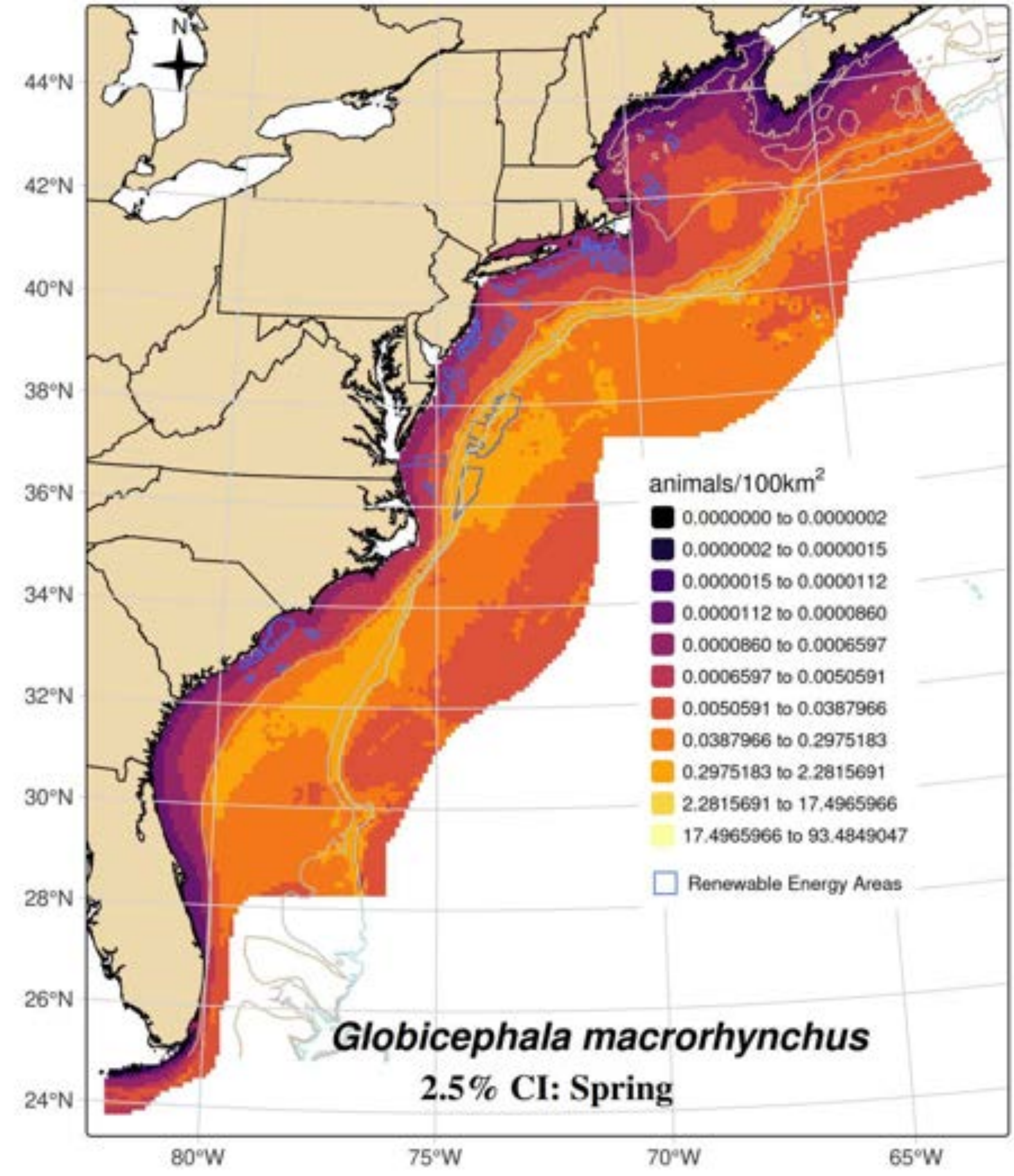

Figure C.2-7. Lower 2.5% confidence interval of the spring short-finned pilot whale density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

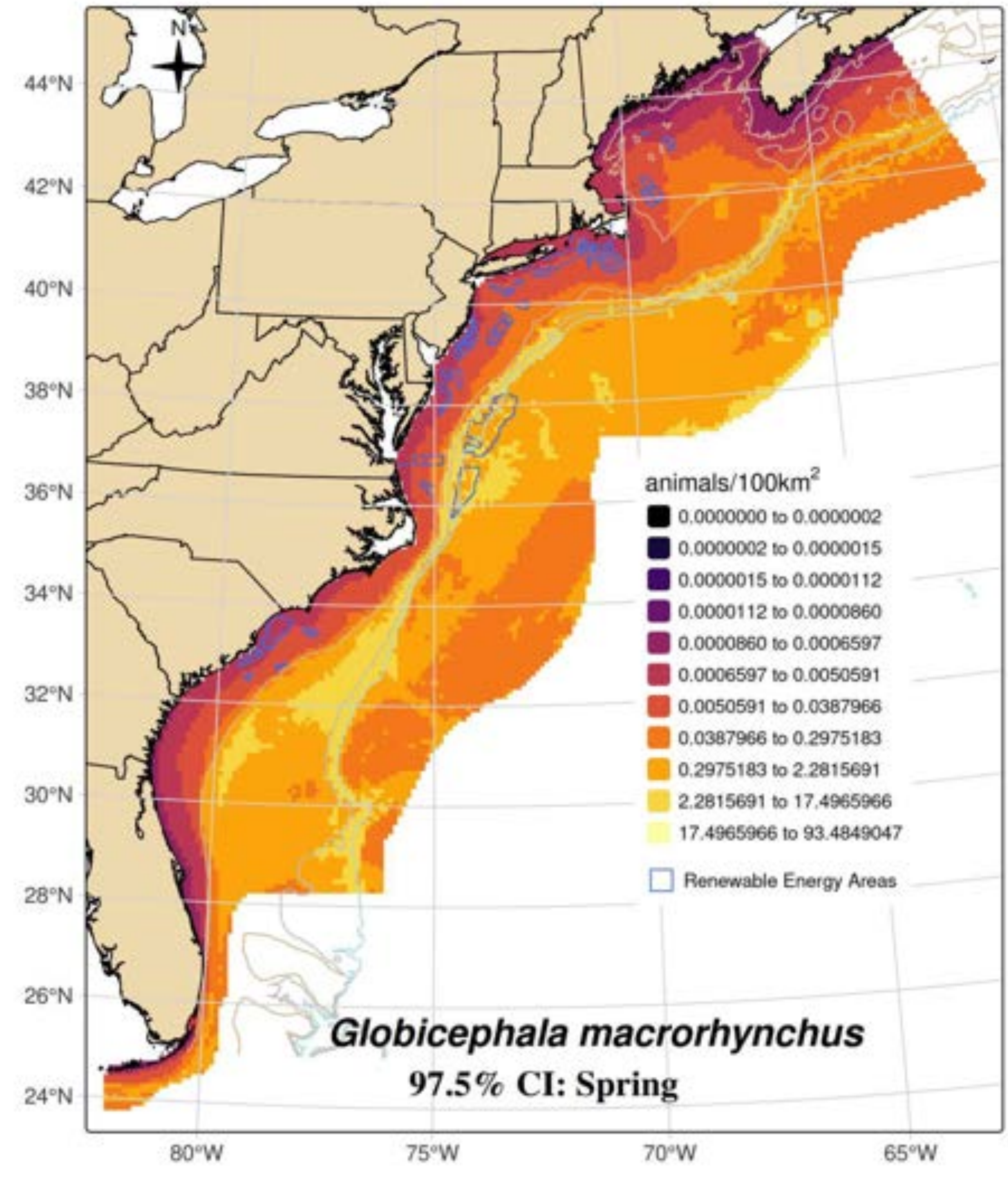

Figure C.2-8. Upper 97.5% confidence interval of the spring short-finned pilot whale density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

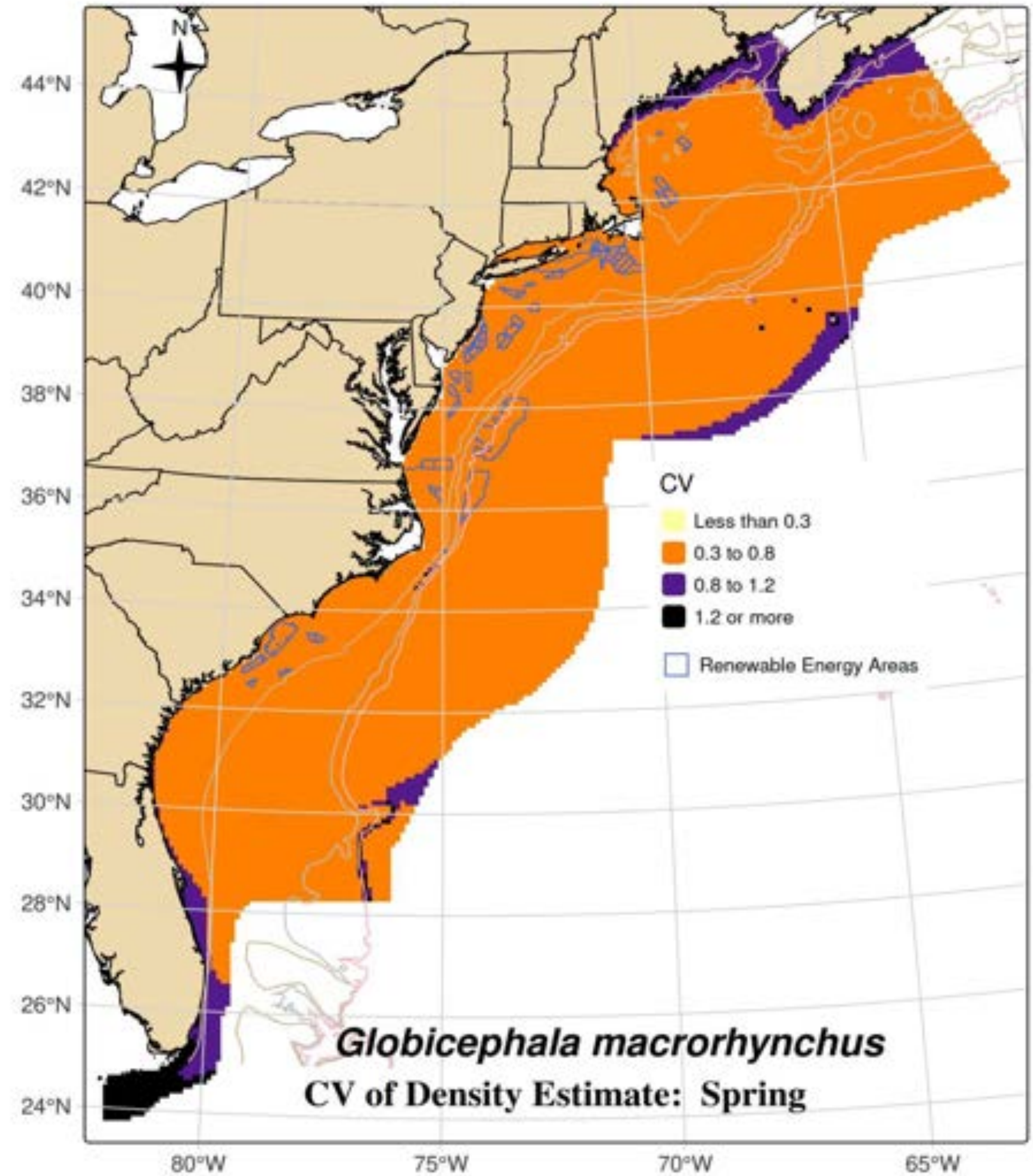

Figure C.2-9. CV of spring short-finned pilot whale density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

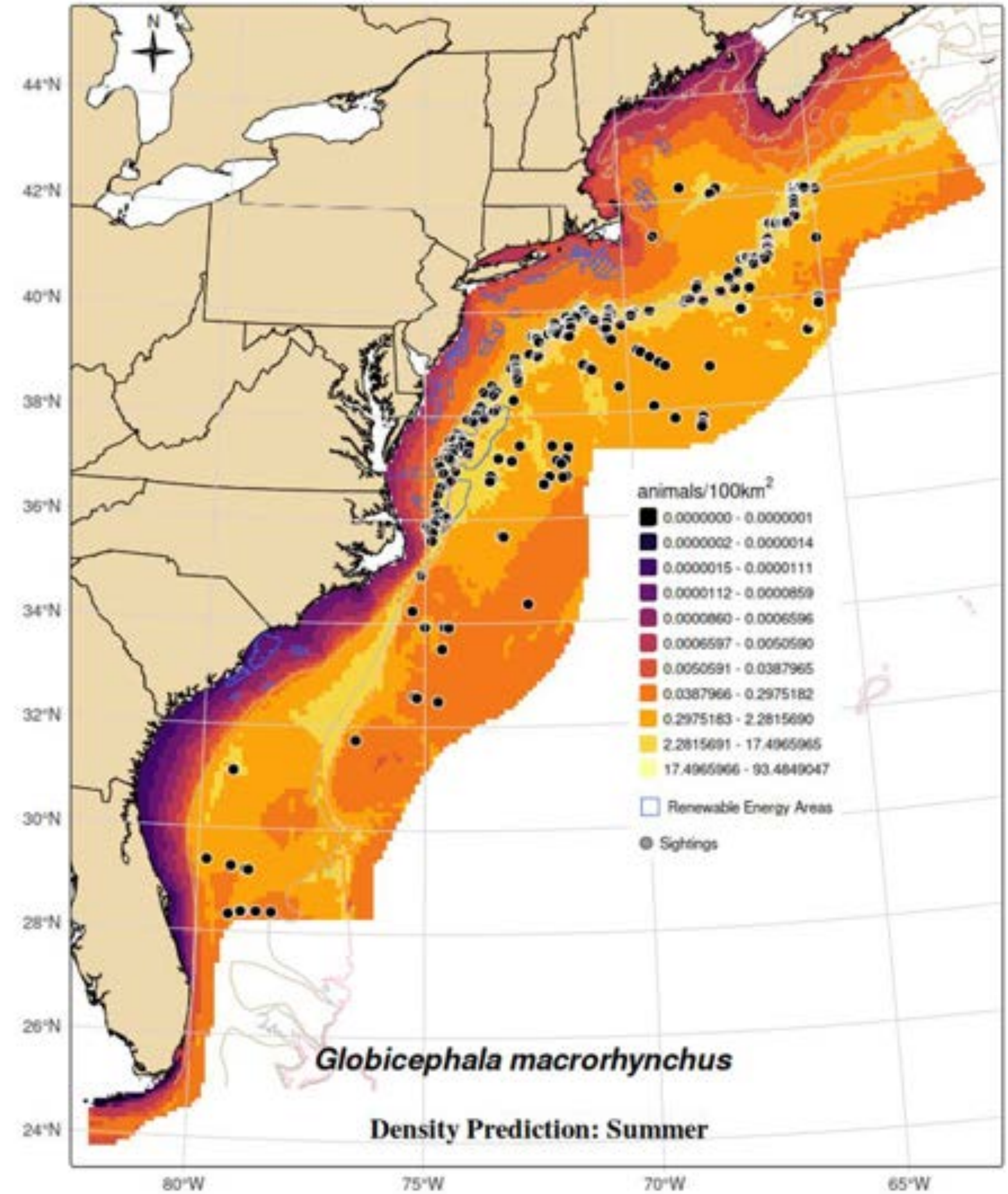

Figure C.2-10. Short-finned pilot whale summer average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

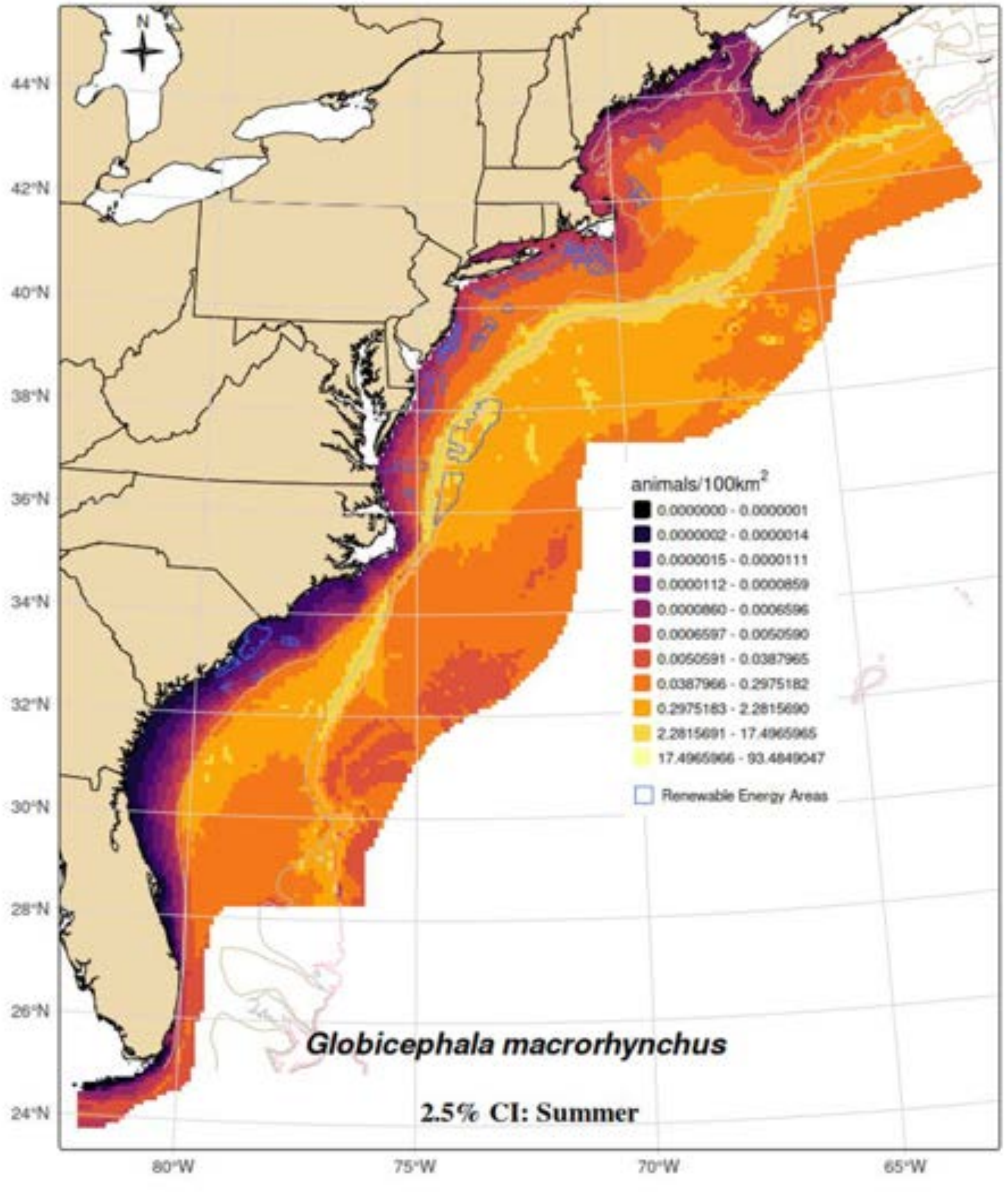

Figure C.2-11. Lower 2.5% confidence interval of summer short-finned pilot whale density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

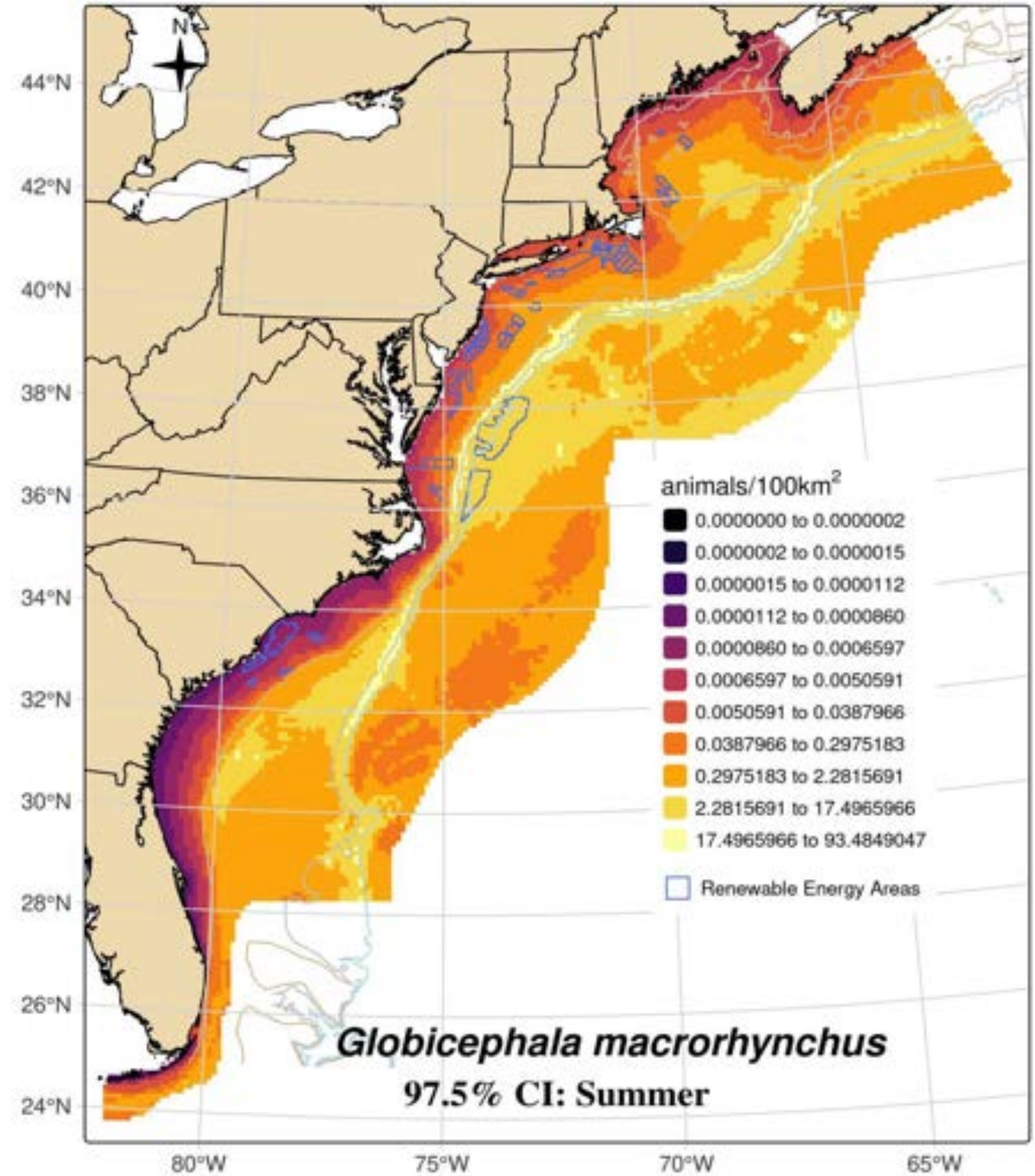

Figure C.2-12. Upper 97.5% confidence interval of summer short-finned pilot whale density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

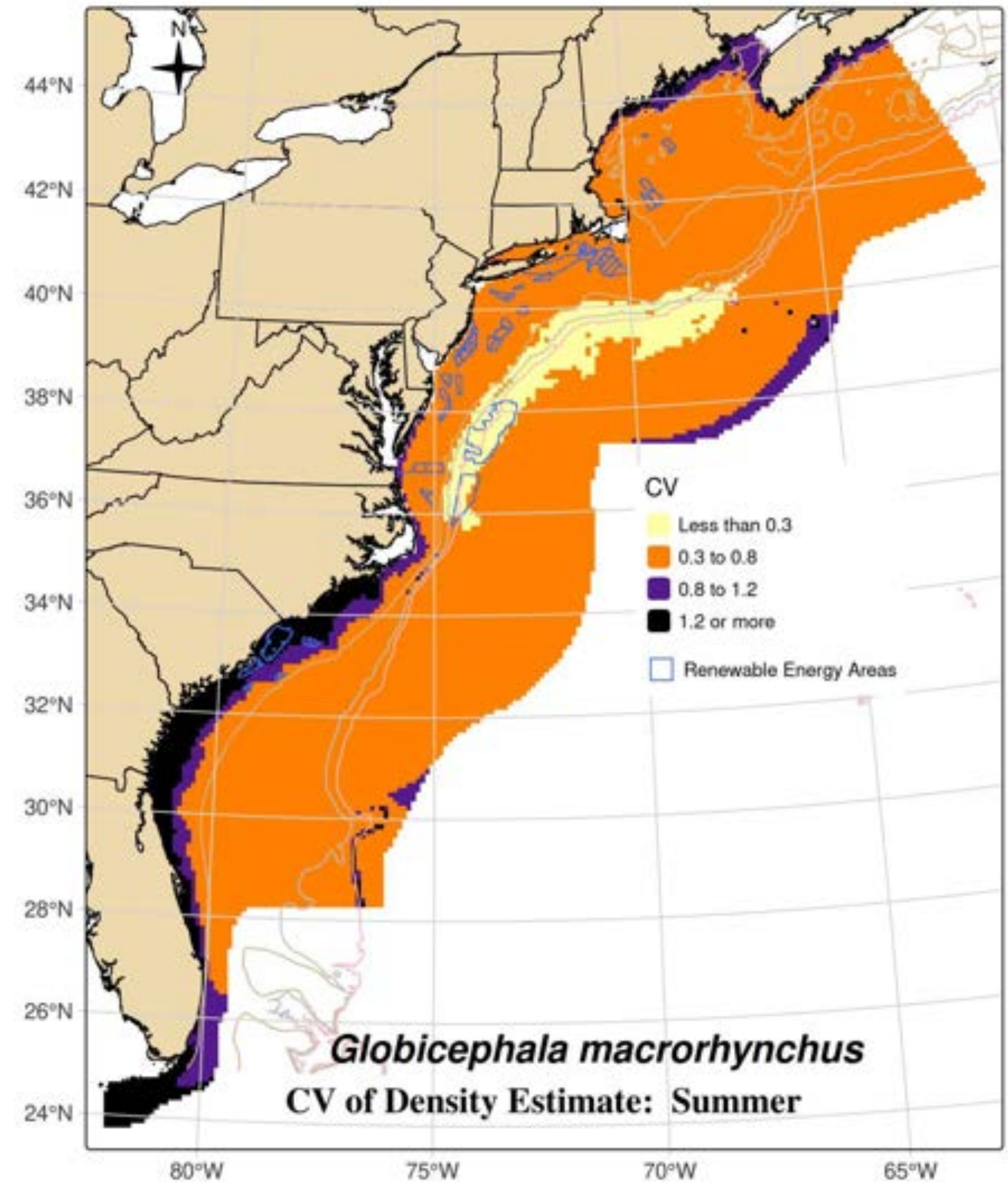

Figure C.2-13. CV of summer short-finned pilot whale density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

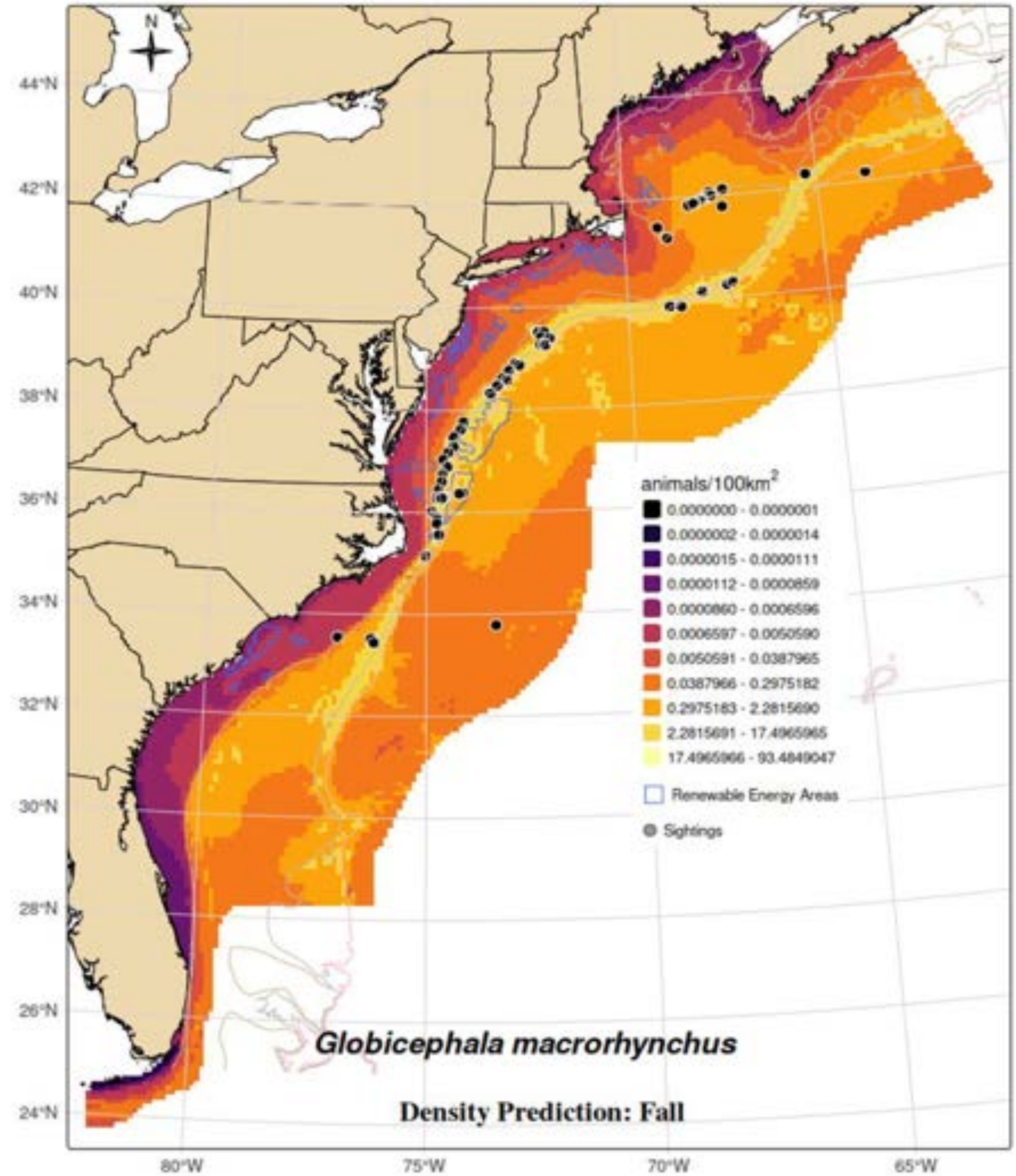

Figure C.2-14. Short-finned pilot whale fall average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

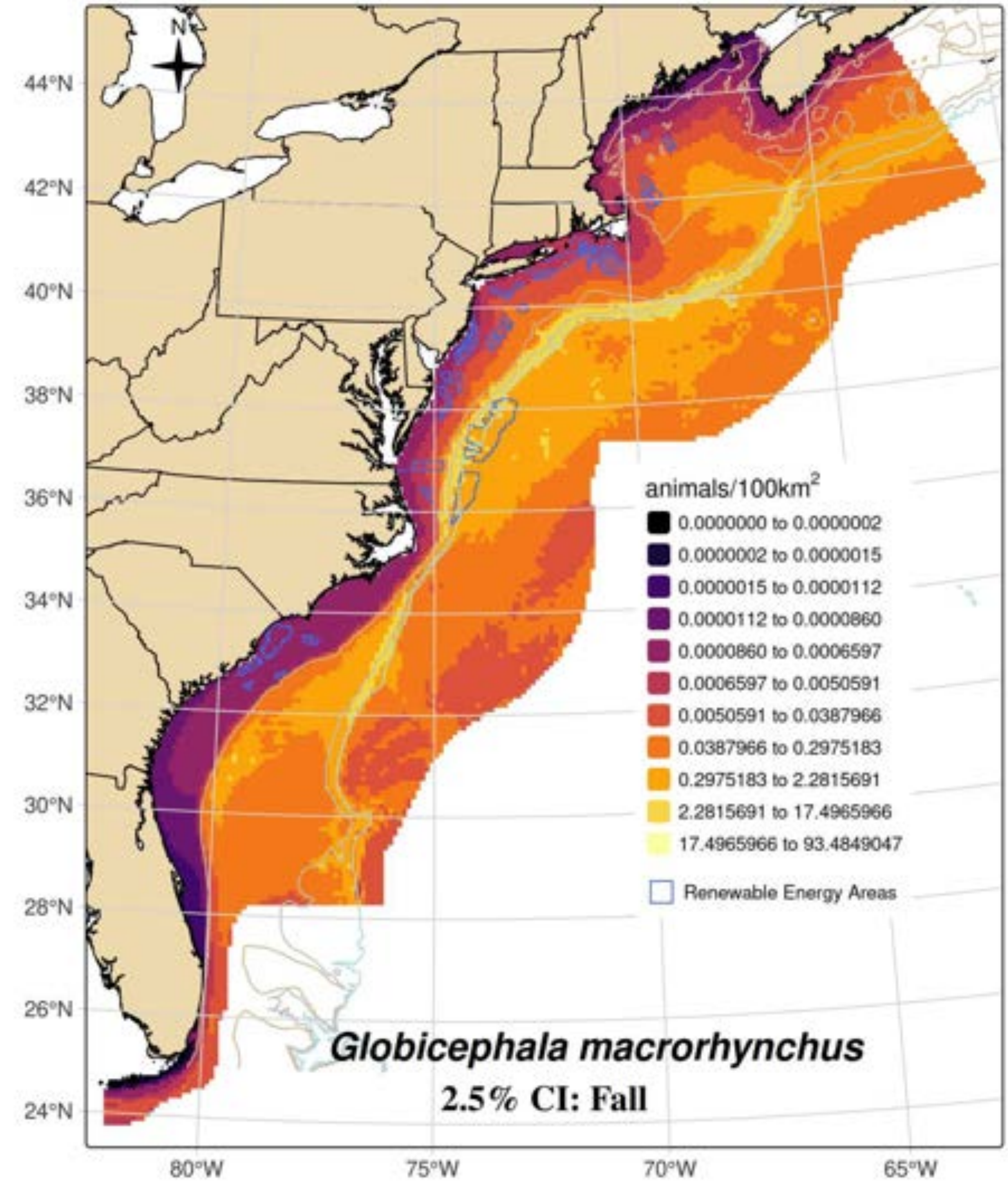

Figure C.2-15. Lower 2.5% confidence interval of the fall short-finned pilot whale density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

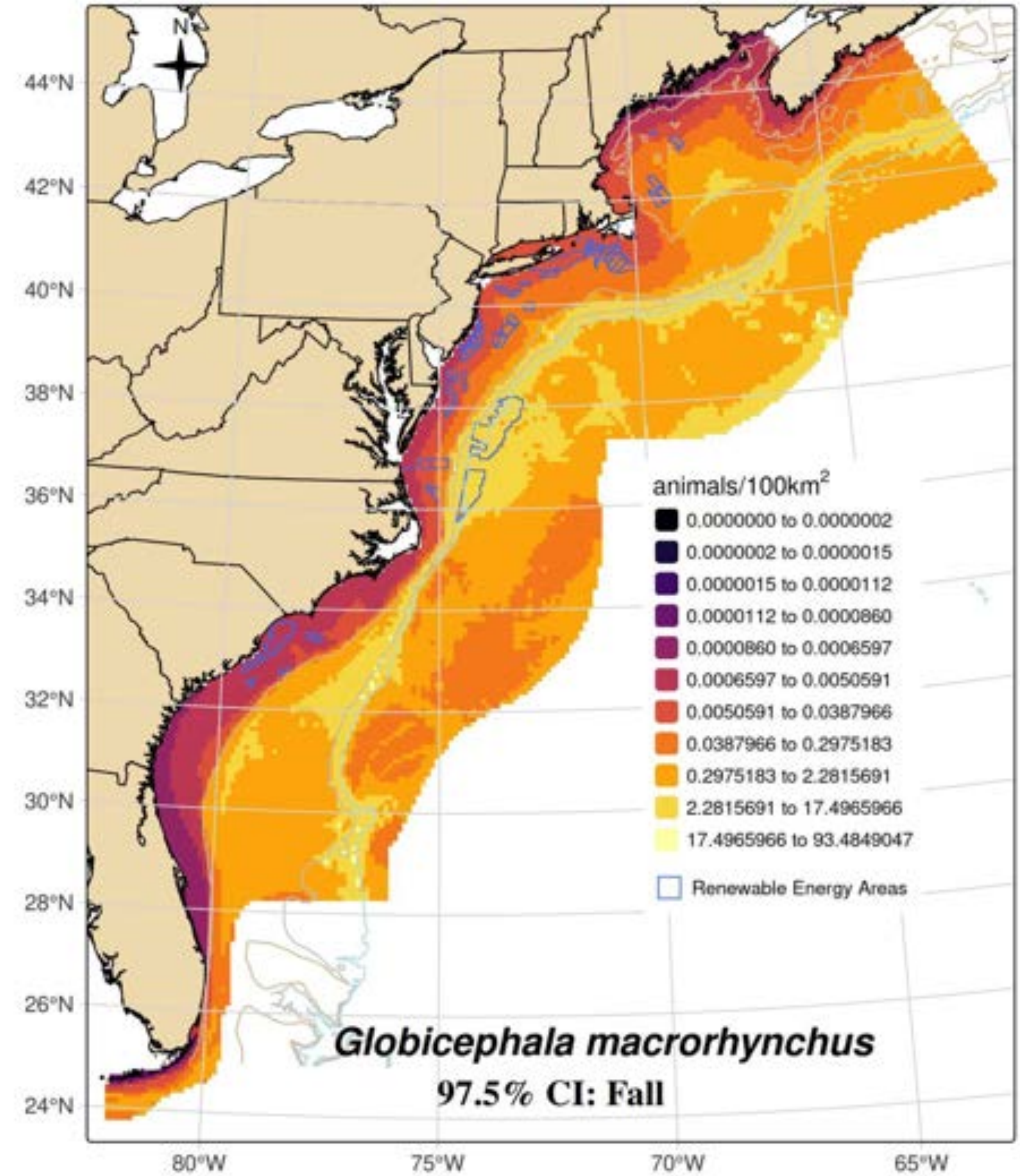

Figure C.2-16. Upper 97.5% confidence interval of the fall short-finned pilot whale density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

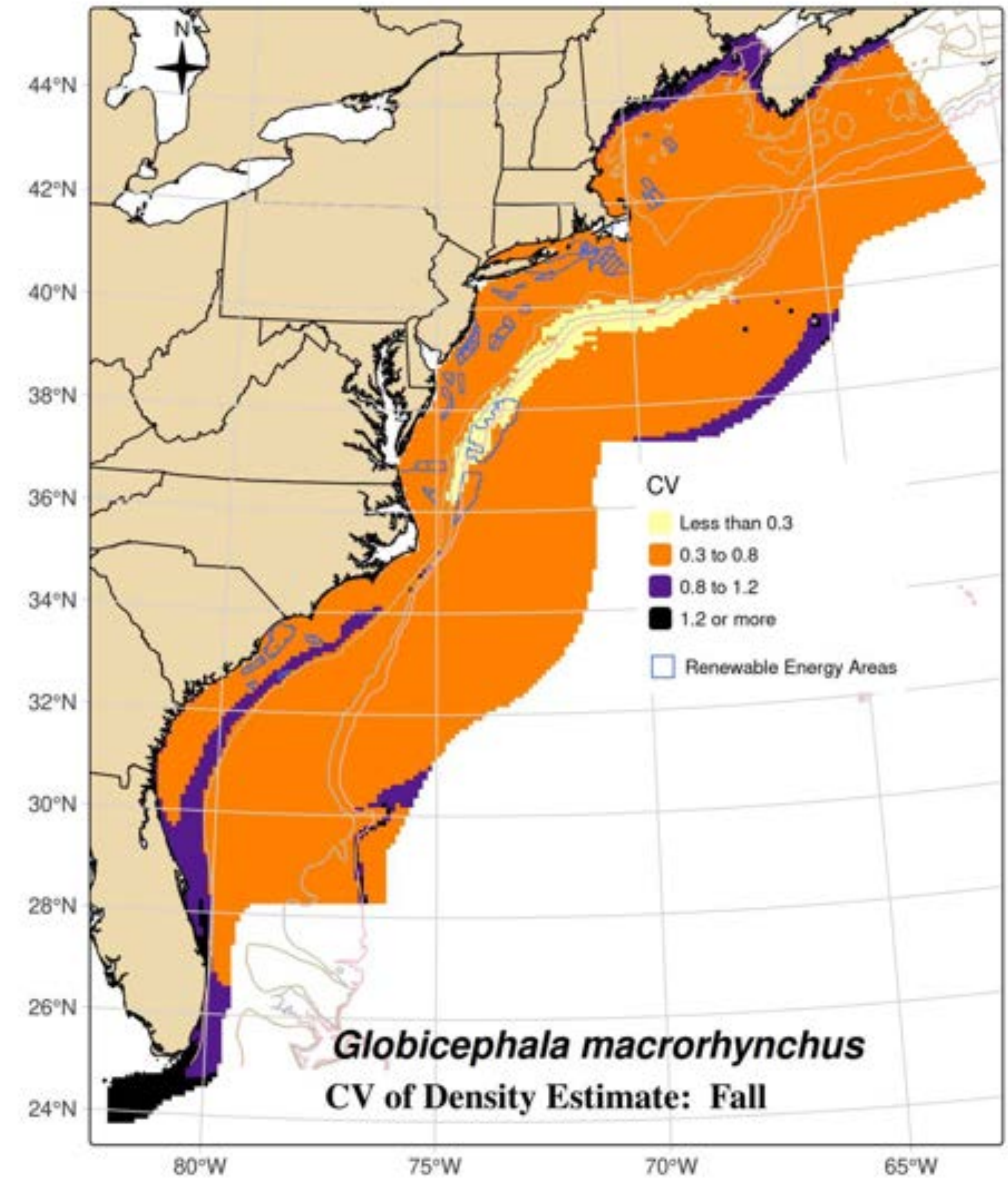

Figure C.2-17. CV of fall short-finned pilot whale density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

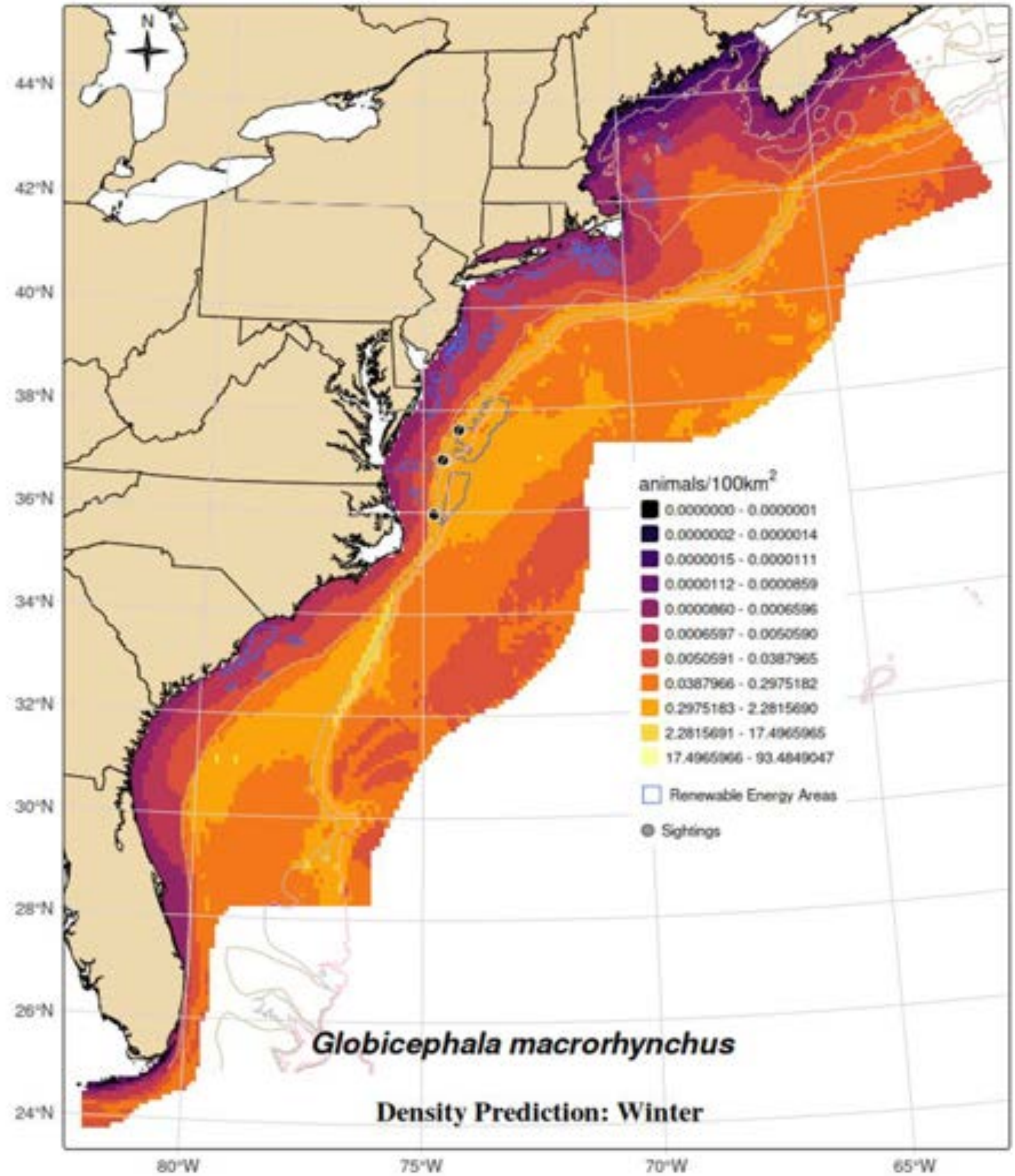

Figure C.2-18. Short-finned pilot whale winter average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

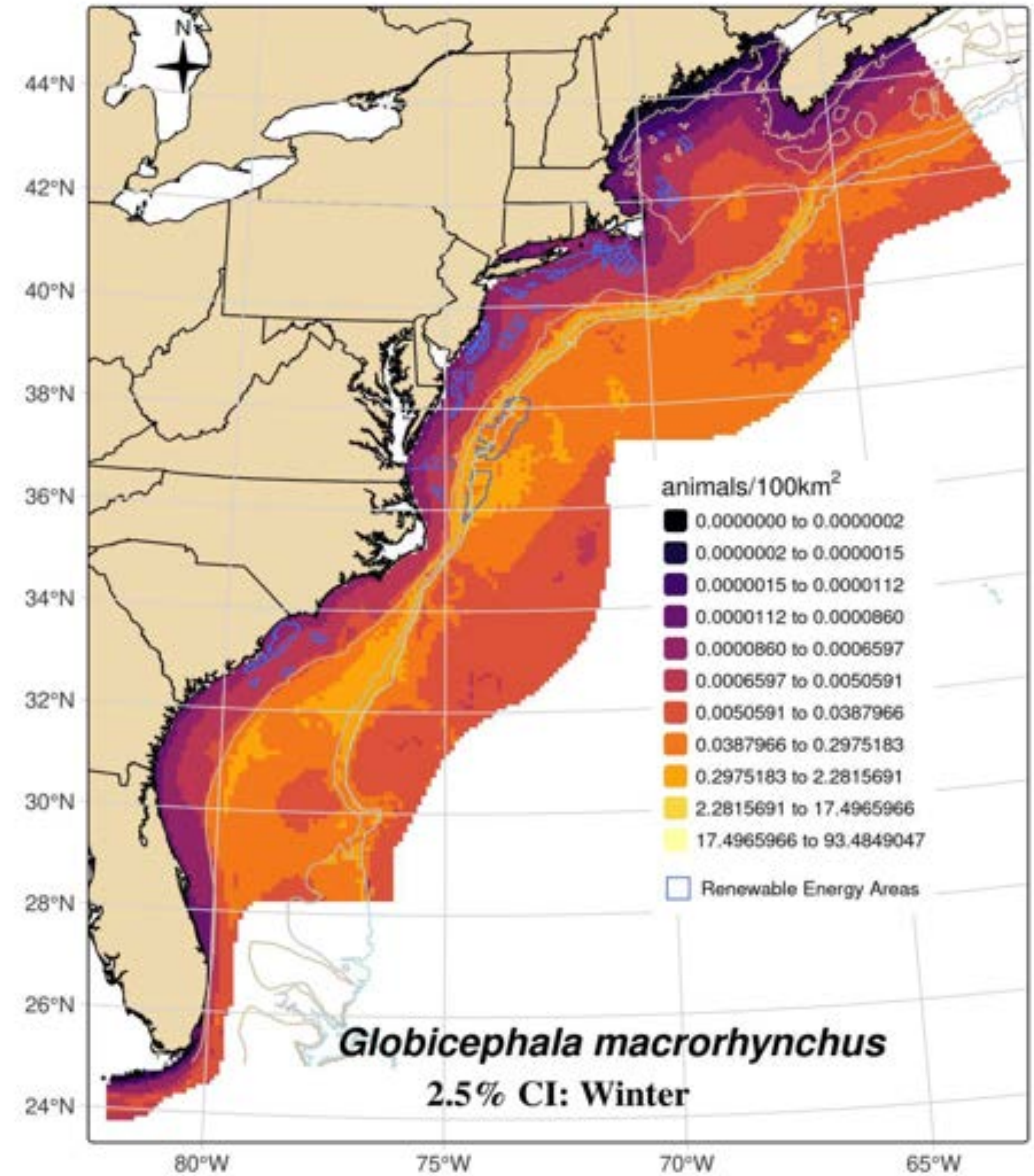

Figure C.2-19. Lower 2.5% confidence interval of the winter short-finned pilot whale density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

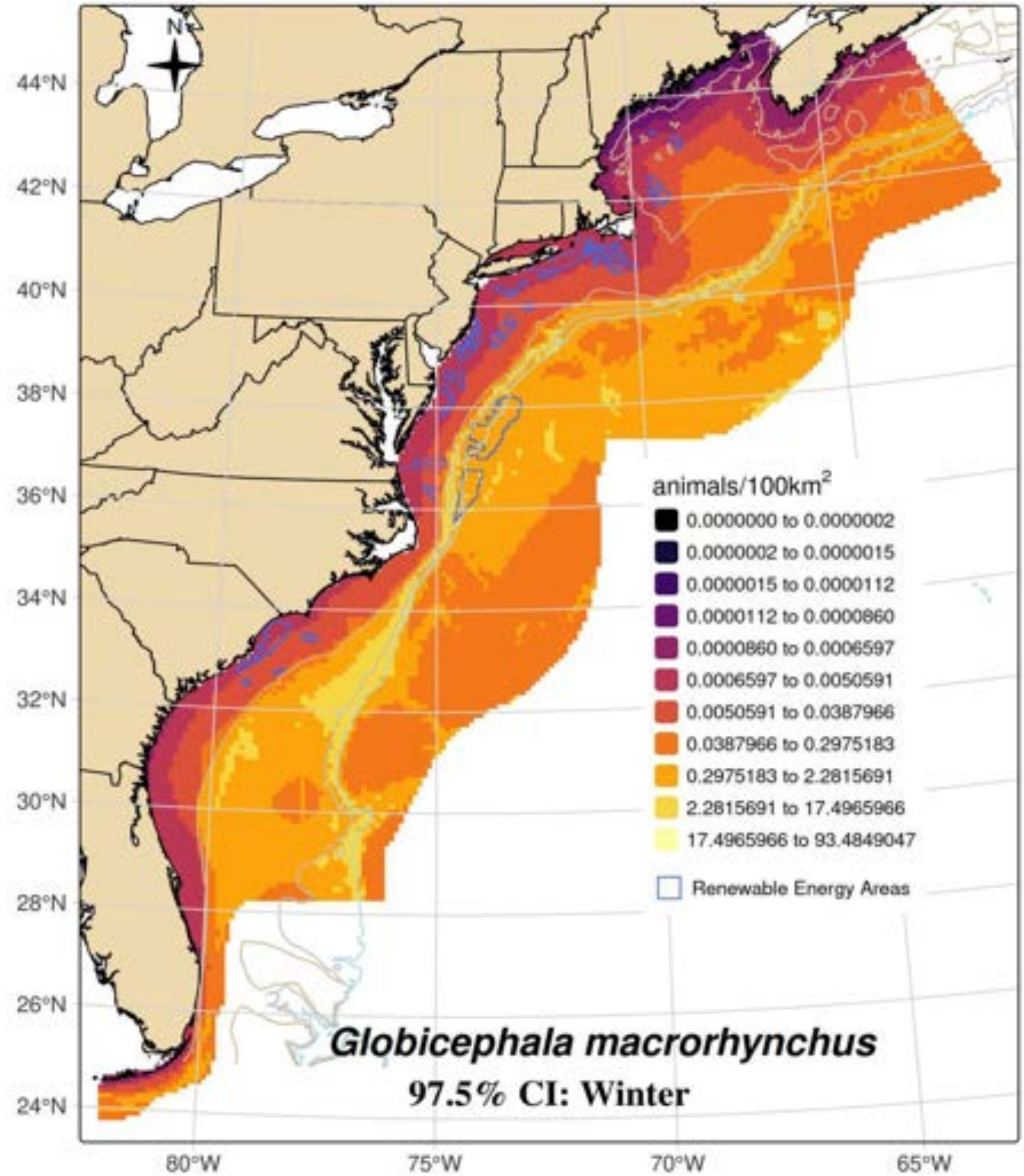

Figure C.2-20. Upper 97.5% confidence interval of the winter short-finned pilot whale density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

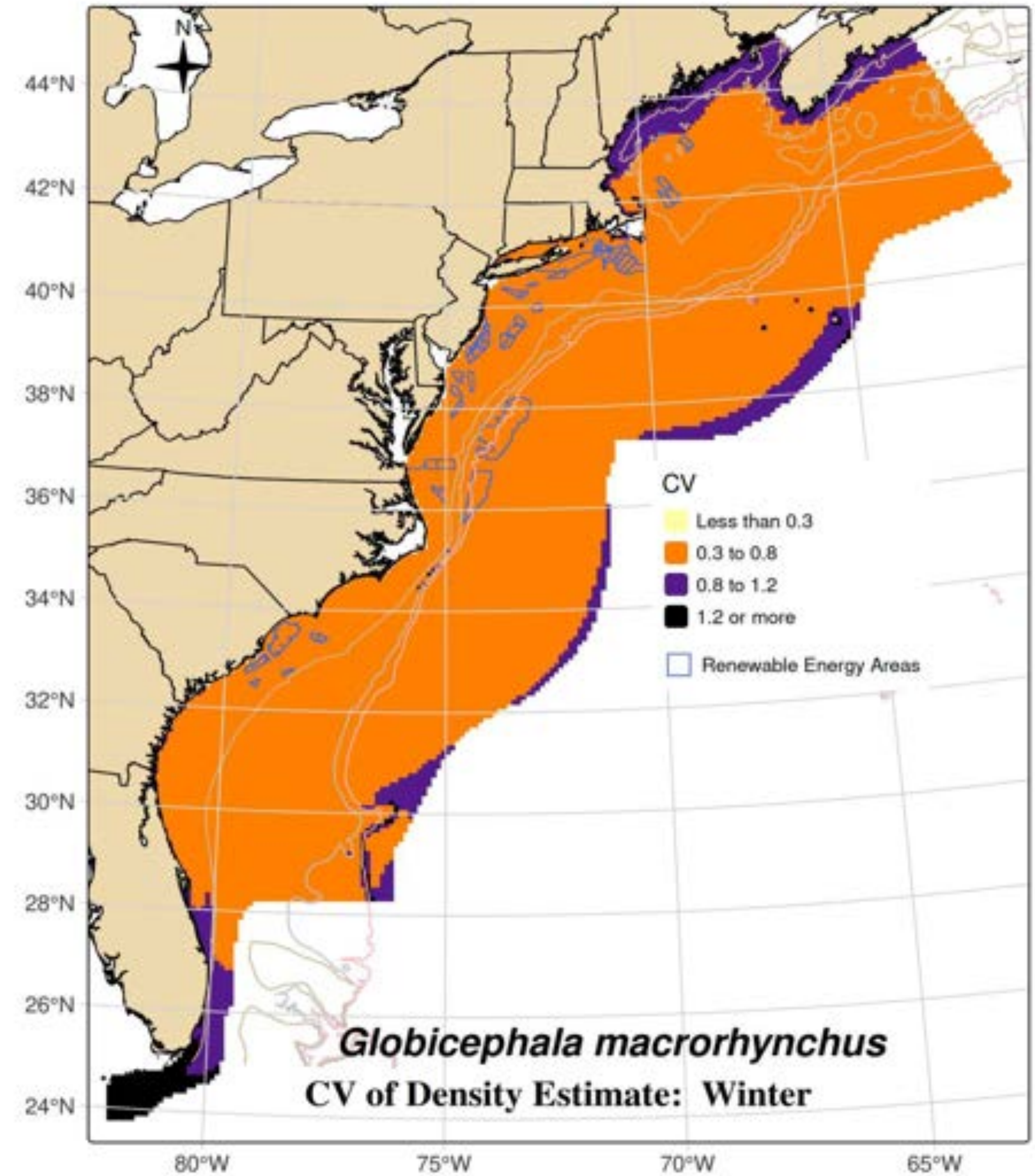

Figure C.2-21. CV of winter short-finned pilot whale density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

C.2.7 Offshore Energy Development Areas

Table C.2-6. Short-finned pilot whale abundance estimates for wind-energy study areas

Season	Wind-Energy Study Area	Abundance*	CV	95% Confidence Interval*
Spring (Mar-May)	RI/MA	0.4	0.47	0.2 - 0.9
	NY	0.1	0.49	0.1 - 0.3
	NJ	0.1	0.51	0 - 0.3
	DE/MD	0.1	0.50	0 - 0.2
	VA	0.2	0.43	0.1 - 0.4
	NC	2.2	0.38	1.1 - 4.5
	NC/SC	0.8	0.48	0.3 – 2.0
	GA	0	0.65	0 - 0
	FL	0.6	0.91	0.1 - 2.9
Summer (Jun-Aug)	RI/MA	6.5	0.41	3.0 - 14.1
	NY	1.1	0.45	0.5 - 2.6
	NJ	0.5	0.47	0.2 - 1.2
	DE/MD	0.3	0.46	0.1 - 0.7
	VA	0.6	0.42	0.3 - 1.3
	NC	8.4	0.35	4.3 - 16.4
	NC/SC	0.8	0.43	0.4 - 1.8
	GA	0	1.57	0 - 0
	FL	0.8	0.89	0.2 - 3.6
Fall (Sep-Nov)	RI/MA	2	0.41	0.9 - 4.3
	NY	0.3	0.48	0.1 - 0.7
	NJ	0.2	0.52	0.1 - 0.5
	DE/MD	0.1	0.49	0 - 0.3
	VA	0.2	0.47	0.1 - 0.5
	NC	4	0.37	2.0- 8.2
	NC/SC	0.5	0.48	0.2 - 1.3
	GA	0	0.67	0 - 0
	FL	0.5	0.91	0.1 - 2.5
Winter (Dec-Feb)	RI/MA	0.2	0.54	0.1 - 0.4
	NY	0	0.55	0 - 0.1
	NJ	0	0.58	0 - 0.1
	DE/MD	0	0.54	0 - 0.1
	VA	0.1	0.45	0 - 0.2
	NC	1.1	0.40	0.5 - 2.3
	NC/SC	0.7	0.50	0.3 - 1.8
	GA	0	0.63	0 - 0
	FL	0.4	0.94	0.1 – 2.0

***** We rounded the mean abundance and 95% confidence interval to the nearest tenth of an animal. If this resulted in a zero for the mean abundance, we calculated the CV using the actual abundance value as estimated by the density-habitat model and then rounded to the nearest tenth. If a wind-energy study area is not included, then we assumed the abundance was zero.

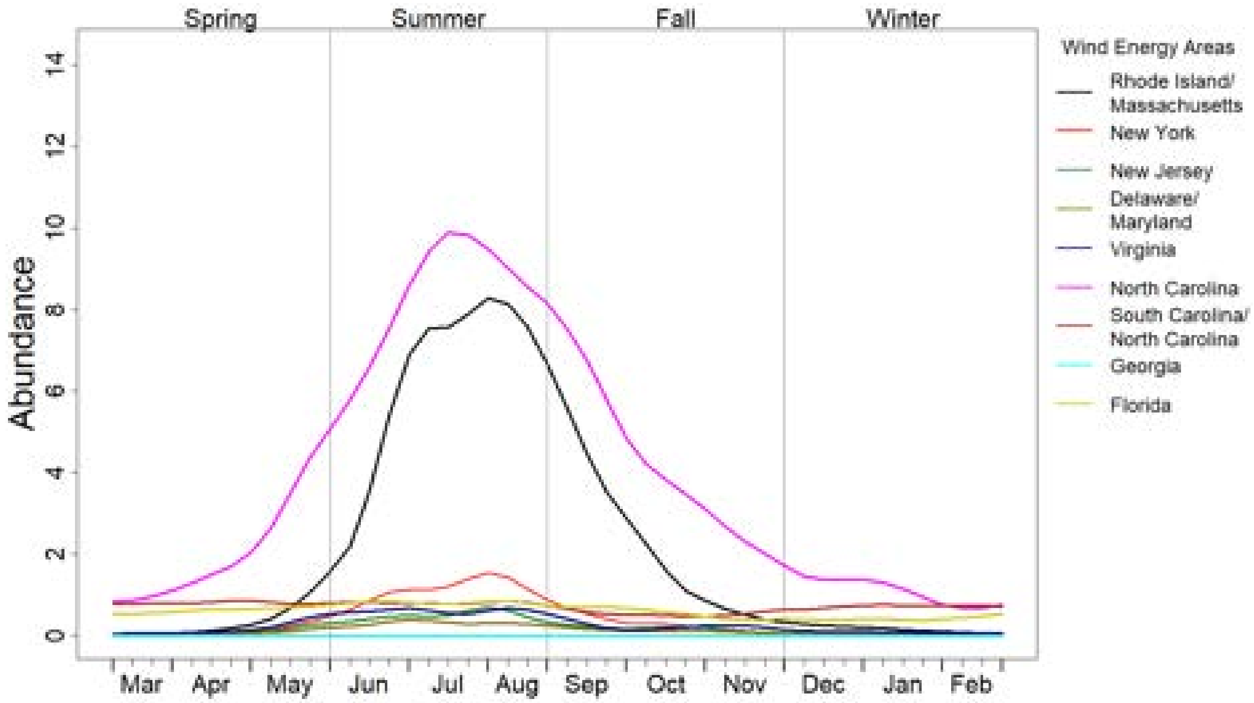

Figure C.2-22. Average seasonal abundance of short-finned pilot whales in wind-energy study areas

C.3 Long-finned Pilot Whale (*Globicephala melas*)

Figure C.3-1. Long-finned pilot whales
Image collected under MMPA Research permit #21371. Credit: NOAA/NEFSC/Jennifer Gatzke

C.3.1 Data Collection

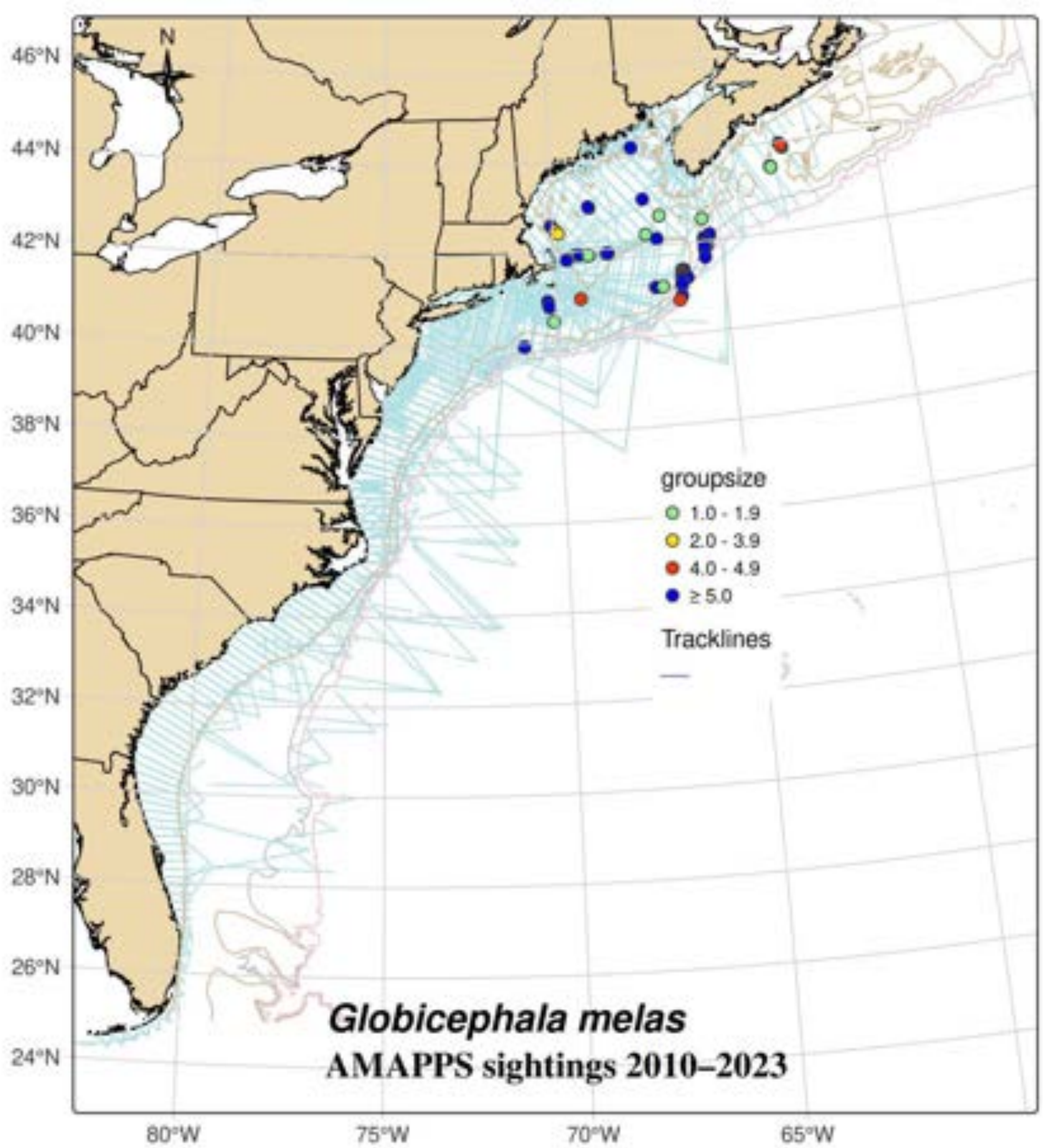

Figure C.3-2. Distribution of track lines and long-finned pilot whale sightings 2010 to 2023
Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

Table C.3-1. AMAPPS research effort 2010 to 2023 and long-finned pilot whale sightings

Survey Region and Platform	Season	Effort (km)	Number of Groups	Number of Animals
NE Shipboard	Spring	8,883	43	302
NE Shipboard	Summer	49,064	26	366
NE Aerial	Spring	38,839	11	48
NE Aerial	Summer	52,003	18	86
NE Aerial	Fall	87,311	23	112
NE Aerial	Winter	24,747	0	0
SE Shipboard	Spring	2,604	0	0
SE Shipboard	Summer	18,331	0	0
SE Shipboard	Fall	2,673	0	0
SE Shipboard	Winter	302	0	0
SE Aerial	Spring	48,634	0	0
SE Aerial	Summer	43,285	0	0
SE Aerial	Fall	21,153	0	0
SE Aerial	Winter	19,152	0	0

C.3.2 Mark-Recapture Distance Sampling Analysis

Table C.3-2. Intermediate parameters in long-finned pilot whale mark-recapture distance sampling (MRDS) models

Analysis Set	MR Model	MR Truncation (m)	DS Model	DS Truncation (m)	Key function	p(0)	p(0) CV	Chi-square p-value	CvM p-value
SE–aerial group 5	distance + observer + glare	400	distance	400	HN + Hermite Poly Adjustment 4	0.76	0.09	0.22	0.83
NE–aerial group 7	distance + observer + log(group size)	460	Distance + glare	460	HR	0.66	0.12	0.68	0.95
NE–shipboard group 7	distance * observer + log(group size) + sea state + glare	4000	distance + time of day	4000	HR	0.67	0.09	0.20	0.92
SE–shipboard group 3	distance * observer + log(group size)	5000	Distance + log(group size)	5000	HR	0.60	0.13	0.15	0.66

MR=Mark-Recapture, DS=Distance Sampling, HR=Hazard Rate, HN= Half Normal, CV=Coefficient of variation. Values of p>0.5 for Chi-square and Cramer-von Mises test (CvM) indicate good fit. The definition of p(0) is the probability of detecting a group on the track line. Species included in the analysis sets are explained in main text Tables 4-20 and 4-21.

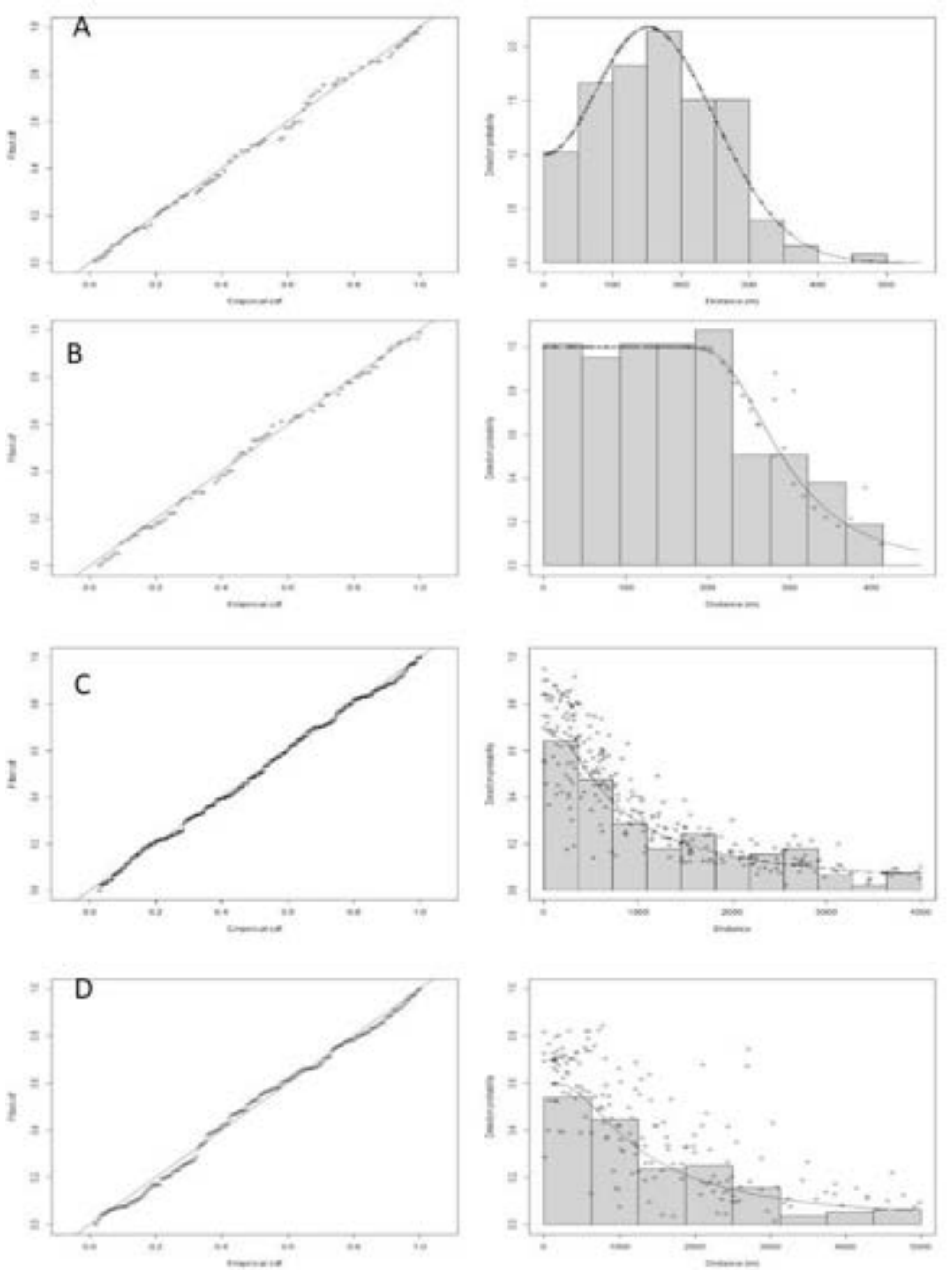

Figure C.3-3. Q-Q plots and detection functions from the long-finned pilot whale MRDS analyses
A) SE-aerial analysis set 5; B) NE-aerial analysis set 7; C) NE-shipboard analysis set 7; D) SE-shipboard analysis set 3.

C.3.3 Generalized Additive Model Analysis

Table C.3-3. 2015–2023 density-habitat model output for long-finned pilot whales

Covariates	Edf	Ref.df	F	C.dev	p-value
s(sstmur)	2.78	5	4.00	9.18	<0.0001
s(poc)	0.92	5	2.17	4.22	0.0005
s(pp)	0.93	5	3.35	1.34	<0.0001
s(dist2GSSw)	2.08	5	1.06	2.72	0.0500
s(slope)	0.99	5	7.91	27.60	<0.0001
s(dist200)	0.86	5	1.16	2.38	0.0086
s(latdd)	1.92	5	3.46	16.20	<0.0001

Adjusted R^2 = 0.0243. Deviance explained = 63.6%.
Includes the estimated degrees of freedom (Edf), reference degrees of freedom (Ref.df), contribution to the deviance (C.dev) explained for each habitat covariate and its associated p-value. Covariate abbreviations explained in main text in Table 4-2.

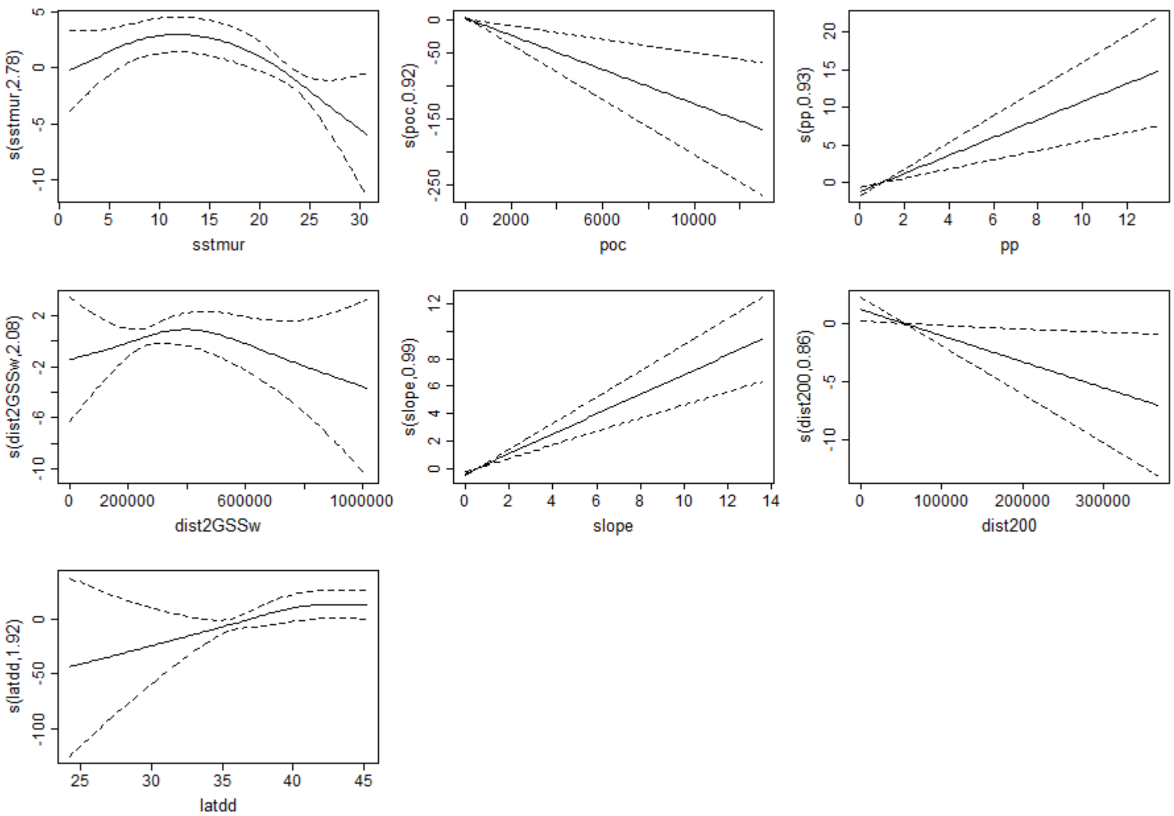

Figure C.3-4. Long-finned pilot whale density relative to significant habitat covariates
Plots represent the partial smooths and interaction terms of the density-habitat model. Covariate abbreviations explained in main text in Table 4-2.

C.3.4 Model Cross-Validation

Table C.3-4. Diagnostic statistics from the long-finned pilot whale density-habitat model

Diagnostic Statistic	Description	Calculated with	Model Values (x)	Score
RHO	Spearman rank correlation	Non-zero density	0.367	Excellent
MAPE	Mean absolute percentage error	Non-zero density	92.598	Fair to good
RHO	Spearman rank correlation	All data divided in 25 random samples	0.149	Fair to good
MAE	Mean absolute error	All data divided in 25 random samples	0.017	Excellent
MAPE	Mean absolute percentage error	All data divided in 25 random samples	84.148	Fair to good

RHO: Poor= x<0.05; Fair to good =0.05<=x<0.3; Excellent= x>0.3
MAPE: Poor= x>150%; Fair to good= 150%>=x>50%; Excellent= x<=50%
MAE: Poor= x>1; Fair to good = 1>=x>0.25; Excellent= x<=0.25

C.3.5 Abundance Estimates for AMAPPS Study Area

Table C.3-5. Long-finned pilot whale average abundance estimates for the AMAPPS study area

Season	Average Abundance	CV	95% Confidence Interval
Spring (March–May)	4,268	0.71	1,220 – 14,930
Summer (June–August)	5,634	0.66	1,734 – 18,309
Fall (September–November)	5,061	0.62	1,655 – 15,478
Winter (December–February)	5,538	0.67	1,679 – 18,268
Summer 2011 U.S. surveys[1]	5,636	0.63	2,671−11,893
Summer 2016 U.S. surveys[1]	9,972	0.55	5,133−19,372
Summer 2021 U.S. surveys[1]	5,711	0.62	1,867 – 17,465

[1]Hayes et al. 2024

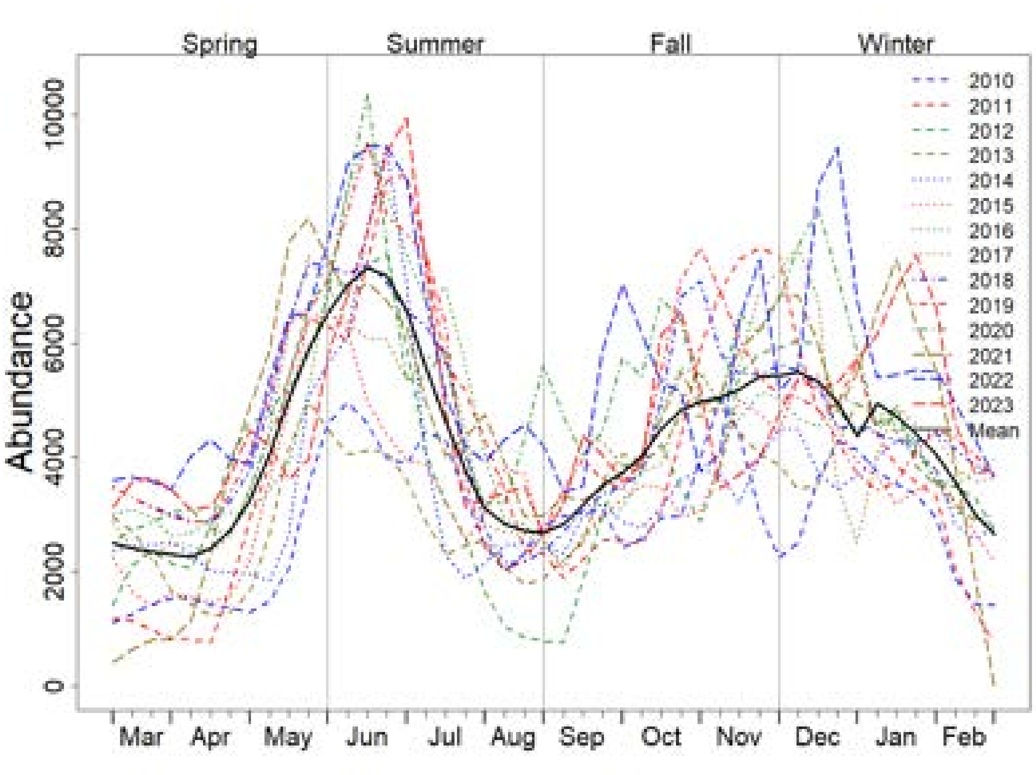

Figure C.3-5. Annual abundance trends for long-finned pilot whales in the AMAPPS study area

C.3.6 Seasonal Prediction Maps

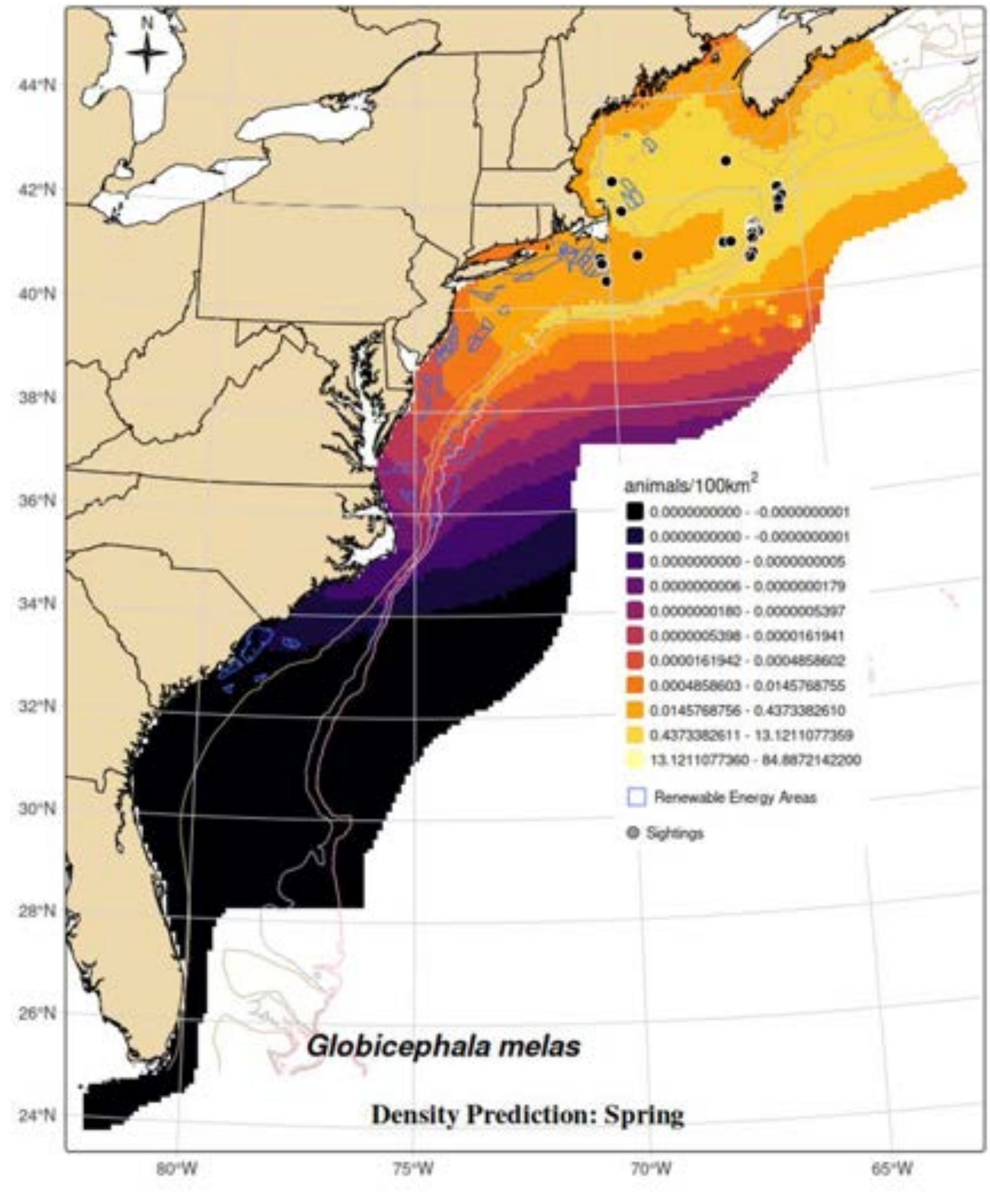

Figure C.3-6. Long-finned pilot whale spring average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

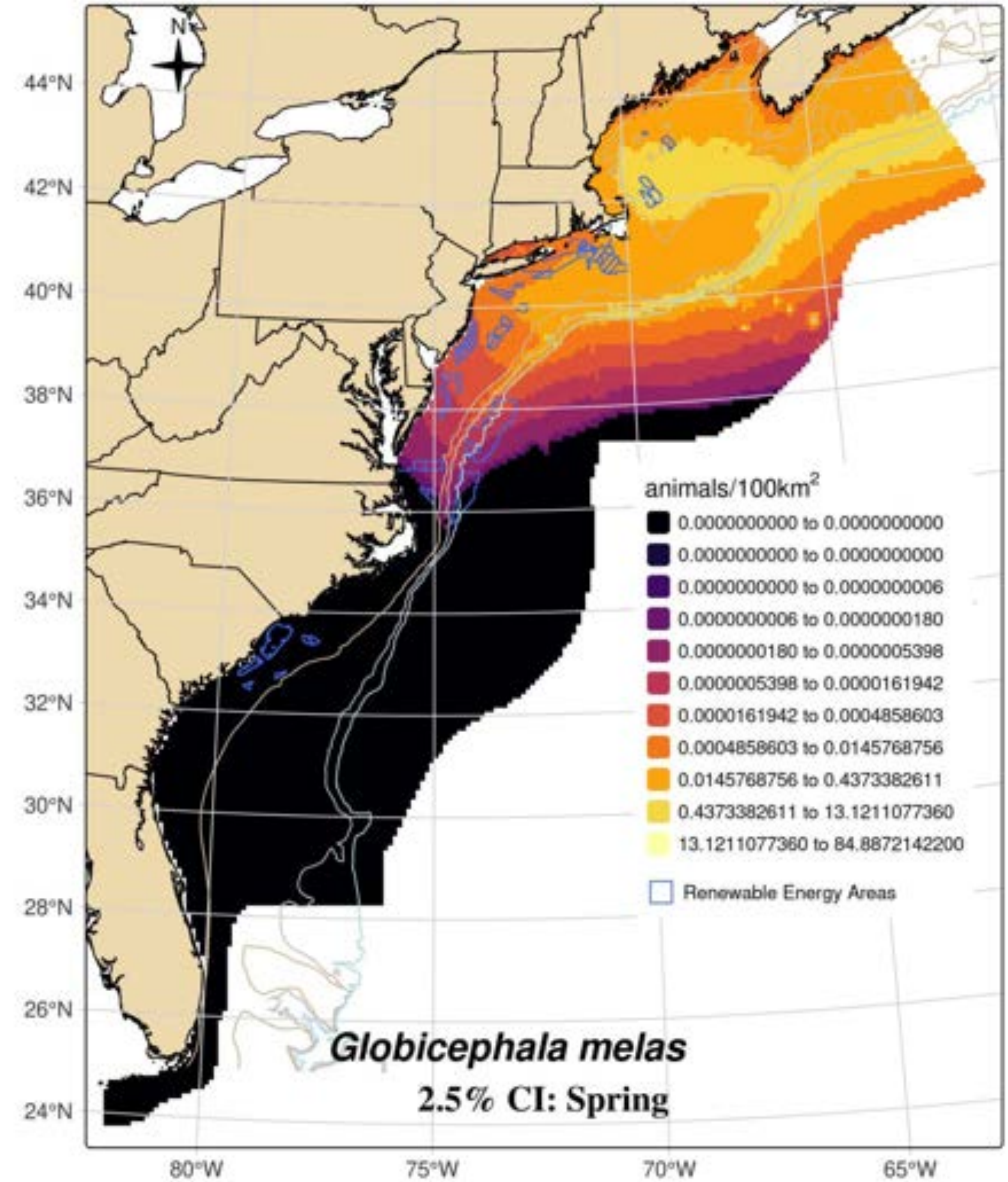

Figure C.3-7. Lower 2.5% confidence interval of the spring long-finned pilot whale density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

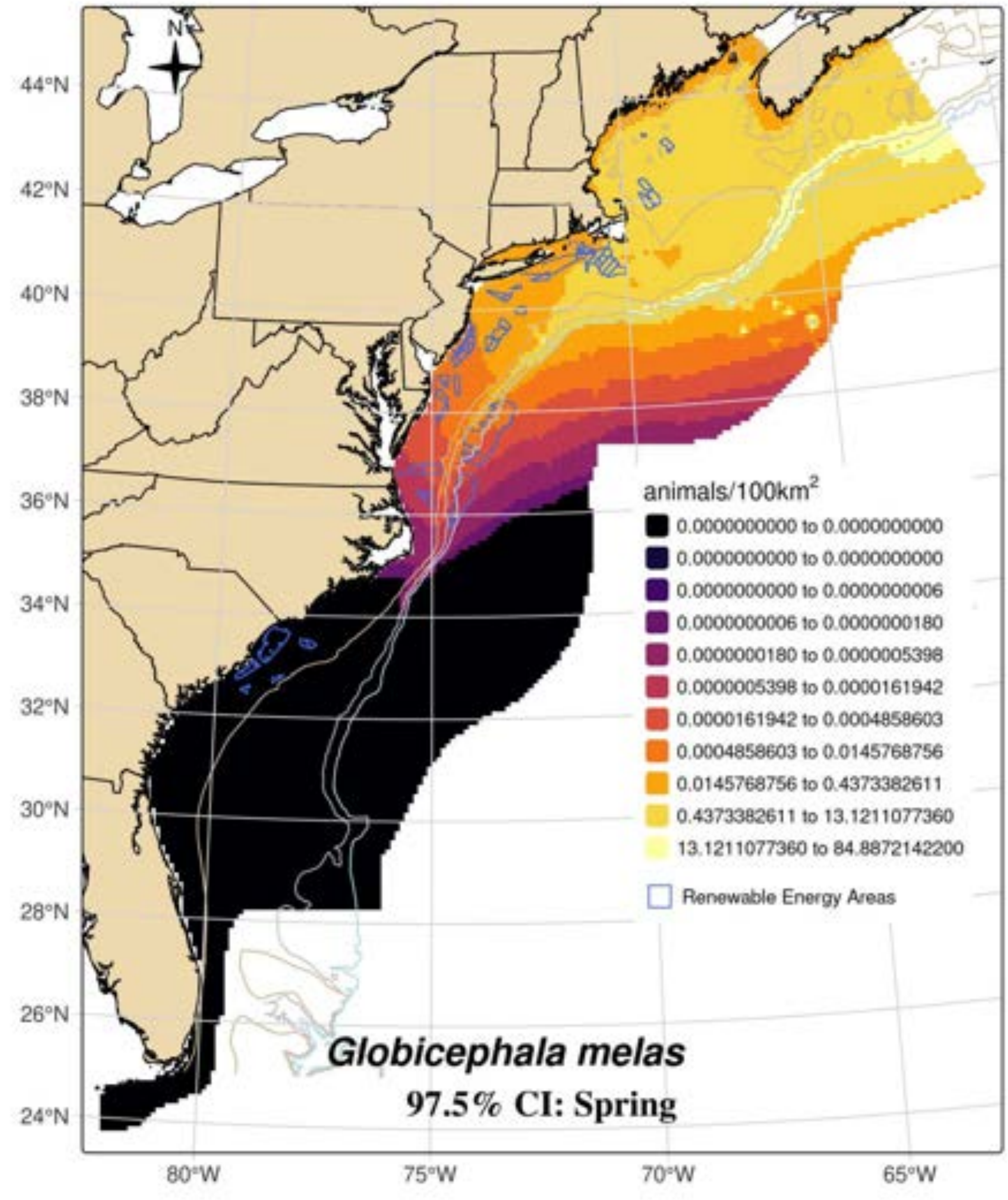

Figure C.3-8. Upper 97.5% confidence interval of the spring long-finned pilot whale density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

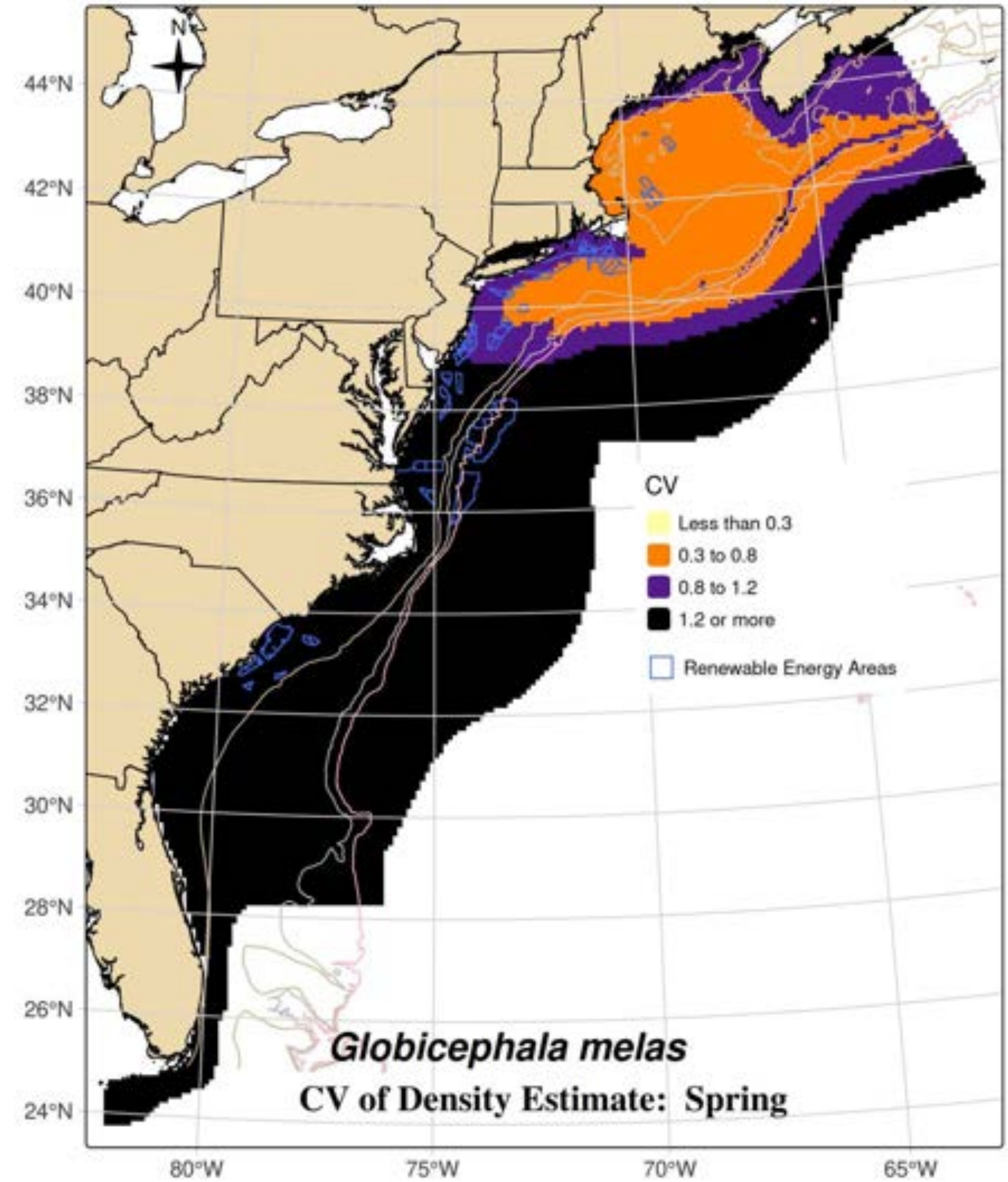

Figure C.3-9. CV of spring long-finned pilot whale density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

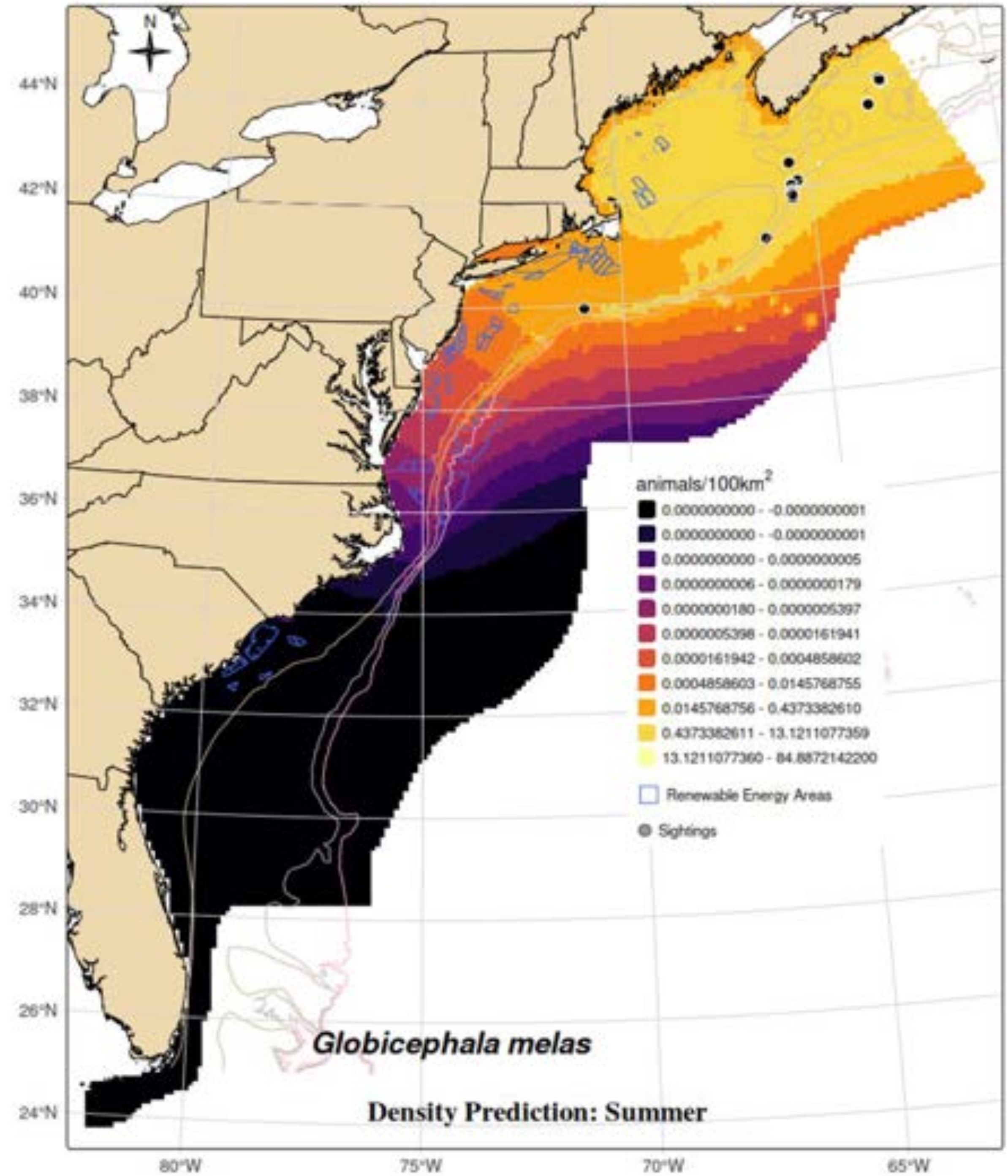

Figure C.3-10. Long-finned pilot whale summer average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

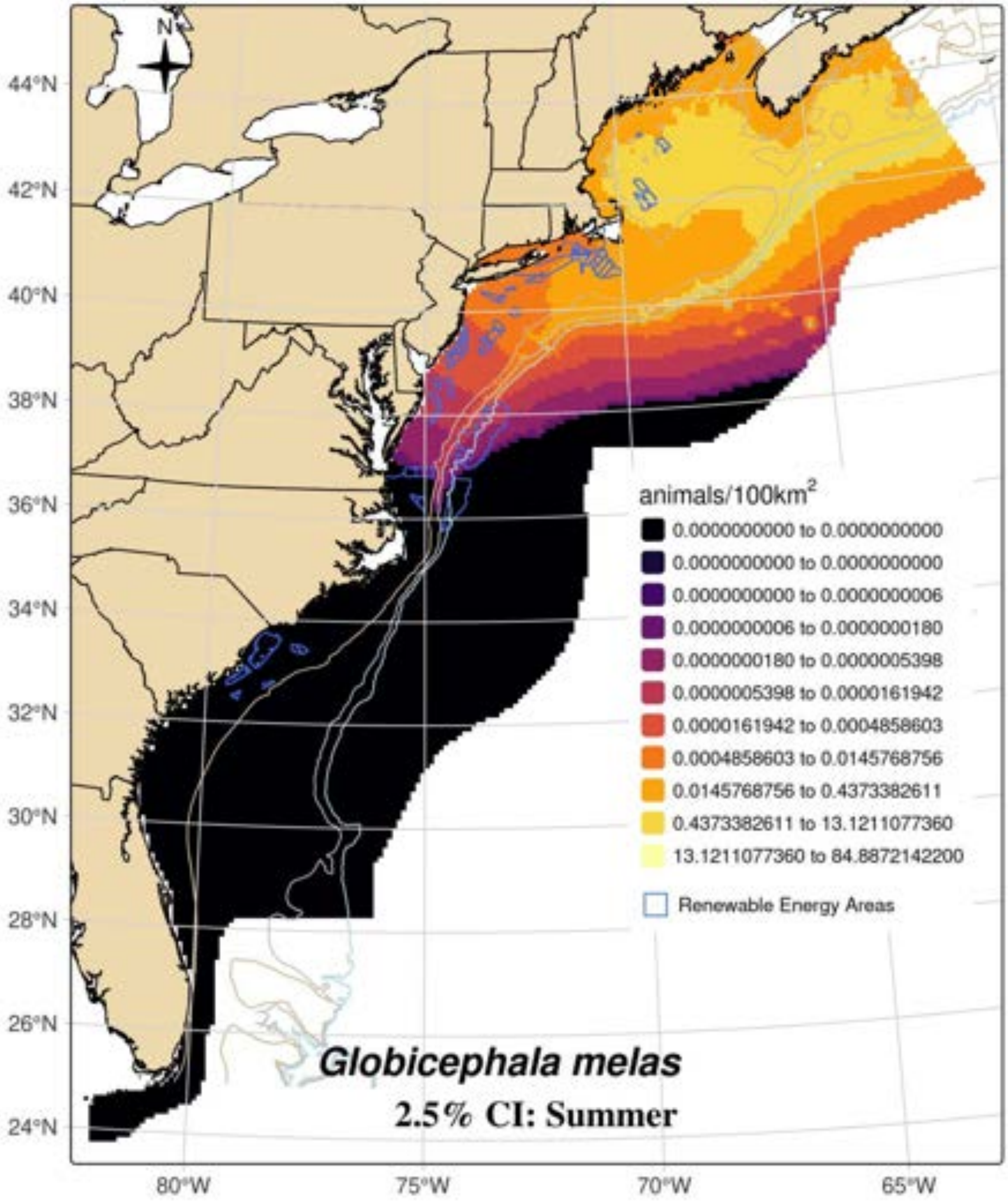

Figure C.3-11. Lower 2.5% confidence interval of the summer long-finned pilot whale density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

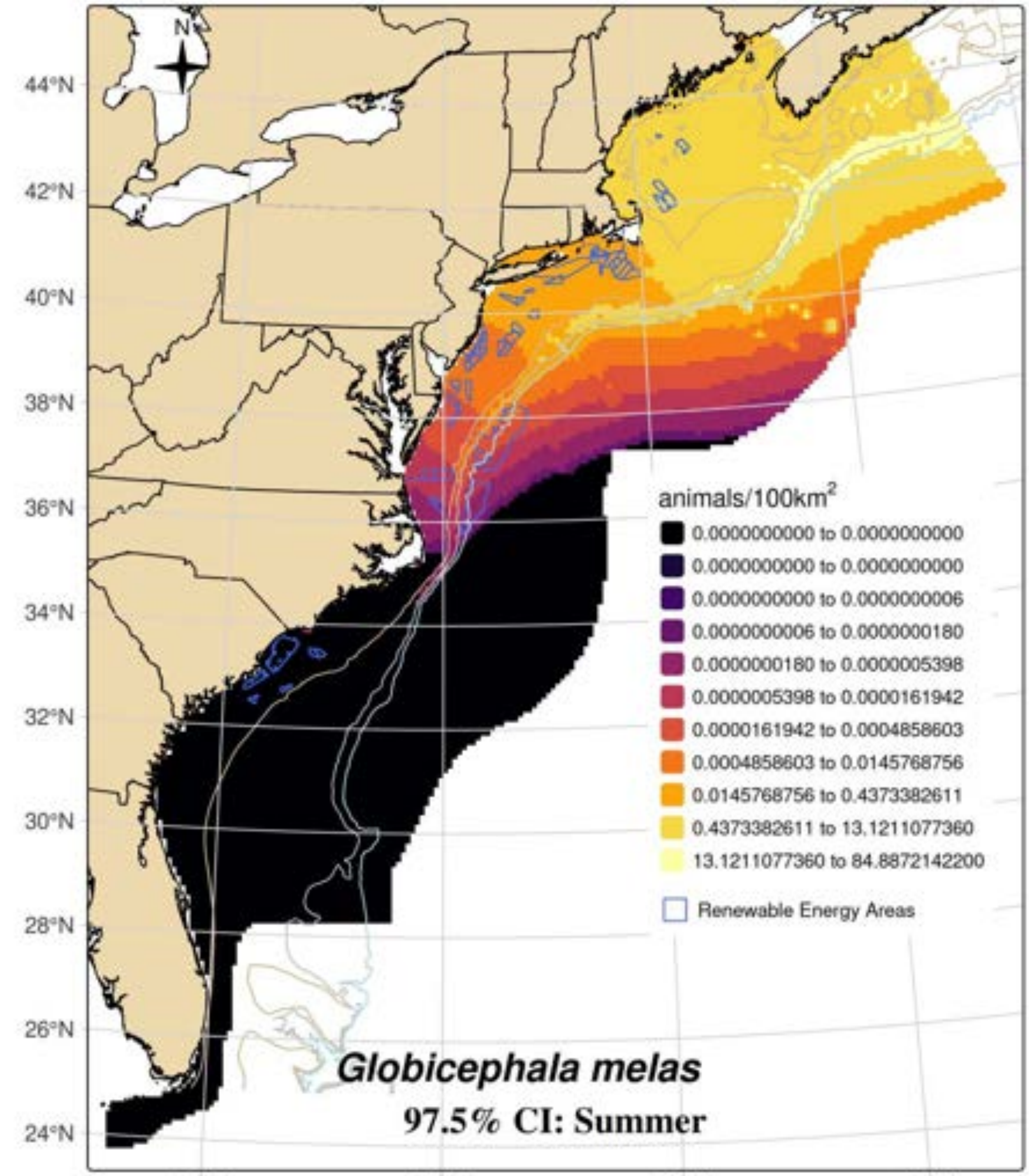

Figure C.3-12. Upper 97.5% confidence interval of summer long-finned pilot whale density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

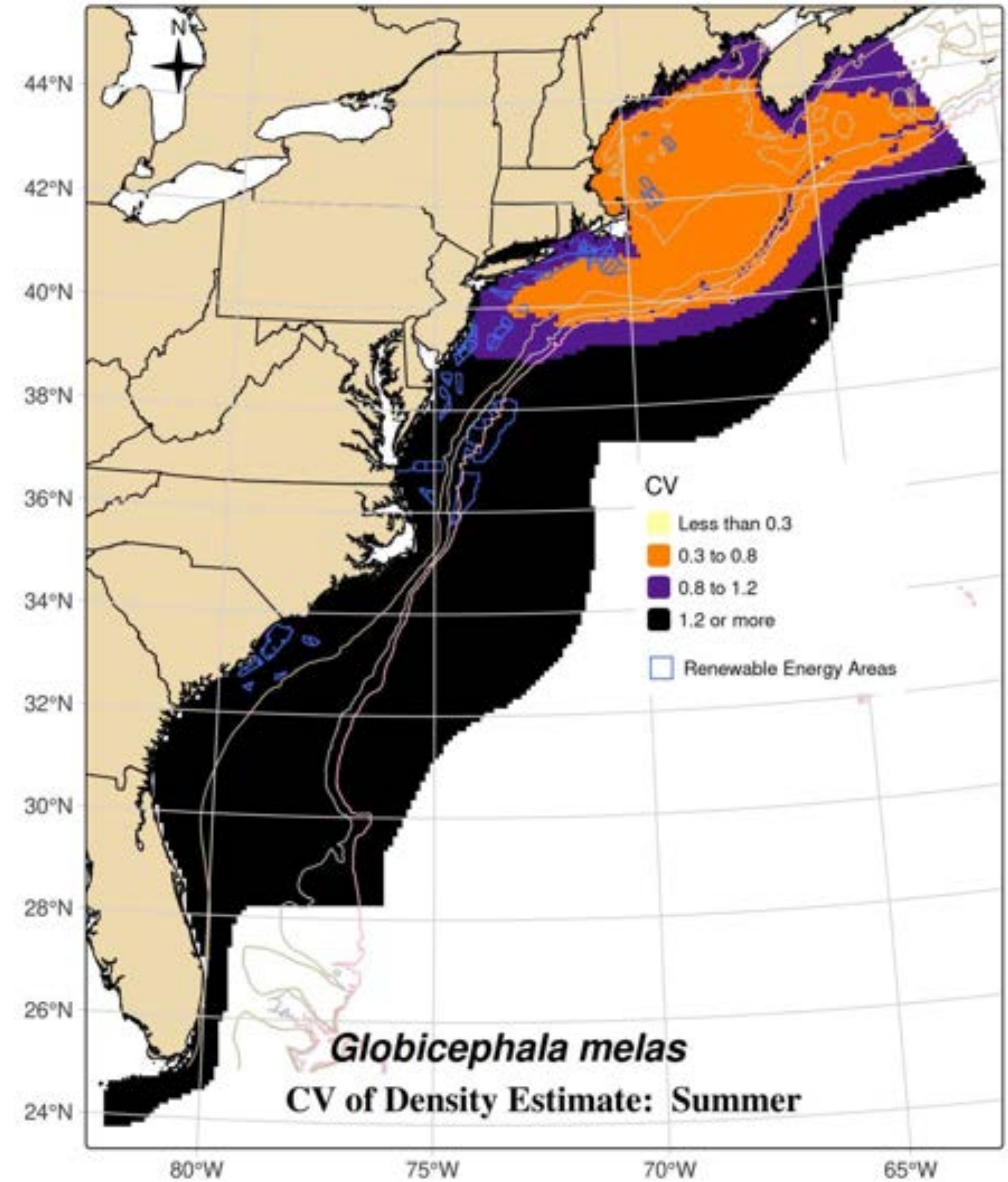

Figure C.3-13. CV of summer long-finned pilot whale density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

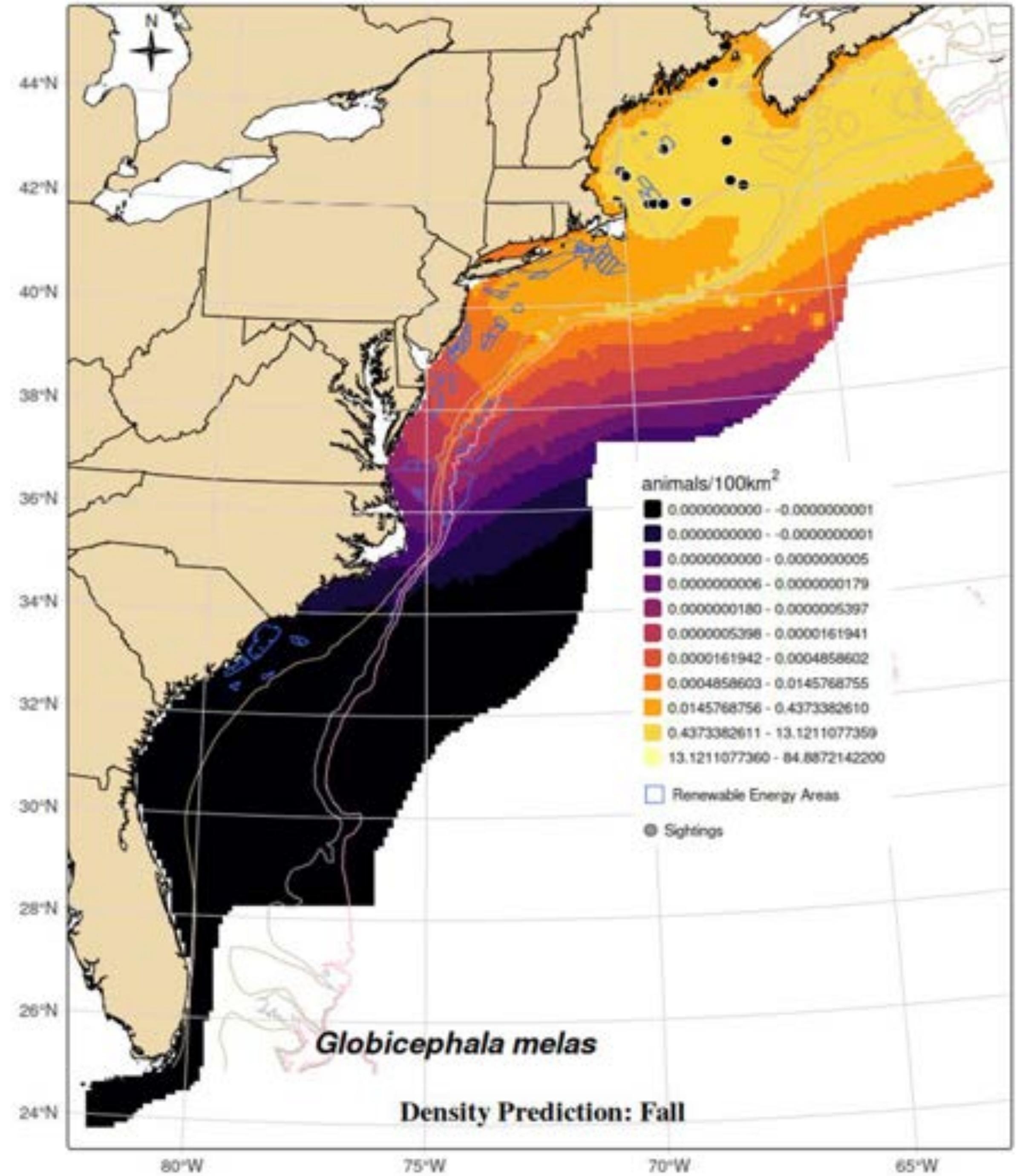

Figure C.3-14. Long-finned pilot whale fall average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

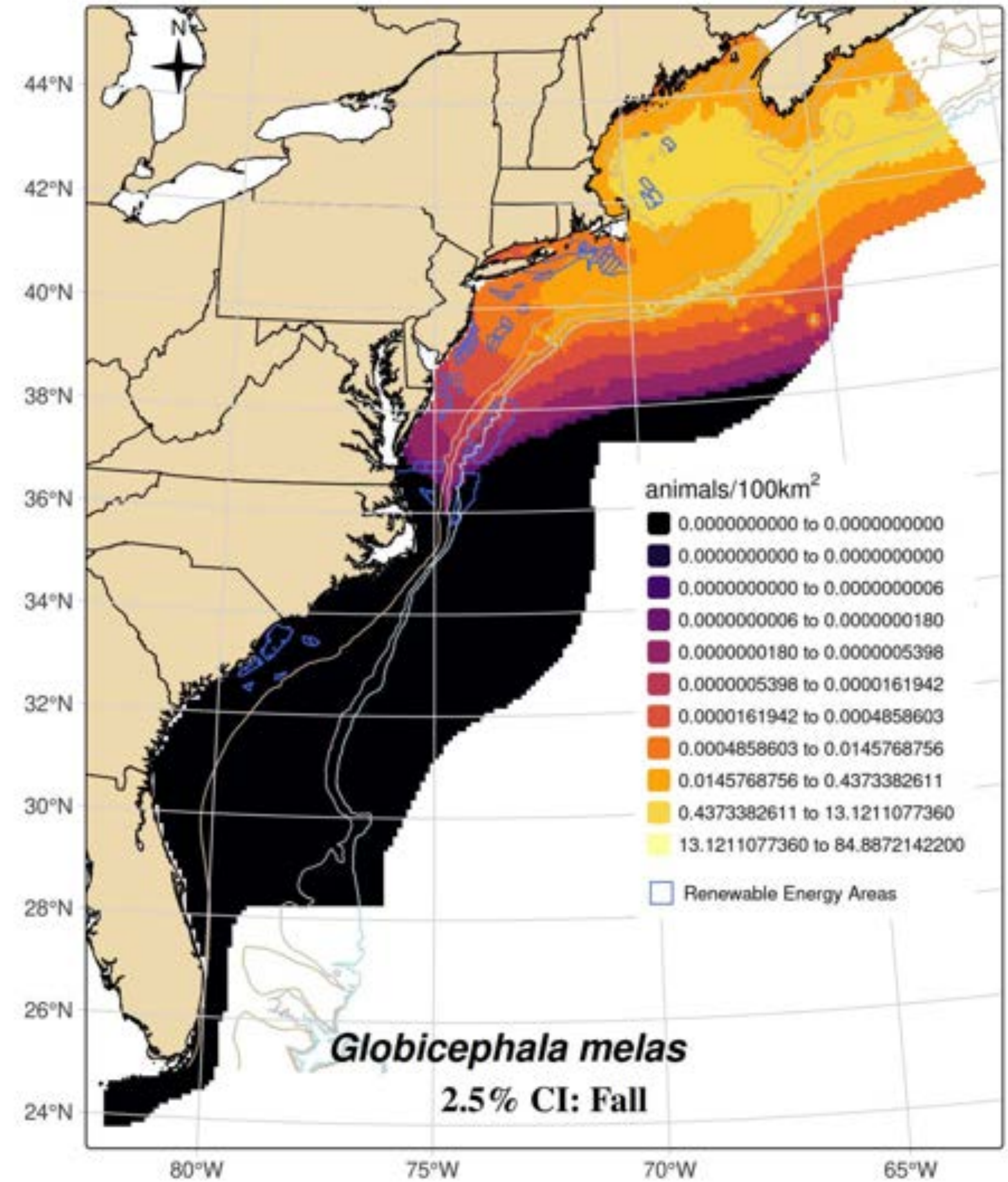

Figure C.3-15. Lower 2.5% confidence interval of the fall long-finned pilot whale density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

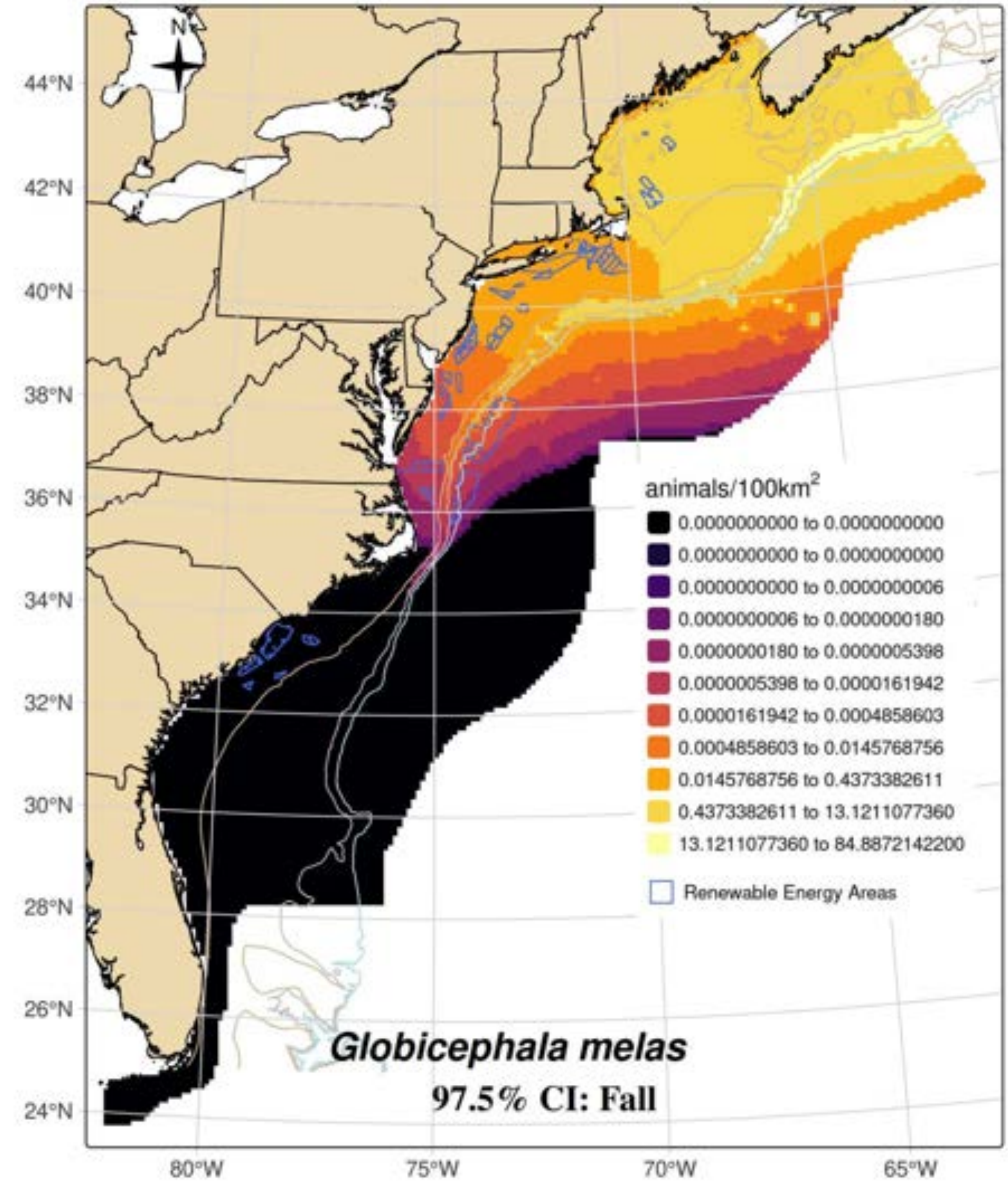

Figure C.3-16. Upper 97.5% confidence interval of the fall long-finned pilot whale density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

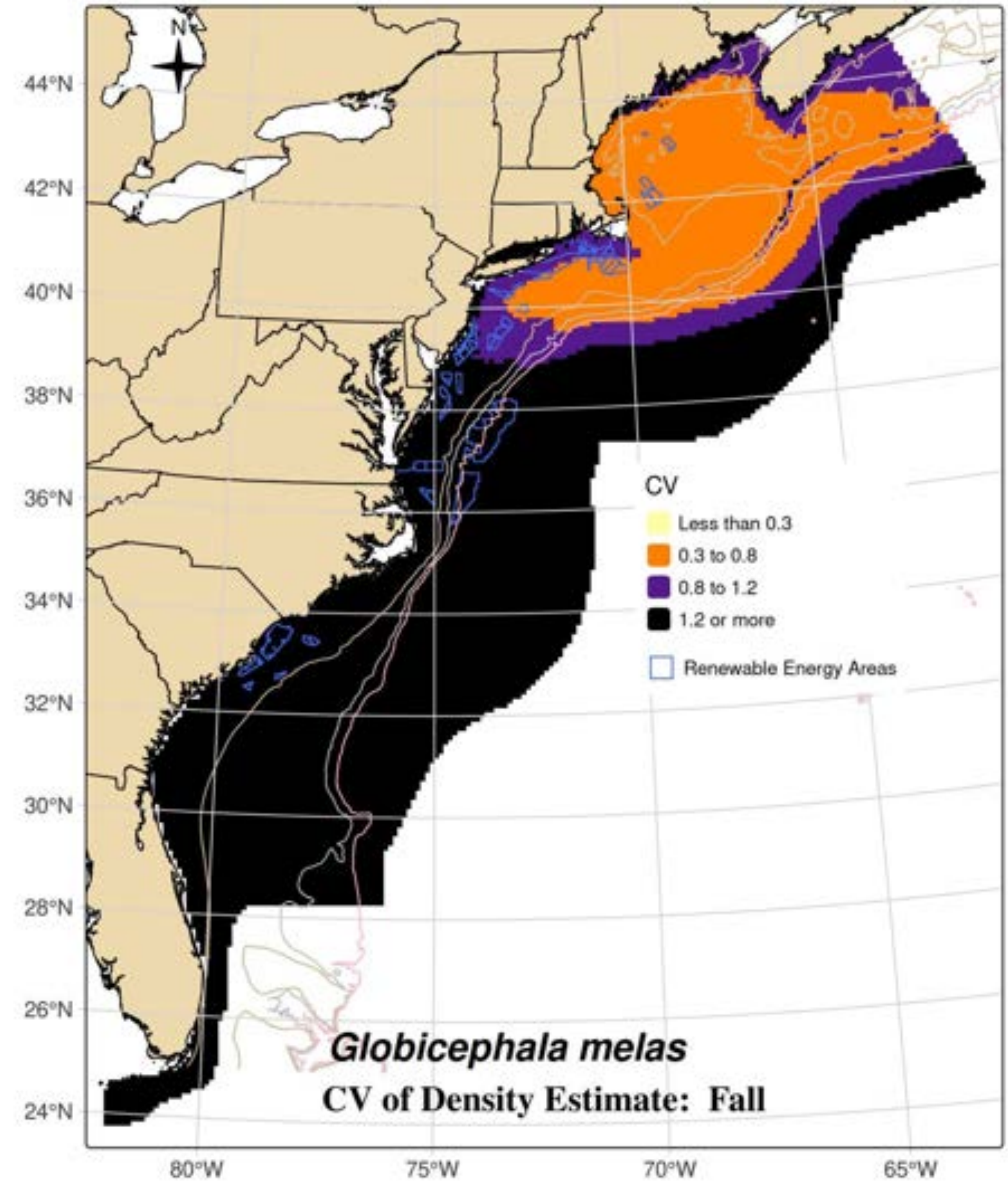

Figure C.3-17. CV of fall long-finned pilot whale density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

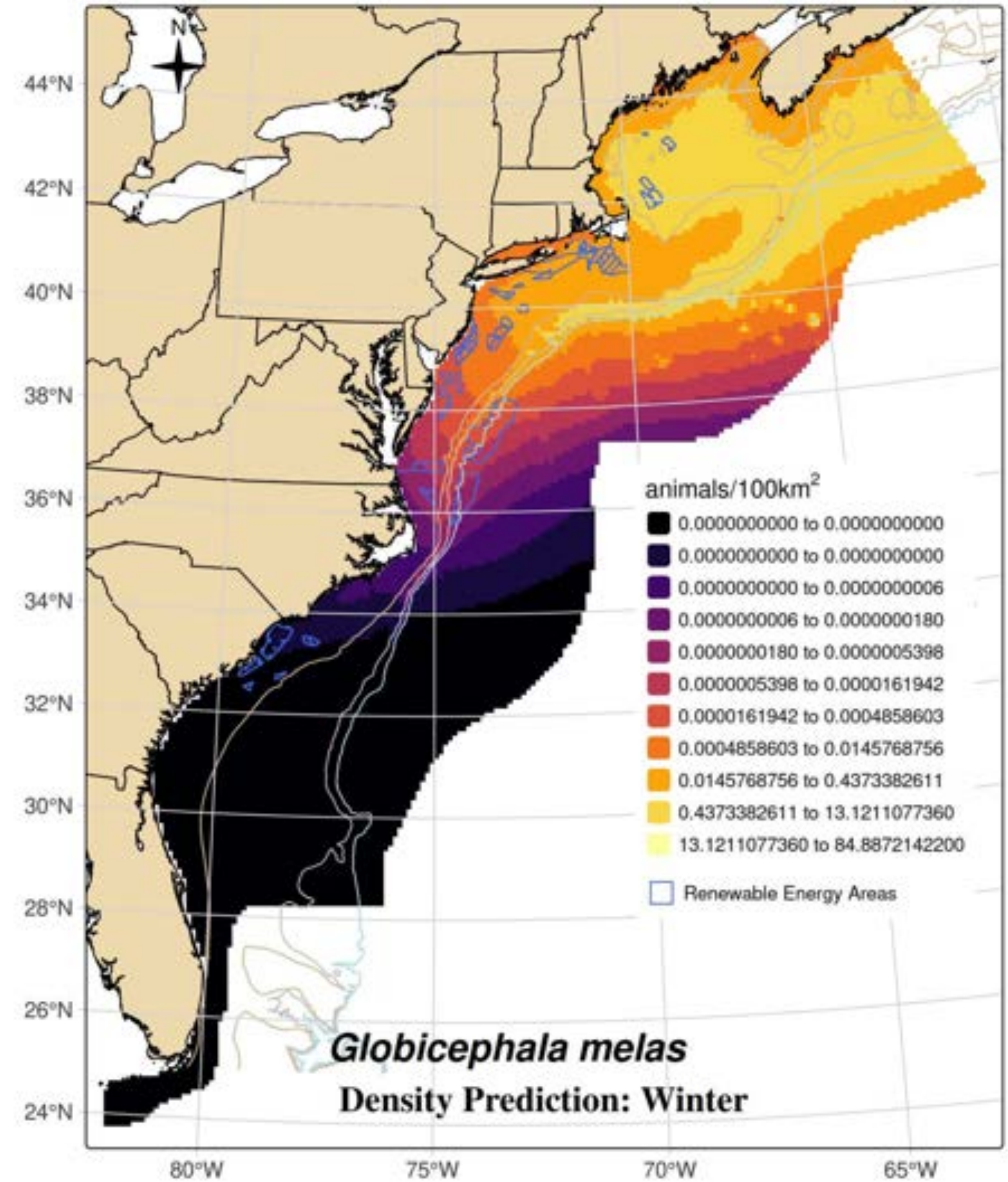

Figure C.3-18. Long-finned pilot whale winter average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

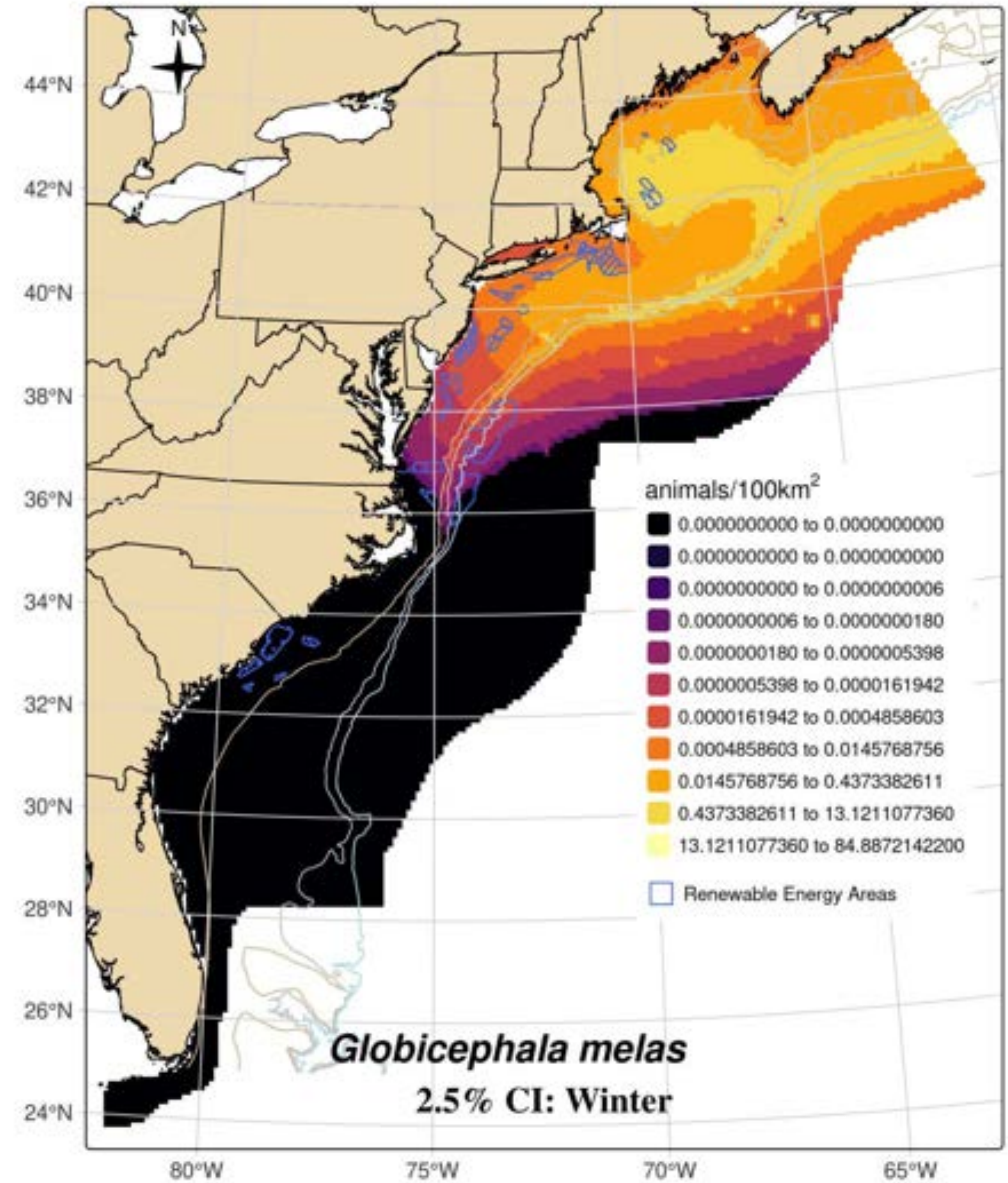

Figure C.3-19. Lower 2.5% confidence interval of the winter long-finned pilot whale density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

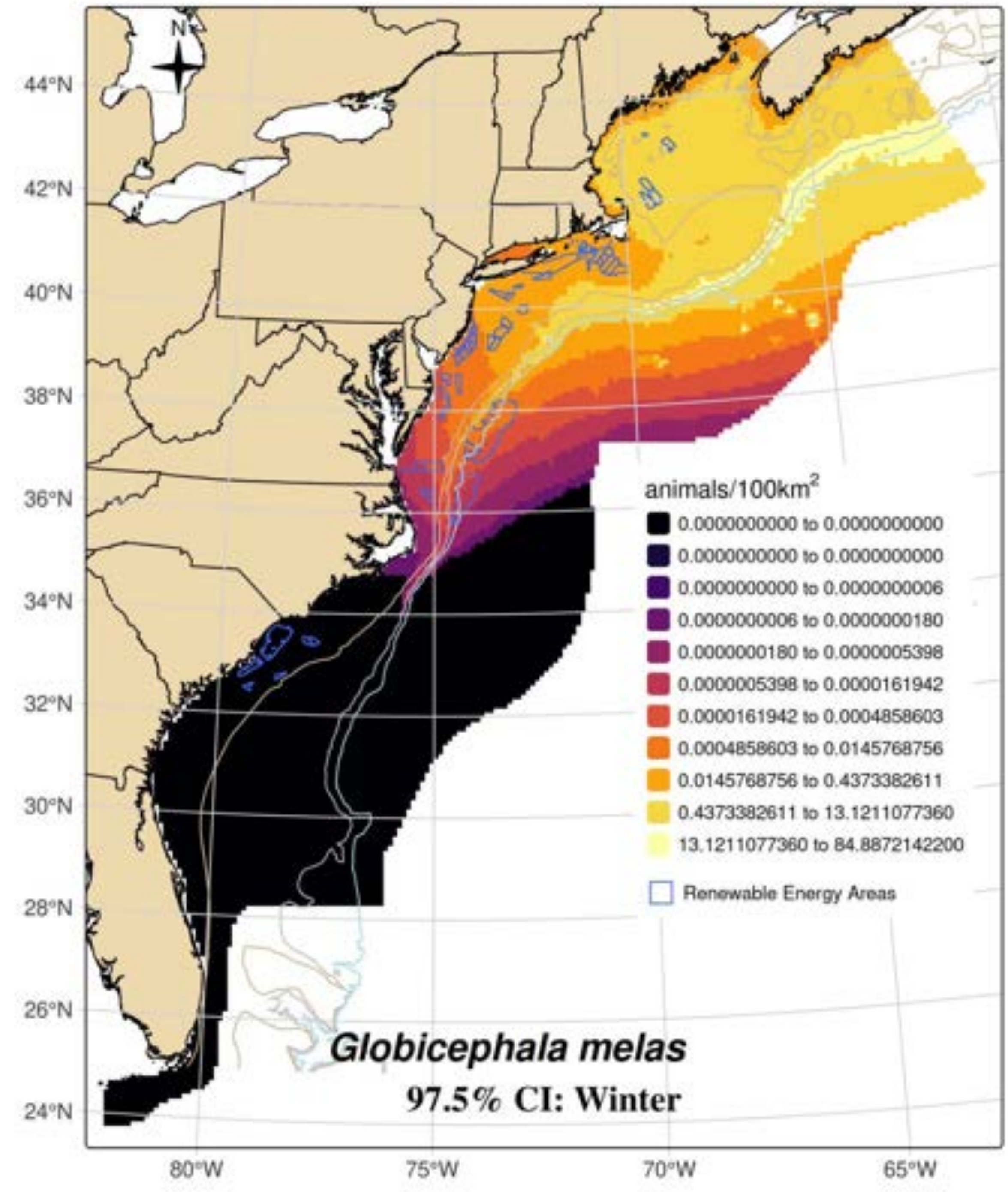

Figure C.3-20. Upper 97.5% confidence interval of the winter long-finned pilot whale density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

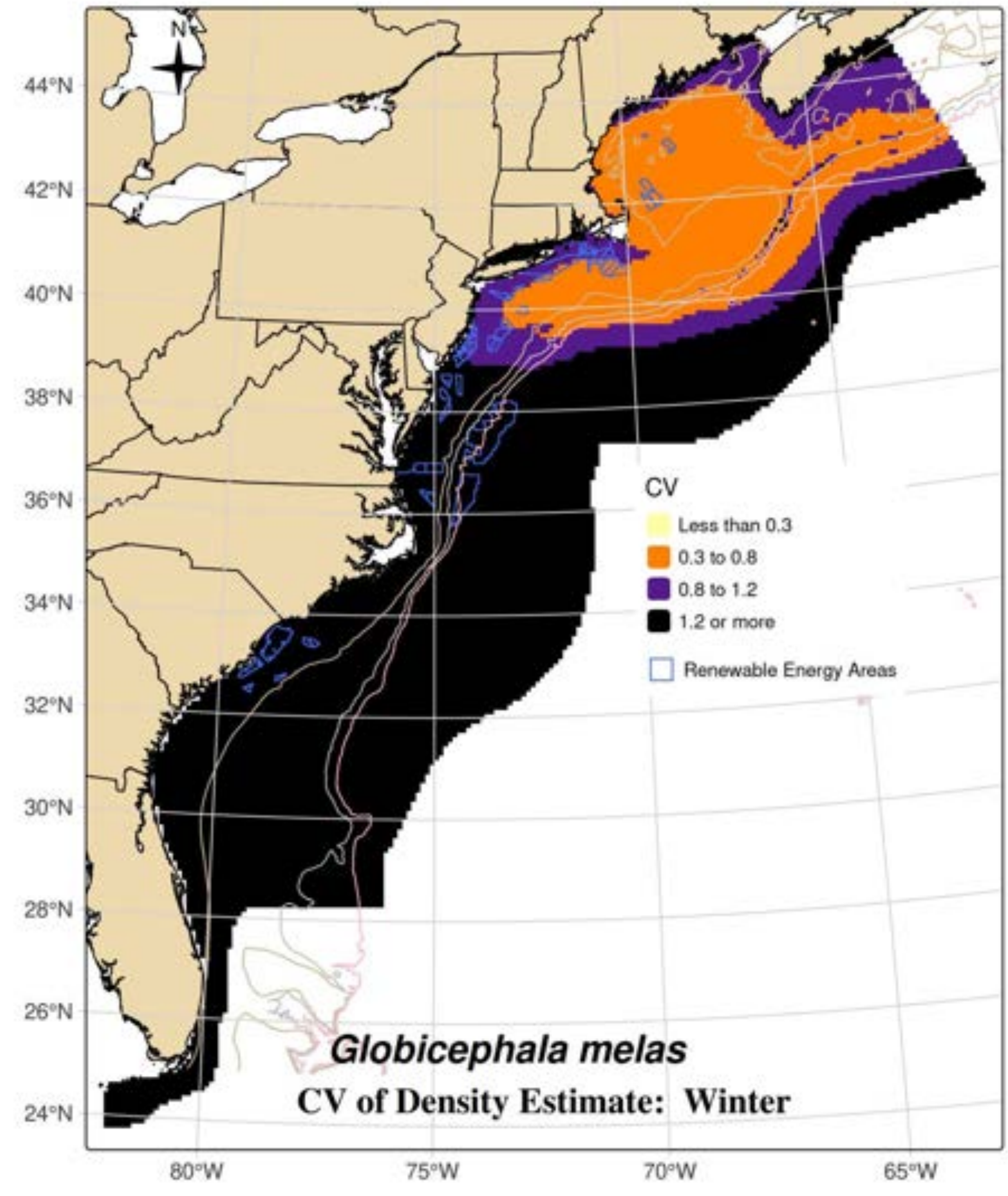

Figure C.3-21. CV of winter long-finned pilot whale density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

C.3.7 Offshore Energy Development Areas

Table C.3-6. Long-finned pilot whale abundance estimates for wind-energy study areas

Season	Wind-Energy Study Area	Abundance*	CV	95% Confidence Interval*
Spring (Mar-May)	RI/MA	13.7	0.75	3.7 - 50.6
	NY	0.8	0.86	0.2 - 3.3
	NJ	0.1	1.12	0 - 0.4
	DE/MD	0	1.57	0 - 0
	VA	0	3.57	0 - 0
	NC	0	4.72	0 - 0
	NC/SC	0	12.26	0 - 0
	GA	0	17.32	0 - 0
	FL	0	38.24	0 - 0
Summer (Jun-Aug)	RI/MA	8.8	0.75	2.4 - 32.6
	NY	0.5	1.05	0.1 - 2.5
	NJ	0	1.19	0 - 0.2
	DE/MD	0	1.61	0 - 0
	VA	0	3.61	0 - 0
	NC	0	4.72	0 - 0
	NC/SC	0	11.68	0 - 0
	GA	0	17.44	0 - 0
	FL	0	38.32	0 - 0
Fall (Sep-Nov)	RI/MA	6.2	0.76	1.7 - 23.5
	NY	0.6	0.92	0.1 - 2.7
	NJ	0.1	1.25	0 - 0.6
	DE/MD	0	1.57	0 - 0
	VA	0	3.56	0 - 0
	NC	0	4.72	0 - 0
	NC/SC	0	12.23	0 - 0
	GA	0	17.32	0 - 0
	FL	0	38.3	0 - 0
Winter (Dec-Feb)	RI/MA	4.9	0.74	1.3 - 18
	NY	0.6	0.87	0.1 - 2.5
	NJ	0.1	1.14	0 - 0.3
	DE/MD	0	1.58	0 - 0
	VA	0	3.56	0 - 0
	NC	0	4.74	0 - 0
	NC/SC	0	12.33	0 - 0
	GA	0	17.27	0 - 0
	FL	0	38.22	0 - 0

***** We rounded the mean abundance and 95% confidence interval to the nearest tenth of an animal. If this resulted in a zero for the mean abundance, we calculated the CV using the actual abundance value as estimated by the density-habitat model and then rounded to the nearest tenth. If a wind-energy study area is not included, then we assumed the abundance was zero.

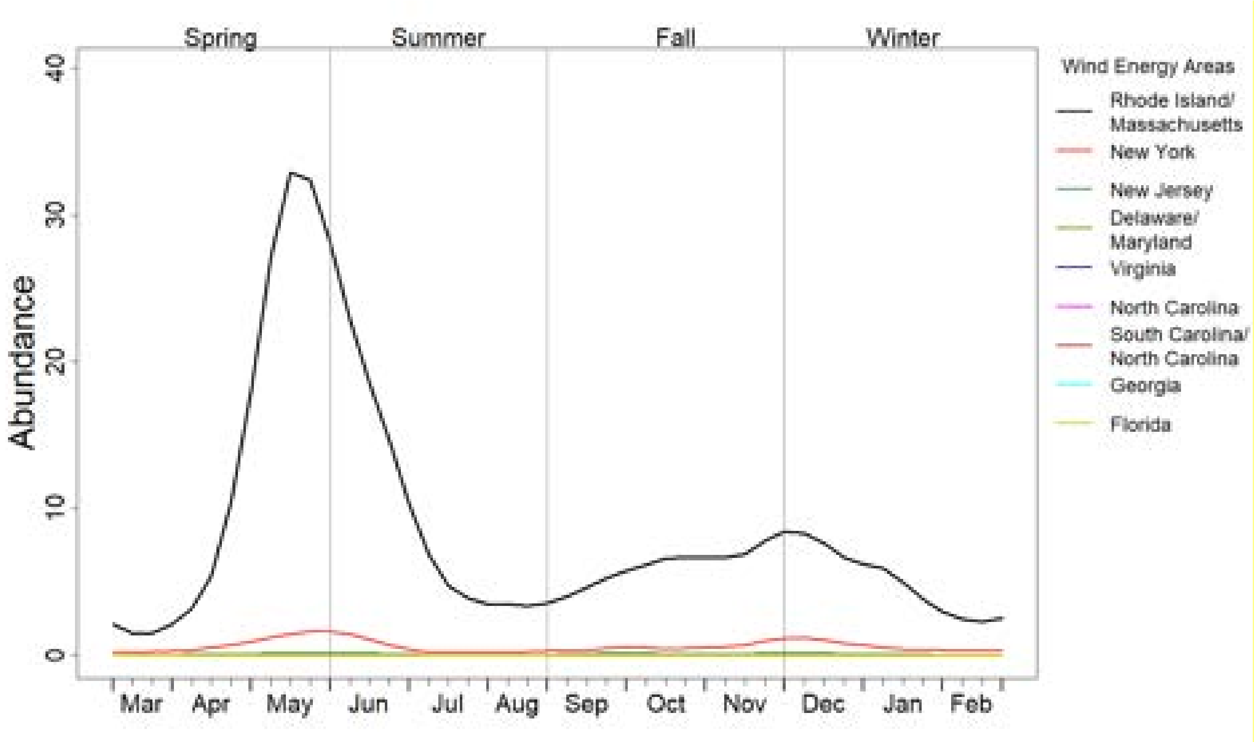

Figure C.3-22. Average seasonal abundance of long-finned pilot whales in wind-energy study areas

C.4 Risso's Dolphin (*Grampus griseus*)

Figure C.4-1. Risso's dolphin
Image collected under MMPA Research permit #132-1362. Credit: NOAA/NEFSC/Peter Duley

C.4.1 Data Collection

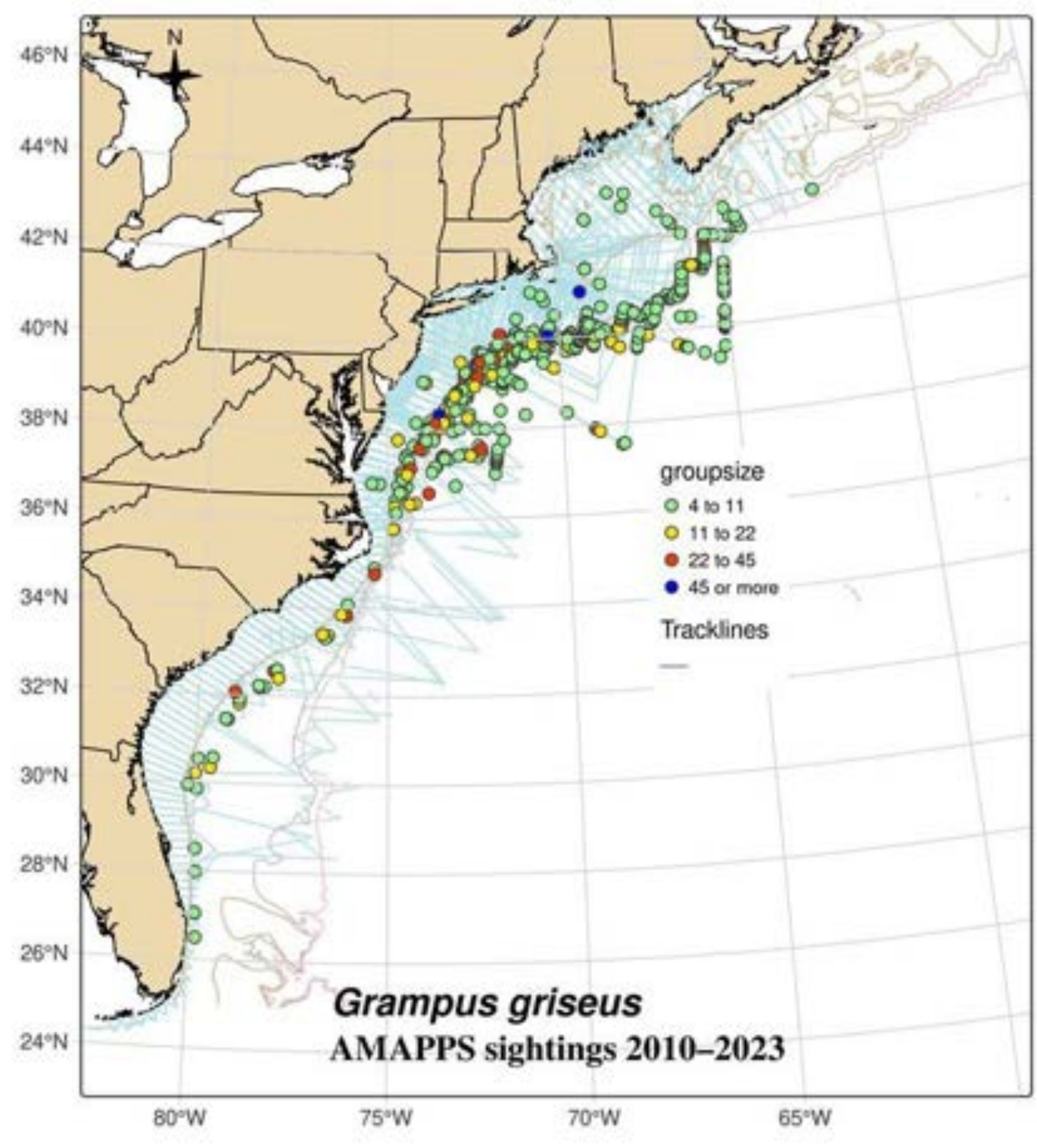

Figure C.4-2. Distribution of track lines and Risso's dolphin sightings 2010 to 2023
Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

Table C.4-1. AMAPPS research effort 2010 to 2023 and Risso's dolphin sightings

Survey Region and Platform	Season	Effort (km)	Number of Groups	Number of Animals
NE Shipboard	Spring	8,883	18	91
NE Shipboard	Summer	49,064	613	4070
NE Aerial	Spring	38,839	42	179
NE Aerial	Summer	52,003	53	549
NE Aerial	Fall	87,311	79	617
NE Aerial	Winter	24,747	25	71
SE Shipboard	Spring	2,604	4	41
SE Shipboard	Summer	18,331	53	580
SE Shipboard	Fall	2,673	10	106
SE Shipboard	Winter	302	2	19
SE Aerial	Spring	48,634	46	375
SE Aerial	Summer	43,285	14	227
SE Aerial	Fall	21,153	7	70
SE Aerial	Winter	19,152	5	56

C.4.2 Mark-Recapture Distance Sampling Analysis

Table C.4-2. Intermediate parameters in Risso's dolphin mark-recapture distance sampling (MRDS) models

Analysis Set	MR Model	MR Truncation (m)	DS Model	DS Truncation (m)	Key function	p(0)	p(0) CV	Chi-square p-value	CvM p-value
SE–aerial group 5	distance + observer + glare	400	distance	400	HN + Hermite Poly Adjustment order 4	0.76	0.09	0.22	0.83
NE–aerial group 6	distance + log(group size)	460	distance + sea state	600	HR	0.49	0.12	0.59	0.91
NE–shipboard group 4	distance * observer + log(group size) + sea state + swell height	4500	distance + glare + log(group size)	4500	HR + Simple Poly Adjustment order 4	0.51	0.10	0.25	0.55
SE–shipboard group 3	distance * observer + log(group size)	5000	Distance + log(group size)	5000	HR	0.60	0.13	0.15	0.66

MR=Mark-Recapture, DS=Distance Sampling, HR=Hazard Rate, HN= Half Normal, CV=Coefficient of variation. Values of p>0.5 for Chi-square and Cramer-von Mises test (CvM) indicate good fit. The definition of p(0) is the probability of detecting a group on the track line. Species included in the analysis sets are explained in main text Tables 4-20 and 4-21.

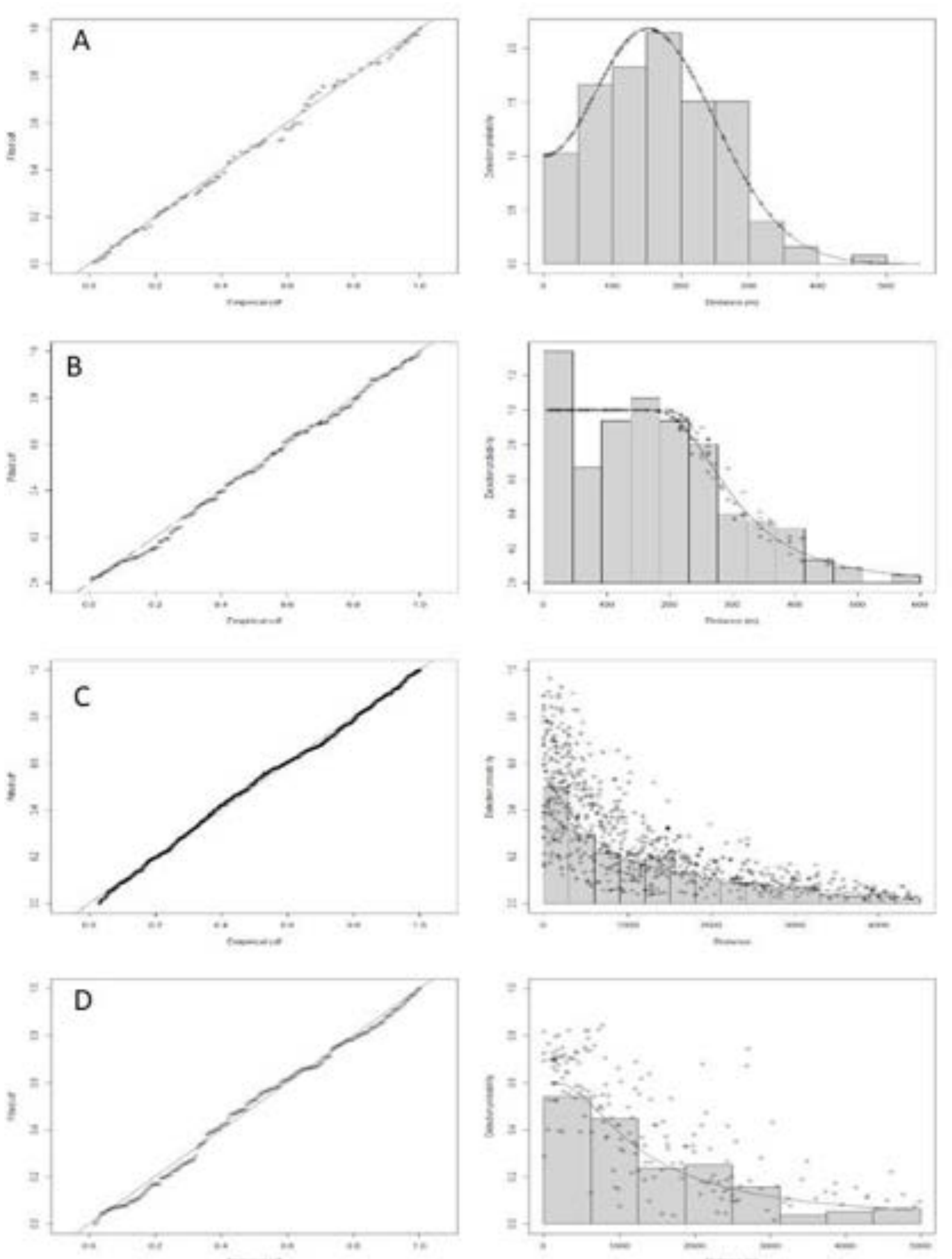

Figure C.4-3. Q-Q plots and detection functions from the Risso's dolphin MRDS analyses
A) SE-aerial analysis set 5; B) NE-aerial analysis set 6; C) NE-shipboard analysis set 4; D) SE-shipboard analysis set 3.

C.4.3 Generalized Additive Model Analysis

Table C.4-3. 2010 to 2023 density-habitat model output for Risso's dolphins

Covariates	Edf	Ref.df	F	C.dev	p-value
s(sstmur)	4.55	5	9.28	6.18	<0.0001
s(mlp)	3.60	5	6.58	3.87	<0.0001
s(btemp)	3.81	5	19.81	5.99	<0.0001
s(dist2GSNw)	4.86	5	14.28	5.07	<0.0001
s(slope)	4.76	5	36.56	11.83	<0.0001
s(latdd)	4.84	5	48.50	19.06	<0.0001

Adjusted R^2 = 0.022. Deviance explained = 52%.

Includes the estimated degrees of freedom (Edf), reference degrees of freedom (Ref.df), contribution to the deviance (C.dev) explained for each habitat covariate and its associated p-value. Covariate abbreviations explained in main text in Table 4-2.

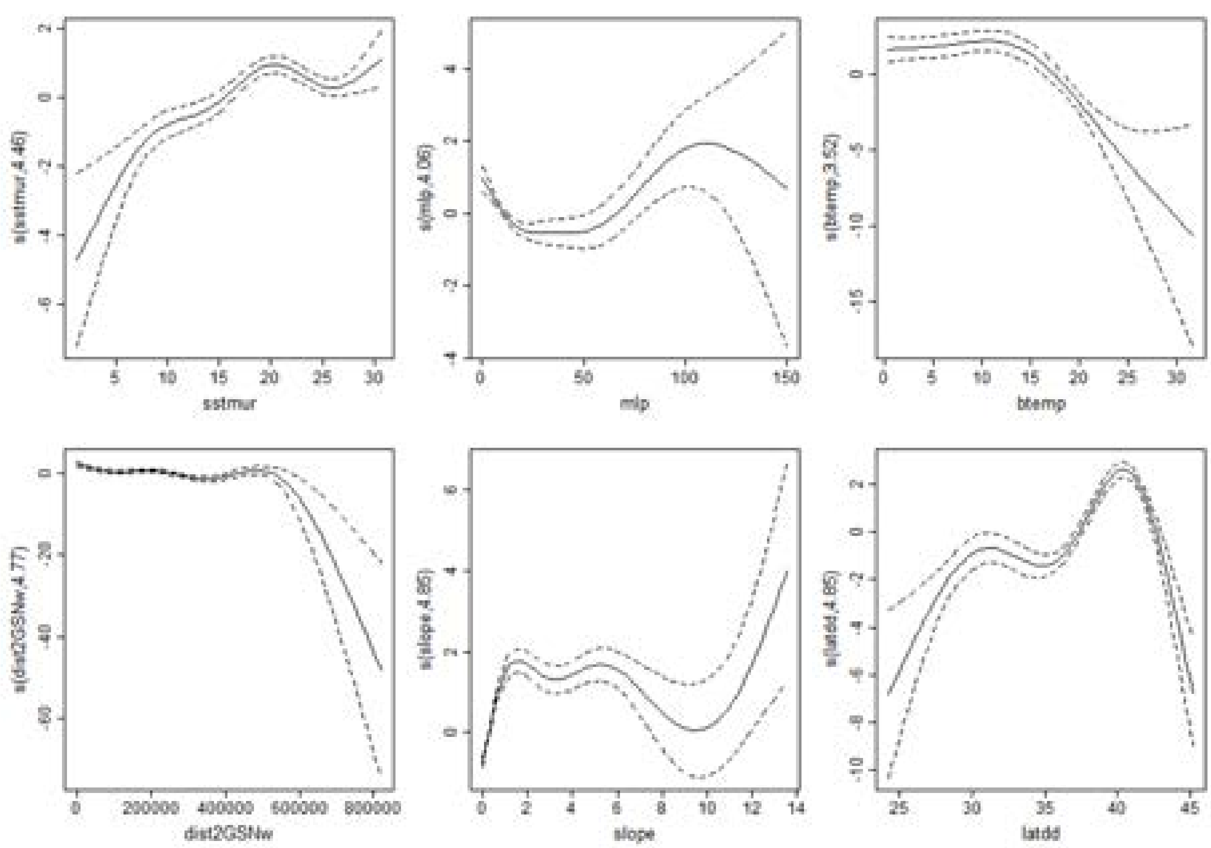

Figure C.4-4. Annual abundance trends for Risso's dolphins in the AMAPPS study area
Plots represent the partial smooths and interaction terms of the density-habitat model. Covariate abbreviations explained in main text in Table 4-2.

C.4.4 Model Cross-Validation

Table C.4-4. Diagnostic statistics from the Risso's dolphin density-habitat model

Diagnostic Statistic	Description	Calculated with	Model Values (x)	Score
RHO	Spearman rank correlation	Non-zero density	0.335	Excellent
MAPE	Mean absolute percentage error	Non-zero density	78.914	Fair to good
RHO	Spearman rank correlation	All data divided in 25 random samples	0.173	Fair to good
MAE	Mean absolute error	All data divided in 25 random samples	0.110	Excellent
MAPE	Mean absolute percentage error	All data divided in 25 random samples	78.200	Fair to good

RHO: Poor= x<0.05; Fair to good =0.05<=x<0.3; Excellent= x>0.3
MAPE: Poor= x>150%; Fair to good= 150%>=x>50%; Excellent= x<=50%
MAE: Poor= x>1; Fair to good = 1>=x>0.25; Excellent= x<=0.25

C.4.5 Abundance Estimates for AMAPPS Study Area

Table C.4-5. Risso's dolphin average abundance estimates for the AMAPPS study area

Season	Average Abundance	CV	95% Confidence Interval
Spring (March–May)	46,038	0.34	24,076 – 88,034
Summer (June–August)	99,351	0.23	63,666 – 155,037
Fall (September–November)	66,372	0.27	39,463 – 111,630
Winter (December–February)	52,095	0.41	24,058 – 112,805
Summer 2011 U.S. surveys[1]	18,250	0.46	10,363 – 32,139
Summer 2016 U.S. surveys[1]	29,142	0.20	22,437 – 37,851
Summer 2021 U.S. surveys[1]	44,067	0.45	18,992 – 102,245

[1]Hayes et al. 2024

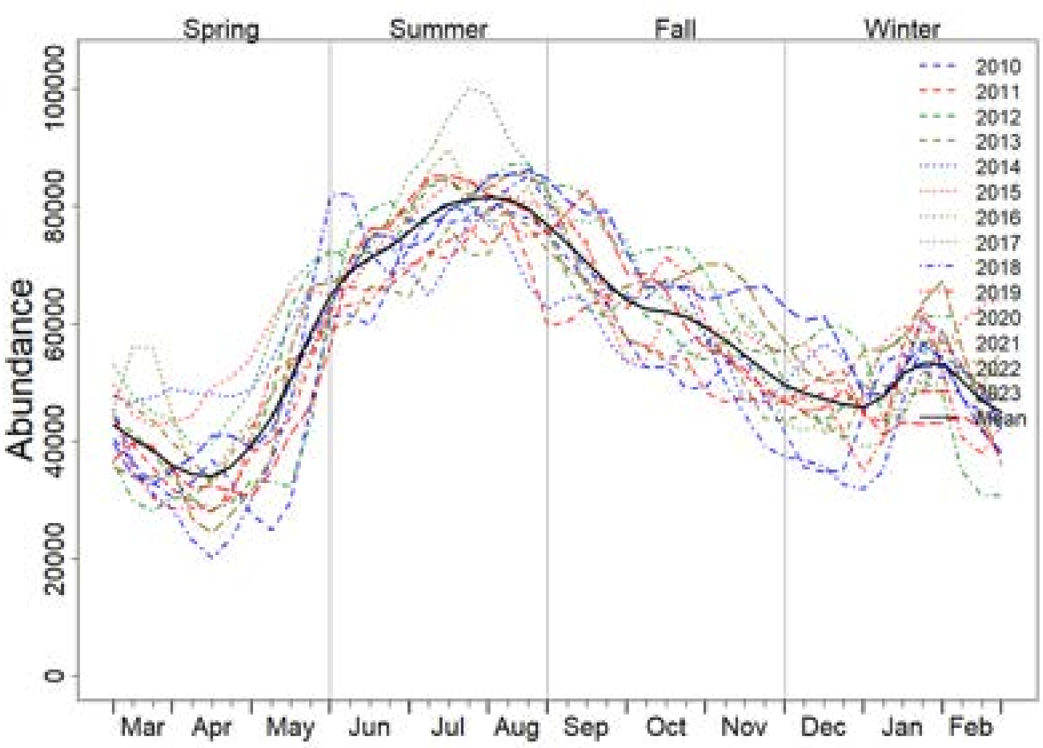

Figure C.4-5. Annual abundance trends for Risso's dolphins in the AMAPPS study area

C.4.6 Seasonal Prediction Maps

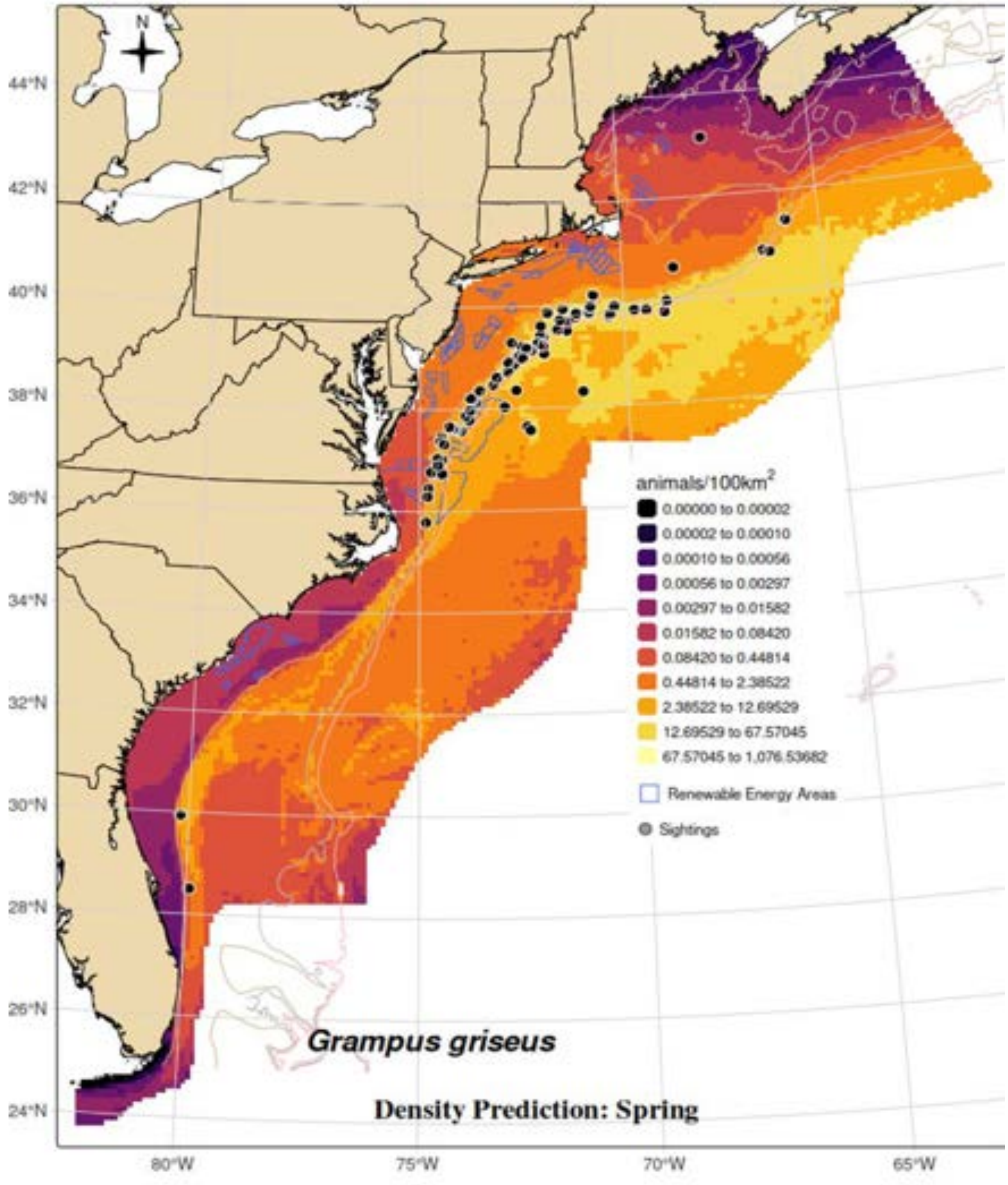

Figure C.4-6. Risso's dolphin spring average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

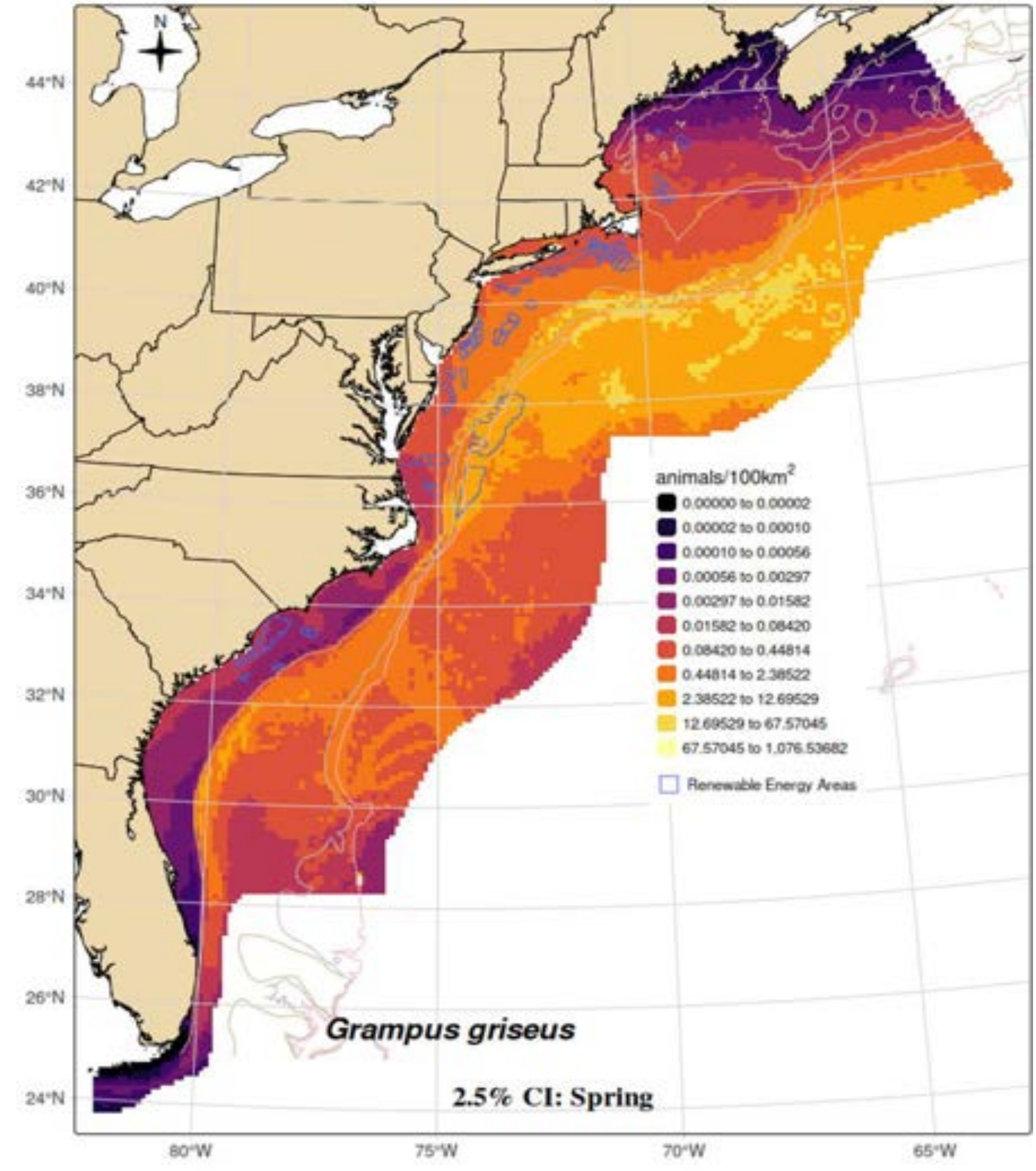

Figure C.4-7. Lower 2.5% confidence interval of the spring Risso's dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

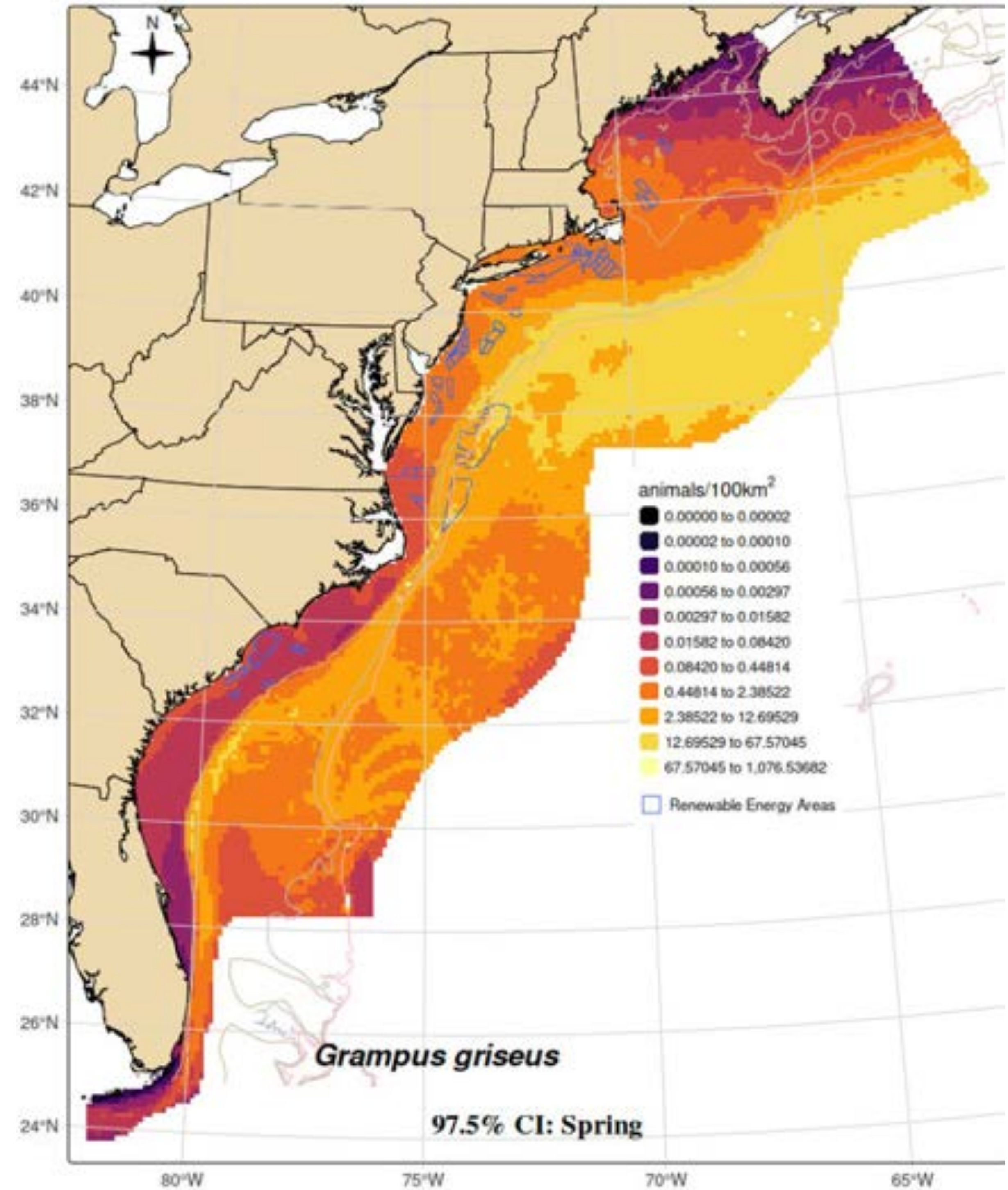

Figure C.4-8. Upper 97.5% confidence interval of the spring Risso's dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

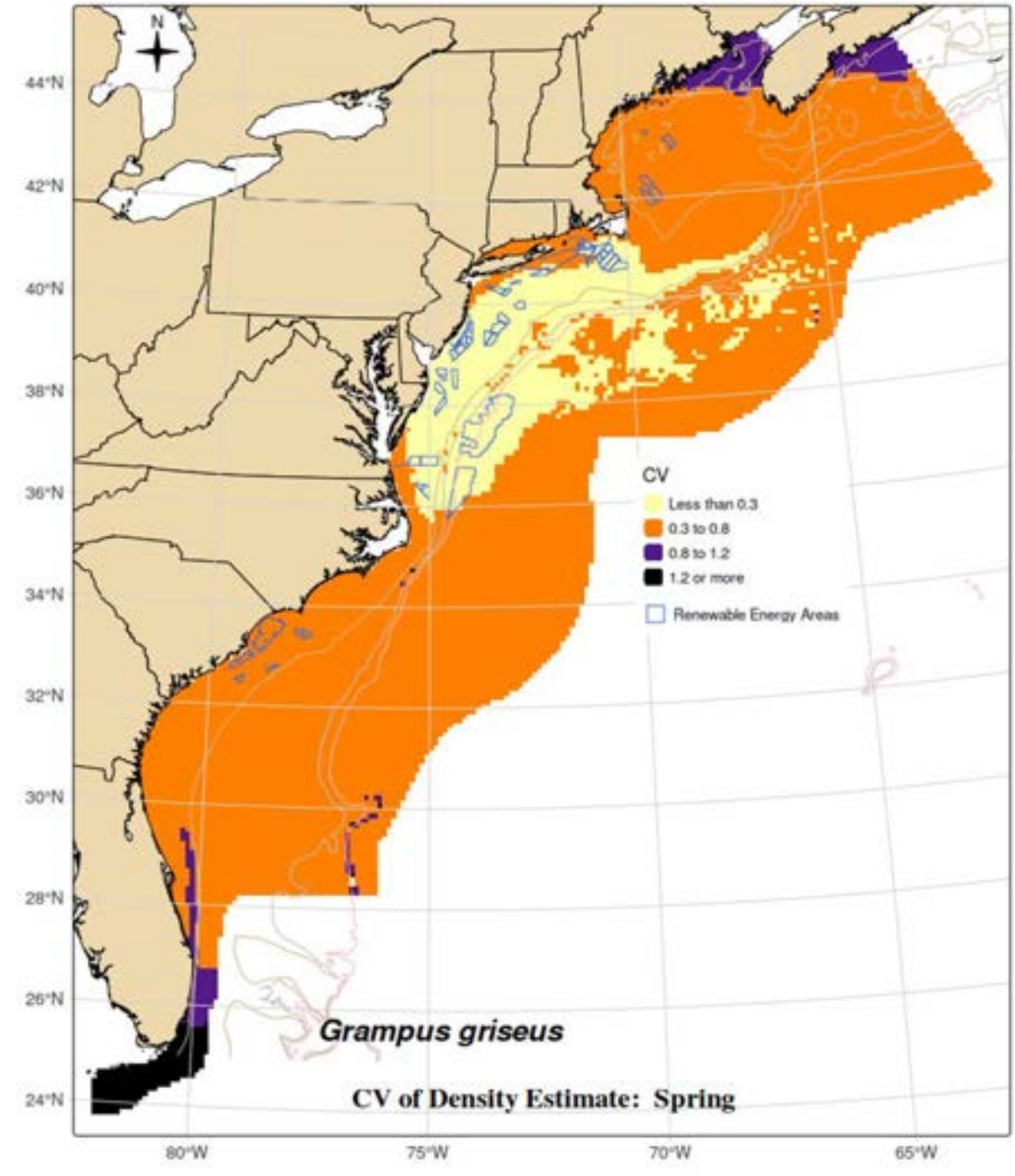

Figure C.4-9. CV of spring Risso's dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

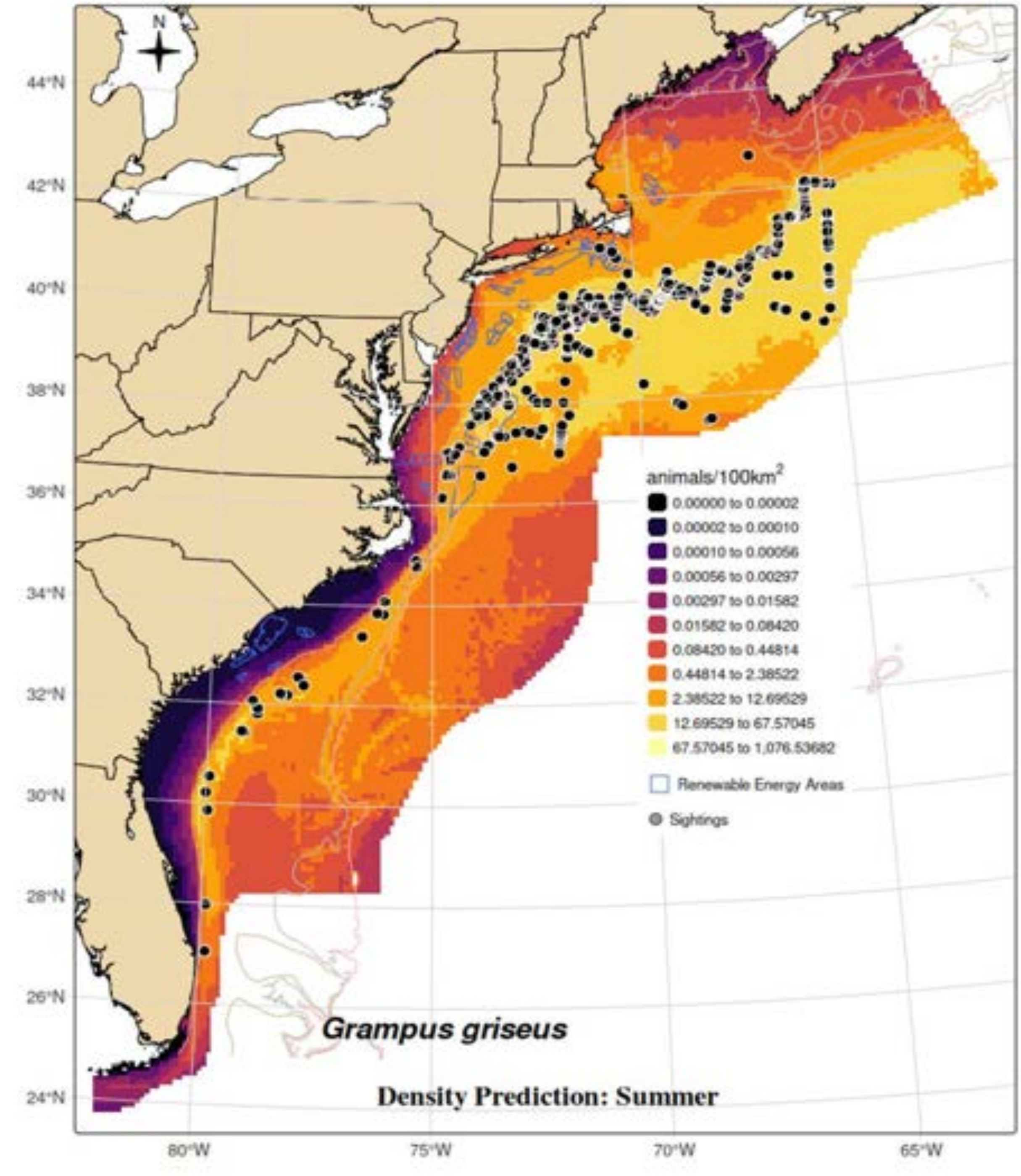

Figure C.4-10. Risso's dolphin summer average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

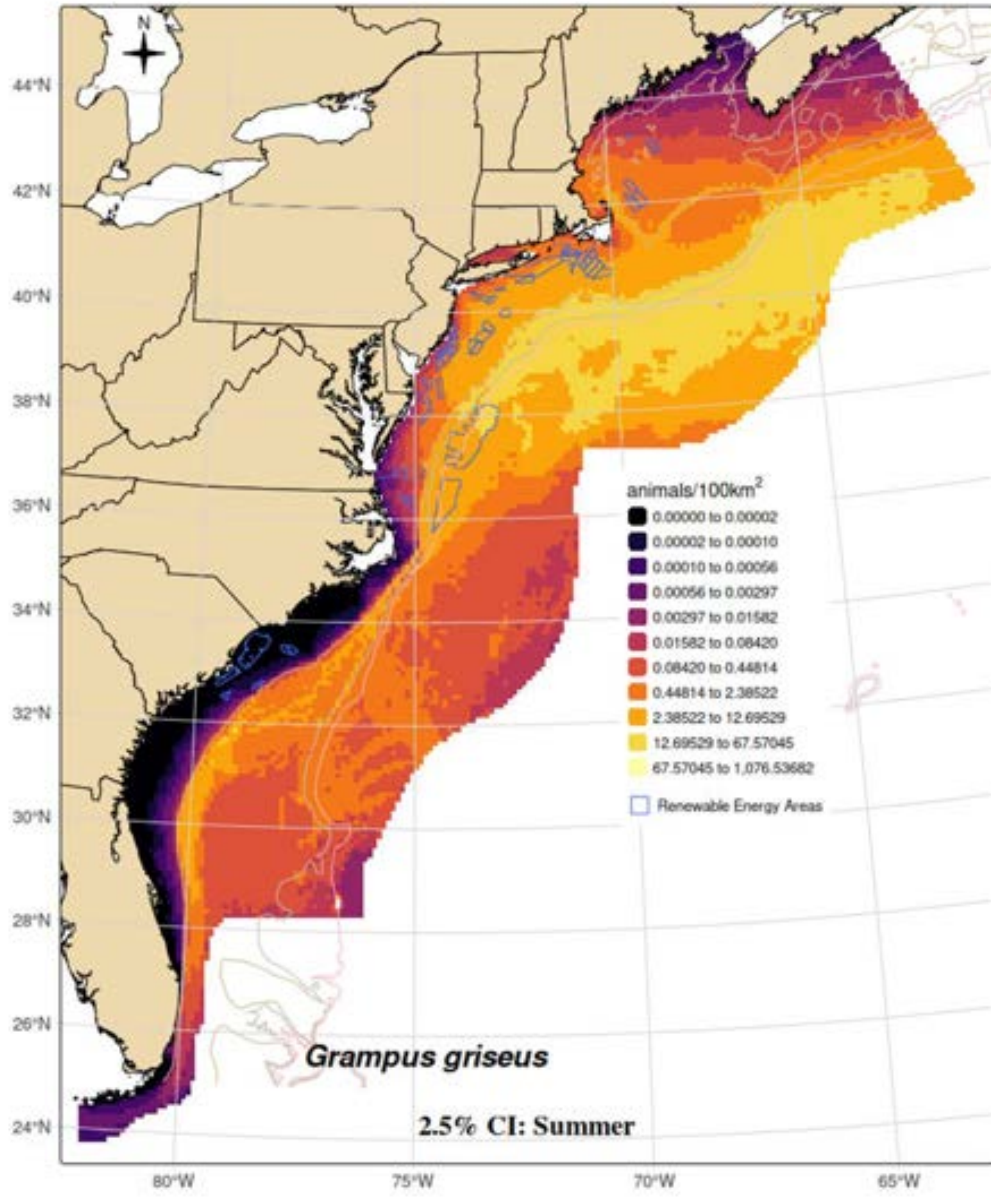

Figure C.4-11. Lower 2.5% confidence interval of the summer Risso's dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

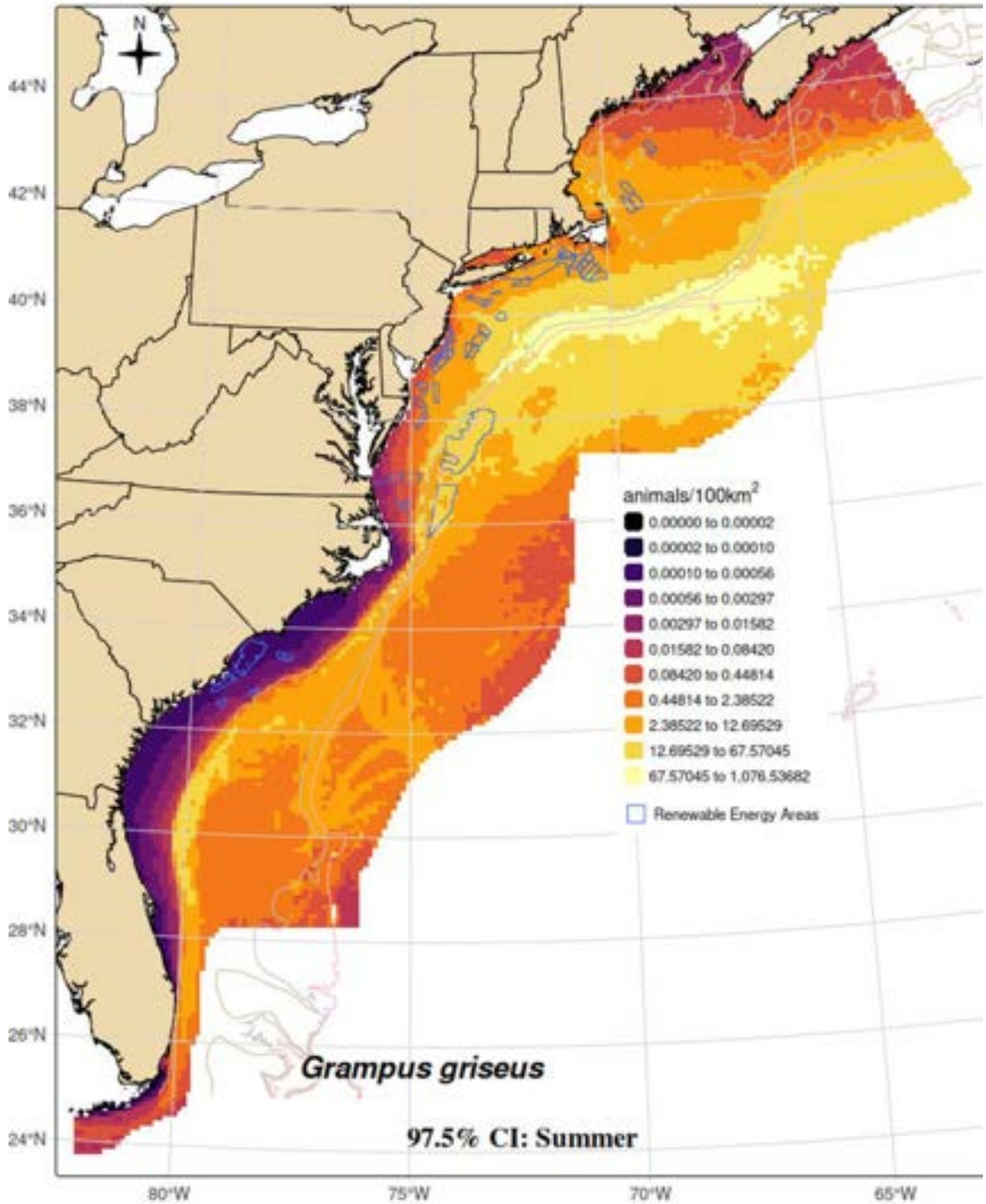

Figure C.4-12. Upper 97.5% confidence interval of the summer Risso's dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

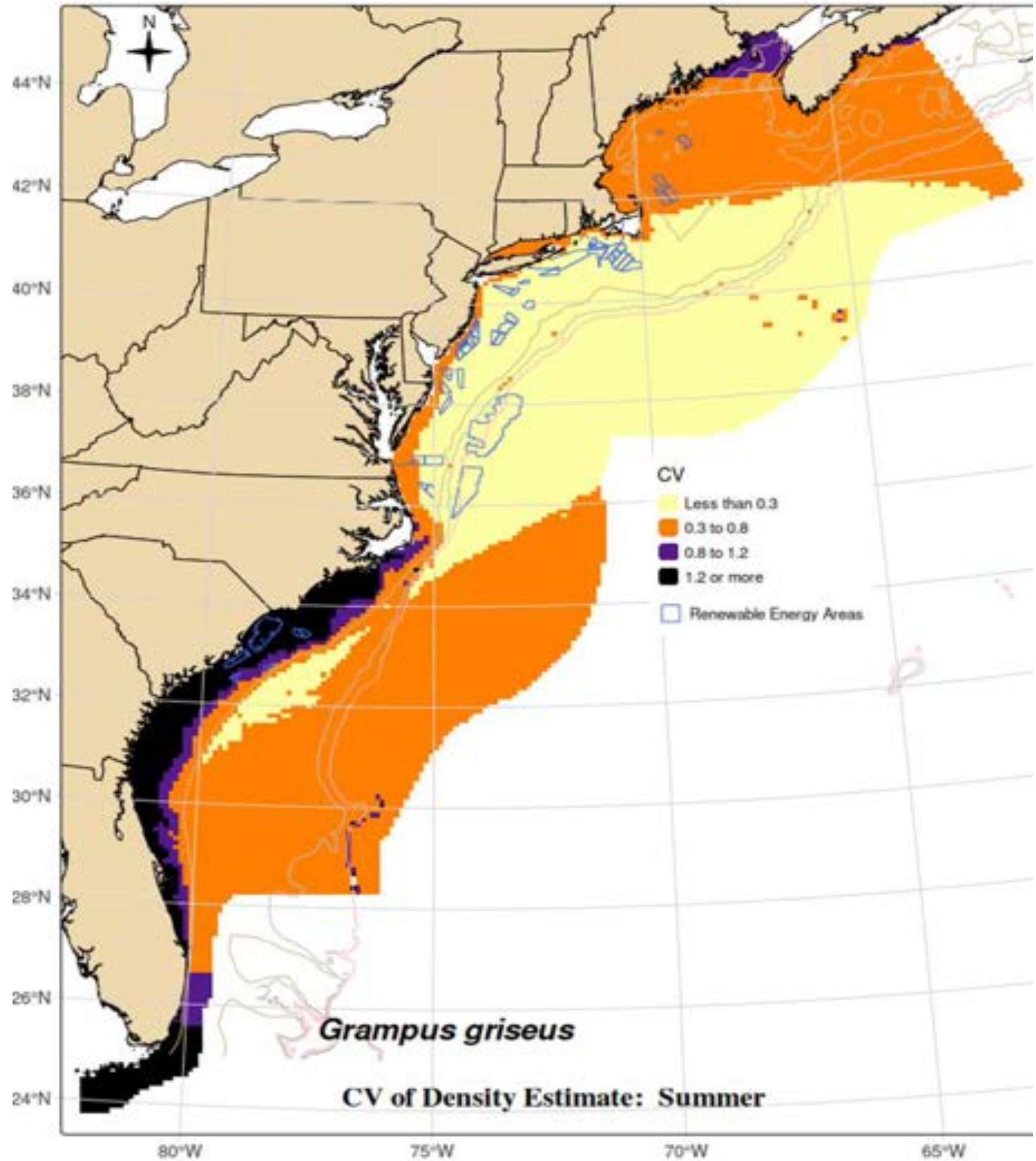

Figure C.4-13. CV of summer Risso's dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

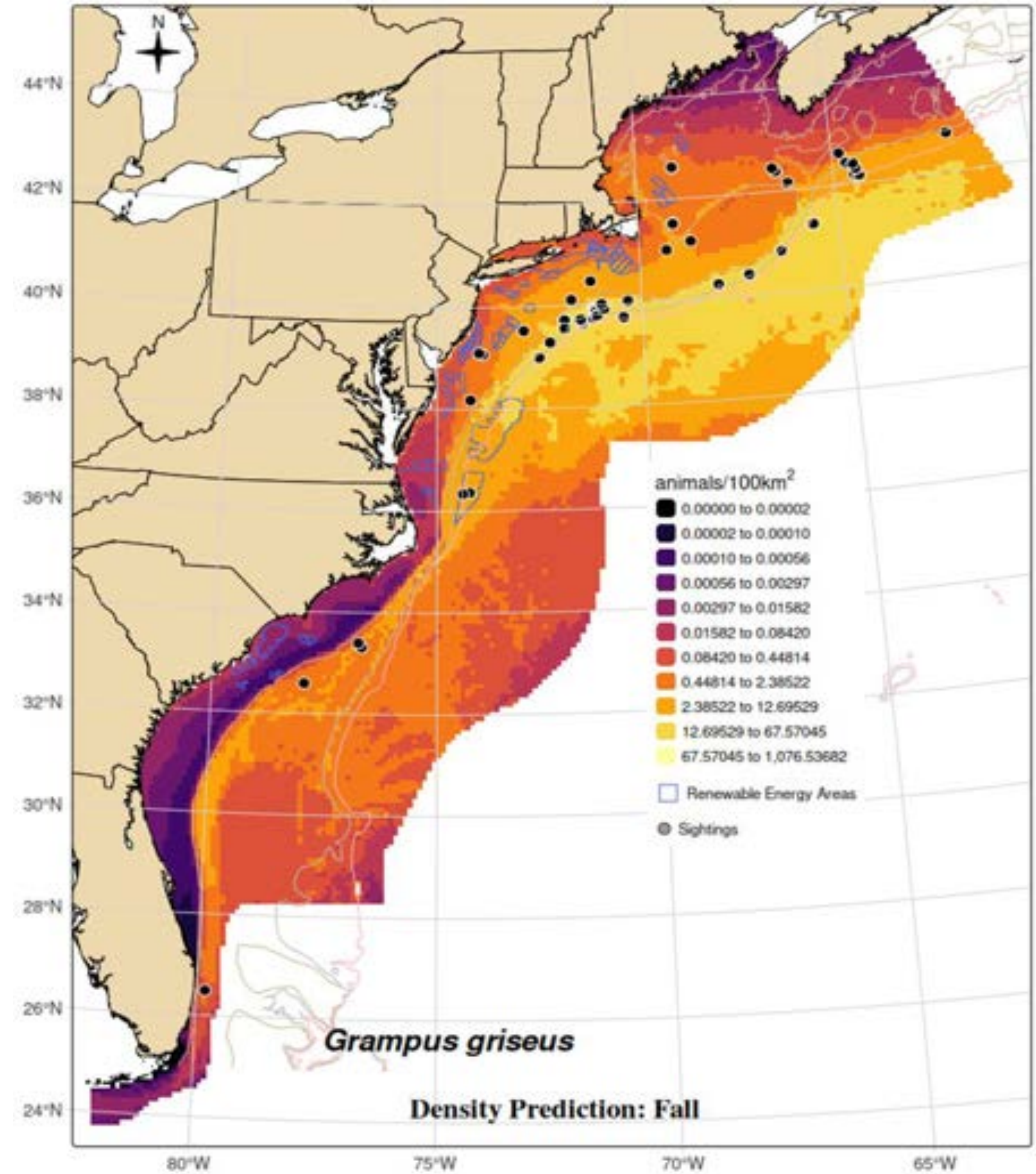

Figure C.4-14. Risso's dolphin fall average density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

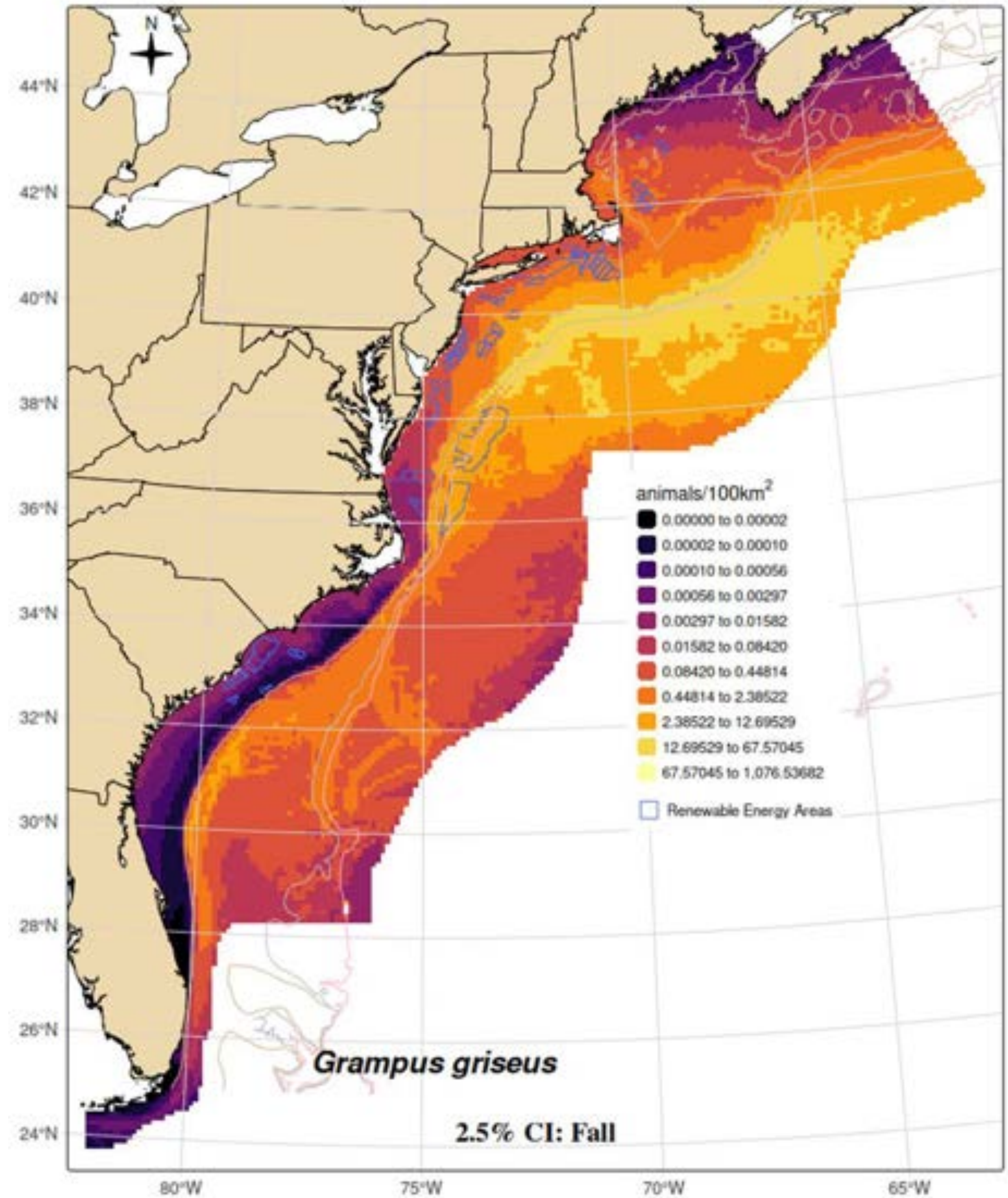

Figure C.4-15. Lower 2.5% confidence interval of the fall Risso's dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

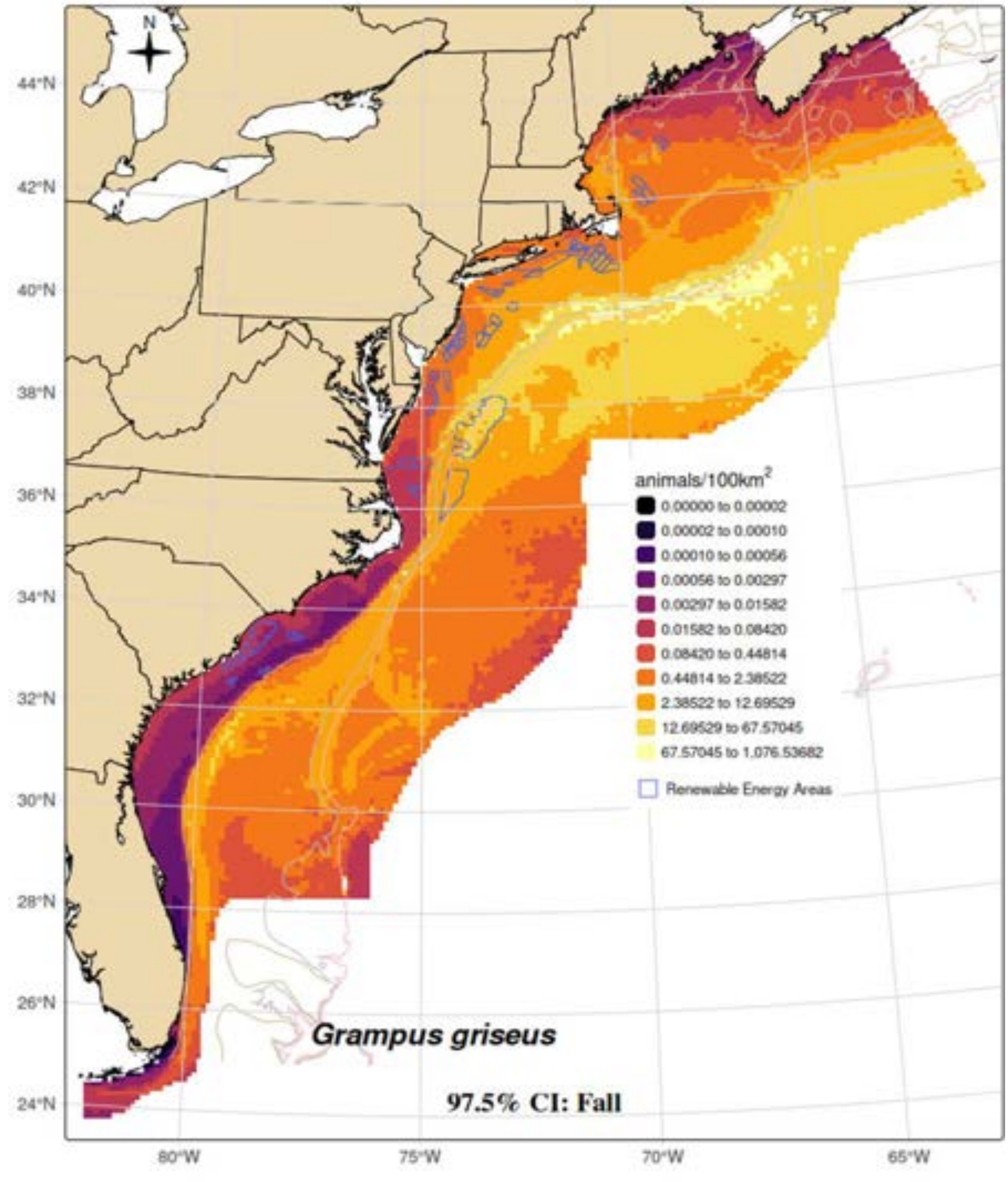

Figure C.4-16. Upper 97.5% confidence interval of the fall Risso's dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

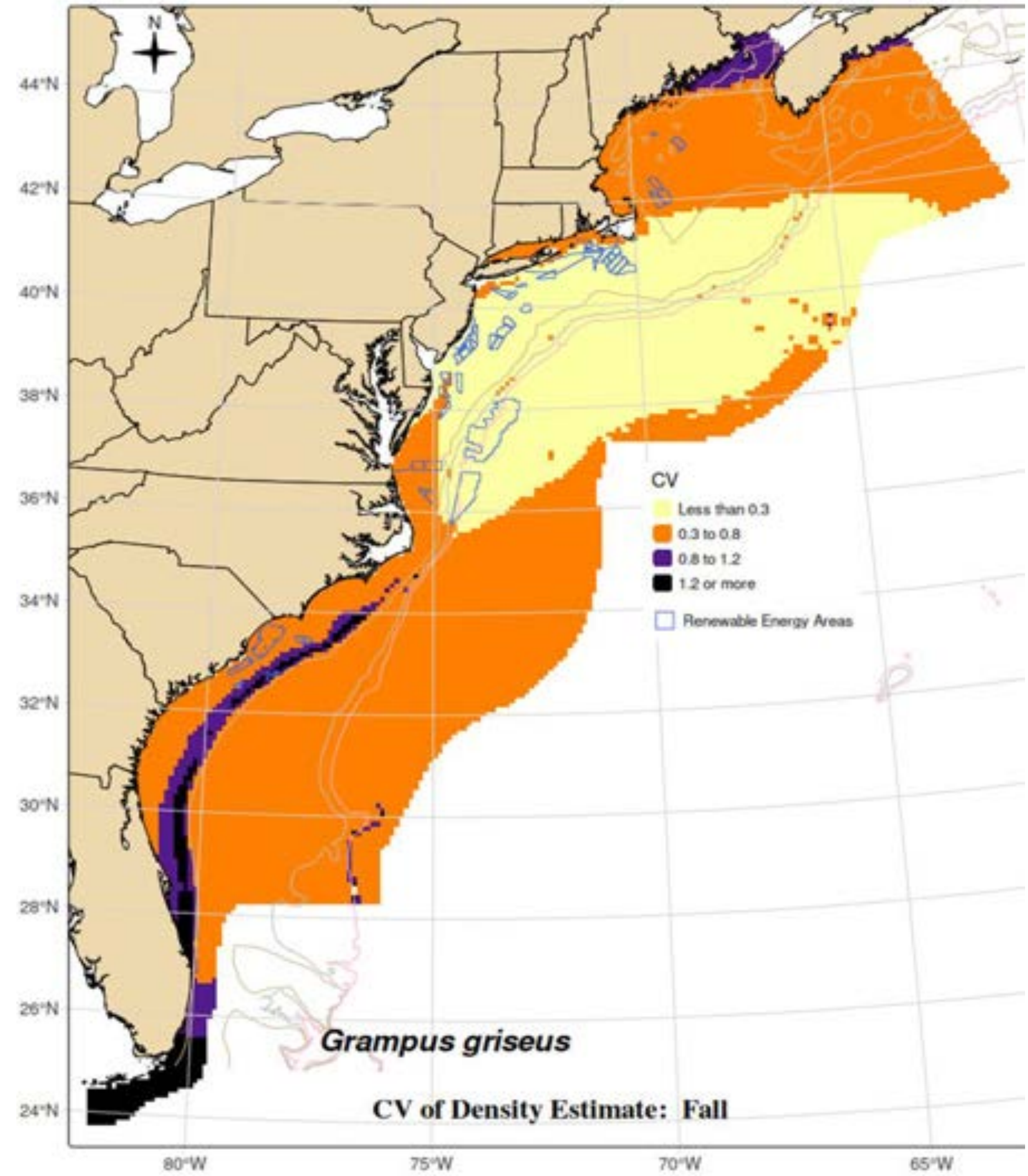

Figure C.4-17. CV of fall Risso's dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

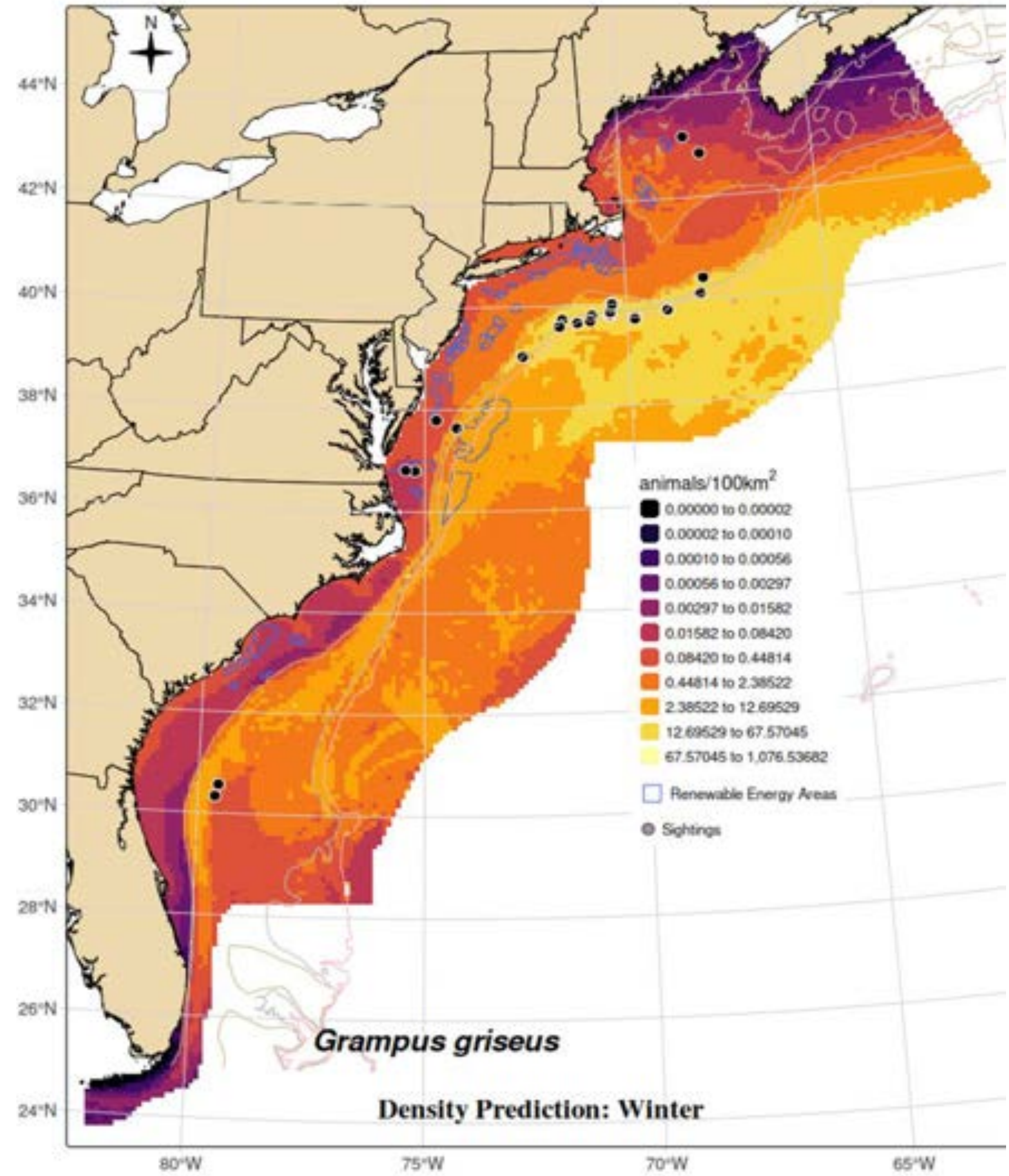

Figure C.4-18. Risso's dolphin winter average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

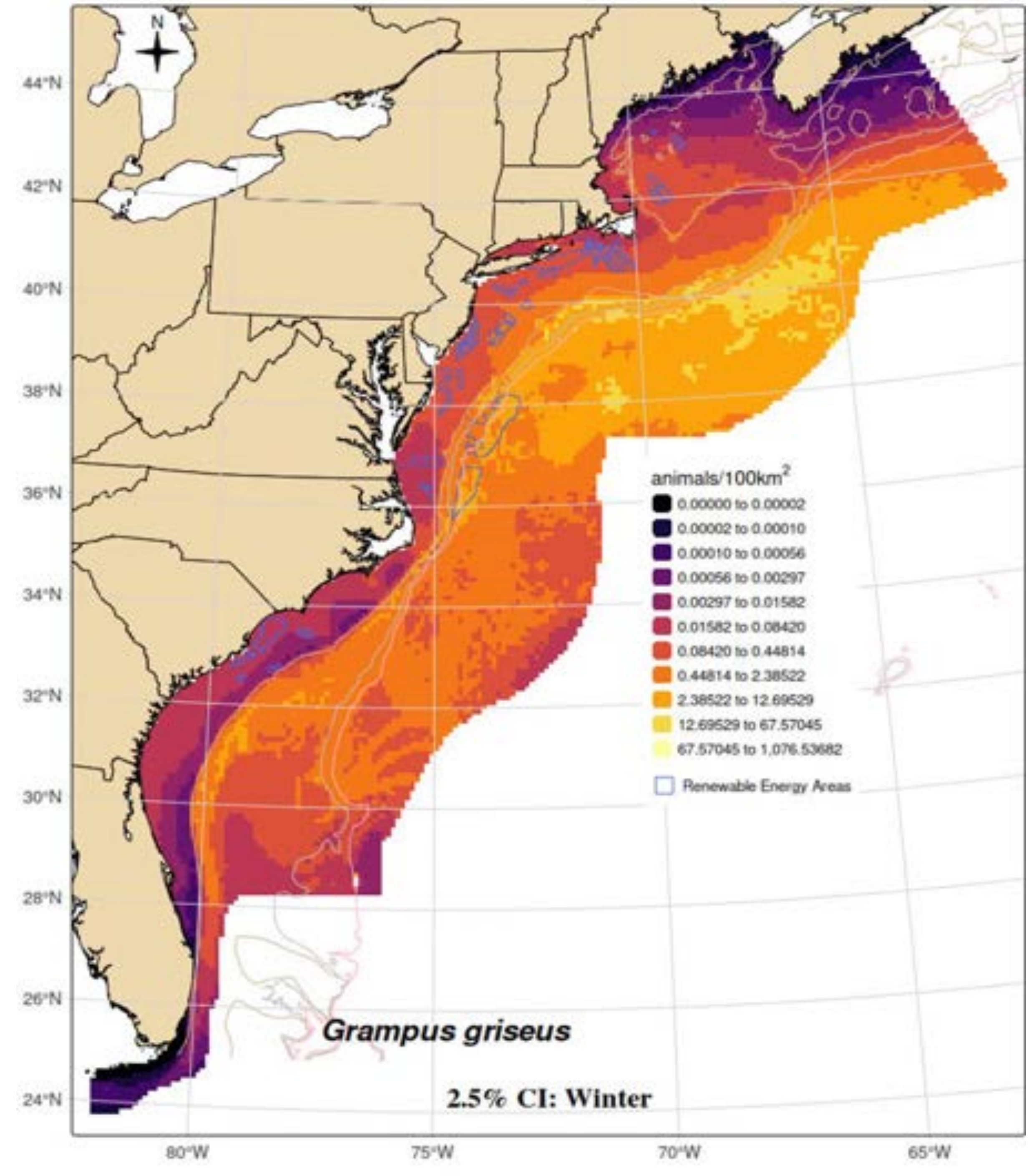

Figure C.4-19. Lower 2.5% confidence interval of the winter Risso's dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

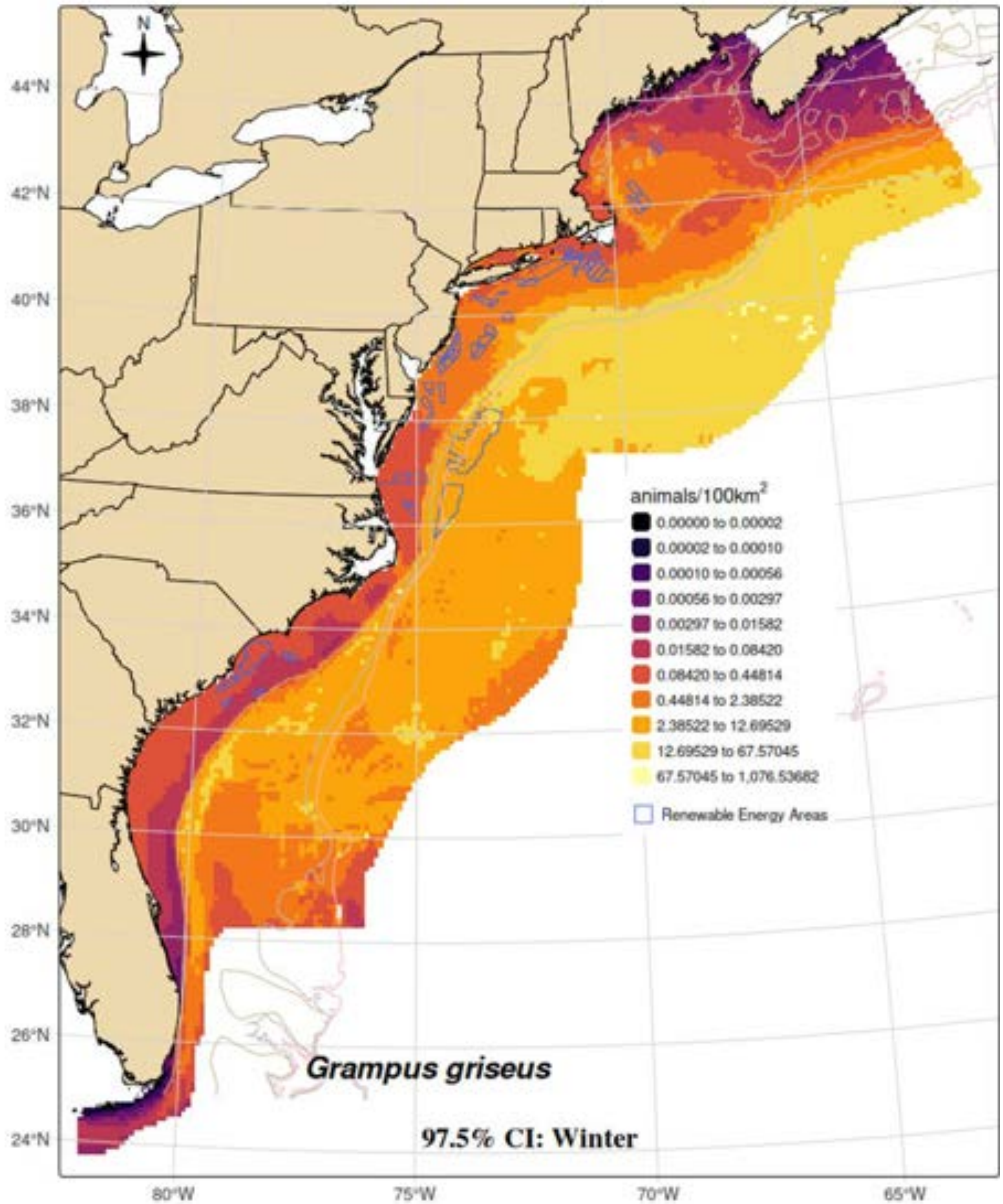

Figure C.4-20. Upper 97.5% confidence interval of the winter Risso's dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

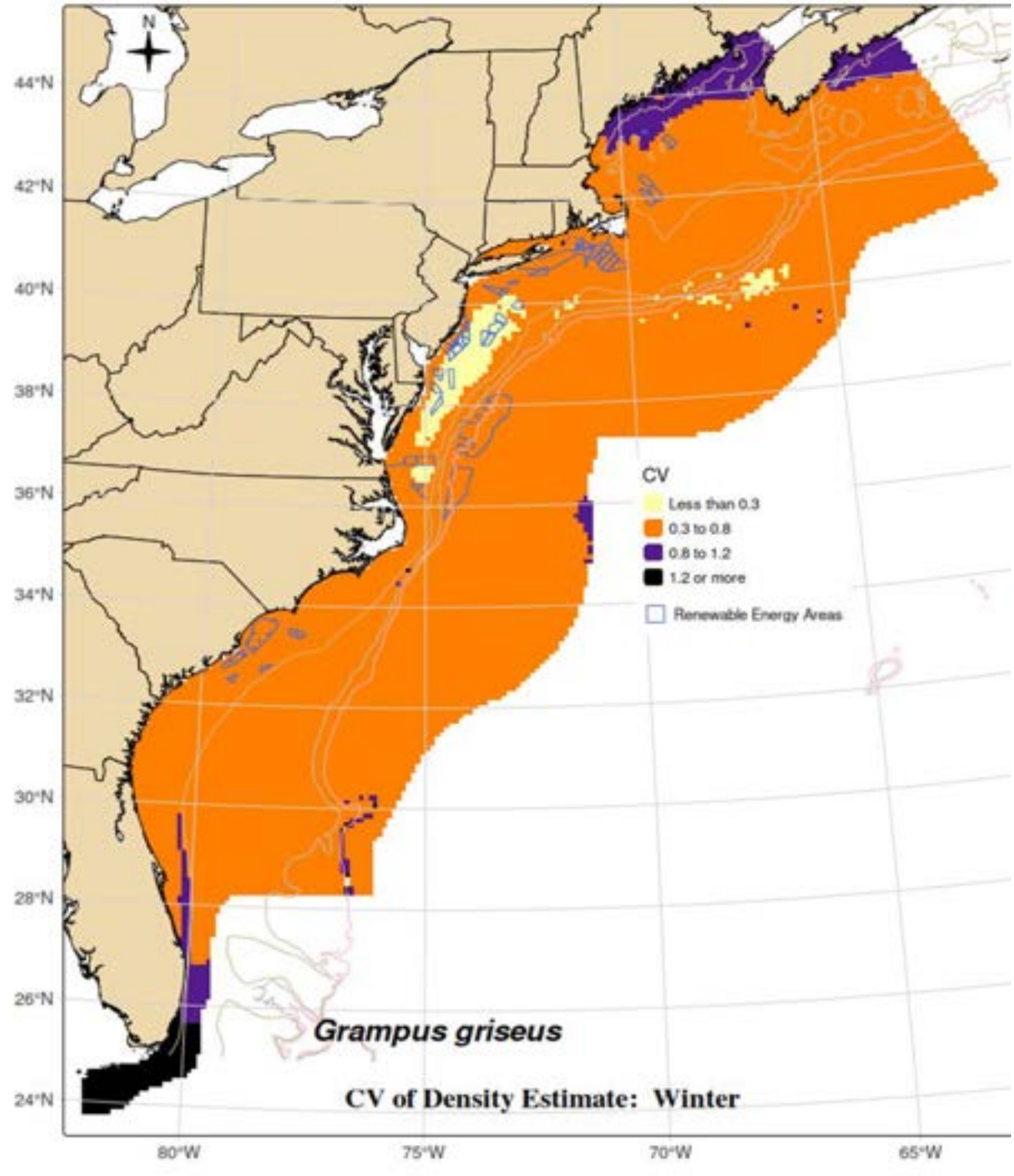

Figure C.4-21. CV of winter Risso's dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

C.4.7 Offshore Energy Development Areas

Table C.4-6. Risso's dolphin abundance estimates for wind-energy study areas

Season	Wind-Energy Study Area	Abundance*	CV	95% Confidence Interval*
Spring (Mar-May)	RI/MA	75.1	0.29	42.8 - 131.7
	NY	23.9	0.30	13.5 - 42.2
	NJ	53.9	0.26	32.7 - 88.8
	DE/MD	27.9	0.26	16.9 - 46.1
	VA	4.5	0.29	2.6 - 7.8
	NC	24.1	0.29	13.8 - 41.8
	NC/SC	5.8	0.41	2.7 - 12.7
	GA	0.7	0.44	0.3 - 1.6
	FL	1.4	1.02	0.3 - 7.2
Summer (Jun-Aug)	RI/MA	599.6	0.22	391.7 - 917.7
	NY	92.6	0.22	60.5 - 141.6
	NJ	88.4	0.22	58.3 - 134.1
	DE/MD	38.3	0.23	24.5 - 59.8
	VA	3.1	0.27	1.8 - 5.3
	NC	34.6	0.26	20.9 - 57.2
	NC/SC	2.2	0.35	1.1 - 4.2
	GA	0.0	1.95	0 - 0
	FL	3.5	1.00	0.7 – 18.0
Fall (Sep-Nov)	RI/MA	192.9	0.23	123.4 - 301.4
	NY	22.2	0.26	13.5 - 36.4
	NJ	28.2	0.27	16.9 - 47
	DE/MD	11.0	0.28	6.3 - 19
	VA	0.8	0.33	0.4 - 1.5
	NC	17.8	0.29	10.2 - 31.1
	NC/SC	2.2	0.41	1 - 4.6
	GA	0.2	0.45	0.1 - 0.4
	FL	1.8	1.01	0.4 - 9.4
Winter (Dec-Feb)	RI/MA	41.8	0.34	22 - 79.4
	NY	9.7	0.32	5.2 - 17.9
	NJ	24.5	0.30	13.8 - 43.6
	DE/MD	12.8	0.30	7.2 - 22.7
	VA	2.2	0.30	1.2 – 4.0
	NC	12.9	0.34	6.7 - 24.8
	NC/SC	11.9	0.40	5.5 - 25.5
	GA	1.7	0.42	0.8 - 3.9
	FL	1.1	1.04	0.2 – 6.0

***** We rounded the mean abundance and 95% confidence interval to the nearest tenth of an animal. If this resulted in a zero for the mean abundance, we calculated the CV using the actual abundance value as estimated by the density-habitat model and then rounded to the nearest tenth. If a wind-energy study area is not included, then we assumed the abundance was zero.

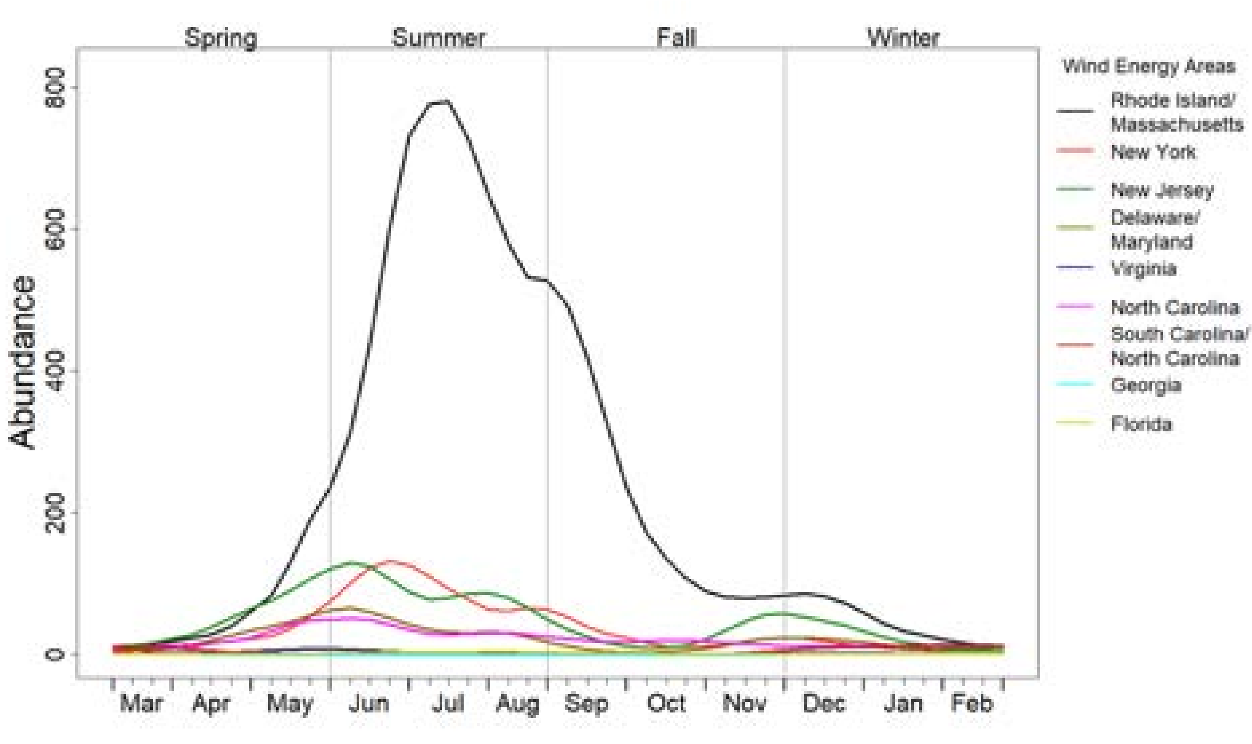

Figure C.4-22. Average seasonal abundance of Risso's dolphins in the wind-energy study areas

C.5 Atlantic White-sided Dolphin (*Lagenorhynchus acutus*)

Figure C.5-1. White-sided dolphins
Image collected under MMPA Research permit #1355. Credit: NOAA/NEFSC/Peter Duley

C.5.1 Data Collection

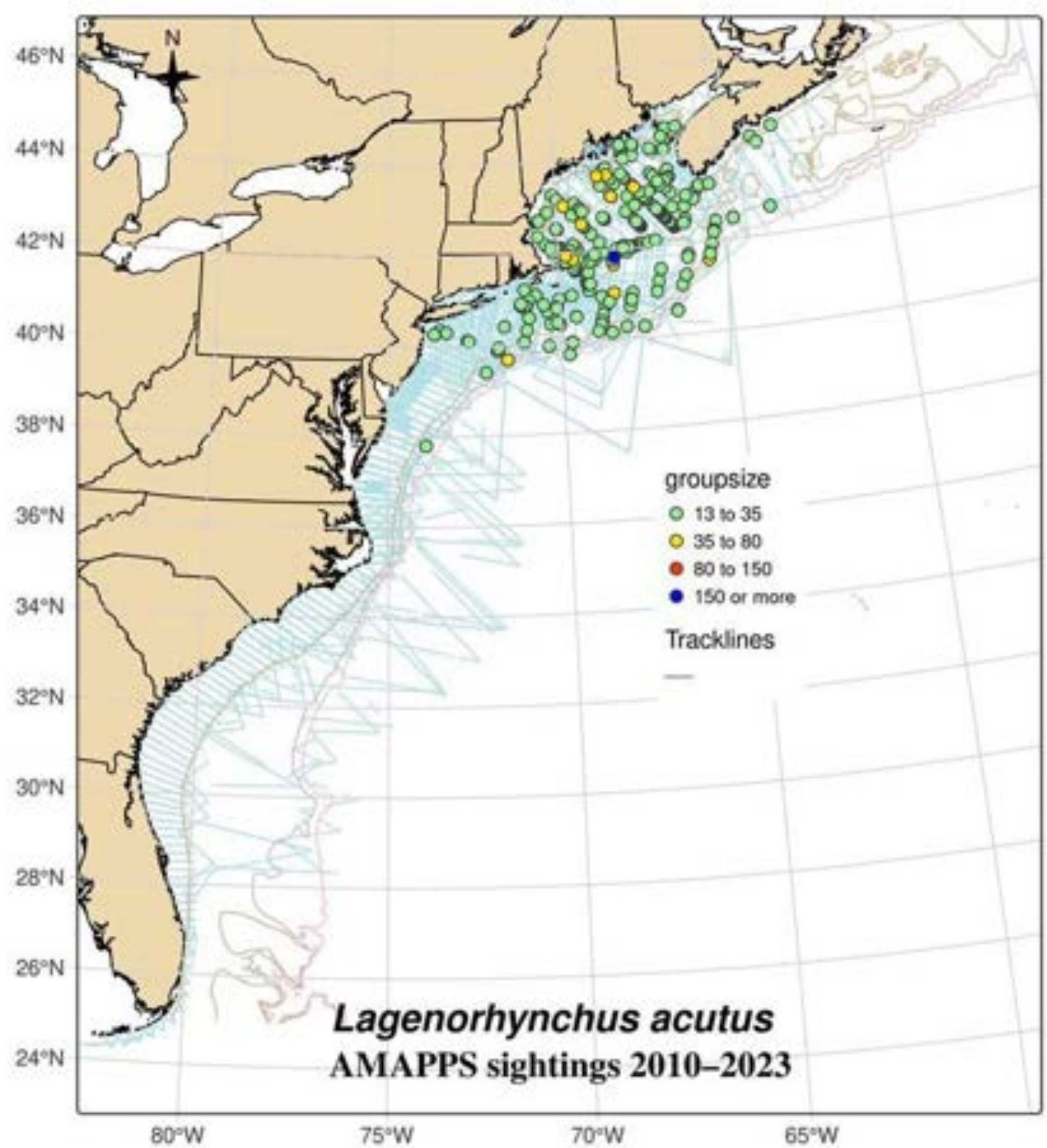

Figure C.5-2. Distribution of track lines and white-sided dolphin sightings 2010 to 2023
Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

Table C.5-1. AMAPPS research effort 2010 to 2023 and Atlantic white-sided dolphin sightings

Survey Region and Platform	Season	Effort (km)	Number of Groups	Number of Animals
NE Shipboard	Spring	8,883	27	261
NE Shipboard	Summer	49,064	6	78
NE Aerial	Spring	38,839	124	838
NE Aerial	Summer	52,003	97	1,135
NE Aerial	Fall	87,311	168	2,856
NE Aerial	Winter	24,747	18	183
SE Shipboard	Spring	2,604	0	0
SE Shipboard	Summer	18,331	0	0
SE Shipboard	Fall	2,673	0	0
SE Shipboard	Winter	302	0	0
SE Aerial	Spring	48,634	0	0
SE Aerial	Summer	43,285	0	0
SE Aerial	Fall	21,153	0	0
SE Aerial	Winter	19,152	0	0

C.5.2 Mark-Recapture Distance Sampling Analysis

Table C.5-2. Intermediate parameters in Atlantic white-sided dolphin mark-recapture distance sampling (MRDS) models

Analysis Set	MR Model	MR Truncation (m)	DS Model	DS Truncation (m)	Key function	p(0)	p(0) CV	Chi-square p-value	CvM p-value
NE–aerial group 8	distance + observer + log(group size)	400	distance + log(group size)	460	HN	0.62	0.06	0.83	0.74
NE–shipboard group 5	distance * observer + log(group size) + sea state + glare + swell height	5000	distance + sea state + swell height + log(group size)	5000	HR with Simple Polynomial Adjustment Order 4	0.39	0.14	0.05	0.55
SE–shipboard group 1	distance + log(group size)	4000	distance + sea state + glare + time of day	4000	HR	0.59	0.10	0.35	0.52

MR=Mark-Recapture, DS=Distance Sampling, HR=Hazard Rate, HN= Half Normal, CV=Coefficient of variation. Values of p>0.5 for Chi-square and Cramer-von Mises test (CvM) indicate good fit. The definition of p(0) is the probability of detecting a group on the track line. Species included in the analysis sets are explained in main text Tables 4-20 and 4-21.

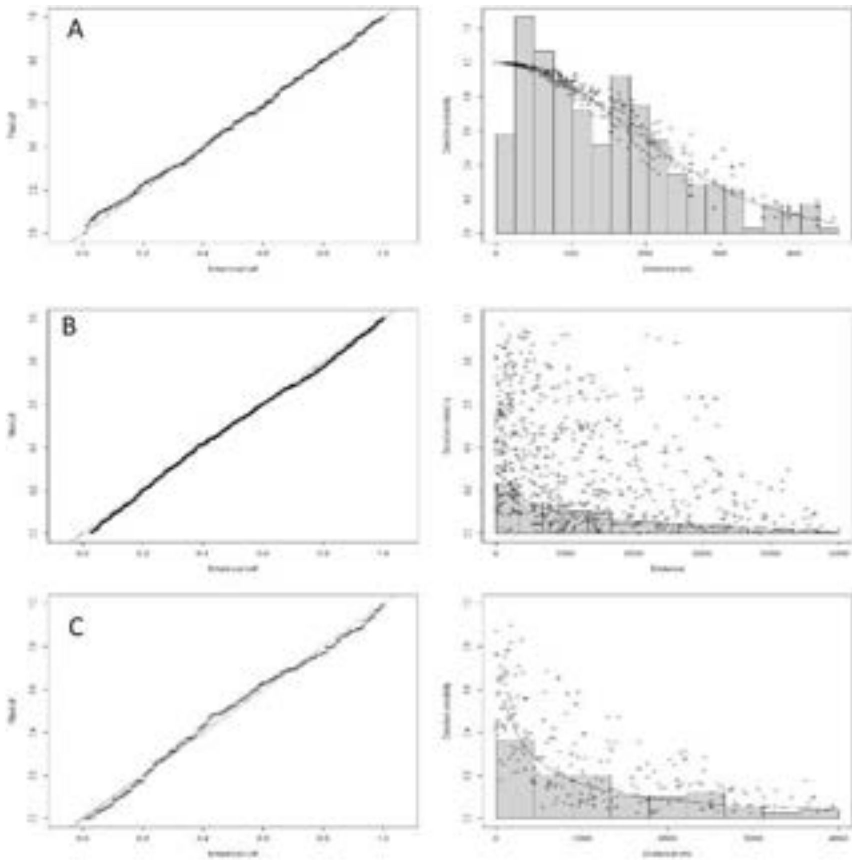

Figure C.5-3. Q-Q plots and detection functions from the Atlantic white-sided dolphins MRDS analyses
A) NE-aerial analysis set 8; B) NE-shipboard analysis set 4; C) SE-shipboard analysis set 1.

C.5.3 Generalized Additive Model Analysis

Table C.5-3. 2010 to 2023 density-habitat model output for Atlantic white-sided dolphins

Covariates	Edf	Ref.df	F	C.dev	p-value
s(chla)	0.86	5	1.34	3.25	0.0052
s(pp)	0.89	5	1.44	2.84	0.0042
s(dist2GSSw)	4.42	5	4.87	3.98	<0.0001
s(dist2shore)	0.99	5	2.86	2.12	<0.0001
s(slope)	0.88	5	1.36	2.28	0.0049
s(dist200)	1.01	5	7.12	14.26	<0.0001
s(dist1000)	0.90	5	1.10	1.61	0.0104
s(latdd)	2.81	5	13.51	13.36	<0.0001

Adjusted R^2 = 0.00403. Deviance explained = 43.7%.
Includes the estimated degrees of freedom (Edf), reference degrees of freedom (Ref.df), contribution to the deviance (C.dev) explained for each habitat covariate and its associated p-value. Covariate abbreviations explained in main text in Table 4-2.

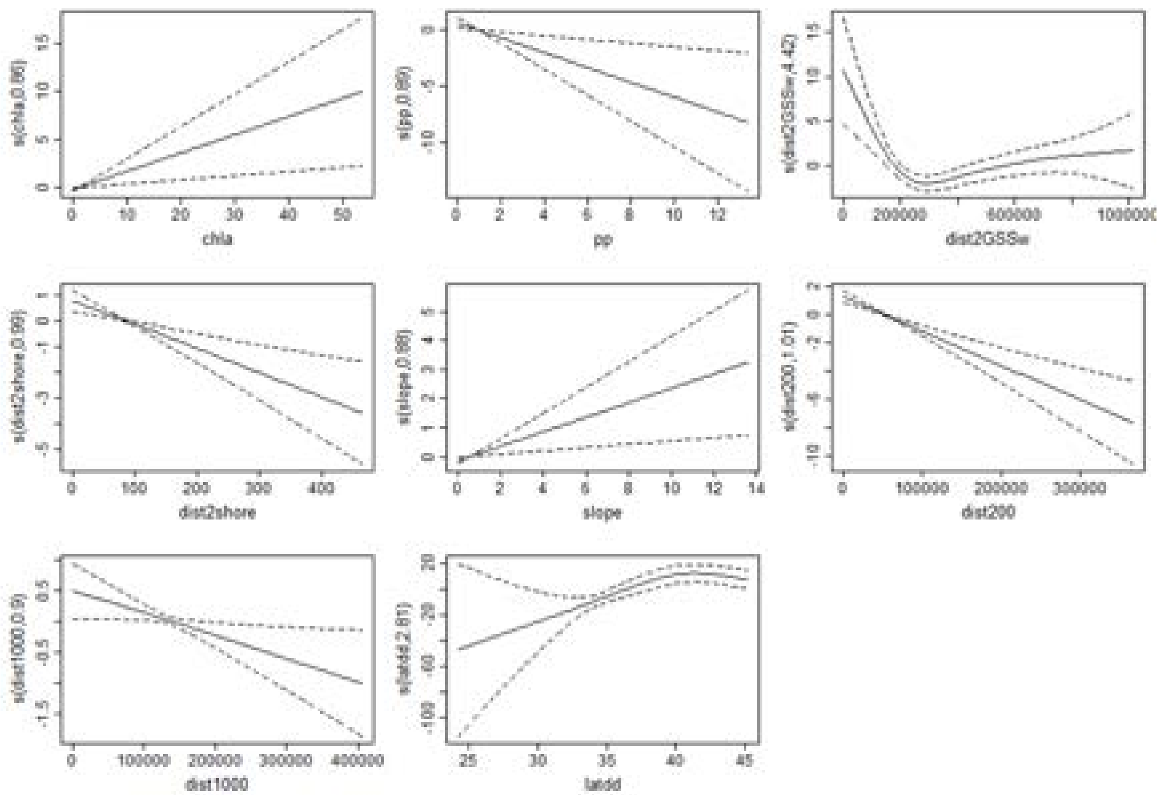

Figure C.5-4. Atlantic white-sided dolphin density relative to significant habitat covariates
Plots represent the partial smooths and interaction terms of the density-habitat model, where the shaded regions represent the 95% credible intervals. Covariate abbreviations explained in main text in Table 4-2.

C.5.4 Model Cross-Validation

Table C.5-4. Diagnostic statistics from the Atlantic white-sided dolphin density-habitat model

Diagnostic Statistic	Description	Calculated with	Model Values (x)	Score
RHO	Spearman rank correlation	Non-zero density	0.077	Fair to good
MAPE	Mean absolute percentage error	Non-zero density	89.492	Fair to good
RHO	Spearman rank correlation	All data divided in 25 random samples	0.113	Fair to good
MAE	Mean absolute error	All data divided in 25 random samples	0.014	Excellent
MAPE	Mean absolute percentage error	All data divided in 25 random samples	91.358	Fair to good

RHO: Poor= x<0.05; Fair to good =0.05<=x<0.3; Excellent= x>0.3
MAPE: Poor= x>150%; Fair to good= 150%>=x>50%; Excellent= x<=50%
MAE: Poor= x>1; Fair to good = 1>=x>0.25; Excellent= x<=0.25

C.5.5 Abundance Estimates for AMAPPS Study Area

Table C.5-5. Atlantic white-sided dolphin average abundance estimates for AMAPPS study area

Season	Average Abundance	CV	95% Confidence Interval
Spring (March–May)	3,788	0.36	1,911 – 7,509
Summer (June–August)	2,689	0.36	1,357 – 5,330
Fall (September–November)	3,500	0.35	1,798 – 6,814
Winter (December–February)	4,493	0.34	2,350 – 8,592
Summer 2011 U.S. surveys[1]	48,819	0.61	23,609 – 100,948
Summer 2016 U.S. surveys[1]	31,912	0.61	15,433 – 65,988
Summer 2021 U.S. surveys[1]	4,632	0.55	1,691 – 12,687

[1]Hayes et al. 2024

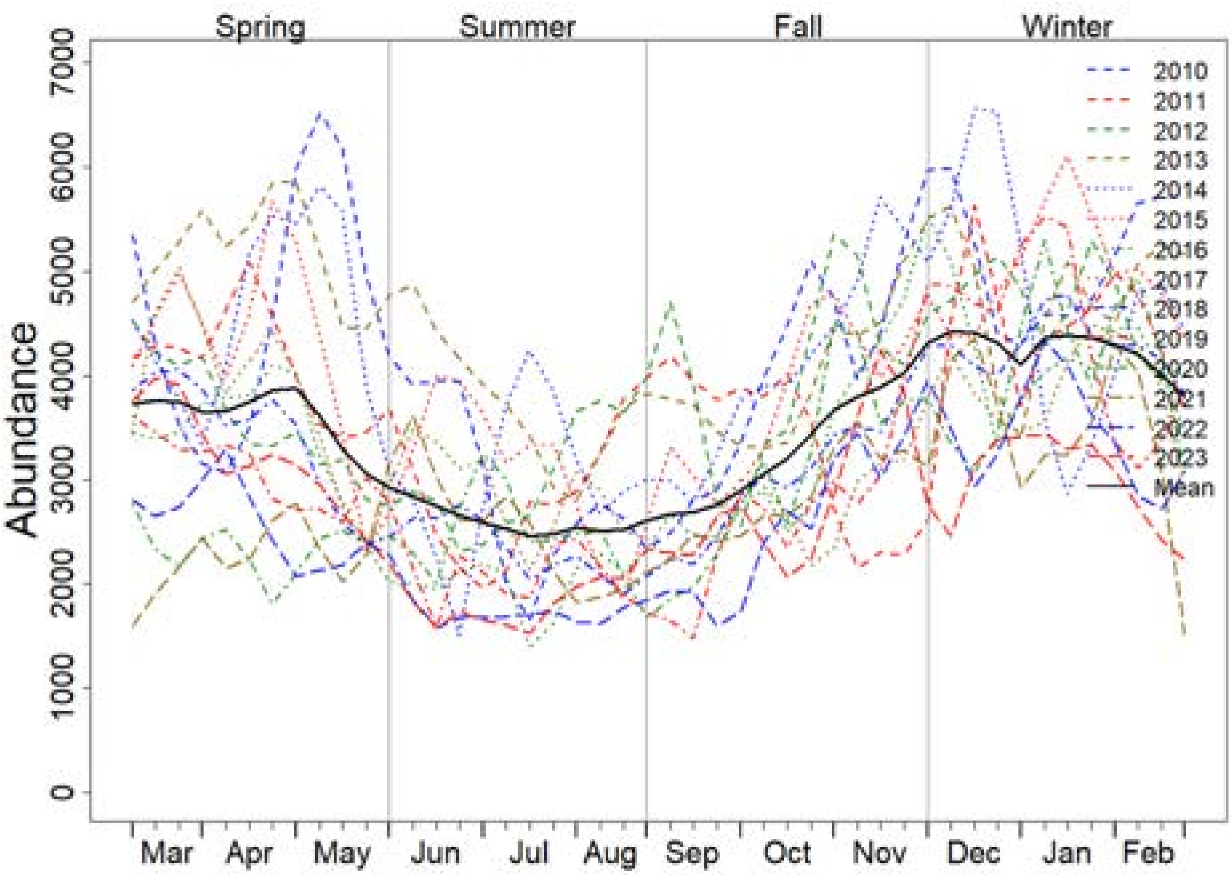

Figure C.5-5. Annual abundance trends for Atlantic white-sided dolphins in AMAPPS study area

C.5.6 Seasonal Prediction Maps

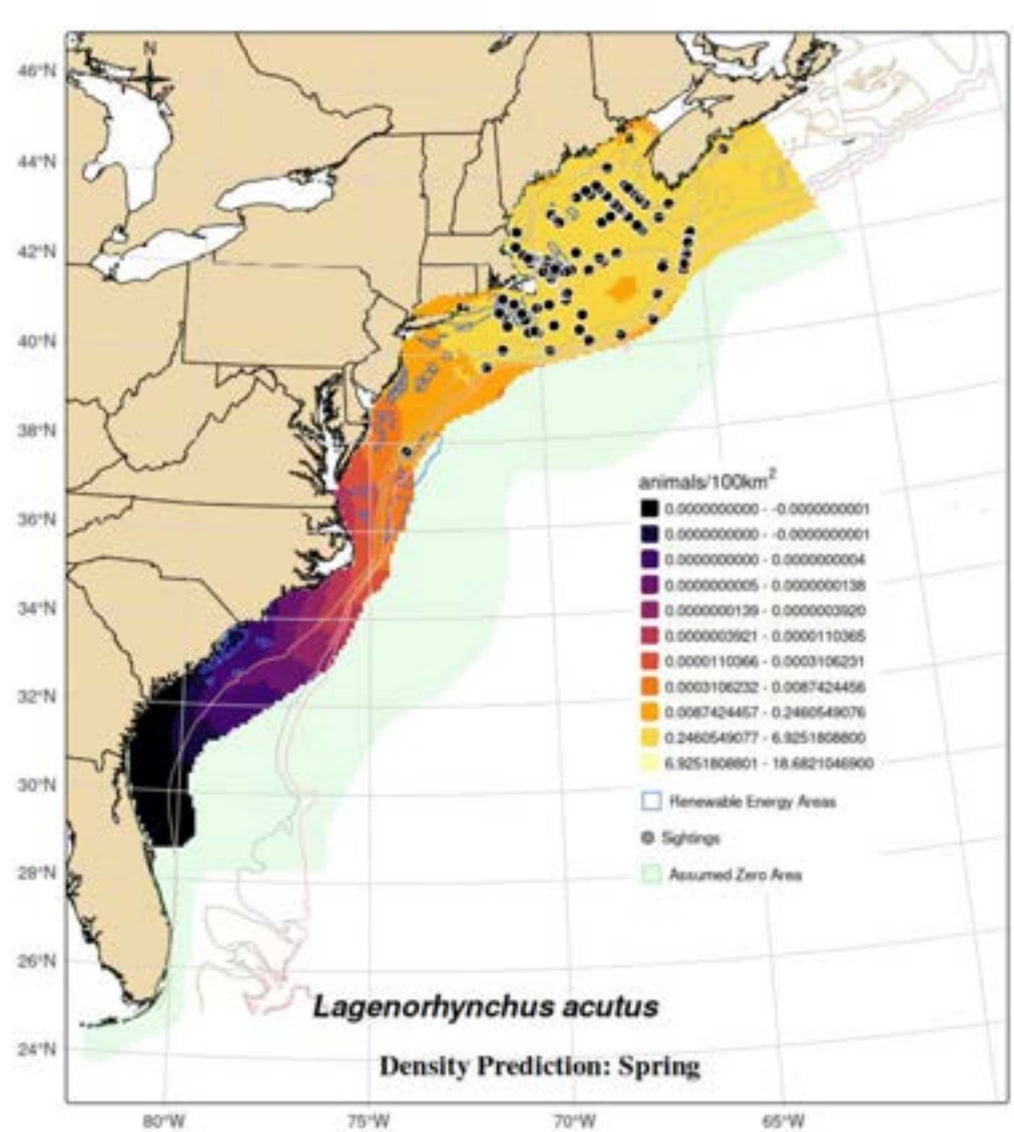

Figure C.5-6. Atlantic white-sided dolphin spring average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

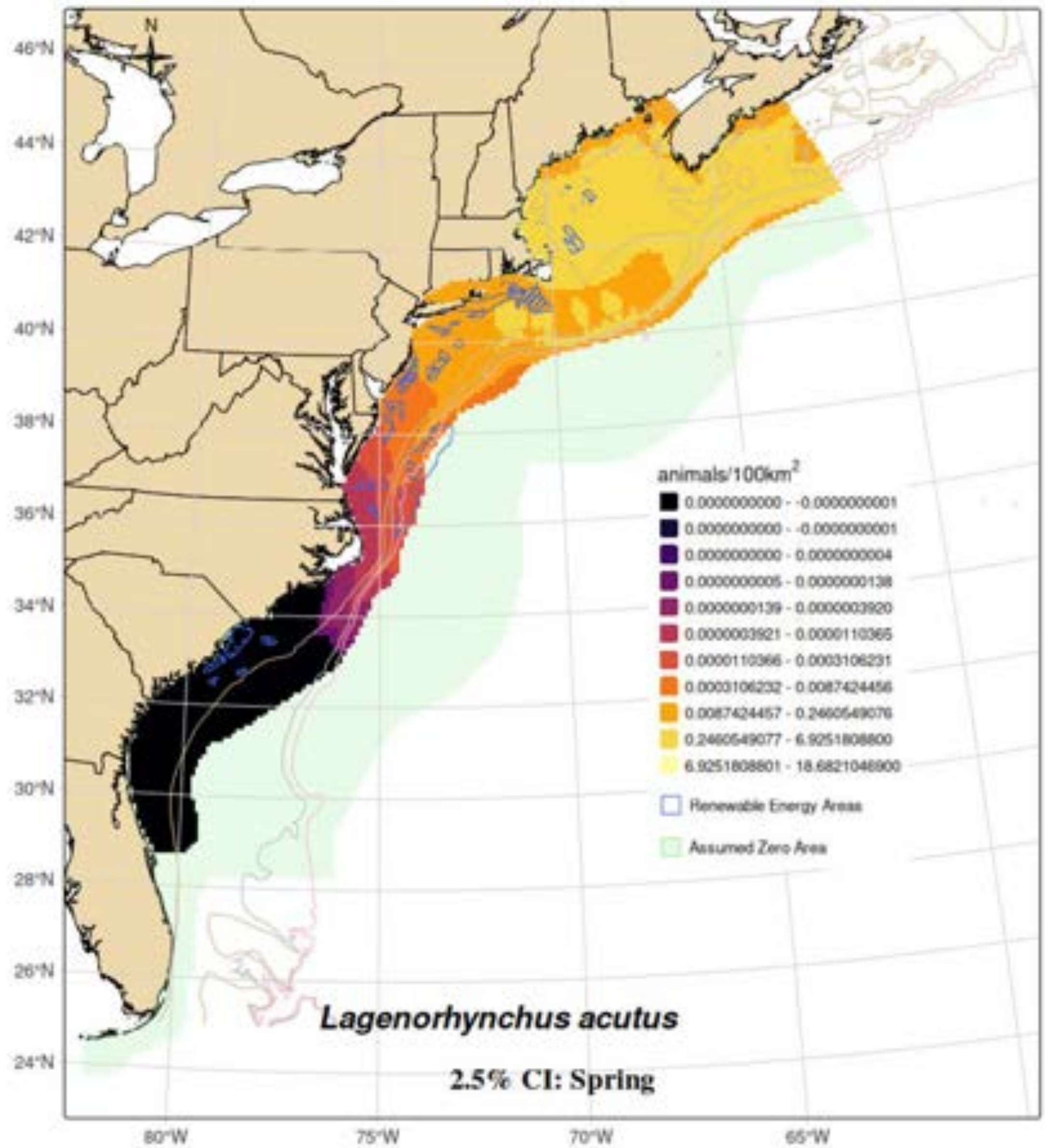

Figure C.5-7. Lower 2.5% confidence interval of the spring white-sided dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

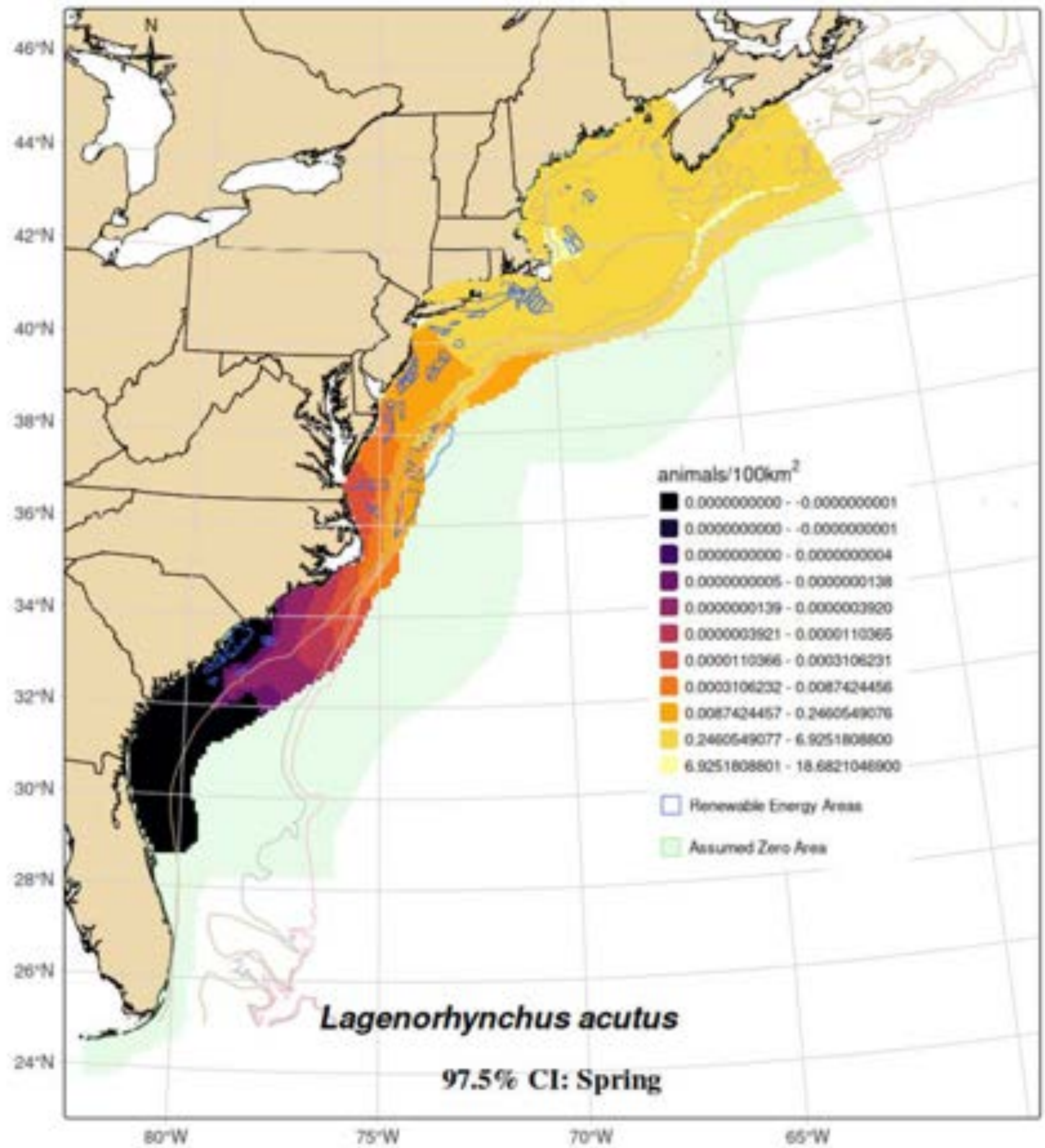

Figure C.5-8. Upper 97.5% confidence interval of the spring white-sided dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

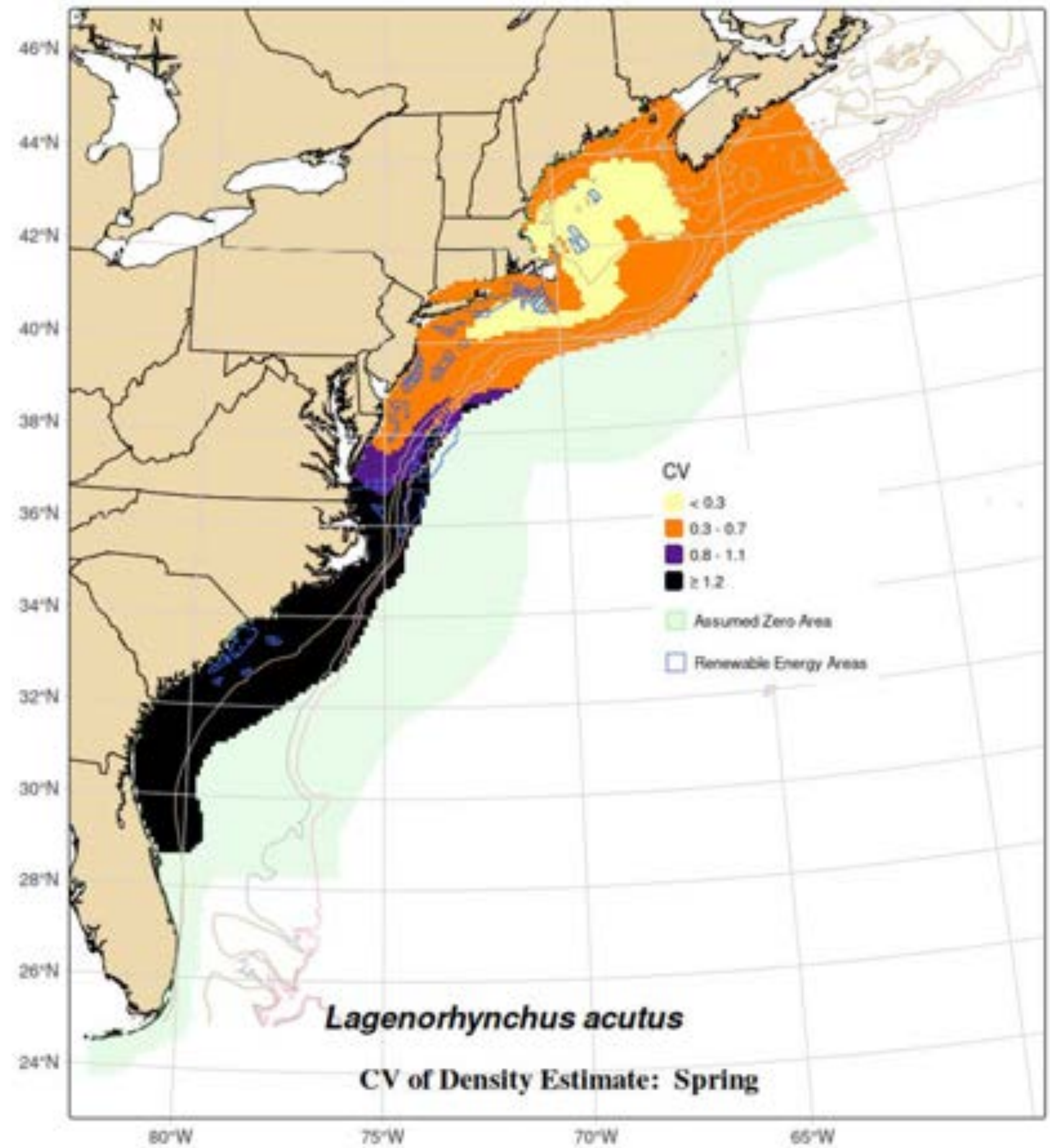

Figure C.5-9. CV of spring Atlantic white-sided dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

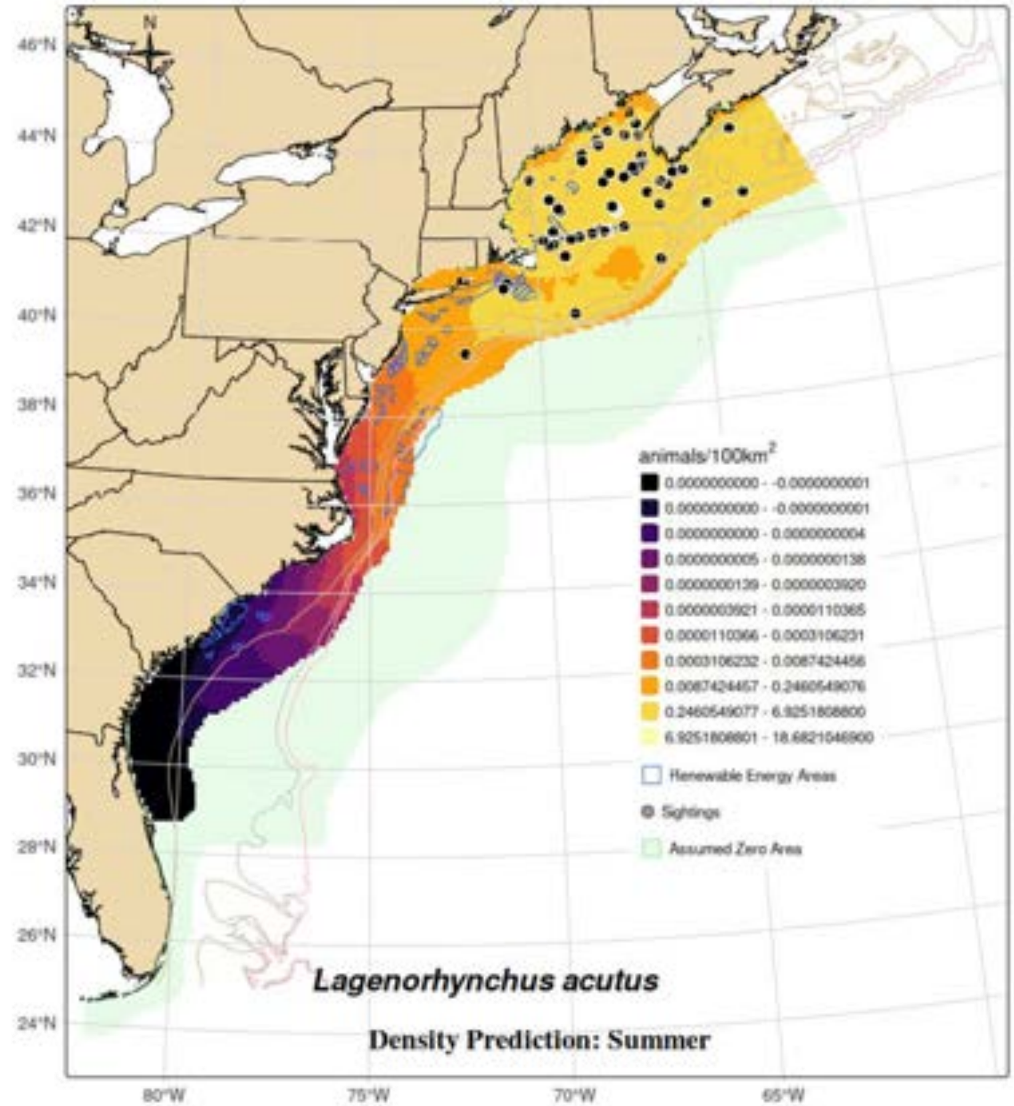

Figure C.5-10. Atlantic white-sided dolphin summer average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

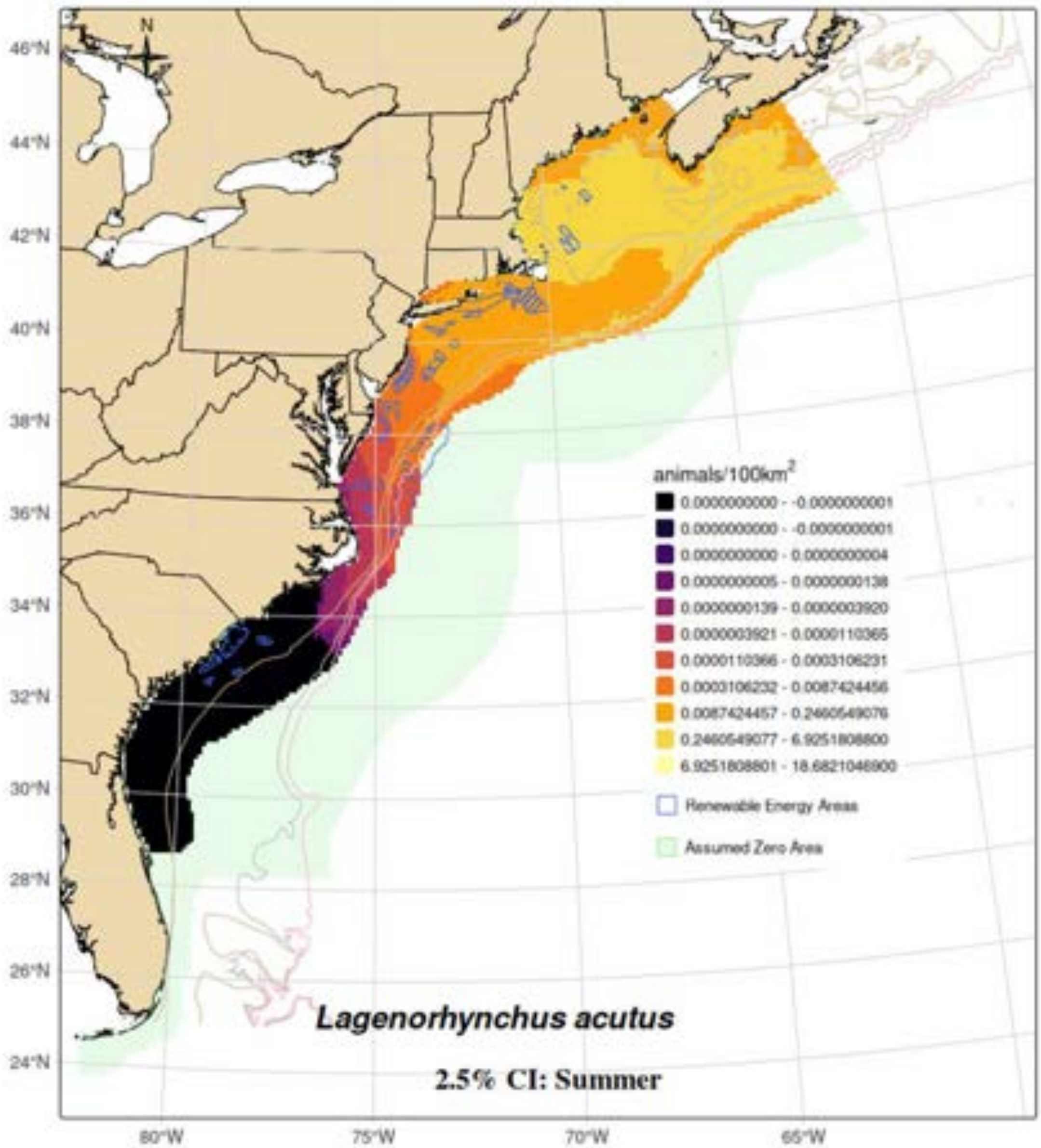

Figure C.5-11. Lower 2.5% confidence interval of summer white-sided dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

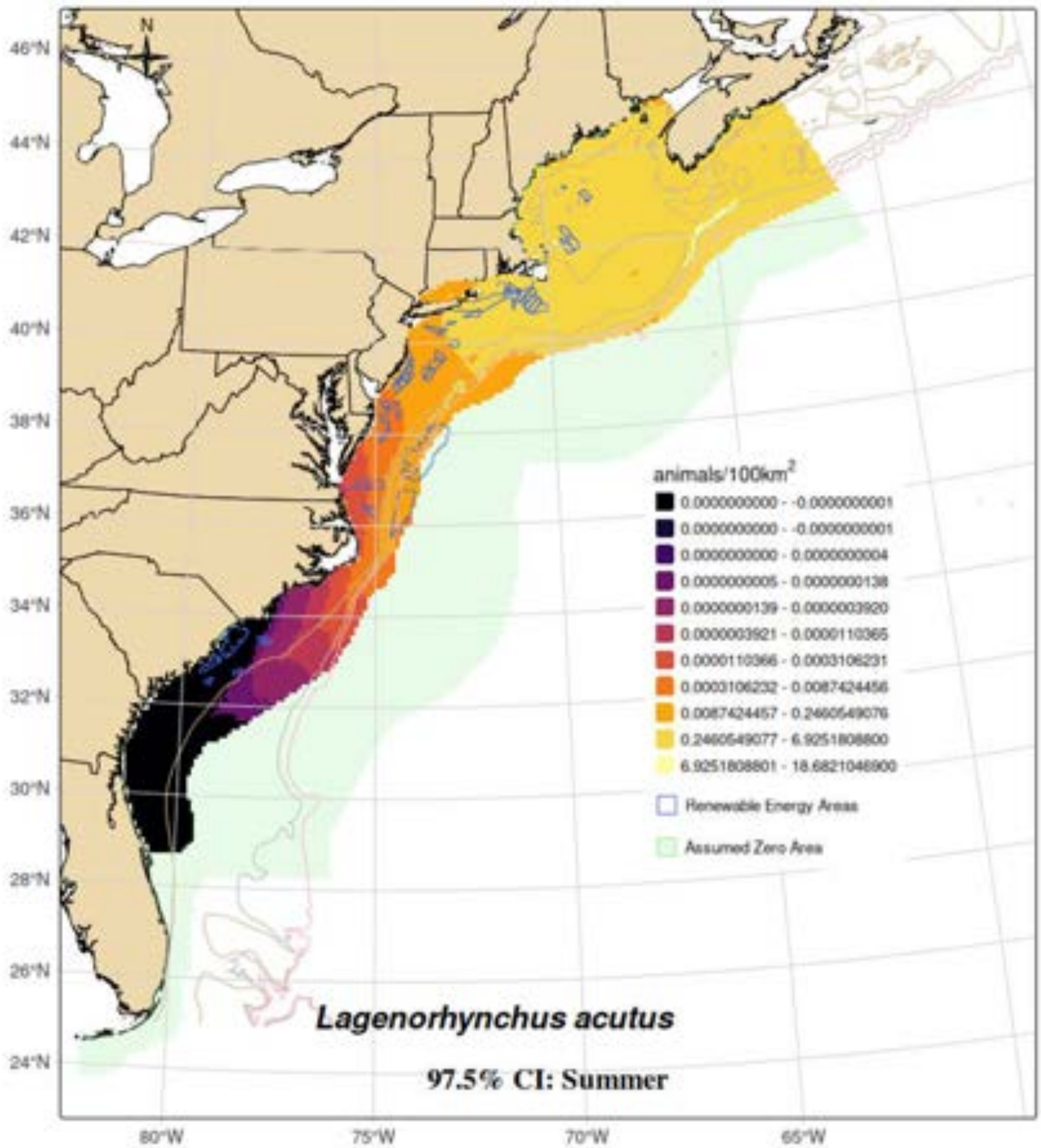

Figure C.5-12. Upper 97.5% confidence interval of summer white-sided dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

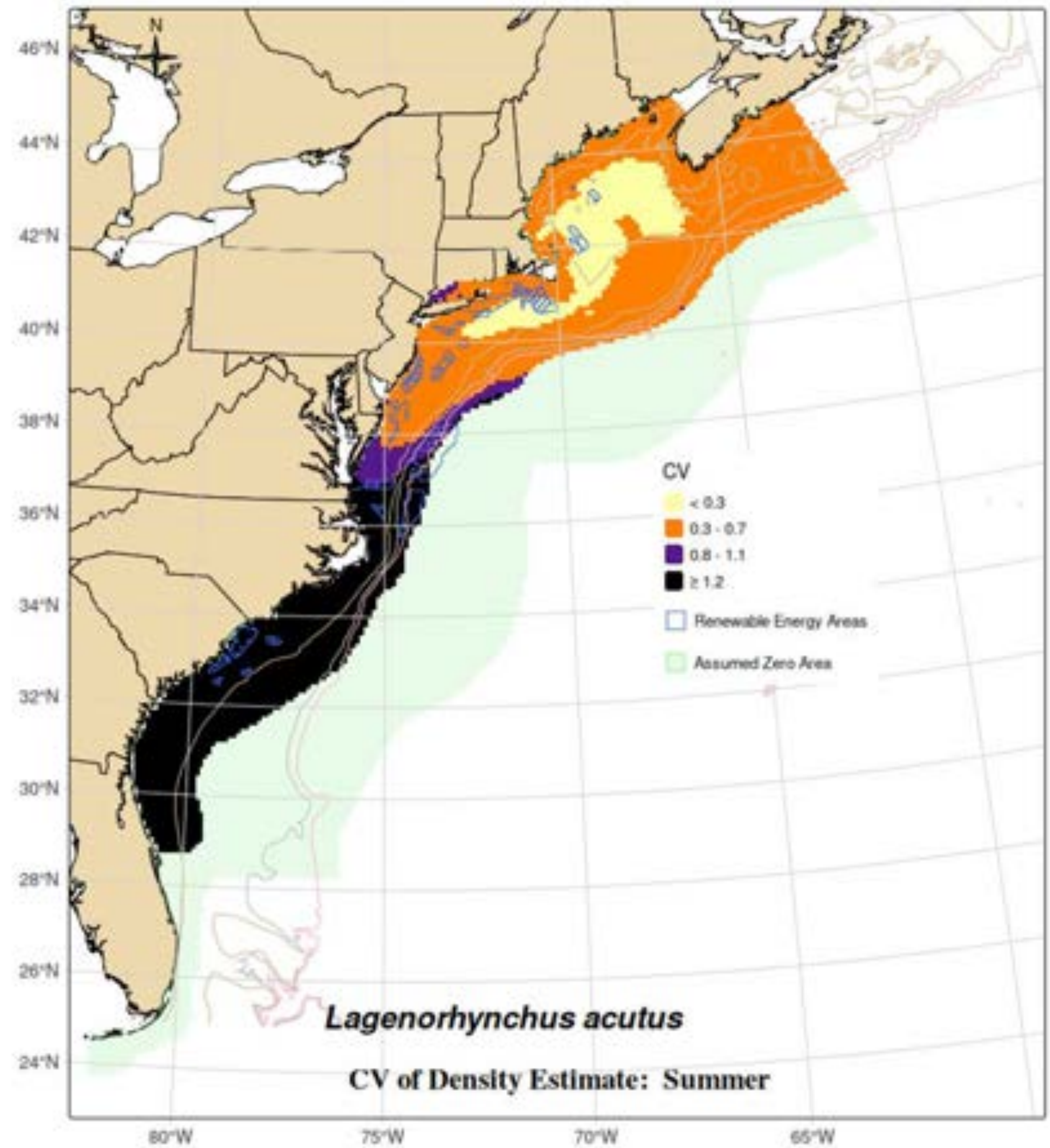

Figure C.5-13. CV of summer Atlantic white-sided dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

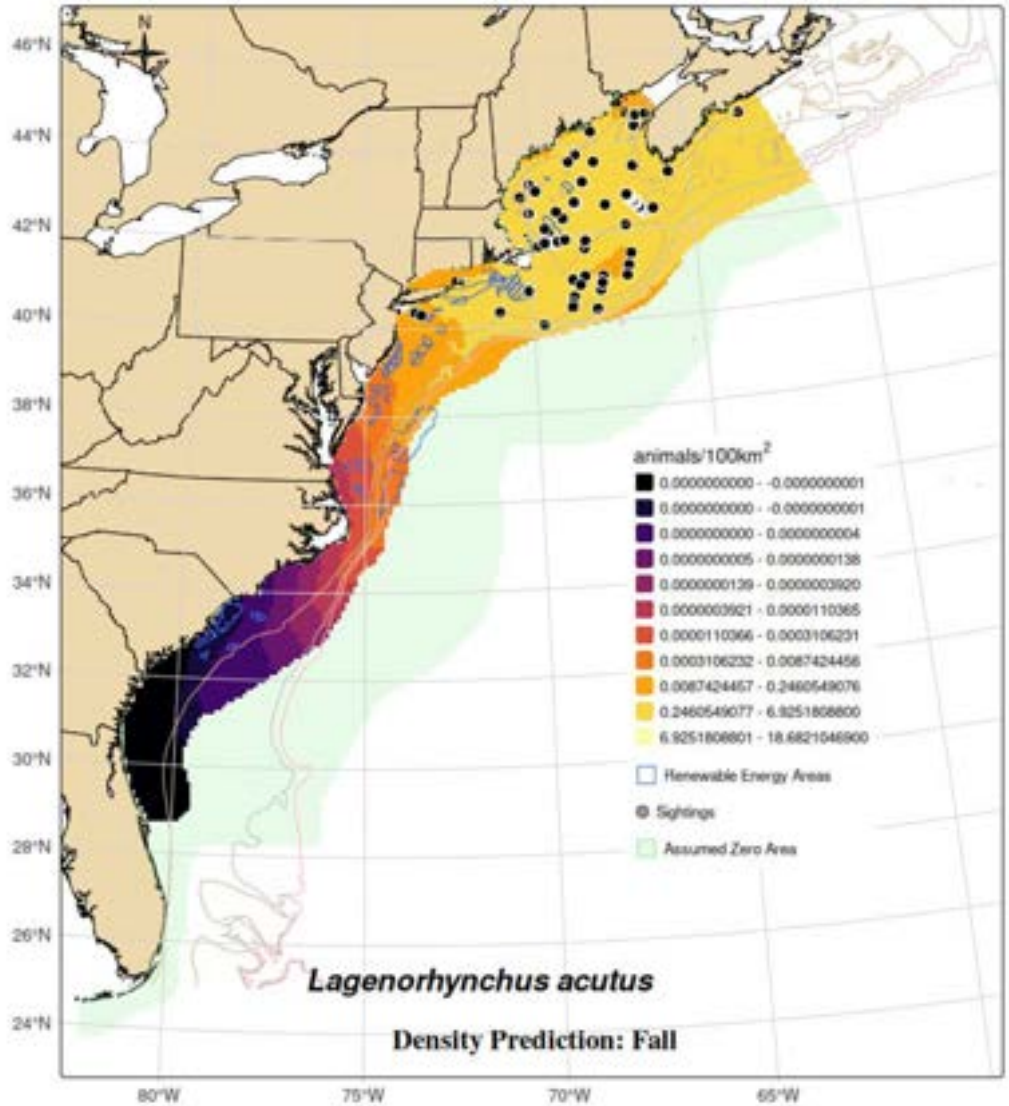

Figure C.5-14. Atlantic white-sided dolphin fall average density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

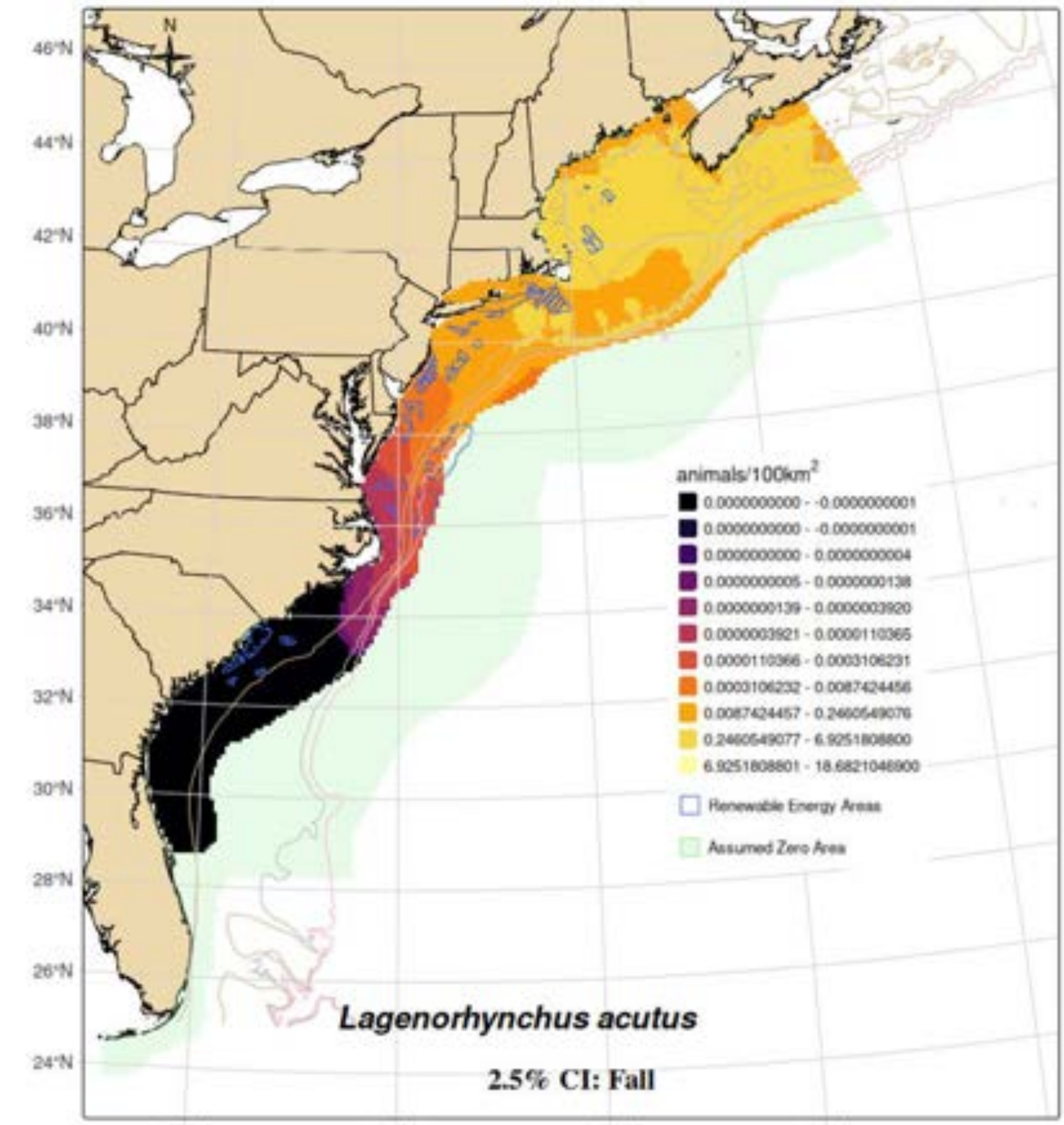

Figure C.5-15. Lower 2.5% confidence interval of the fall white-sided dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

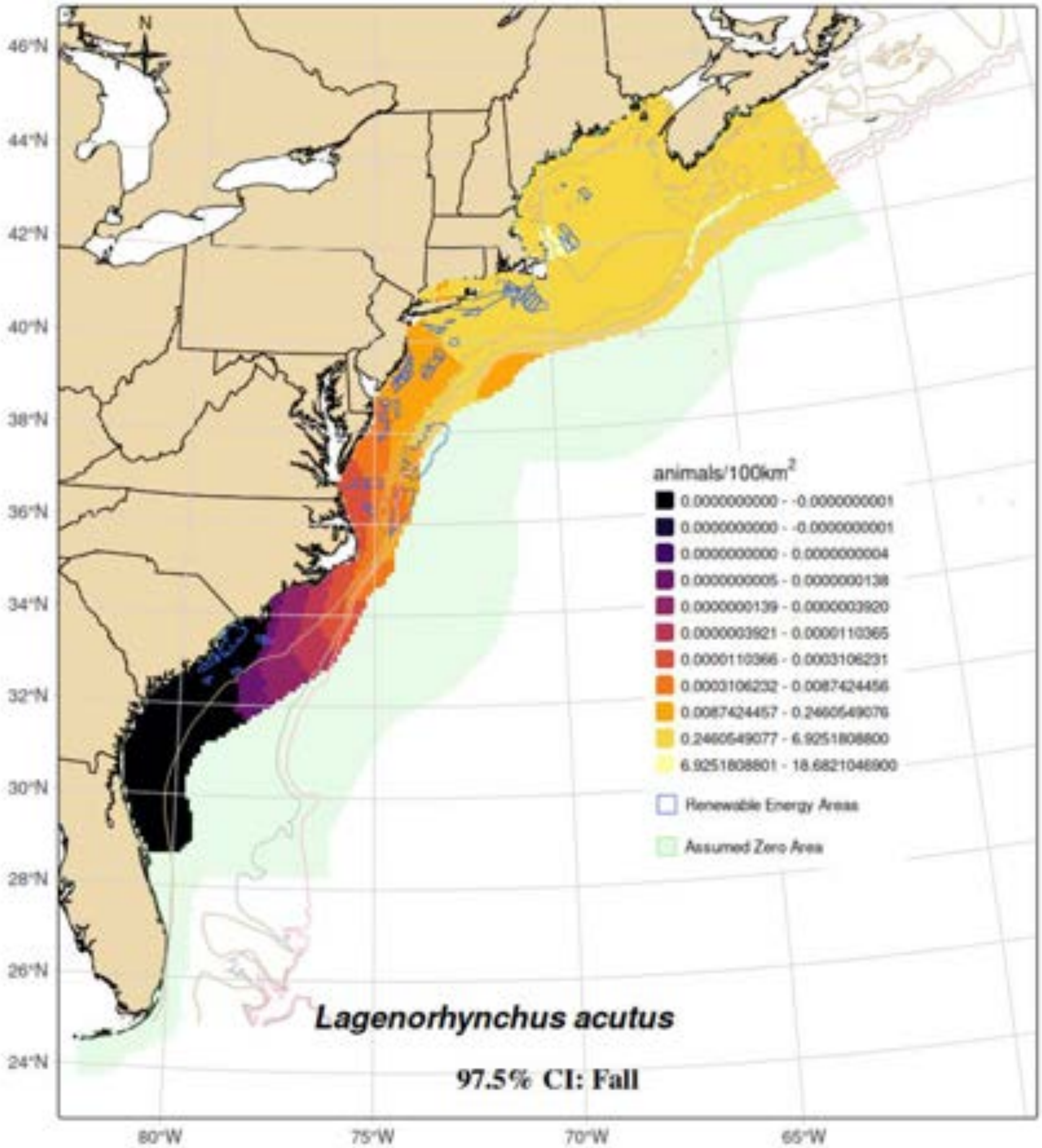

Figure C.5-16. Upper 97.5% confidence interval of the fall white-sided dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

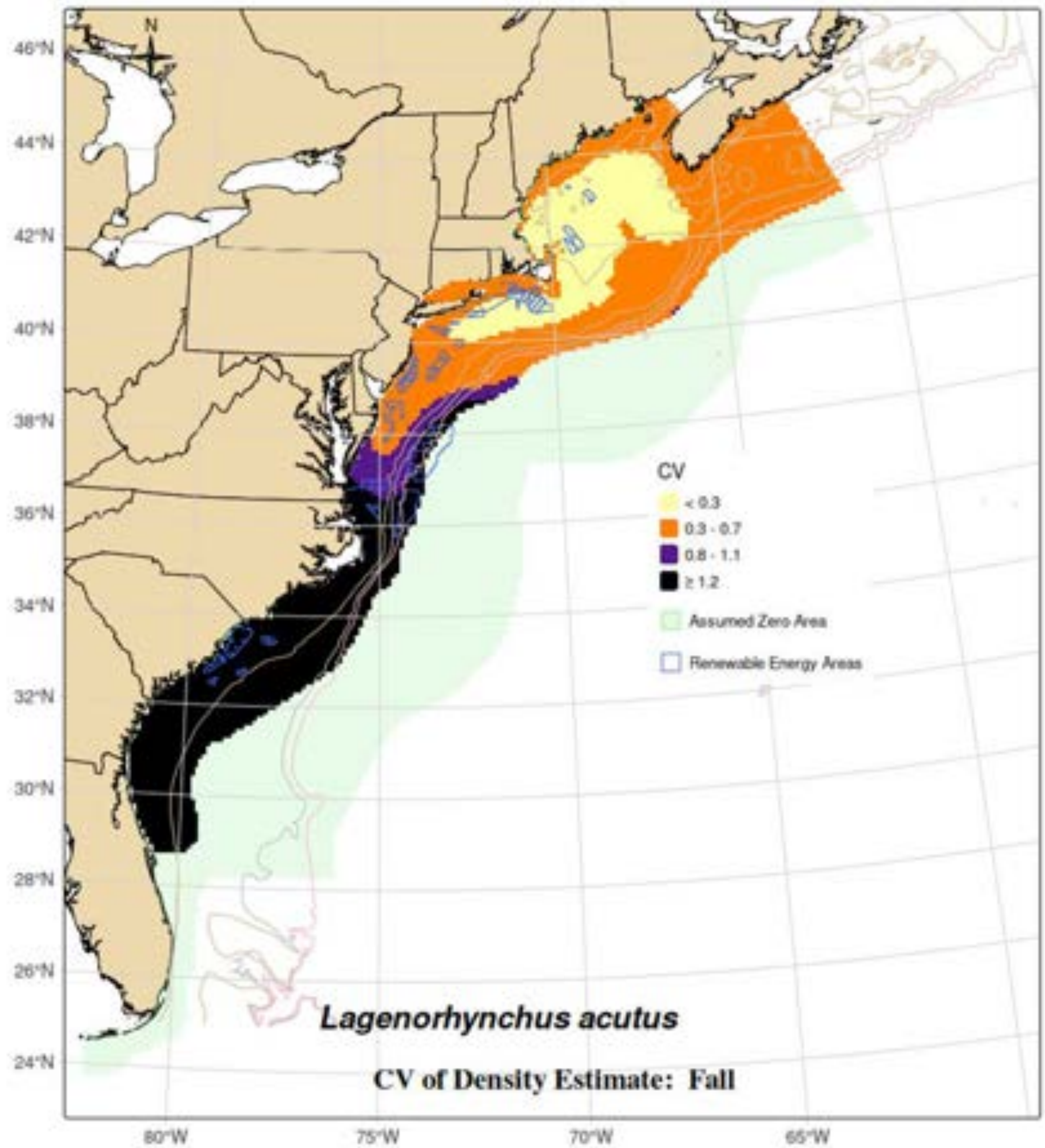

Figure C.5-17. CV of fall Atlantic white-sided dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

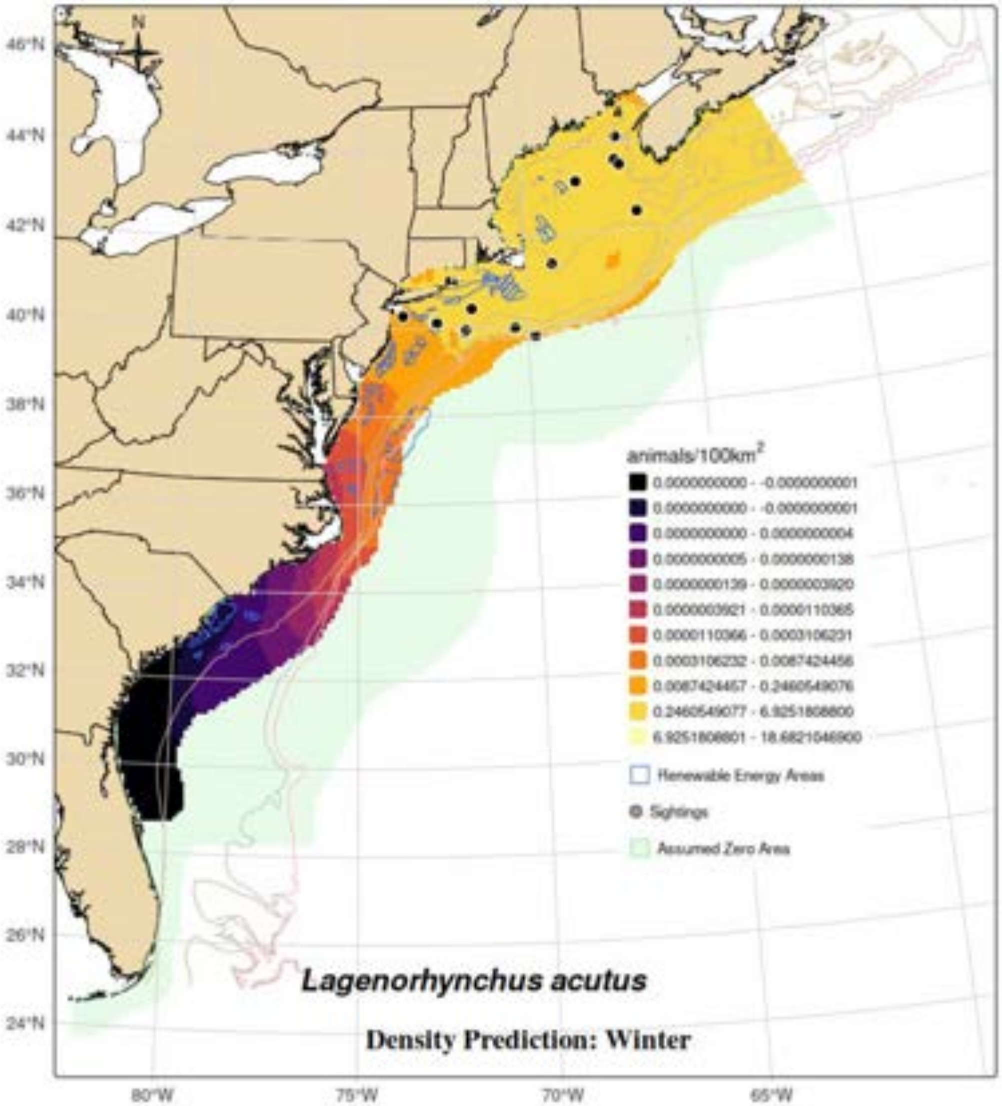

Figure C.5-18. Atlantic white-sided dolphin winter average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

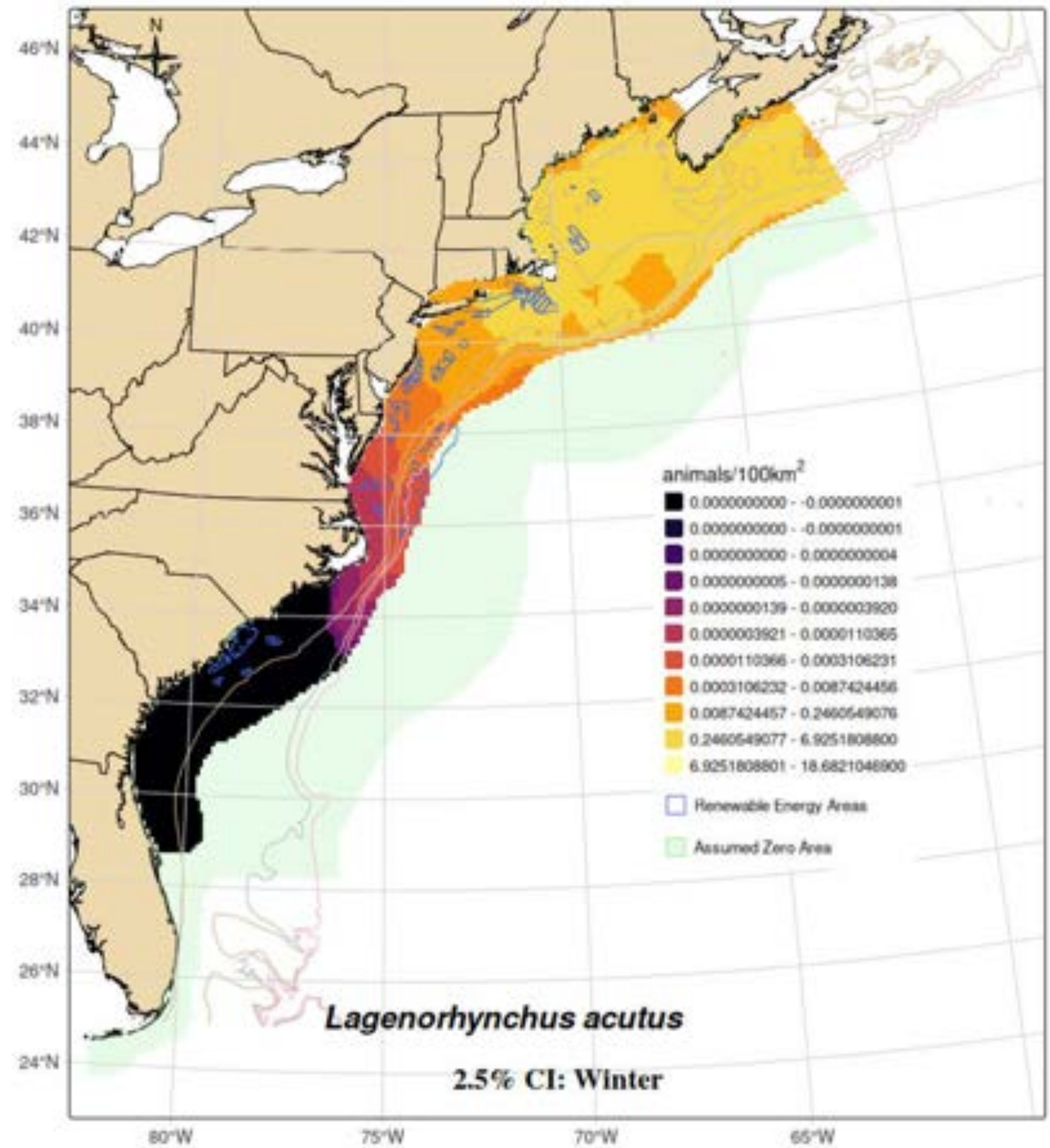

Figure C.5-19. Lower 2.5% confidence interval of the winter white-sided dolphin density estimates
Densities are f.or grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

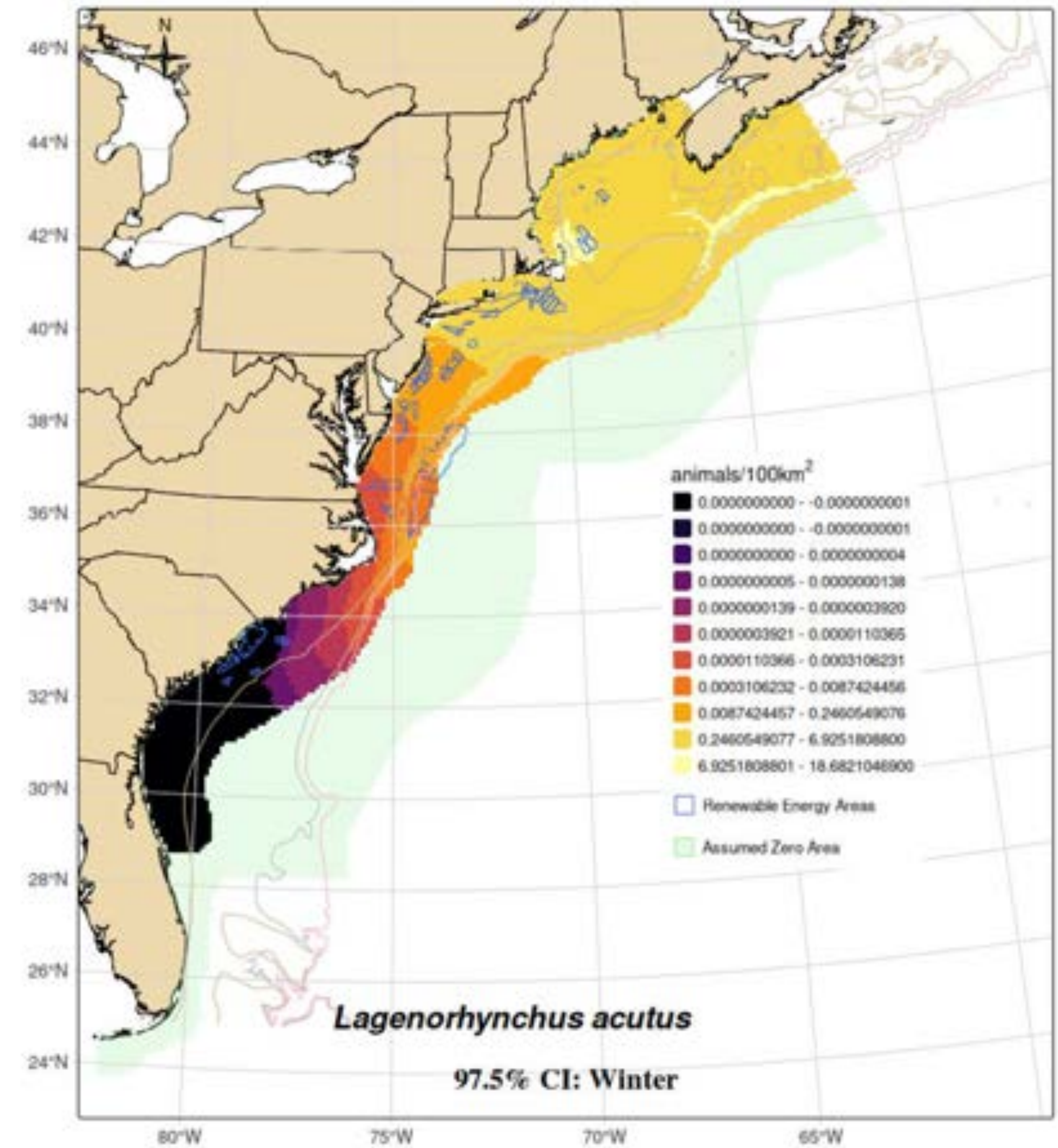

Figure C.5-20. Upper 97.5% confidence interval of winter white-sided dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

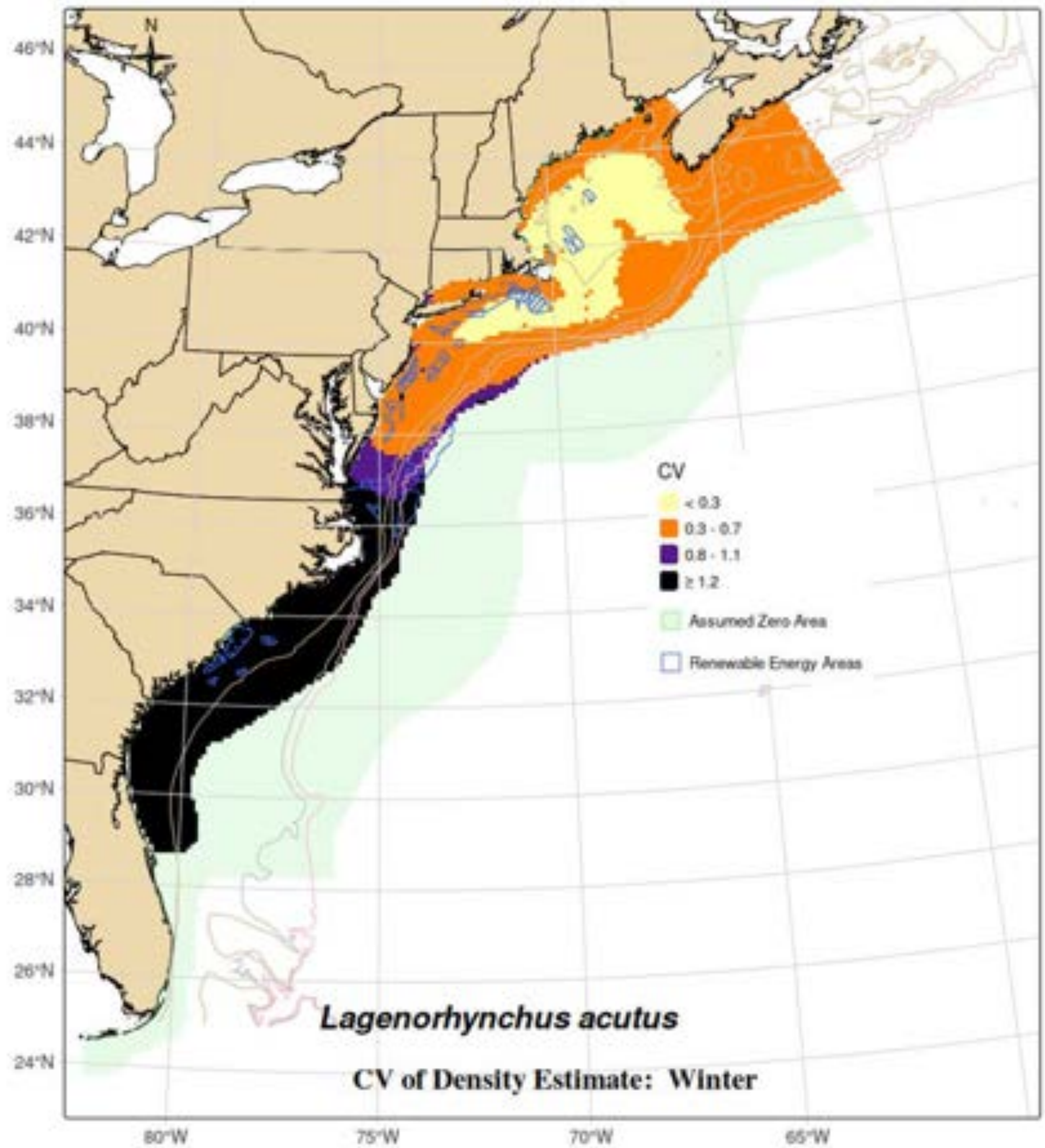

Figure C.5-21. CV of winter Atlantic white-sided dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

C.5.7 Offshore Energy Development Areas

Table C.5-6. Atlantic white-sided dolphin abundance estimates for wind-energy study areas

Season	Wind-Energy Study Area	Abundance*	CV	95% Confidence Interval*
Spring (Mar-May)	RI/MA	39.5	0.31	21.7 - 71.8
	NY	4.7	0.35	2.4 - 9.1
	NJ	1.0	0.44	0.4 - 2.2
	DE/MD	0.1	0.57	0 - 0.3
	VA	0.0	1.10	0 - 0
	NC	0.0	1.55	0 - 0
	NC/SC	0.0	6.04	0 - 0
	GA	0.0	9.20	0 - 0
Summer (Jun-Aug)	RI/MA	26.0	0.30	14.5 - 46.5
	NY	2.7	0.38	1.3 - 5.4
	NJ	0.5	0.50	0.2 - 1.2
	DE/MD	0.1	0.61	0 - 0.2
	VA	0.0	1.17	0 - 0
	NC	0.0	1.90	0 - 0.1
	NC/SC	0.0	5.40	0 - 0
	GA	0.0	9.59	0 - 0
Fall (Sep-Nov)	RI/MA	37.6	0.29	21.6 - 65.6
	NY	4.5	0.34	2.3 - 8.7
	NJ	0.8	0.44	0.4 - 1.9
	DE/MD	0.1	0.57	0 - 0.3
	VA	0.0	1.10	0 - 0
	NC	0.0	1.42	0 - 0
	NC/SC	0.0	5.67	0 - 0
	GA	0.0	9.53	0 - 0
Winter (Dec-Feb)	RI/MA	52.6	0.30	29.6 - 93.3
	NY	6.5	0.35	3.3 - 12.8
	NJ	1.4	0.50	0.5 - 3.5
	DE/MD	0.1	0.57	0.1 - 0.4
	VA	0.0	1.13	0 - 0
	NC	0.0	1.42	0 - 0
	NC/SC	0.0	5.67	0 - 0
	GA	0.0	9.55	0 - 0

***** We rounded the mean abundance and 95% confidence interval to the nearest tenth of an animal. If this resulted in a zero for the mean abundance, we calculated the CV using the actual abundance value as estimated by the density-habitat model and then rounded to the nearest tenth. If a wind-energy study area is not included, then we assumed the abundance was zero.

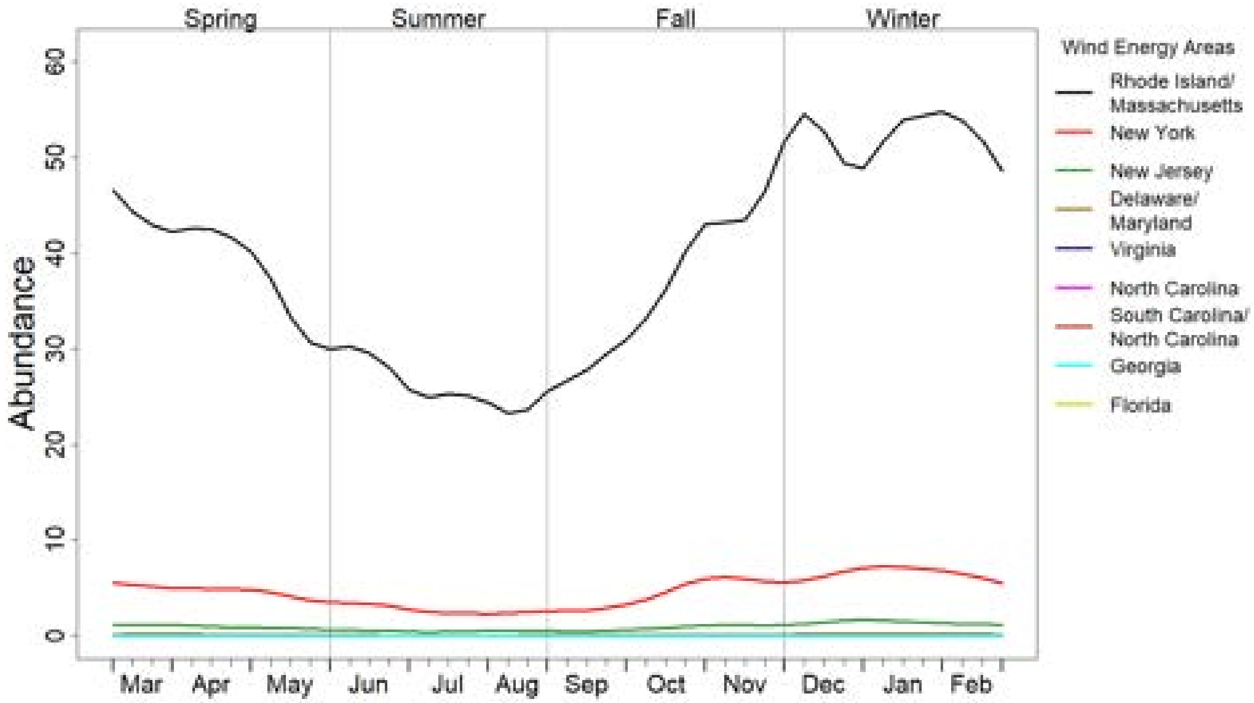

Figure C.5-22. Average seasonal abundance of white-sided dolphins in wind-energy study areas

C.6 Common dolphin (*Delphinus delphis*)

Figure C.6-1. Common dolphin
Image collected under MMPA Research permit #775-1875. Credit: NOAA/NEFSC/Allison Henry.

C.6.1 Data Collection

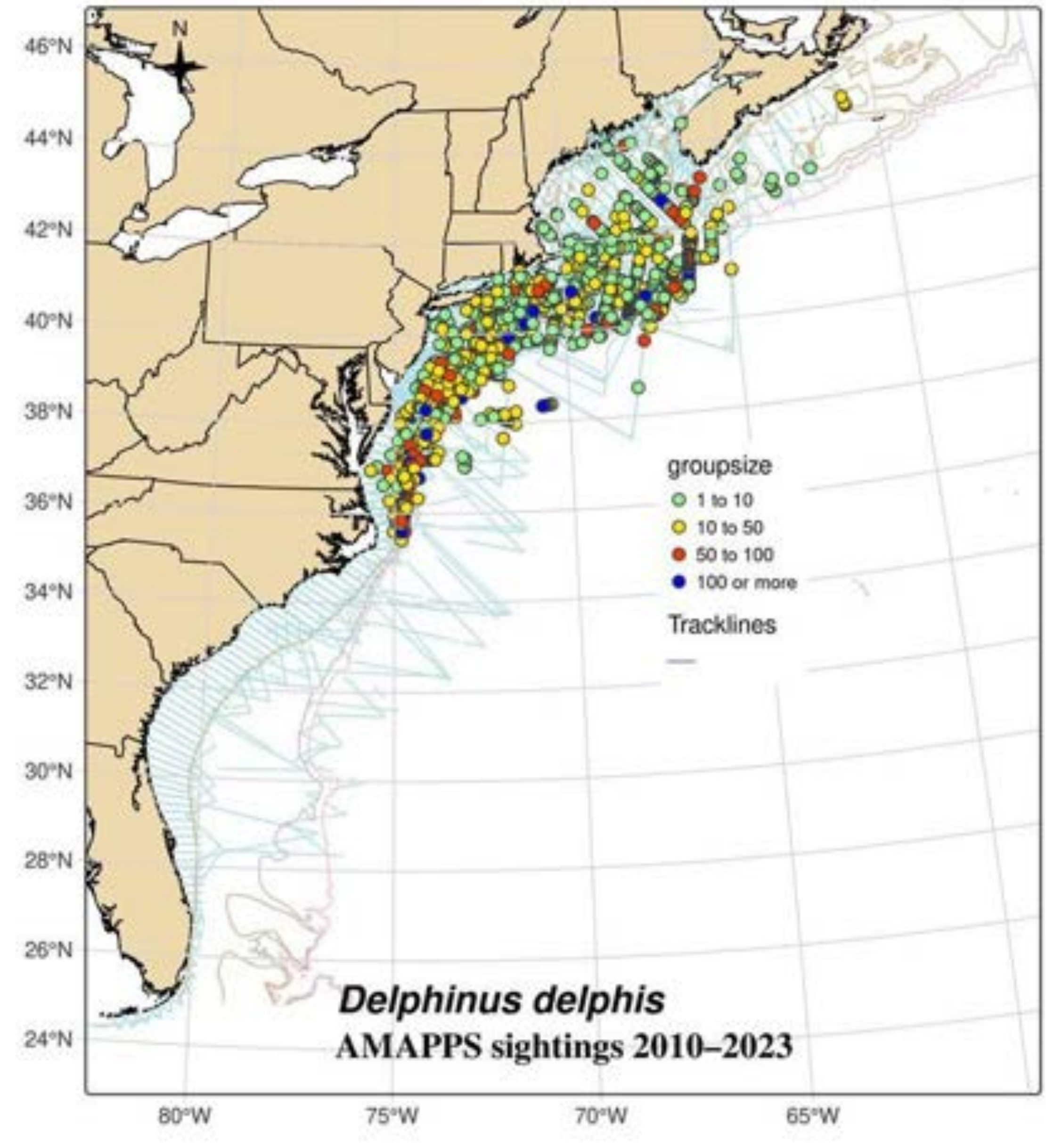

Figure C.6-2. Distribution of track lines and common dolphin sightings 2010 to 2023
Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

Table C.6-1. AMAPPS research effort 2010 to 2023 and common dolphin sightings

Survey Region and Platform	Season	Effort (km)	Number of Groups	Number of Animals
NE Shipboard	Spring	8,883	63	1,648
NE Shipboard	Summer	49,064	516	2,2102
NE Aerial	Spring	38,839	235	1,496
NE Aerial	Summer	52,003	335	10,984
NE Aerial	Fall	87,311	555	9,825
NE Aerial	Winter	24,747	98	3,148
SE Shipboard	Spring	2,604	49	2,111
SE Shipboard	Summer	18,331	9	836
SE Shipboard	Fall	2,673	0	0
SE Shipboard	Winter	302	0	0
SE Aerial	Spring	48,634	161	7,637
SE Aerial	Summer	43,285	11	784
SE Aerial	Fall	21,153	15	677
SE Aerial	Winter	19,152	28	1,266

C.6.2 Mark-Recapture Distance Sampling Analysis

Table C.6-2. Intermediate parameters in common dolphin mark-recapture distance sampling (MRDS) models

Analysis Set	MR Model	MR Truncation (m)	DS Model	DS Truncation (m)	Key function	p(0)	p(0) CV	Chi-square p-value	CvM p-value
SE–aerial group 3	distance + observer + log(group size) + sea state	380	distance + glare	380	HN with Cosine Adjustment Order 2	0.85	0.04	0.21	0.89
NE–aerial group 9	distance + observer + log(group size) + sea state + glare	480	distance + sea state + glare + log(group size)	550	HN with Cosine Adjustment Order 3	0.58	0.04	0.14	0.79
NE–shipboard group 5	distance * observer + log(group size) + sea state + glare + swell height	5000	distance + sea state + swell height + log(group size)	5000	HR with Simple Polynomial Adjustment Order 4	0.39	0.14	0.05	0.55
SE–shipboard group 1	distance + log(group size)	4000	distance + sea state + glare + time of day	4000	HR	0.59	0.10	0.35	0.52

MR=Mark-Recapture, DS=Distance Sampling, HR=Hazard Rate, HN= Half Normal, CV=Coefficient of variation. Values of p>0.5 for Chi-square and Cramer-von Mises test (CvM) indicate good fit. The definition of p(0) is the probability of detecting a group on the track line. Species included in the analysis sets are explained in main text Tables 4-20 and 4-21.

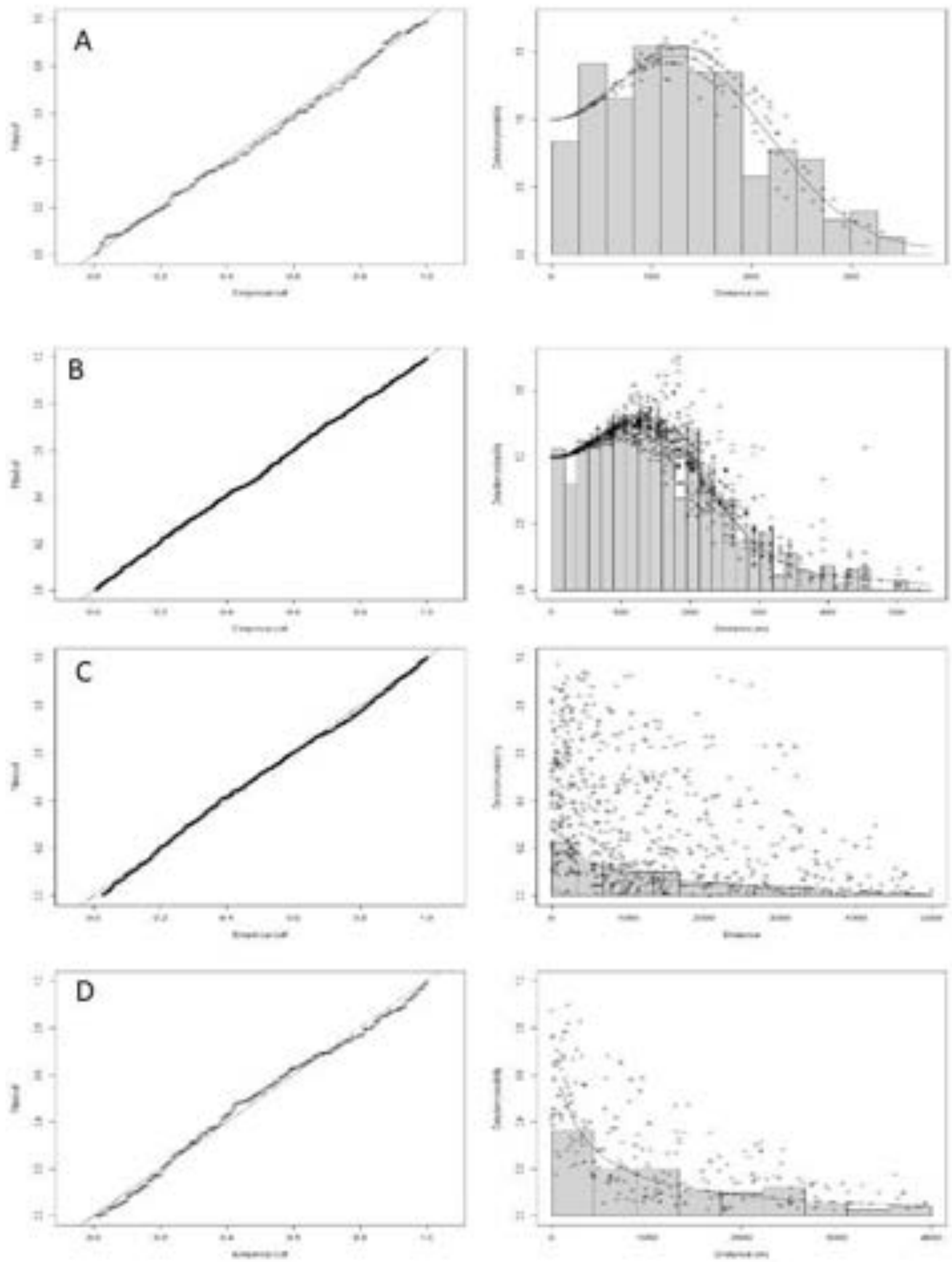

Figure C.6-3. Q-Q plots and detection functions from the common dolphins MRDS analyses
A) SE-aerial analysis set 3; B) NE-aerial analysis set 9; C) NE-shipboard analysis set 5; D) SE-shipboard analysis set 1.

C.6.3 Generalized Additive Model Analysis

Table C.6-3. 2010 to 2023 density-habitat model output for common dolphins

Covariates	Edf	Ref.df	F	C. dev	p-value
s(sstmur)	4.65	5	32.4	14.02	<0.0001
s(btemp)	4.11	5	26.7	8.24	<0.0001
s(pp)	0.76	5	0.6	0.38	0.0455
s(dist2GSSw)	4.74	5	22.3	8.25	<0.0001
s(dist2shore)	4.04	5	5.3	1.87	<0.0001
s(dist125)	0.99	5	4.3	1.86	<0.0001
s(dist1000)	4.72	5	12.8	4.07	<0.0001
s(latdd)	3.89	5	16.2	7.19	<0.0001

Adjusted R^2 = 0.0164. Deviance explained = 45.9%.
Includes the estimated degrees of freedom (Edf), reference degrees of freedom (Ref.df), contribution to the deviance (C.dev) explained for each habitat covariate and its associated p-value. Covariate abbreviations explained in main text in Table 4-2.

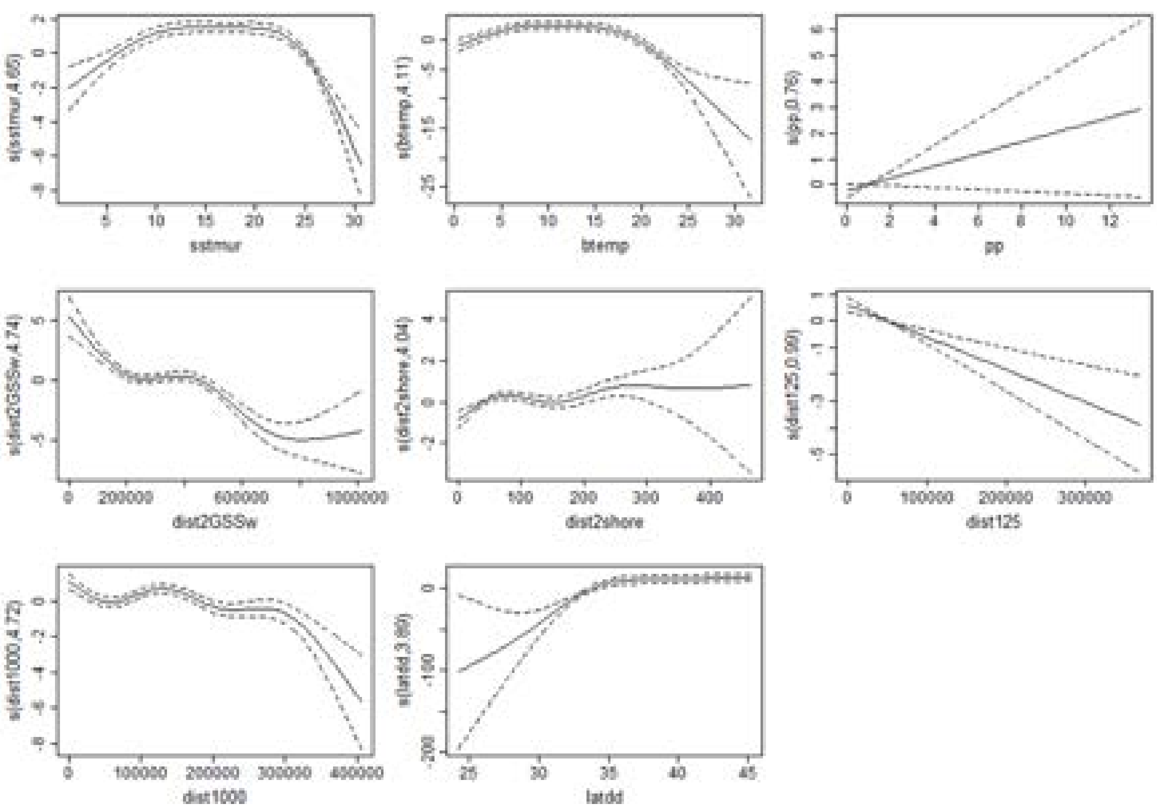

Figure C.6-4. Common dolphin density related to significant habitat covariates
Plots represent the partial smooths and interaction terms of the density-habitat model. Covariate abbreviations explained in main text in Table 4-2.

C.6.4 Model Cross-Validation

Table C.6-4. Diagnostic statistics from the common dolphin density-habitat model

Diagnostic Statistic	Description	Calculated with	Model Values (x)	Score
RHO	Spearman rank correlation	Non-zero density	0.234	Fair to good
MAPE	Mean absolute percentage error	Non-zero density	110.316	Fair to good
RHO	Spearman rank correlation	All data divided in 25 random samples	0.176	Fair to good
MAE	Mean absolute error	All data divided in 25 random samples	0.244	Excellent
MAPE	Mean absolute percentage error	All data divided in 25 random samples	128.719	Fair to good

RHO: Poor= x<0.05; Fair to good =0.05<=x<0.3; Excellent= x>0.3
MAPE: Poor= x>150%; Fair to good= 150%>=x>50%; Excellent= x<=50%
MAE: Poor= x>1; Fair to good = 1>=x>0.25; Excellent= x<=0.25

C.6.5 Abundance Estimates for AMAPPS Study Area

Table C.6-5. Common dolphin average abundance estimates for the AMAPPS study area

Season	Average Abundance	CV	95% Confidence Interval
Spring (March–May)	82,694	0.32	44,843 – 152,494
Summer (June–August)	123,574	0.28	72,122 – 211,731
Fall (September–November)	142,093	0.28	82,931 – 243,462
Winter (December–February)	87,419	0.30	49,172 – 155,414
Summer 2011 U.S. surveys[1]	70,184	0.28	49,218 − 100,081
Summer 2016 U.S. surveys[1]	81,127	0.27	55,082 − 119,487
Summer 2021 U.S. surveys[1]	93,100	0.56	33,449 – 259,131

[1]Hayes et al. 2024

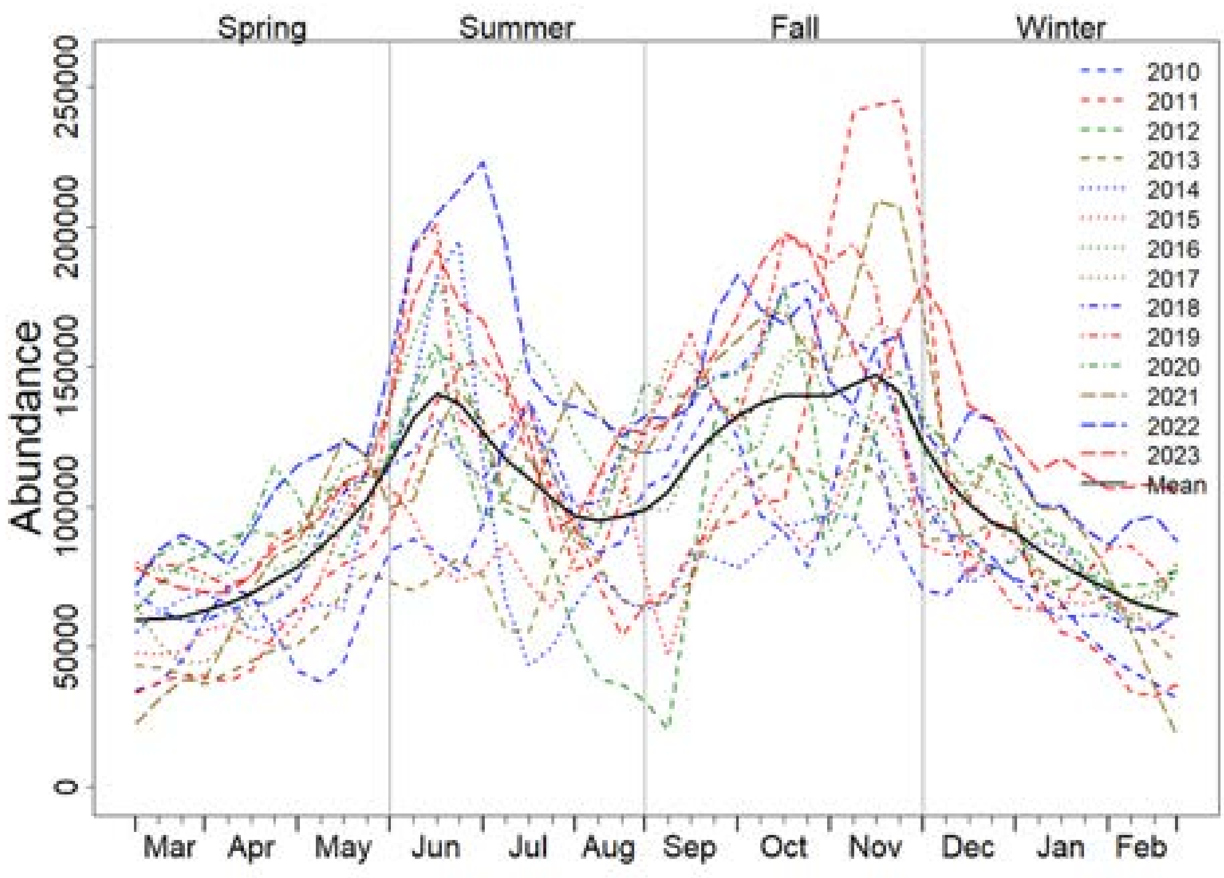

Figure C.6-5. Annual abundance trends for common dolphins in the AMAPPS study area

C.6.6 Seasonal Prediction Maps

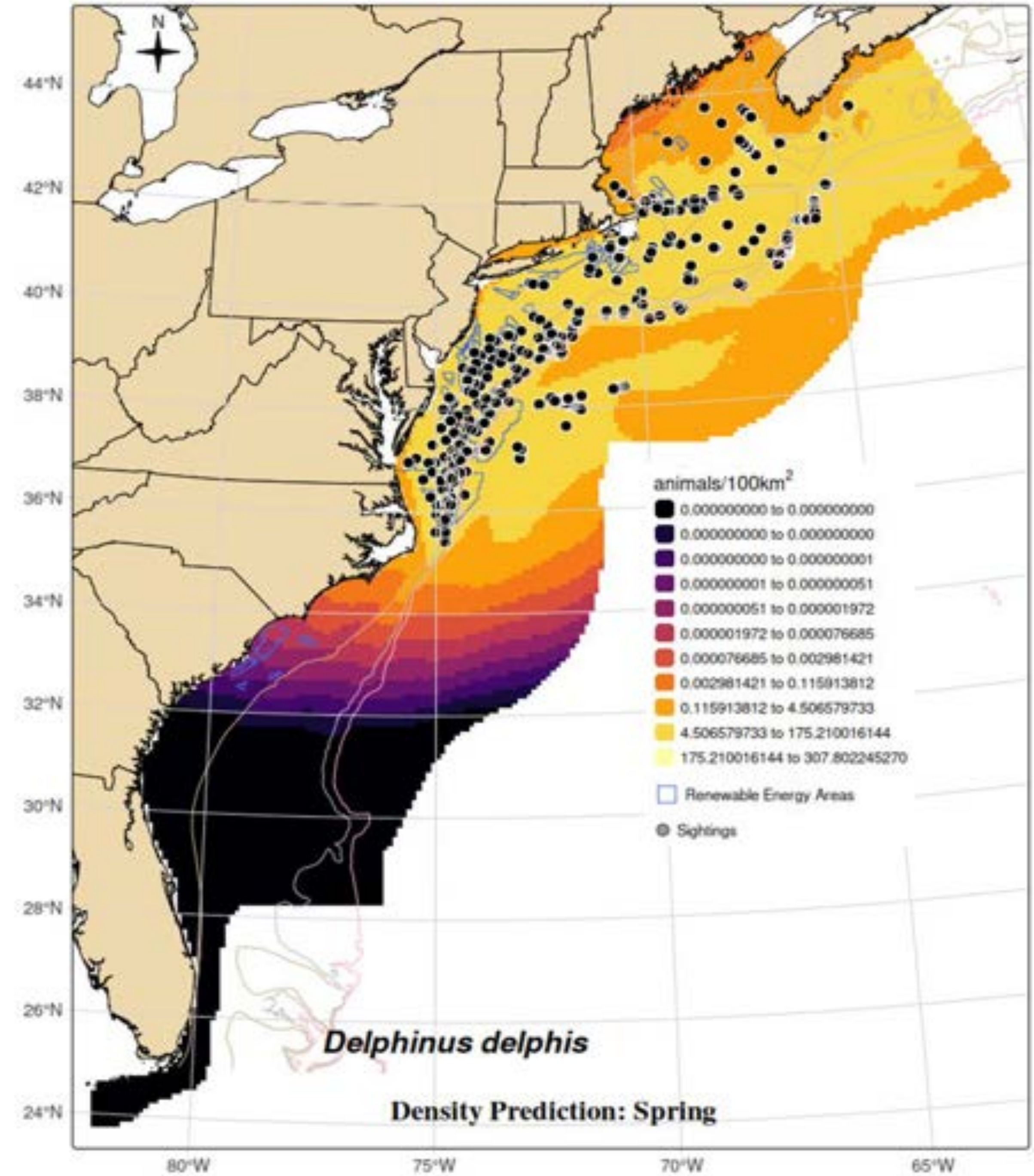

Figure C.6-6. Common dolphin spring average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

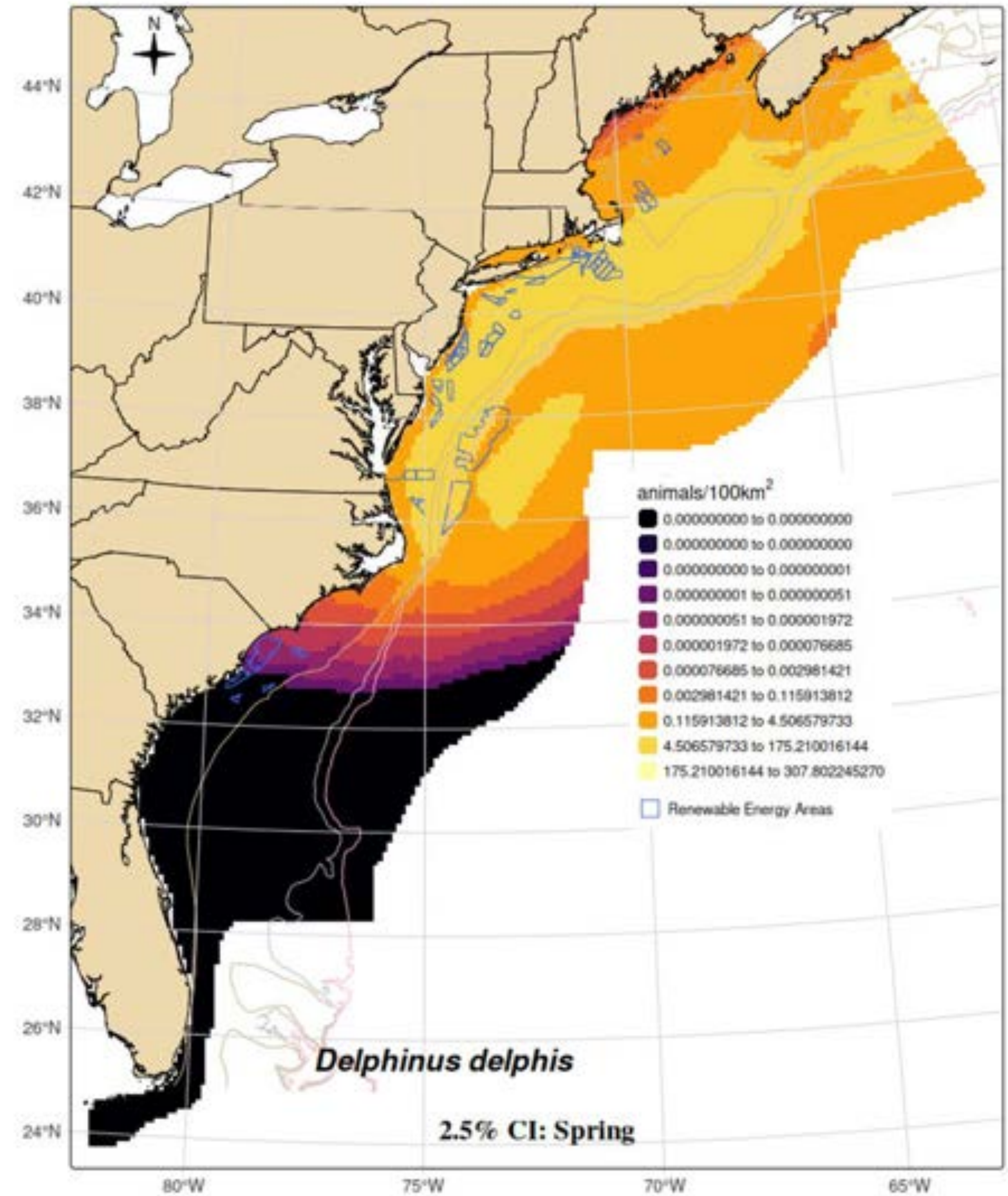

Figure C.6-7. Lower 2.5% confidence interval of the spring common dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

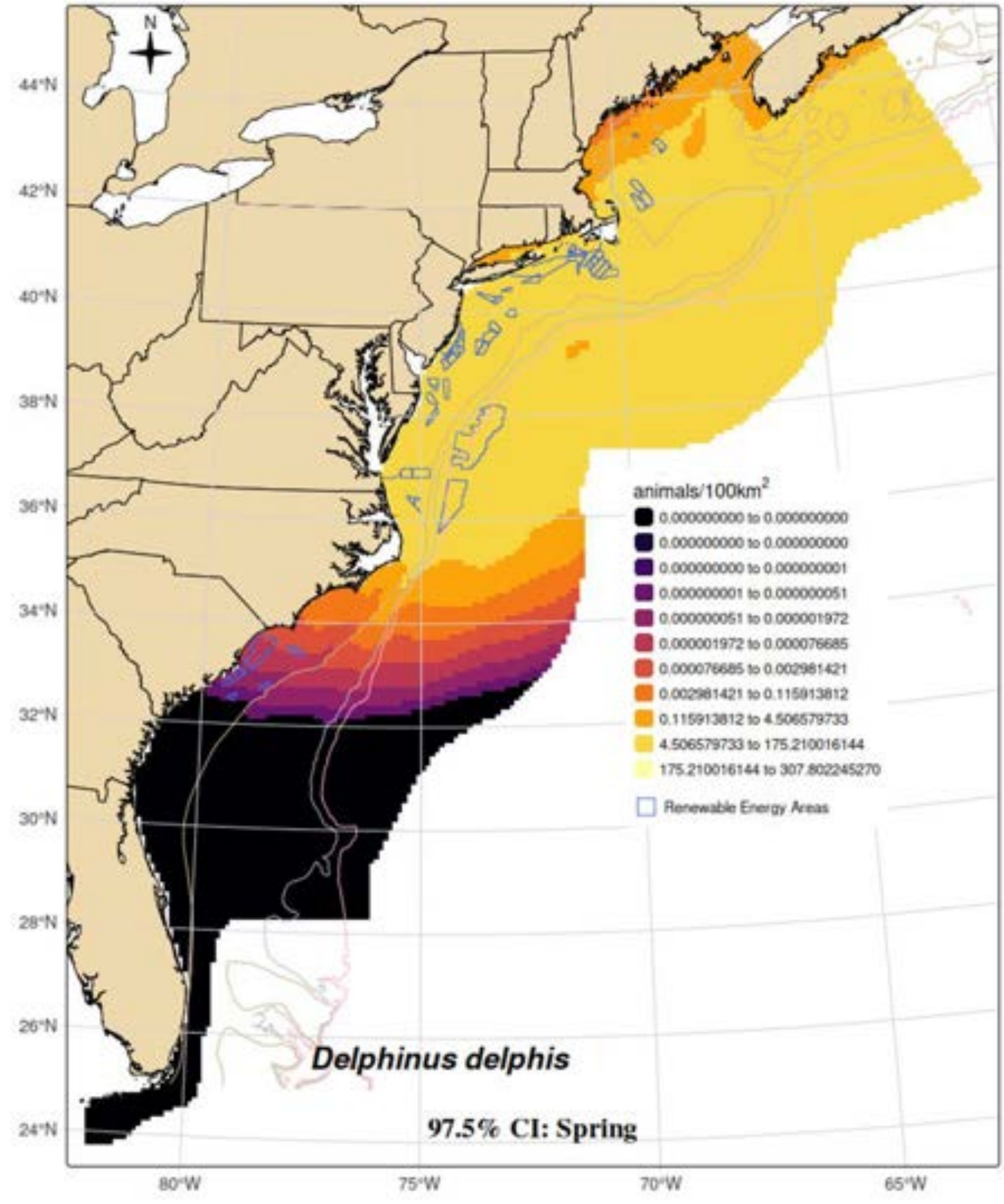

Figure C.6-8. Upper 97.5% confidence interval of the spring common dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

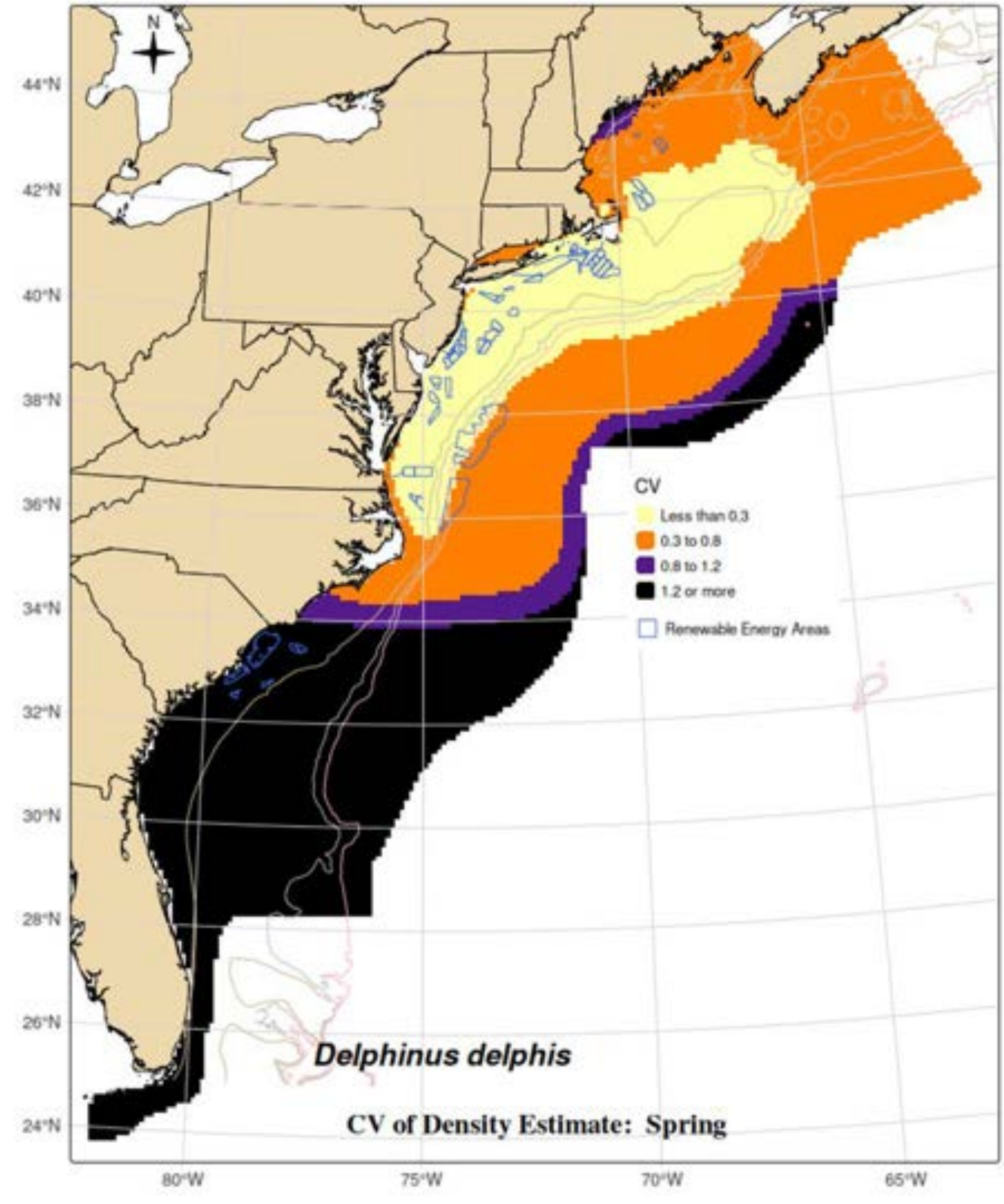

Figure C.6-9. CV of spring common dolphin density estimates

CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

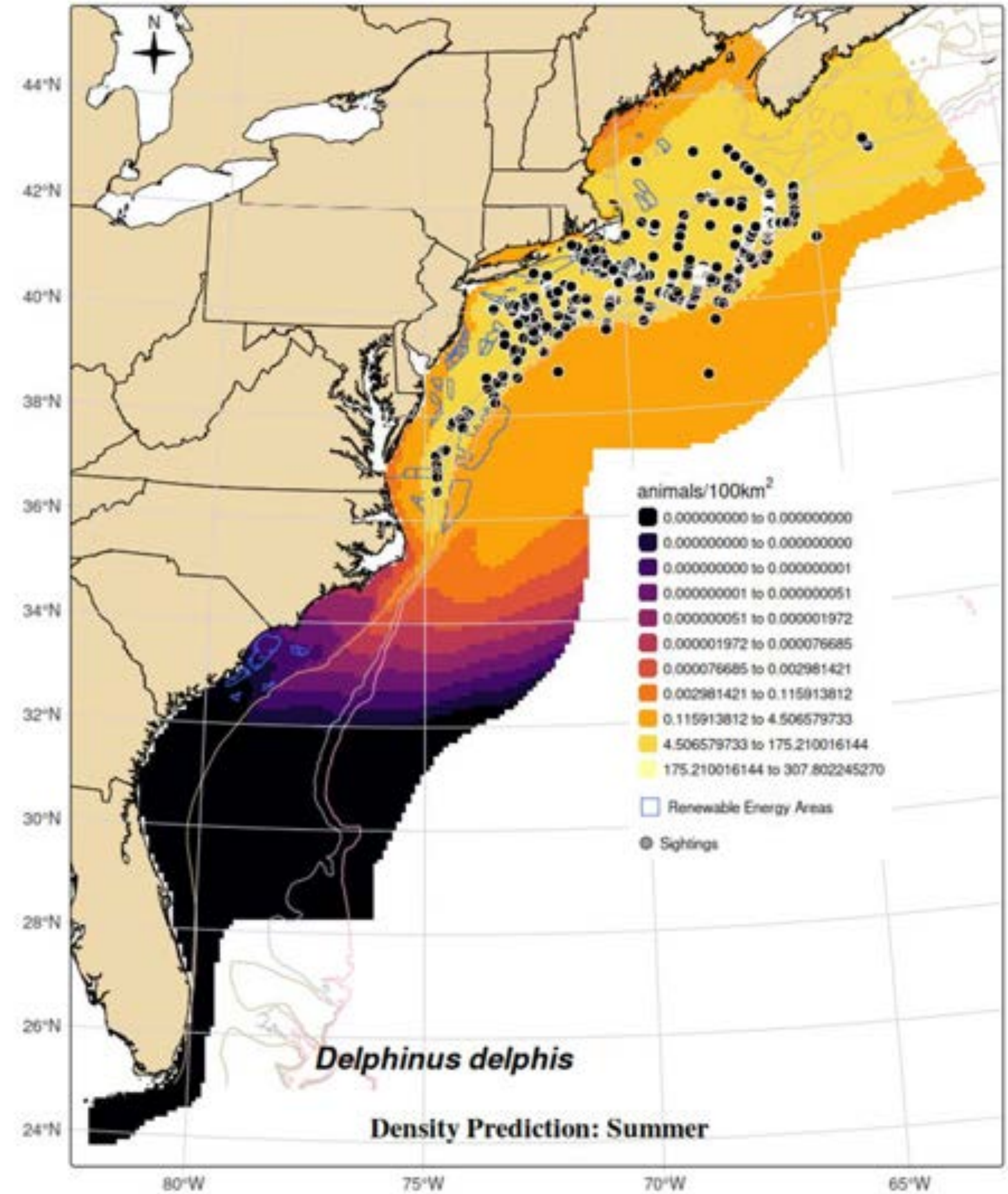

Figure C.6-10. Common dolphin summer average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

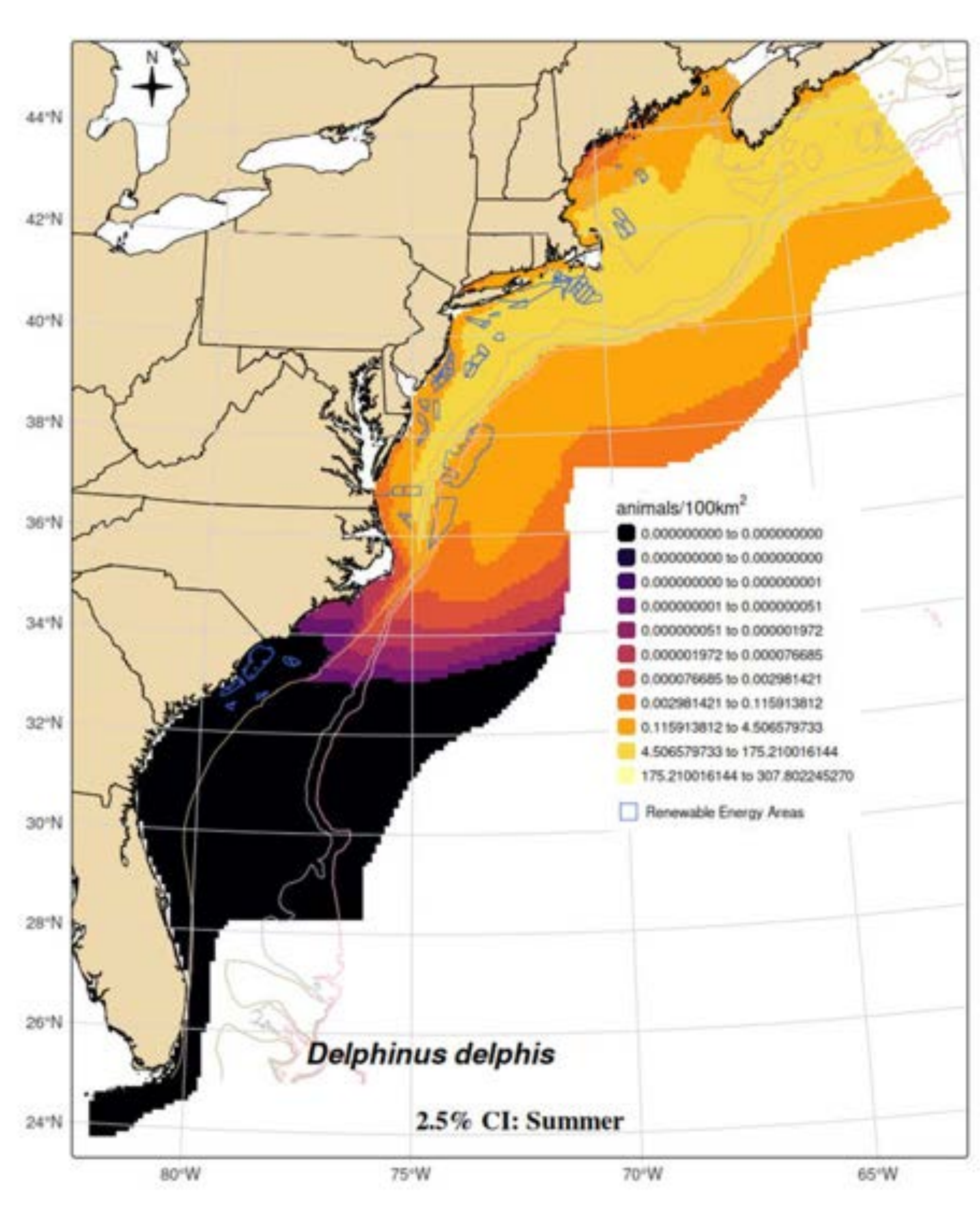

Figure C.6-11. Lower 2.5% confidence interval of the summer common dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

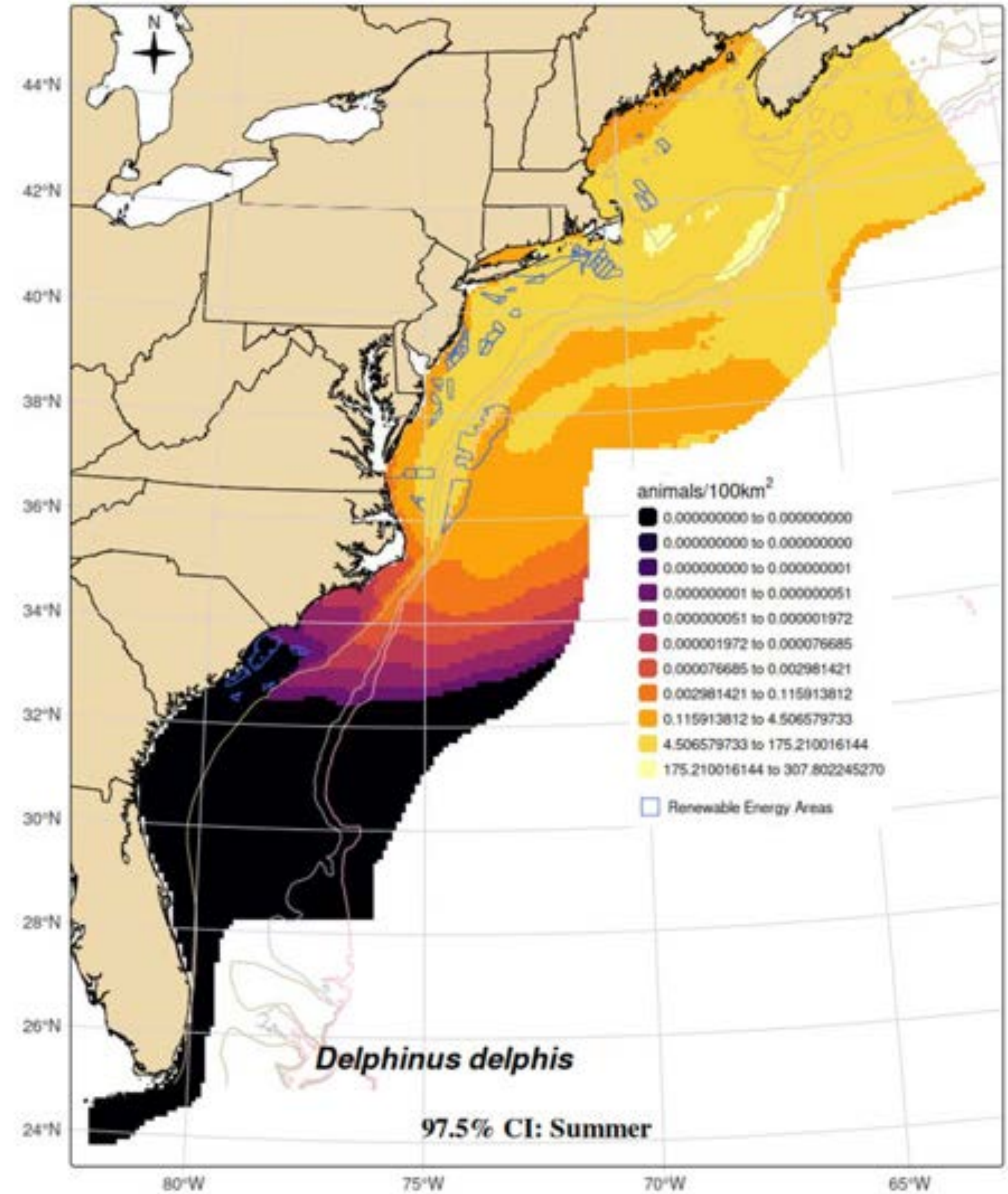

Figure C.6-12. Upper 97.5% confidence interval of the summer common dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

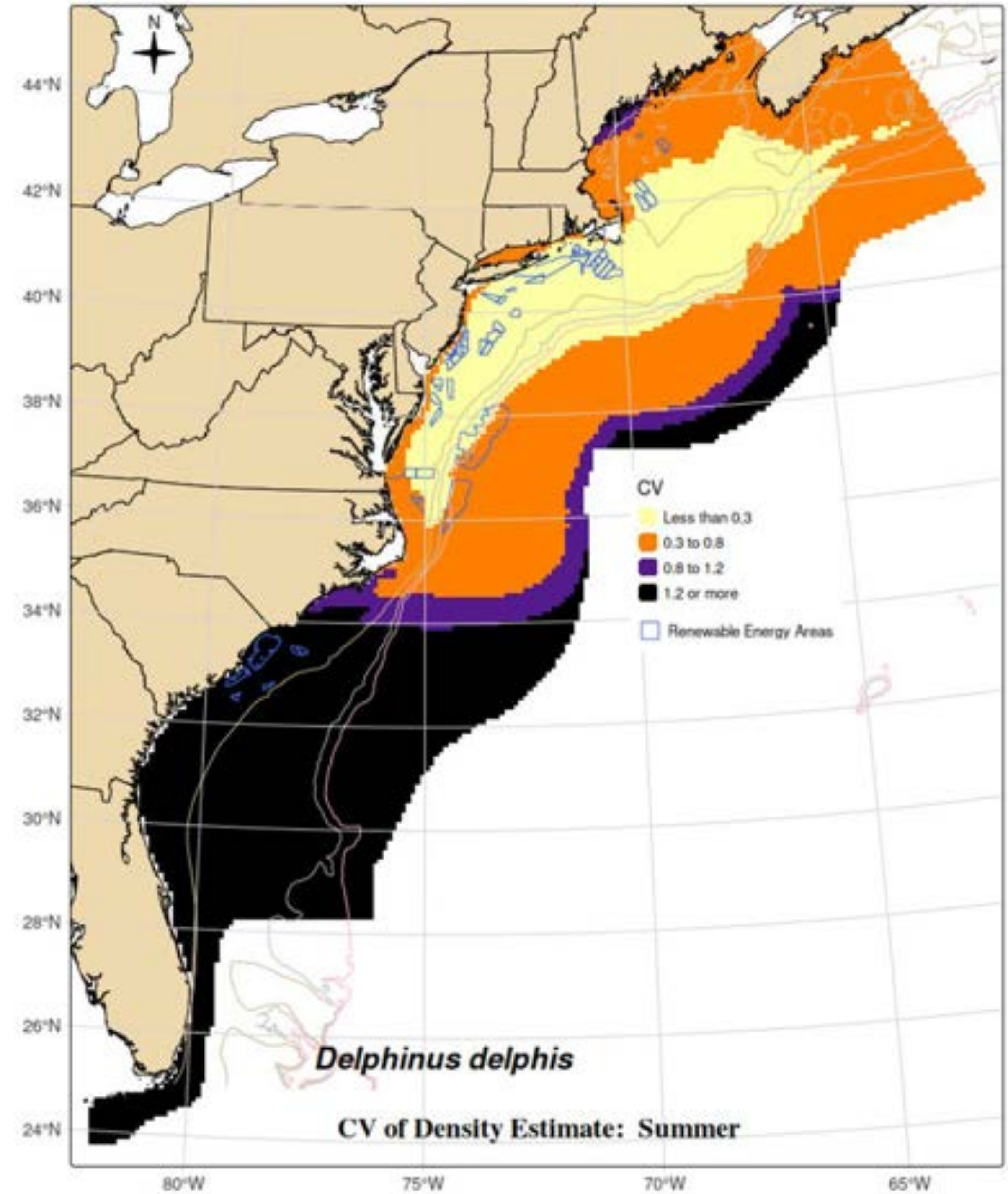

Figure C.6-13. CV of summer common dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

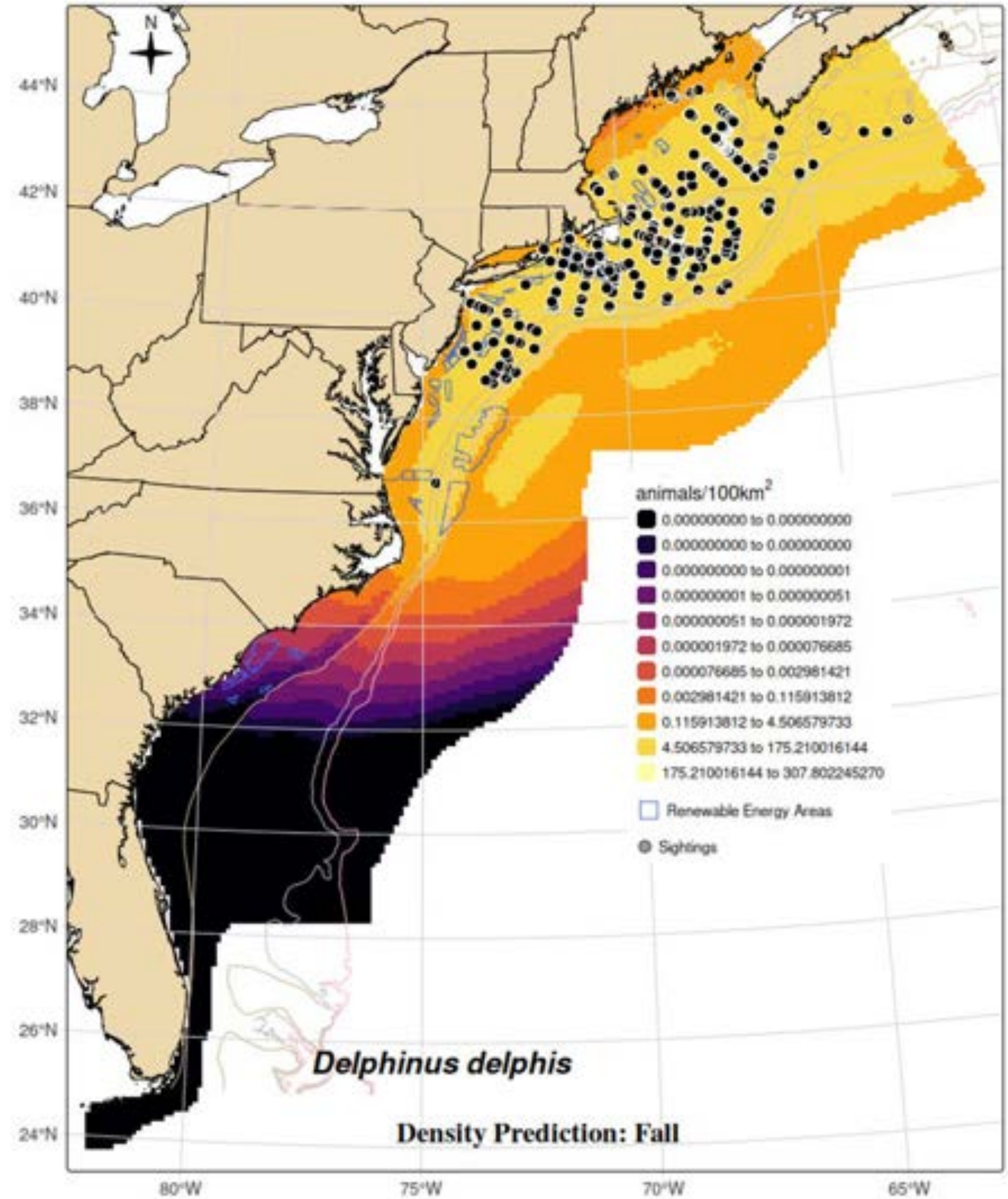

Figure C.6-14. Common dolphin fall average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

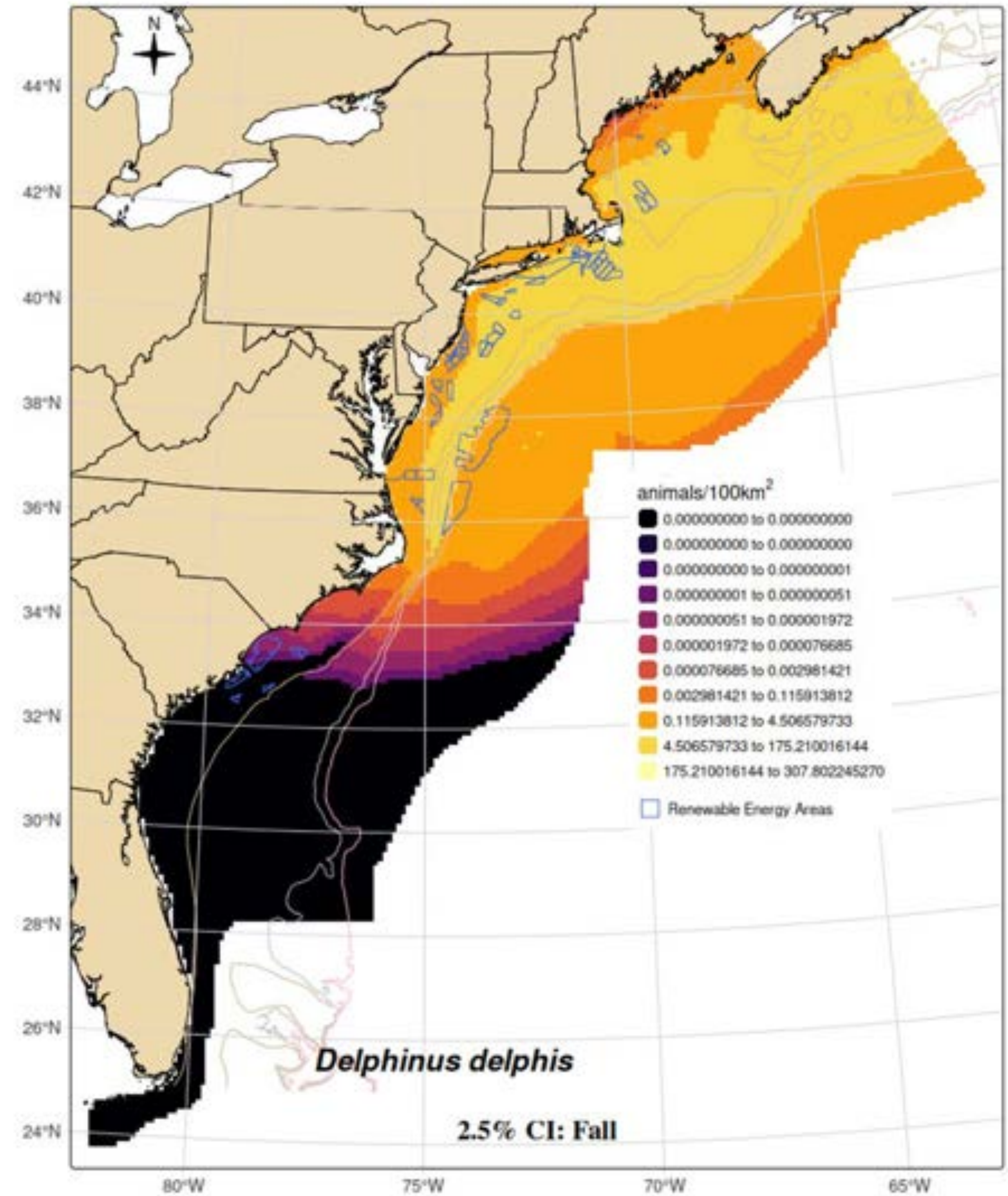

Figure C.6-15. Lower 2.5% confidence interval of the fall common dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

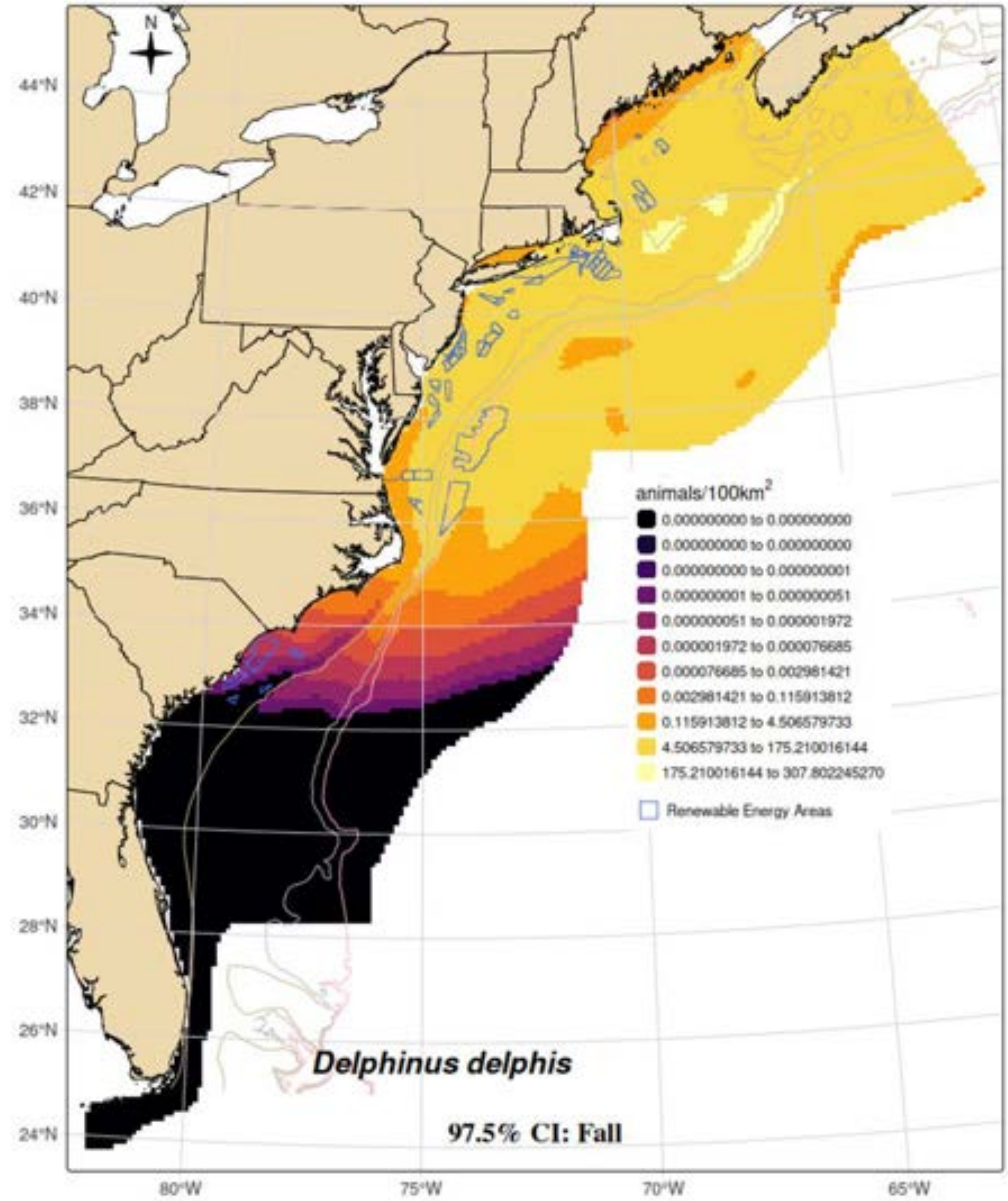

Figure C.6-16. Upper 97.5% confidence interval of the fall common dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

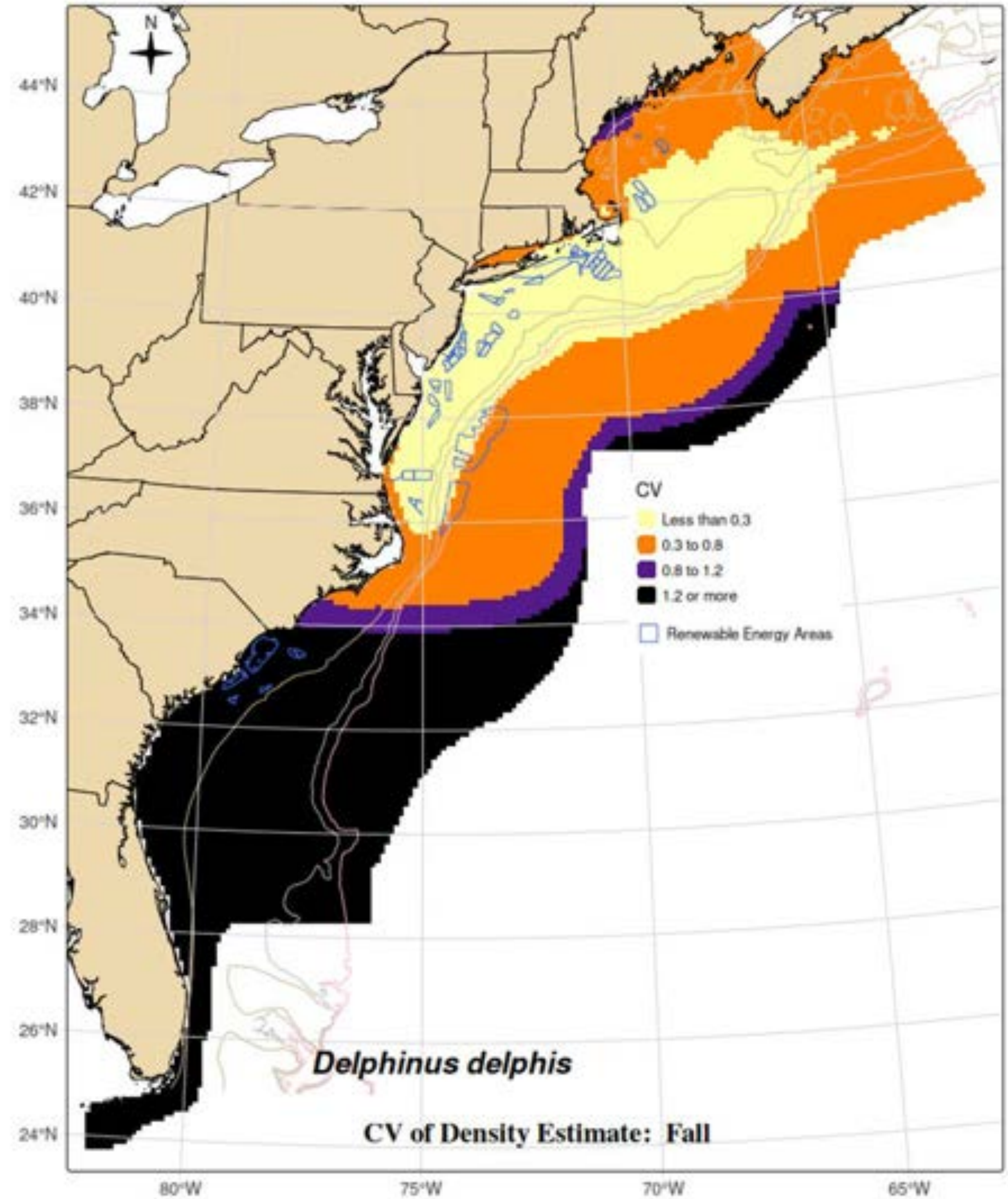

Figure C.6-17. CV of fall common dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

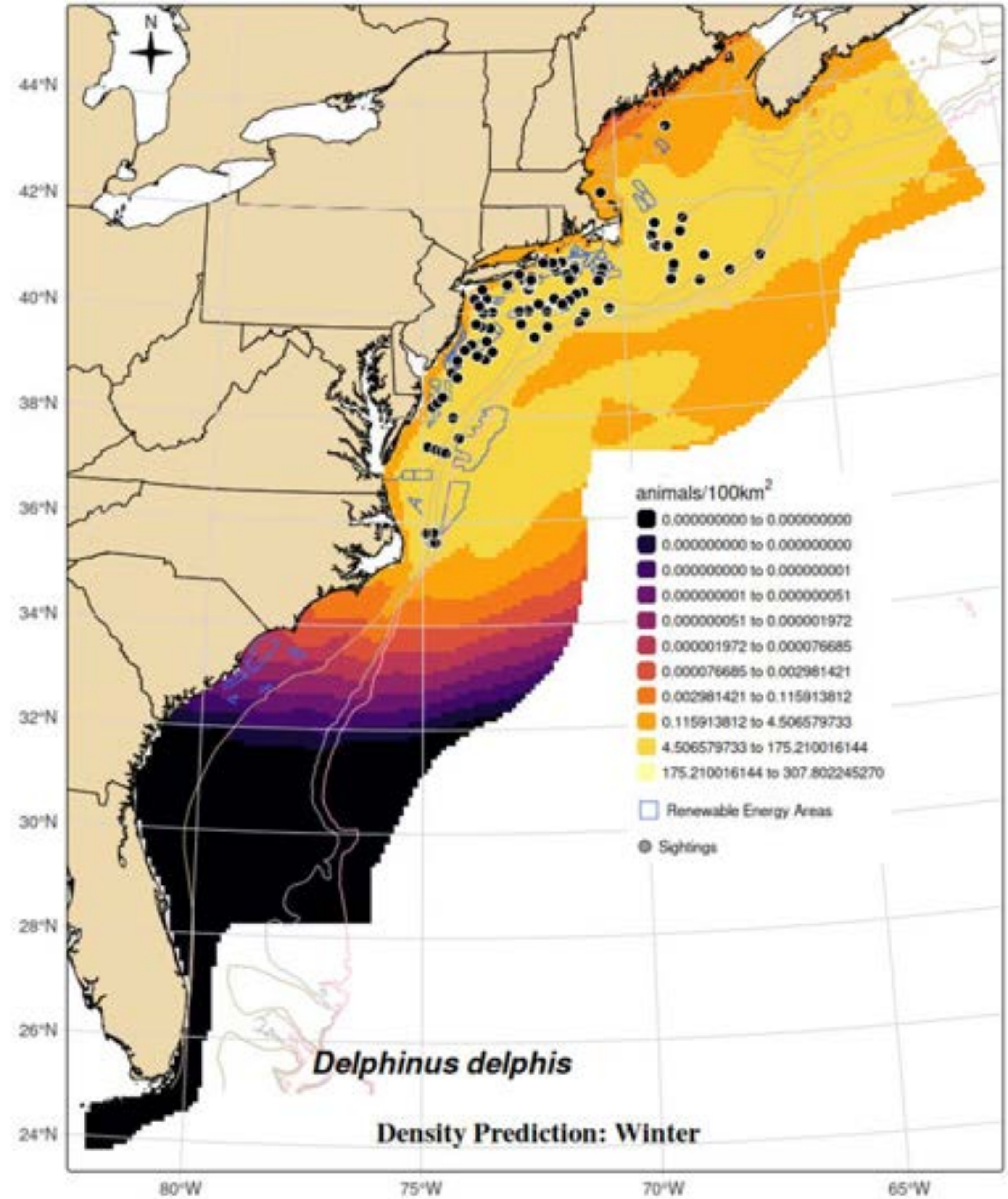

Figure C.6-18. Common dolphin winter average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

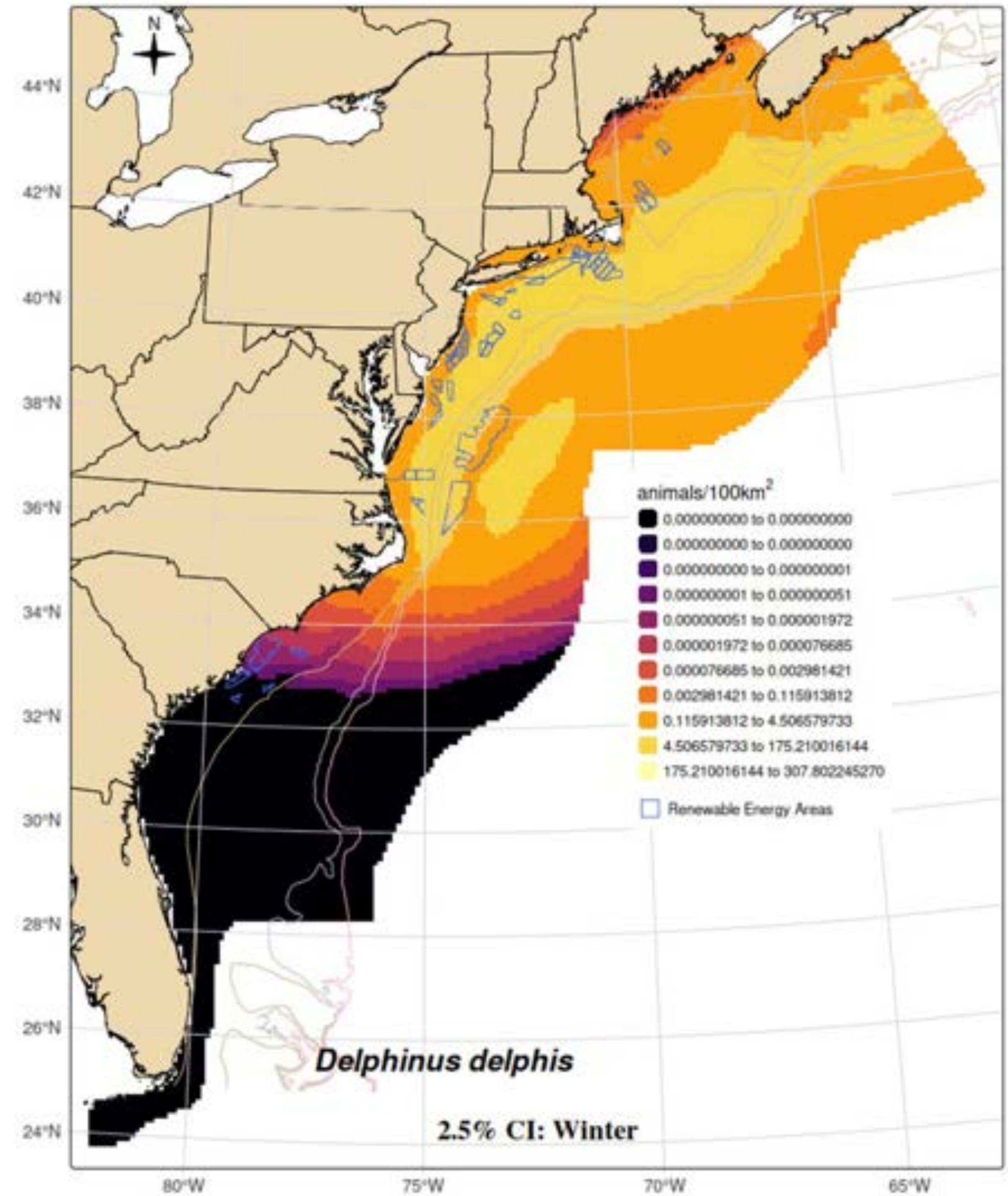

Figure C.6-19. Lower 2.5% confidence interval of the winter common dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

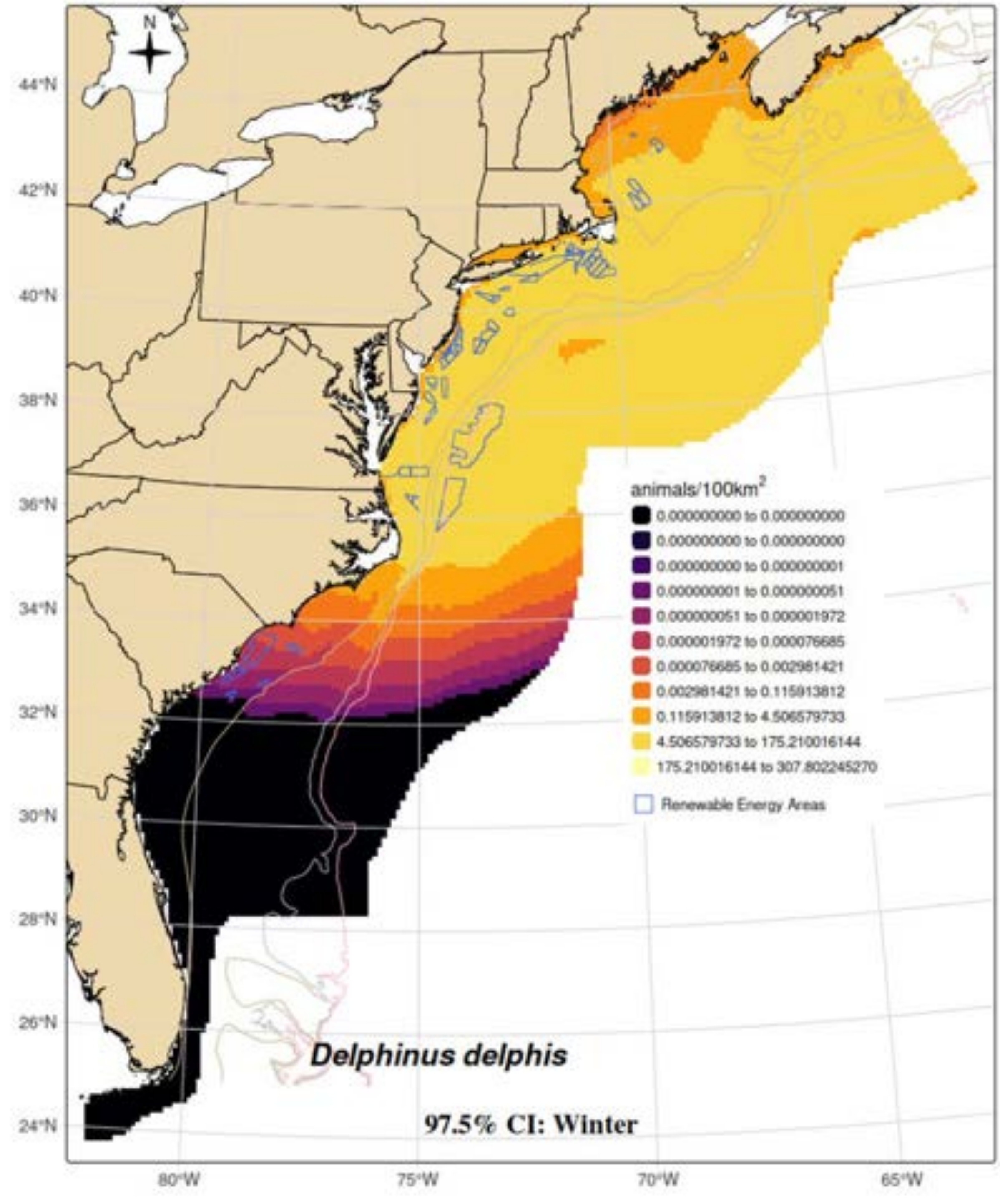

Figure C.6-20. Upper 97.5% confidence interval of the winter common dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

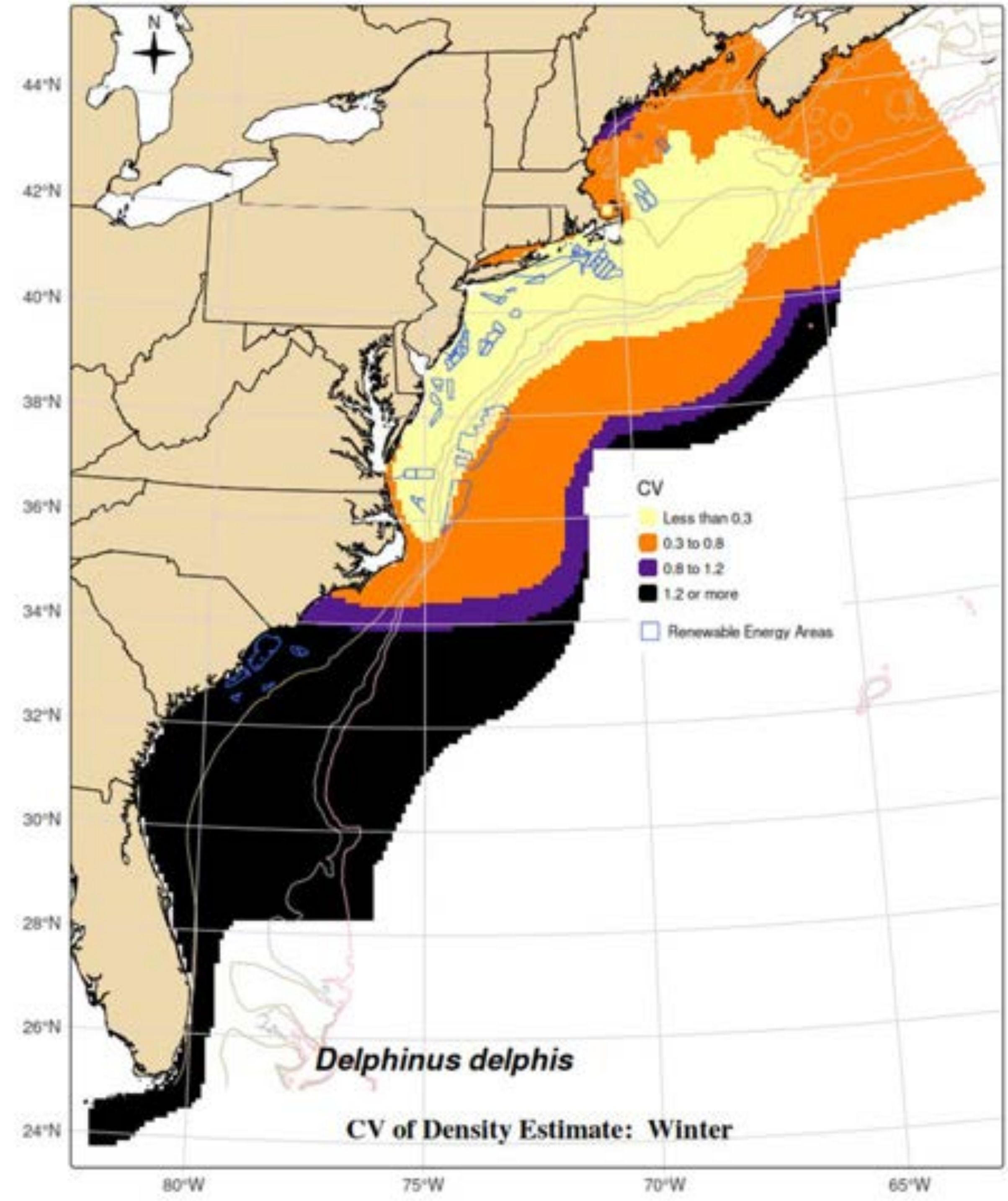

Figure C.6-21. CV of winter common dolphin density estimates

CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

C.6.7 Offshore Energy Development Areas

Table C.6-6. Common dolphin average abundance estimates for wind-energy study areas

Season	Wind-Energy Study Area	Abundance*	CV	95% Confidence Interval*
Spring (Mar-May)	RI/MA	1,585.2	0.21	10,60.5 – 2,369.7
	NY	347.2	0.21	231.9 - 520
	NJ	436.5	0.21	290.5 - 656
	DE/MD	313.6	0.22	205.9 - 477.6
	VA	312.6	0.24	198 - 493.4
	NC	1,008.7	0.23	641.6 – 1,585.9
	NC/SC	0.0	1.55	0 - 0
	GA	0.0	4.53	0 - 0
	FL	0.0	34.88	0 - 0
Summer (Jun-Aug)	RI/MA	3,237.8	0.21	21,55.6 – 48,63.2
	NY	359.3	0.23	231 - 558.7
	NJ	184.6	0.24	116.9 - 291.3
	DE/MD	109.7	0.25	67.9 - 177.1
	VA	57.6	0.28	33.8 - 97.9
	NC	204.1	0.27	120.4 - 345.9
	NC/SC	0.0	1.85	0 - 0
	GA	0.0	5.62	0 - 0
	FL	0.0	34.89	0 - 0
Fall (Sep-Nov)	RI/MA	3,021.9	0.20	2069 – 4,413.4
	NY	335.1	0.21	222.2 - 505.4
	NJ	266.9	0.22	174 - 409.5
	DE/MD	165.6	0.23	106.2 - 258.2
	VA	99.0	0.26	60.3 - 162.5
	NC	441.8	0.26	267.6 - 729.4
	NC/SC	0.0	1.47	0 - 0
	GA	0.0	4.77	0 - 0
	FL	0.0	34.88	0 - 0
Winter (Dec-Feb)	RI/MA	1,594.8	0.18	1,113.3 – 2,284.5
	NY	292.7	0.20	200.1 - 428
	NJ	274.8	0.20	185 - 408.2
	DE/MD	212.0	0.21	141.4 - 317.9
	VA	280.7	0.23	180 - 437.7
	NC	1,011.2	0.23	647.4 – 1,579.5
	NC/SC	0.0	1.55	0 - 0
	GA	0.0	4.47	0 - 0
	FL	0.0	34.88	0 - 0

***** We rounded the mean abundance and 95% confidence interval to the nearest tenth of an animal. If this resulted in a zero for the mean abundance, we calculated the CV using the actual abundance value as estimated by the density-habitat model and then rounded to the nearest tenth. If a wind-energy study area is not included, then we assumed the abundance was zero.

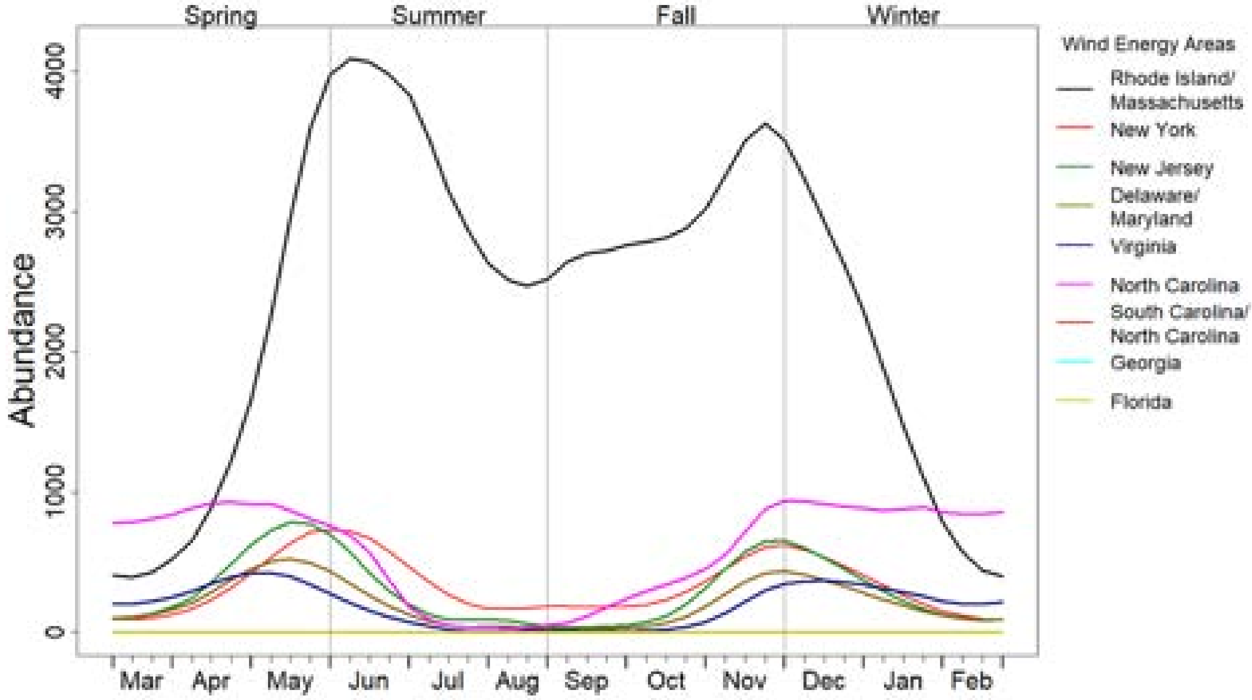

Figure C.6-22. Average seasonal abundance of common dolphins in the wind-energy study areas

C.7 Atlantic Spotted Dolphin (*Stenella frontalis*)

Figure C.7-1. Atlantic Spotted Dolphins
Image collected under MMPA Research permit #775-1875. Credit: NOAA/NEFSC/Allison Henry

C.7.1 Data Collection

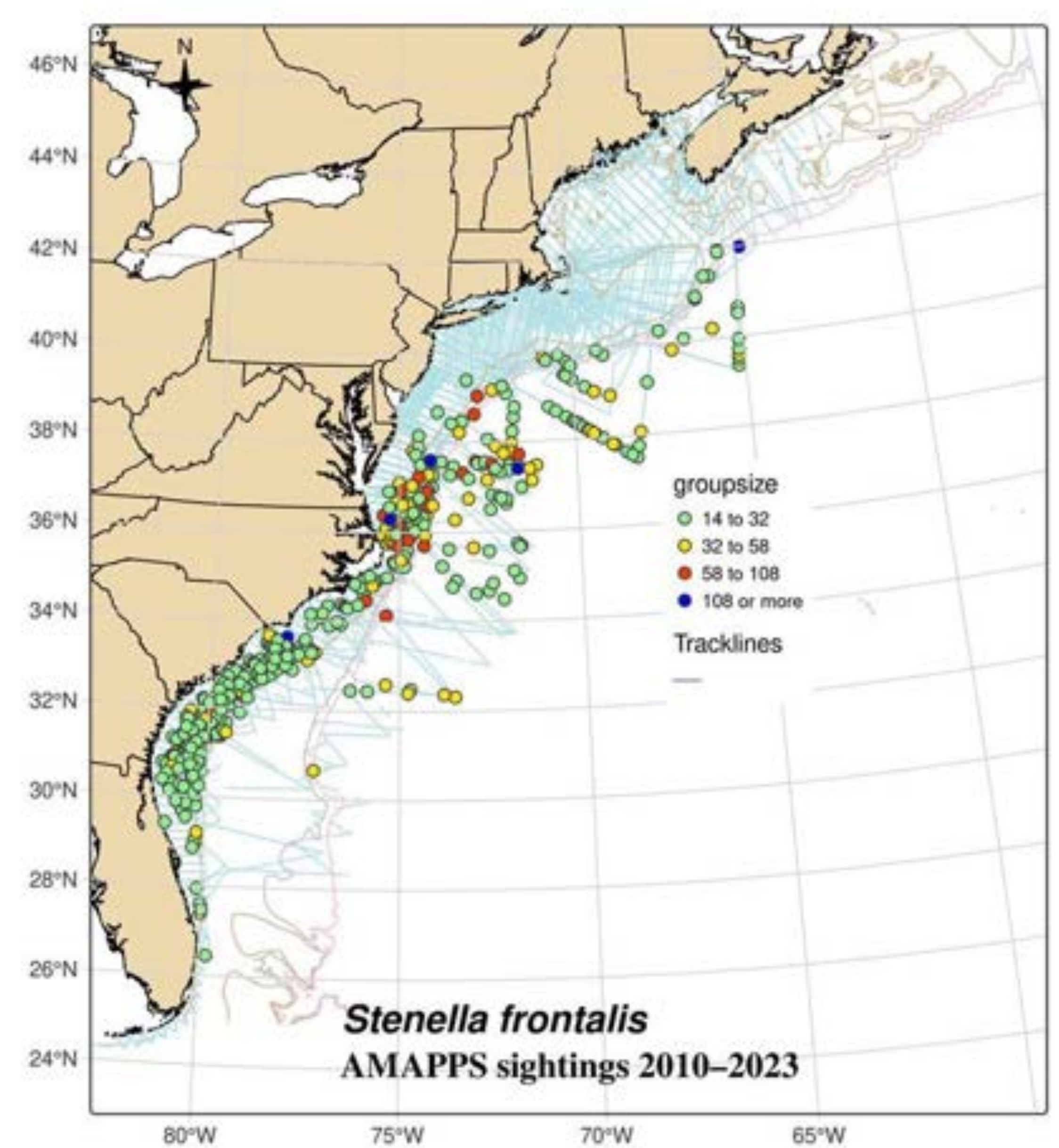

Figure C.7-2. Distribution of track lines and Atlantic spotted dolphin sightings 2010 to 2023
Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

Table C.7-1. AMAPPS research effort 2010 to 2023 and Atlantic spotted dolphin sightings

Survey Region and Platform	Season	Effort (km)	Number of Groups	Number of Animals
NE Shipboard	Spring	8,883	0	0
NE Shipboard	Summer	49,064	86	2,535
NE Aerial	Spring	38,839	0	0
NE Aerial	Summer	52,003	0	0
NE Aerial	Fall	87,311	0	0
NE Aerial	Winter	24,747	0	0
SE Shipboard	Spring	2,604	6	83
SE Shipboard	Summer	18,331	96	3,564
SE Shipboard	Fall	2,673	25	789
SE Shipboard	Winter	302	0	0
SE Aerial	Spring	48,634	73	1252
SE Aerial	Summer	43,285	92	1,614
SE Aerial	Fall	21,153	37	580
SE Aerial	Winter	19,152	25	548

C.7.2 Mark-Recapture Distance Sampling Analysis

Table C.7-2. Intermediate parameters in Atlantic spotted dolphin mark-recapture distance sampling (MRDS) models

Analysis Set	MR Model	MR Truncation (m)	DS Model	DS Truncation (m)	Key function	p(0)	p(0) CV	Chi-square p-value	CvM p-value
SE–aerial group 1	distance + observer + sea state + quality	360	distance + sea state	360	HR	0.79	0.06	0.42	0.98
NE–shipboard group 1	distance	2300	distance + glare + log(group size)	2300	HR	0.91	0.38	0.60	0.99
SE–shipboard group 1	distance + log(group size)	4000	distance + sea state + glare + time of day	4000	HR	0.59	0.10	0.35	0.52

MR=Mark-Recapture, DS=Distance Sampling, HR=Hazard Rate, HN= Half Normal, CV=Coefficient of variation. Values of p>0.5 for Chi-square and Cramer-von Mises test (CvM) indicate good fit. The definition of p(0) is the probability of detecting a group on the track line. Species included in the analysis sets are explained in main text Tables 4-20 and 4-21.

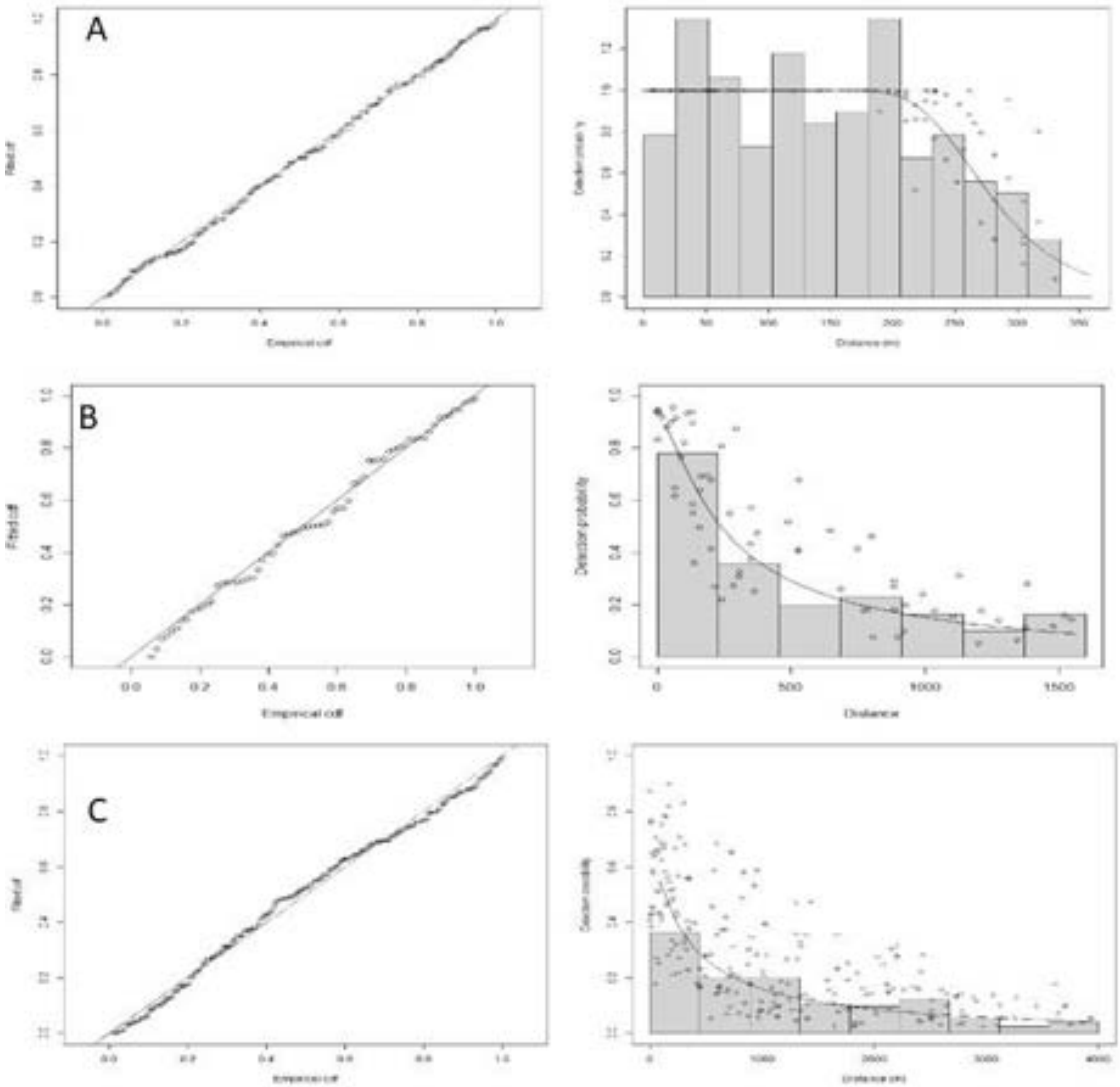

Figure C.7-3. Q-Q plots and detection functions from the Atlantic spotted dolphins MRDS analyses
A) SE-aerial analysis set 1; B) NE-shipboard analysis set 1; C) SE-shipboard analysis set 1.

C.7.3 Generalized Additive Model Analysis

Table C.7-3. 2010 to 2023 density-habitat model output for Atlantic spotted dolphins

Covariates	Edf	Ref.df	F	C.dev	p-value
s(btemp)	4.22	5	9.81	8.22	<0.0001
s(mlp)	0.97	5	5.04	3.74	<0.0001
s(pp)	2.81	5	4.64	5.28	<0.0001
s(dist2GSSw)	3.47	5	6.53	2.75	<0.0001
s(dist2shore)	3.98	5	13.19	10.84	<0.0001
s(latdd)	4.76	5	11.32	6.88	<0.0001

Adjusted R^2 = 0.0173. Deviance explained = 37.7%.
Includes the estimated degrees of freedom (Edf), reference degrees of freedom (Ref.df), contribution to the deviance (C.dev) explained for each habitat covariate and its associated p-value. Covariate abbreviations explained in main text in Table 4-2.

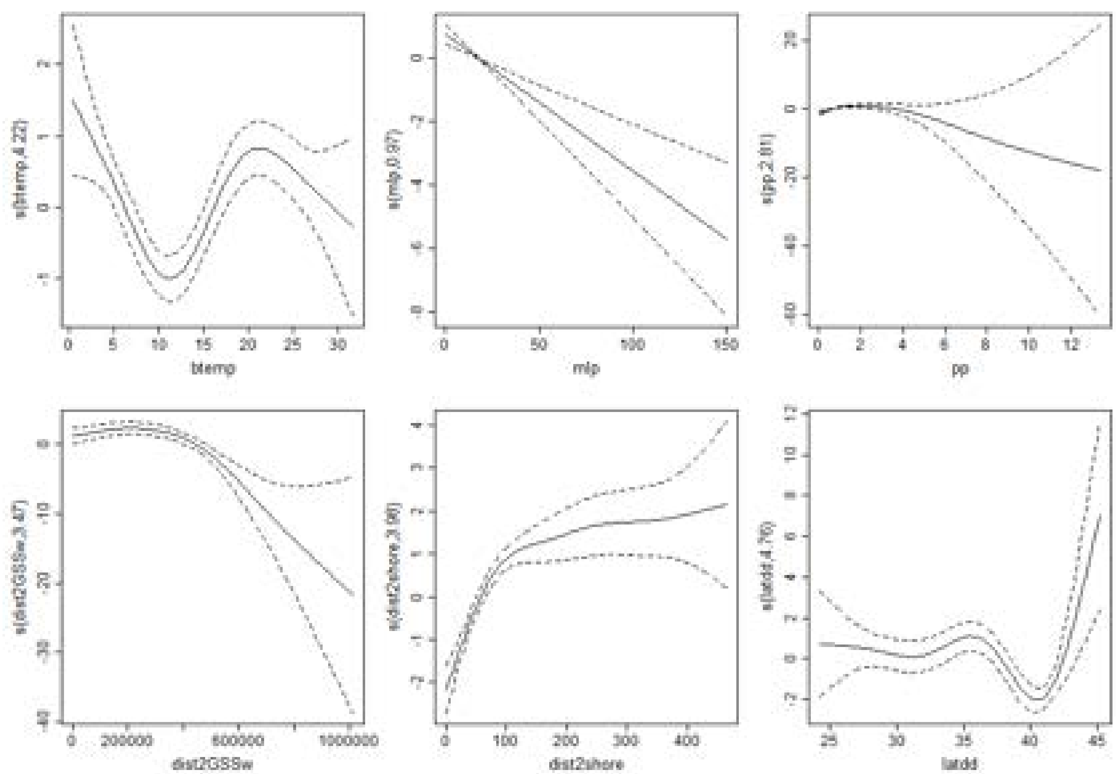

Figure C.7-4. Atlantic spotted dolphin density relative to significant habitat covariates
Plots represent the partial smooths and interaction terms of the density-habitat model, where the shaded regions represent the 95% credible intervals. Covariate abbreviations explained in main text in Table 4-2.

C.7.4 Model Cross-Validation

Table C.7-4. Diagnostic statistics from the Atlantic spotted dolphin density-habitat model

Diagnostic Statistic	Description	Calculated with	Model Values (x)	Score
RHO	Spearman rank correlation	Non-zero density	0.447	Excellent
MAPE	Mean absolute percentage error	Non-zero density	91.358	Fair to good
RHO	Spearman rank correlation	All data divided in 25 random samples	0.113	Fair to good
MAE	Mean absolute error	All data divided in 25 random samples	0.014	Excellent

RHO: Poor= x<0.05; Fair to good =0.05<=x<0.3; Excellent= x>0.3
MAPE: Poor= x>150%; Fair to good= 150%>=x>50%; Excellent= x<=50%
MAE: Poor= x>1; Fair to good = 1>=x>0.25; Excellent= x<=0.25

C.7.5 Abundance Estimates for AMAPPS Study Area

Table C.7-5. Atlantic spotted dolphin average abundance estimates for the AMAPPS study area

Season	Average Abundance	CV	95% Confidence Interval
Spring (March–May)	11,166	0.38	5,436 – 22,936
Summer (June–August)	20,922	0.35	10,746 – 40,735
Fall (September–November)	8,915	0.36	4,497 – 17,671
Winter (December–February)	2,544	0.45	1,096 – 5,903
Summer 2011 U.S. surveys[1]	44,715	0.43	26,266 – 76,122
Summer 2016 U.S. surveys[1]	39,921	0.27	28,462 – 55,993
Summer 2021 U.S. surveys[1]	31,506	0.28	18,388 – 53,982

[1]Hayes et al. 2024

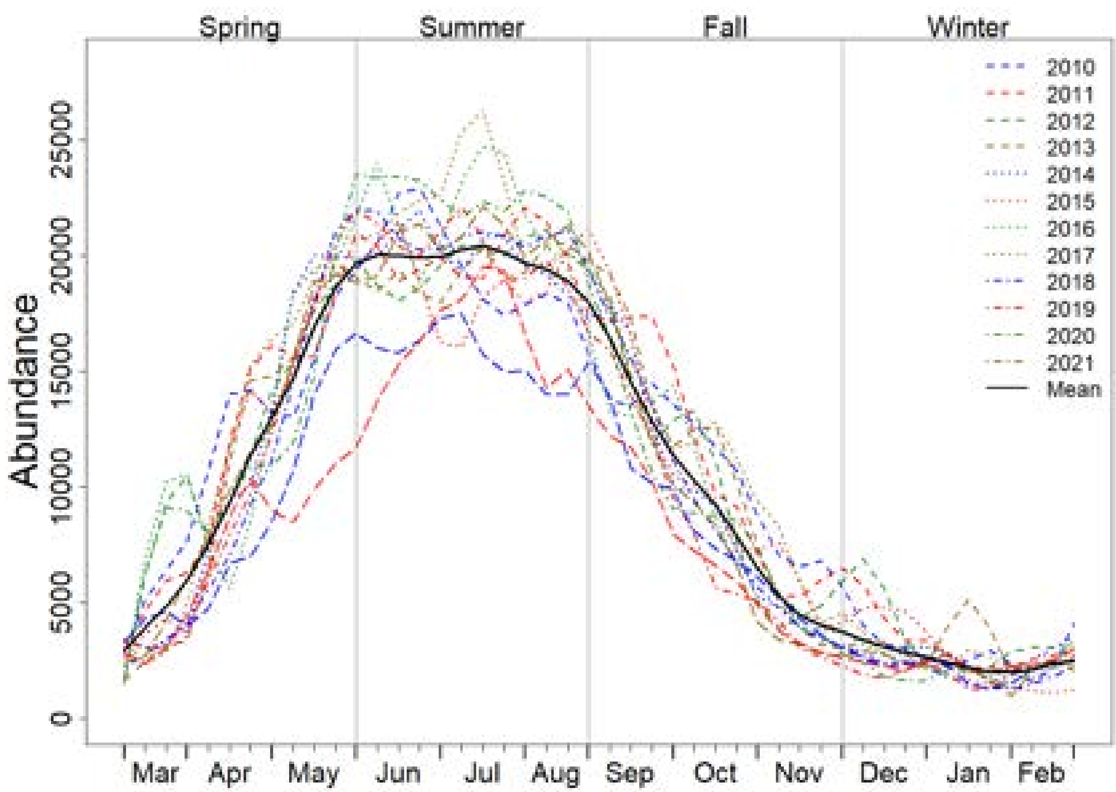

Figure C.7-5. Annual abundance trends for Atlantic spotted dolphins in the AMAPPS study area

C.7.6 Seasonal Prediction Maps

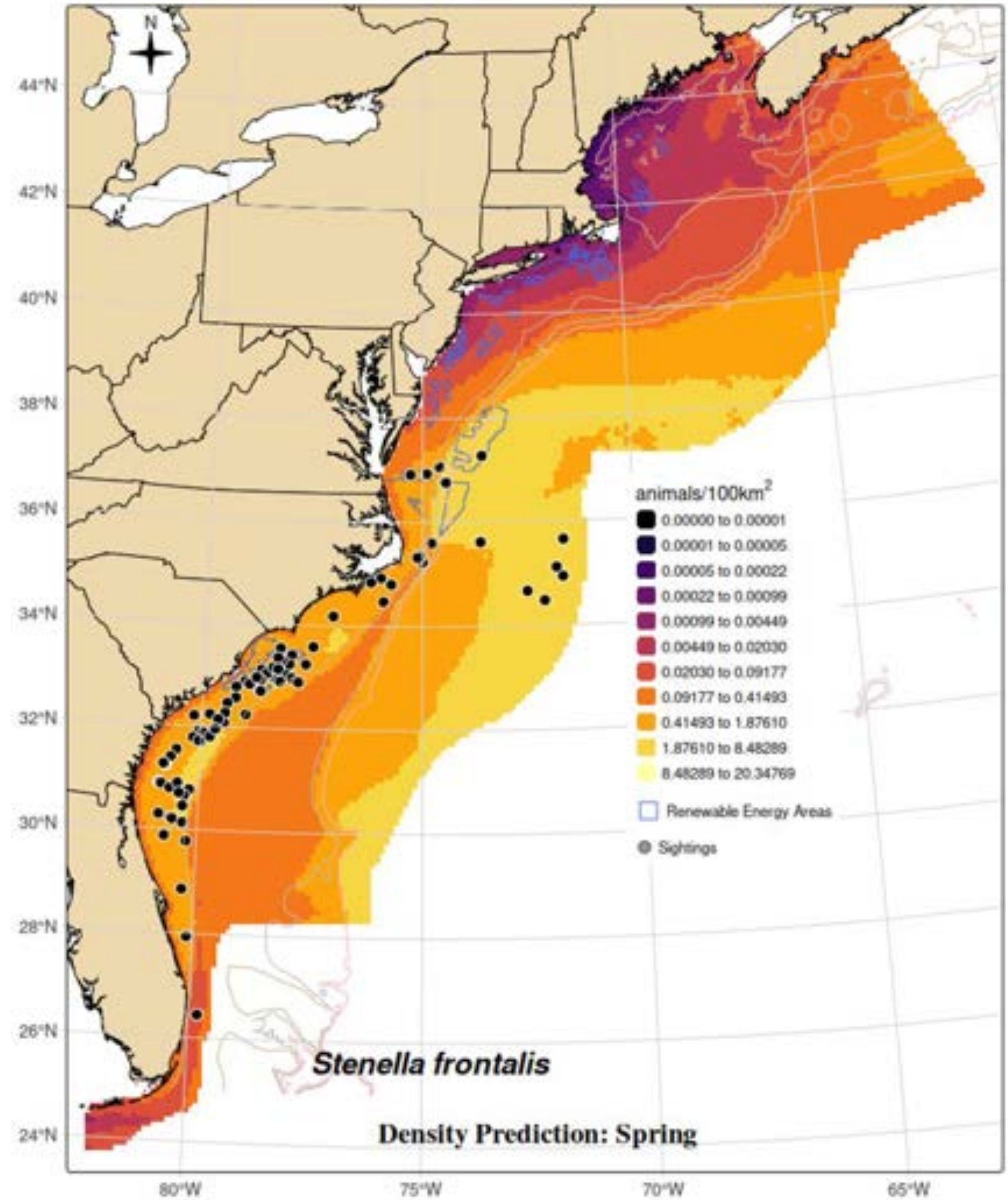

Figure C.7-6. Atlantic spotted dolphin spring average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

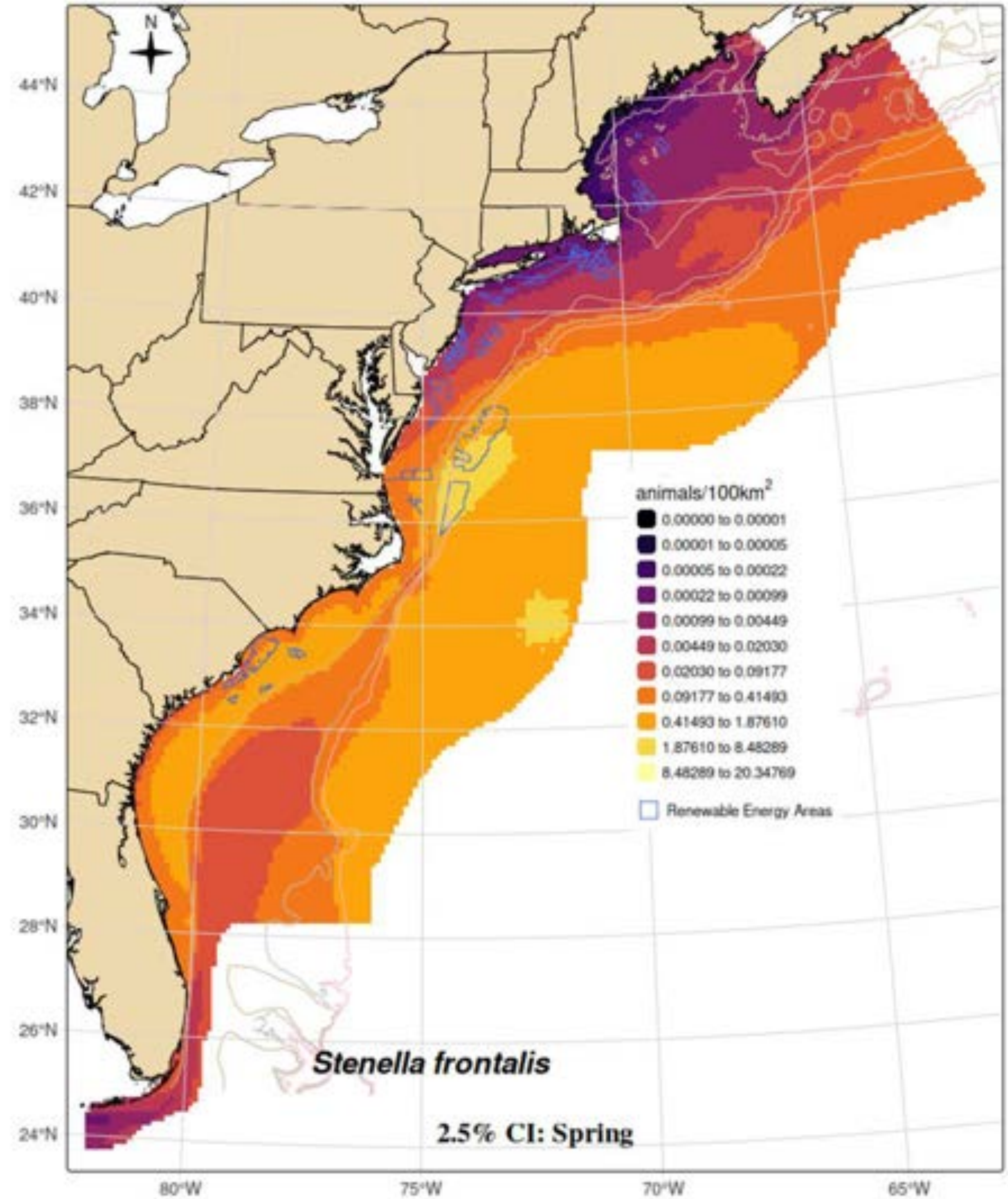

Figure C.7-7. Lower 2.5% confidence interval of spring Atlantic spotted dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

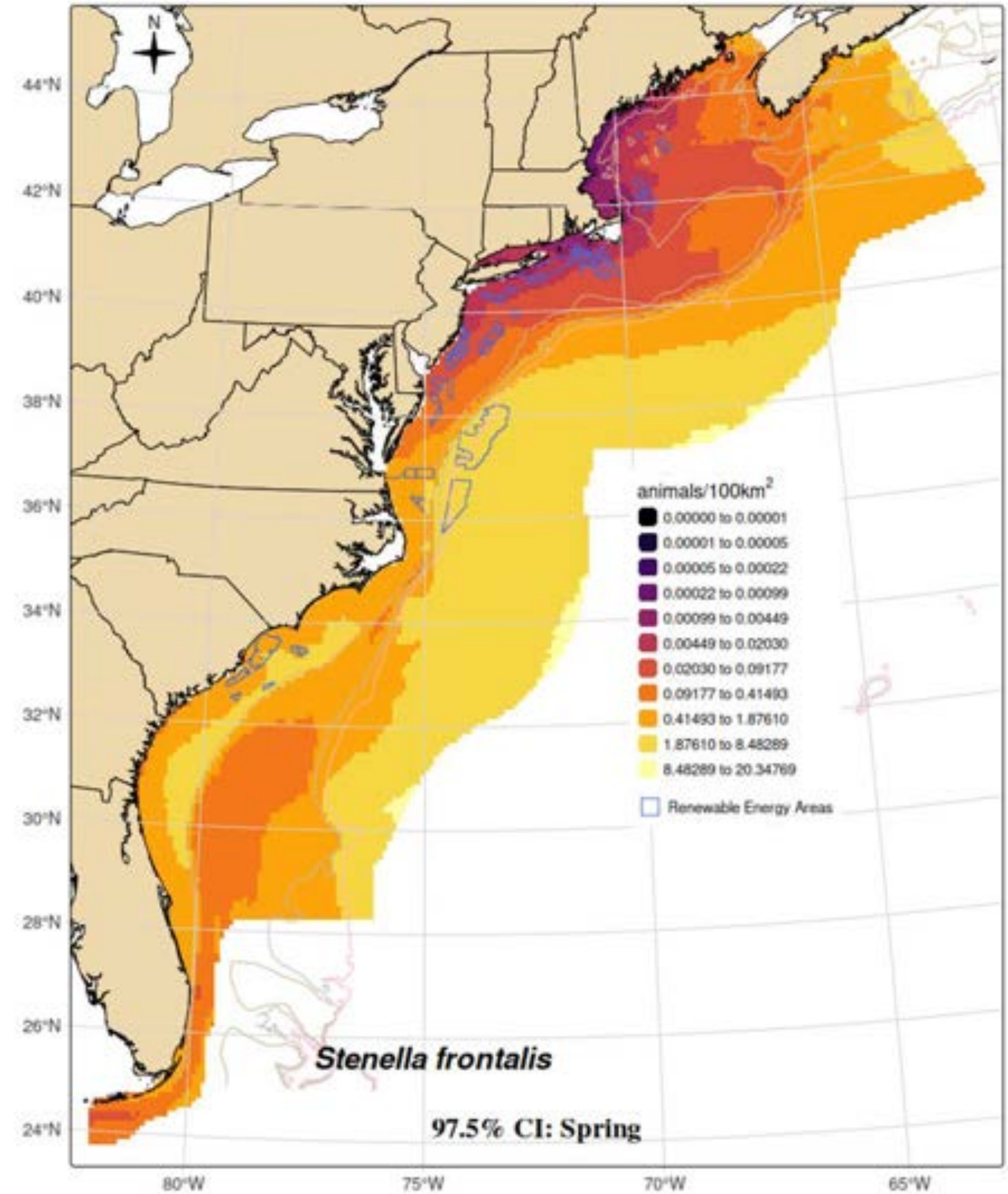

Figure C.7-8. Upper 97.5% confidence interval of spring Atlantic spotted dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

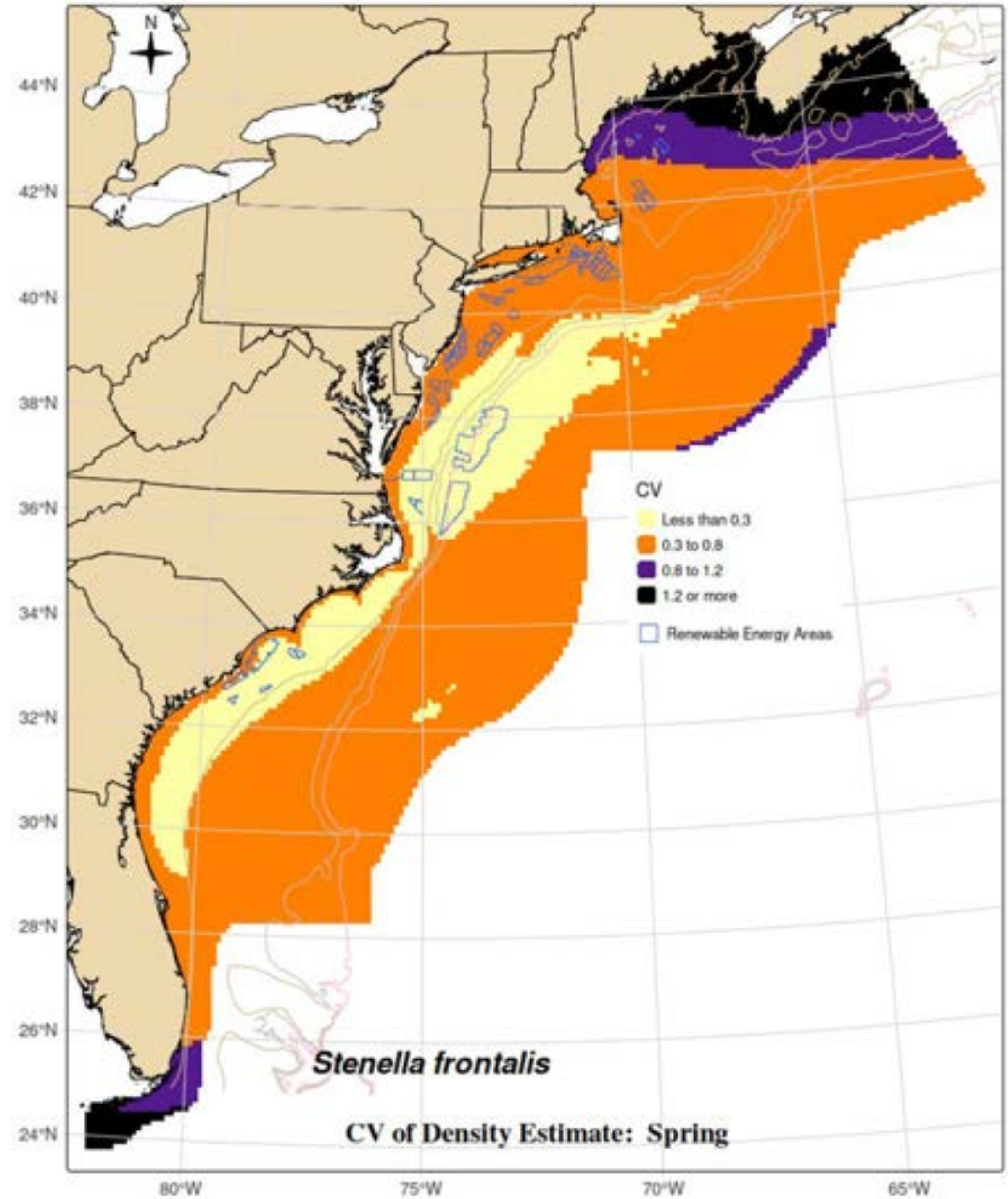

Figure C.7-9. CV of spring Atlantic spotted dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

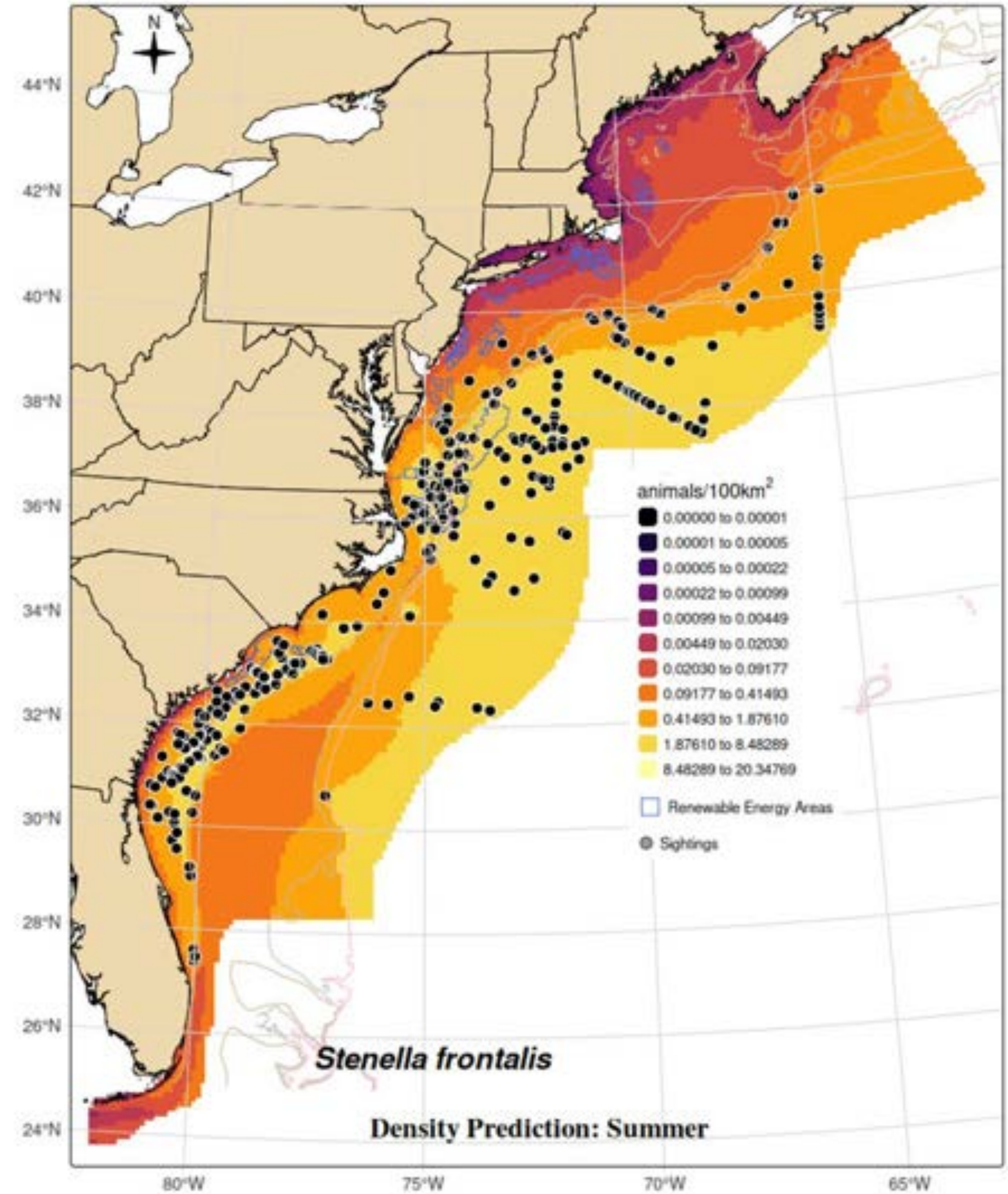

Figure C.7-10. Atlantic spotted dolphin summer average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

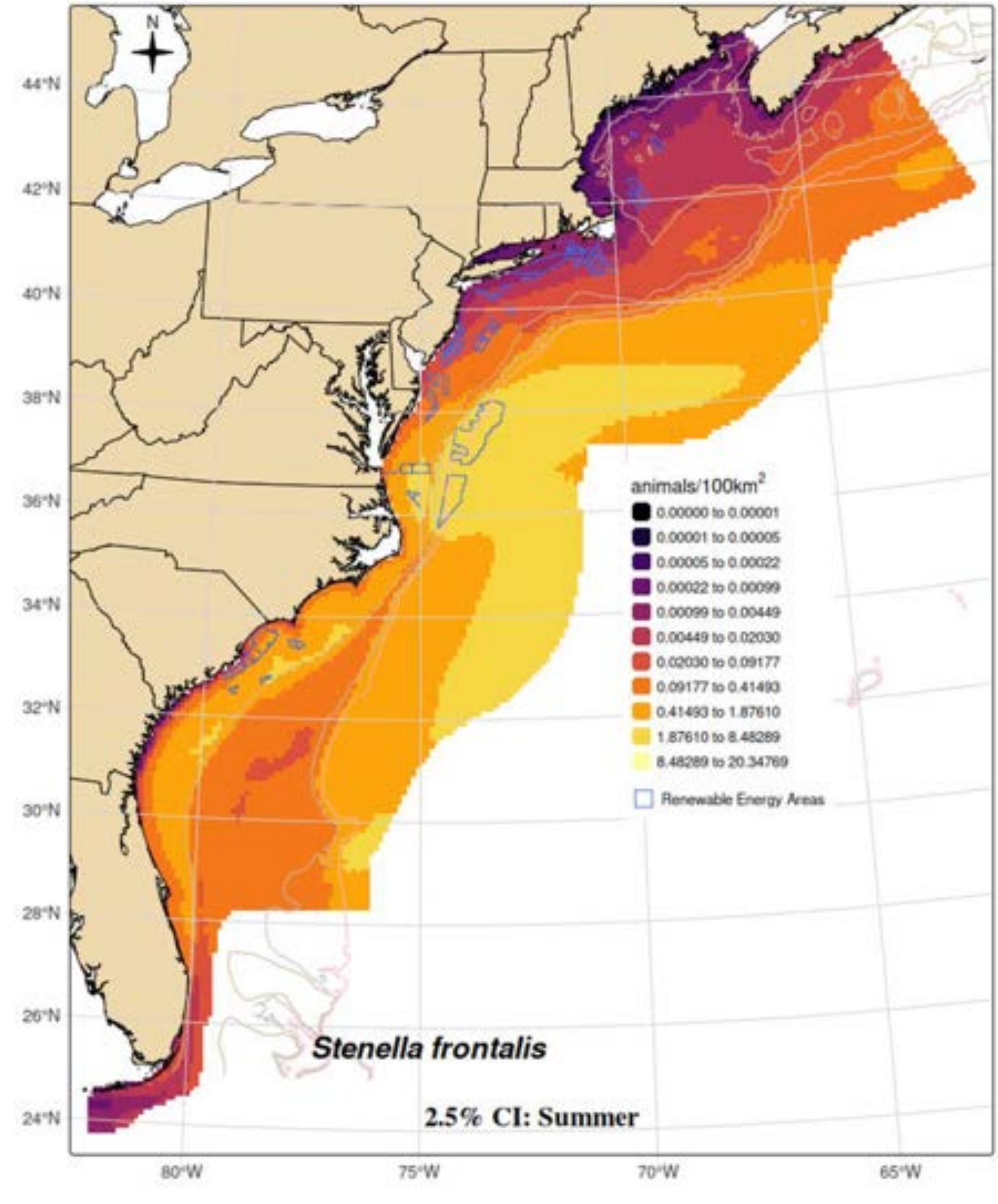

Figure C.7-11. Lower 2.5% confidence interval of summer Atlantic spotted dolphin density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

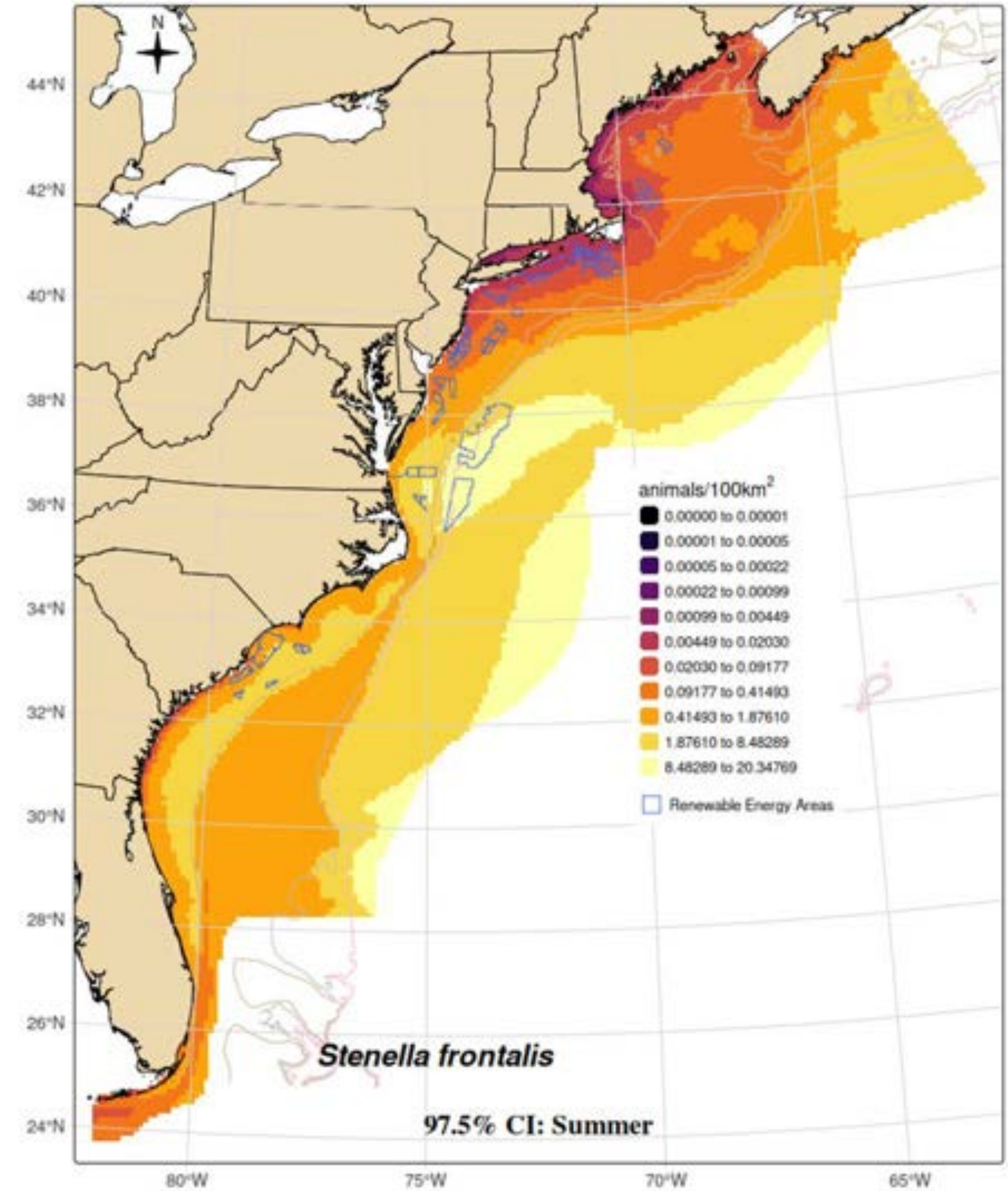

Figure C.7-12. Upper 97.5% confidence interval of summer Atlantic spotted dolphin density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

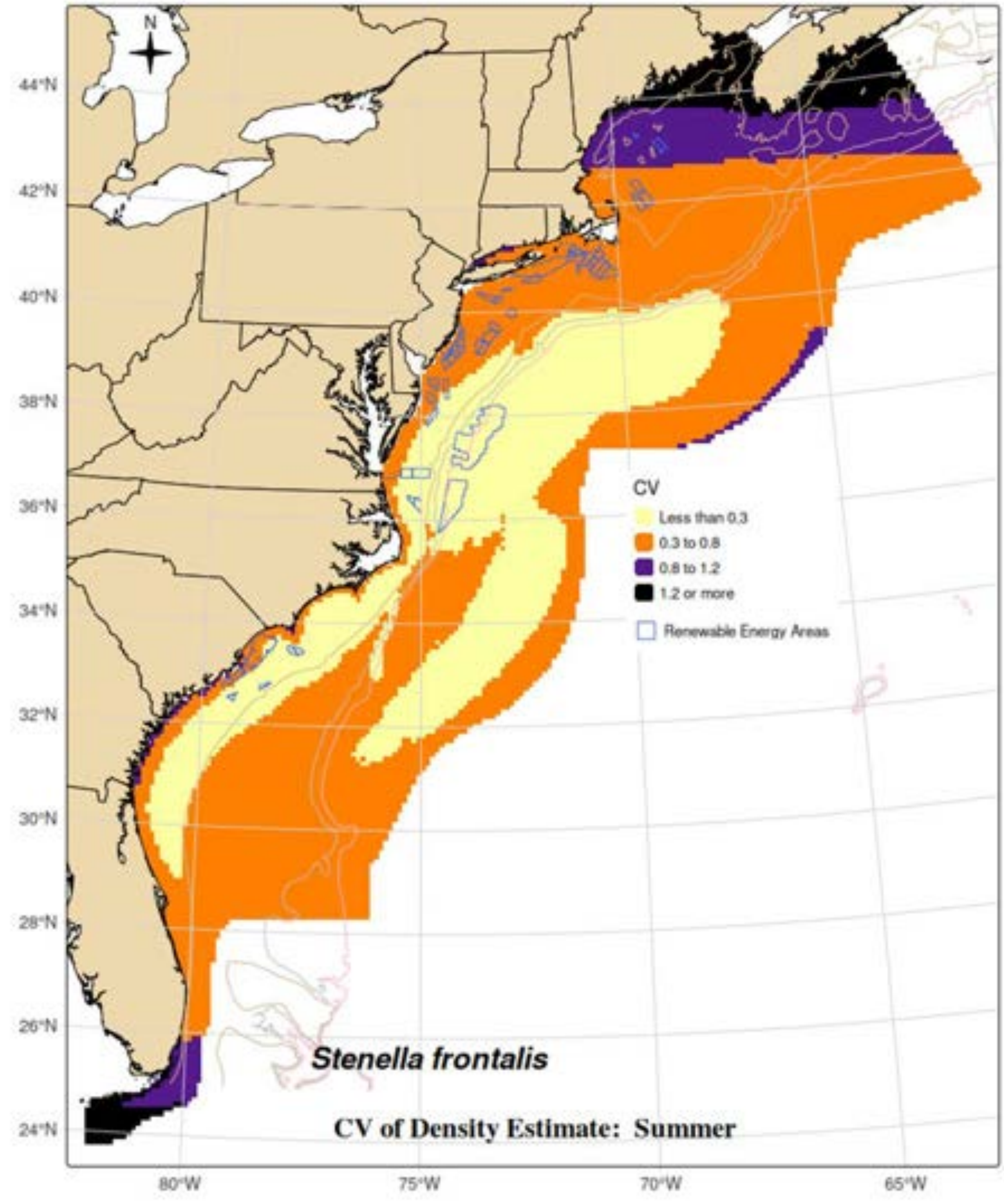

Figure C.7-13. CV of summer Atlantic spotted dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

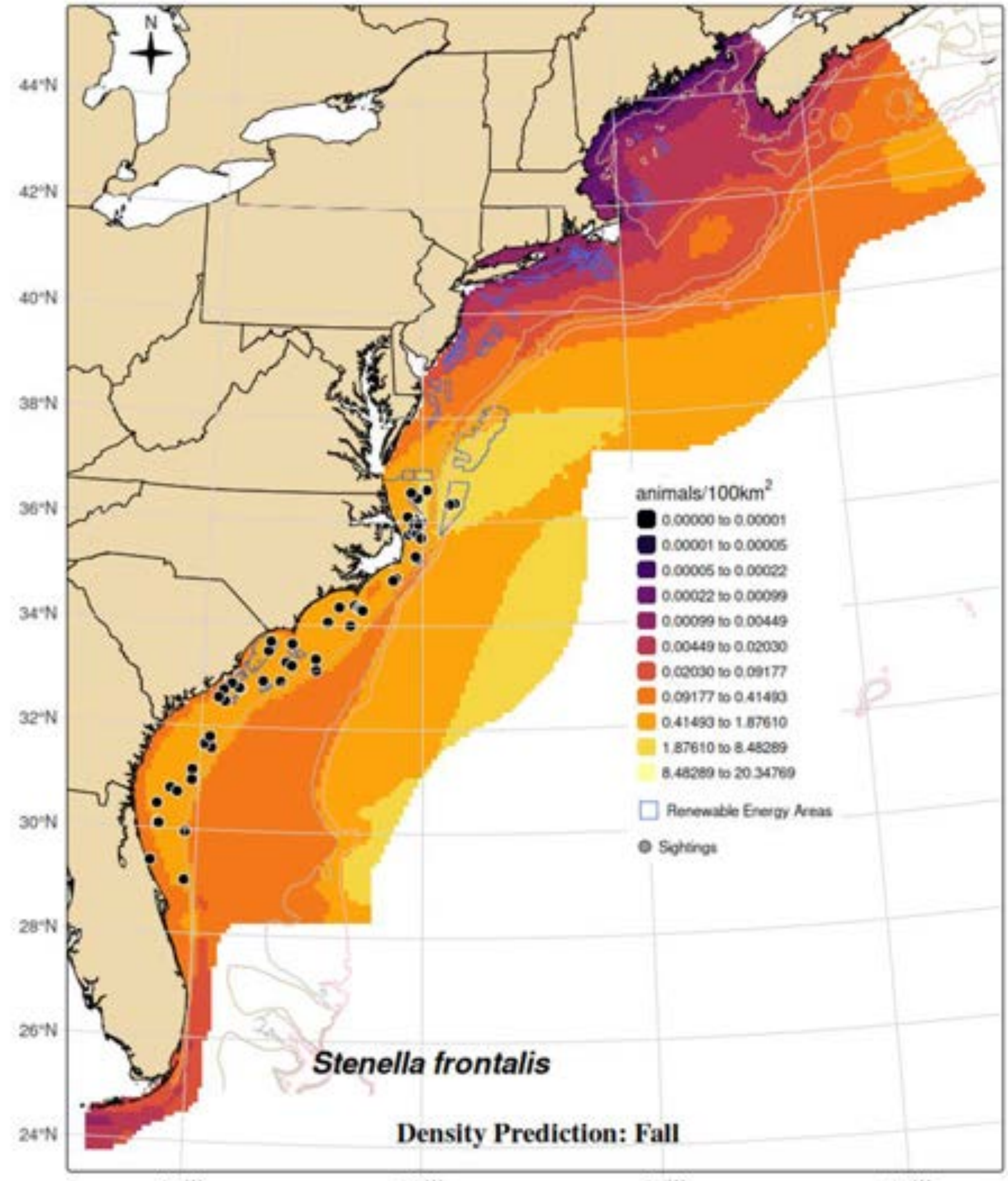

Figure C.7-14. Atlantic spotted dolphin fall average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

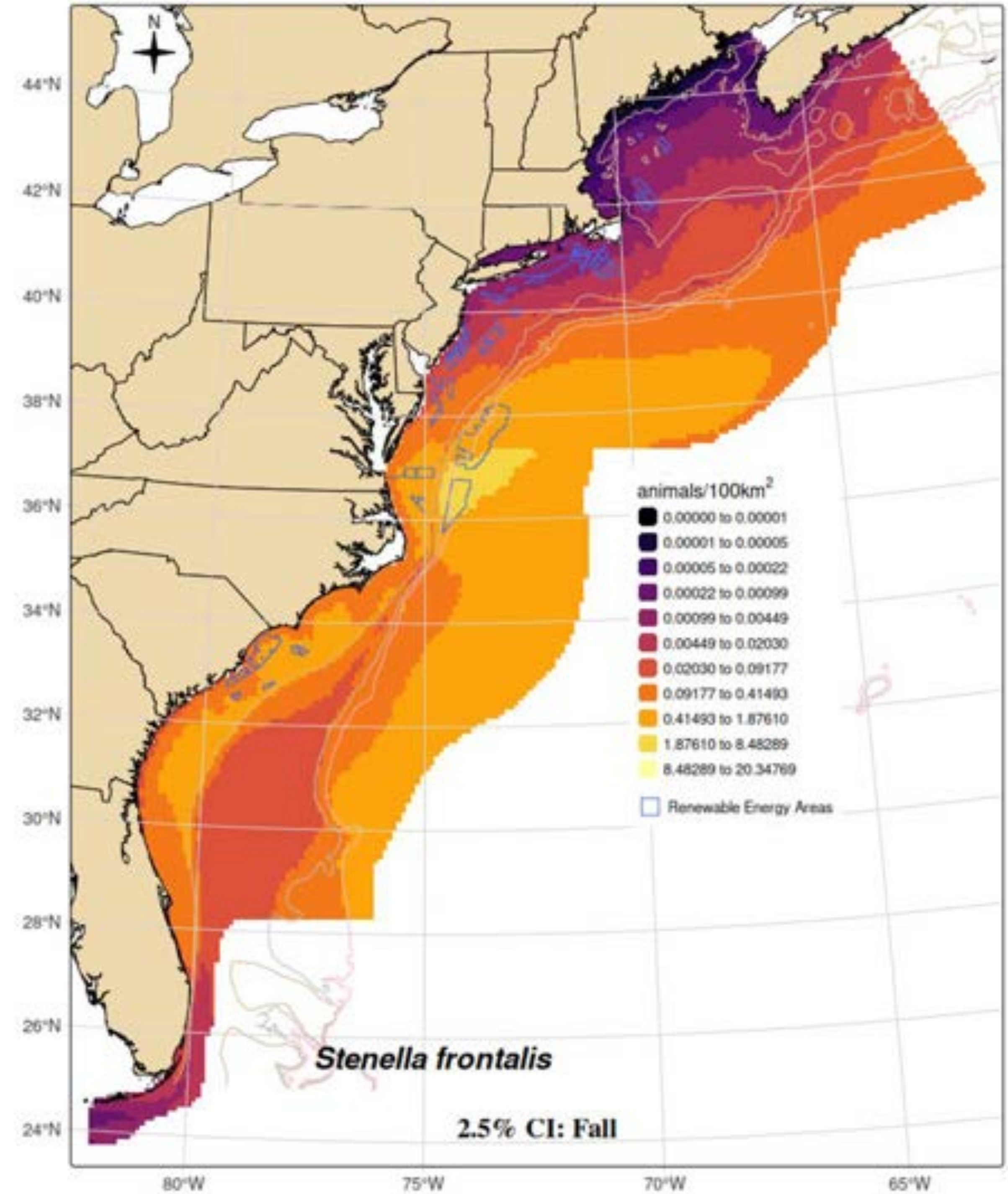

Figure C.7-15. Lower 2.5% confidence interval of fall Atlantic spotted dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

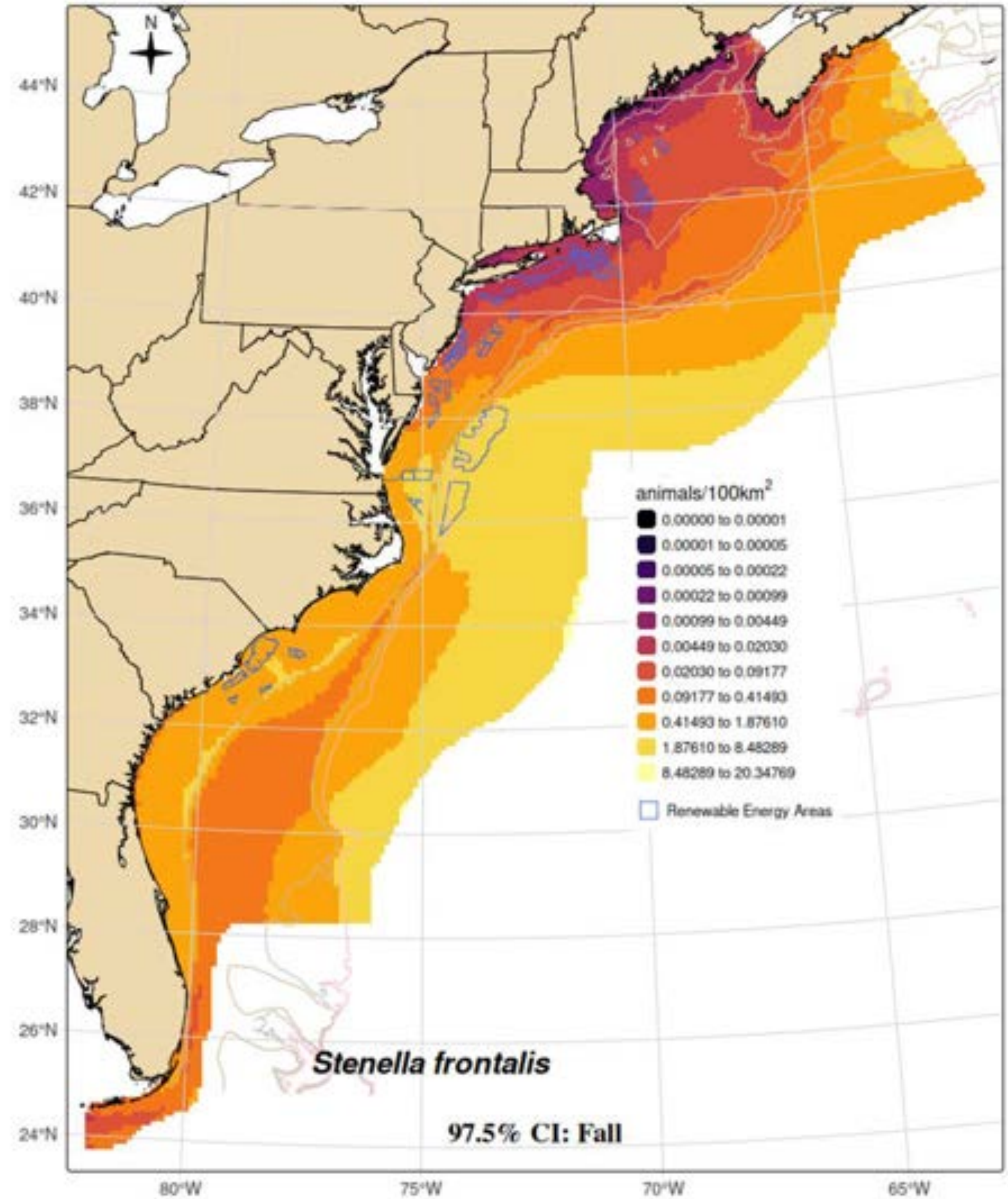

Figure C.7-16. Upper 97.5% confidence interval of fall Atlantic spotted dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

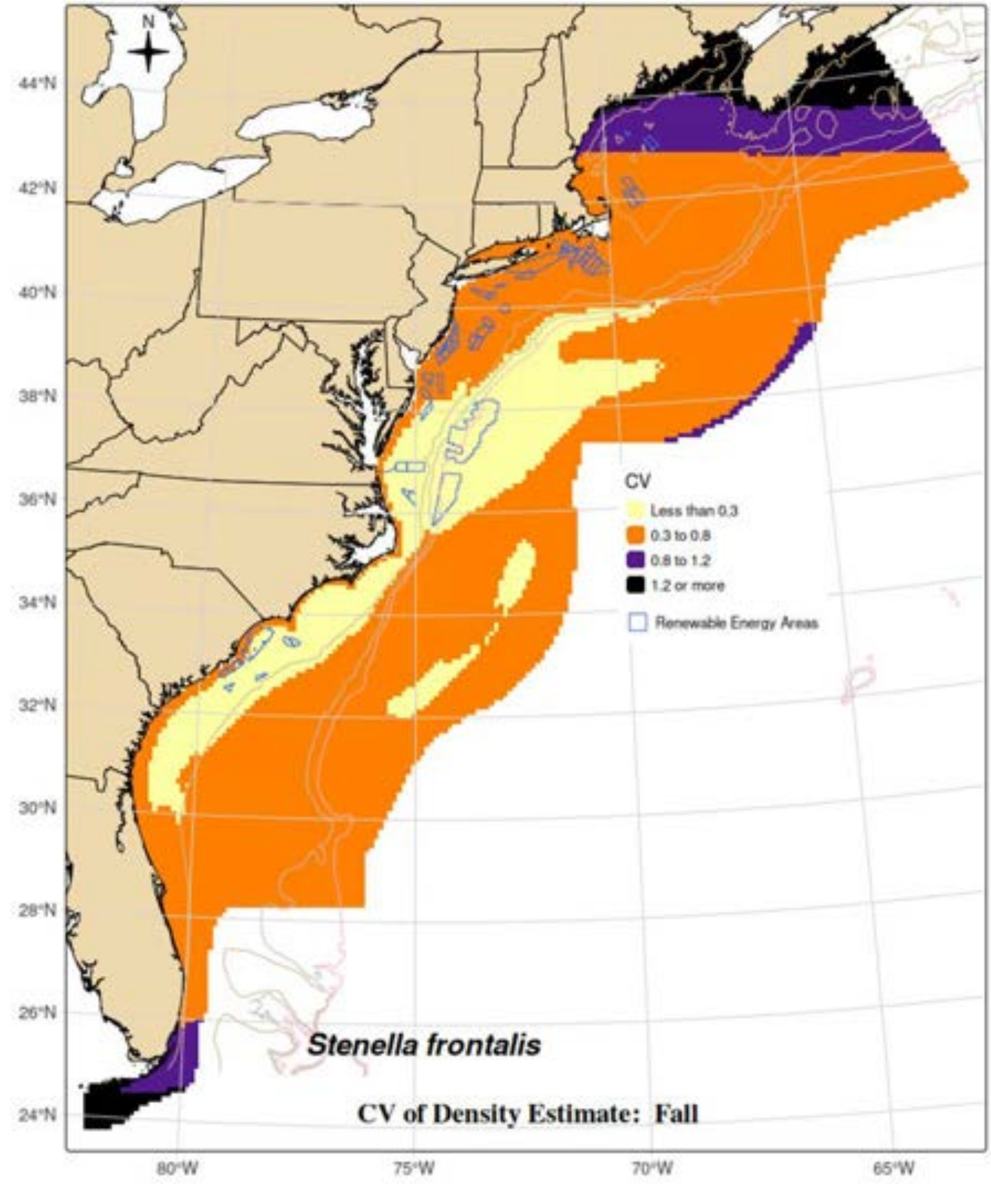

Figure C.7-17. CV of fall Atlantic spotted dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

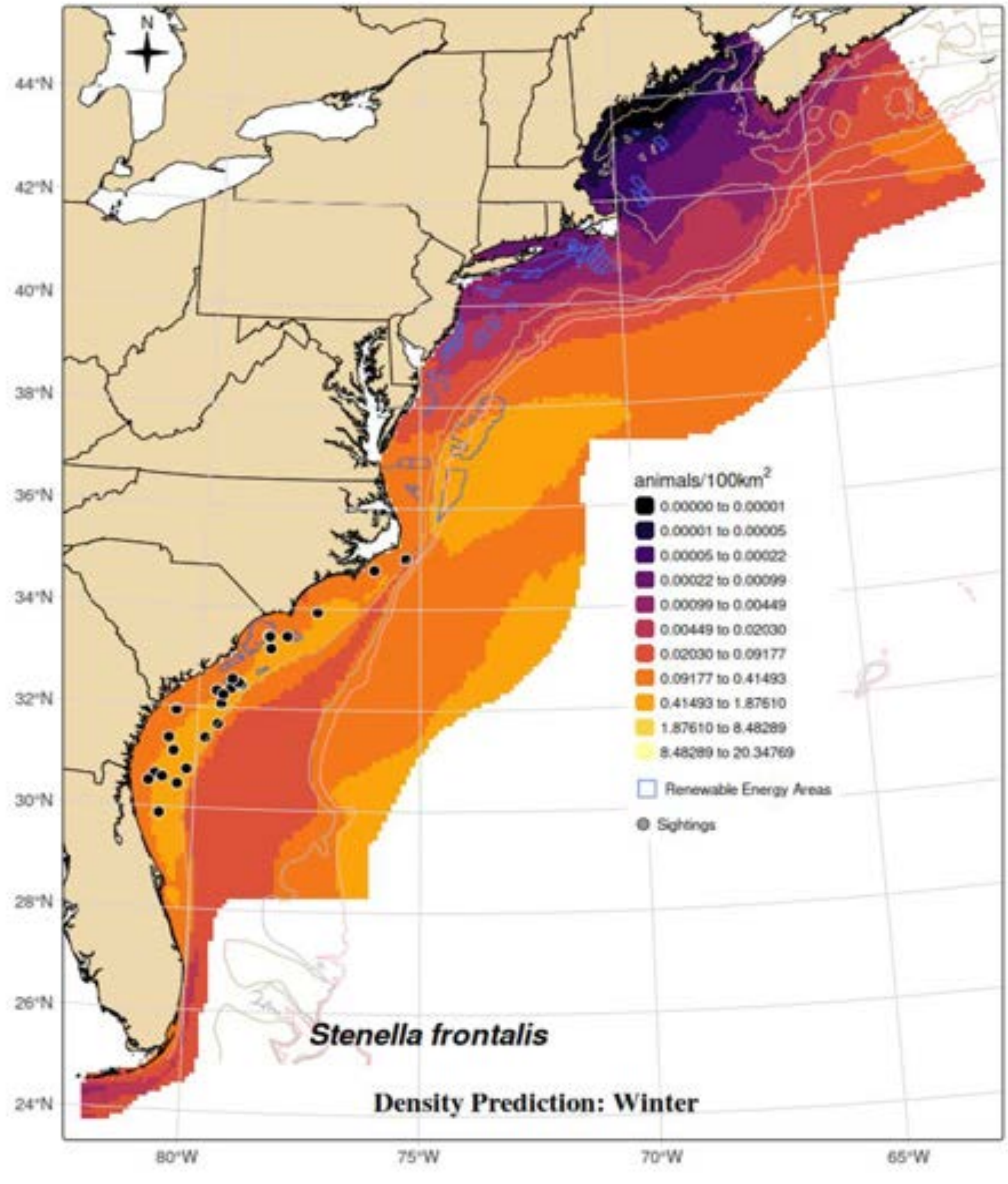

Figure C.7-18. Atlantic spotted dolphin winter average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

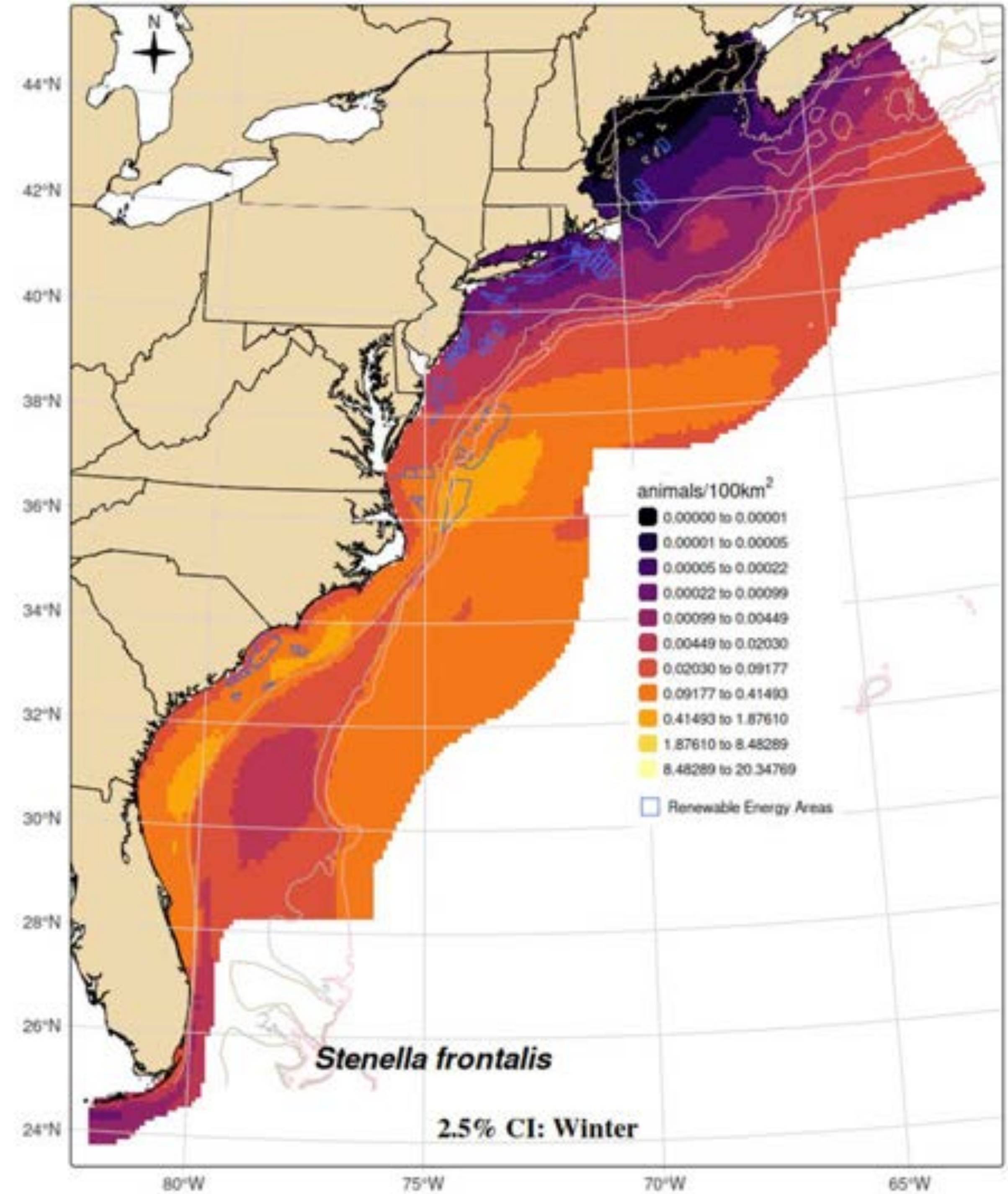

Figure C.7-19. Lower 2.5% confidence interval of winter Atlantic spotted dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

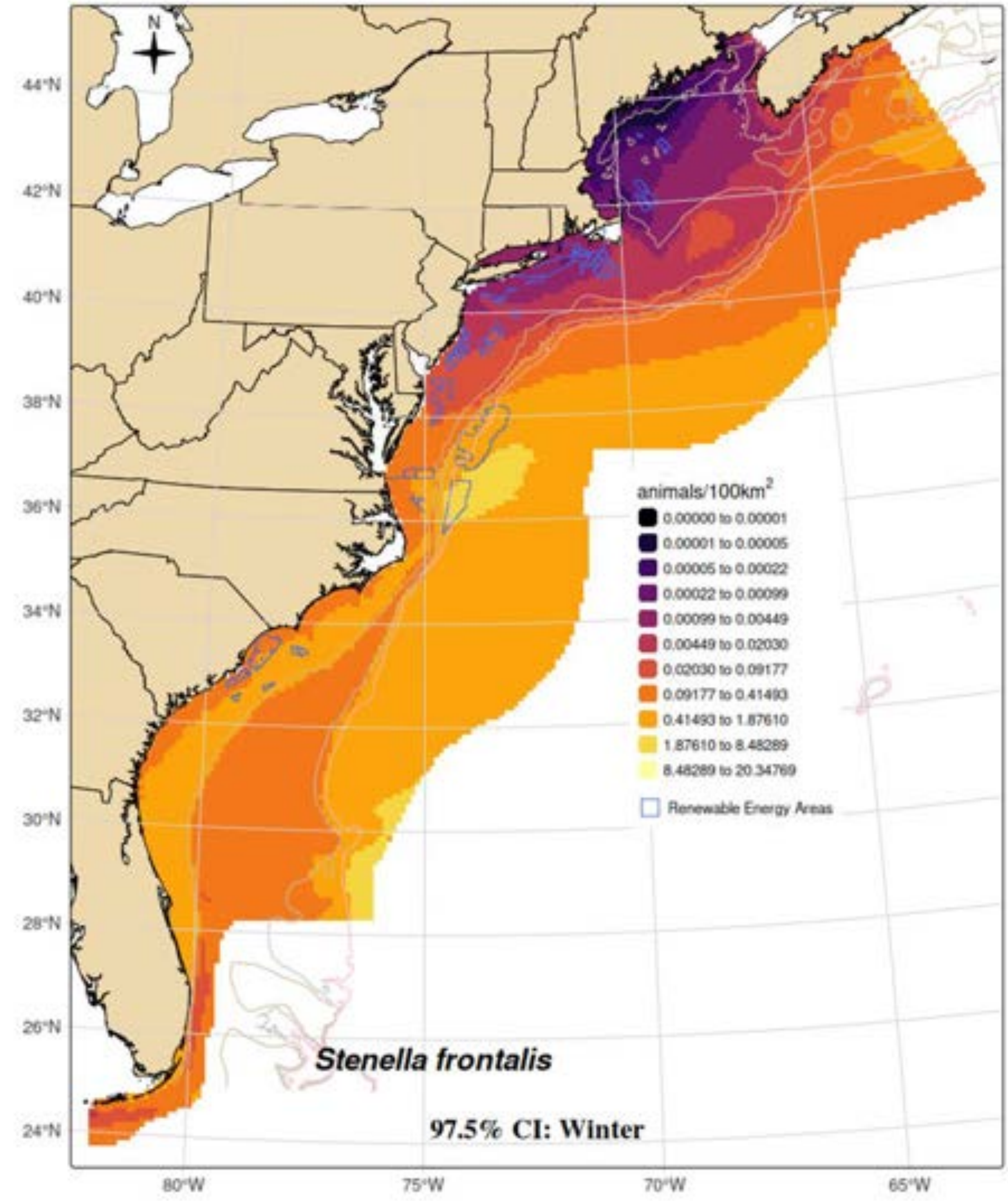

Figure C.7-20. Upper 97.5% confidence interval of winter Atlantic spotted dolphin density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

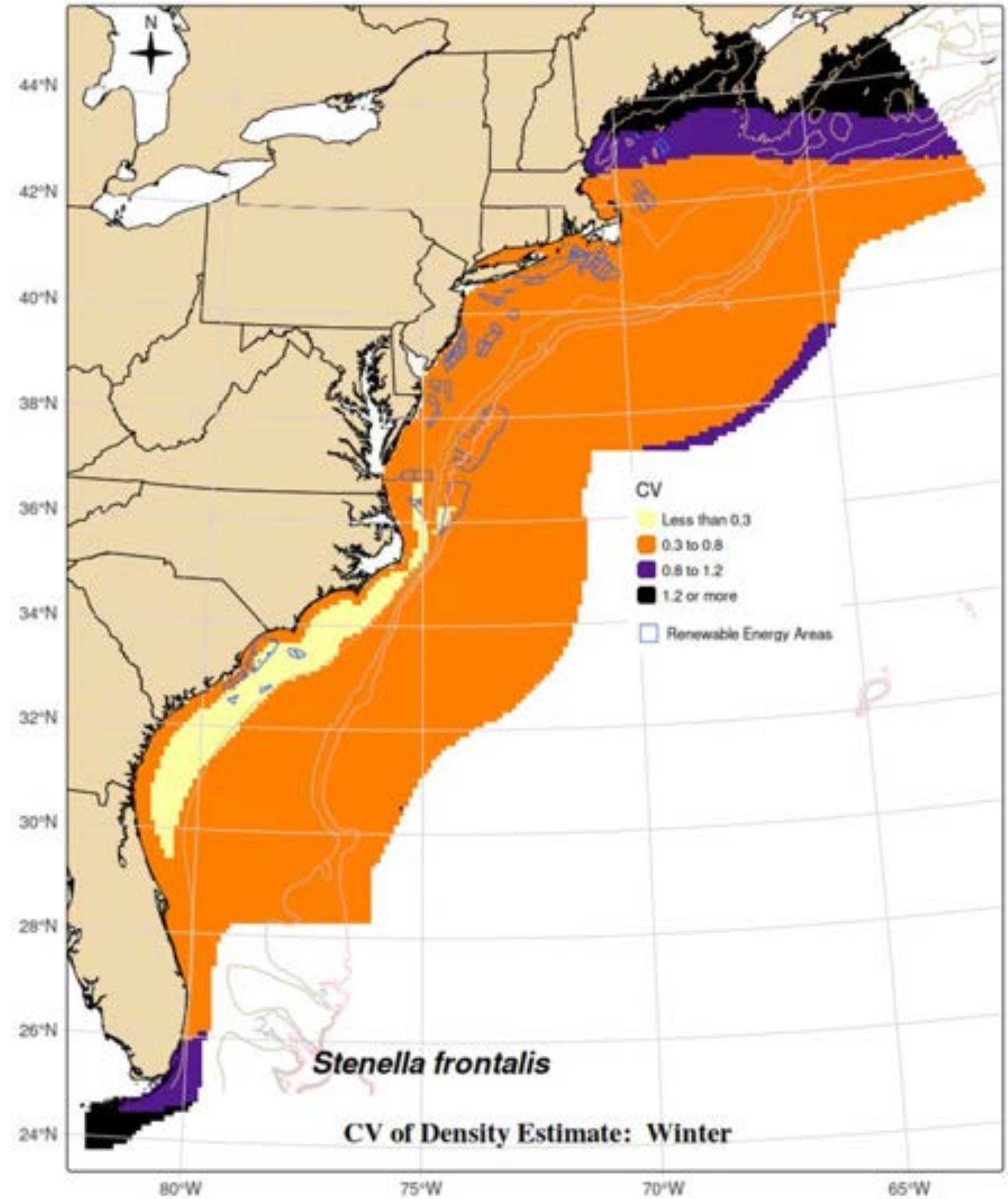

Figure C.7-21. CV of winter Atlantic spotted dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

C.7.7 Offshore Energy Development Areas

Table C.7-6. Atlantic spotted dolphin abundance estimates for wind-energy study areas

Season	Wind-Energy Study Area	Abundance*	CV	95% Confidence Interval*
Spring (Mar-May)	RI/MA	1.0	0.42	0.5 - 2.2
	NY	0.2	0.43	0.1 - 0.4
	NJ	1.0	0.37	0.5 - 2
	DE/MD	2.1	0.34	1.1 - 4.1
	VA	16.4	0.28	9.6 - 28.3
	NC	27.7	0.27	16.3 - 46.8
	NC/SC	140.7	0.25	86.2 - 229.8
	GA	6.8	0.36	3.5 - 13.5
	FL	0.7	0.75	0.2 - 2.6
Summer (Jun-Aug)	RI/MA	2.5	0.41	1.1 - 5.3
	NY	0.5	0.45	0.2 - 1.1
	NJ	4.4	0.36	2.2 - 8.8
	DE/MD	9.6	0.33	5.1 - 18
	VA	77.7	0.28	45.4 - 132.7
	NC	122.7	0.25	75.3 - 199.8
	NC/SC	174.6	0.27	104.7 - 291.1
	GA	3.3	0.44	1.4 - 7.5
	FL	1.1	0.75	0.3 - 4
Fall (Sep-Nov)	RI/MA	1.0	0.40	0.5 - 2.2
	NY	0.3	0.42	0.1 - 0.6
	NJ	2.4	0.35	1.2 - 4.7
	DE/MD	5.2	0.32	2.8 - 9.5
	VA	34.2	0.26	20.8 - 56.4
	NC	54.0	0.25	33.6 - 87
	NC/SC	108.4	0.27	64.1 - 183.4
	GA	5.9	0.34	3.1 - 11.3
	FL	0.5	0.76	0.1 - 2
Winter (Dec-Feb)	RI/MA	0.2	0.48	0.1 - 0.5
	NY	0.1	0.48	0 - 0.1
	NJ	0.5	0.43	0.2 - 1.2
	DE/MD	1.0	0.40	0.5 - 2.2
	VA	5.4	0.32	2.9 - 9.9
	NC	7.7	0.31	4.3 - 13.8
	NC/SC	49.6	0.27	29.5 - 83.3
	GA	2.4	0.35	1.2 - 4.6
	FL	0.4	0.78	0.1 - 1.4

***** We rounded the mean abundance and 95% confidence interval to the nearest tenth of an animal. If this resulted in a zero for the mean abundance, we calculated the CV using the actual abundance value as estimated by the density-habitat model and then rounded to the nearest tenth. If a wind-energy study area is not included, then we assumed the abundance was zero.

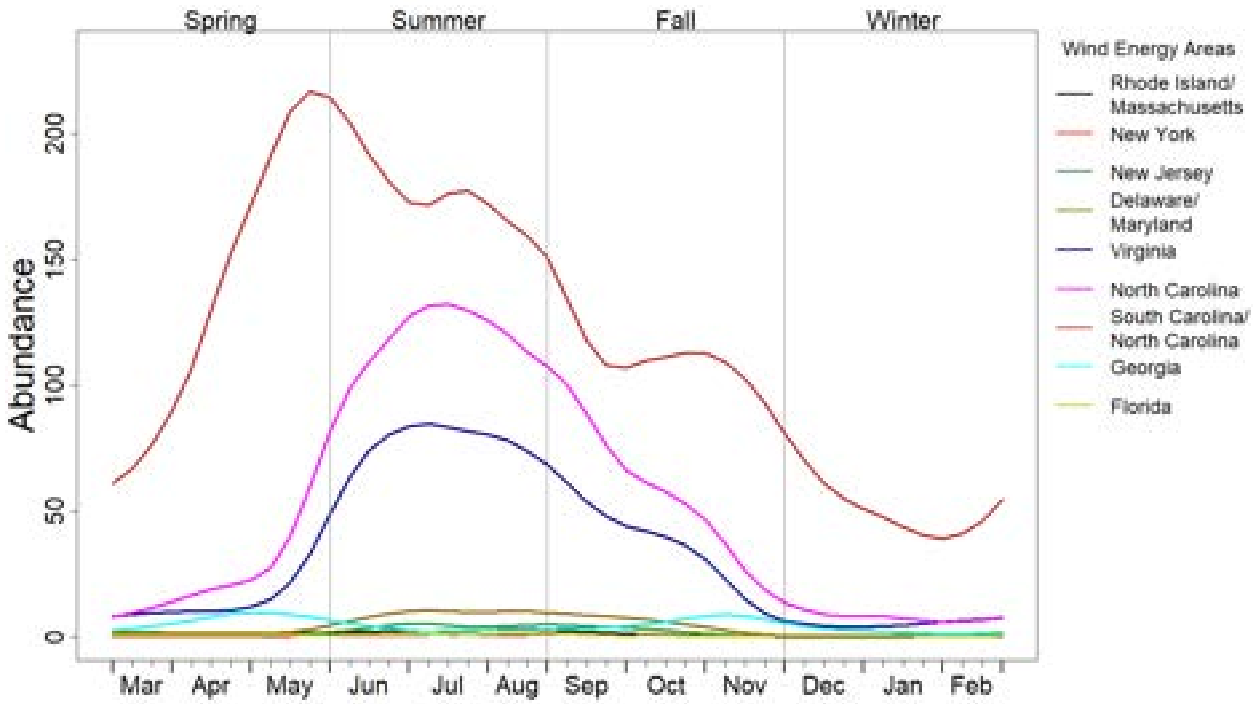

Figure C.7-22. Average seasonal abundance of Atlantic spotted dolphins in wind-energy study areas

C.8 Striped Dolphin (*Stenella coeruleoalba*)

Figure C.8-1. Striped Dolphins
Image collected under MMPA Research permit #17355. Credit: NOAA/NEFSC/Todd Pusser.

C.8.1 Data Collection

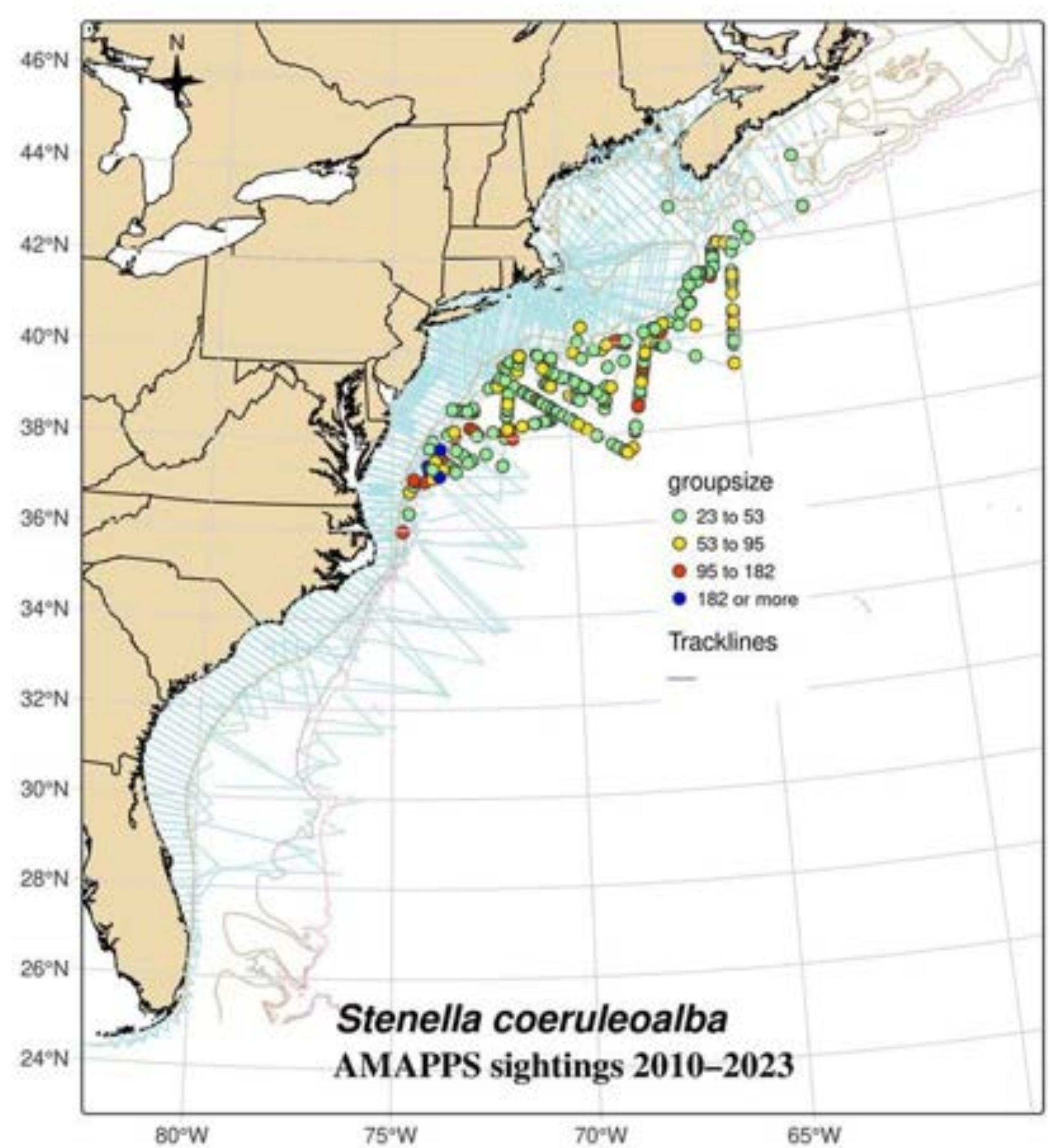

Figure C.8-2. Distribution of track lines and striped dolphin sightings 2010 to 2023
Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

Table C.8-1. AMAPPS research effort 2010 to 2023 and striped dolphin sightings

Survey Region and Platform	Season	Effort (km)	Number of Groups	Number of Animals
NE Shipboard	Spring	8,883	4	66
NE Shipboard	Summer	49,064	281	11,780
NE Aerial	Spring	38,839	2	170
NE Aerial	Summer	52,003	6	146
NE Aerial	Fall	87,311	7	325
NE Aerial	Winter	24,747	8	61
SE Shipboard	Spring	2,604	13	508
SE Shipboard	Summer	18,331	16	1,953
SE Shipboard	Fall	2,673	0	0
SE Shipboard	Winter	302	0	0
SE Aerial	Spring	48,634	1	110
SE Aerial	Summer	43,285	0	0
SE Aerial	Fall	21,153	0	0
SE Aerial	Winter	19,152	0	0

C.8.2 Mark-Recapture Distance Sampling Analysis

Table C.8-2. Intermediate parameters in striped dolphin mark-recapture distance sampling (MRDS) models

Analysis Set	MR Model	MR Truncation (m)	DS Model	DS Truncation (m)	Key function	p(0)	p(0) CV	Chi-square p-value	CvM p-value
SE–aerial group 3	distance + observer + log(group size) + sea state	380	distance + glare	380	HN with Cosine Adjustment Order 2	0.85	0.04	0.21	0.89
NE–aerial group 9	distance + observer + log(group size) + sea state + glare	480	distance + sea state + glare + log(group size)	550	HN with Cosine Adjustment Order 3	0.58	0.04	0.14	0.79
NE–shipboard group 2	distance * observer + log(group size) + sea state	5100	distance + swell height	5100	HR	0.70	0.08	0.91	0.93
SE–shipboard group 1	distance + log(group size)	4000	distance + sea state + glare + time of day	4000	HR	0.59	0.10	0.35	0.52

MR=Mark-Recapture, DS=Distance Sampling, HR=Hazard Rate, HN= Half Normal, CV=Coefficient of variation. Values of p>0.5 for Chi-square and Cramer-von Mises test (CvM) indicate good fit. The definition of p(0) is the probability of detecting a group on the track line. Species included in the analysis sets are explained in main text Tables 4-20 and 4-21.

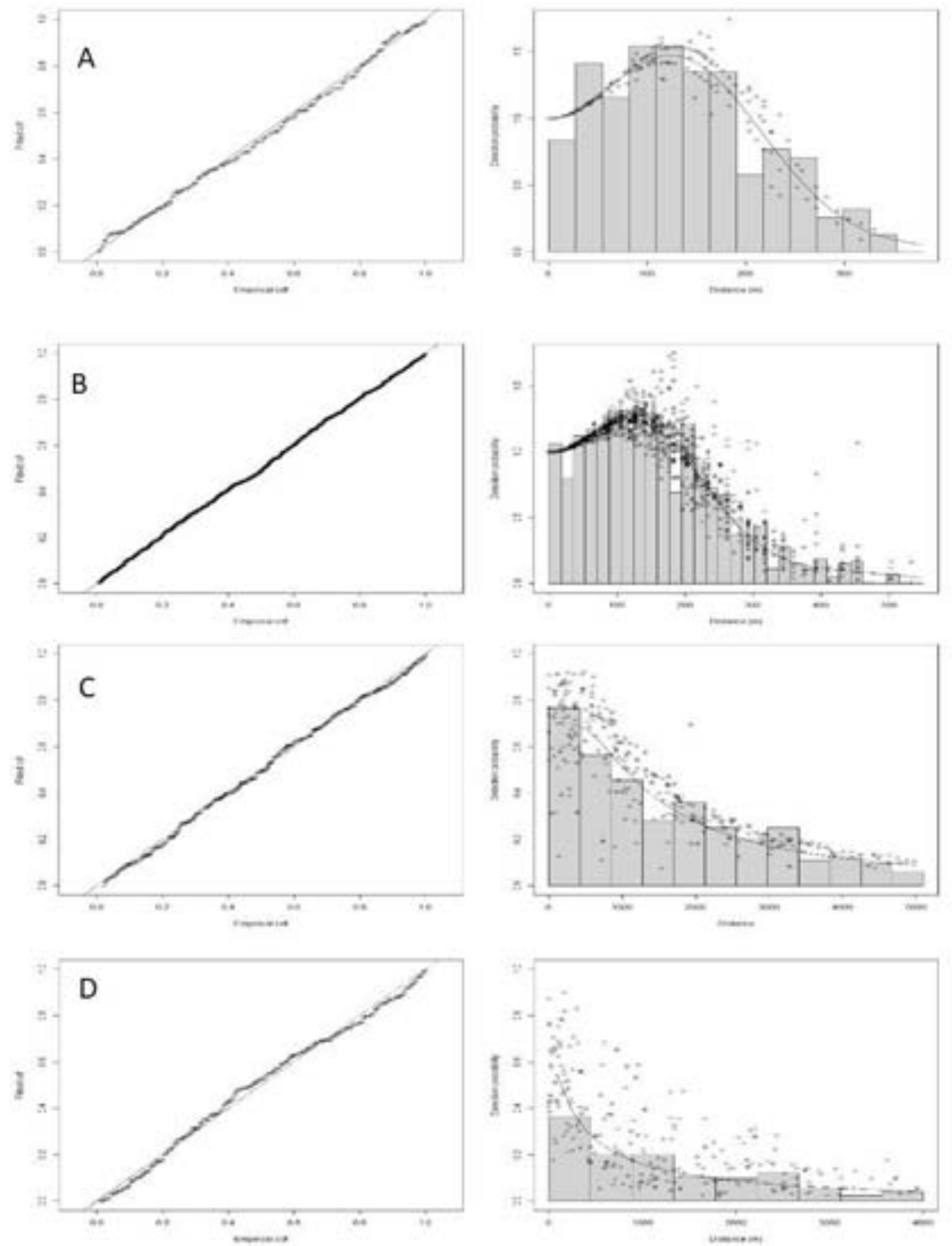

Figure C.8-3. Q-Q plots and detection functions from the striped dolphins MRDS analyses
A) SE-aerial analysis set 3; B) NE-aerial analysis set 9; C) NE-shipboard analysis set 2; D) SE-shipboard analysis set 1.

C.8.3 Generalized Additive Model Analysis

Table C.8-3. 2010 to 2023 density-habitat model output for striped dolphins

Covariates	Edf	Ref.df	F	C.dev	p-value
s(sstmur)	4.32	5	15.70	9.98	<0.0001
s(chlaf)	0.82	5	0.89	0.92	0.0186
s(btemp)	2.19	5	48.99	44.97	<0.0001
s(salinity)	3.37	5	9.10	4.40	<0.0001
s(dist1000)	0.96	5	1.73	0.15	0.0013

Adjusted R^2 = 0.0464. Deviance explained = 60.4%.
Includes the estimated degrees of freedom (Edf), reference degrees of freedom (Ref.df), contribution to the deviance (C.dev) explained for each habitat covariate and its associated p-value. Covariate abbreviations explained in main text in Table 4-2.

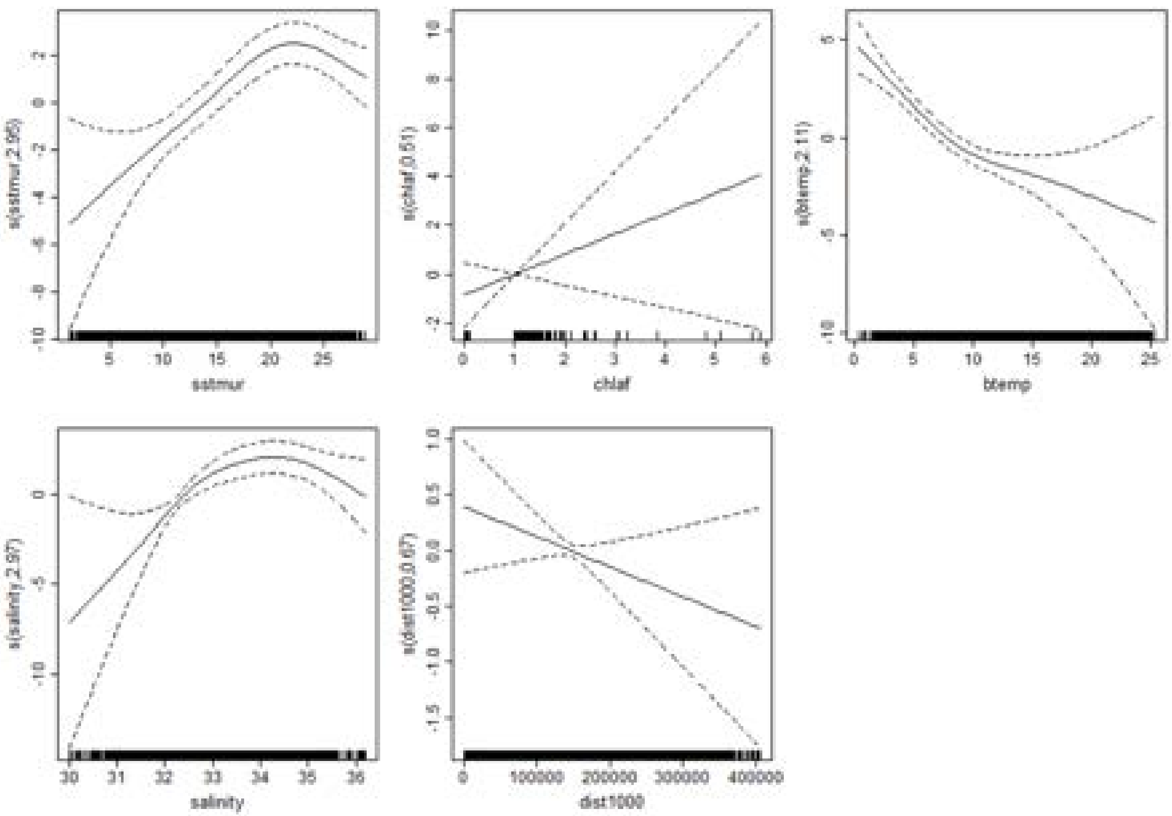

Figure C.8-4. Striped dolphin density relative to significant habitat covariates
Plots represent the partial smooths and interaction terms of the density-habitat model, where the shaded regions represent the 95% credible intervals. Covariate abbreviations explained in main text in Table 4-2.

C.8.4 Model Cross-Validation

Table C.8-4. Diagnostic statistics from the striped dolphin density-habitat model

Diagnostic Statistic	Description	Calculated with	Model Values (x)	Score
RHO	Spearman rank correlation	Non-zero density	0.268	Fair to good
MAPE	Mean absolute percentage error	Non-zero density	76.717	Fair to good
RHO	Spearman rank correlation	All data divided in 25 random samples	0.189	Fair to good
MAE	Mean absolute error	All data divided in 25 random samples	0.031	Excellent
MAPE	Mean absolute percentage error	All data divided in 25 random samples	75.430	Fair to good

RHO: Poor= x<0.05; Fair to good =0.05<=x<0.3; Excellent= x>0.3
MAPE: Poor= x>150%; Fair to good= 150%>=x>50%; Excellent= x<=50%
MAE: Poor= x>1; Fair to good = 1>=x>0.25; Excellent= x<=0.25

C.8.5 Abundance Estimates for AMAPPS Study Area

Table C.8-5. Striped dolphin average abundance estimates for the AMAPPS study area

Season	Average Abundance	CV	95% Confidence Interval
Spring (March–May)	24,556	0.71	7,020 – 85,902
Summer (June–August)	48,317	0.38	23,522 – 99,247
Fall (September–November)	51,468	0.43	22,957 – 115,385
Winter (December–February)	20,830	0.79	5,320 – 81,558
Summer 2011 U.S. surveys[1]	54,807	0.30	37,511 – 80,078
Summer 2011 U.S. surveys[1]	67,036	0.29	46,632 – 96,368
Summer 2021 U.S. surveys[1]	48,274	0.29	27,658 – 84,256

[1]Hayes et al. 2024

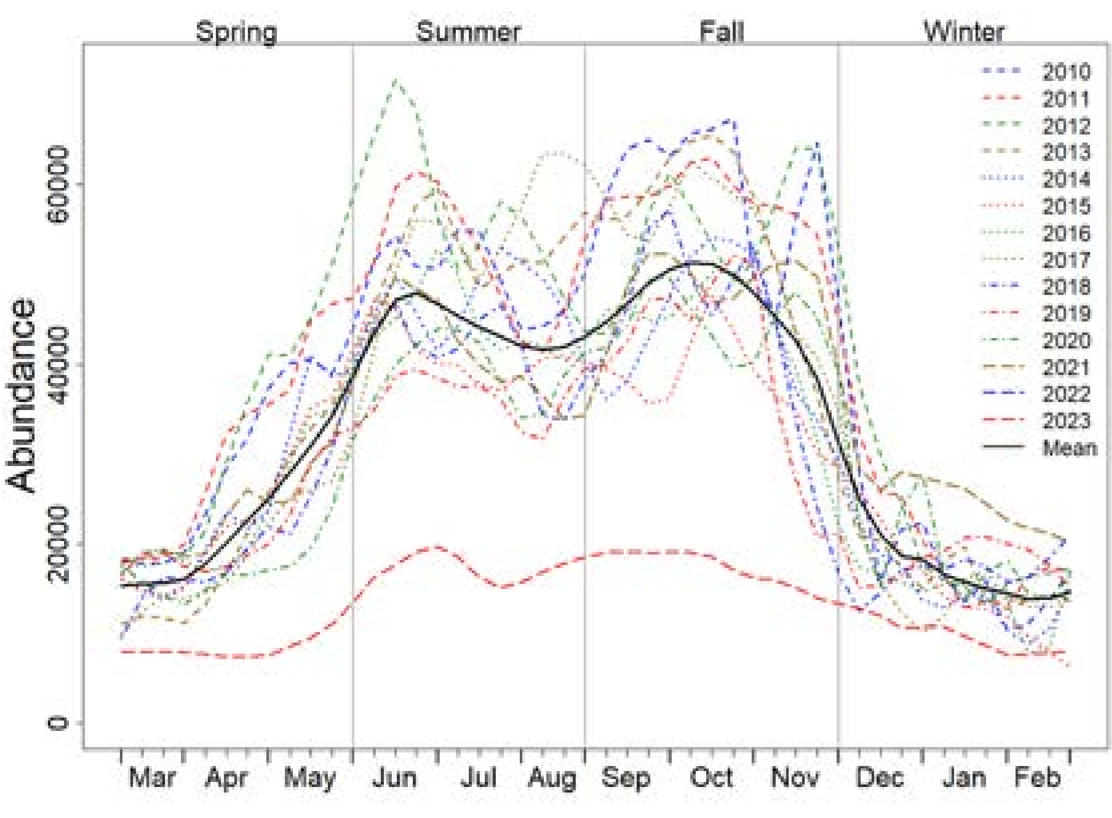

Figure C.8-5. Annual abundance trends for striped dolphins in the AMAPPS study area

C.8.6 Seasonal Prediction Maps

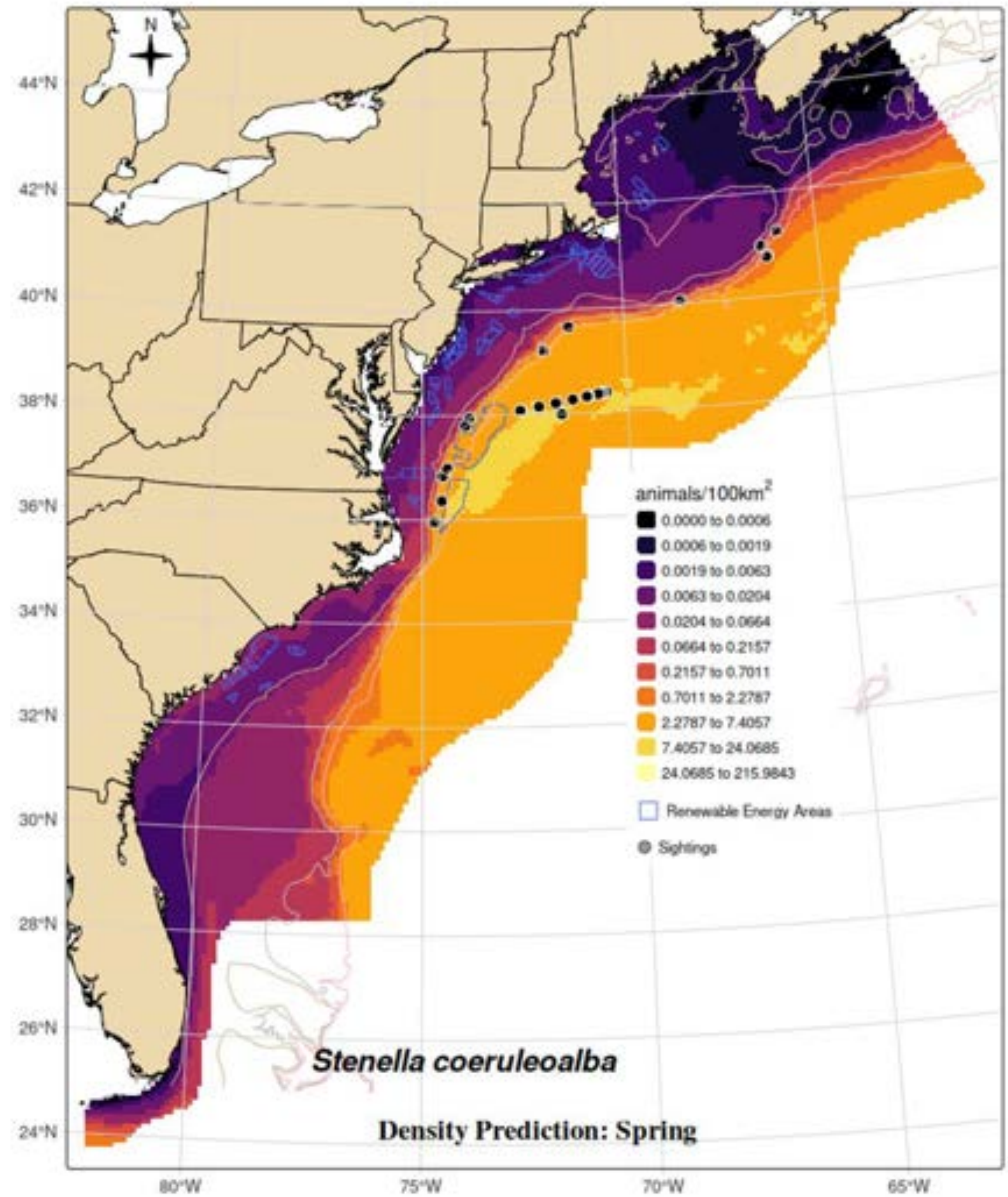

Figure C.8-6. Striped dolphin spring average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

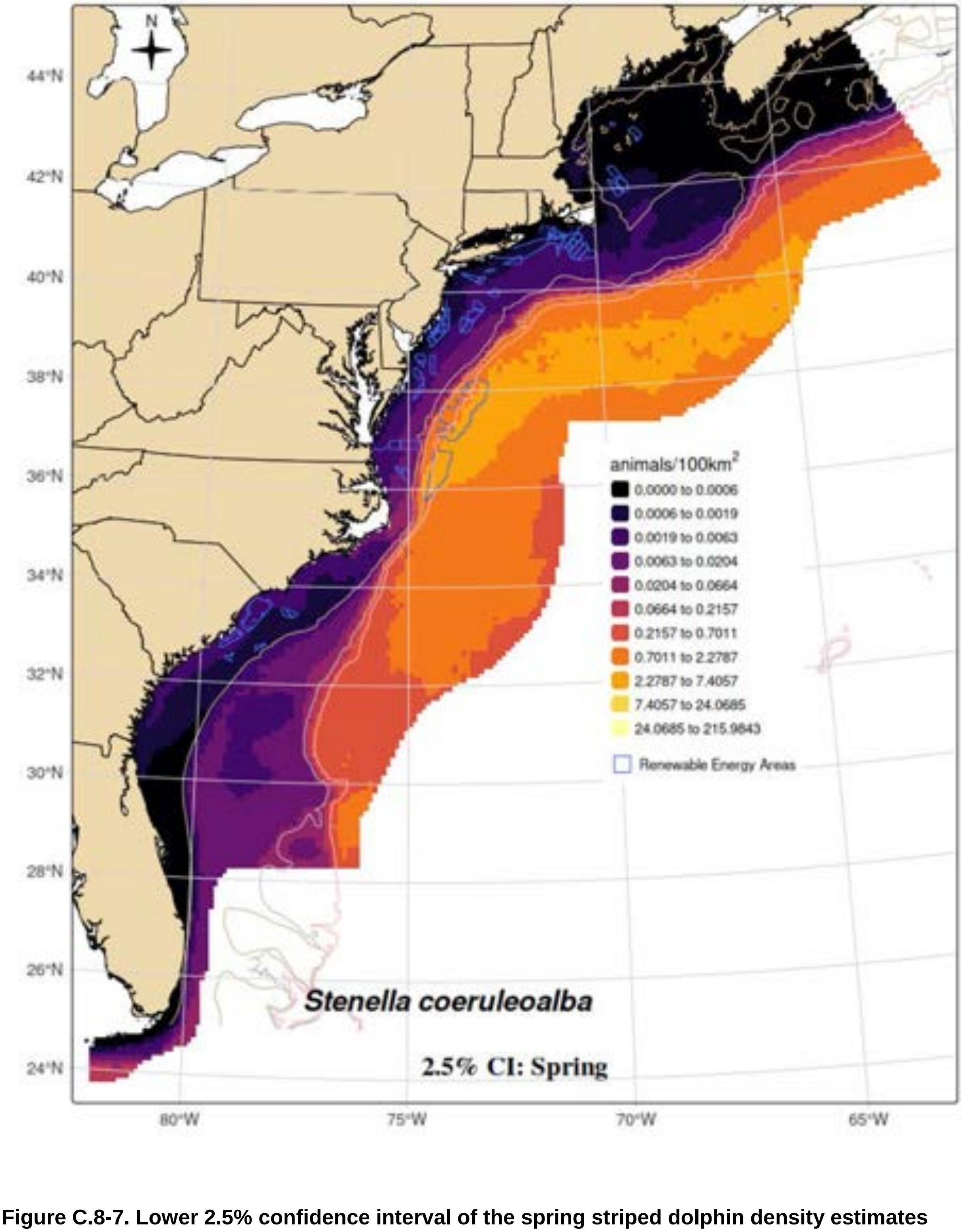

Figure C.8-7. Lower 2.5% confidence interval of the spring striped dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

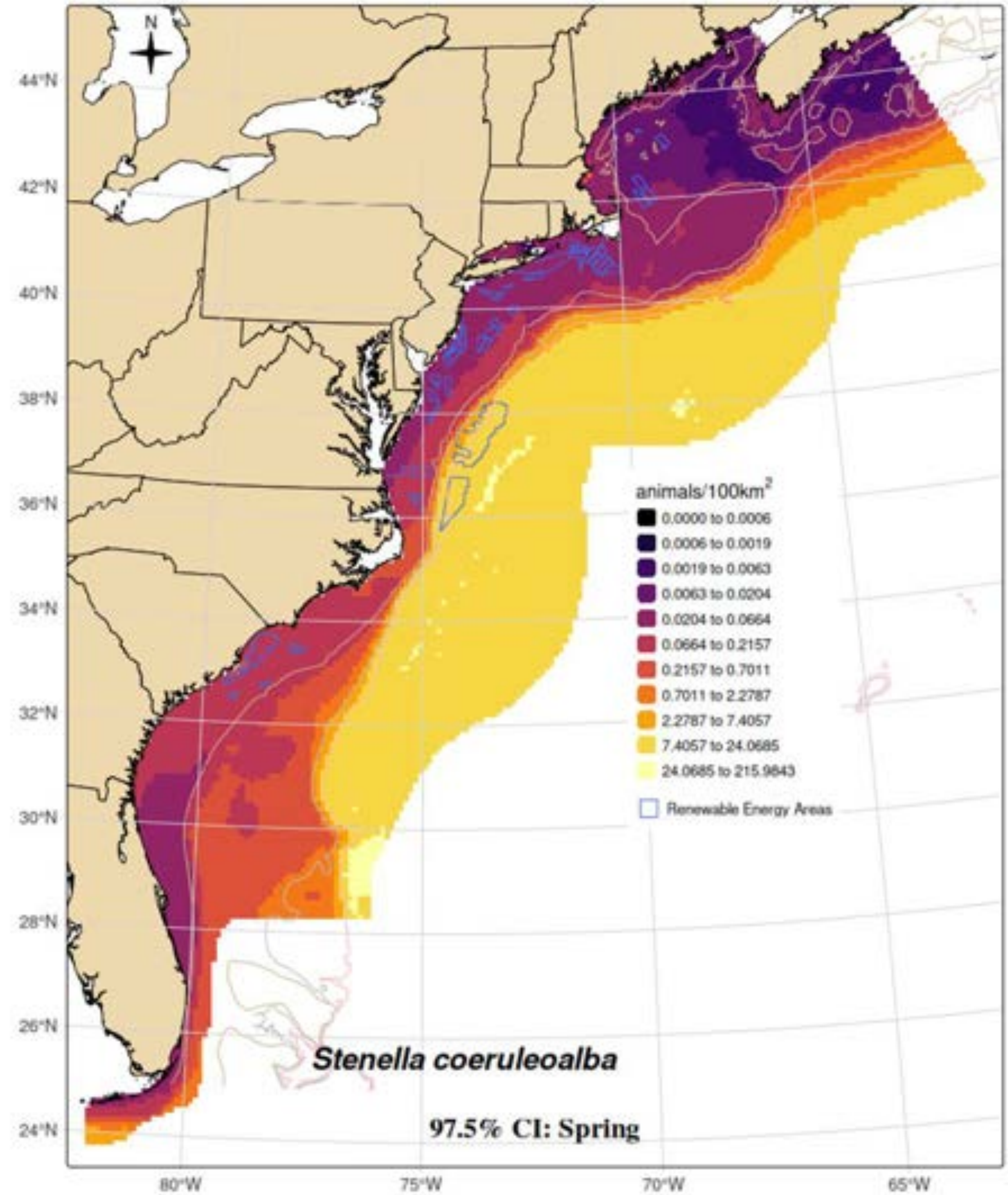

Figure C.8-8. Upper 97.5% confidence interval of the spring striped dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

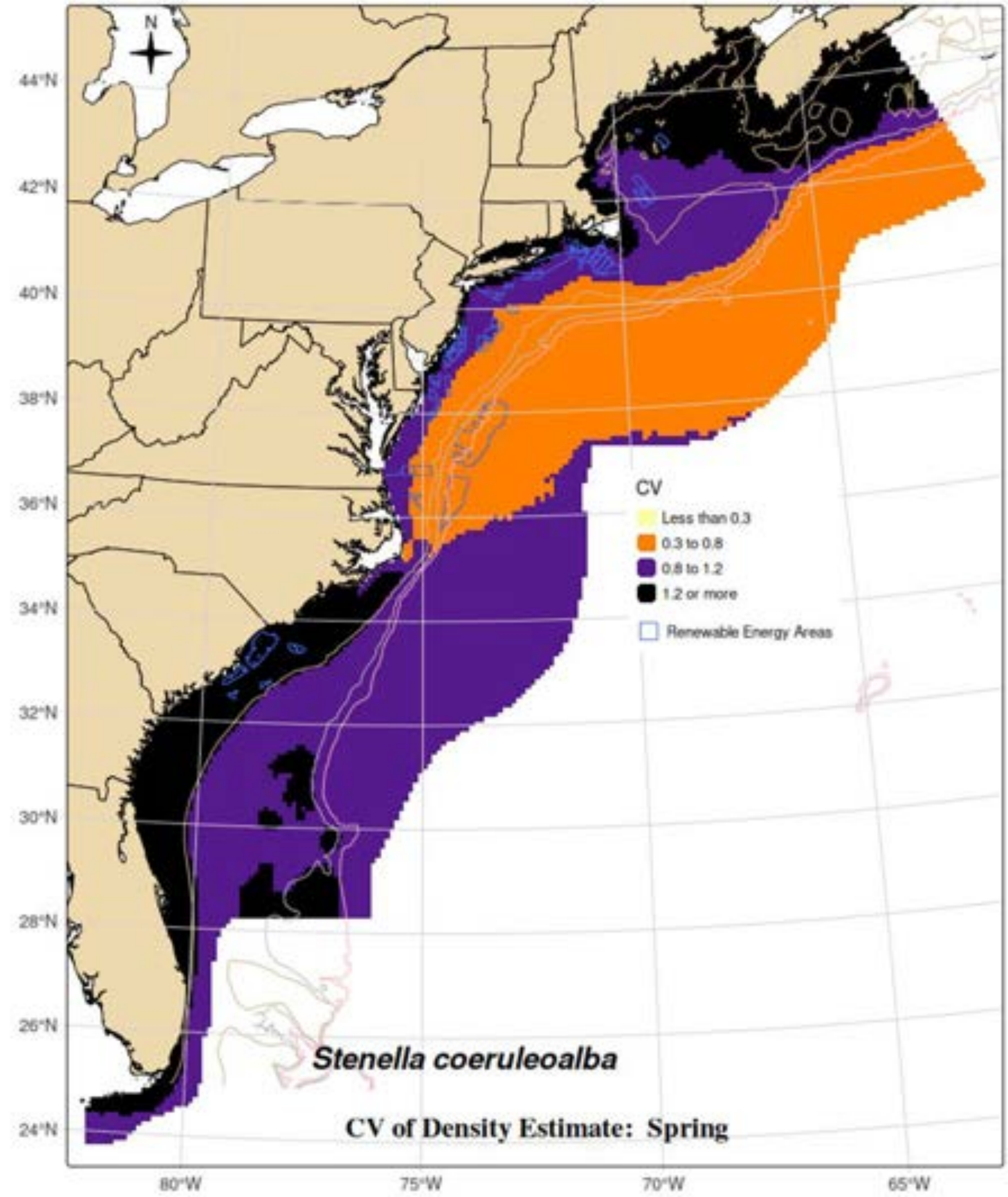

Figure C.8-9. CV of spring striped dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

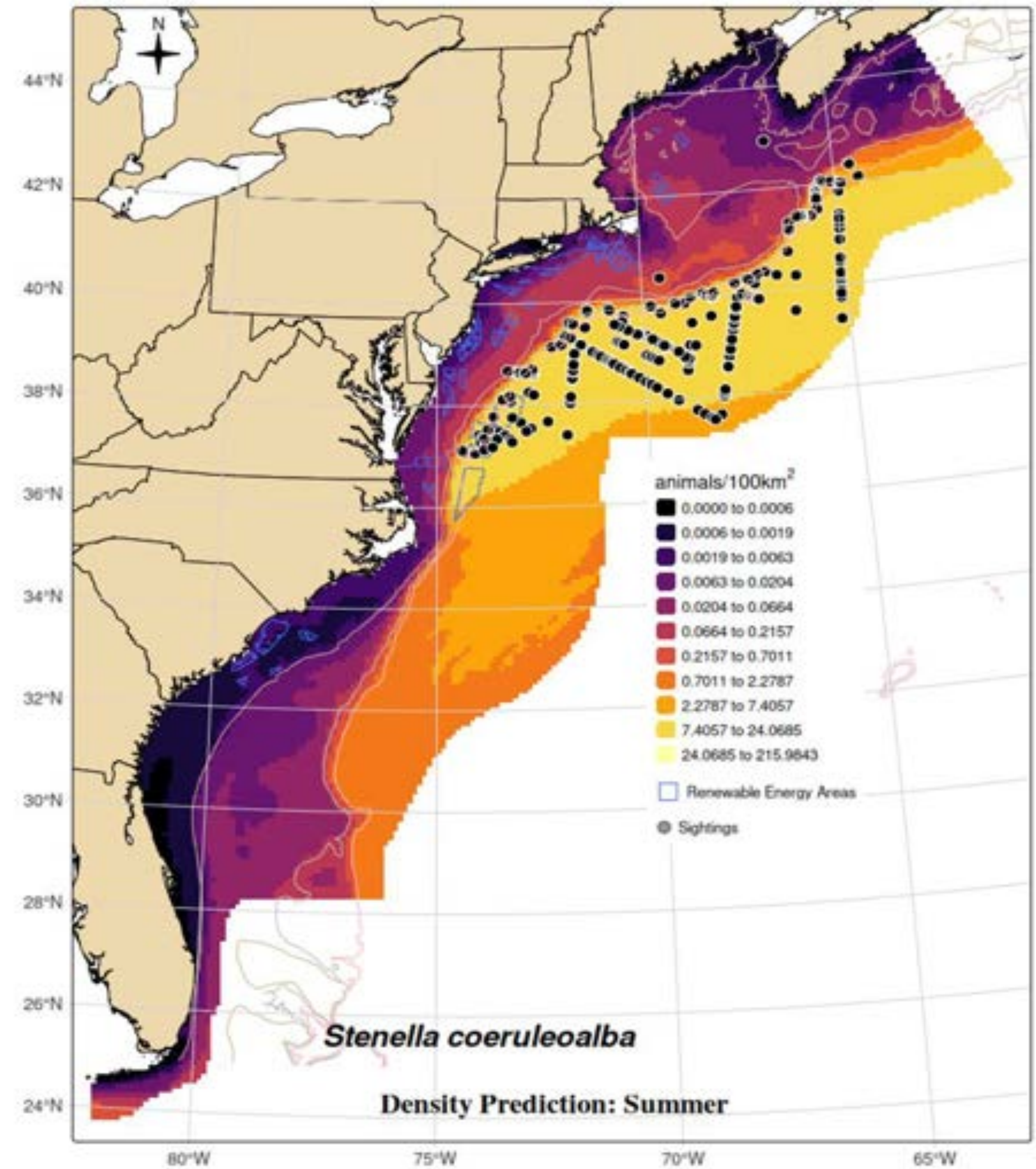

Figure C.8-10. Striped dolphin summer average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

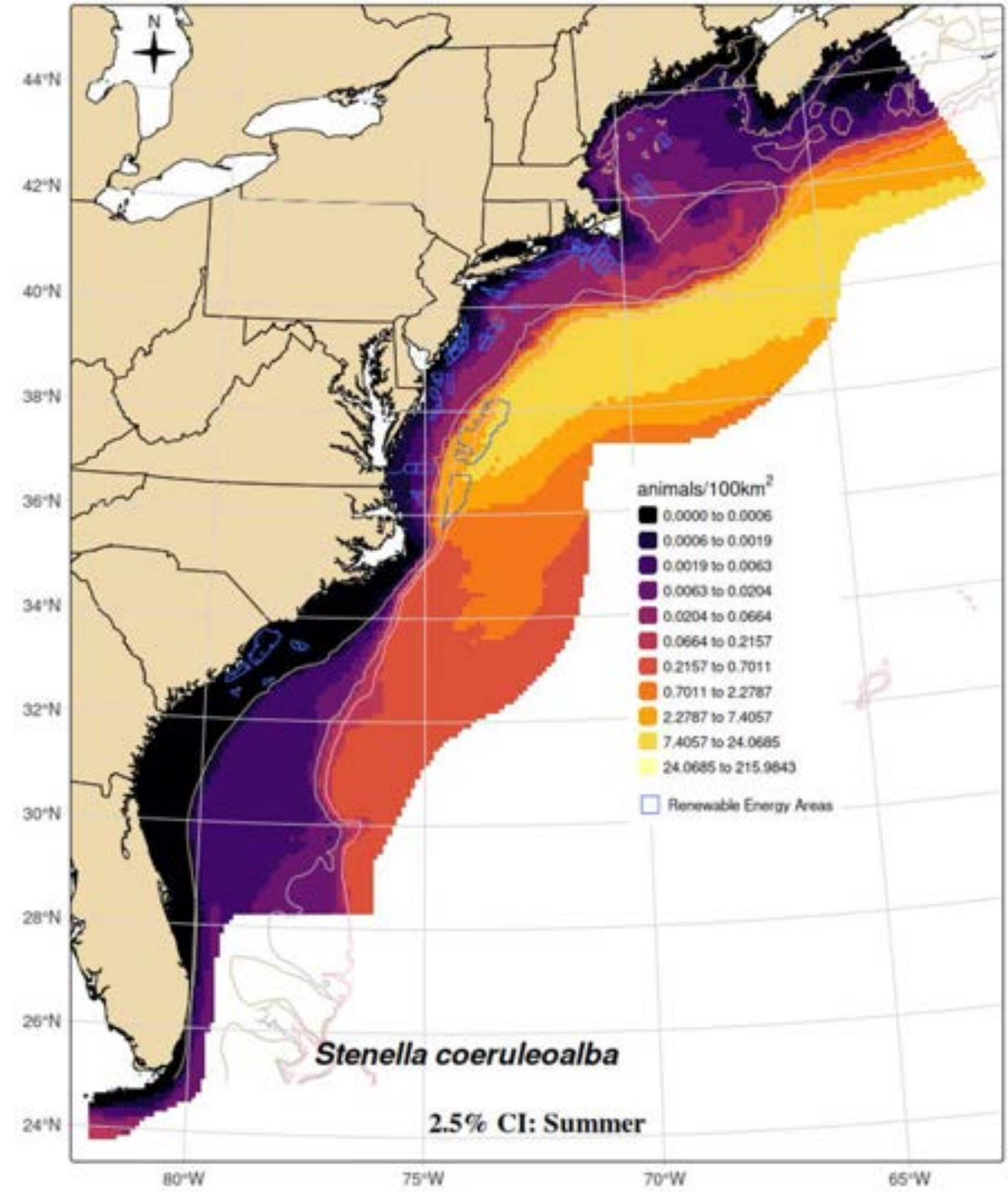

Figure C.8-11. Lower 2.5% confidence interval of the summer striped dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

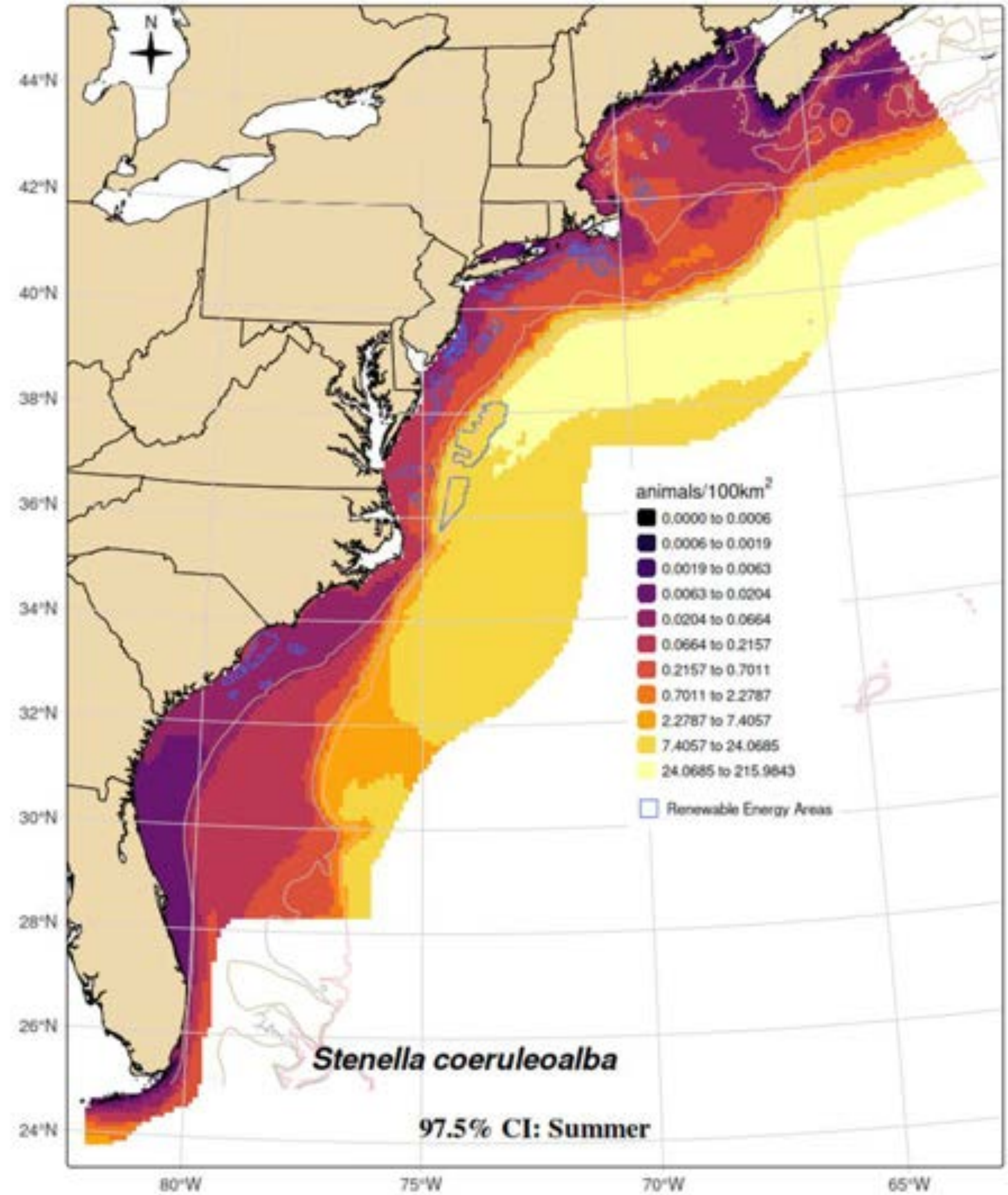

Figure C.8-12. Upper 97.5% confidence interval of the summer striped dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

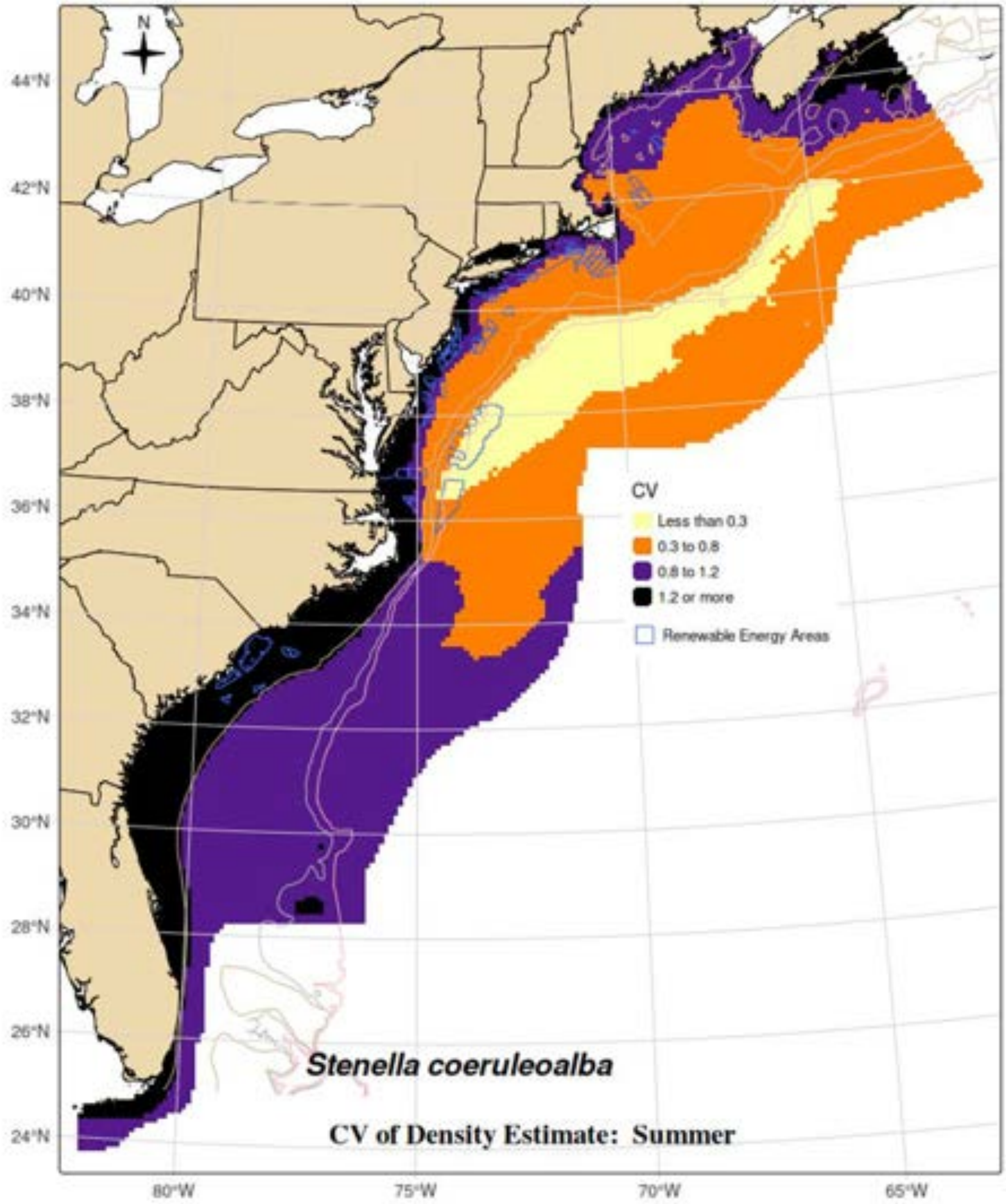

Figure C.8-13. CV of summer striped dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

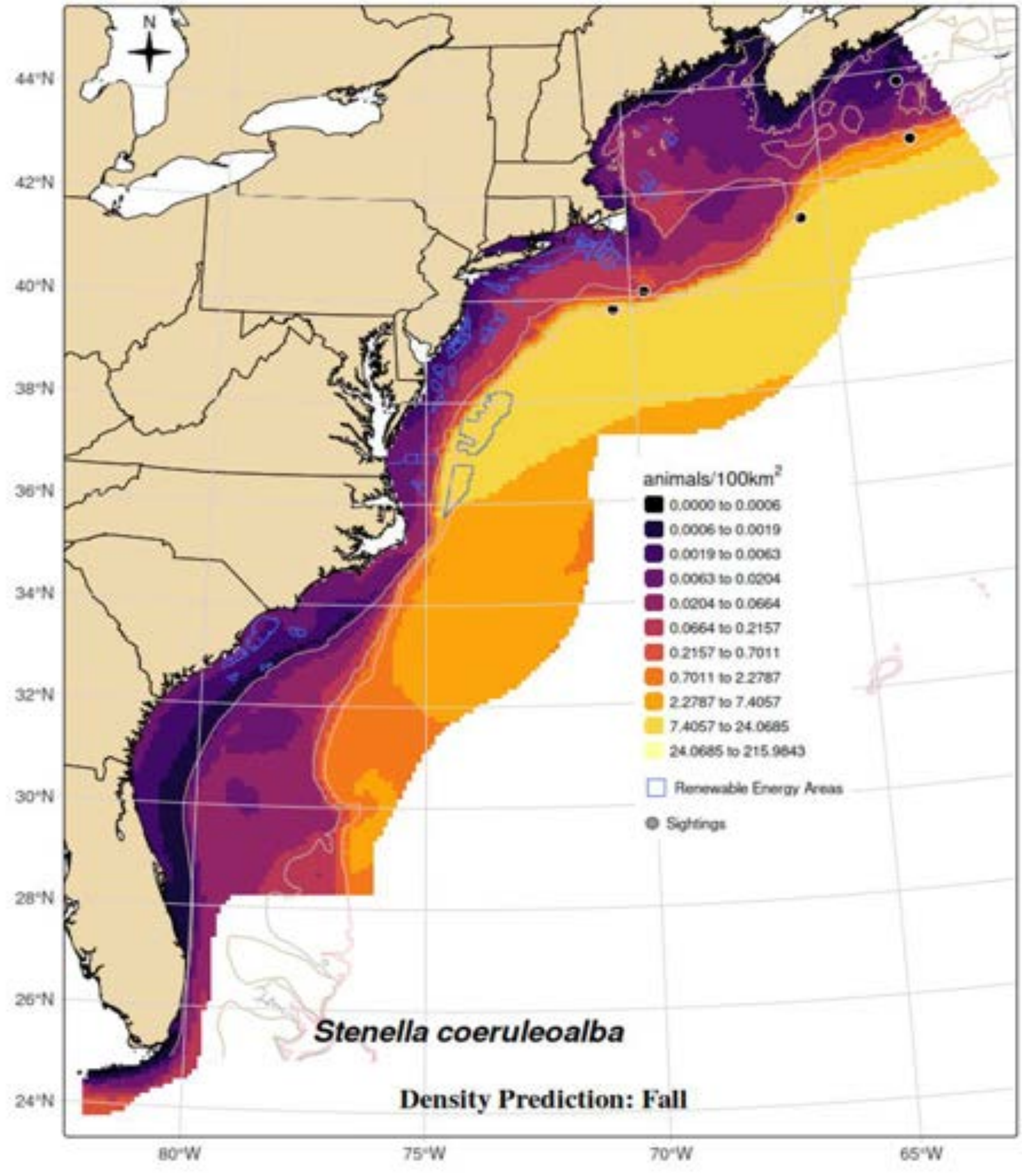

Figure C.8-14. Striped dolphin fall average density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

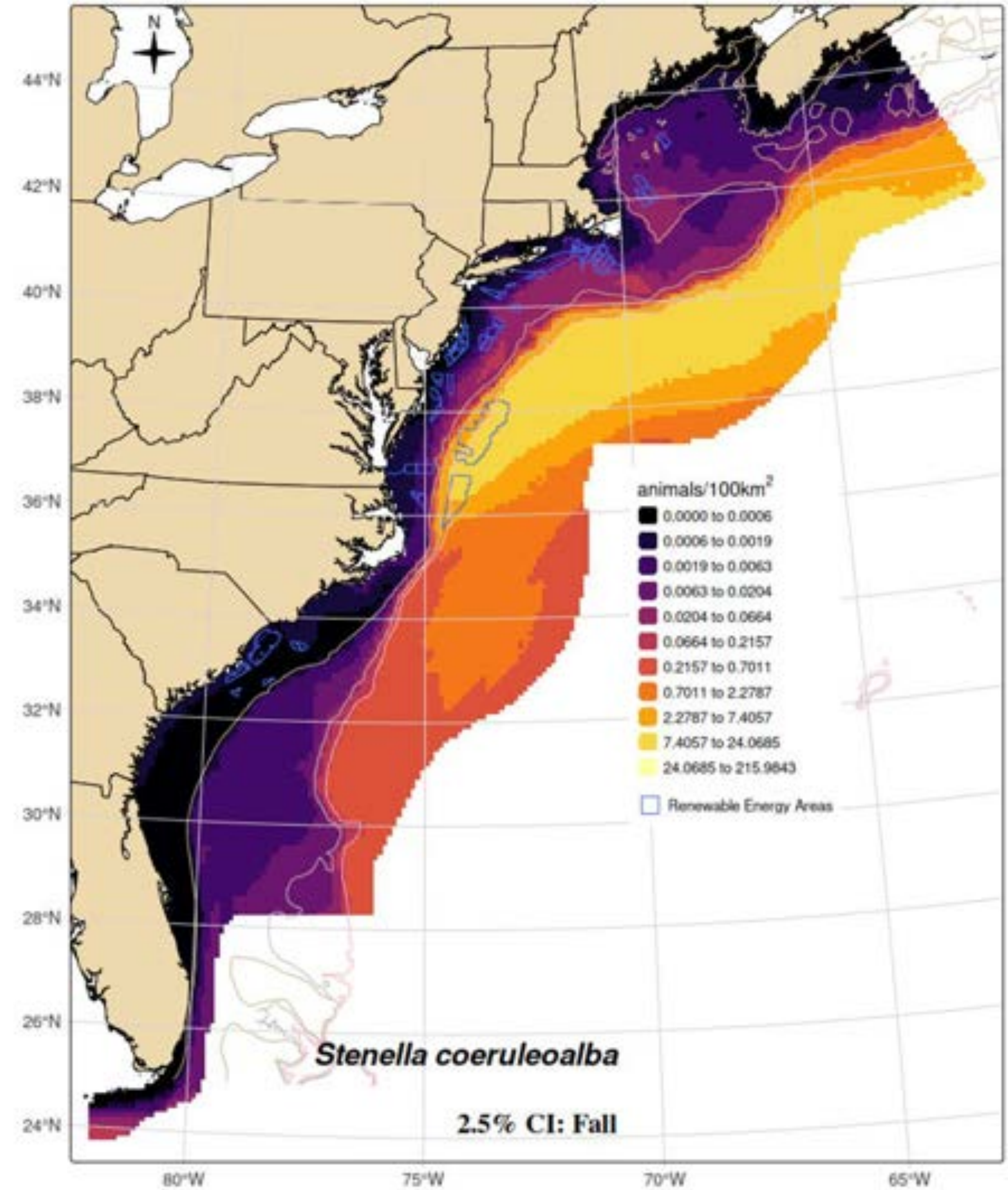

Figure C.8-15. Lower 2.5% confidence interval of the fall striped dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

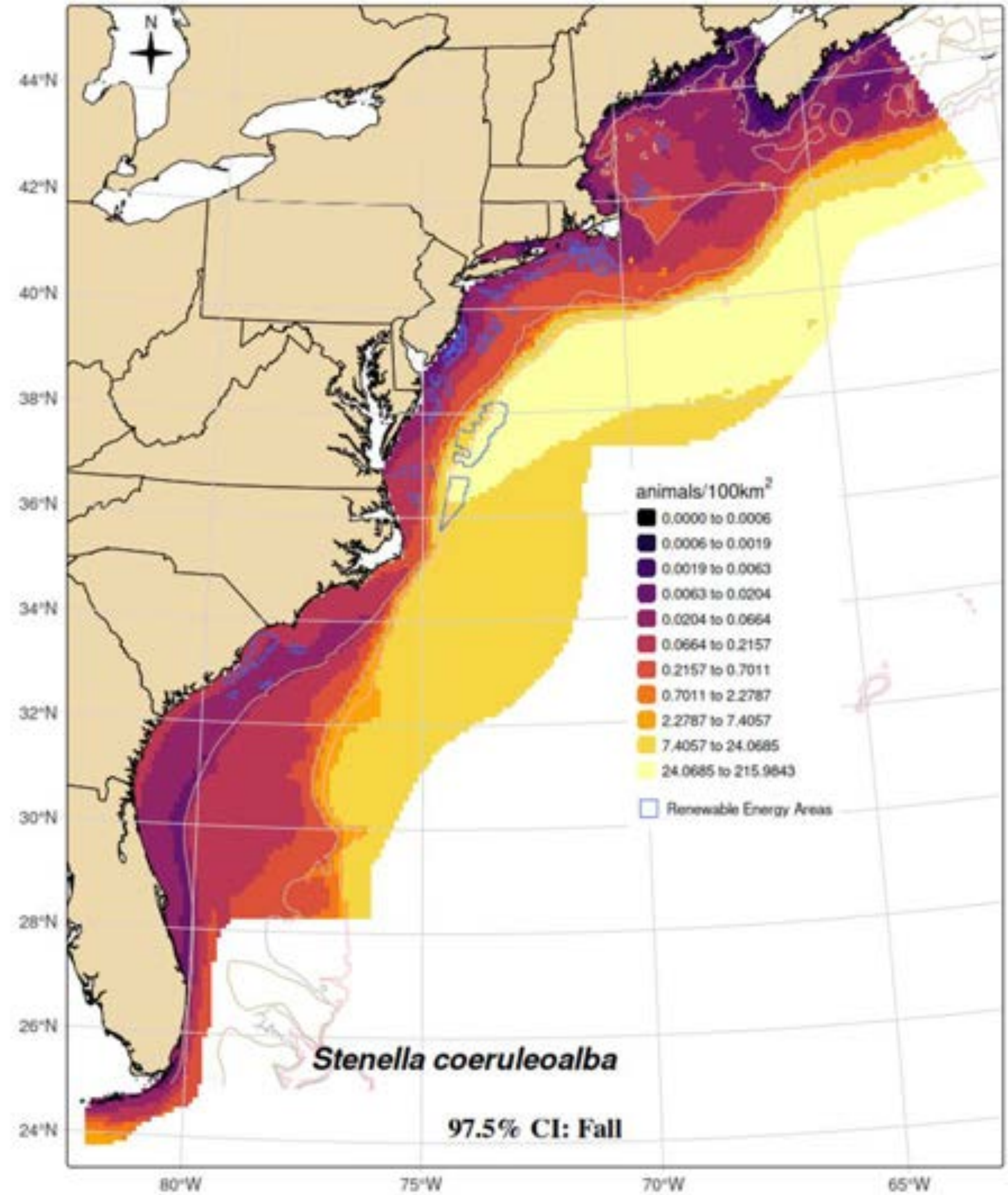

Figure C.8-16. Upper 97.5% confidence interval of the fall striped dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

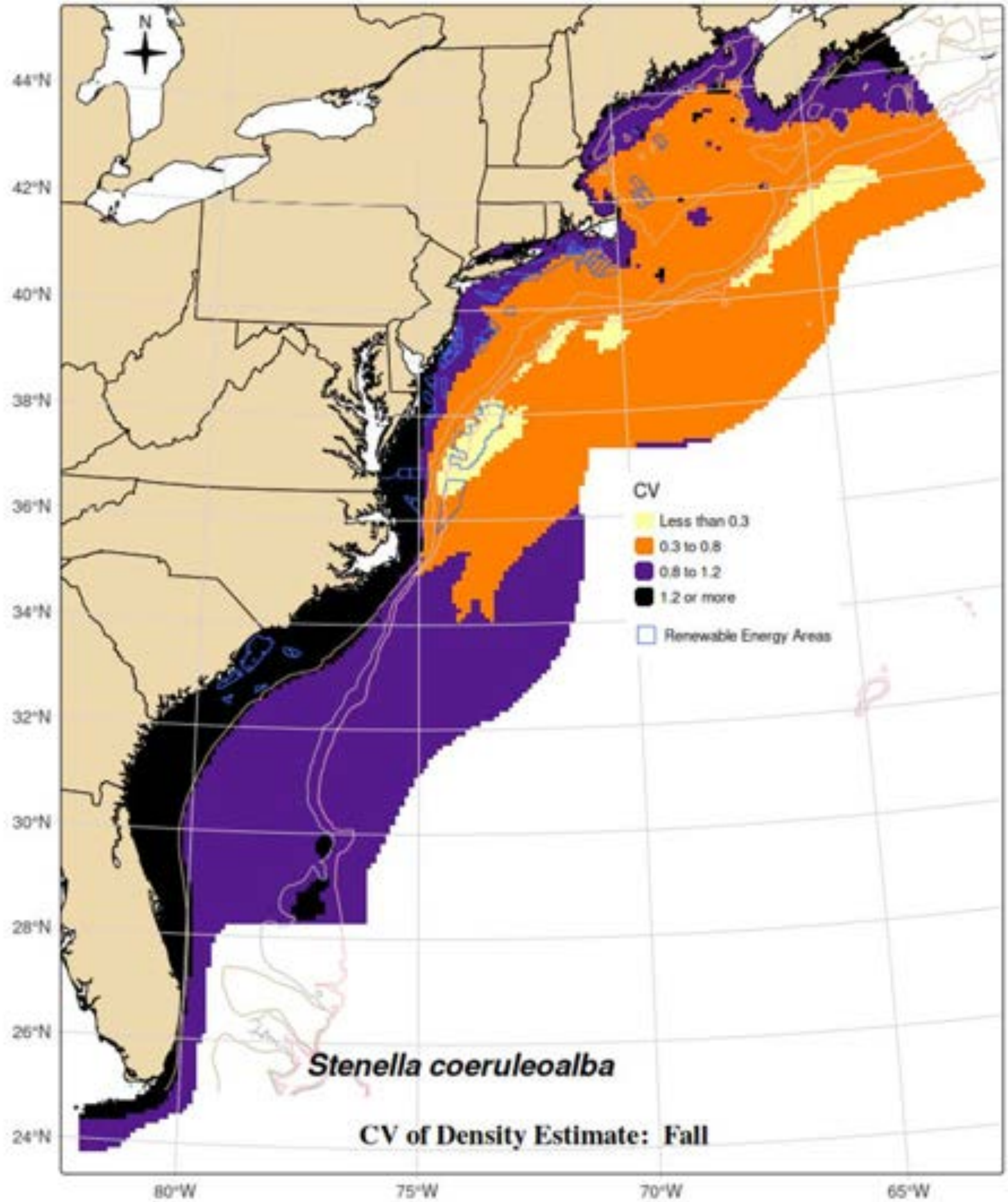

Figure C.8-17. CV of fall striped dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

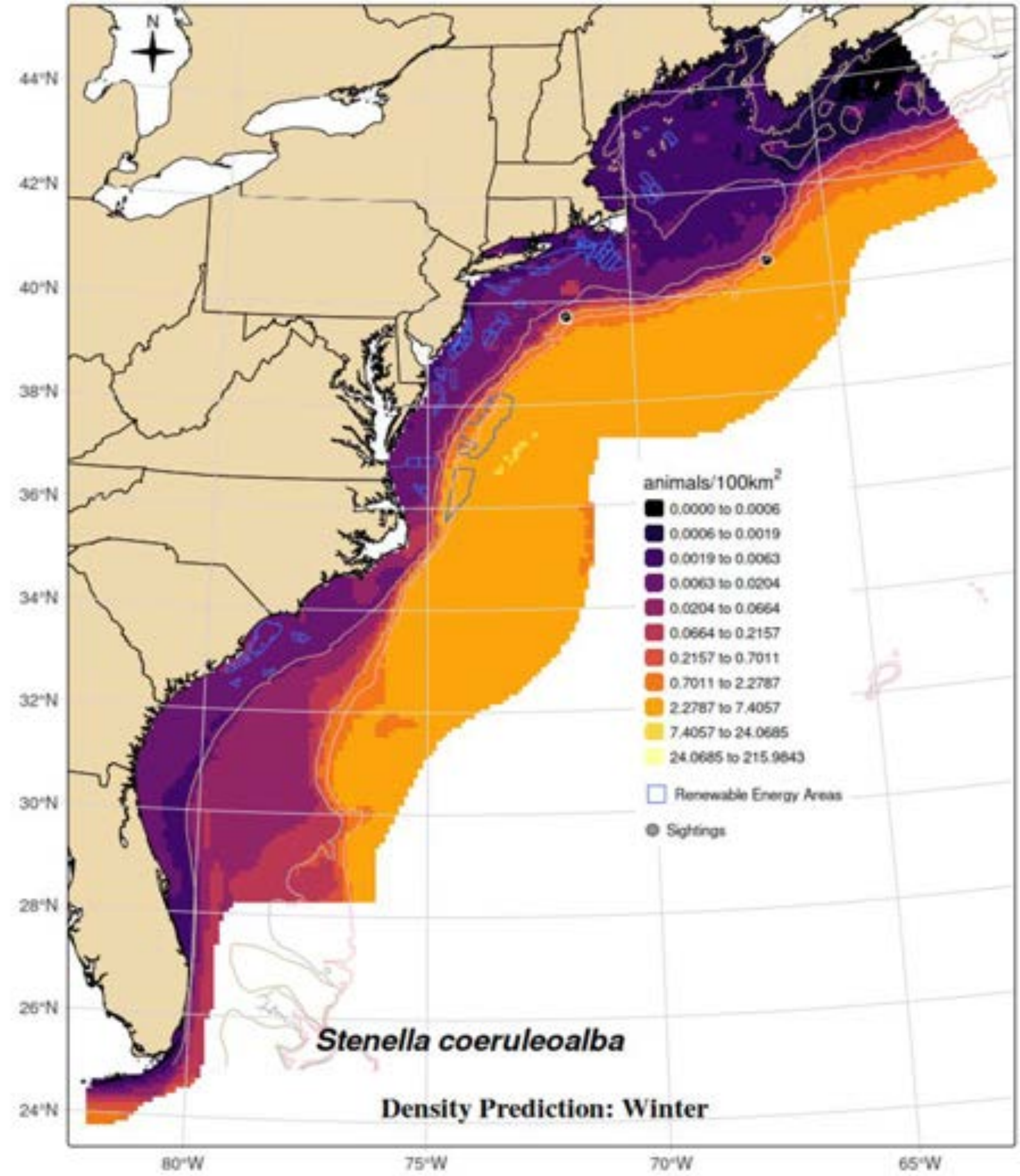

Figure C.8-18. Striped dolphin winter average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

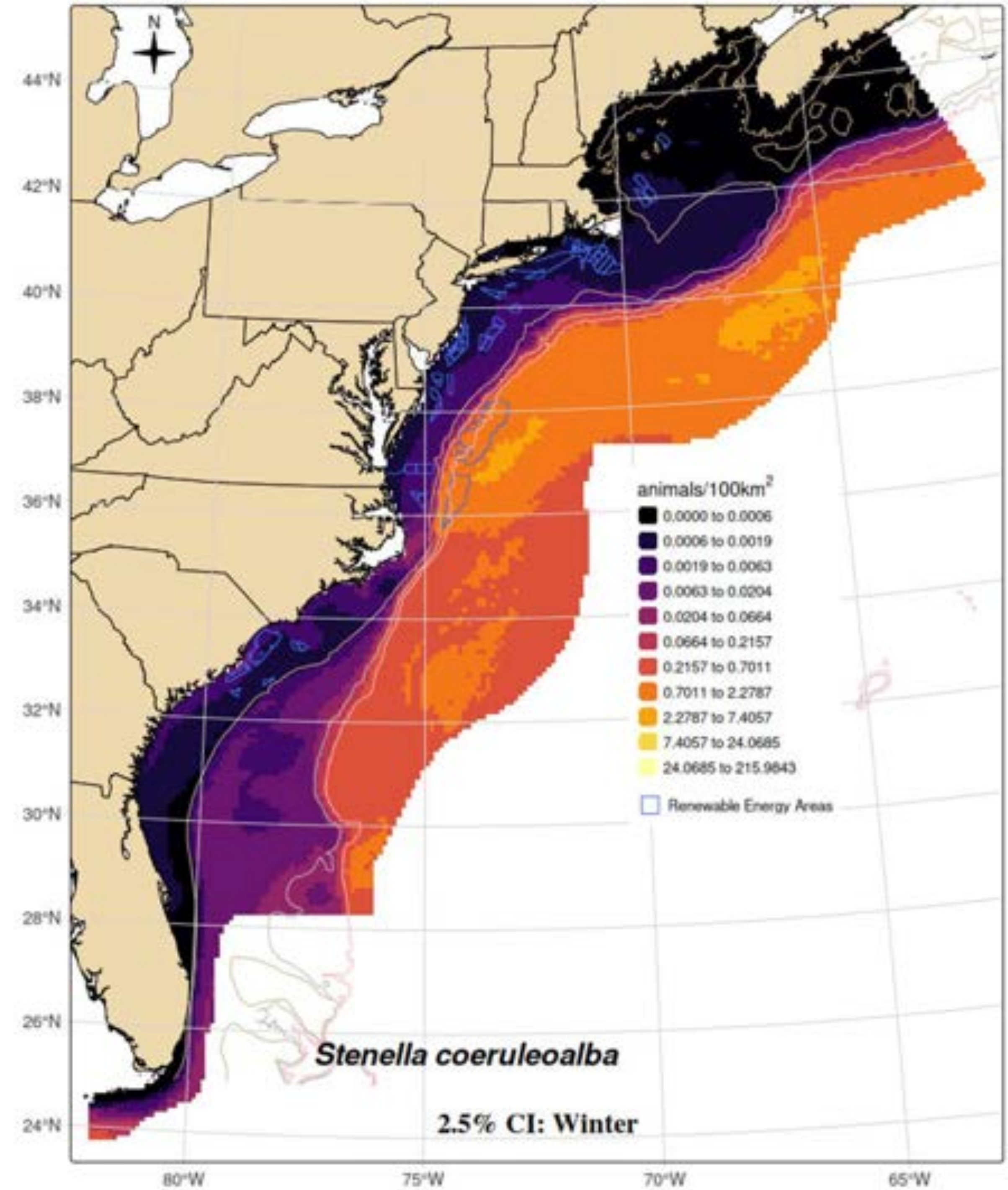

Figure C.8-19. Lower 2.5% confidence interval of the winter striped dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

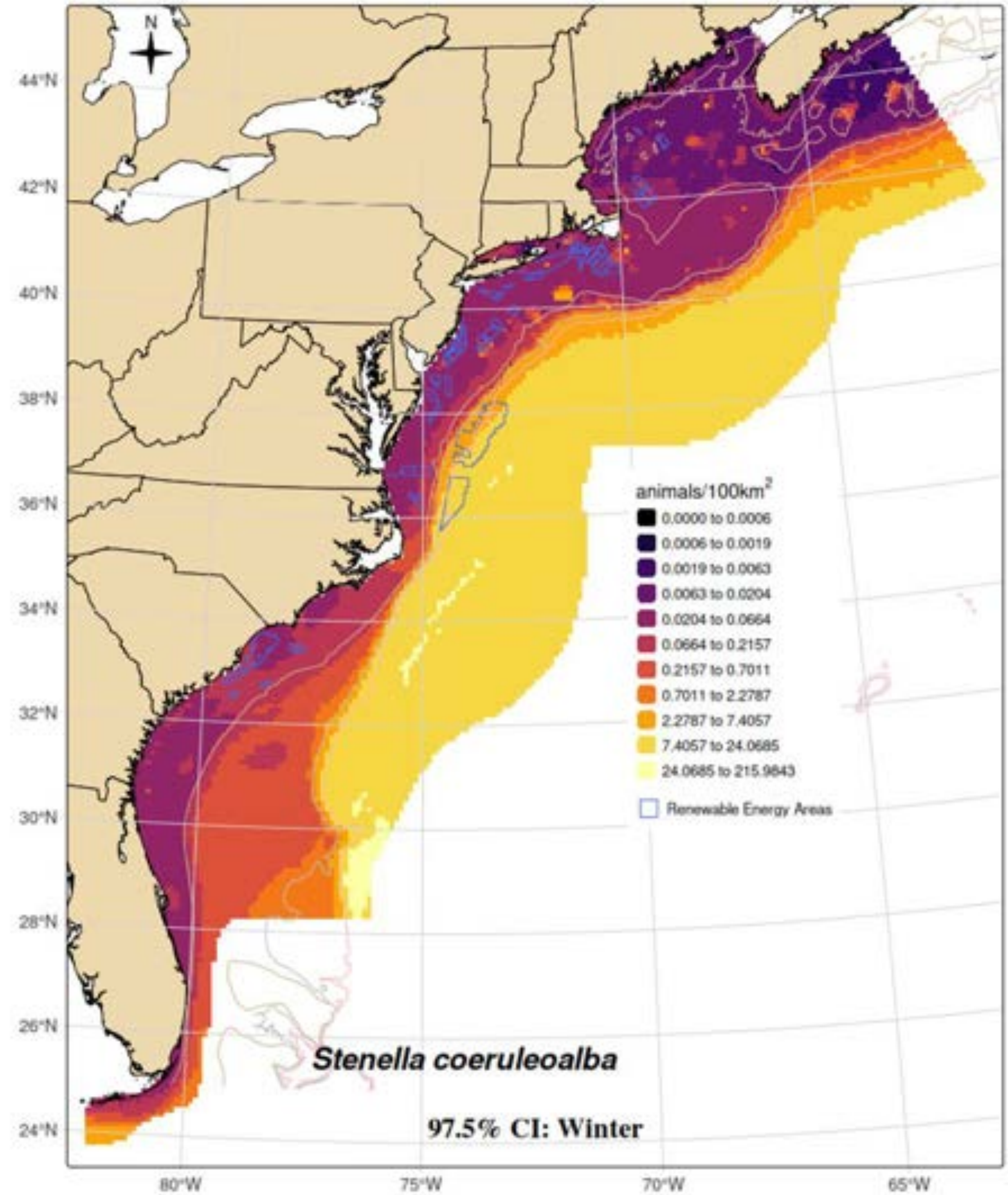

Figure C.8-20. Upper 97.5% confidence interval of the winter striped dolphin density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

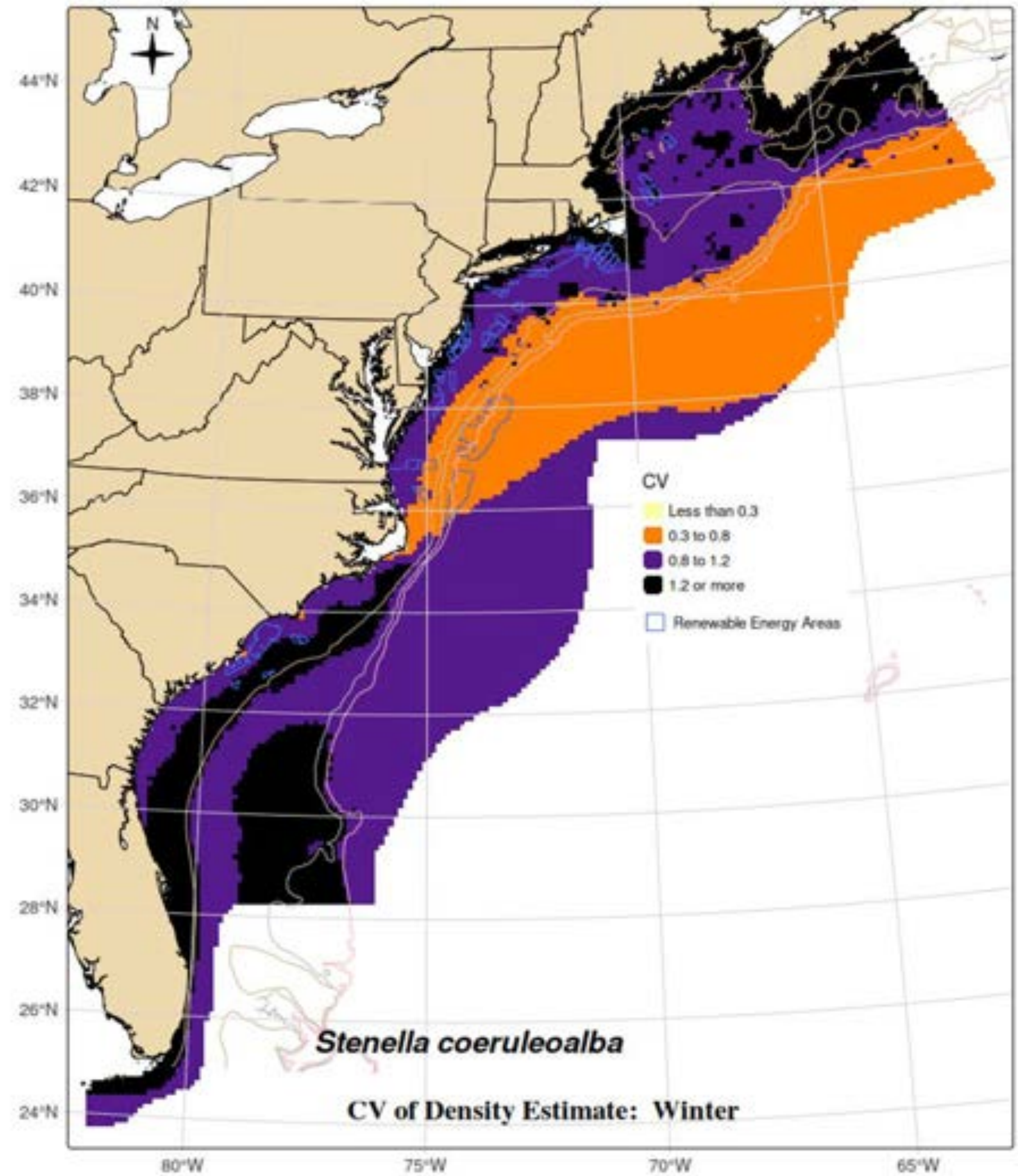

Figure C.8-21. CV of winter striped dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

C.8.7 Offshore Energy Development Areas

Table C.8-6. Striped dolphin abundance estimates for wind-energy study areas

Season	Wind-Energy Study Area	Abundance*	CV	95% Confidence Interval*
Spring (Mar-May)	RI/MA	0.9	1.00	0.2 - 4.8
	NY	0.2	1.02	0 - 1
	NJ	0.4	1.06	0.1 - 2
	DE/MD	0.4	0.95	0.1 - 1.7
	VA	0.6	0.81	0.1 - 2.2
	NC	1.5	0.71	0.4 - 5.3
	NC/SC	2.8	1.40	0.4 - 21.9
	GA	0.3	1.46	0 - 2.4
	FL	0.6	1.10	0.1 - 3.2
Summer (Jun-Aug)	RI/MA	7.9	0.61	2.6 - 23.9
	NY	0.4	0.87	0.1 - 1.6
	NJ	0.4	1.13	0.1 - 2.6
	DE/MD	0.6	1.04	0.1 - 3.2
	VA	0.6	1.31	0.1 - 4.5
	NC	2.6	0.95	0.5 - 12.8
	NC/SC	0.3	2.87	0 - 6.4
	GA	0.0	3.46	0 - 0.5
	FL	0.3	1.11	0 - 1.6
Fall (Sep-Nov)	RI/MA	4.7	0.65	1.5 - 14.9
	NY	0.3	1.01	0.1 - 1.4
	NJ	0.3	1.13	0 - 1.5
	DE/MD	0.3	1.14	0 - 1.5
	VA	0.4	1.46	0 - 3.2
	NC	1.6	1.08	0.3 - 8.8
	NC/SC	1.0	1.87	0.1 - 10.9
	GA	0.1	1.87	0 - 1.5
	FL	0.3	1.05	0.1 - 1.9
Winter (Dec-Feb)	RI/MA	0.7	1.59	0.1 - 6.3
	NY	0.2	1.15	0 - 1.2
	NJ	0.4	1.32	0.1 - 2.8
	DE/MD	0.3	1.11	0.1 - 1.8
	VA	0.3	0.87	0.1 - 1.4
	NC	0.7	0.78	0.2 - 2.9
	NC/SC	2.0	1.06	0.4 - 11.1
	GA	0.2	0.98	0 - 0.9
	FL	0.6	1.10	0.1 - 3.7

***** We rounded the mean abundance and 95% confidence interval to the nearest tenth of an animal. If this resulted in a zero for the mean abundance, we calculated the CV using the actual abundance value as estimated by the density-habitat model and then rounded to the nearest tenth. If a wind-energy study area is not included, then we assumed the abundance was zero.

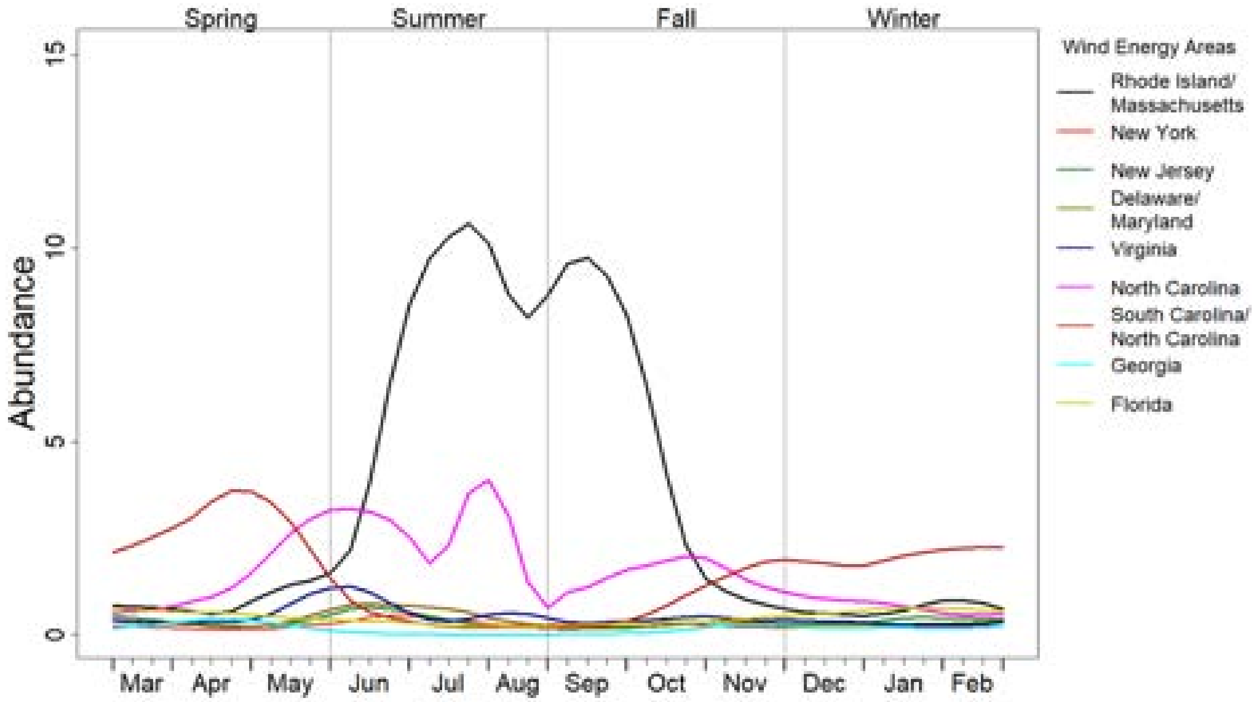

Figure C.8-22. Average seasonal abundance of striped dolphins in the wind-energy study areas

C.9 Common Bottlenose Dolphin (*Tursiops truncatus*)

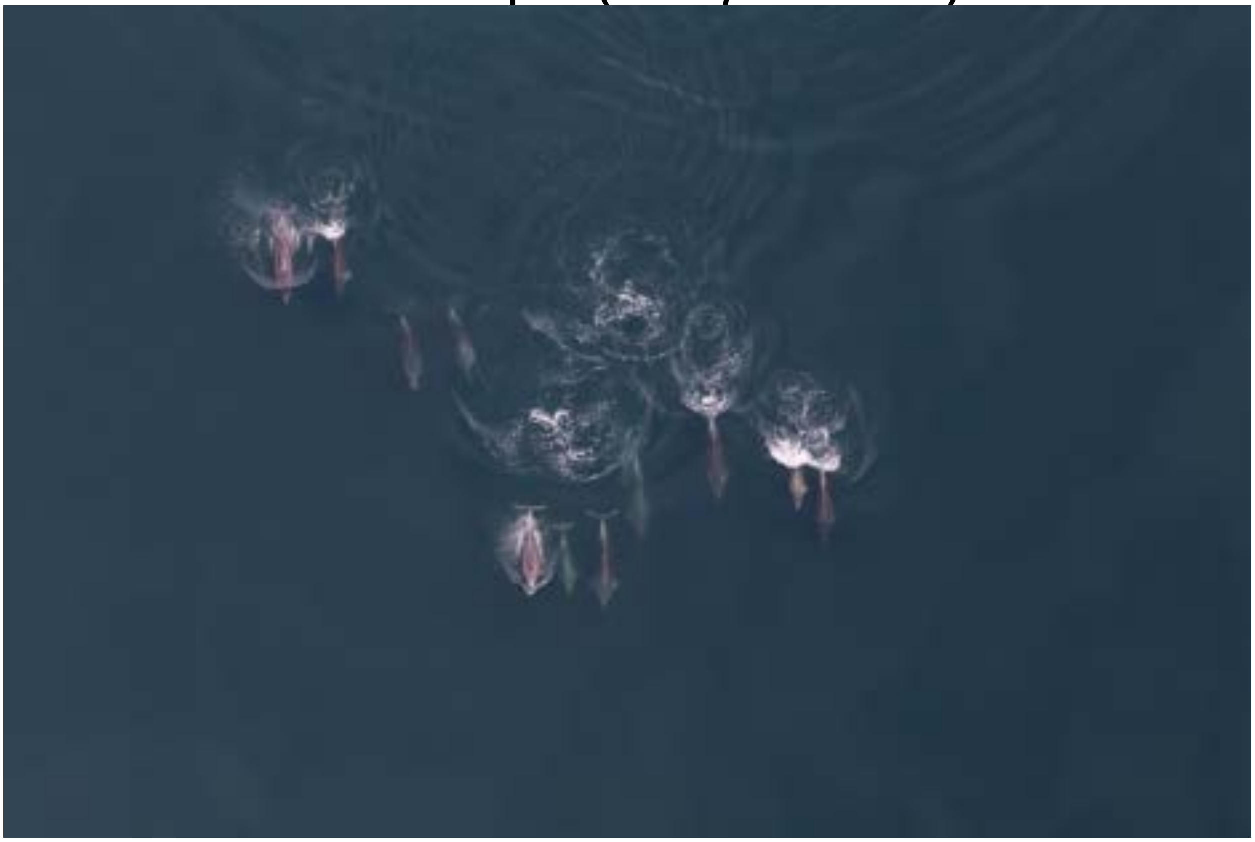

Figure C.9-1. Common bottlenose dolphins
Image collected under MMPA Research permit #17355. Credit: NOAA/NEFSC/Corey Accardo

C.9.1 Data Collection

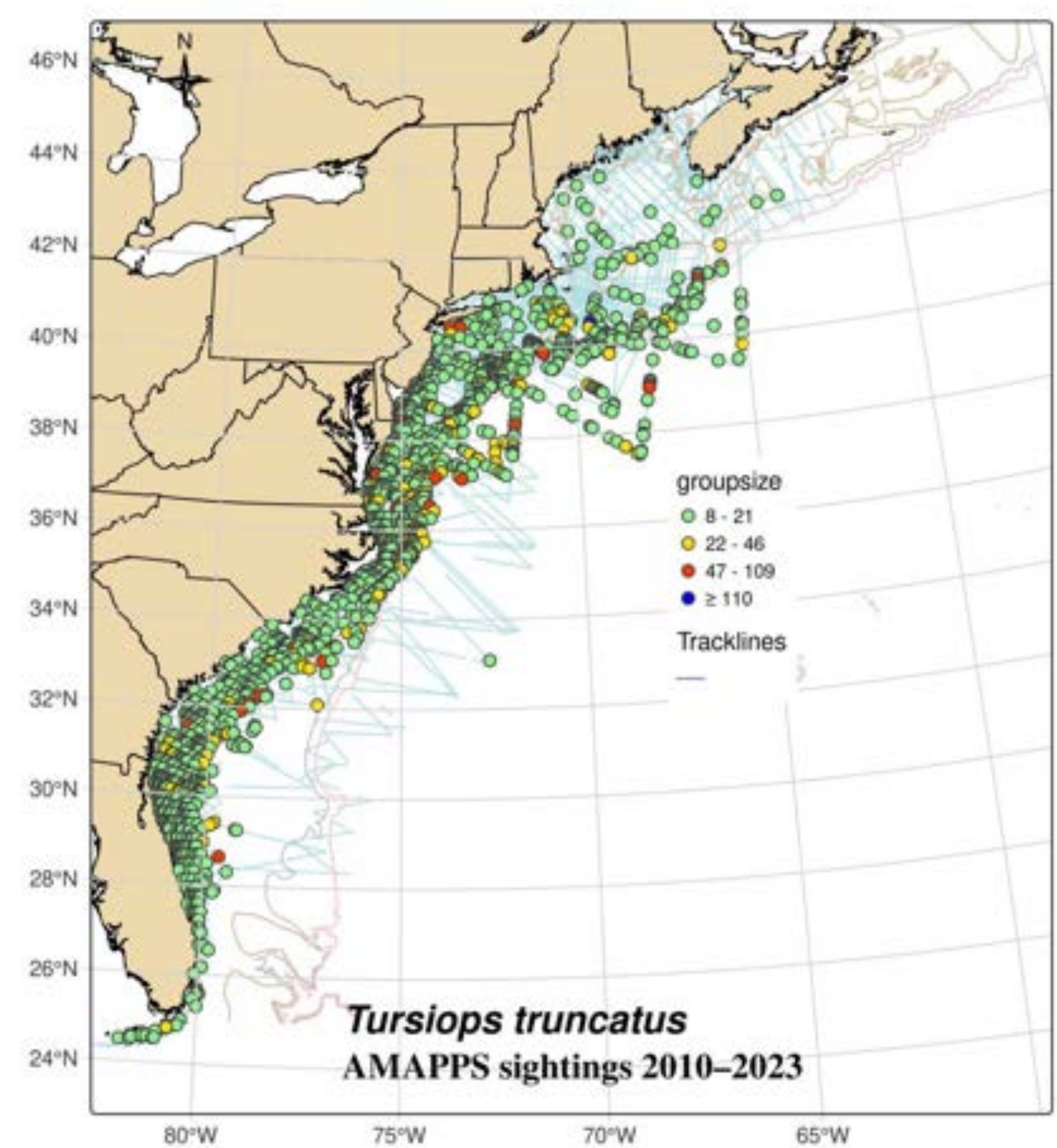

Figure C.9-2. Distribution of track lines and common bottlenose dolphin sightings 2010 to 2023
Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

Table C.9-1. AMAPPS research effort 2010 to 2023 and common bottlenose dolphin sightings

Survey Region and Platform	Season	Effort (km)	Number of Groups	Number of Animals
NE Shipboard	Spring	8,883	26	390
NE Shipboard	Summer	49,064	483	5,651
NE Aerial	Spring	38,839	75	396
NE Aerial	Summer	52,003	62	556
NE Aerial	Fall	87,311	84	936
NE Aerial	Winter	24,747	4	25
SE Shipboard	Spring	2,604	23	427
SE Shipboard	Summer	18,331	197	3,618
SE Shipboard	Fall	2,673	43	925
SE Shipboard	Winter	302	1	15
SE Aerial	Spring	48,634	675	5,897
SE Aerial	Summer	43,285	404	4,209
SE Aerial	Fall	21,153	235	2,728
SE Aerial	Winter	19,152	284	2,002

C.9.2 Mark-Recapture Distance Sampling Analysis

Table C.9-2. Intermediate parameters in common bottlenose dolphin mark-recapture distance sampling (MRDS) models

Analysis Set	MR Model	MR Truncation (m)	DS Model	DS Truncation (m)	Key function	p(0)	p(0) CV	Chi-square p-value	CvM p-value
SE–aerial group 2	Distance * observer + log(group size) + sea state + glare	460	distance + glare	460	HN with Hermite Polynomial Adjustment Order 6	0.81	0.03	0.00	0.78
NE–aerial group 4	distance * observer + log(group size)	380	distance + log(group size)	550	HR	0.31	0.18	0.30	0.94
NE–shipboard group 3	distance * observer + log(group size) + sea state + glare + swell height	4100	distance + sea state + glare	4100	HR	0.64	0.07	0.05	0.79
SE–shipboard group 2	Distance*observer + log(group size)	5000	Distance + glare + log(group size)	5000	HR	0.57	0.12	0.05	0.73

MR=Mark-Recapture, DS=Distance Sampling, HR=Hazard Rate, HN= Half Normal, CV=Coefficient of variation. Values of p>0.5 for Chi-square and Cramer-von Mises test (CvM) indicate good fit. The definition of p(0) is the probability of detecting a group on the track line. Species included in the analysis sets are explained in main text Tables 4-20 and 4-21.

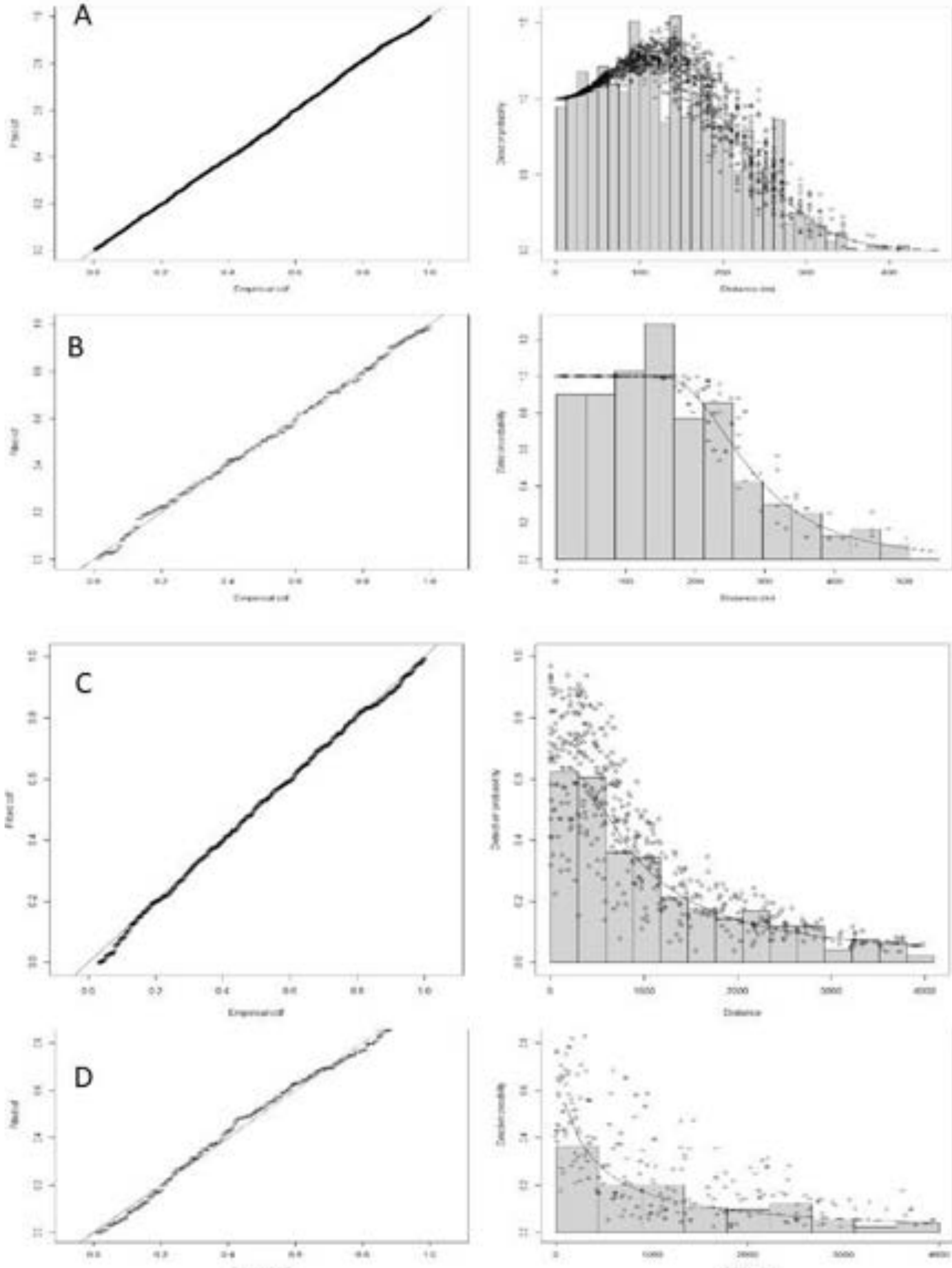

Figure C.9-3. Q-Q plots and detection functions from common bottlenose dolphin MRDS analyses
A) SE-aerial analysis set 2; B) NE-aerial analysis set 4; C) NE-shipboard analysis set 3; D) SE-shipboard analysis set 2.

C.9.3 Generalized Additive Model Analysis

Table C.9-3. 2010 to 2023 density-habitat model output for common bottlenose dolphins

Covariates	Edf	Ref.df	F	C.dev	p-value
s(sstmur)	4.10	5	21.76	5.80	<0.0001
s(chlaf)	3.25	5	3.87	0.42	0.0002
s(mlp)	2.12	5	7.06	1.03	<0.0001
s(btemp)	4.77	5	13.80	2.79	<0.0001
s(dist2GSNw)	4.69	5	22.26	1.50	<0.0001
s(dist2shore)	4.69	5	29.15	6.79	<0.0001
s(dist200)	4.74	5	34.71	5.29	<0.0001
s(latdd)	4.86	5	77.57	10.88	<0.0001

Adjusted R^2 = 0.0373. Deviance explained = 34.5%.
Includes the estimated degrees of freedom (Edf), reference degrees of freedom (Ref.df), contribution to the deviance (C.dev) explained for each habitat covariate and its associated p-value. Covariate abbreviations explained in main text in Table 4-2.

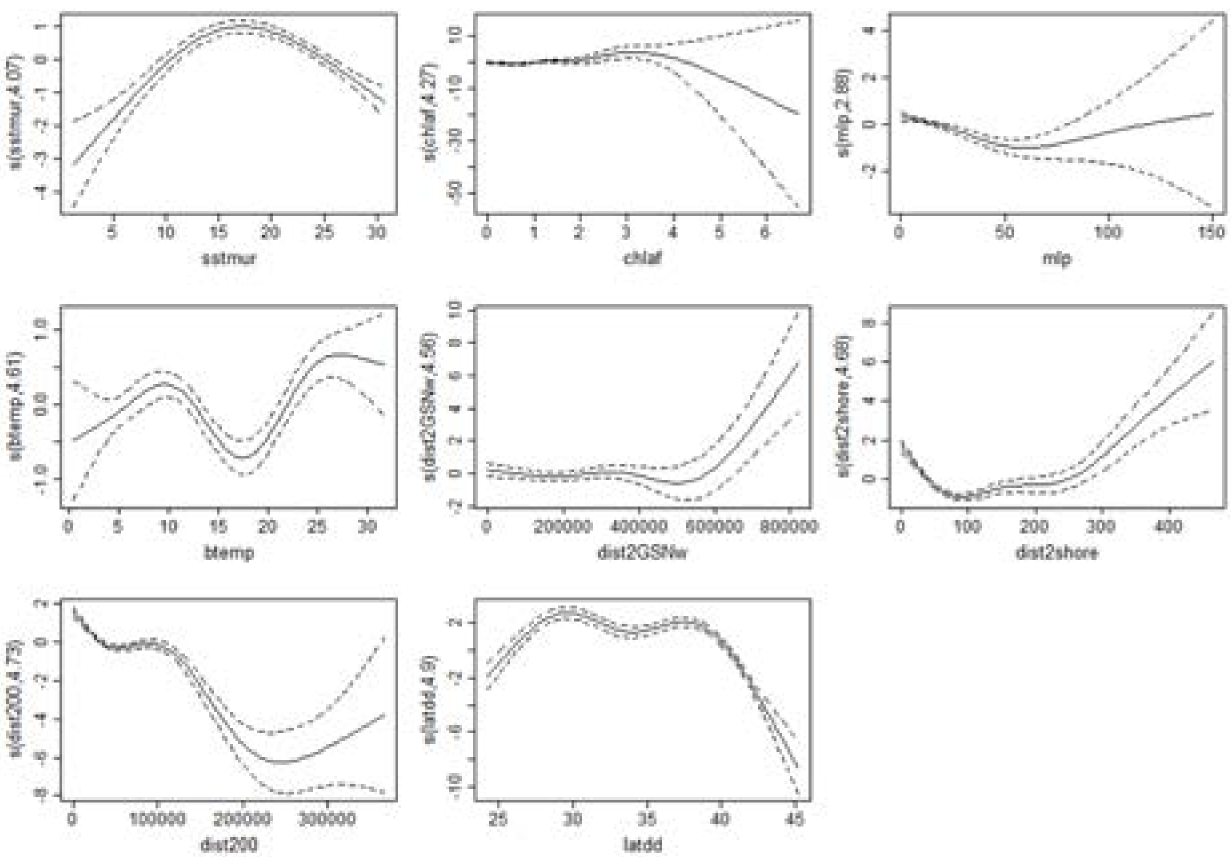

Figure C.9-4. Common bottlenose dolphin density relative to significant habitat covariates
Plots represent the partial smooths and interaction terms of the density-habitat model. Covariate abbreviations explained in main text in Table 4-2.

C.9.4 Model Cross-Validation

Table C.9-4. Diagnostic statistics from the common bottlenose dolphin density-habitat model

Diagnostic Statistic	Description	Calculated with	Model Values (x)	Score
RHO	Spearman rank correlation	Non-zero density	0.302	Excellent
MAPE	Mean absolute percentage error	Non-zero density	83.690	Fair to good
RHO	Spearman rank correlation	All data divided in 25 random samples	0.172	Fair to good
MAE	Mean absolute error	All data divided in 25 random samples	0.311	Excellent
MAPE	Mean absolute percentage error	All data divided in 25 random samples	81.456	Fair to good

RHO: Poor= x<0.05; Fair to good =0.05<=x<0.3; Excellent= x>0.3
MAPE: Poor= x>150%; Fair to good= 150%>=x>50%; Excellent= x<=50%
MAE: Poor= x>1; Fair to good = 1>=x>0.25; Excellent= x<=0.25

C.9.5 Abundance Estimates for AMAPPS Study Area

Table C.9-5. Common bottlenose dolphin average abundance estimates for AMAPPS study area

Season	Average Abundance	CV	95% Confidence Interval
Spring (March–May)	68,186	0.29	39,067 – 119,010
Summer (June–August)	55,155	0.26	33,410 – 91,053
Fall (September–November)	54,424	0.26	32,967 – 89,846
Winter (December–February)	49,587	0.30	27,892 – 88,156
Summer 2011 U.S. surveys[1]	77,532	0.40	47,138 – 127,524
Summer 2016 U.S. surveys[1]	61,888	0.23	46,084 – 83,111
Summer 2021 U.S. surveys	64,587	0.24	40,617 – 102,703

[1]Hayes et al. 2024

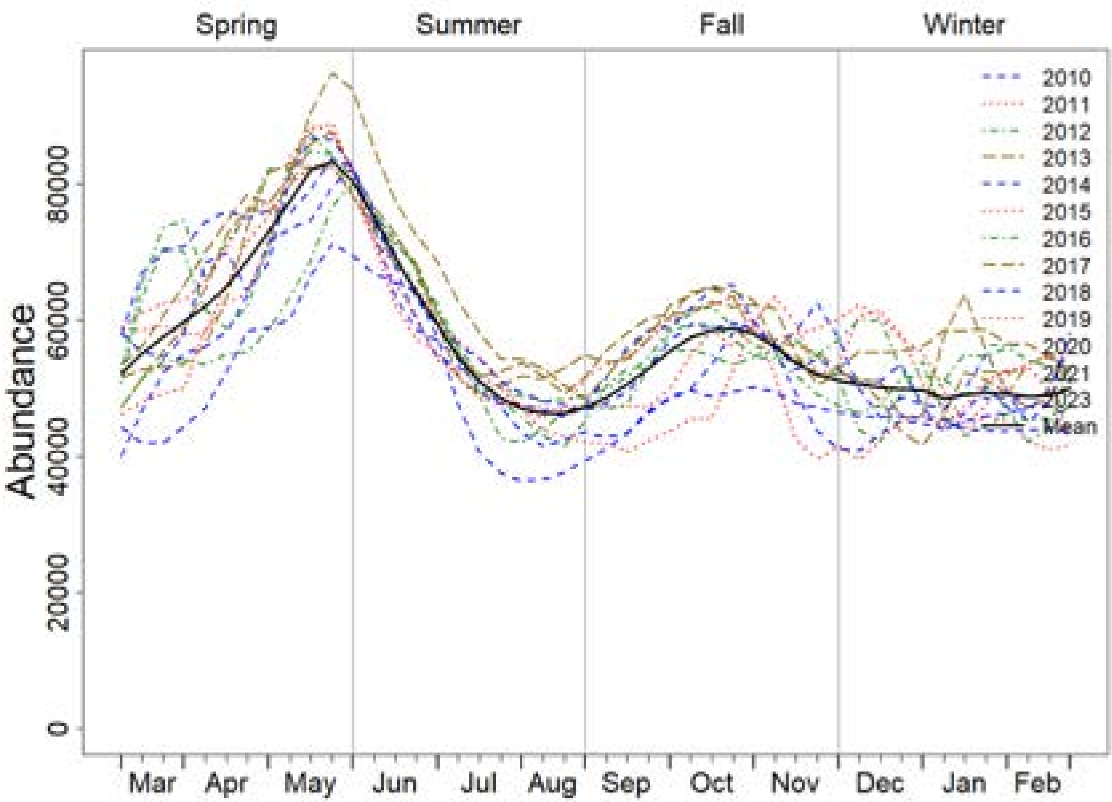

Figure C.9-5. Annual abundance trends for common bottlenose dolphins in AMAPPS study area

C.9.6 Seasonal Prediction Maps

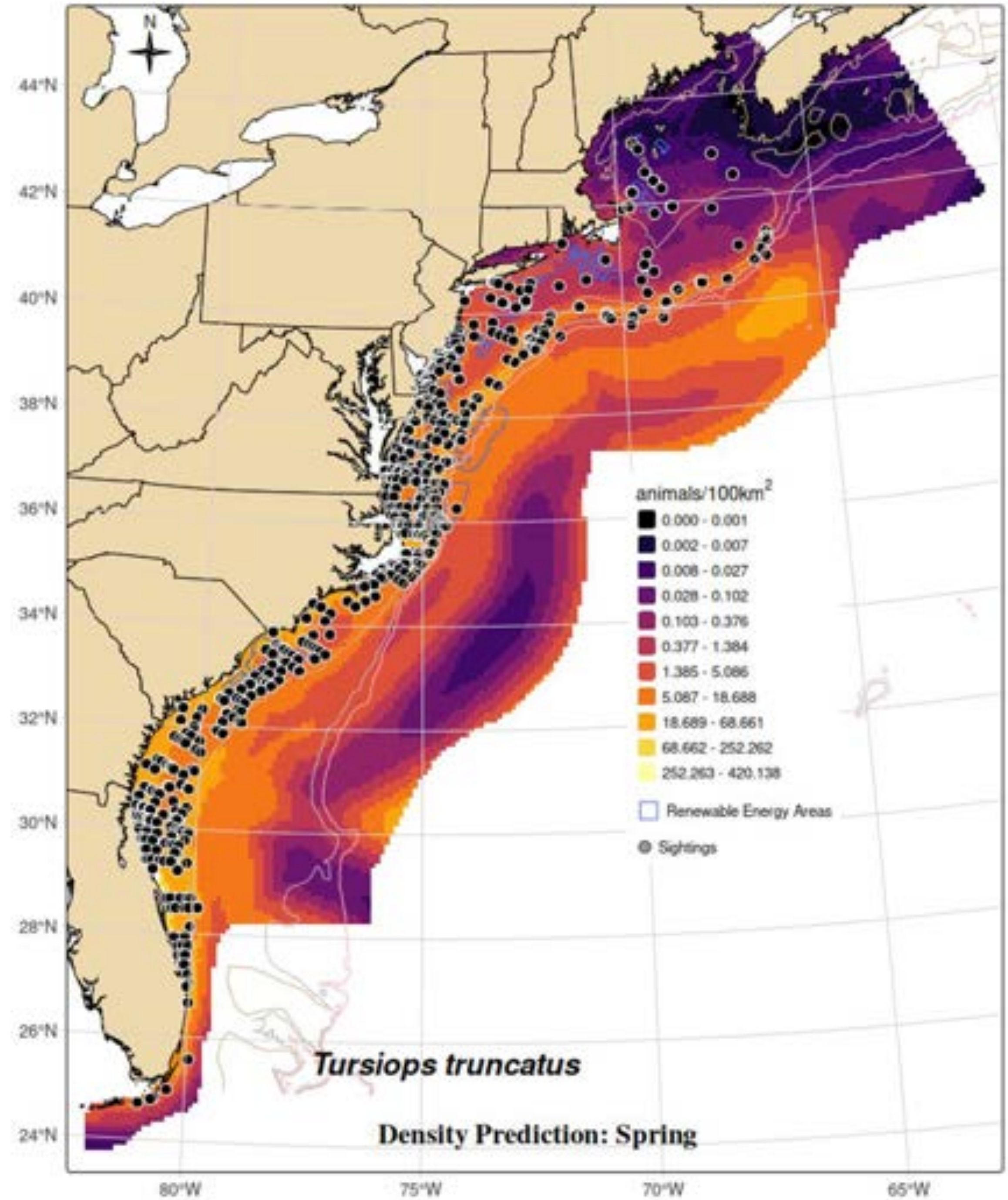

Figure C.9-6. Common bottlenose dolphin spring average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

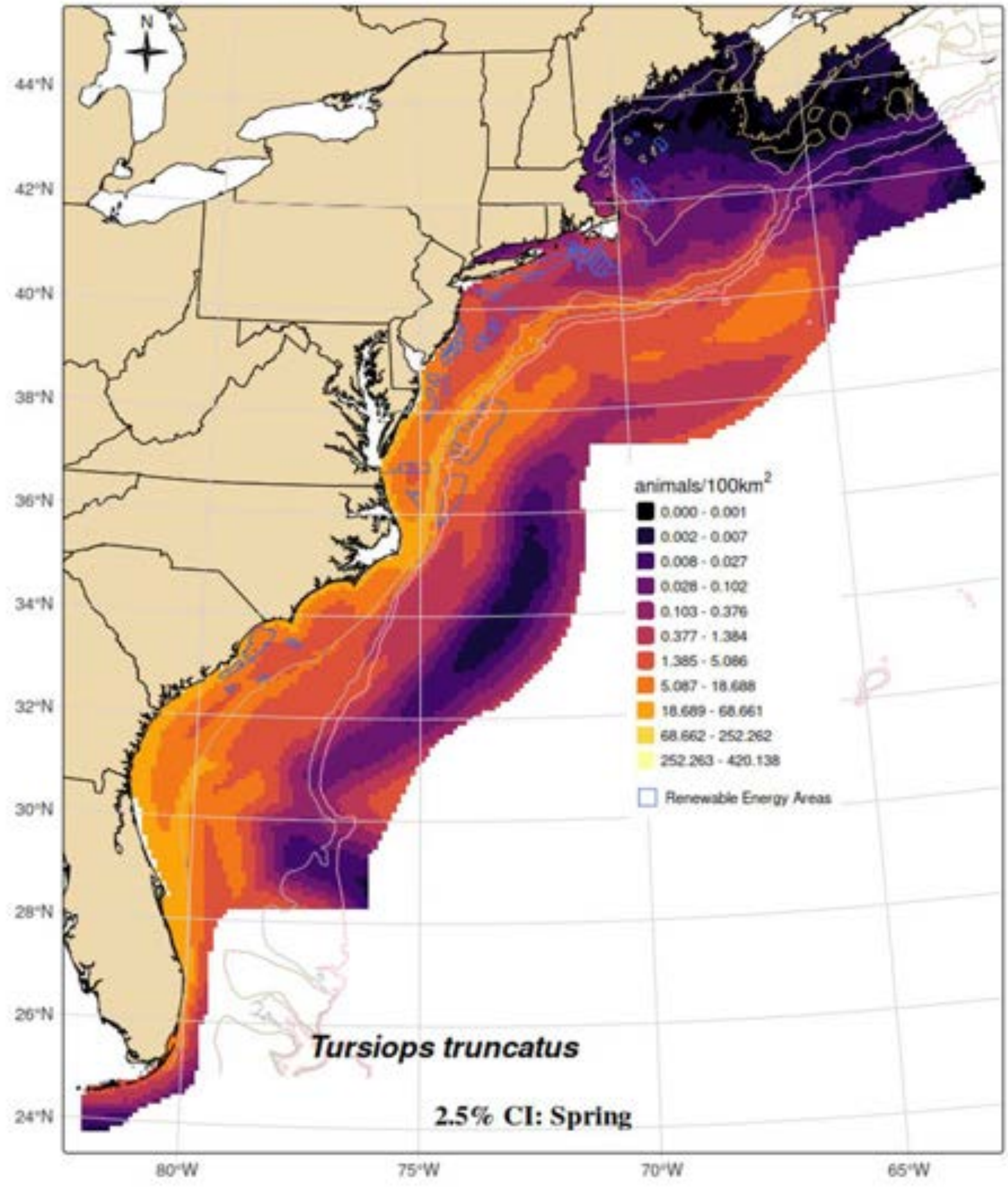

Figure C.9-7. Lower 2.5% confidence interval of spring common bottlenose dolphin density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

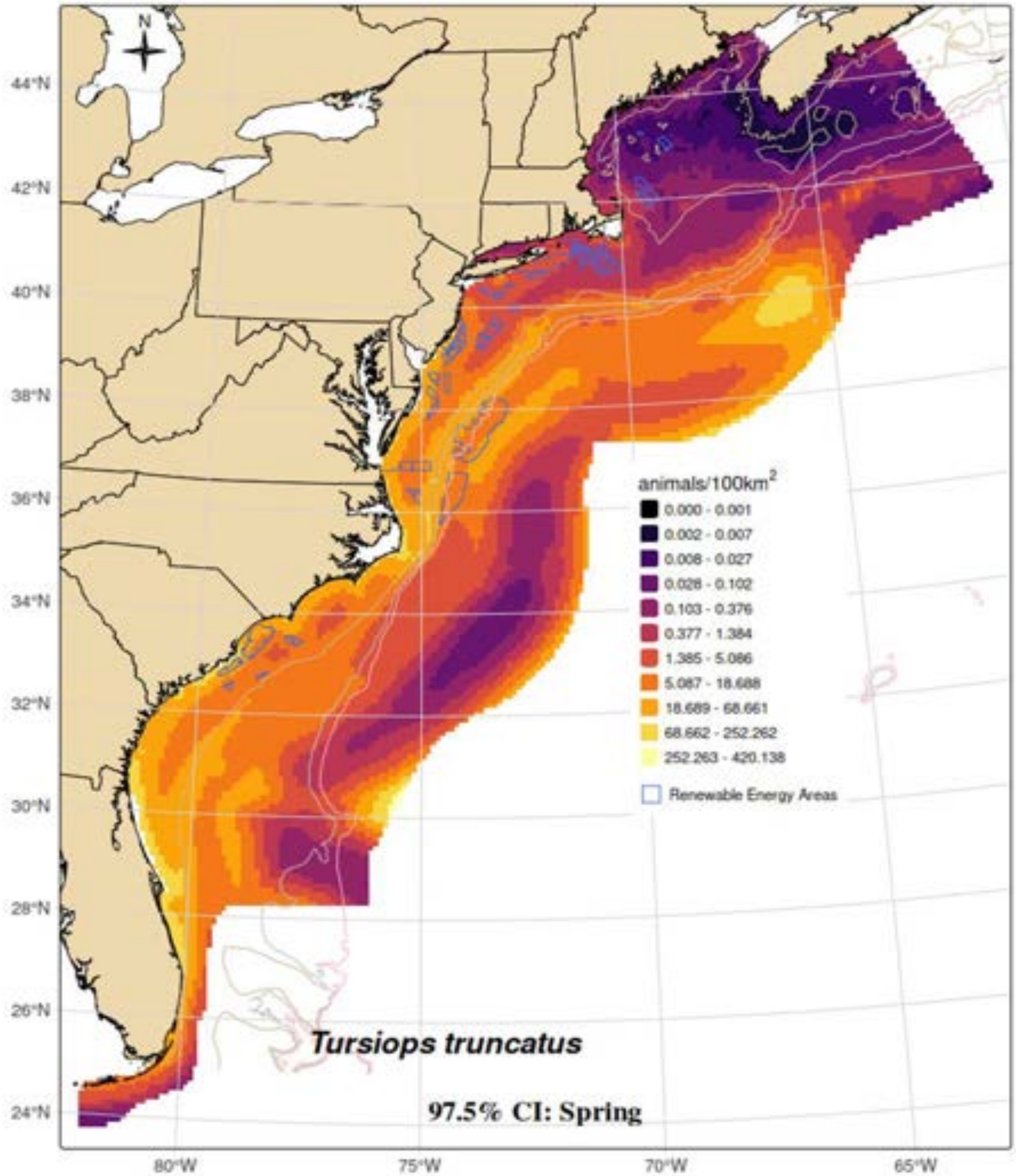

Figure C.9-8. Upper 97.5% confidence interval of spring common bottlenose dolphin density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

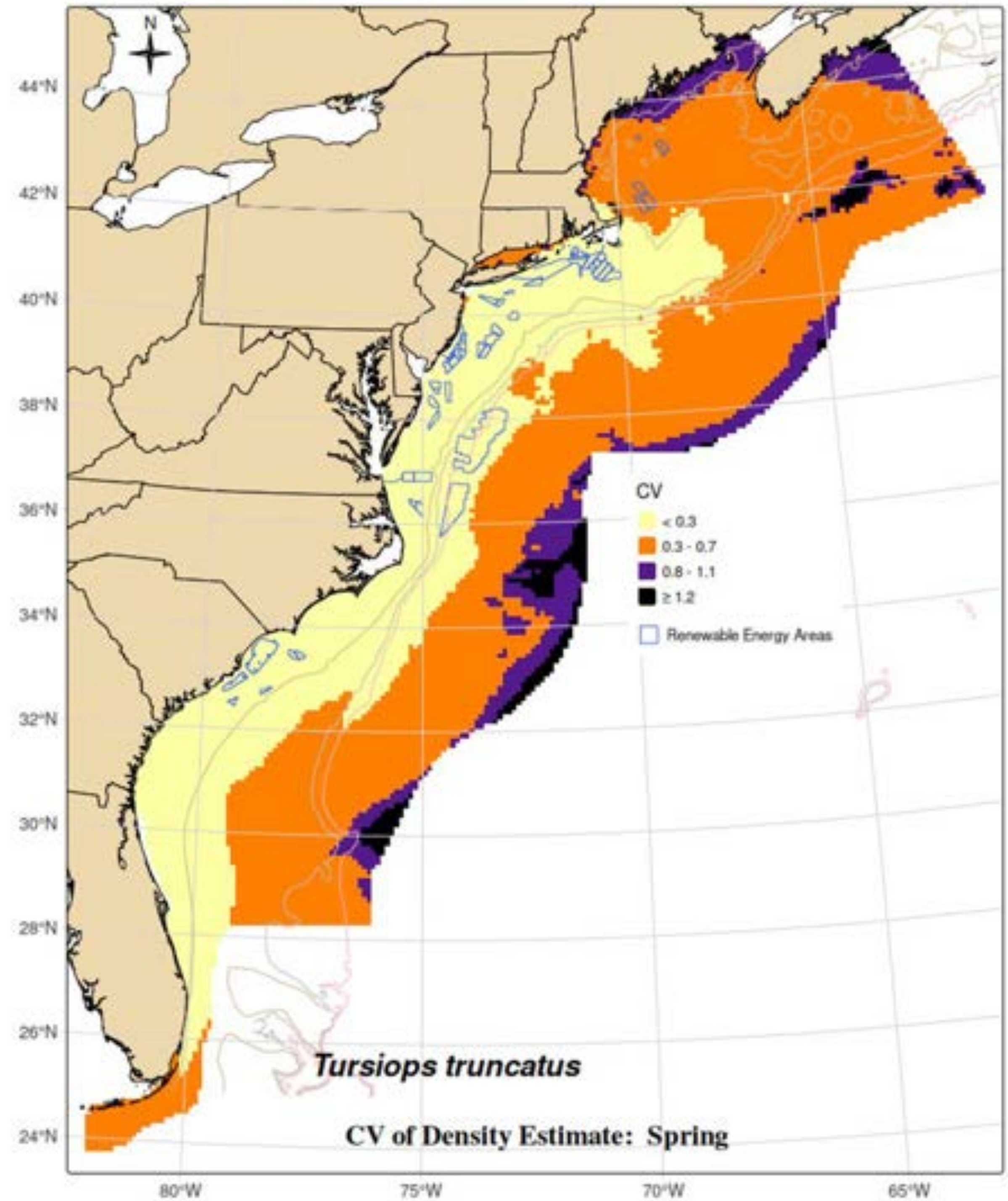

Figure C.9-9. CV of spring common bottlenose dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

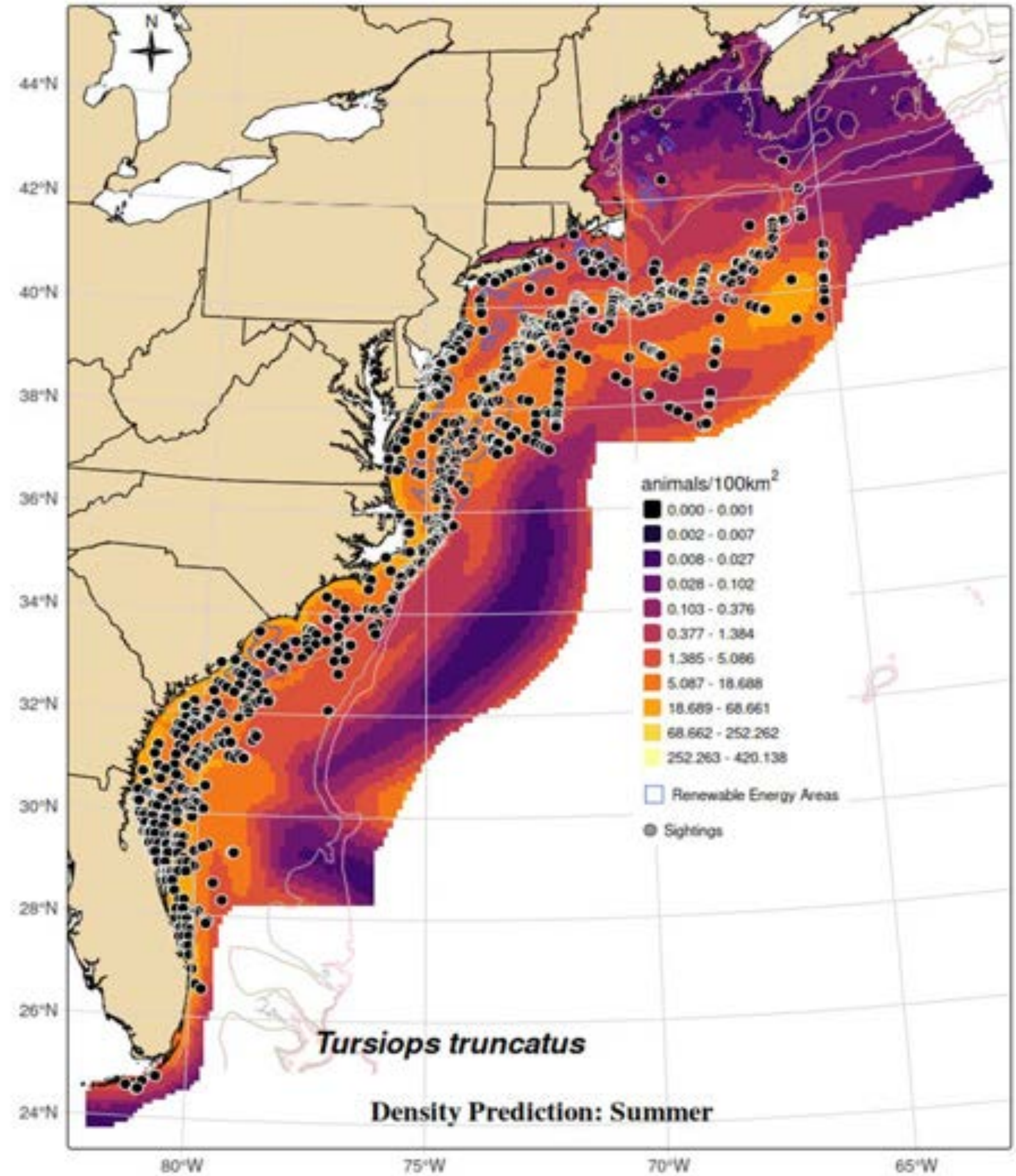

Figure C.9-10. Common bottlenose dolphin summer average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

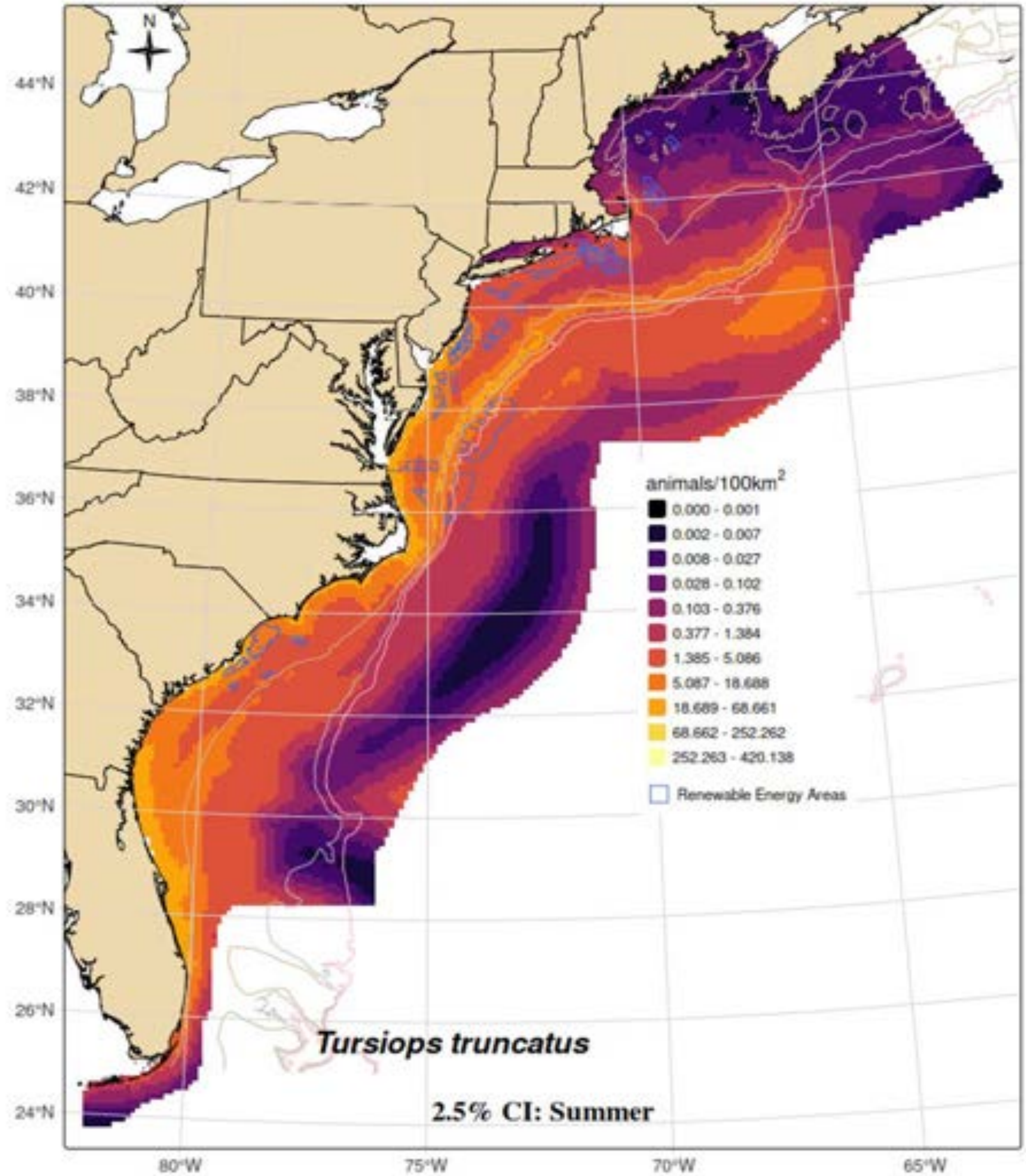

Figure C.9-11. Lower 2.5% confidence interval of summer common bottlenose dolphin density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

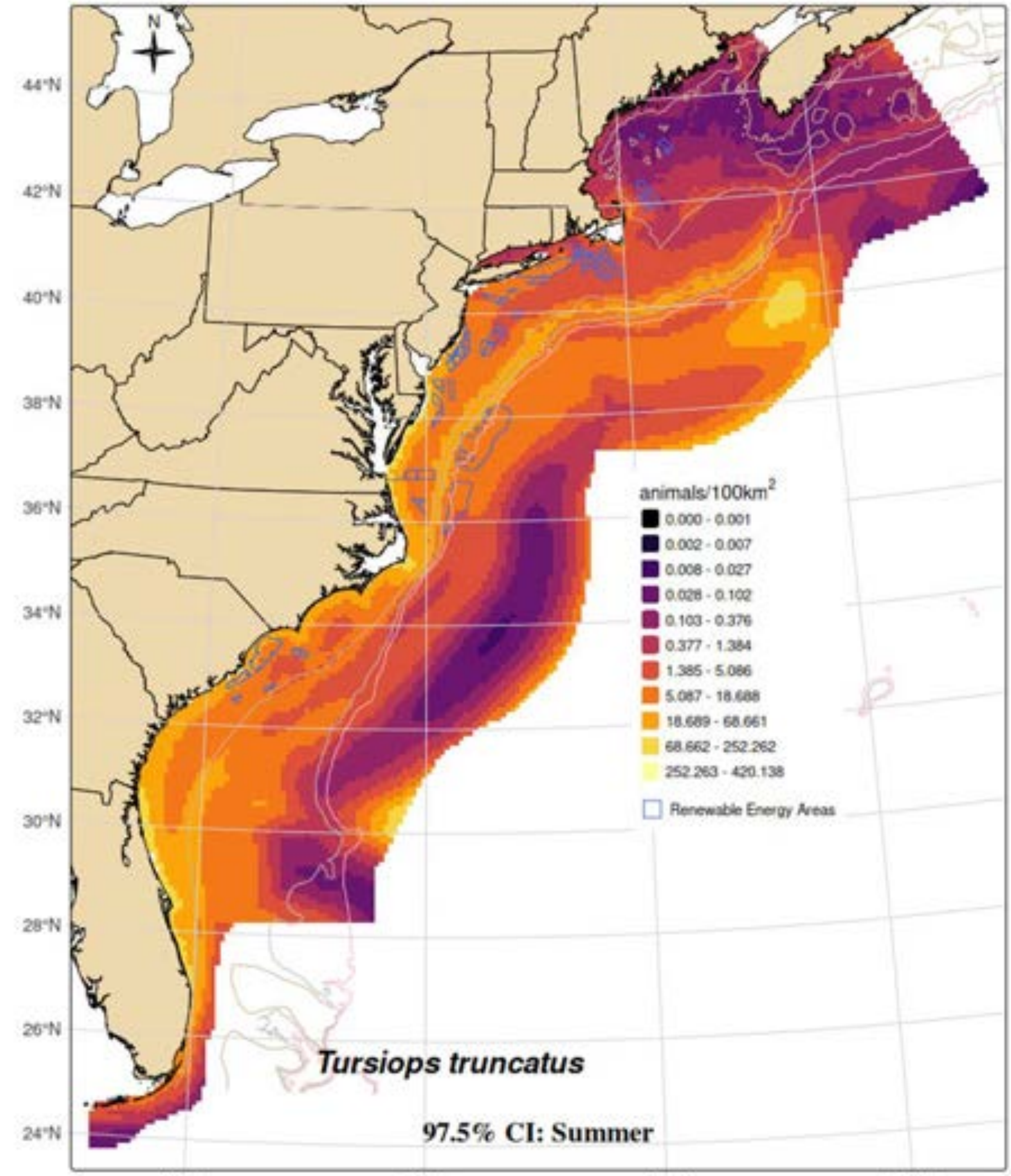

Figure C.9-12. Upper 97.5% confidence interval of summer common bottlenose dolphin density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

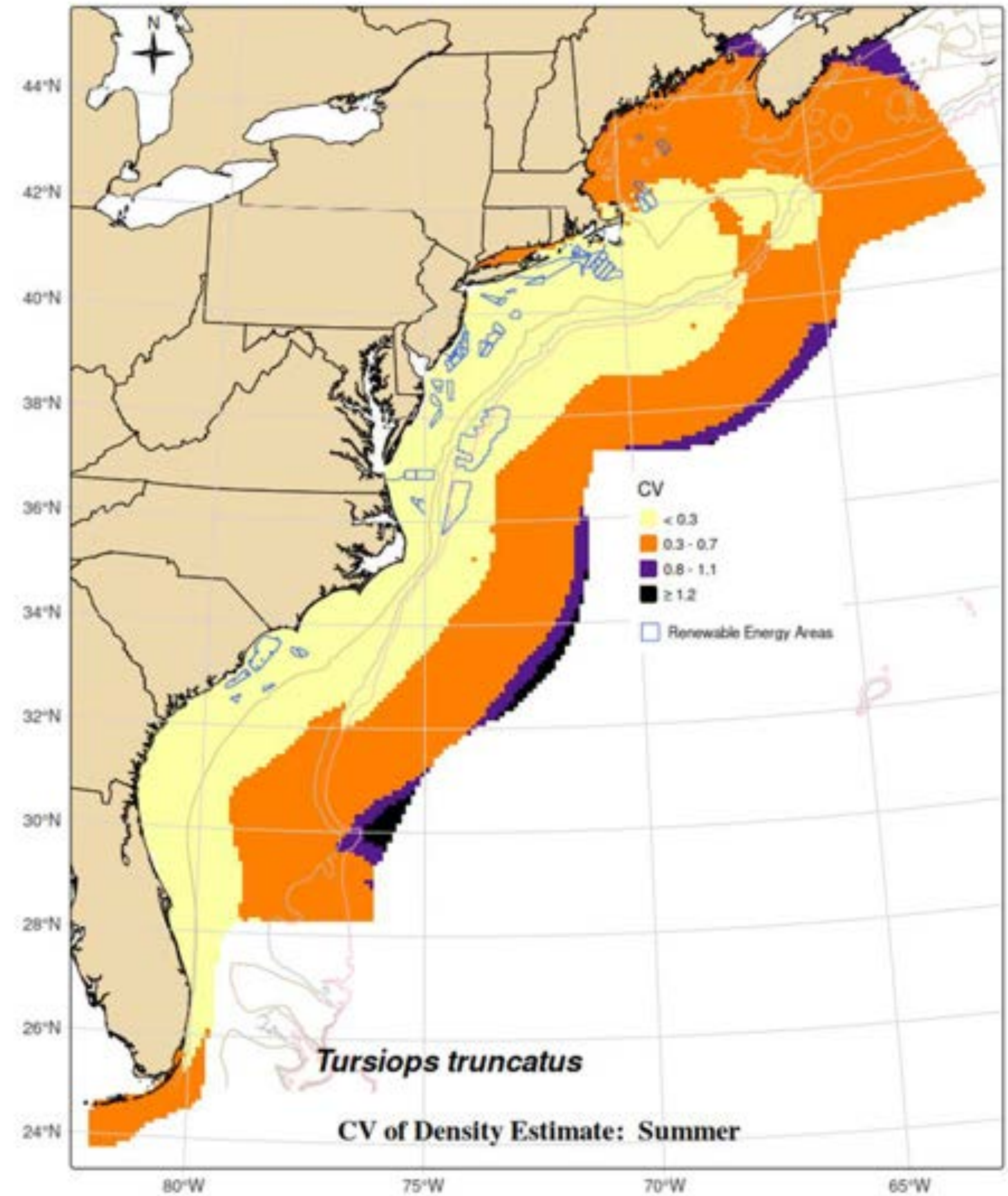

Figure C.9-13. CV of summer common bottlenose dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

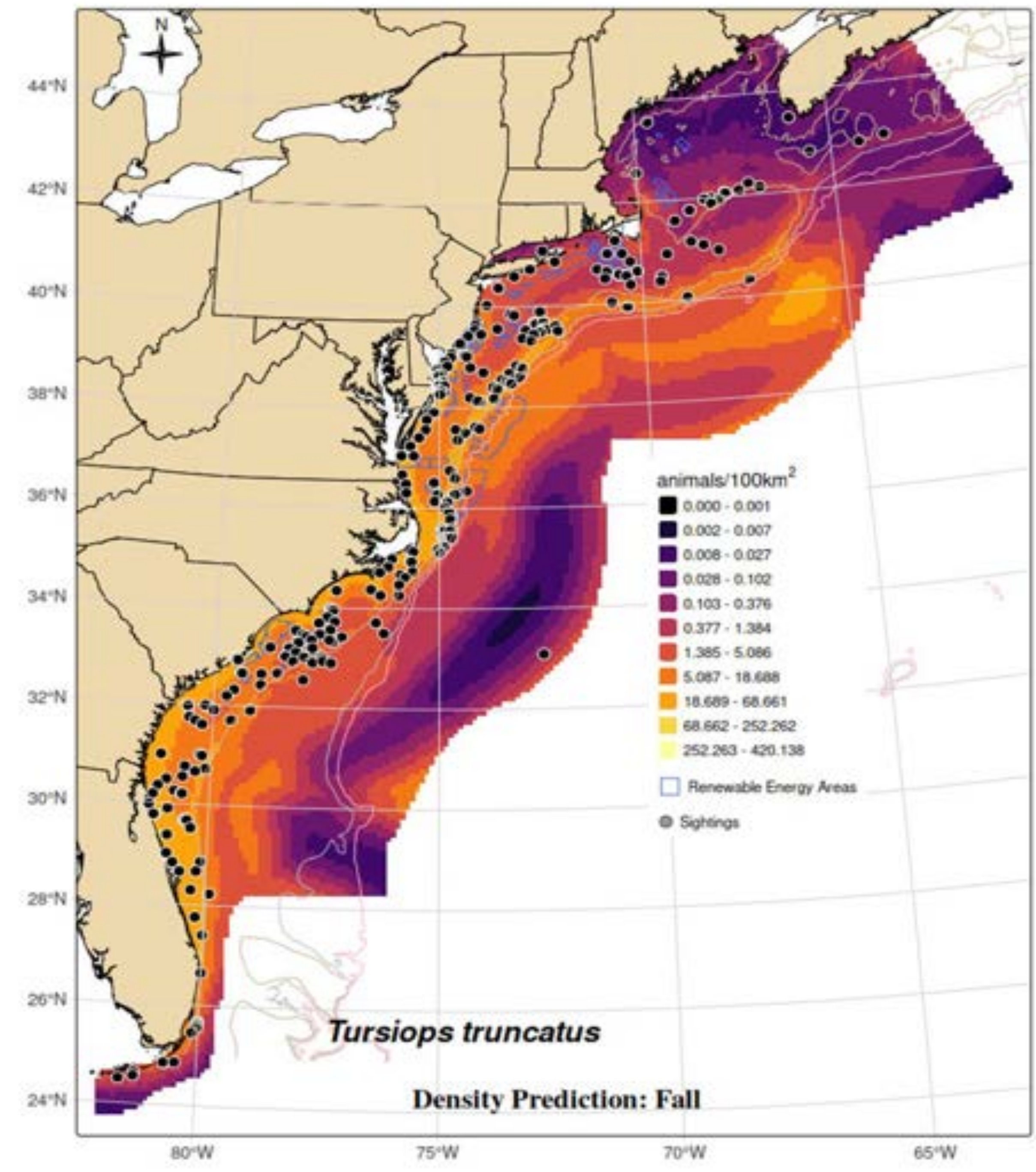

Figure C.9-14. Common bottlenose dolphin fall average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

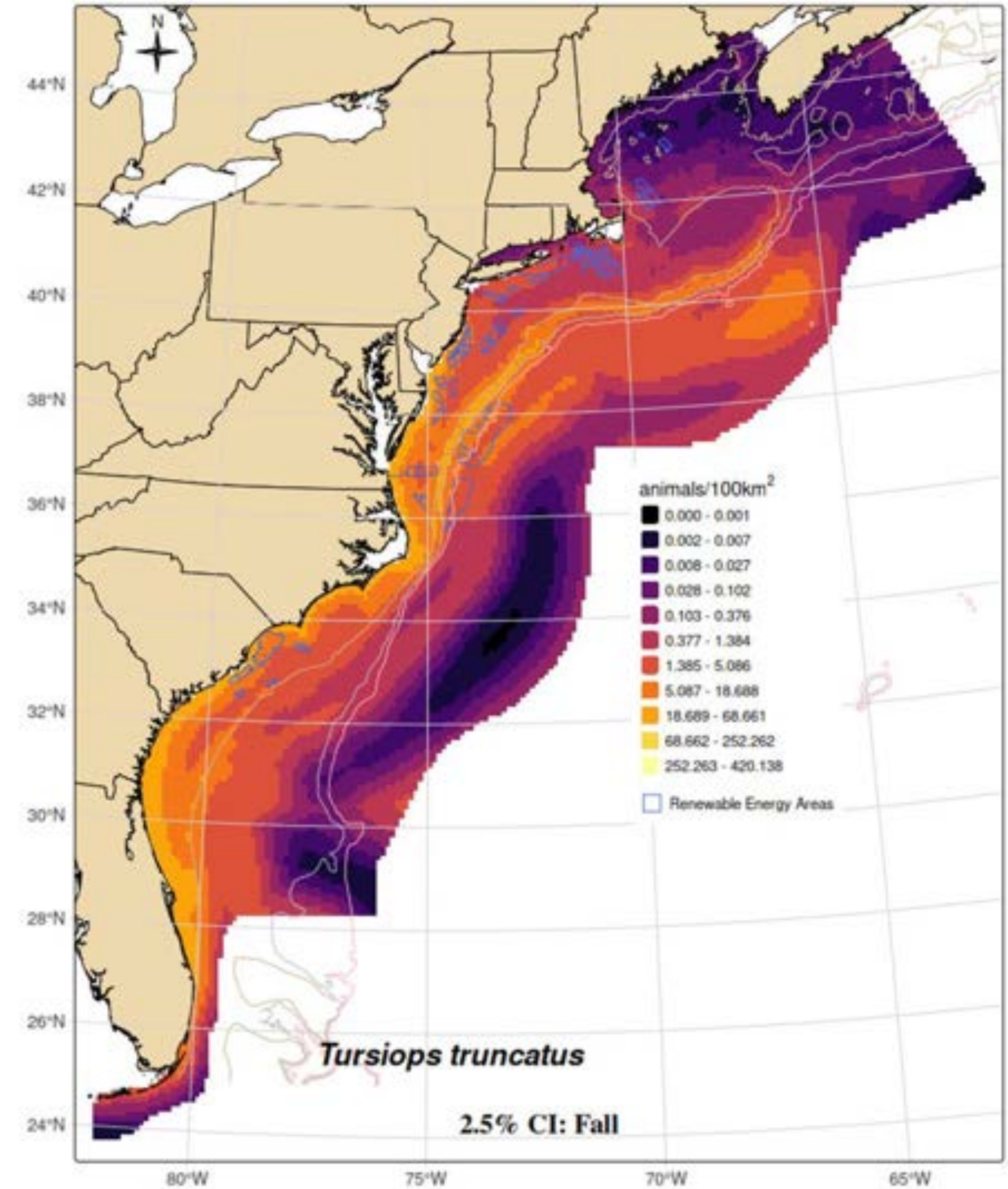

Figure C.9-15. Lower 2.5% confidence interval of fall common bottlenose dolphin density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

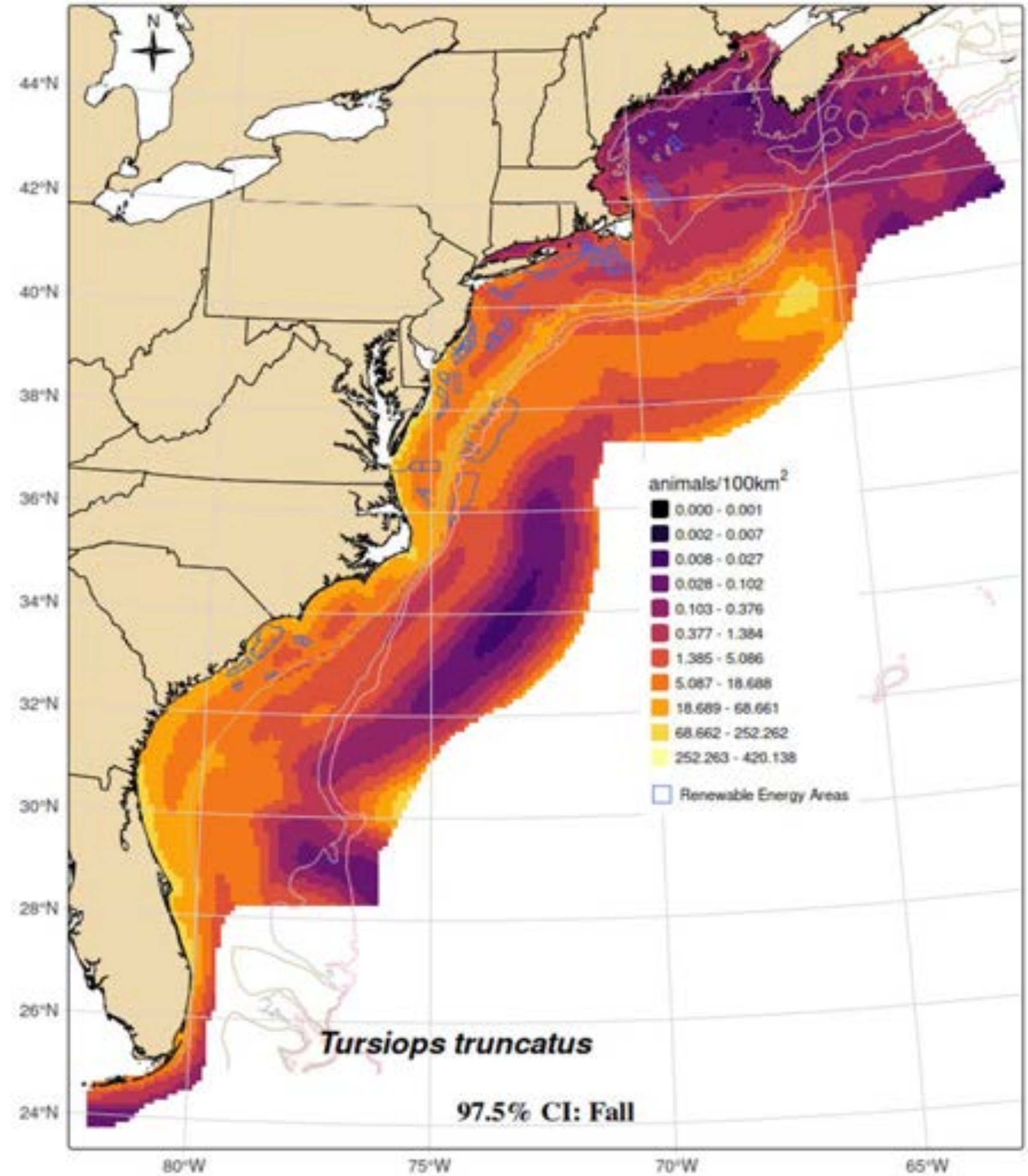

Figure C.9-16. Upper 97.5% confidence interval of fall common bottlenose dolphin density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

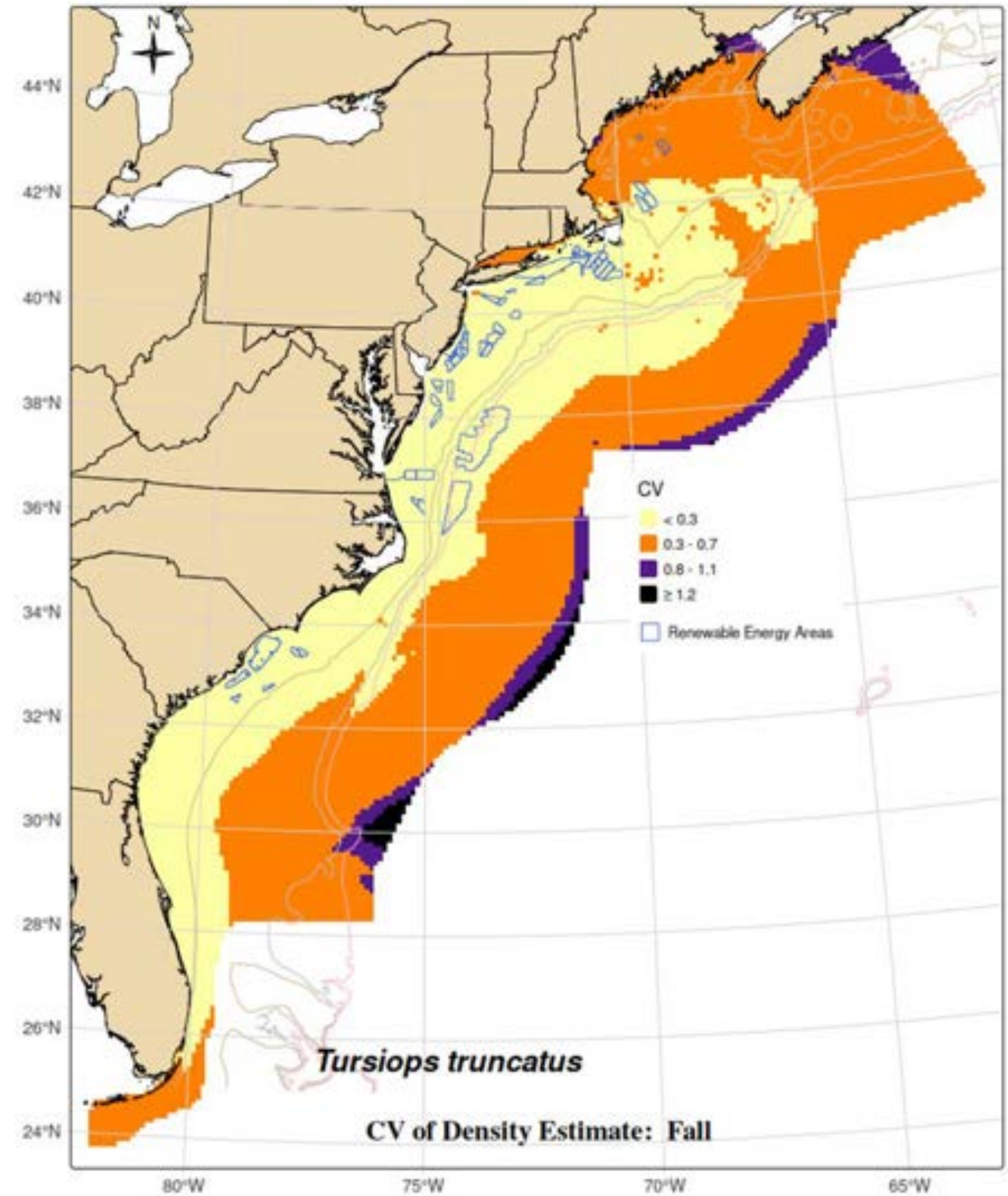

Figure C.9-17. CV of fall common bottlenose dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

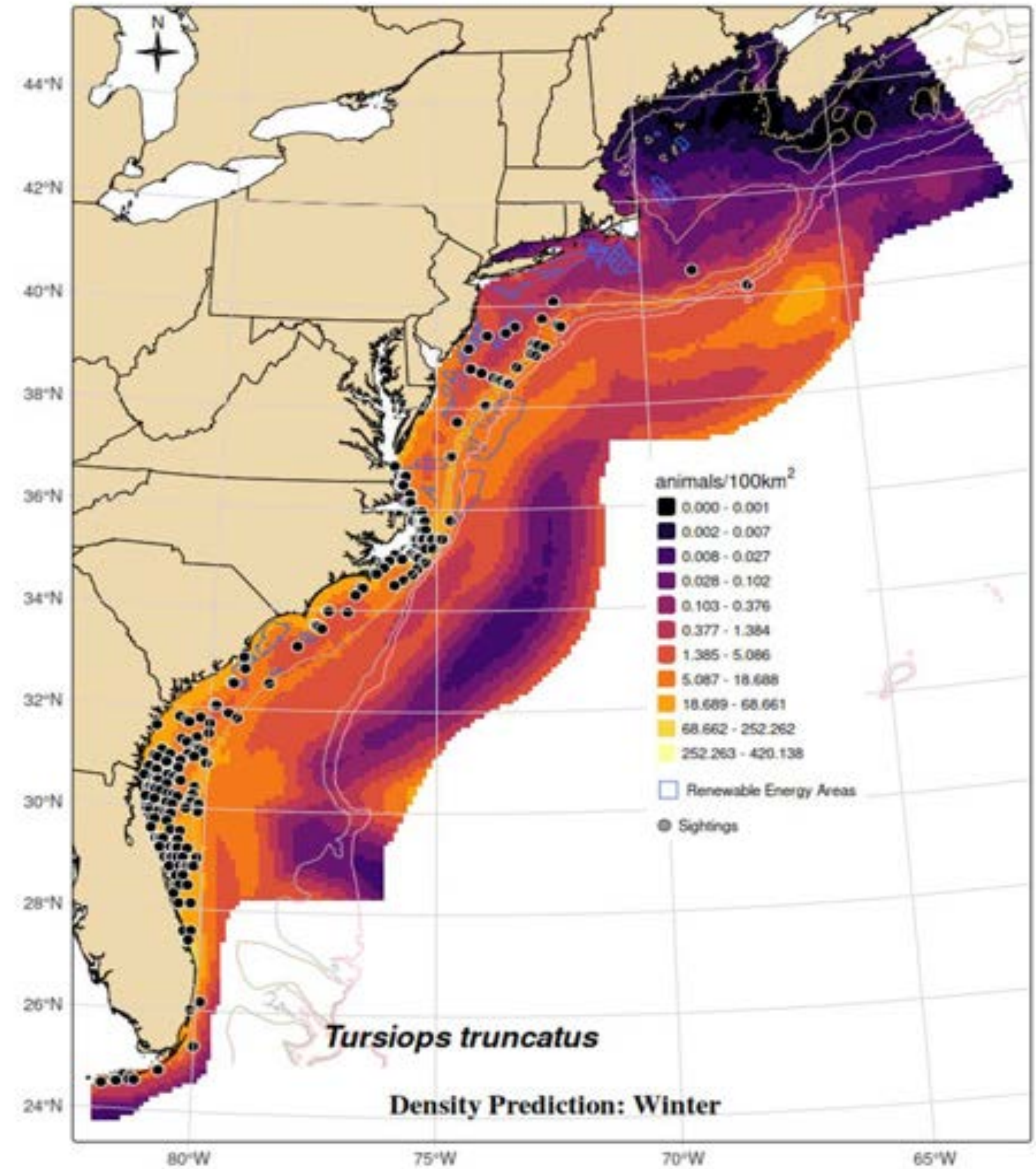

Figure C.9-18. Common bottlenose dolphin winter average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

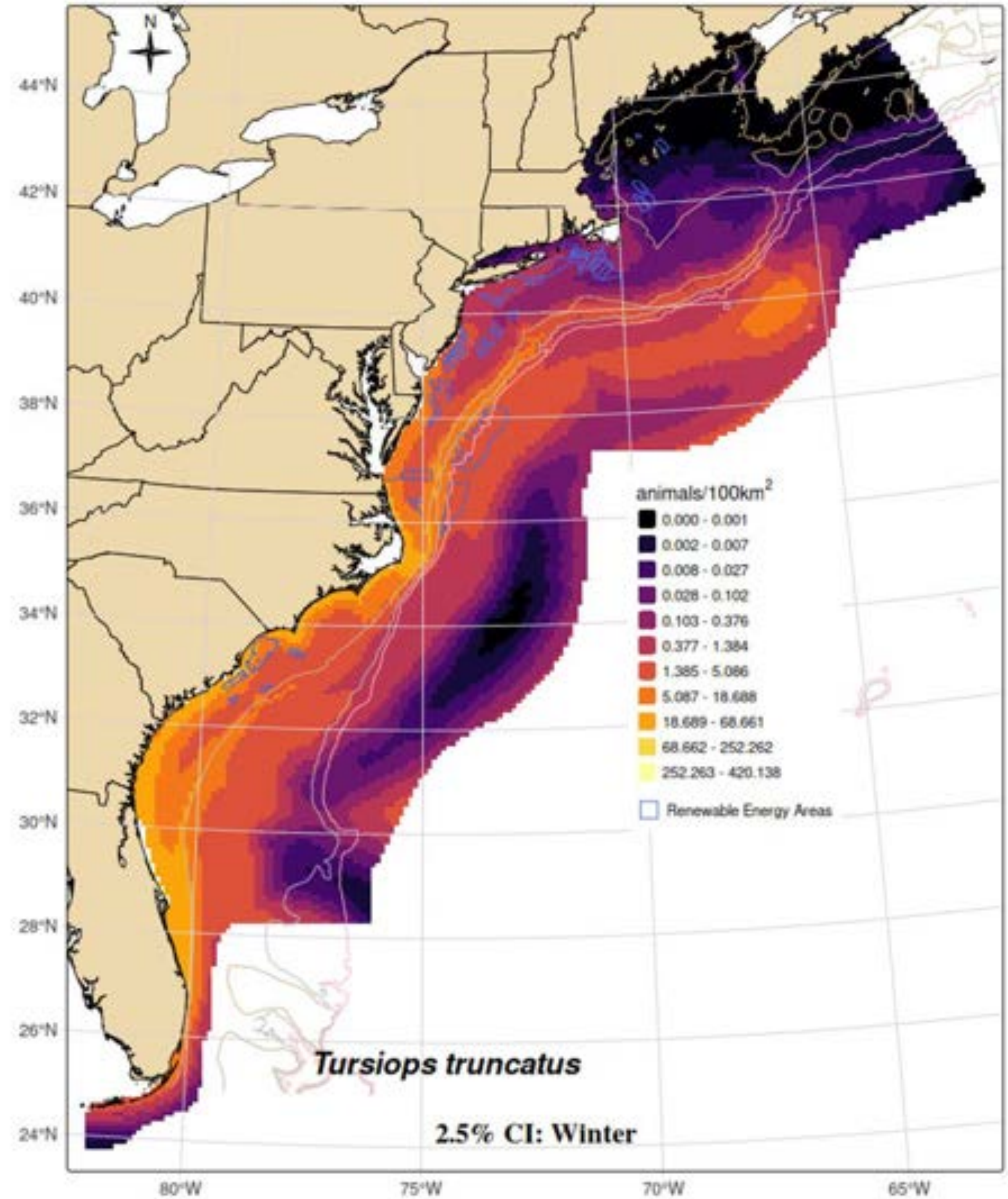

Figure C.9-19. Lower 2.5% confidence interval of winter common bottlenose dolphin density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

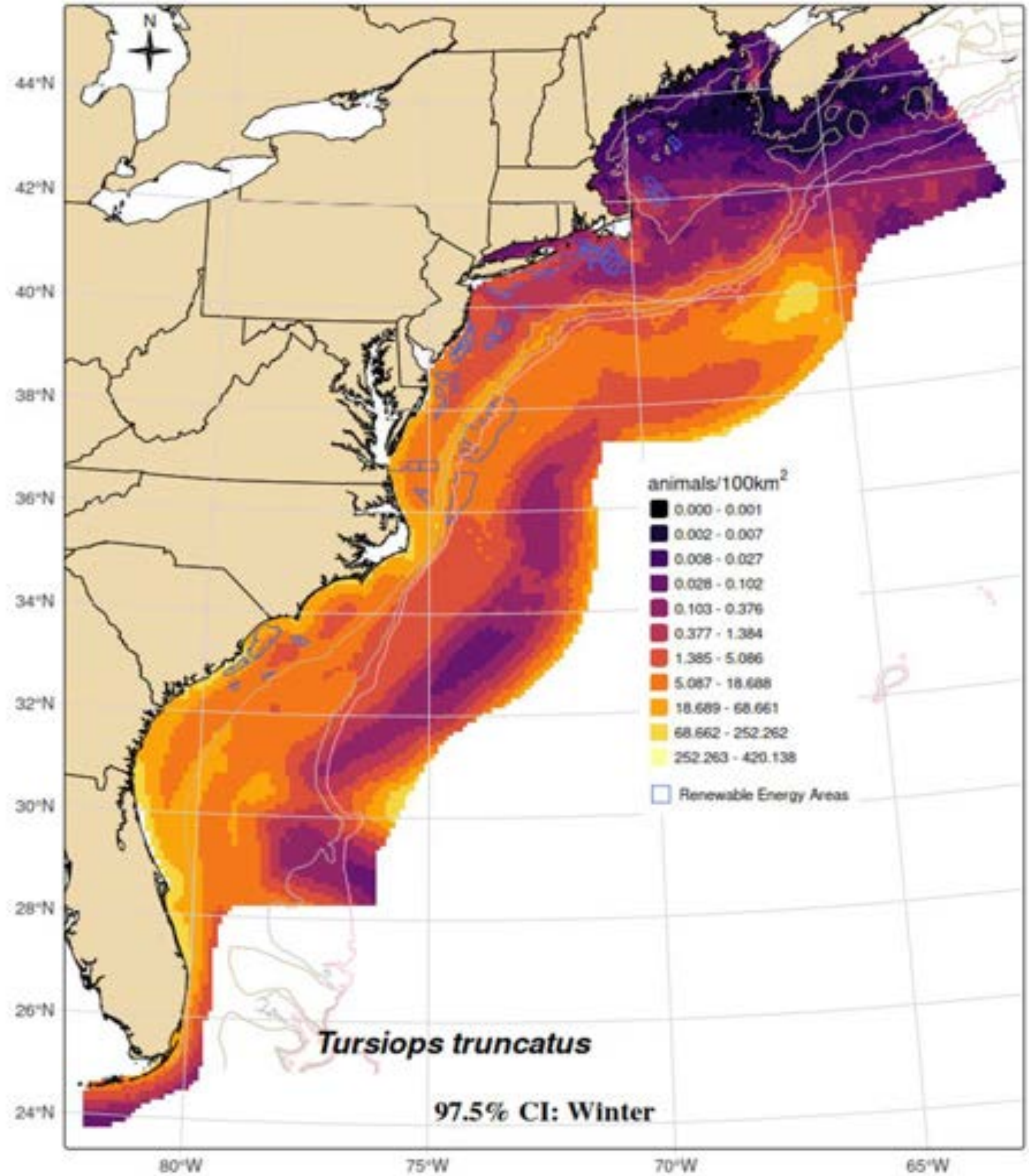

Figure C.9-20. Upper 97.5% confidence interval of winter common bottlenose dolphin density estimates

Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

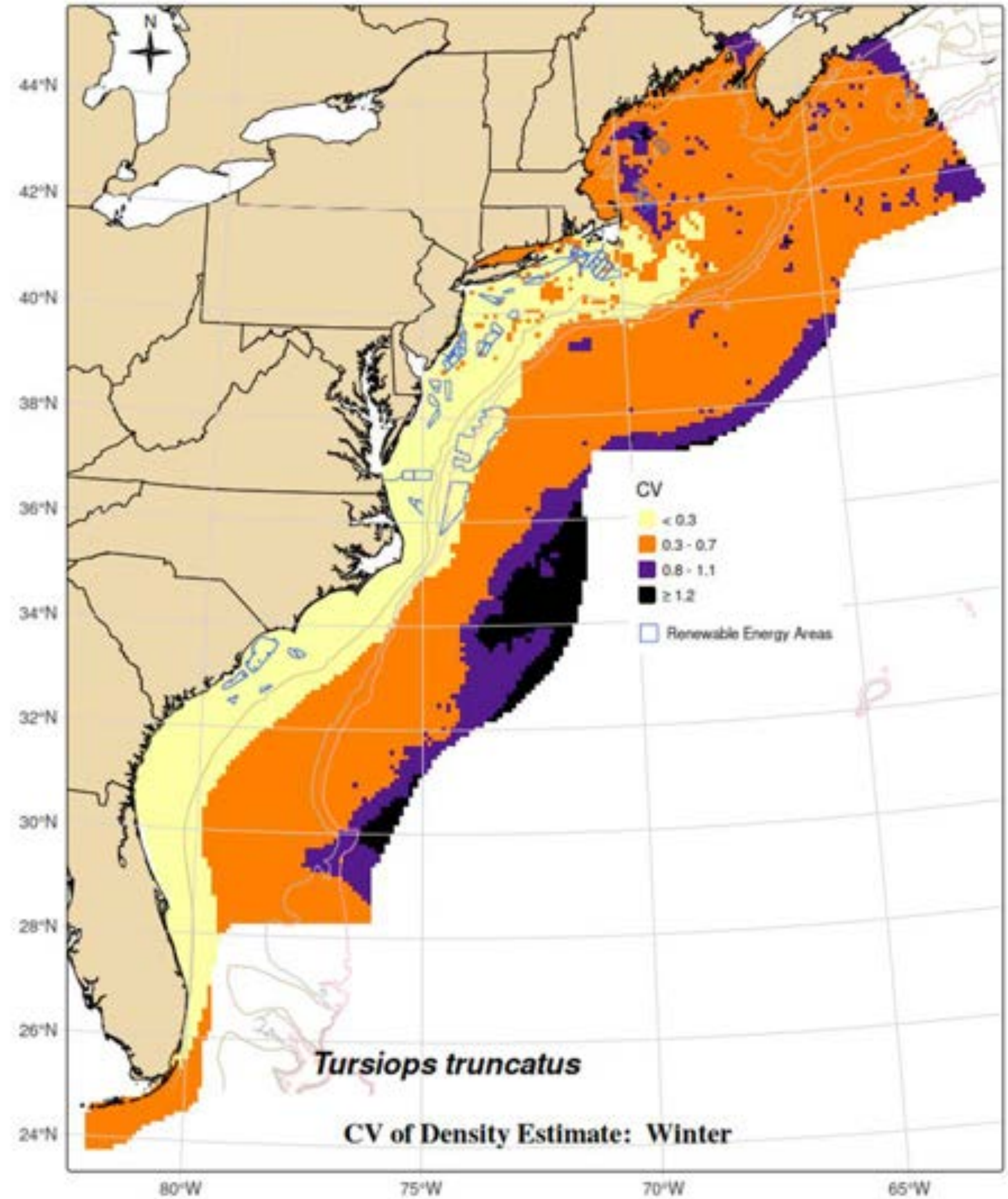

Figure C.9-21. CV of winter common bottlenose dolphin density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

C.9.7 Offshore Energy Development Areas

Table C.9-6. Common bottlenose dolphin abundance estimates for wind-energy study areas

Season	Wind-Energy Study Area	Abundance*	CV	95% Confidence Interval*
Spring (Mar-May)	RI/MA	59.8	0.23	38.5 - 92.8
	NY	63.9	0.23	41.1 - 99.1
	NJ	528.9	0.19	364.9 - 766.5
	DE/MD	621.5	0.18	439.5 - 878.8
	VA	274.8	0.17	196.1 - 385.2
	NC	537.4	0.18	380.5 - 758.8
	NC/SC	2,663.3	0.16	1,941.9 – 3,652.5
	GA	514.9	0.18	365.8 - 724.8
	FL	110.2	0.25	67.9 - 178.7
Summer (Jun-Aug)	RI/MA	193.2	0.22	126.2 - 295.7
	NY	116.2	0.21	76.9 - 175.7
	NJ	823.0	0.18	580.9 – 1,165.9
	DE/MD	873.7	0.17	632.8 – 1,206.4
	VA	300.3	0.16	220.8 - 408.4
	NC	329.2	0.17	237.9 - 455.5
	NC/SC	2,027.2	0.16	1,479.4 – 2,777.9
	GA	321.5	0.18	228.2 - 453.1
	FL	71.3	0.25	44.1 - 115.2
Fall (Sep-Nov)	RI/MA	108.0	0.22	71 - 164.2
	NY	75.6	0.22	49 - 116.7
	NJ	758.0	0.18	530.8 – 1,082.4
	DE/MD	830.0	0.17	594.9 – 1,158
	VA	318.5	0.16	231.9 - 437.6
	NC	394.8	0.17	285 - 546.8
	NC/SC	2,574.9	0.16	1,900.5 – 3,488.7
	GA	474.7	0.16	344.4 - 654.4
	FL	60.6	0.26	36.8 – 100.0
Winter (Dec-Feb)	RI/MA	23.7	0.30	13.3 - 42.1
	NY	24.9	0.24	15.5 - 39.8
	NJ	228.8	0.23	148 - 353.9
	DE/MD	292.8	0.20	198.8 - 431.2
	VA	179.6	0.18	125.9 - 256.3
	NC	329.7	0.19	230.1 - 472.5
	NC/SC	2,722.2	0.17	1,956.7 – 3,787.2
	GA	507.8	0.18	355.4 - 725.7
	FL	87.3	0.27	52.1 - 146.6

***** We rounded the mean abundance and 95% confidence interval to the nearest tenth of an animal. If this resulted in a zero for the mean abundance, we calculated the CV using the actual abundance value as estimated by the density-habitat model and then rounded to the nearest tenth. If a wind-energy study area is not included, then we assumed the abundance was zero.

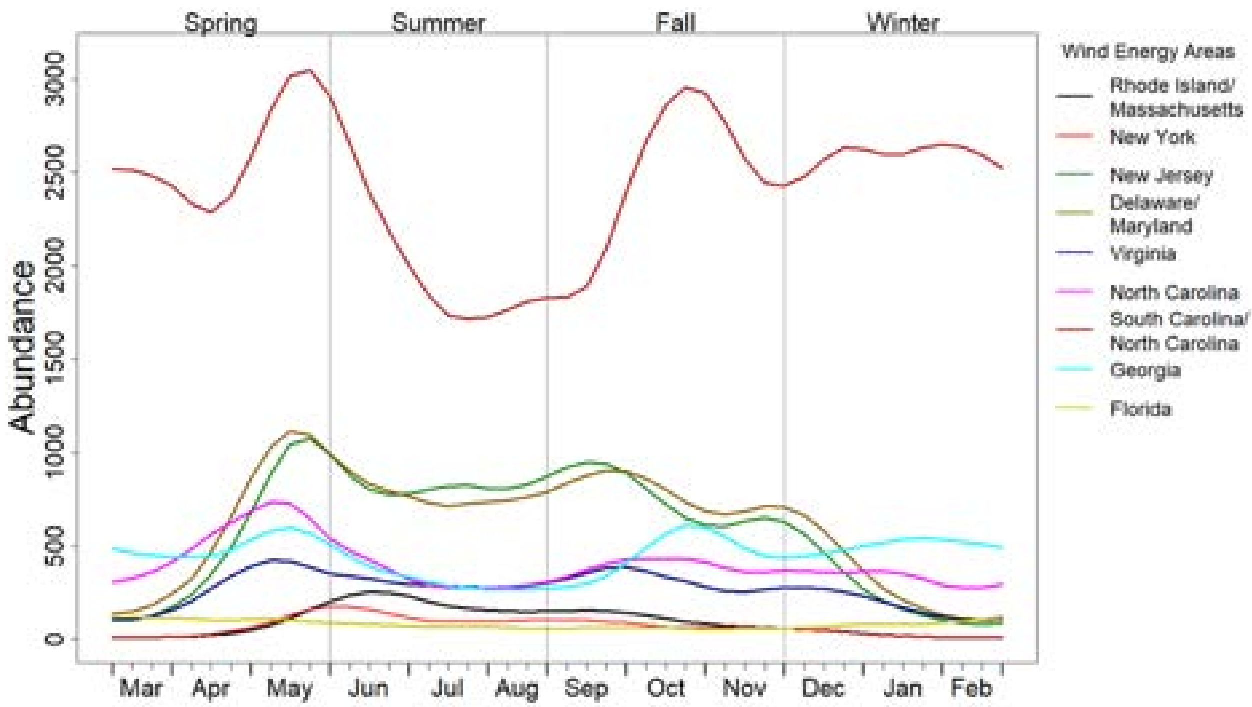

Figure C.9-22. Average seasonal abundance of common bottlenose dolphins in wind-energy study areas

C.10 Harbor Porpoise (*Phocoena phocoena*)

Figure C.10-1. Harbor porpoises

C.10.1 Data Collection

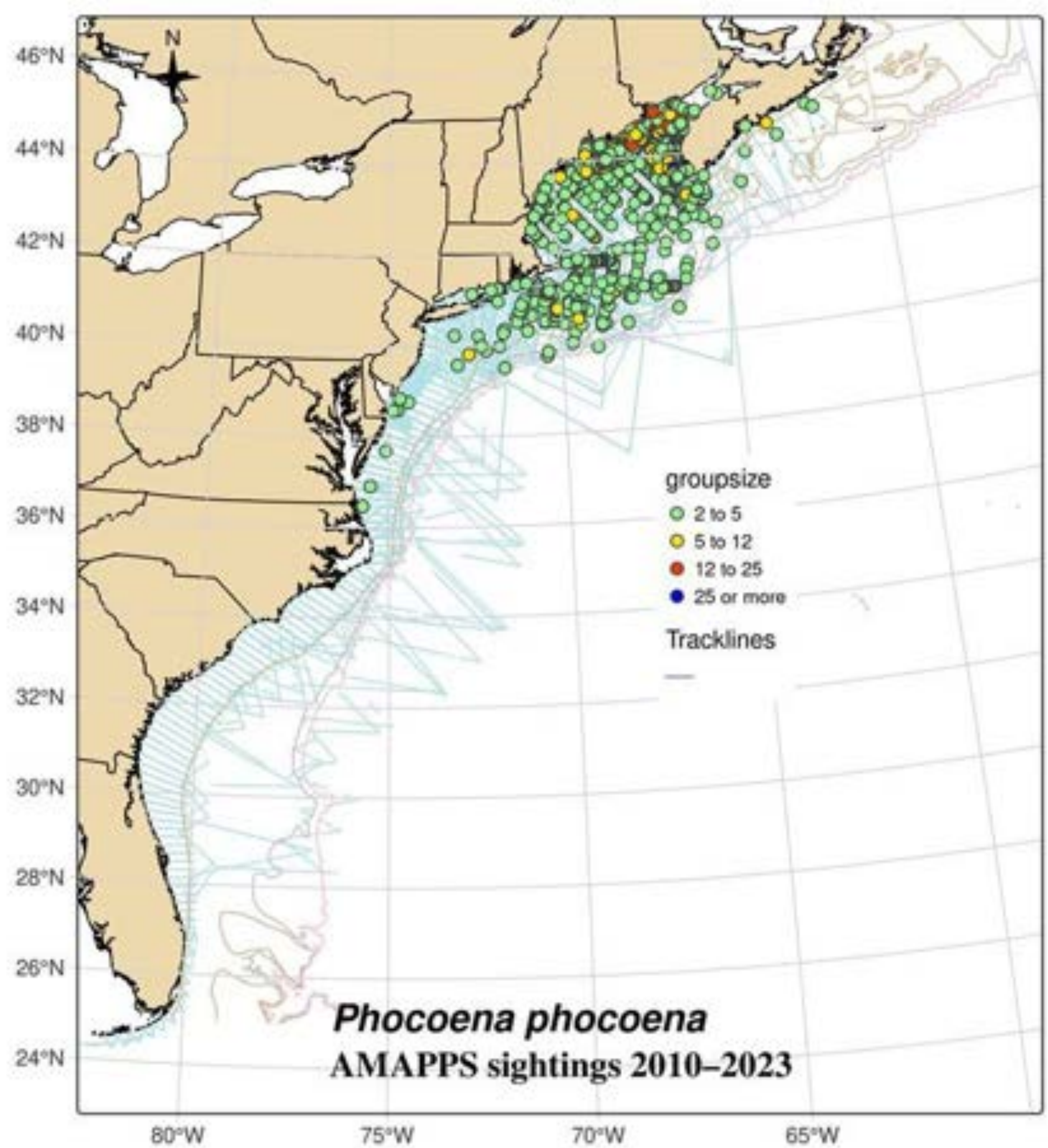

Figure C.10-2. Distribution of track lines and harbor porpoise sightings 2010 to 2023
Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

Table C.10-1. AMAPPS research effort 2010 to 2023 and harbor porpoise sightings

Survey Region and Platform	Season	Effort (km)	Number of Groups	Number of Animals
NE Shipboard	Spring	8,883	11	21
NE Shipboard	Summer	49,064	4	6
NE Aerial	Spring	38,839	500	682
NE Aerial	Summer	52,003	417	957
NE Aerial	Fall	87,311	541	1,942
NE Aerial	Winter	24,747	66	100
SE Shipboard	Spring	2,604	0	0
SE Shipboard	Summer	18,331	0	0
SE Shipboard	Fall	2,673	0	0
SE Shipboard	Winter	302	0	0
SE Aerial	Spring	48,634	8	13
SE Aerial	Summer	43,285	0	0
SE Aerial	Fall	21,153	0	0
SE Aerial	Winter	19,152	0	0

C.10.2 Mark-Recapture Distance Sampling Analysis

Table C.10-2. Intermediate parameters in harbor porpoise mark-recapture distance sampling (MRDS) models

Analysis Set	MR Model	MR Truncation (m)	DS Model	DS Truncation (m)	Key function	p(0)	p(0) CV	Chi-square p-value	CvM p-value
NE - air group 5	distance + log(group size) + glare	360	distance + sea state + glare	350	HR with Hermite Polynomial Adjustment Order 4	0.38	0.06	0.20	0.56
NE–shipboard group 5	distance * observer + log(group size) + sea state + glare + swell height	5000	distance + sea state + swell height + log(group size)	5000	HR with Simple Polynomial Adjustment Order 4	0.39	0.14	0.05	0.55

MR=Mark-Recapture, DS=Distance Sampling, HR=Hazard Rate, HN= Half Normal, CV=Coefficient of variation. Values of p>0.5 for Chi-square and Cramer-von Mises test (CvM) indicate good fit. The definition of p(0) is the probability of detecting a group on the track line. Species included in the analysis sets are explained in main text Tables 4-20 and 4-21.

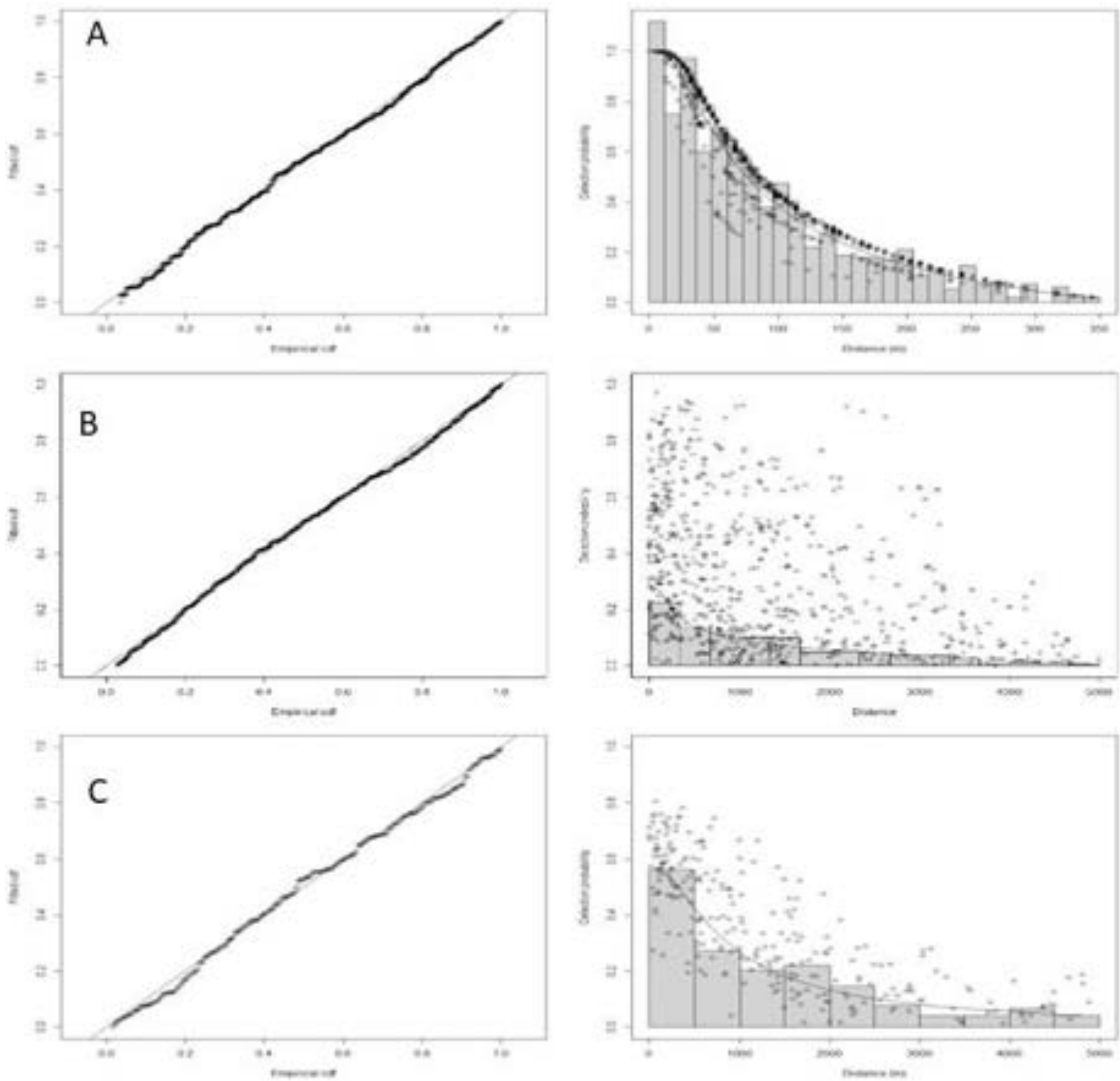

Figure C.10-3. Q-Q plots and detection functions from the harbor porpoise MRDS analyses
A) NE-aerial analysis set 5; B) NE-shipboard analysis set 5; C) SE-shipboard analysis set 2

C.10.3 Generalized Additive Model Analysis

Table C.10-3. 2010 to 2023 density-habitat model output for harbor porpoises

Covariates	Edf	Ref.df	F	C.dev	p-value
s(sstmur)	3.69	5	30.48	16.17	<0.0001
s(mlp)	3.62	5	17.54	8.3	<0.0001
s(btemp)	3.45	5	9.49	5.68	<0.0001
s(dist2GSNw)	1.14	5	3.24	1.94	<0.0001
s(depth)	2.94	5	1.77	0.74	0.01823
s(dist200)	3.21	5	2.56	1.02	0.00264
s(dist1000)	1.05	5	2.87	1.61	<0.0001
s(latdd)	2.13	5	19.31	7.98	<0.0001

Adjusted R^2 = 0.0224, Deviance explained = 43.4%

Includes the estimated degrees of freedom (Edf), reference degrees of freedom (Ref.df), contribution to the deviance (C.dev) explained for each habitat covariate and its associated p-value. Covariate abbreviations explained in main text in Table 4-2.

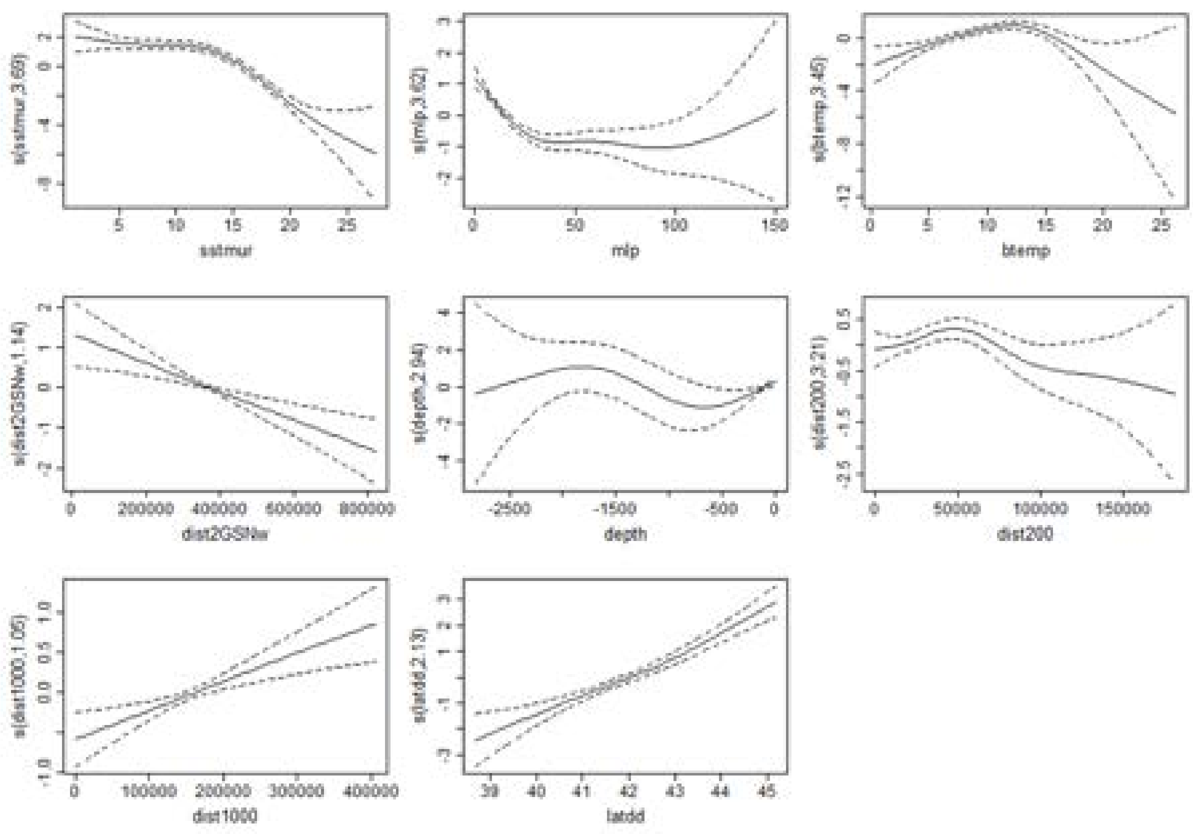

Figure C.10-4. Harbor porpoise density relative to significant habitat covariates
Plots represent the partial smooths and interaction terms of the density-habitat model. Covariate abbreviations explained in main text in Table 4-2.

C.10.4 Model Cross-Validation

Table C.10-4. Diagnostic statistics from the harbor porpoise density-habitat model

Diagnostic Statistic	Description	Calculated with	Model Values (x)	Score
RHO	Spearman rank correlation	Non-zero density	0.315	Excellent
MAPE	Mean absolute percentage error	Non-zero density	83.357	Fair to good
RHO	Spearman rank correlation	All data divided in 25 random samples	0.186	Fair to good
MAPE	Mean absolute percentage error	All data divided in 25 random samples	88.384	Fair to good
MAE	Mean absolute error	All data divided in 25 random samples	0.239	Excellent

RHO: Poor= x<0.05; Fair to good =0.05<=x<0.3; Excellent= x>0.3
MAPE: Poor= x>150%; Fair to good= 150%>=x>50%; Excellent= x<=50%
MAE: Poor= x>1; Fair to good = 1>=x>0.25; Excellent= x<=0.25

C.10.5 Abundance Estimates for AMAPPS Study Area

Table C.10-5. Harbor porpoise average abundance estimates for the AMAPPS study area

Season	Average Abundance	CV	95% Confidence Interval
Spring (March–May)	82,130	0.31	45,358 – 148,713
Summer (June–August)	80,391	0.23	51,516 – 125,450
Fall (September–November)	64,140	0.24	40,336 – 101,992
Winter (December–February)	52,033	0.34	27,211 – 99,498
Summer 2011 U.S. surveys[1]	79,883	0.32	43,319 – 147,310
Summer 2016 U.S. surveys[1]	75,079	0.38	36,551 – 154,219
Summer 2021 U.S. surveys	85,765	0.53	32,343 – 227,426

[1]Hayes et al. 2024

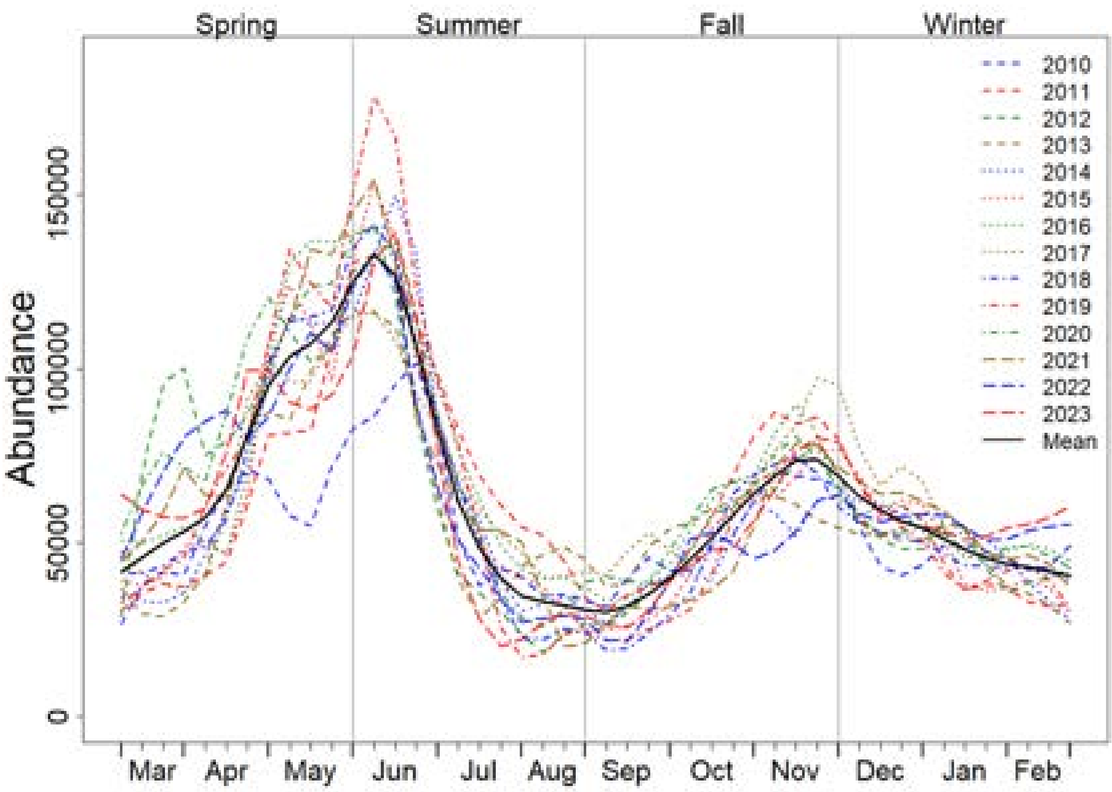

Figure C.10-5. Annual abundance trends for harbor porpoises in the AMAPPS study area

C.10.6 Seasonal Prediction Maps

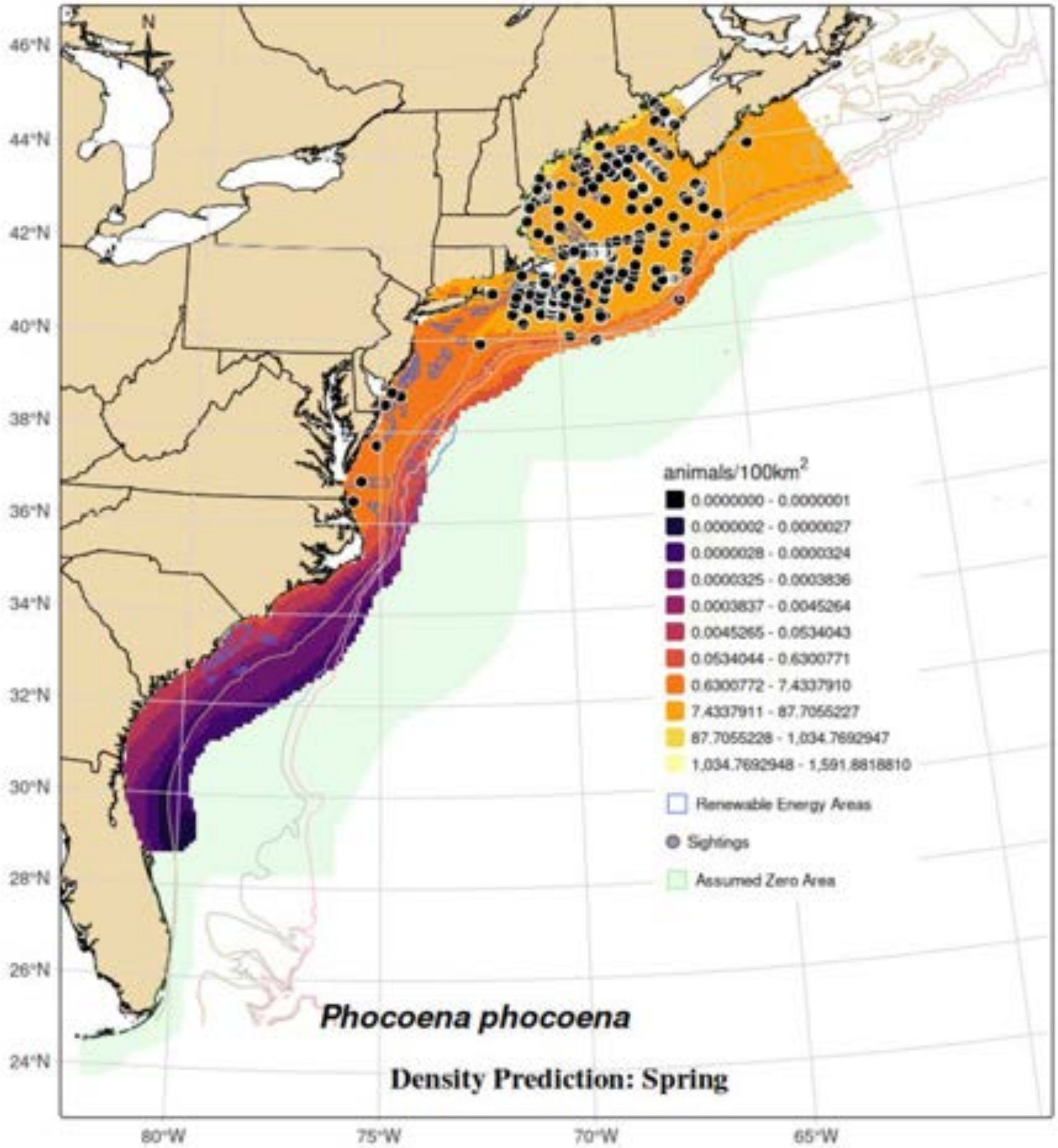

Figure C.10-6. Harbor porpoise spring average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

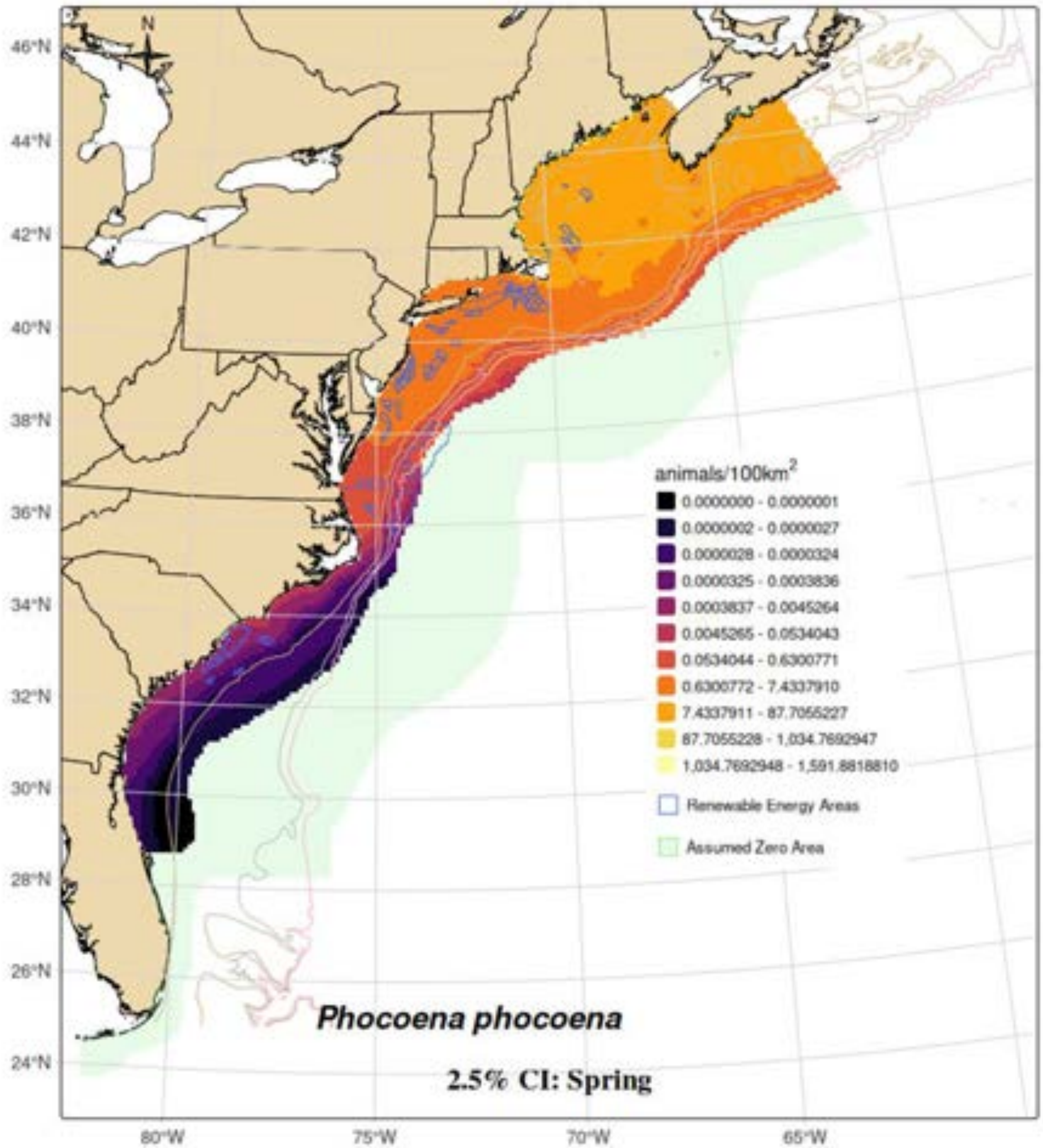

Figure C.10-7. Lower 2.5% confidence interval of the spring harbor porpoise density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

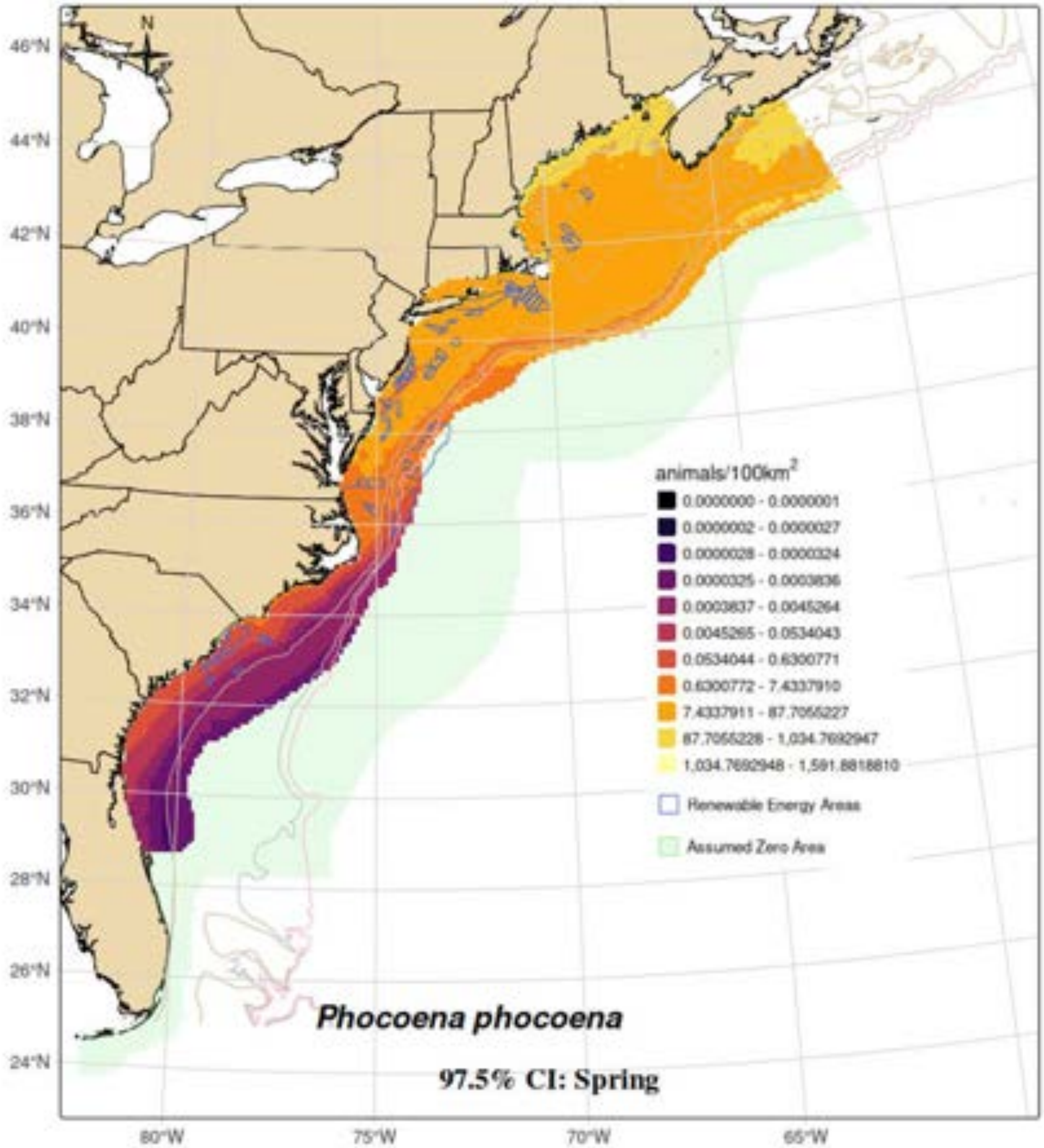

Figure C.10-8. Upper 97.5% confidence interval of the spring harbor porpoise density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

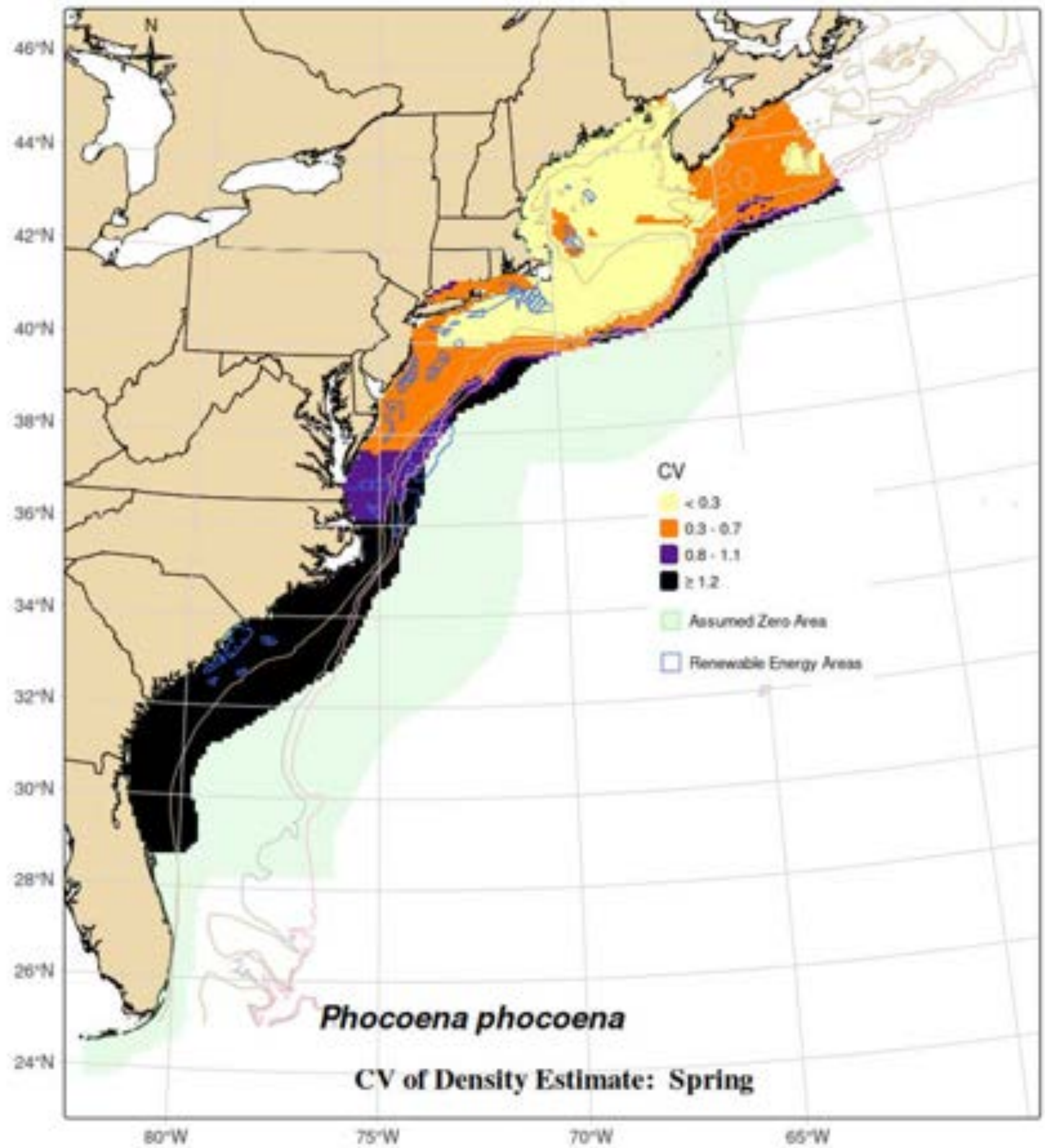

Figure C.10-9. CV of spring harbor porpoise density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

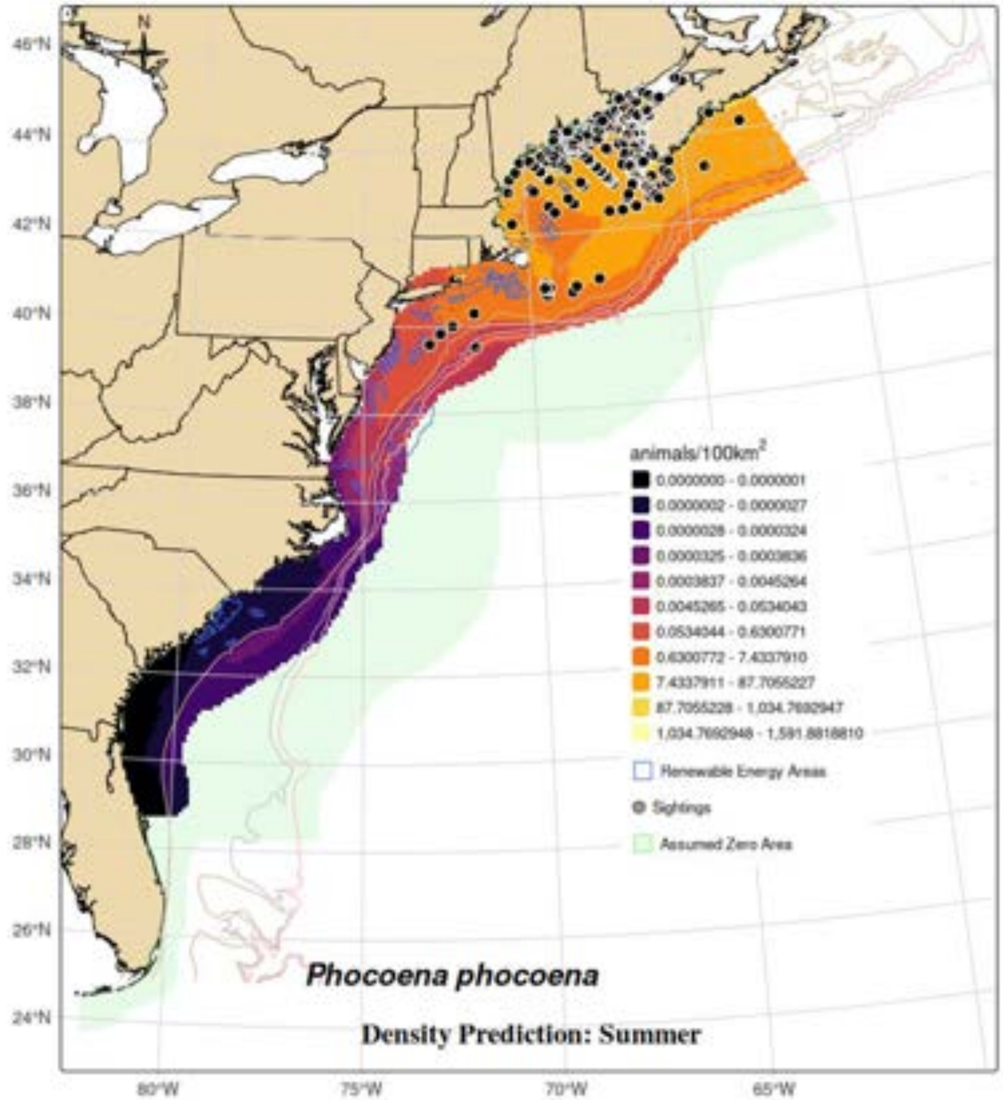

Figure C.10-10. Harbor porpoise summer average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

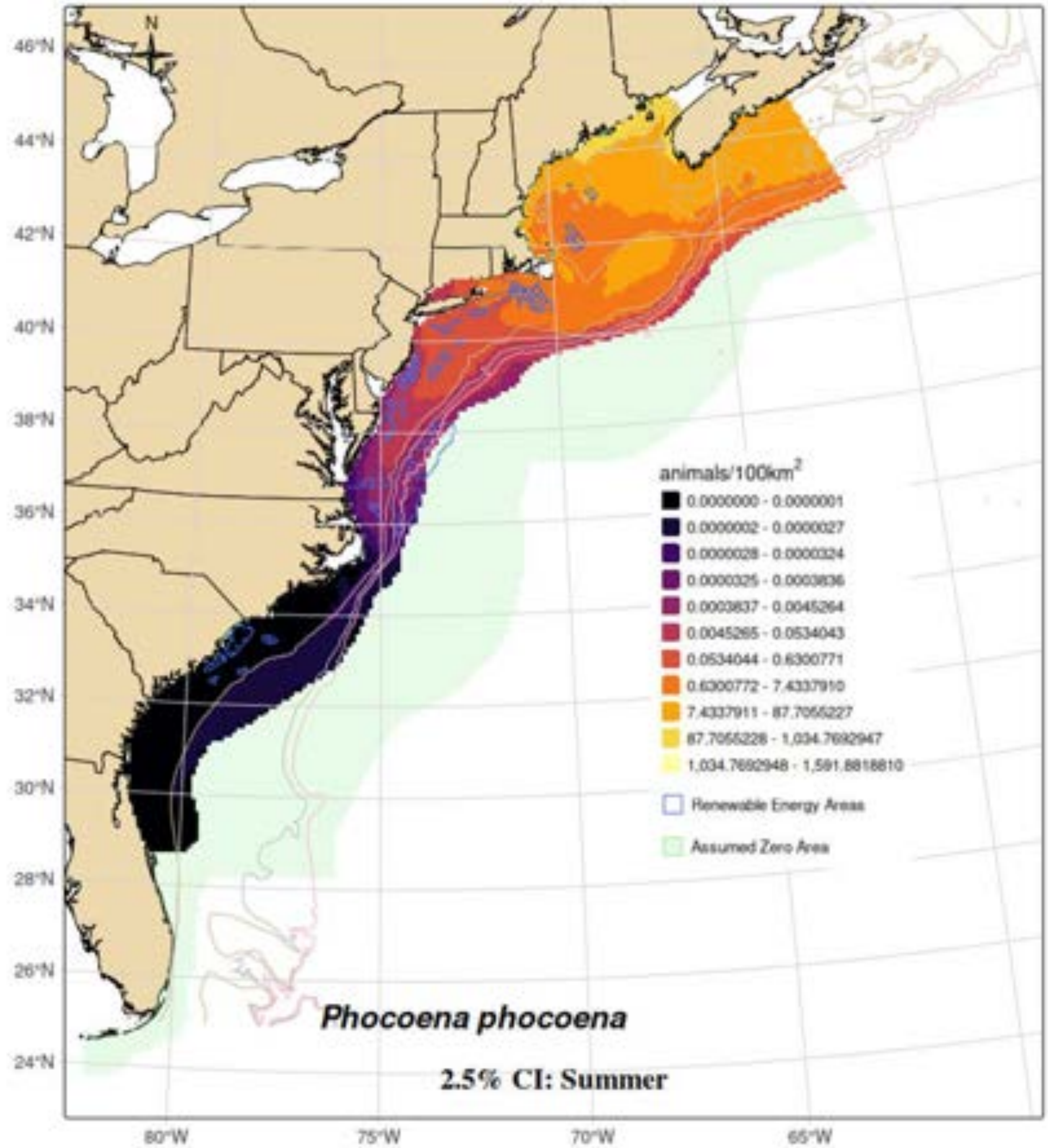

Figure C.10-11. Lower 2.5% confidence interval of the summer harbor porpoise density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

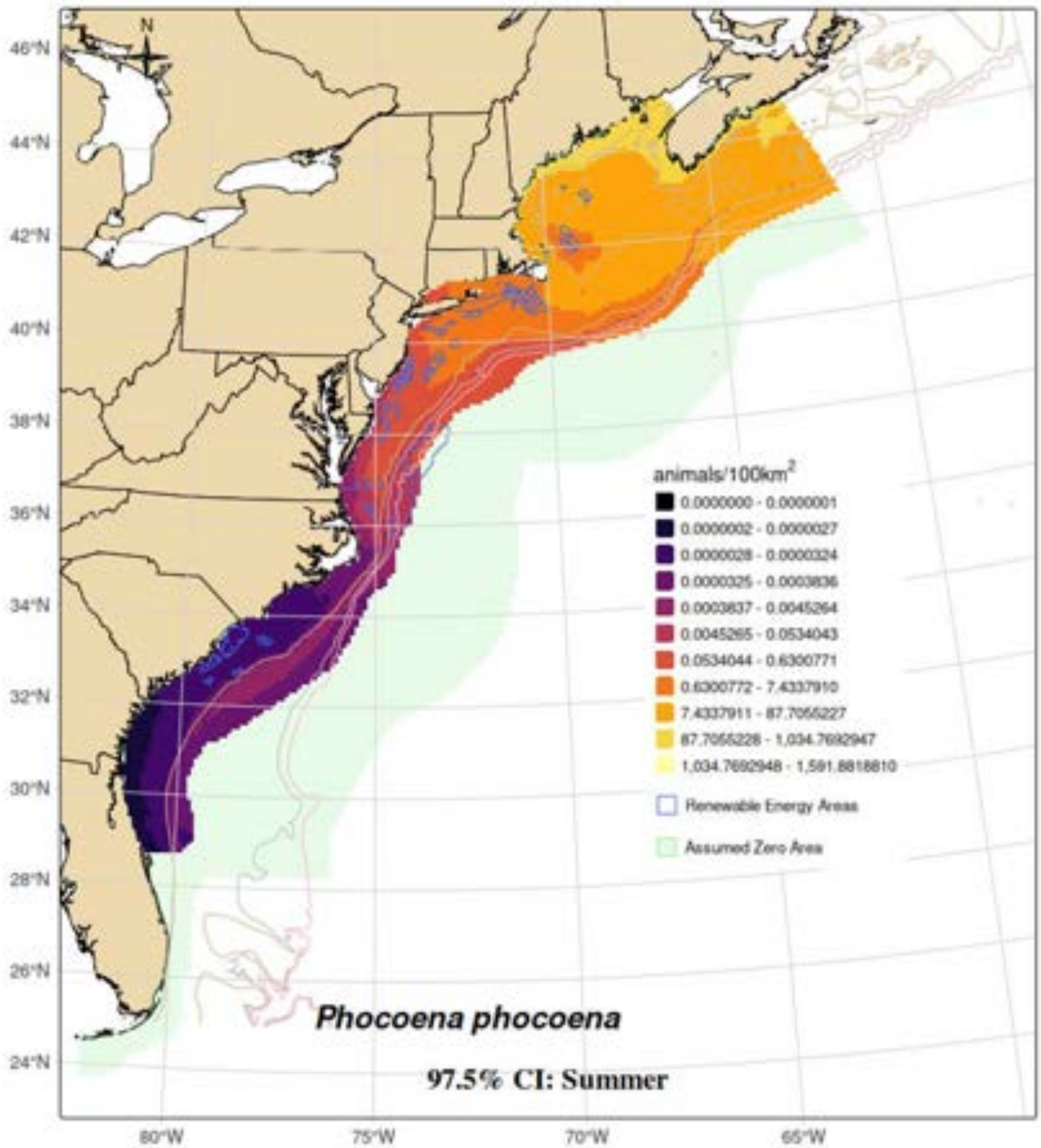

Figure C.10-12. Upper 97.5% confidence interval of the summer harbor porpoise density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

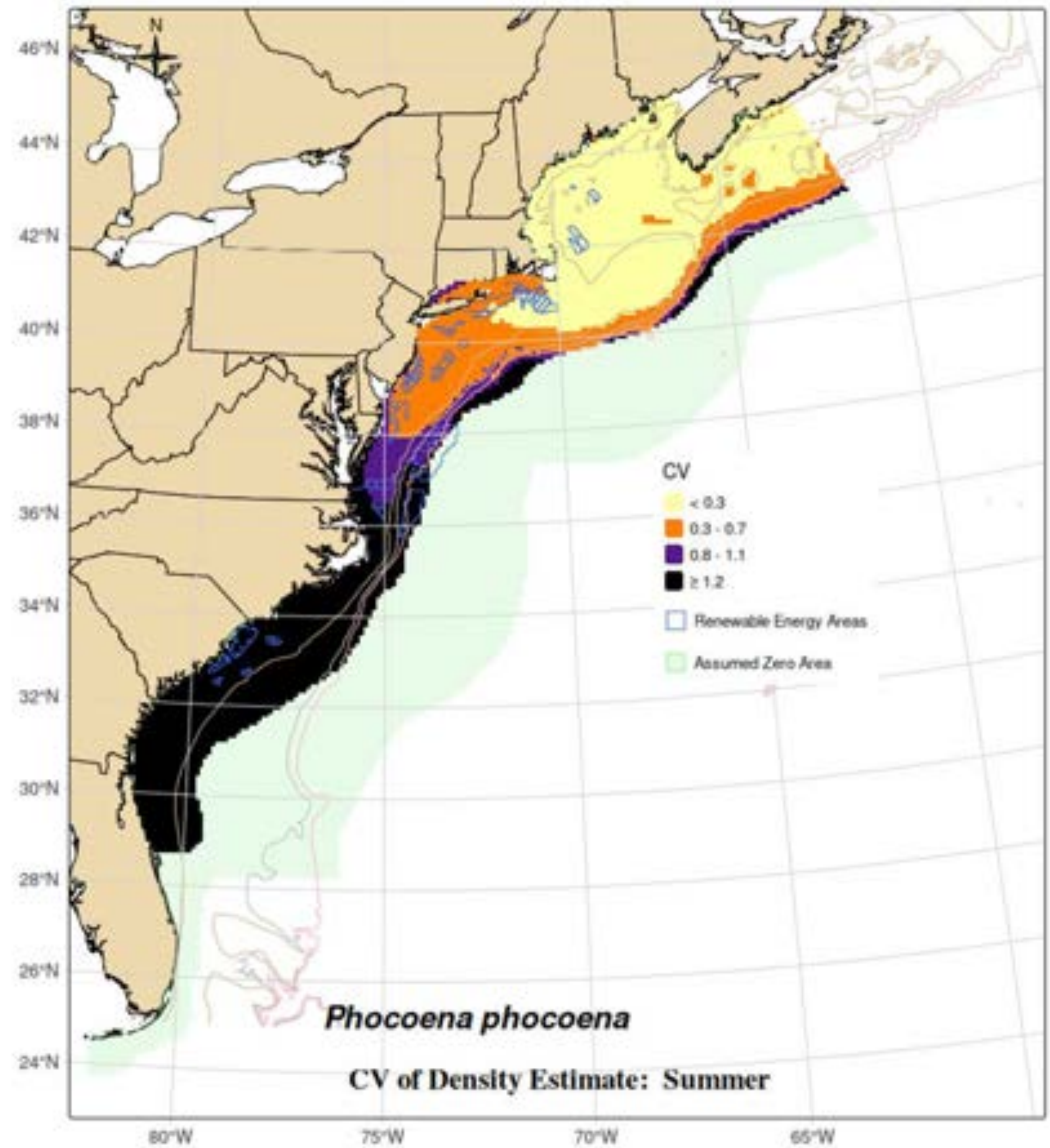

Figure C.10-13. CV of summer harbor porpoise density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

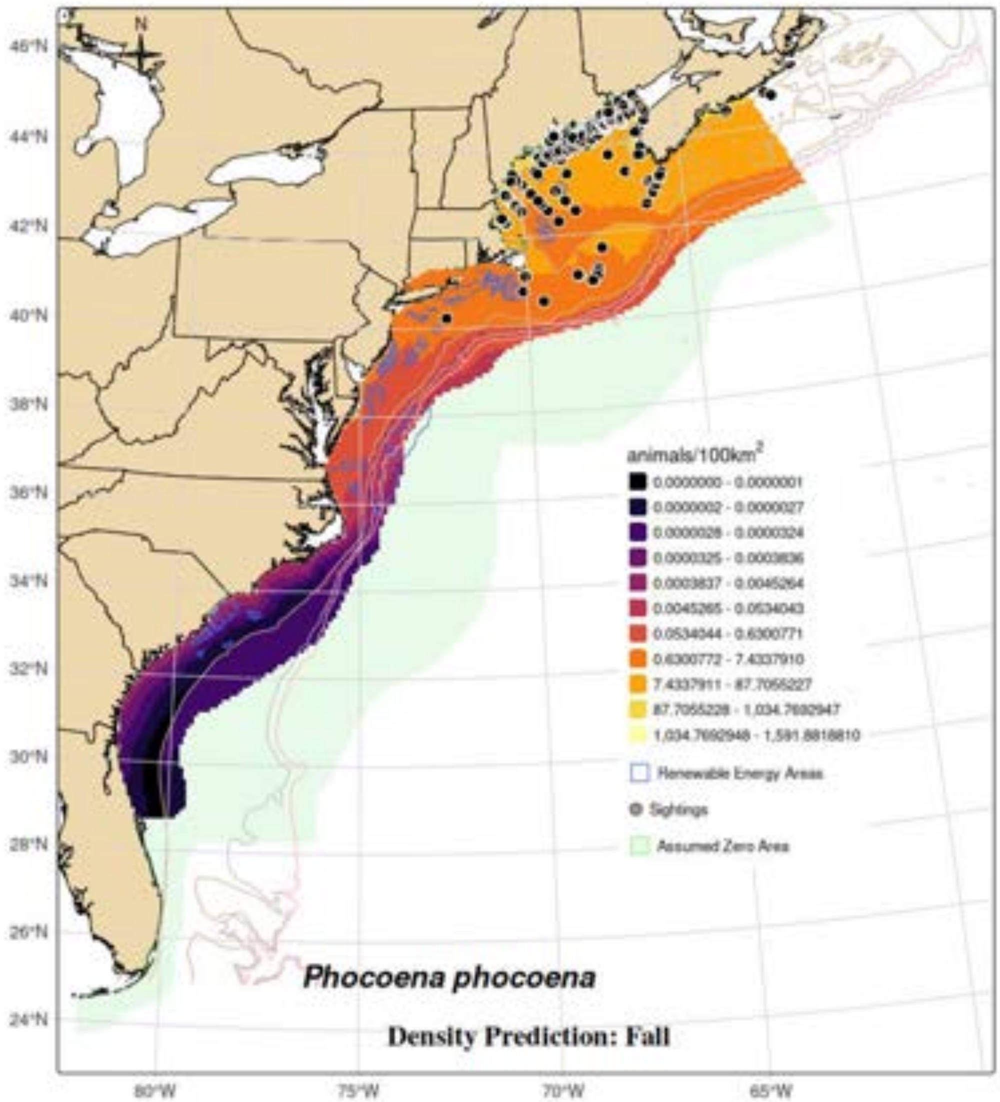

Figure C.10-14. Harbor porpoise fall average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

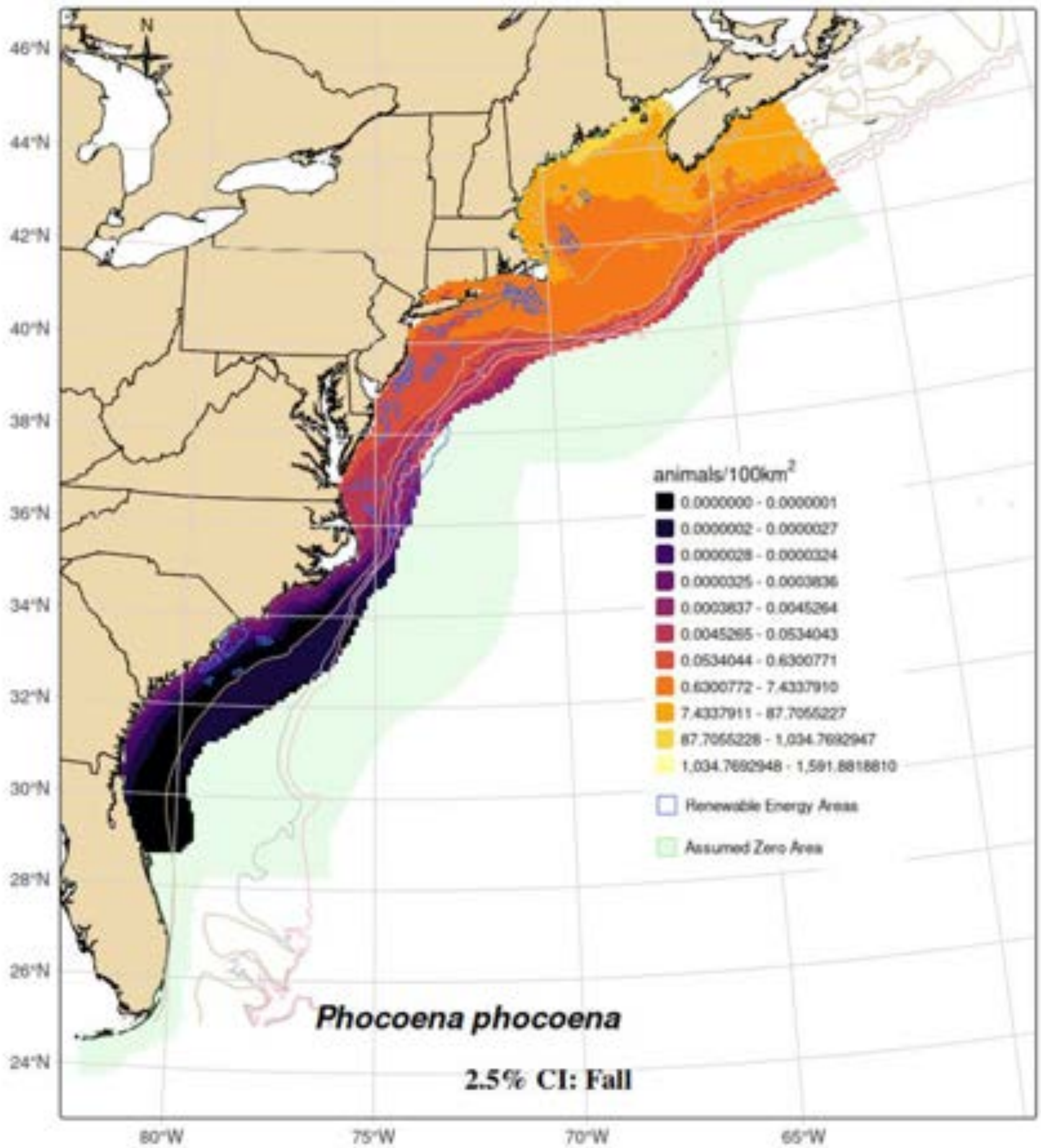

Figure C.10-15. Lower 2.5% confidence interval of the fall harbor porpoise density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

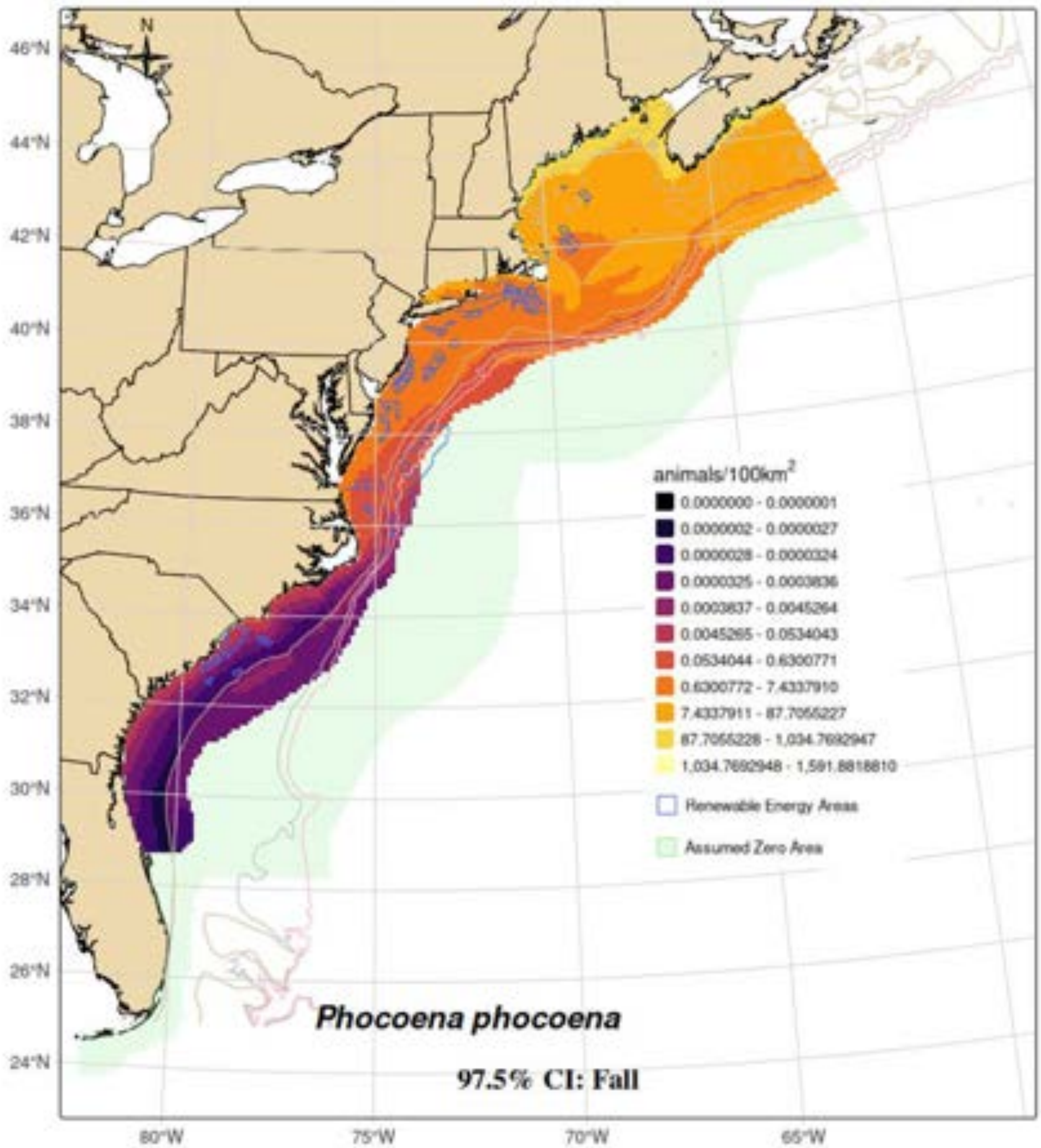

Figure C.10-16. Upper 97.5% confidence interval of the fall harbor porpoise density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

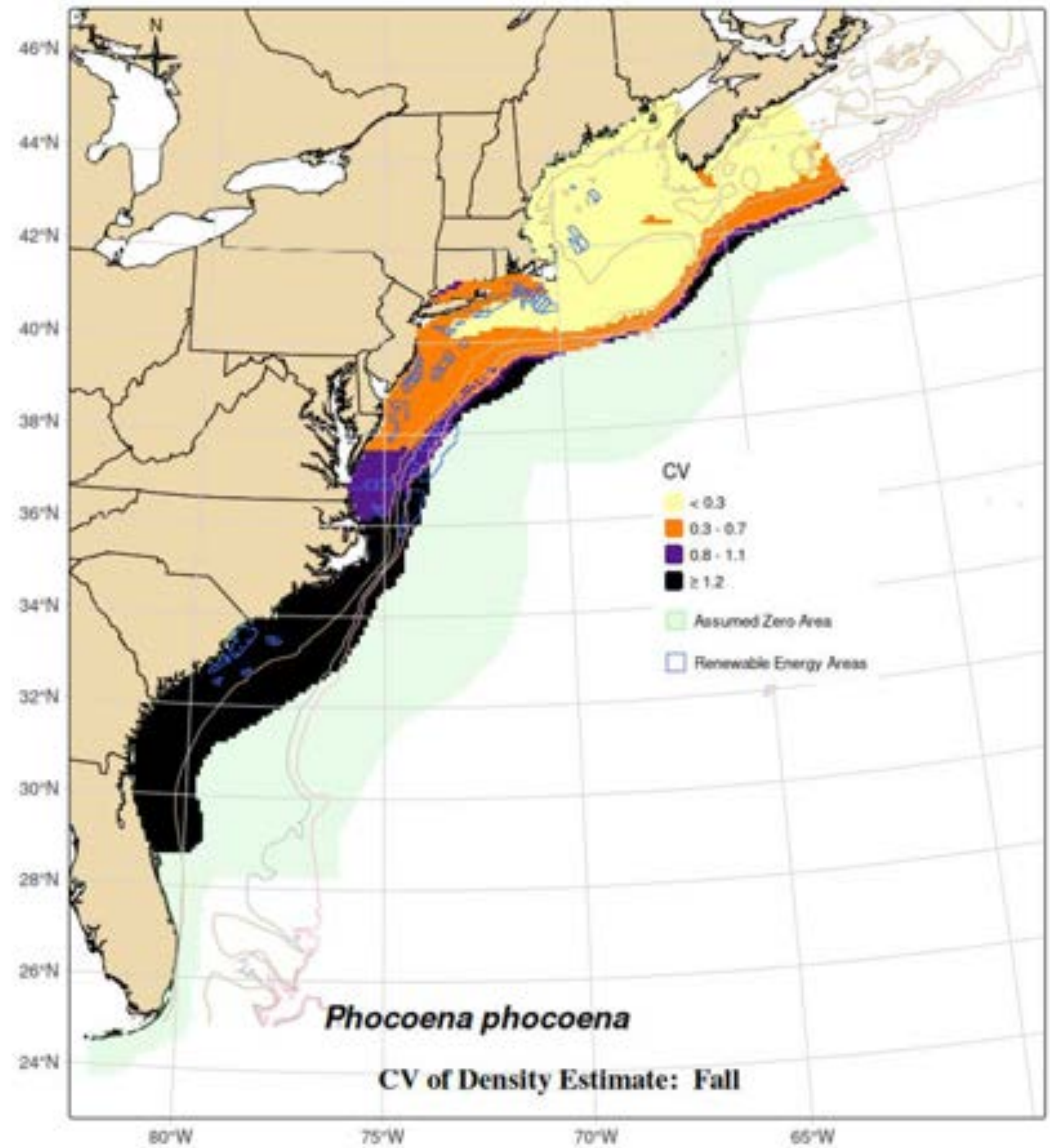

Figure C.10-17. CV of fall harbor porpoise density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

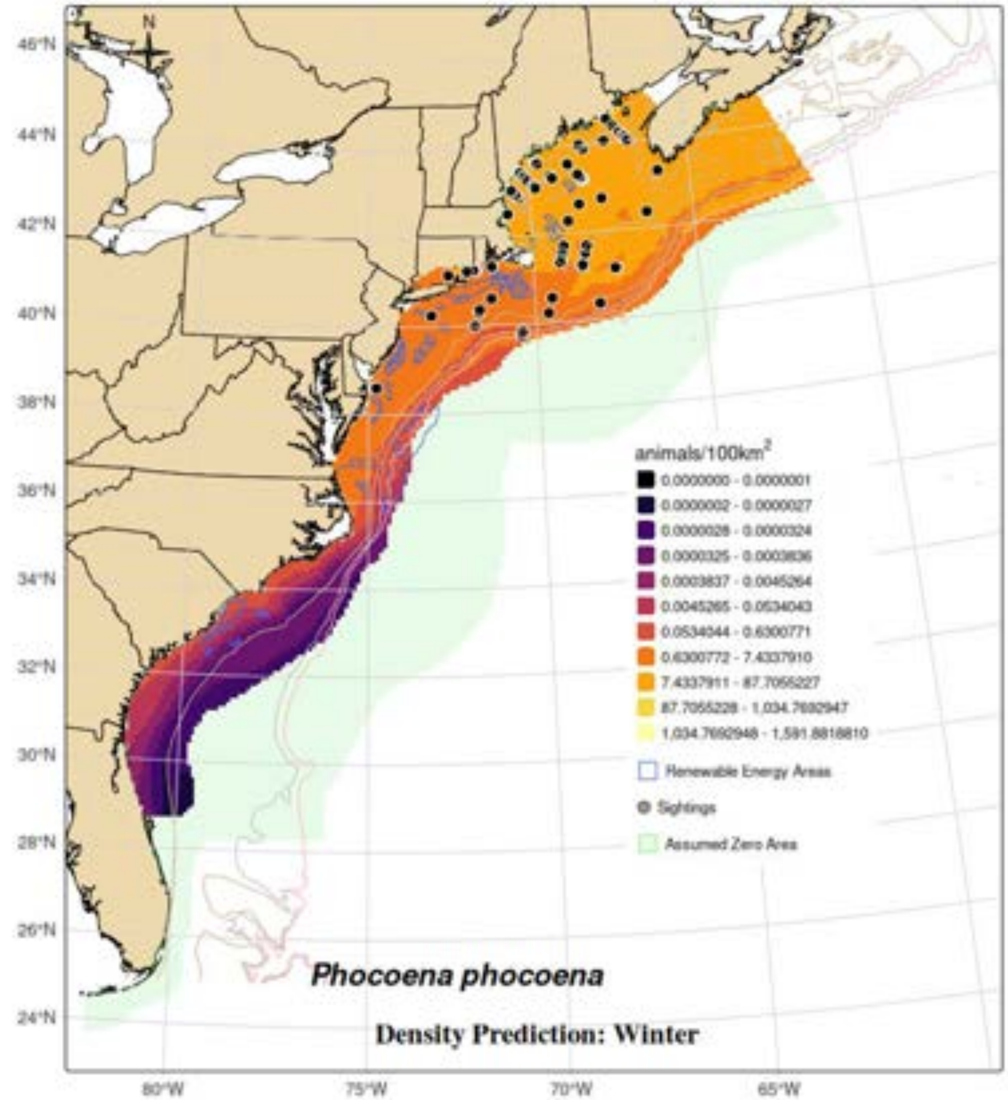

Figure C.10-18. Harbor porpoise winter average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

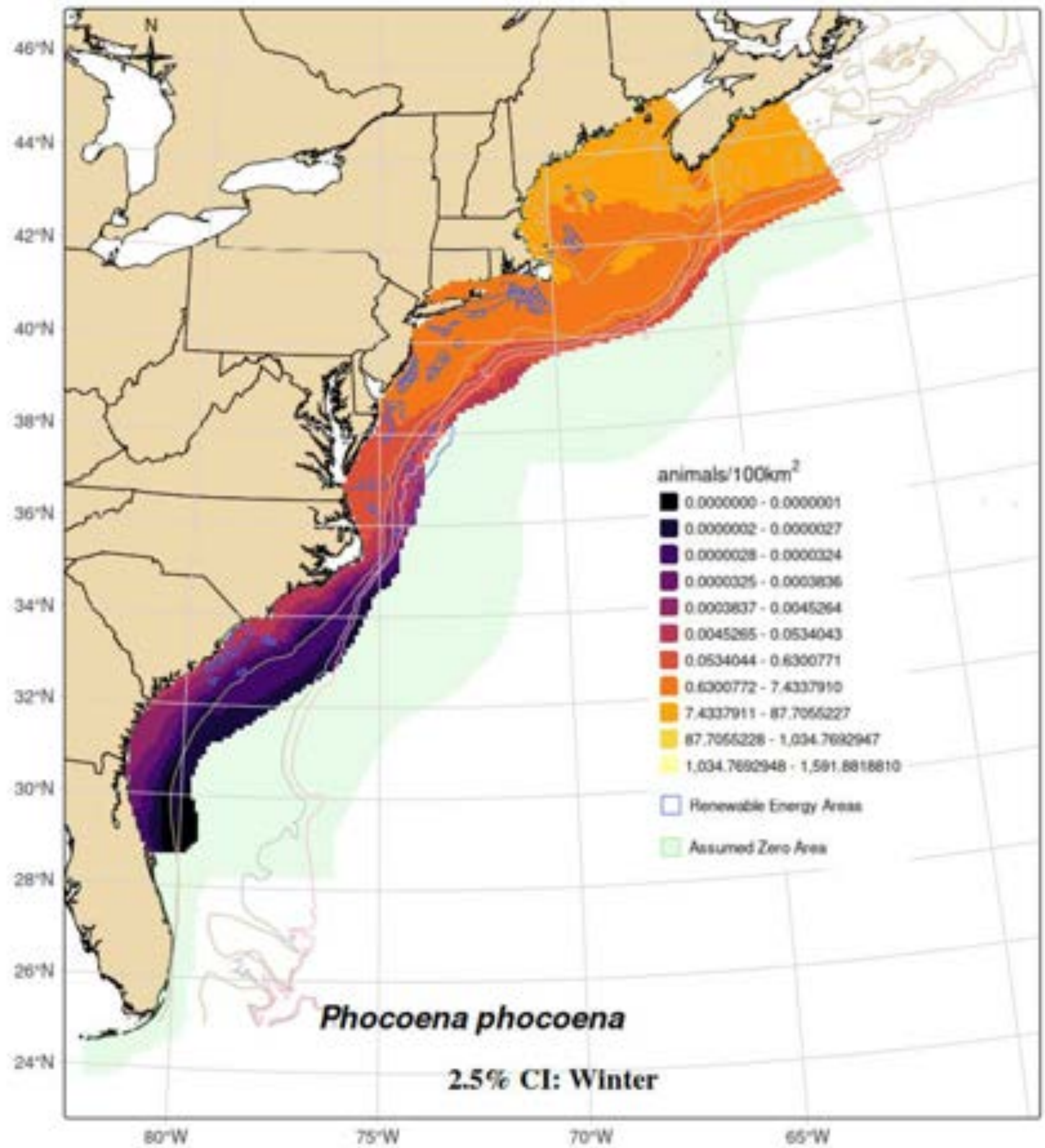

Figure C.10-19. Lower 2.5% confidence interval of the winter harbor porpoise density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

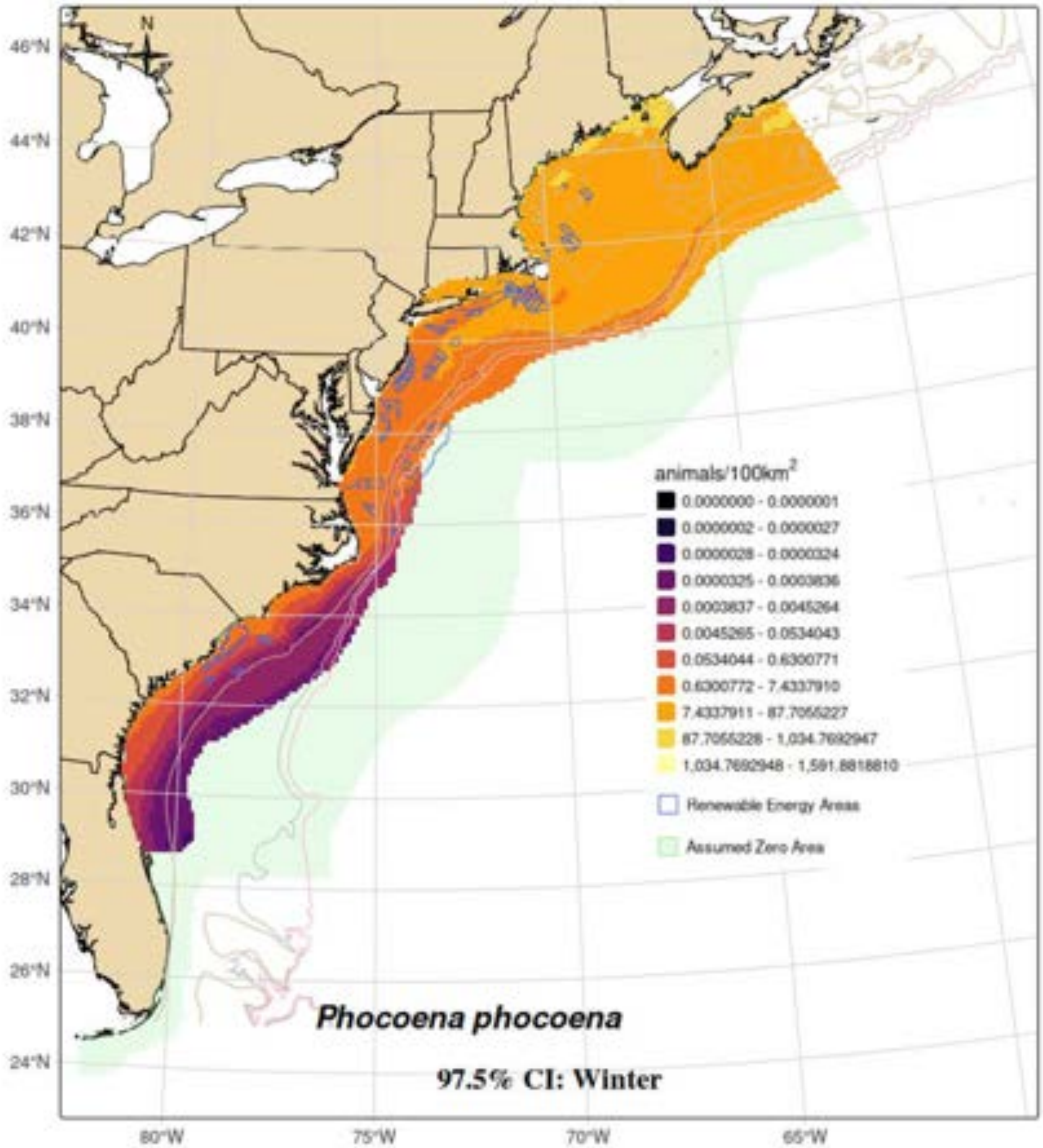

Figure C.10-20. Upper 97.5% confidence interval of the winter harbor porpoise density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

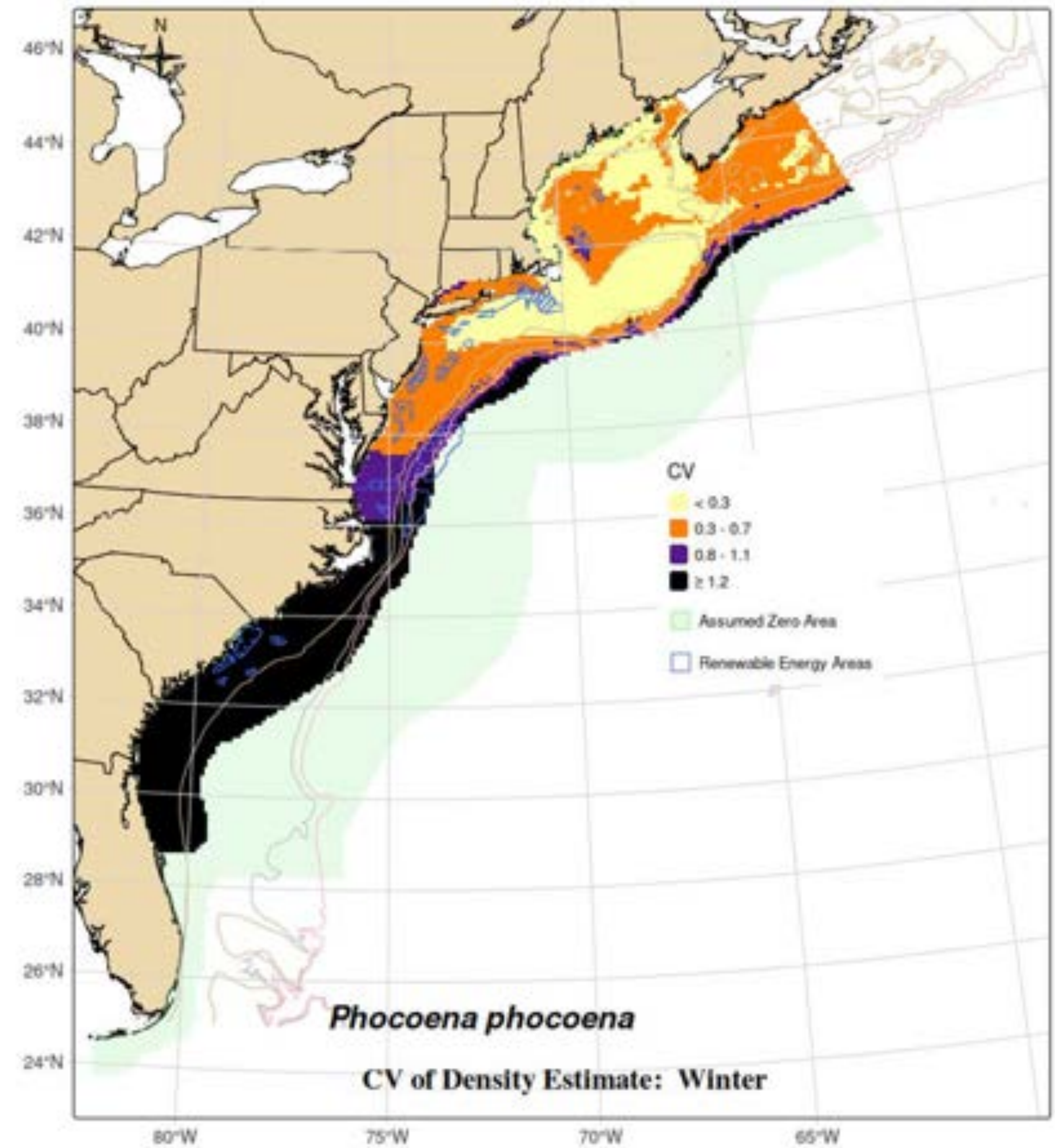

Figure C.10-21. CV of winter harbor porpoise density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas. Light green region indicates the region within the AMAPPS study area where we assumed the density was 0.

C.10.7 Offshore Energy Development Areas

Table C.10-6. Harbor porpoise abundance estimates for wind-energy study areas

Season	Wind-Energy Study Area	Abundance*	CV	95% Confidence Interval*
Spring (Mar-May)	RI/MA	876.7	0.27	523 – 1,469.7
	NY	179.7	0.32	97.9 - 329.6
	NJ	198.8	0.44	87.9 - 449.8
	DE/MD	108.6	0.59	37.4 - 315.6
	VA	36.6	0.98	7.3 – 184
	NC	24.0	1.14	4.0 - 143.2
	NC/SC	2.5	1.95	0.2 - 28.7
	GA	0.2	2.41	0 - 2.4
Summer (Jun-Aug)	RI/MA	255.2	0.29	146.8 - 443.7
	NY	12.3	0.36	6.2 - 24.2
	NJ	3.6	0.52	1.4 - 9.4
	DE/MD	1.5	0.68	0.4 - 4.9
	VA	0.2	1.08	0 – 1.0
	NC	0.1	1.26	0 - 0.7
	NC/SC	0.0	3.17	0 – 0
	GA	0.0	4.14	0 – 0
Fall (Sep-Nov)	RI/MA	253.3	0.29	144.2 - 444.8
	NY	35.9	0.34	18.8 - 68.5
	NJ	43.9	0.44	19.2 - 100.1
	DE/MD	19.0	0.58	6.6 - 54.8
	VA	2.9	0.99	0.6 - 14.5
	NC	1.1	1.15	0.2 - 6.8
	NC/SC	0.1	1.94	0 - 1.5
	GA	0.0	2.44	0 - 0.1
Winter (Dec-Feb)	RI/MA	533.9	0.28	314 - 907.7
	NY	103.8	0.32	56.6 - 190.4
	NJ	123.2	0.44	54.3 – 280
	DE/MD	72.0	0.59	24.7 - 209.6
	VA	31.0	0.99	6.2 - 155.9
	NC	19.7	1.13	3.3 - 117.2
	NC/SC	7.5	1.95	0.6 - 87.9
	GA	0.8	2.41	0.1 - 11.7

***** We rounded the mean abundance and 95% confidence interval to the nearest tenth of an animal. If this resulted in a zero for the mean abundance, we calculated the CV using the actual abundance value as estimated by the density-habitat model and then rounded to the nearest tenth. If a wind-energy study area is not included, then we assumed the abundance was zero.

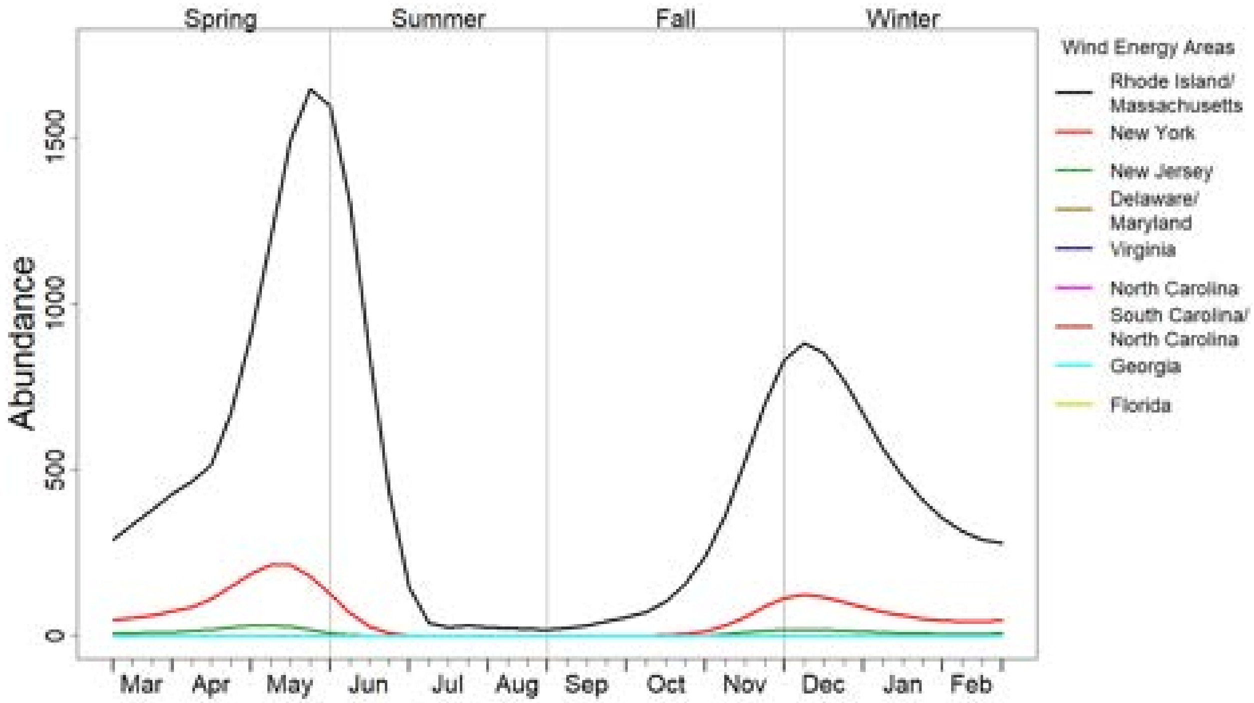

Figure C.10-22. Average seasonal abundance of harbor porpoises in the wind-energy study areas

C.10 References Cited

Hayes SA, Josephson E, Maze-Foley K, Rosel PE, McCordic J, Brossard A, Chavez-Rosales S, Cole TVN, Garrison LP, Hatch J, et al. 2024. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2023. NOAA Technical Memorandum NMFS-NE-321. https://www.fisheries.noaa.gov/s3/2025-01/Atlantic-MMSAR-122025.pdf