Supplement to

Atlantic Marine Assessment Program for Protected Species: 2019-2025

Appendix D

Sea Turtle
Generalize Additive Density-Habitat Models and Maps, by Species

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D.1 Study Area

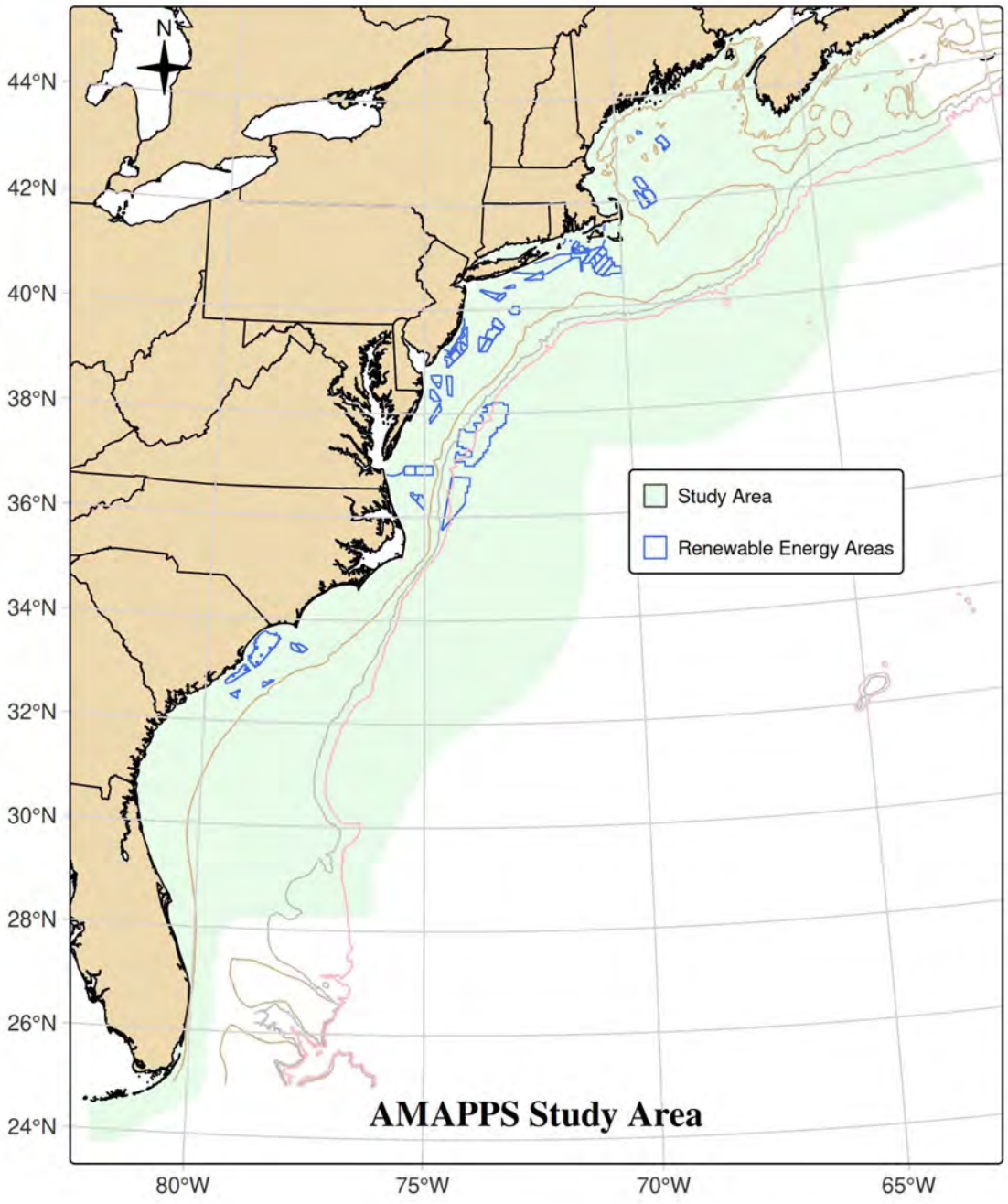

Figure D.1-1 AMAPPS study area and Massachusetts to North Carolina wind-energy study areas
We identified the locations of the offshore wind energy areas (blue line) in relationship to the AMAPPS study area (green shaded). Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

D.2 Loggerhead turtle (*Caretta caratta*)

Figure D.2-1. Loggerhead turtle

D.2.1 Data Collection

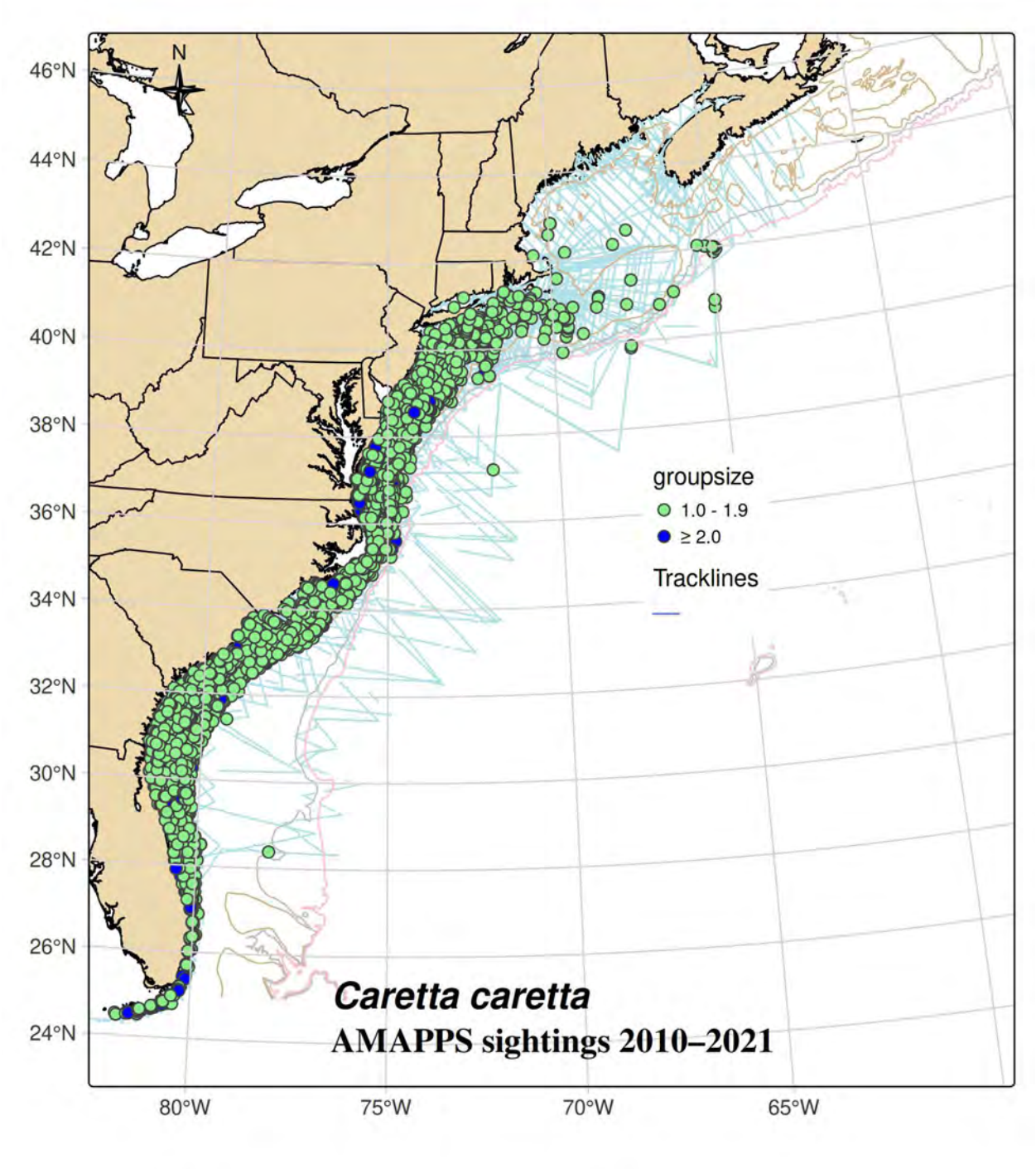

Figure D.2-2. Distribution of track lines and loggerhead turtle sightings 2010 to 2021
Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

Table D.2-1. AMAPPS research effort 2010 to 2021 and loggerhead turtle sightings

Survey Region and Platform	Season	Effort (km)	Number of Groups	Number of Animals
NE Shipboard	Spring	8,883	-	-
NE Shipboard	Summer	49,064	102	106
NE Aerial	Spring	27,229	1	1
NE Aerial	Summer	41,806	504	509
NE Aerial	Fall	58,178	175	184
NE Aerial	Winter	10,645	4	4
SE Shipboard	Summer	18,331	-	-
SE Shipboard	Fall	2,673	-	-
SE Aerial	Spring	42,185	1,760	2,072
SE Aerial	Summer	43,285	2,029	2,408
SE Aerial	Fall	21,153	1,031	1,182
SE Aerial	Winter	19,152	648	782

D.2.2 Mark-Recapture Distance Sampling Analysis

Table D.2-2. Intermediate parameters in loggerhead turtle 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 - air group 6	distance + observer + quality	430	distance + glare	300	HN with Hermite Polynomial Adjustment Order 4	0.601	0.014	-	0.613
NE– air group 10	distance * observer + log(size)	350	distance + time of day	450	HN with Hermite Polynomial Adjustment Order 4	0.600	0.047	-	0.954

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.

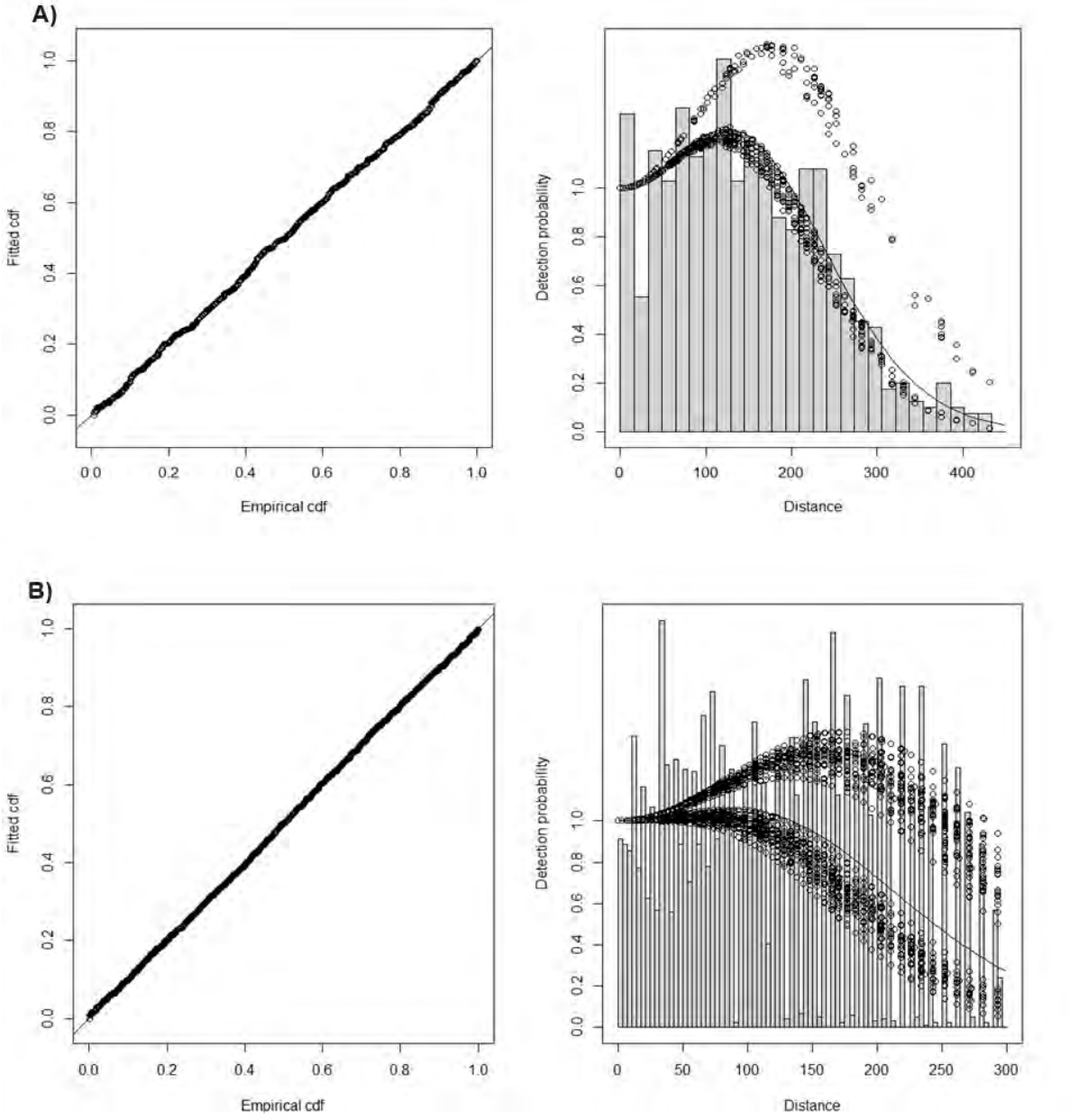

Figure D.2-3. Q-Q plots and detection functions from the loggerhead turtle MRDS analyses
A) SE-aerial analysis; B) NE-aerial analysis, the perpendicular distance is in meters.

D.2.3 Generalized Additive Model Analysis

Table D.2-3. 2010 to 2023 density-habitat model output for loggerhead turtles

Covariates	Edf	Ref.df	F	C.dev	p-value
s(sstmur)	3.956	4	159.67	19.72	<0.0001
s(pp)	2.983	4	14.384	0.98	<0.0001
s(DGSNW)	3.469	4	14.256	1.32	<0.0001
s(DGSSW)	3.157	4	8.266	0.66	<0.0001
s(depth)	3.428	4	41.745	2.82	<0.0001
s(dist2shore)	3.075	4	26.174	2.06	<0.0001
s(dist200)	3.207	4	20.305	0.66	<0.0001
s(dist1000)	3.855	4	32.279	2.2	<0.0001
s(latitude)	3.97	4	97.52	7.14	<0.0001

Adjusted R^2 = 0.154, Deviance explained = 37.3%
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.

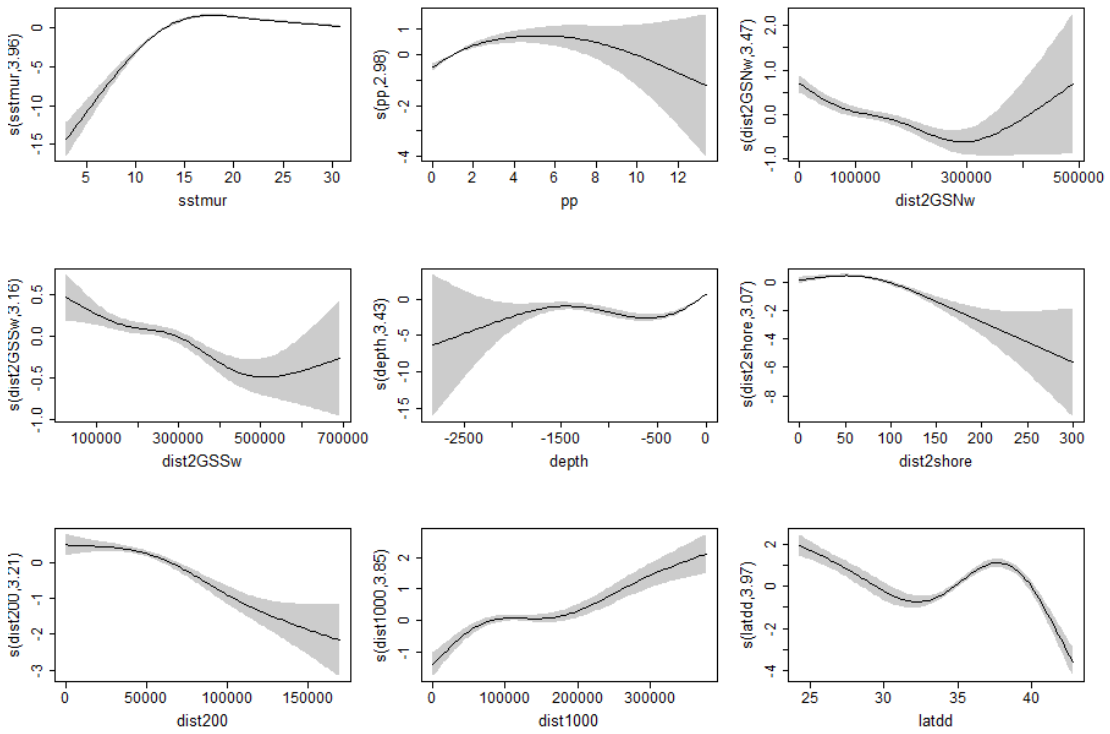

Figure D.2-4. Loggerhead turtle density relative to significant habitat covariates
Plots represent the partial smooths and interaction terms of the density-habitat model. Covariate abbreviations explained in main text in Table 4-2.

D.2.4 Model Cross-Validation

Table D.2-4. Diagnostic statistics from the loggerhead turtle density-habitat model

Diagnostic Statistic	Description	Calculated with	Model Values (x)	Score
RHO	Spearman rank correlation	Non-zero density	0.406	Excellent
MAPE	Mean absolute percentage error	Non-zero density	69.149	Fair to good
RHO	Spearman rank correlation	All data divided in 25 random samples	0.464	Excellent
MAPE	Mean absolute percentage error	All data divided in 25 random samples	70.86	Fair to good
MAE	Mean absolute error	All data divided in 25 random samples	0.953	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

D.2.5 Abundance Estimates for AMAPPS Study Area

Table D.2-5. Loggerhead turtle average abundance estimates for the AMAPPS study area

Season	Average Abundance	CV	95% Confidence Interval
Spring (March–May)	231,900	0.13	179,931 – 298,879
Summer (June–August)	219,086	0.14	166,733 – 287,877
Fall (September–November)	244,310	0.12	193,268 – 308,832
Winter (December–February)	233,777	0.11	188,560 – 289,837
Summer 2011 U.S. surveys[1]	-	-	-
Summer 2016 U.S. surveys[1]	-	-	-
Summer 2021 U.S. surveys	-	-	-

[1]Hayes et al. 2024

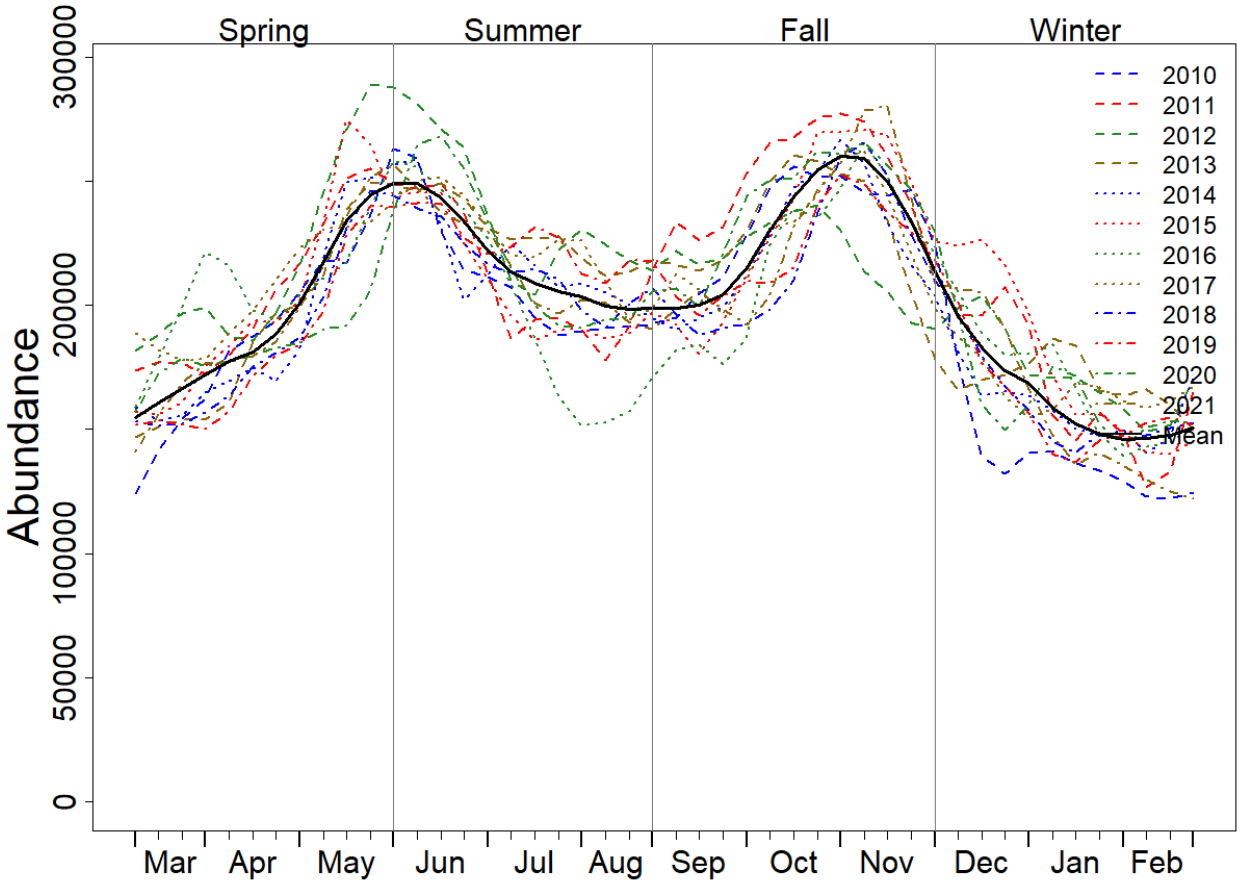

Figure D.2-5. Annual abundance trends for loggerhead turtle in the AMAPPS study area

D.2.6 Seasonal Prediction Maps

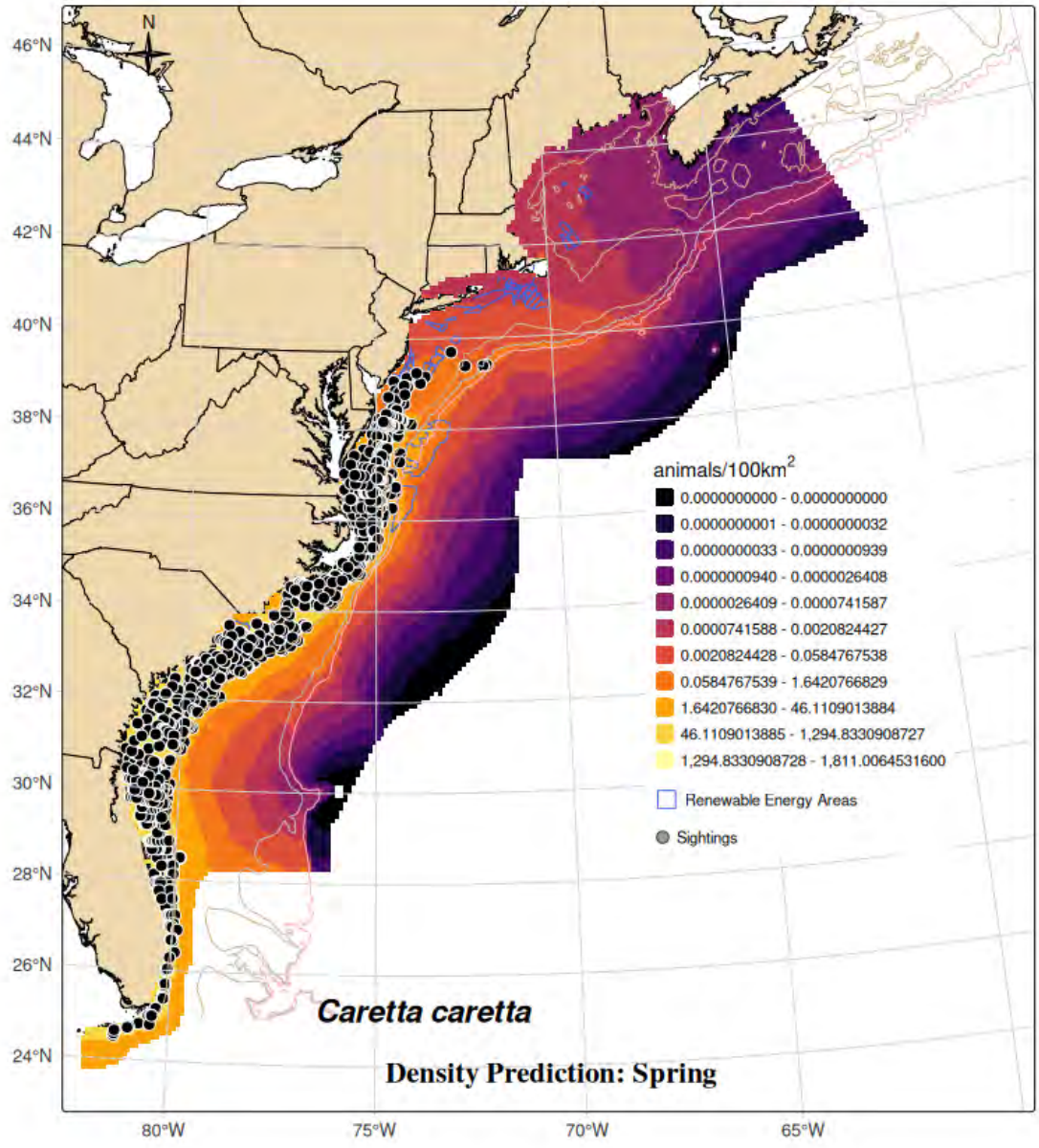

Figure D.2-6. Loggerhead turtle spring average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate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

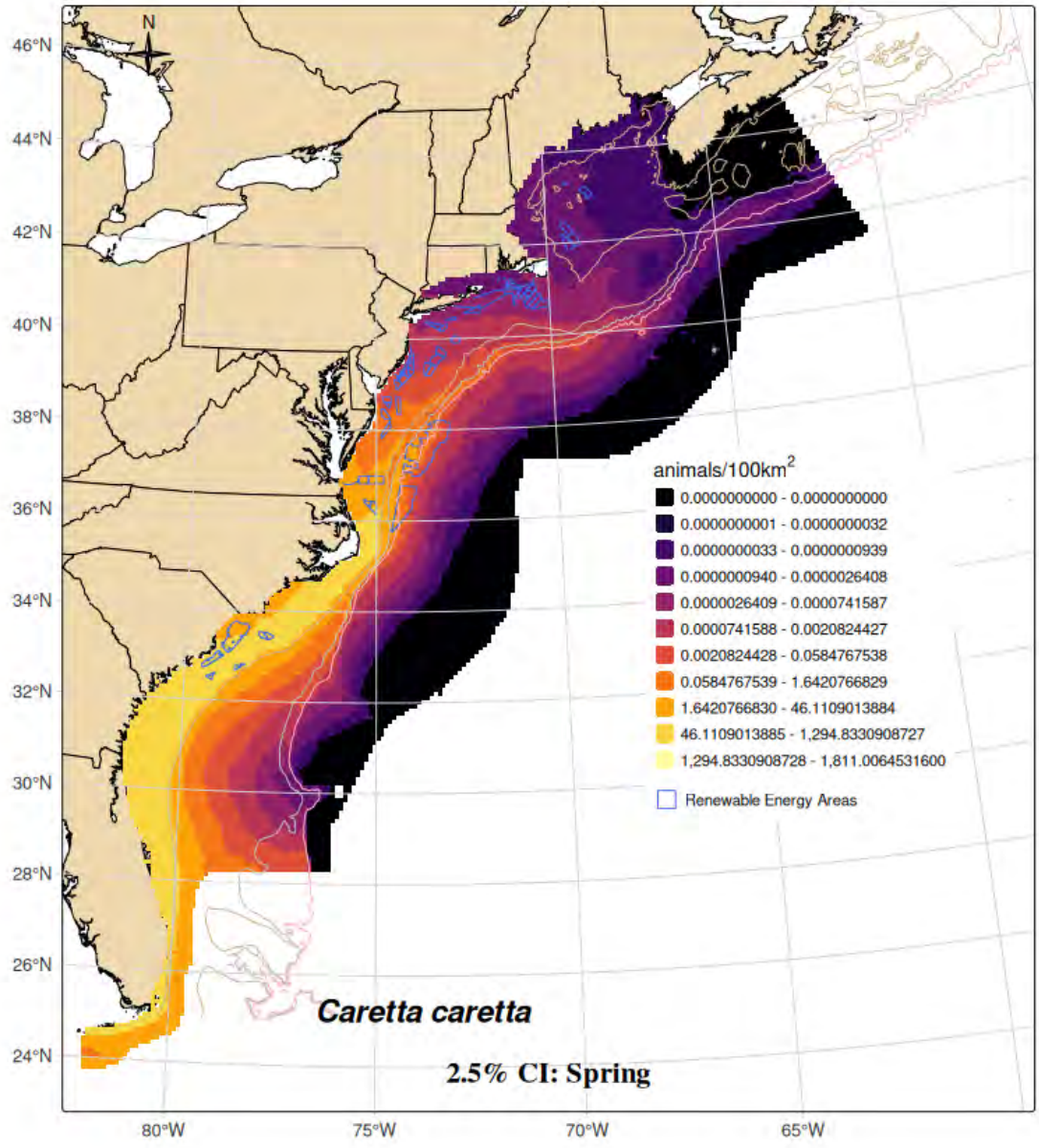

Figure D.2-7. Lower 2.5% confidence interval of the spring loggerhead turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

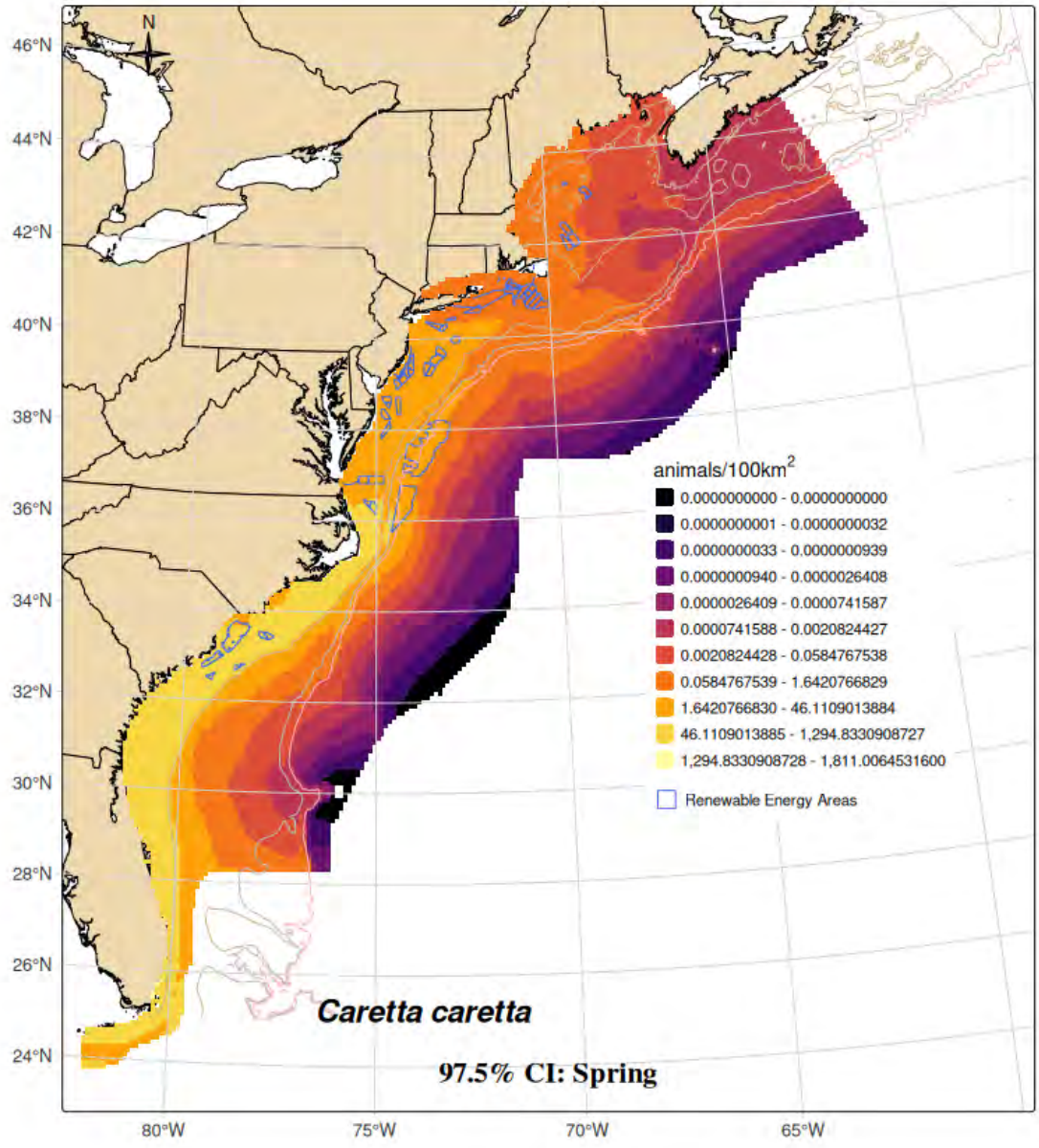

Figure D.2-8. Upper 97.5% confidence interval of the spring loggerhead turtle density estimates Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

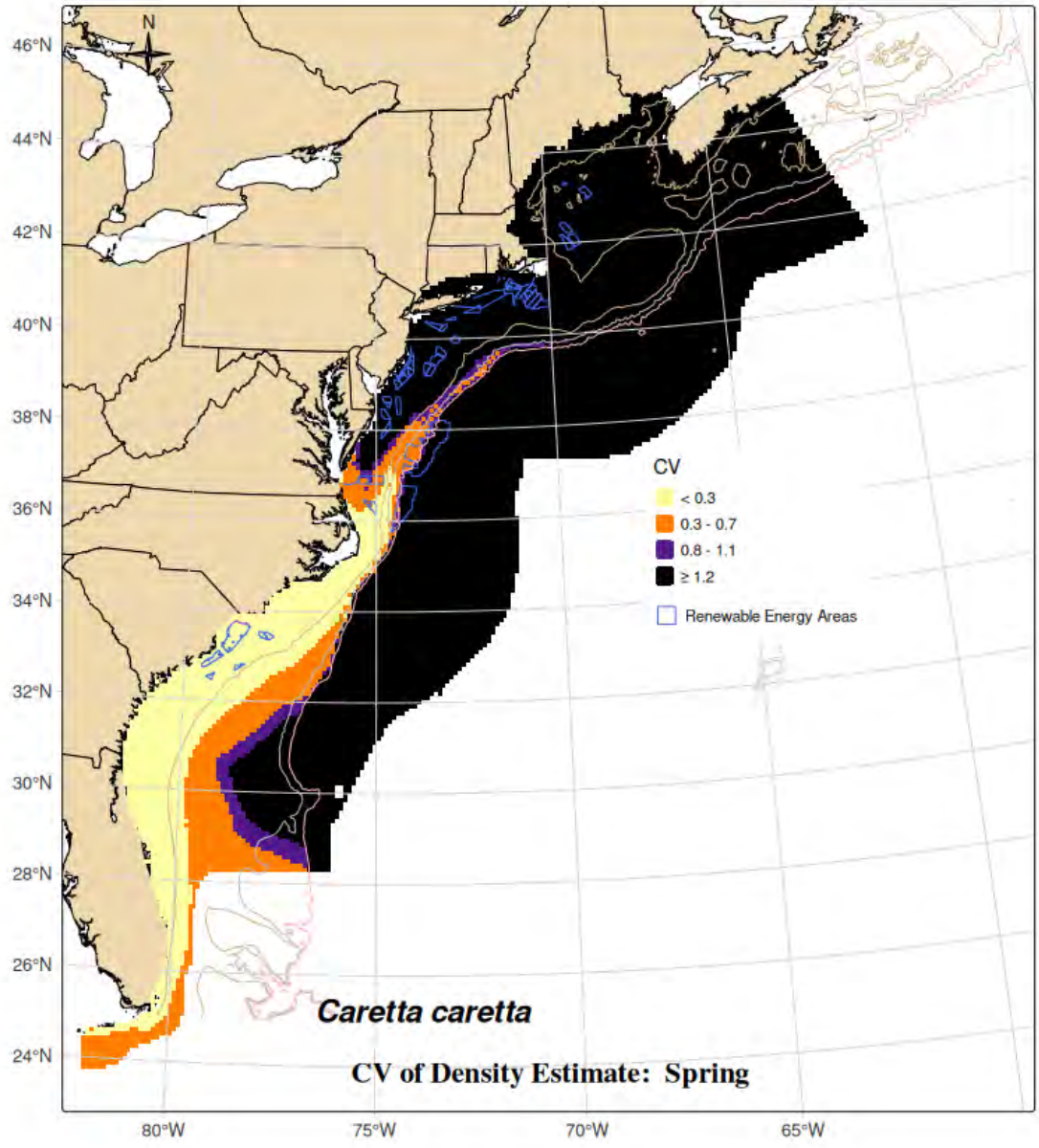

Figure D.2-9. CV of spring loggerhead turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas

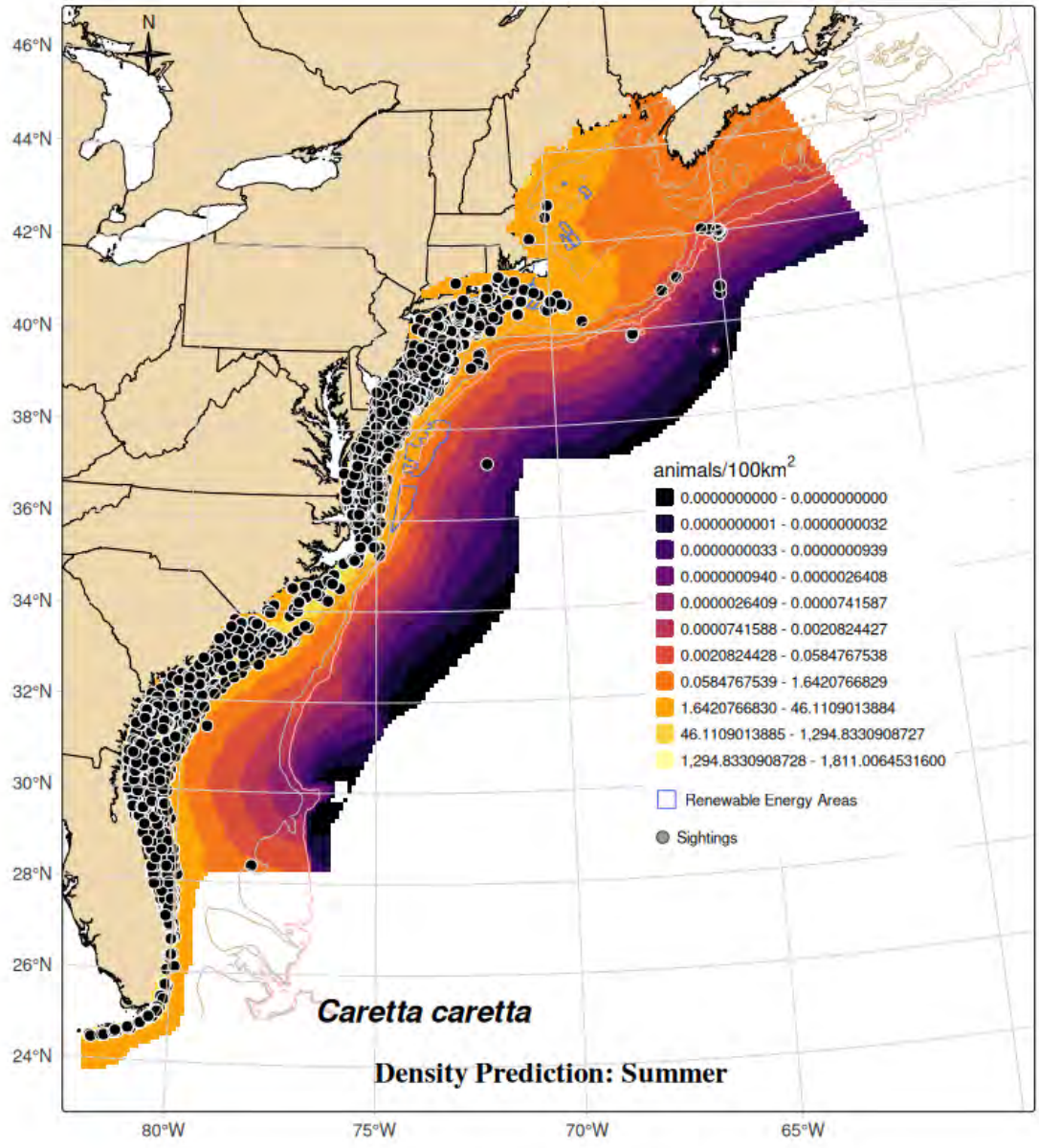

Figure D.2-10. Loggerhead turtle summer average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate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

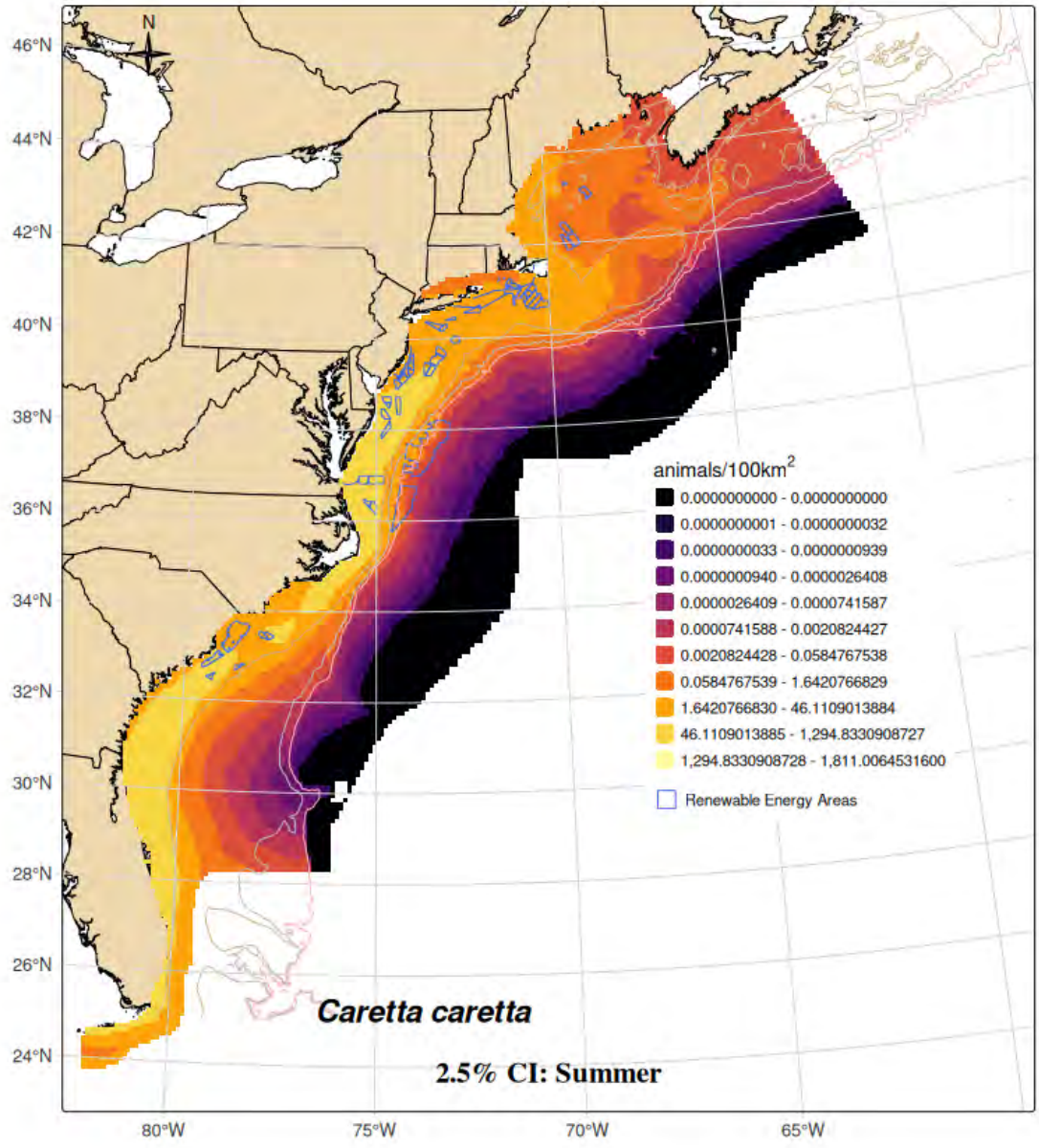

Figure D.2-11. Lower 2.5% confidence interval of the summer loggerhead turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

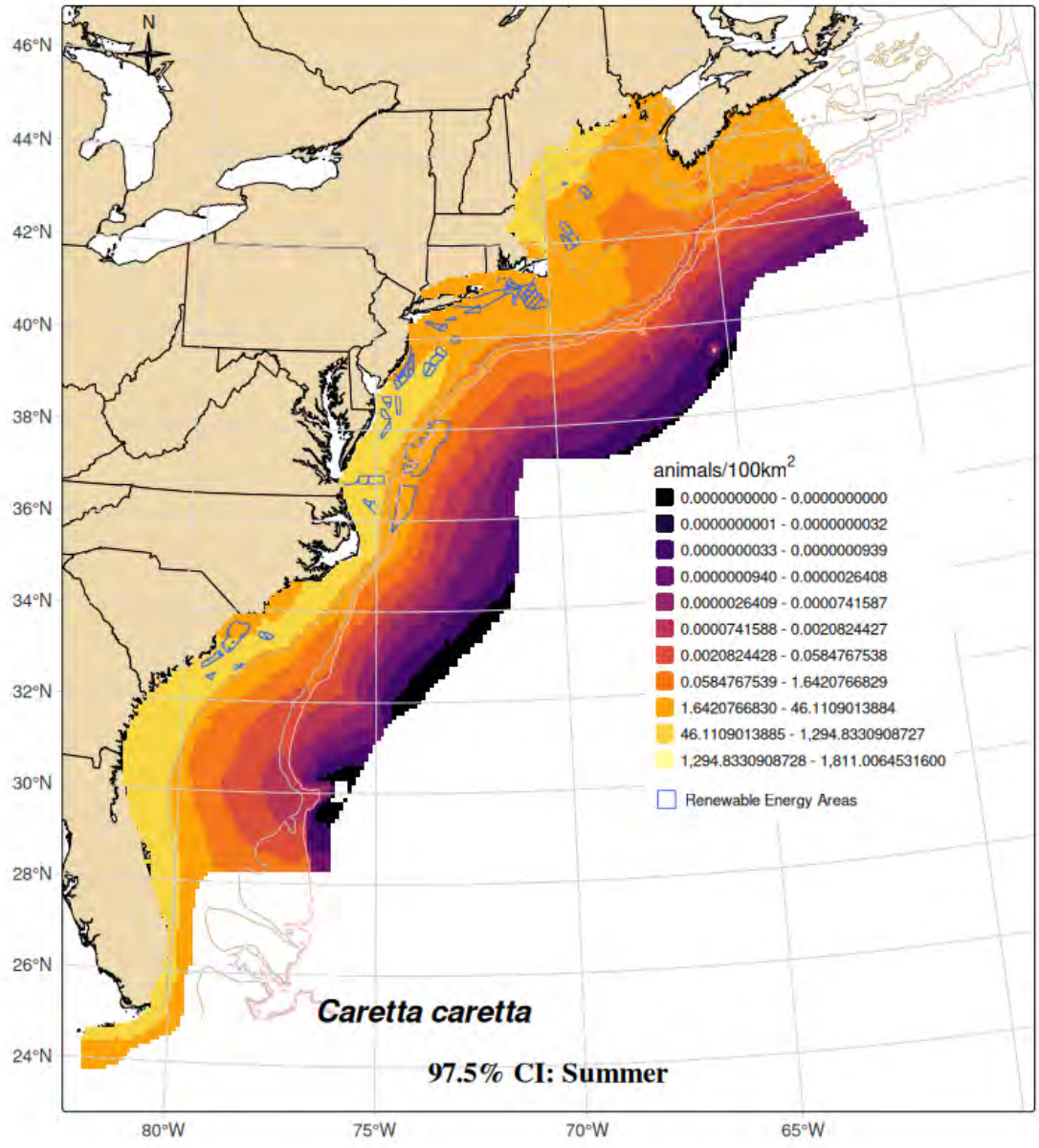

Figure D.2-12. Upper 97.5% confidence interval of the summer loggerhead turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

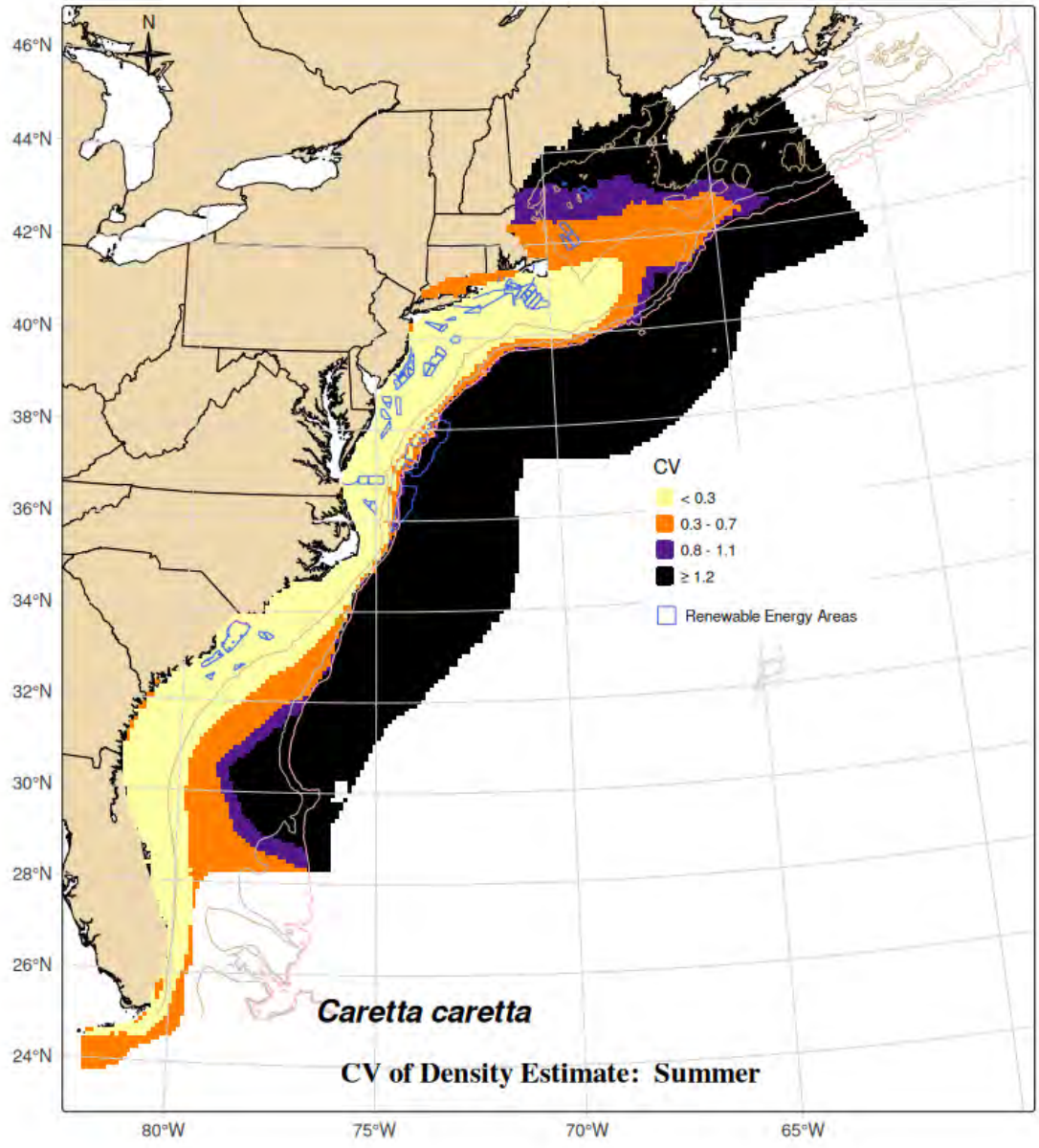

Figure D.2-13. CV of summer loggerhead turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

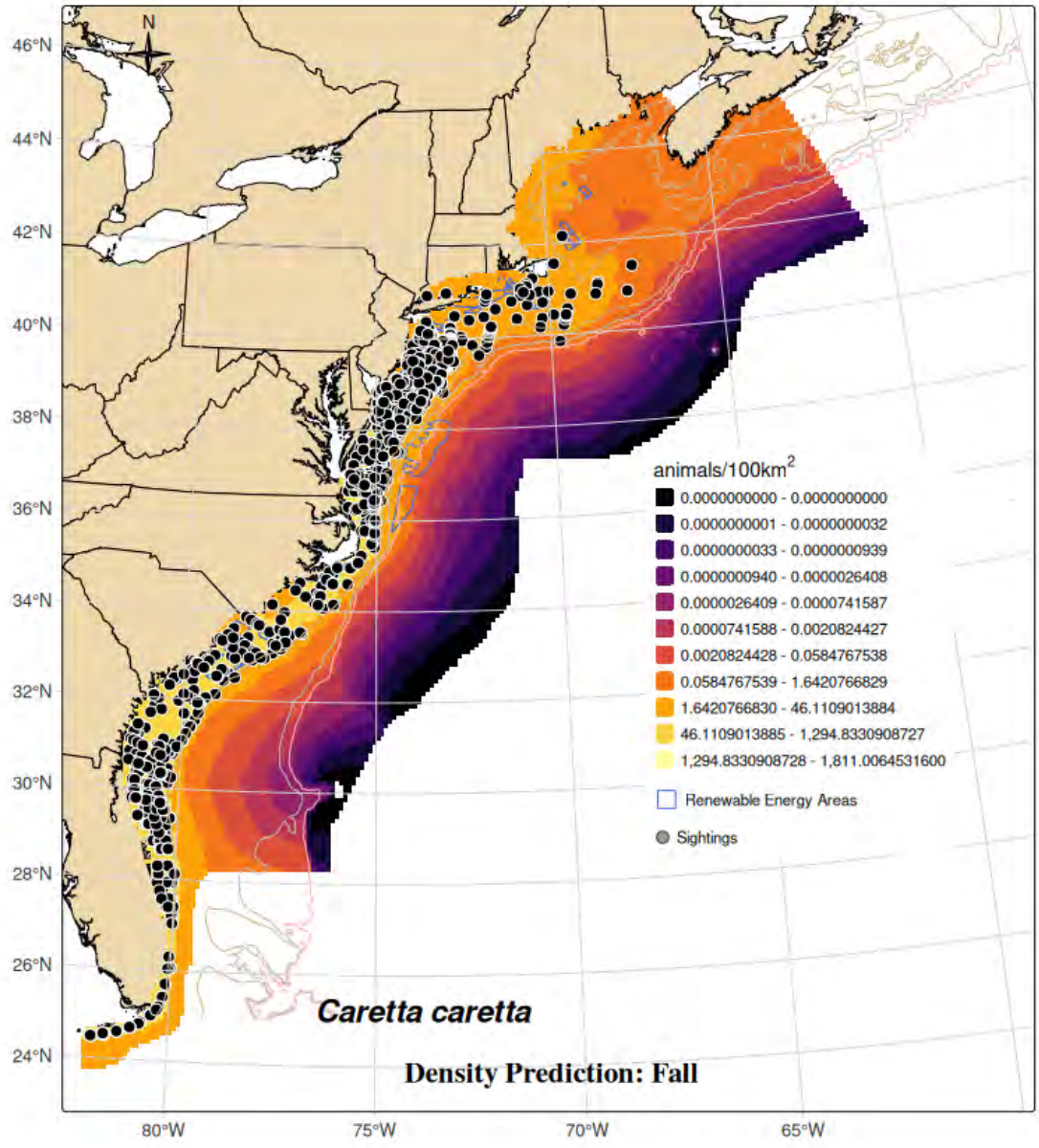

Figure D.2-14. Loggerhead turtle fall average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate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

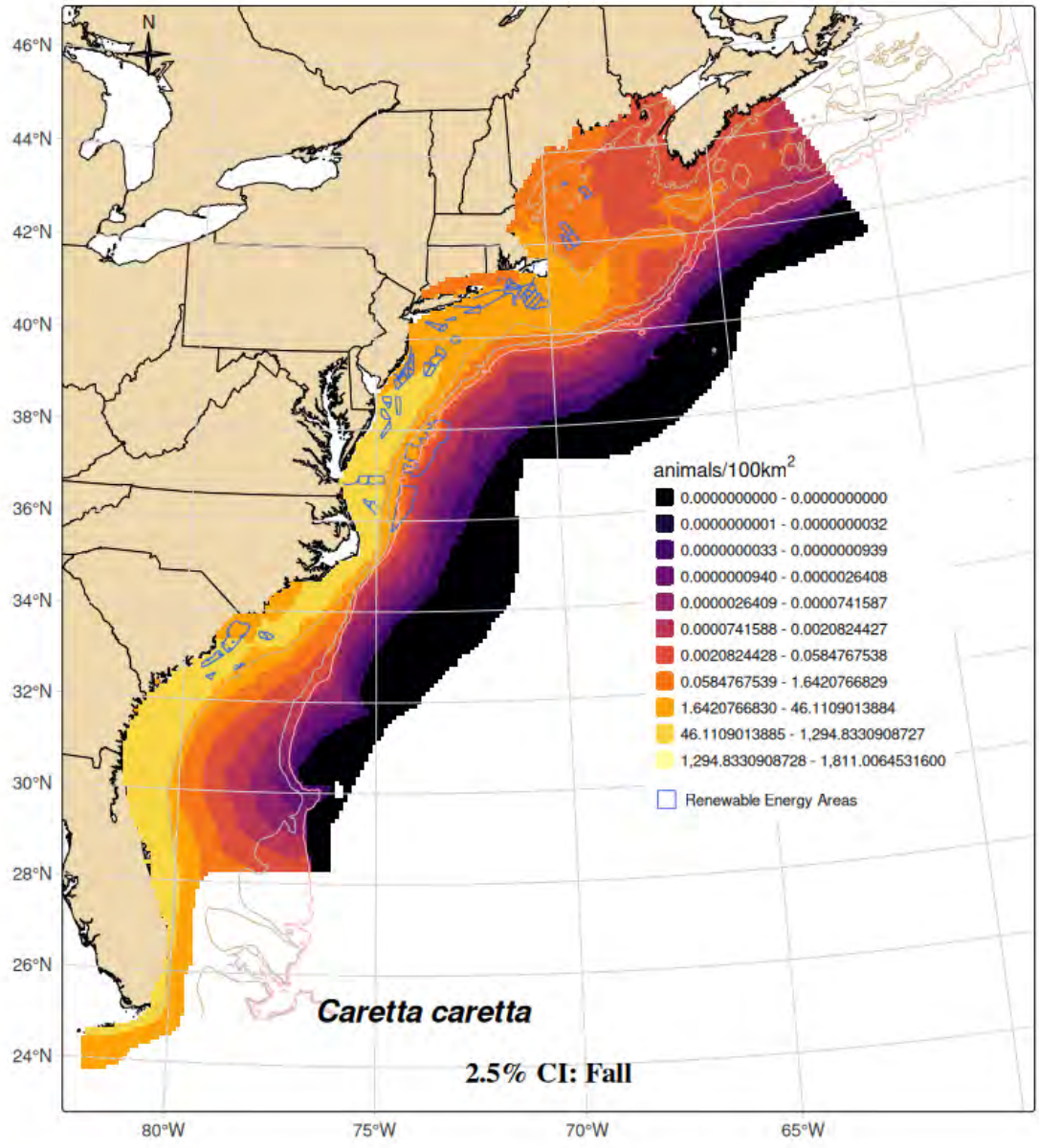

Figure D.2-15. Lower 2.5% confidence interval of the fall loggerhead turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

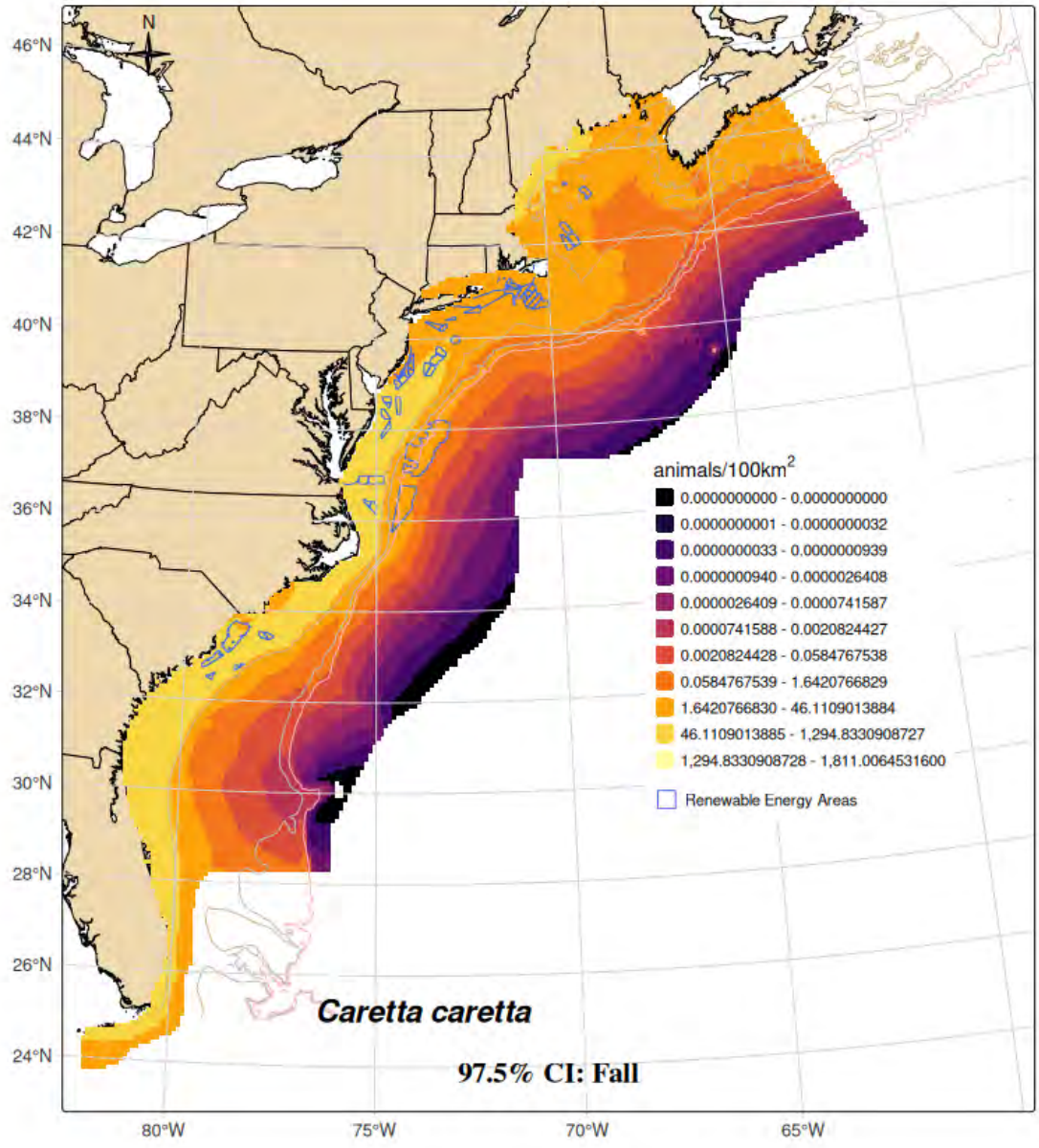

Figure D.2-16. Upper 97.5% confidence interval of the fall loggerhead turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

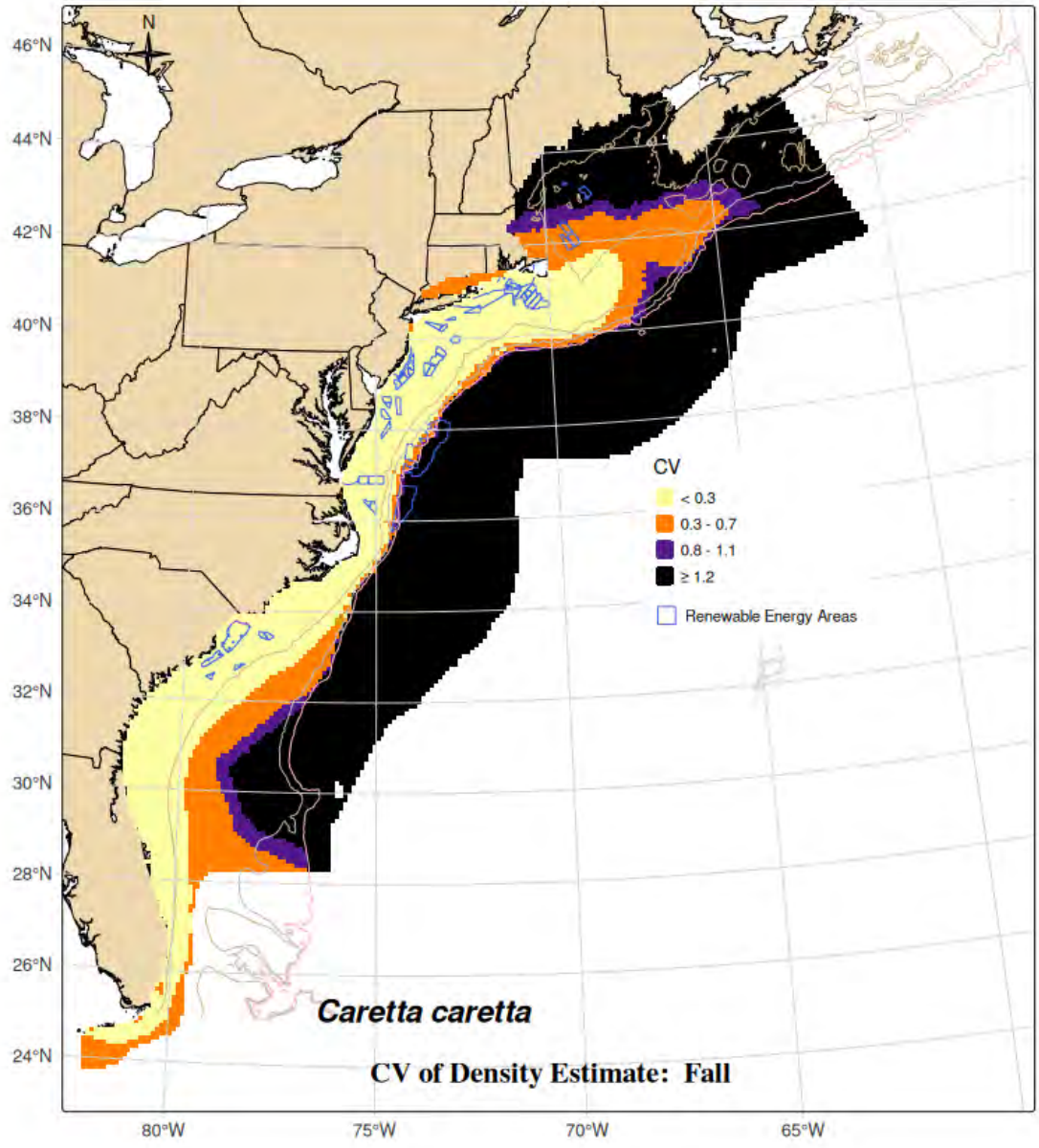

Figure D.2-17. CV of fall loggerhead turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

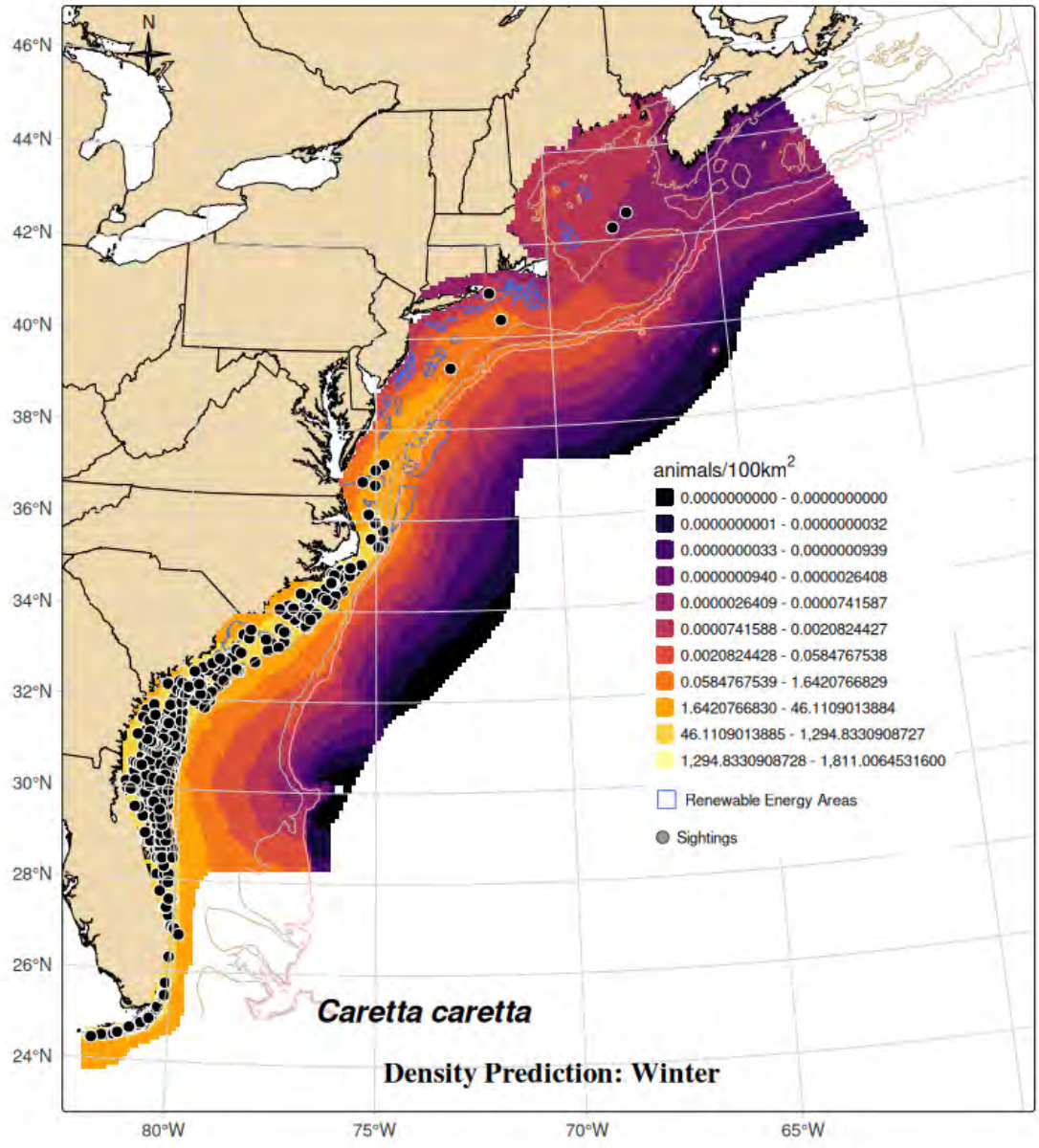

Figure D.2-18. Loggerhead turtle winter average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate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

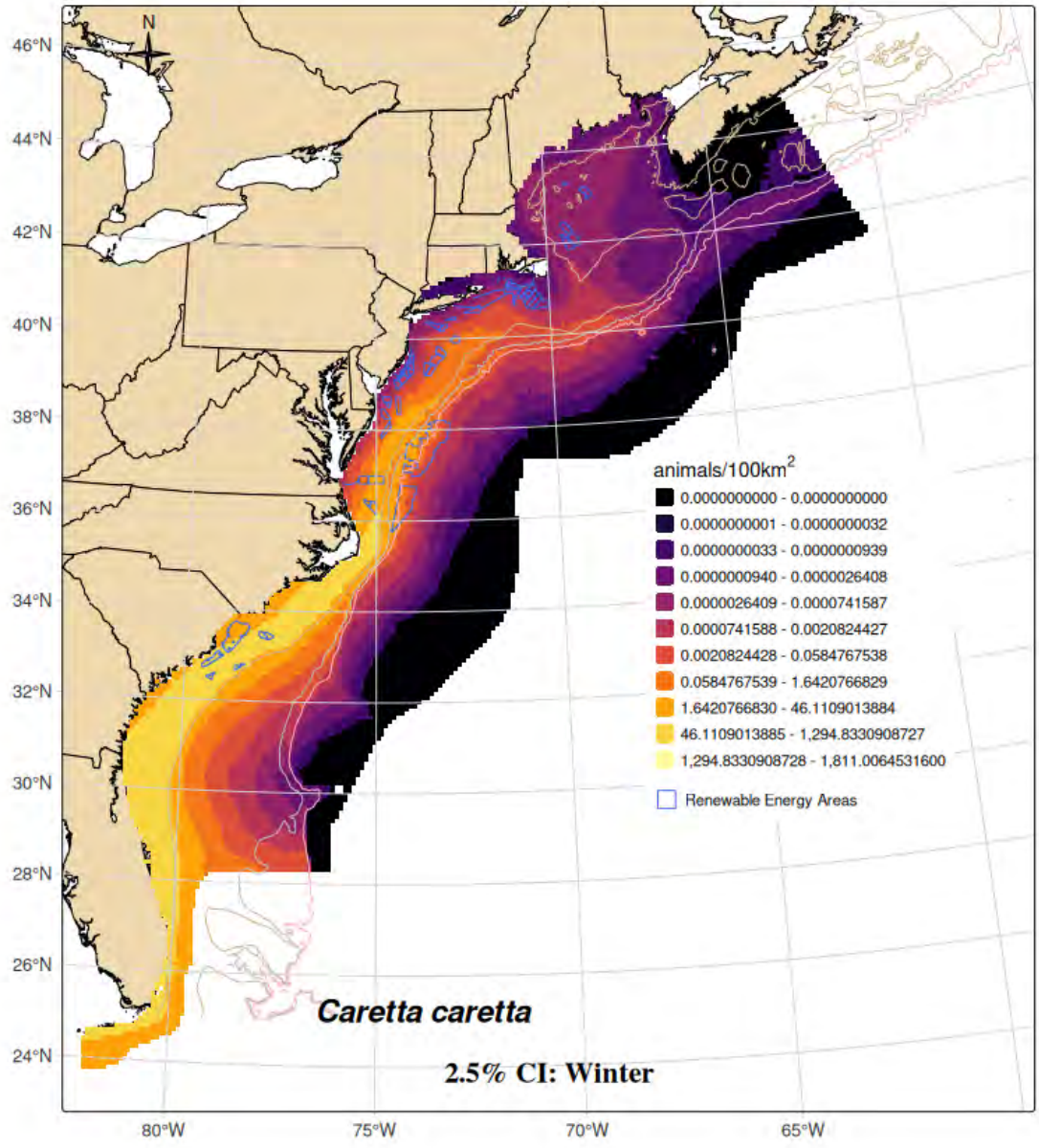

Figure D.2-19. Lower 2.5% confidence interval of the winter loggerhead turtle density estimates Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

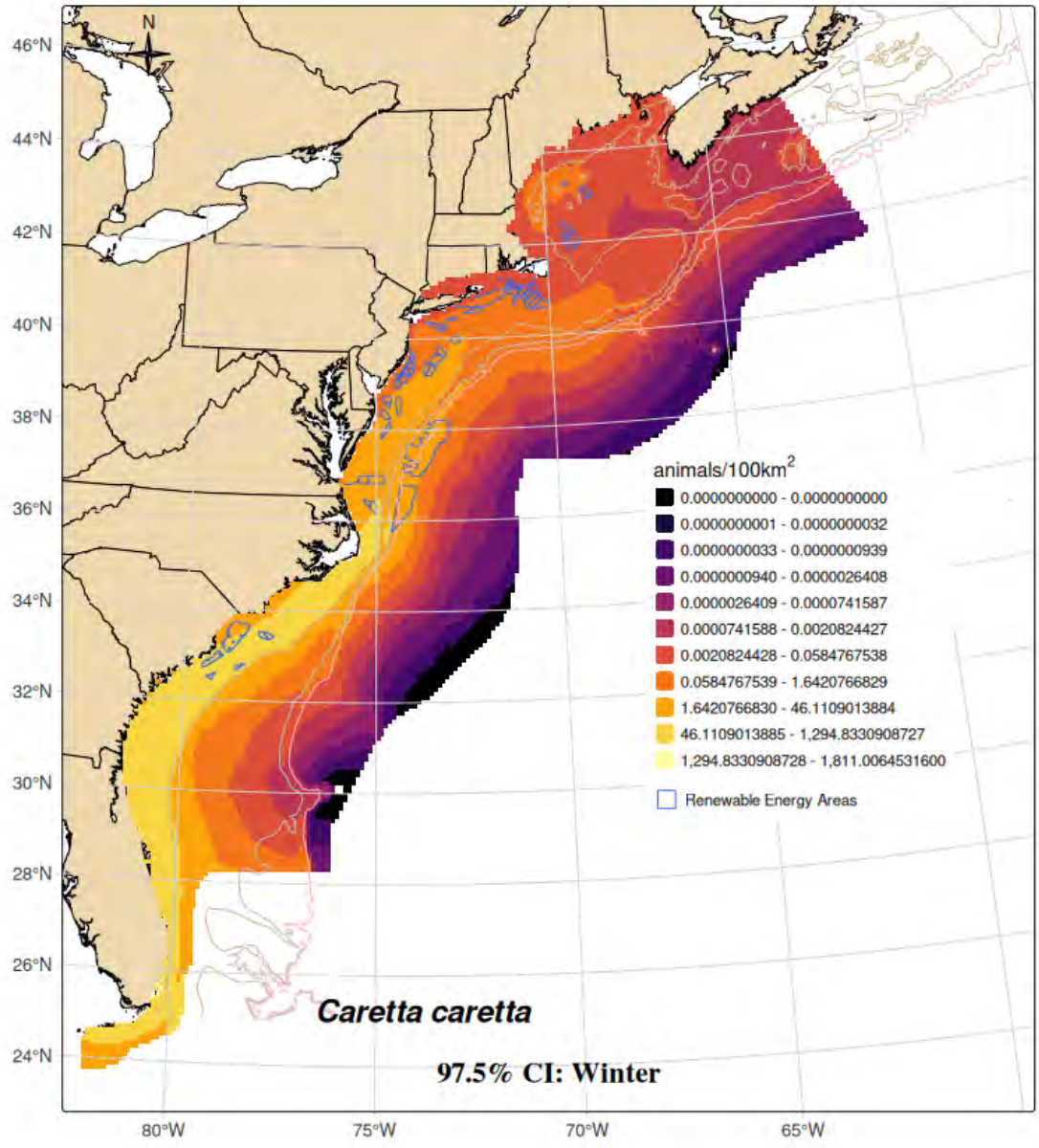

Figure D.2-20. Upper 97.5% confidence interval of the winter loggerhead turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

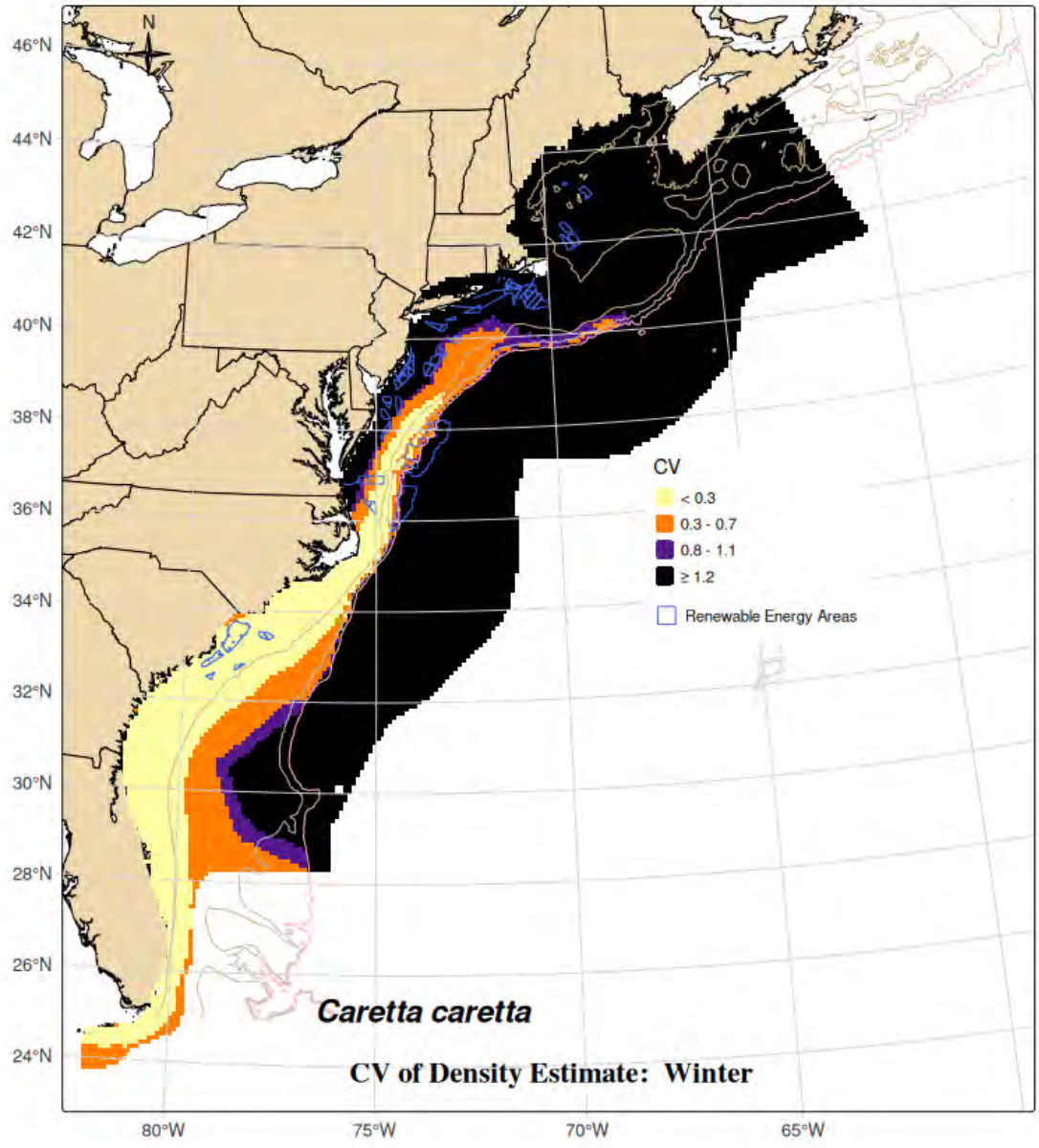

Figure D.2-21. CV of winter loggerhead turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

D.2.7 Offshore Energy Development Areas

Table D.2-6. Loggerhead turtle abundance estimates for wind-energy study areas

Season	Wind-Energy Study Area	Abundance*	CV	95% Confidence Interval*
Spring (Mar-May)	RI/MA	0.2	41.28	0 – 48.4
	NY	0.4	29.15	0 – 57.2
	NJ	8.9	7.52	0.2 – 459.6
	DE/MD	45.5	2.94	2.4 – 870.6
	VA	308.2	0.70	89.6 – 1,060.5
	NC	1,612.6	0.18	1,144.9 – 2,271.3
	NC/SC	13,468.1	0.09	11,291.5 – 16,064.1
	GA	1,694.5	0.12	1,348.7 – 2,129
	FL	563.8	0.22	369.7 - 859.9
Summer (Jun-Aug)	RI/MA	975.7	0.15	731.8 – 1,300.8
	NY	385.8	0.16	284.8 – 522.5
	NJ	2,527.4	0.11	2,052.8 – 3,111.6
	DE/MD	4,903.2	0.09	4,096.2 – 5,869.2
	VA	5,392.6	0.08	4,574.5 – 6,357.1
	NC	4,285.6	0.08	3,637.2 – 5,049.5
	NC/SC	7,659.5	0.10	6,299.5 – 9,313.1
	GA	1,046.2	0.13	812.4 – 1,347.3
	FL	401.9	0.22	264.5 – 610.6
Fall (Sep-Nov)	RI/MA	829.9	0.13	644.3 – 1069
	NY	357.4	0.15	267.4 – 477.6
	NJ	2,458.1	0.11	1,997.6 – 3,024.6
	DE/MD	4,986.3	0.09	4,210.1 – 5,905.6
	VA	6,144.5	0.08	5,268.5 – 7,166.2
	NC	5,476.6	0.08	4,678.3 – 6411.0
	NC/SC	10,078.1	0.10	8,363.1 – 12,144.8
	GA	14,07.4	0.12	1,107.6 – 1,788.4
	FL	433.4	0.20	293.5 - 639.8
Winter (Dec-Feb)	RI/MA	0.4	5.05	0 – 15.6
	NY	0.3	3.81	0 – 6.7
	NJ	1.3	4.82	0 – 43.8
	DE/MD	11.2	1.69	1.2 – 109.2
	VA	98.5	0.64	31.5 – 308.5
	NC	896.6	0.19	623.5 – 1,289.3
	NC/SC	12,344.3	0.09	10,370.9 – 14,693.4
	GA	988.9	0.12	786.9 – 1,242.8
	FL	632.1	0.19	437.3 – 913.7

***** 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.

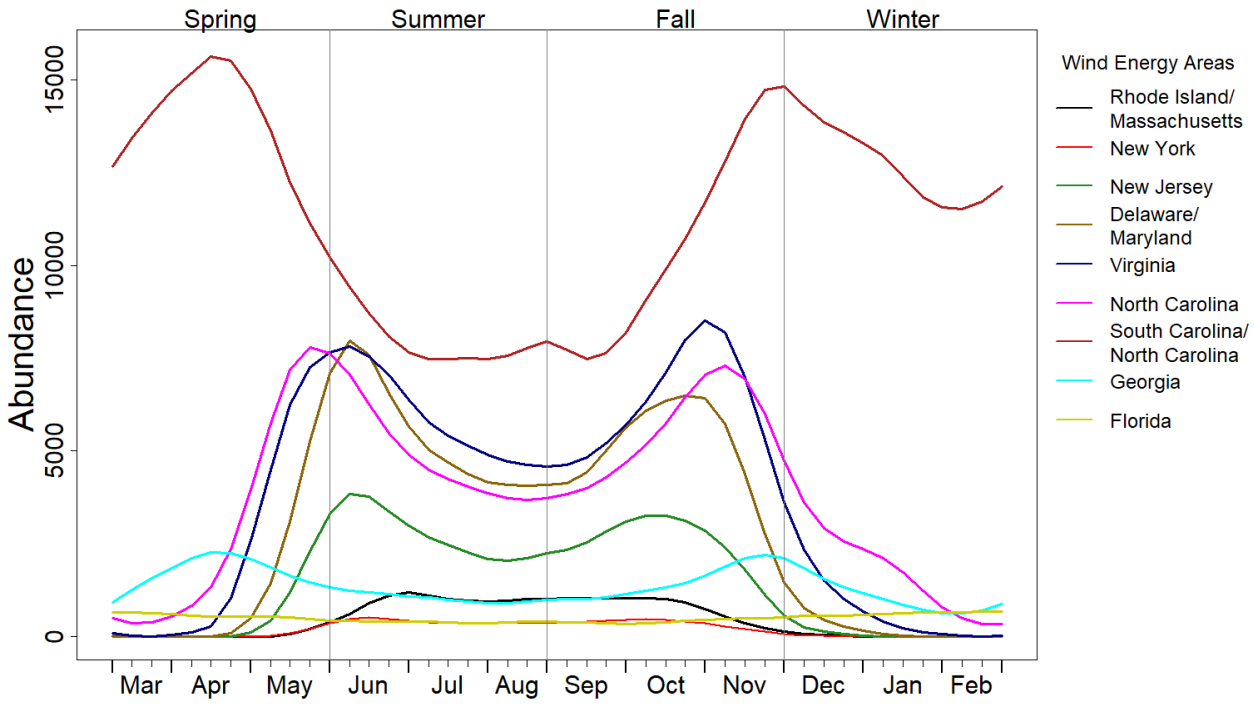

Figure D.2-22. Average seasonal abundance of loggerhead turtle in the wind-energy study areas

D.3 Leatherback turtle (*Dermochelys coriacea*)

Figure D.3-1. Leatherback turtle

D.3.1 Data Collection

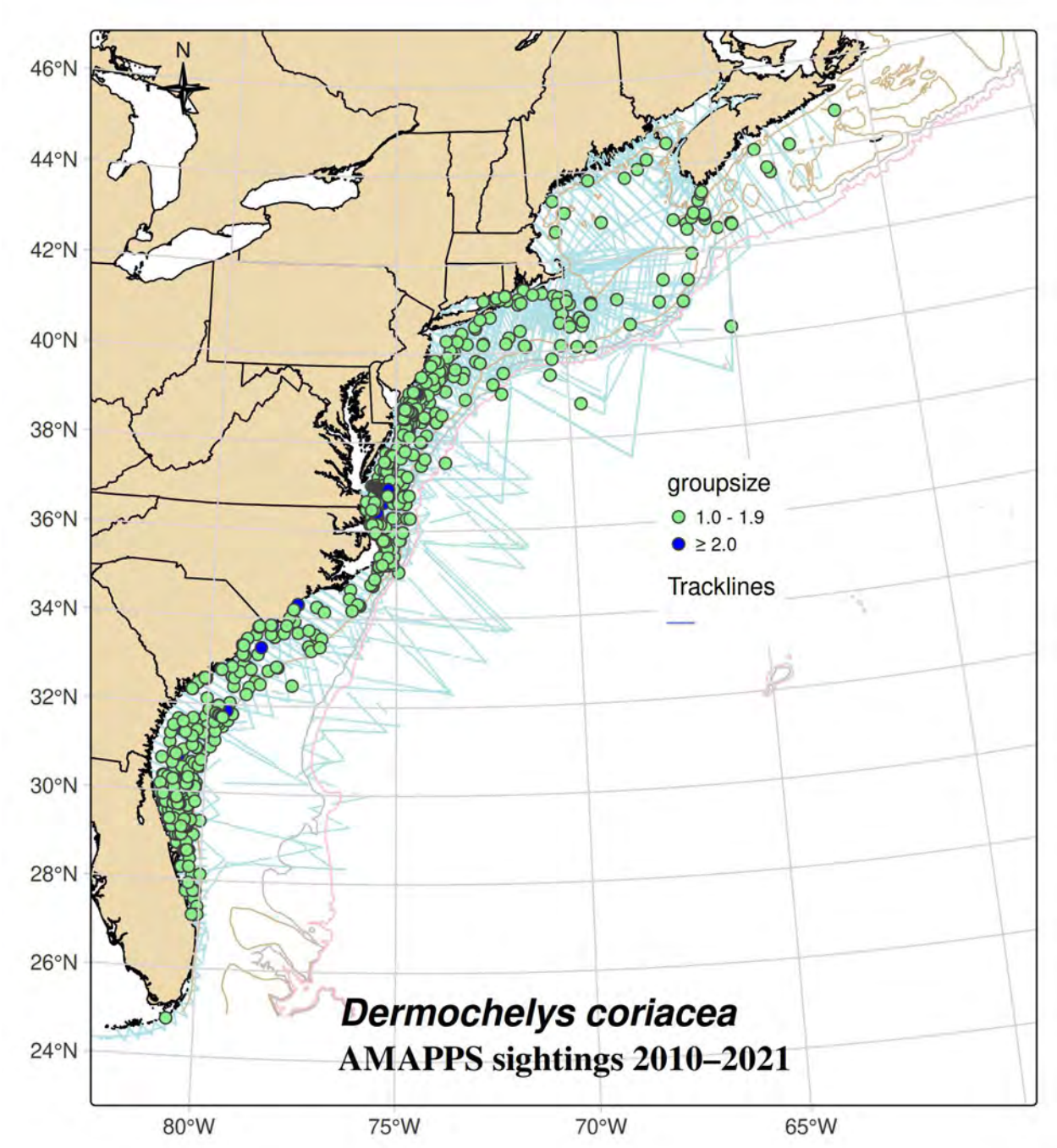

Figure D.3-2. Distribution of track lines and leatherback turtle sightings 2010 to 2021
Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

Table D.3-1. AMAPPS research effort 2010 to 2021 and leatherback turtle sightings

Survey Region and Platform	Season	Effort (km)	Number of Groups	Number of Animals
NE Shipboard	Spring	8,883	-	-
NE Shipboard	Summer	49,064	24	25
NE Aerial	Spring	27,229	-	-
NE Aerial	Summer	41,806	53	54
NE Aerial	Fall	58,178	50	50
NE Aerial	Winter	10,645	-	-
SE Shipboard	Summer	18,331	-	-
SE Shipboard	Fall	2,673	-	-
SE Aerial	Spring	42,185	130	141
SE Aerial	Summer	43,285	269	288
SE Aerial	Fall	21,153	155	163
SE Aerial	Winter	19,152	54	55

D.3.2 Mark-Recapture Distance Sampling Analysis

Table D.3-2. Intermediate parameters in leatherback turtle 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 - air group 7	distance + observer + sea state + glare	350	distance + sea state	340	HR with Hermite Polynomial Adjustment Order 4	0.596	0.055	-	0.961
NE – air group 11	distance * observer +	350	distance + sea state	340	HR	0.606	0.141	0.05	0.589

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.

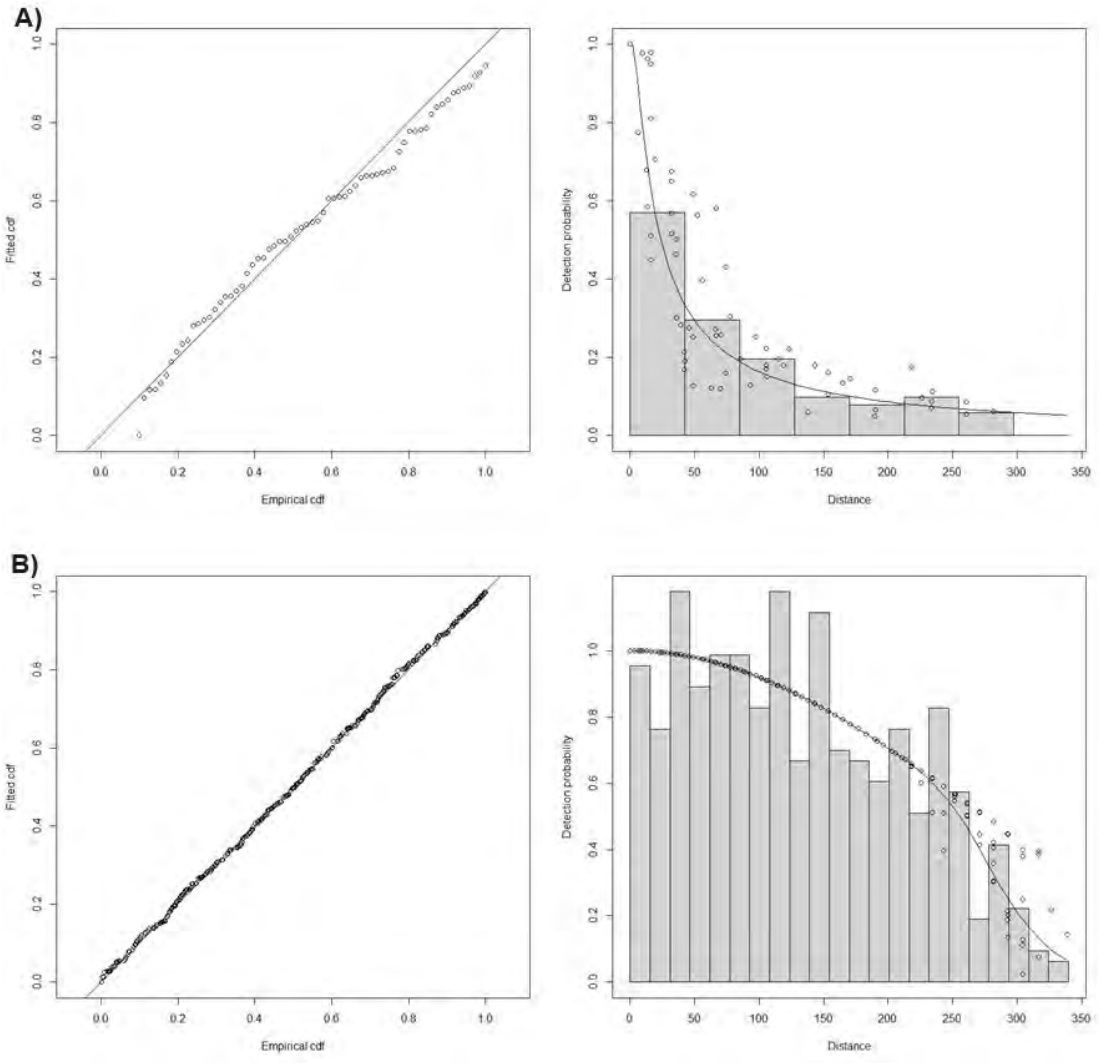

Figure D.3-3. Q-Q plots and detection functions from the leatherback turtle MRDS analyses
A) SE-aerial analysis; B) NE-aerial analysis, the perpendicular distance is in meters.

D.3.3 Generalized Additive Model Analysis

Table D.3-3. 2010 to 2021 density-habitat model output for leatherback turtles

Covariates	Edf	Ref.df	F	C.dev	p-value
s(sstmur)	3.08	5	4.726	0.73	<0.0001
s(mlp)	3.367	5	5.644	2.54	<0.0001
s(btemp)	1.579	5	12.257	6.81	<0.0001
s(DGSNW)	3.044	5	3.639	2.29	<0.0001
s(dist125)	4.497	5	9.737	5.04	<0.0001
s(latitude)	4.666	5	11.455	5.83	<0.0001
te(LY,sstmur)	11.331	23	3.248	8.16	<0.0001

Adjusted R^2 = 0.0155, Deviance explained = 31.4%
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.

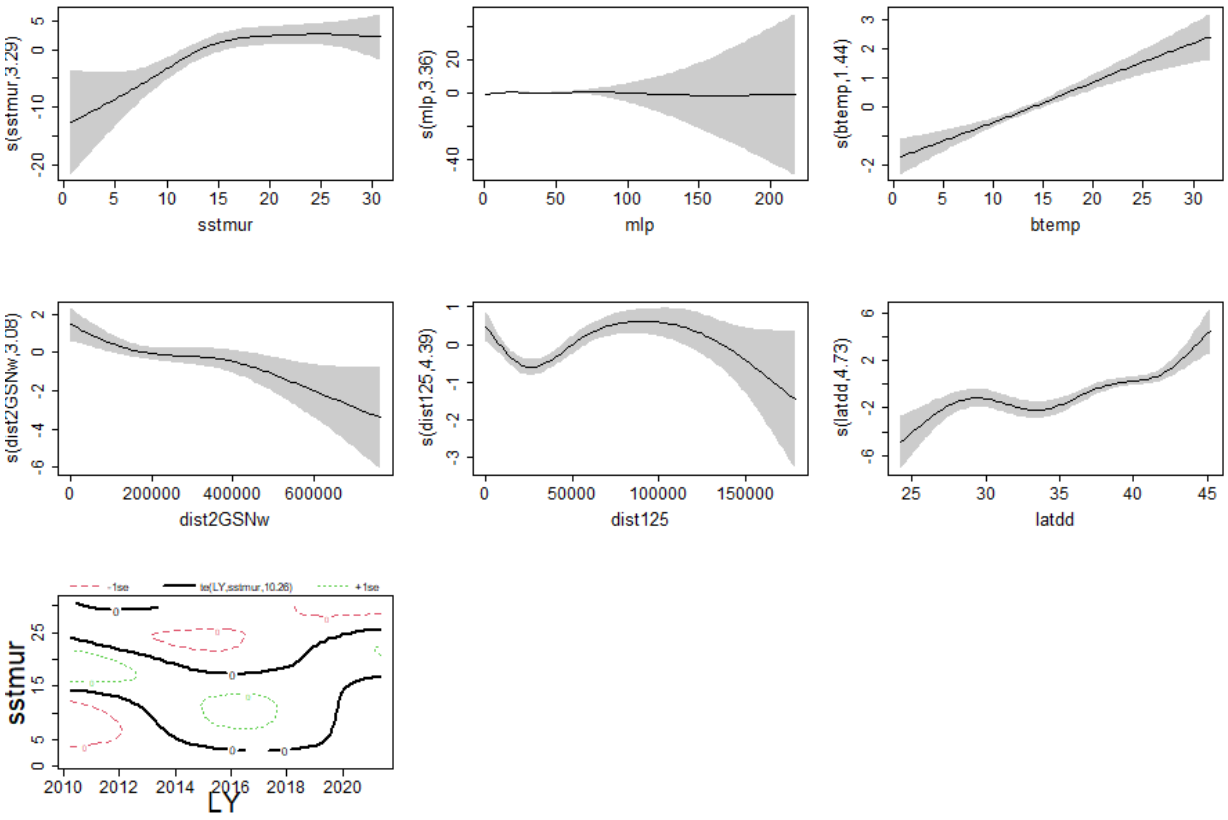

Figure D.3-4. Leatherback turtle density relative to significant habitat covariates
Plots represent the partial smooths and interaction terms of the density-habitat model. Covariate abbreviations explained in main text in Table 4-2.

D.3.4 Model Cross-Validation

Table D.3-4. Diagnostic statistics from the leatherback turtle density-habitat model

Diagnostic Statistic	Description	Calculated with	Model Values (x)	Score
RHO	Spearman rank correlation	Non-zero density	0.209	Fair to good
MAPE	Mean absolute percentage error	Non-zero density	91.52	Fair to good
RHO	Spearman rank correlation	All data divided in 25 random samples	0.137	Fair to good
MAPE	Mean absolute percentage error	All data divided in 25 random samples	92.02	Fair to good
MAE	Mean absolute error	All data divided in 25 random samples	0.129	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

D.3.5 Abundance Estimates for AMAPPS Study Area

Table D.3-5. Leatherback turtle average abundance estimates for the AMAPPS study area

Season	Average Abundance	CV	95% Confidence Interval
Spring (March–May)	21,819	0.45	9,404 – 50,625
Summer (June–August)	39,959	0.4	18,779 – 85,025
Fall (September–November)	60,117	0.42	27,284 – 132,462
Winter (December–February)	19,877	0.57	7,028 – 56,214
Summer 2011 U.S. surveys[1]	-	-	-
Summer 2016 U.S. surveys[1]	-	-	-
Summer 2021 U.S. surveys	-	-	-

[1]Hayes et al. 2024

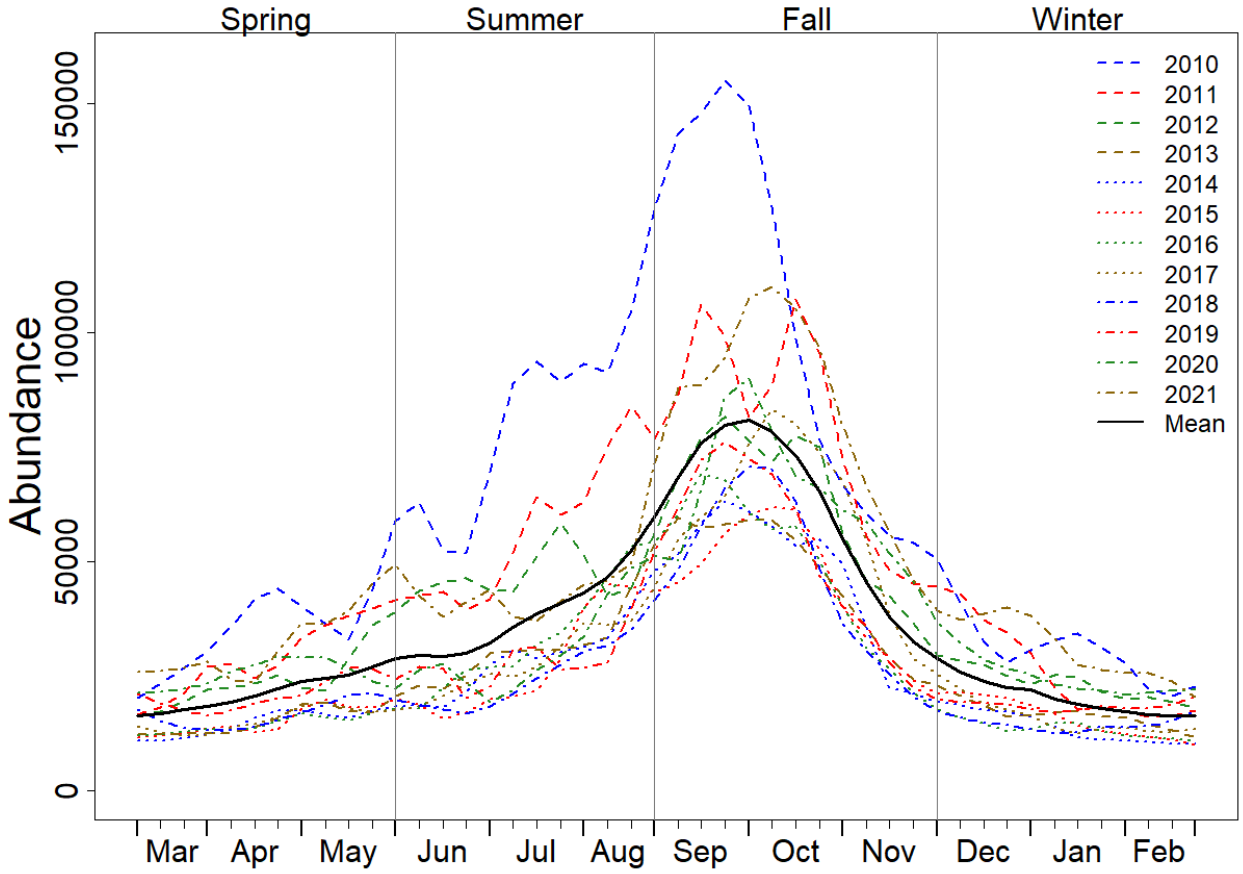

Figure D.3-5. Annual abundance trends for leatherback turtle in the AMAPPS study area

D.3.6 Seasonal Prediction Maps

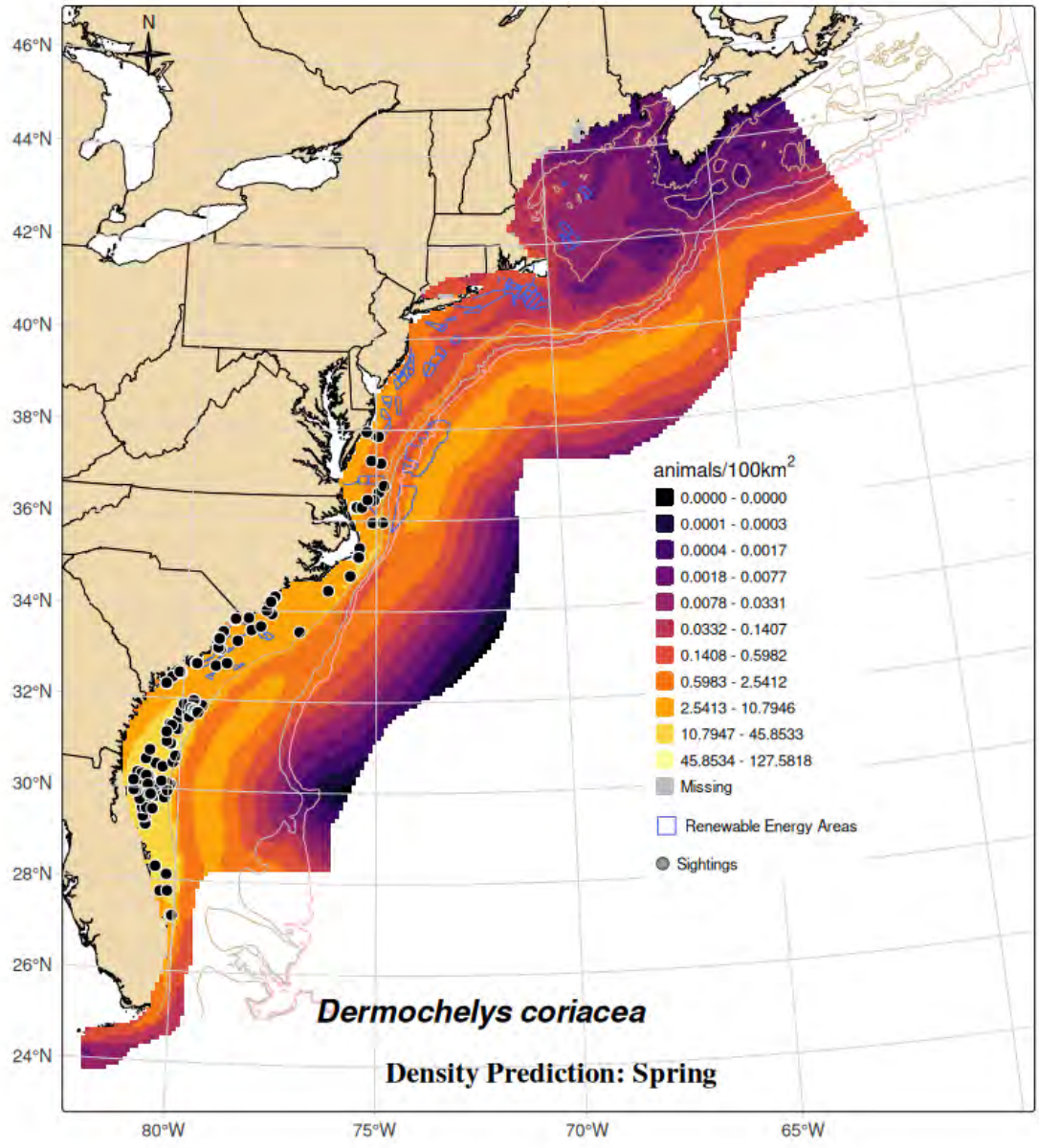

Figure D.3-6. Leatherback turtle spring average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate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

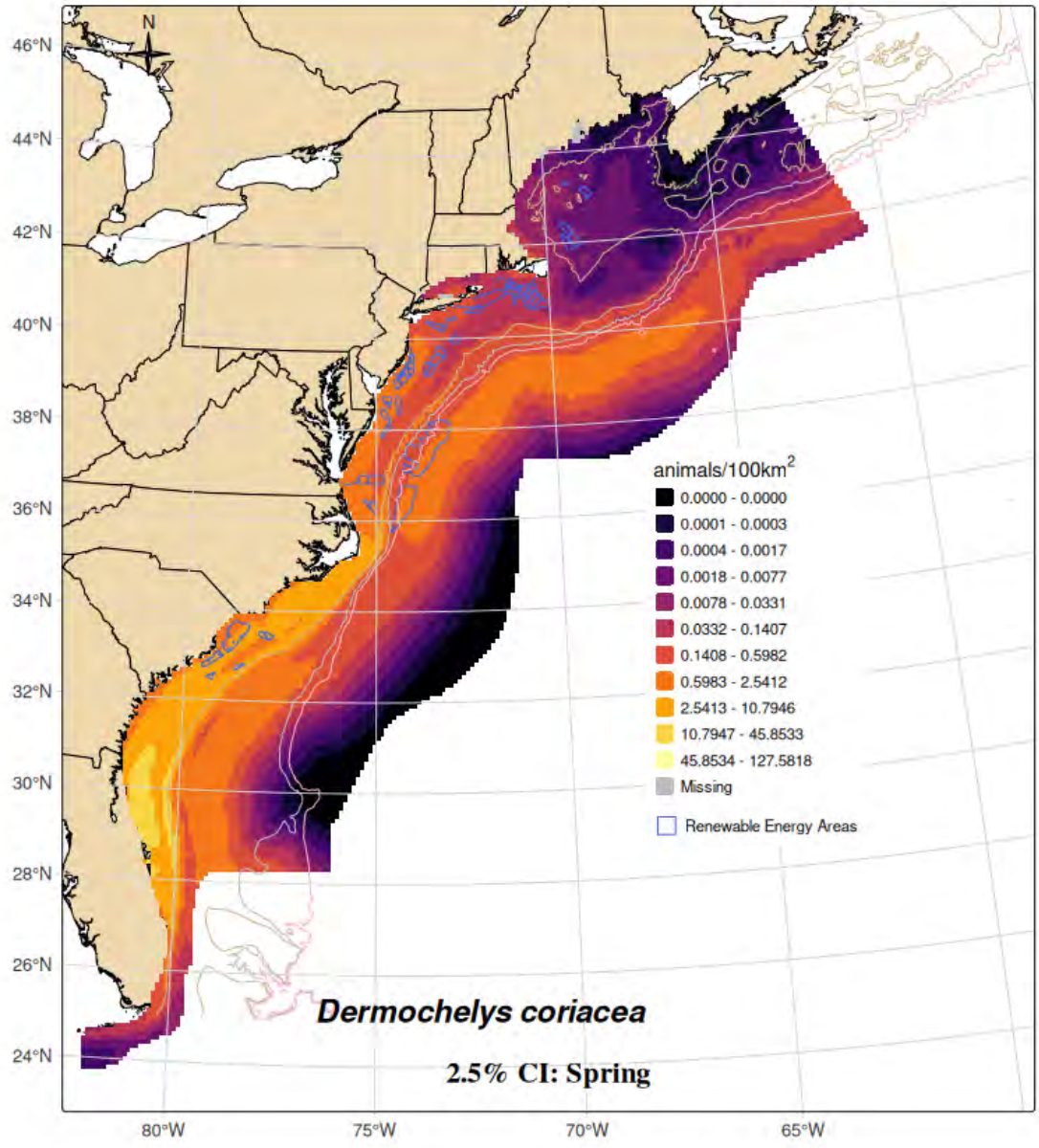

Figure D.3-7. Lower 2.5% confidence interval of the spring leatherback turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

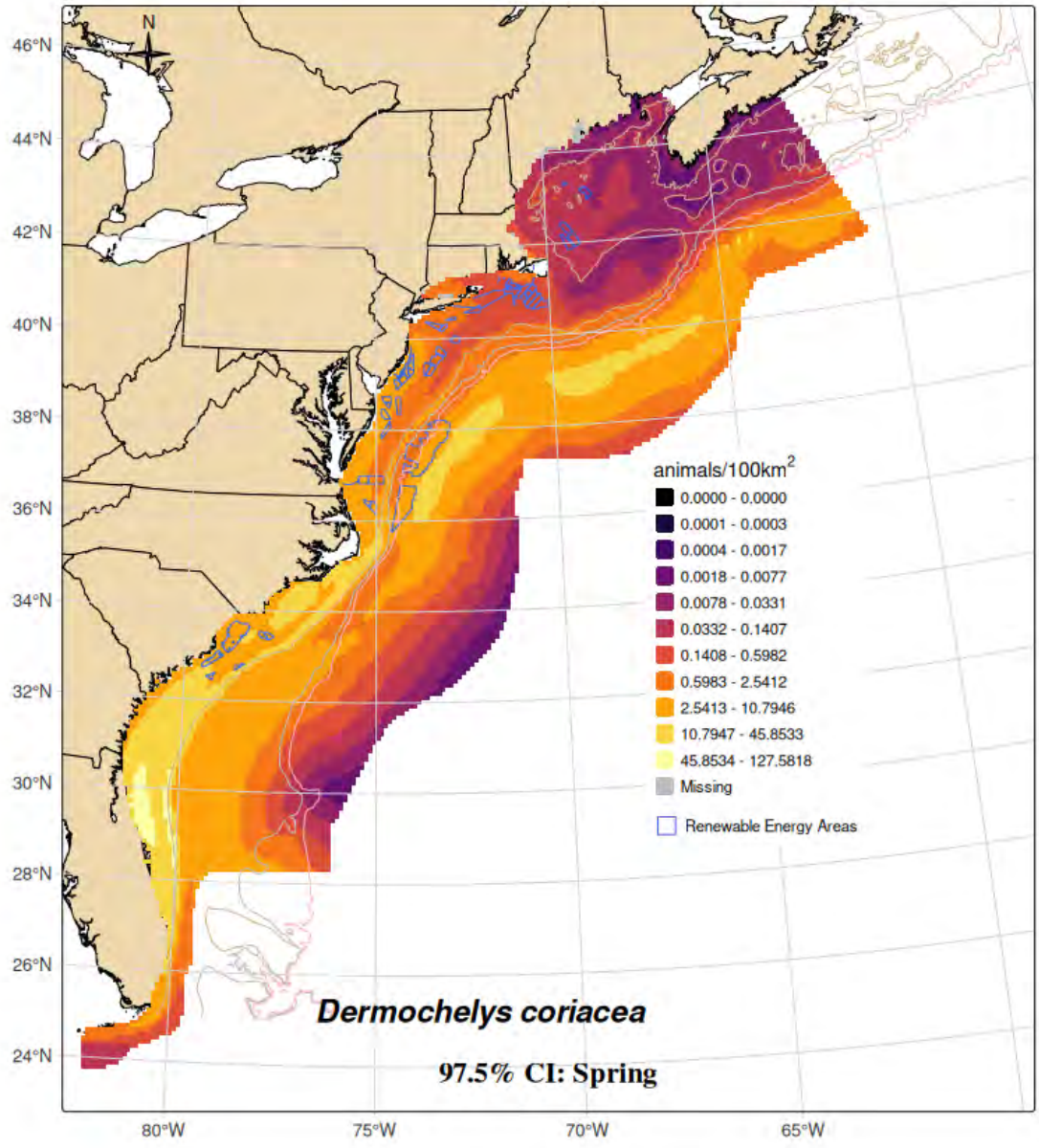

Figure D.3-8. Upper 97.5% confidence interval of the spring leatherback turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

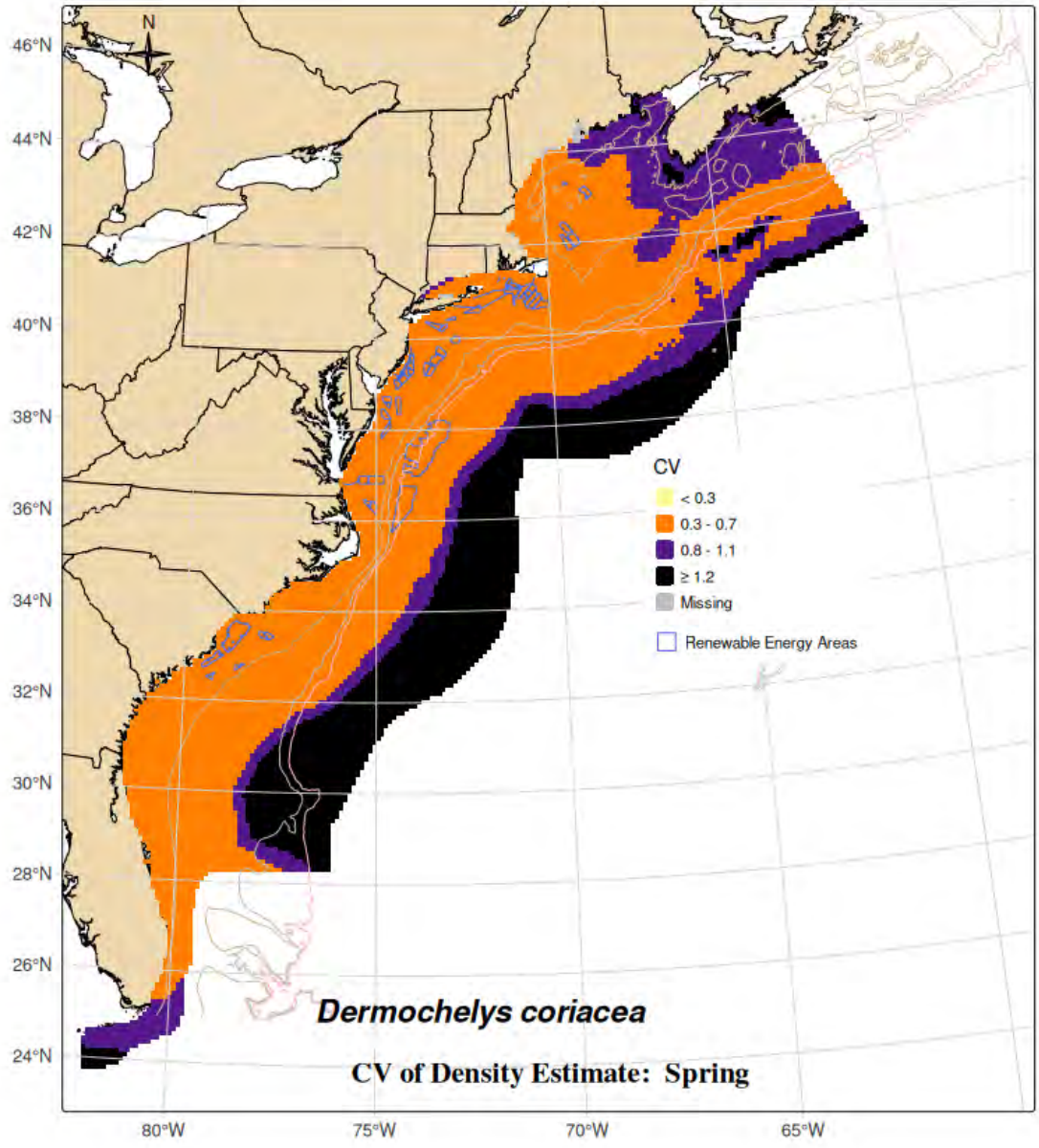

Figure D.3-9. CV of spring leatherback turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

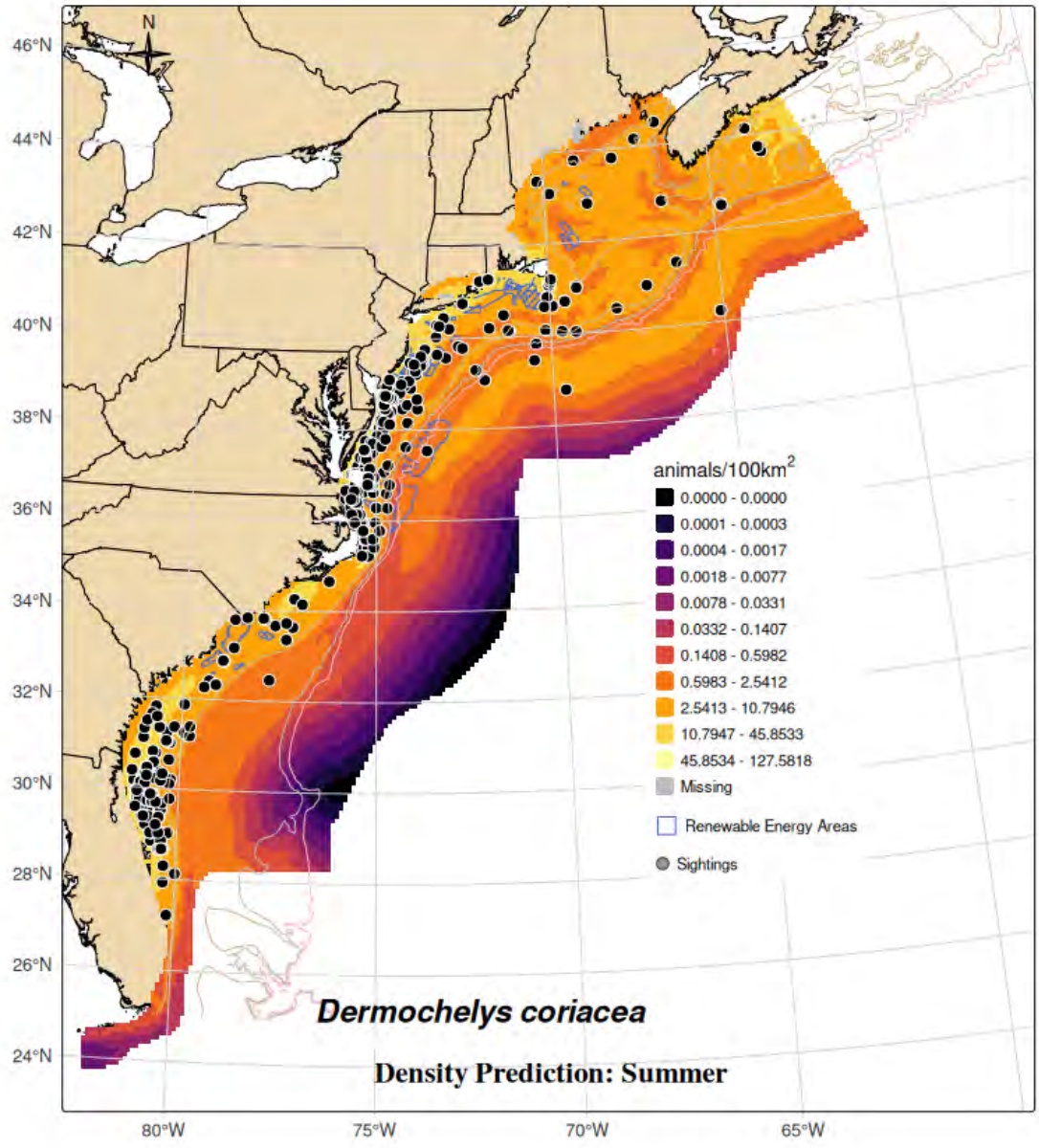

Figure D.3-10. Leatherback turtle summer average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate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

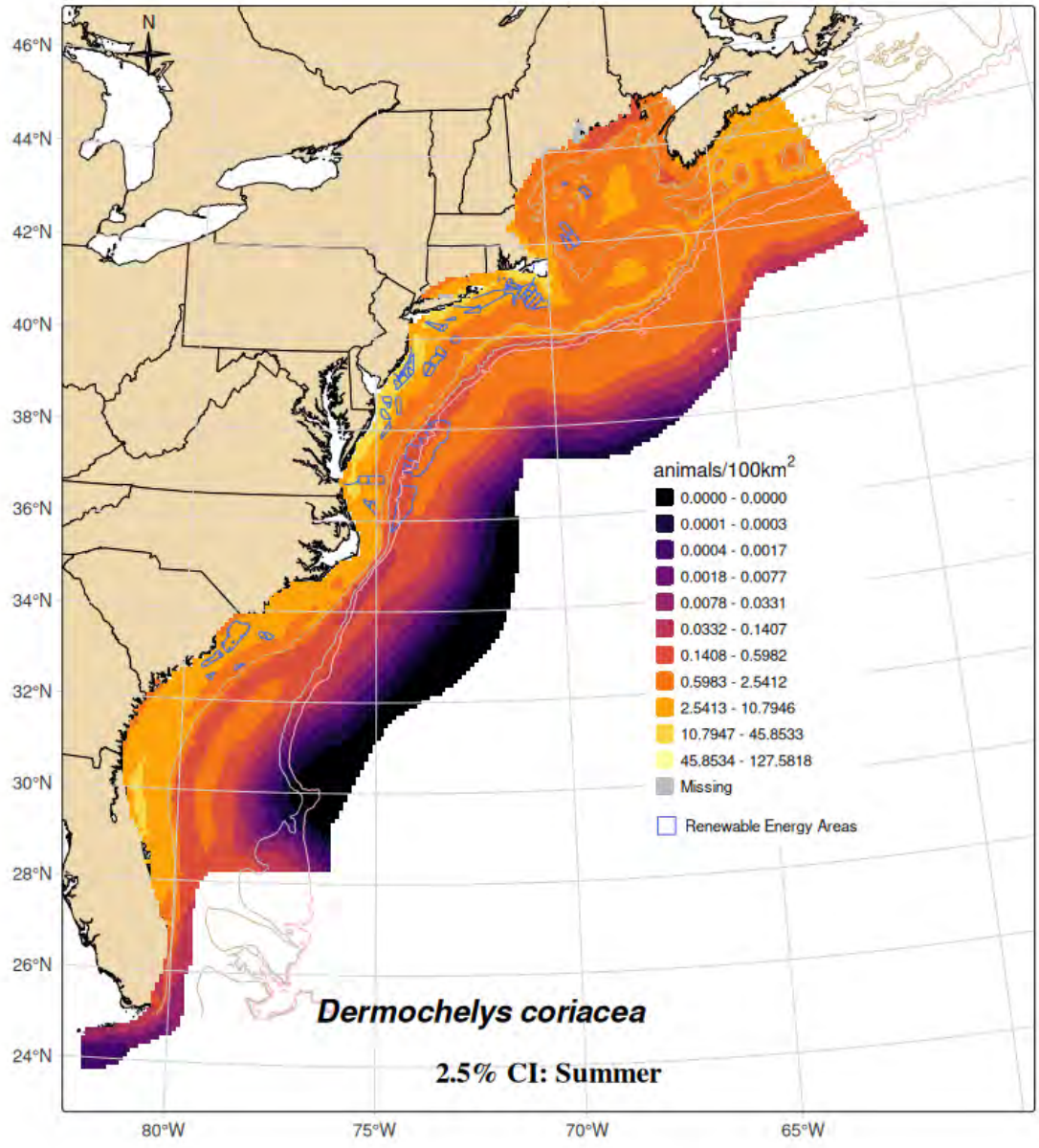

Figure D.3-11. Lower 2.5% confidence interval of the summer leatherback turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

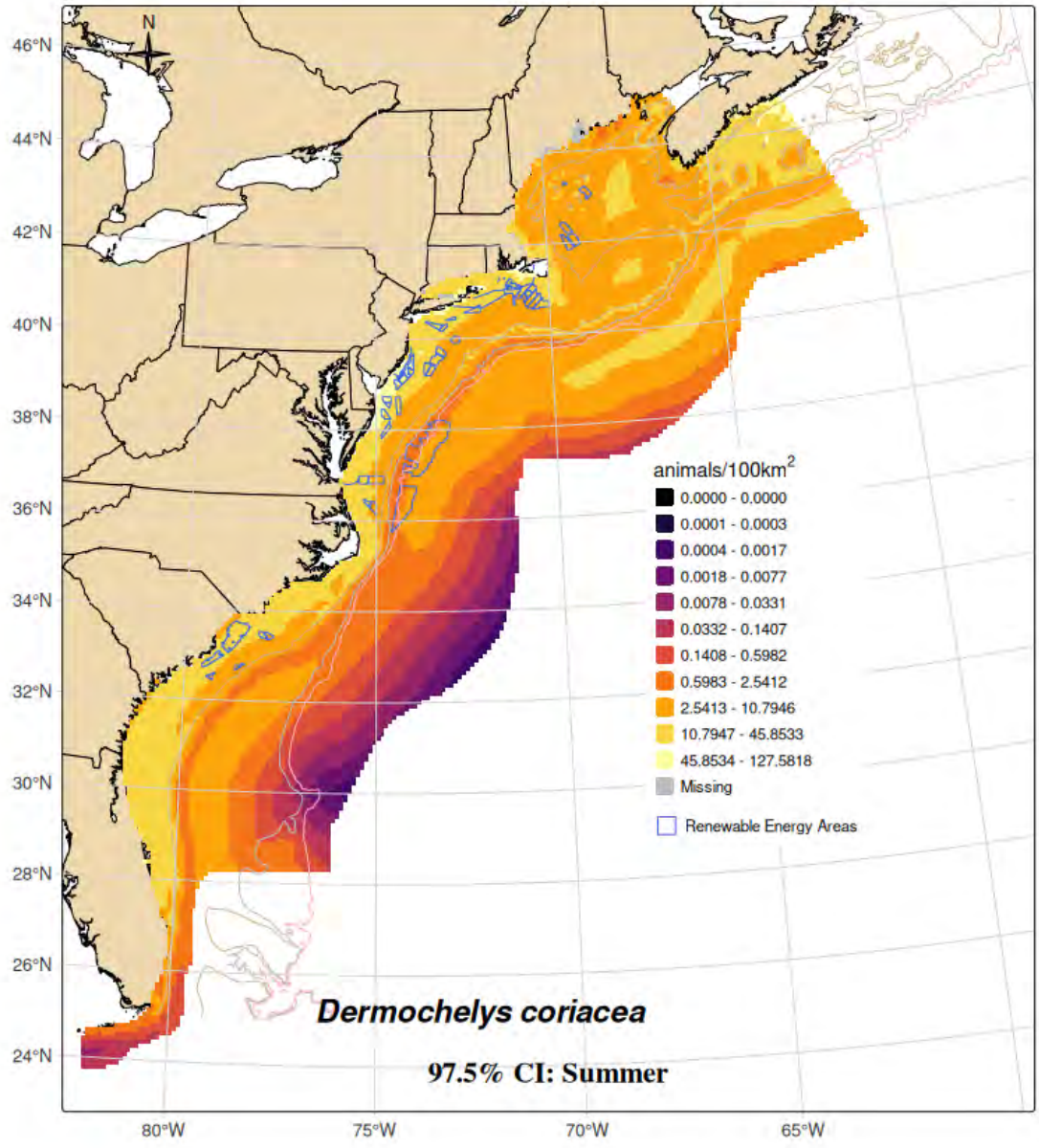

Figure D.3-12. Upper 97.5% confidence interval of the summer leatherback turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

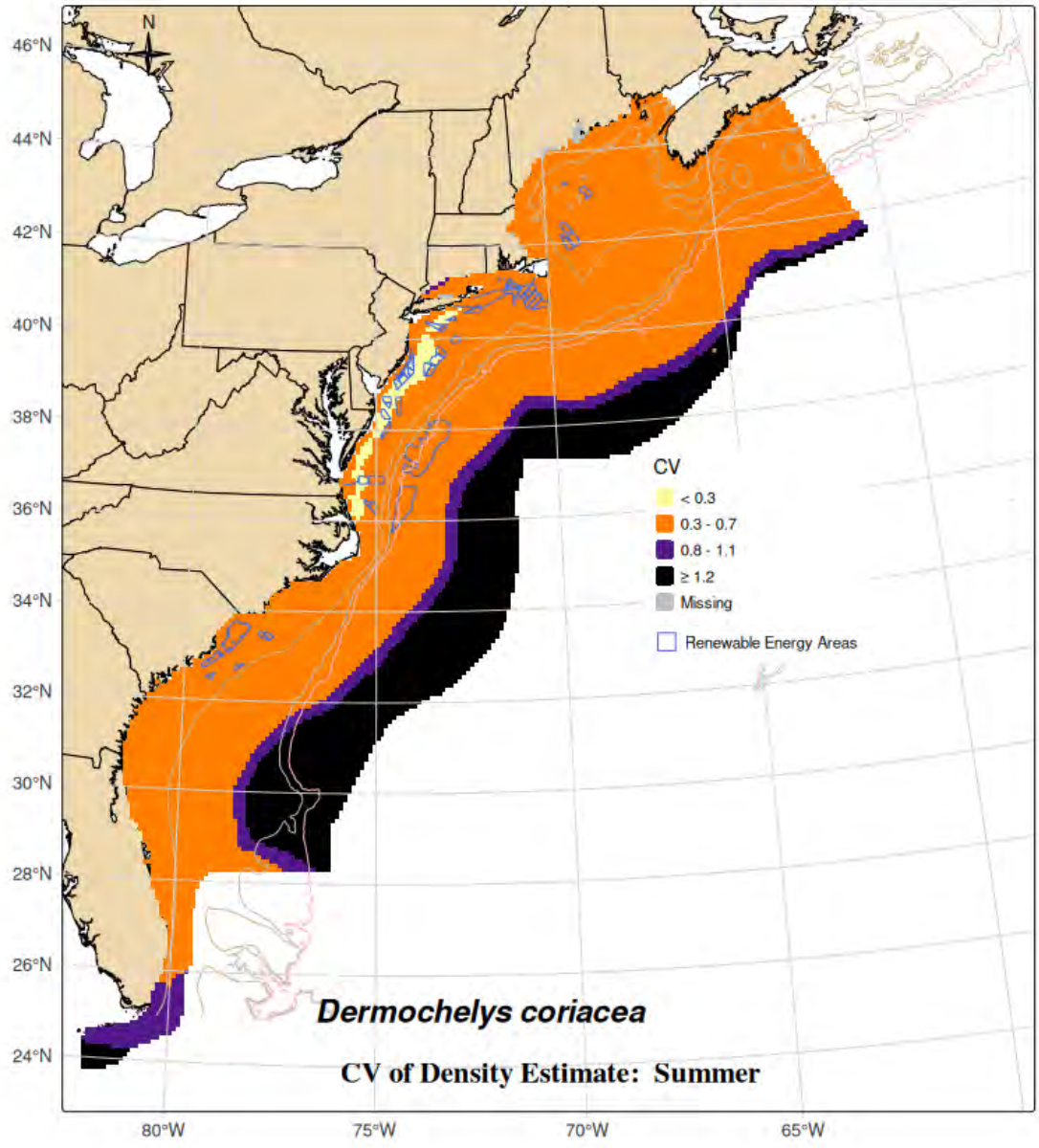

Figure D.3-13. CV of summer leatherback turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

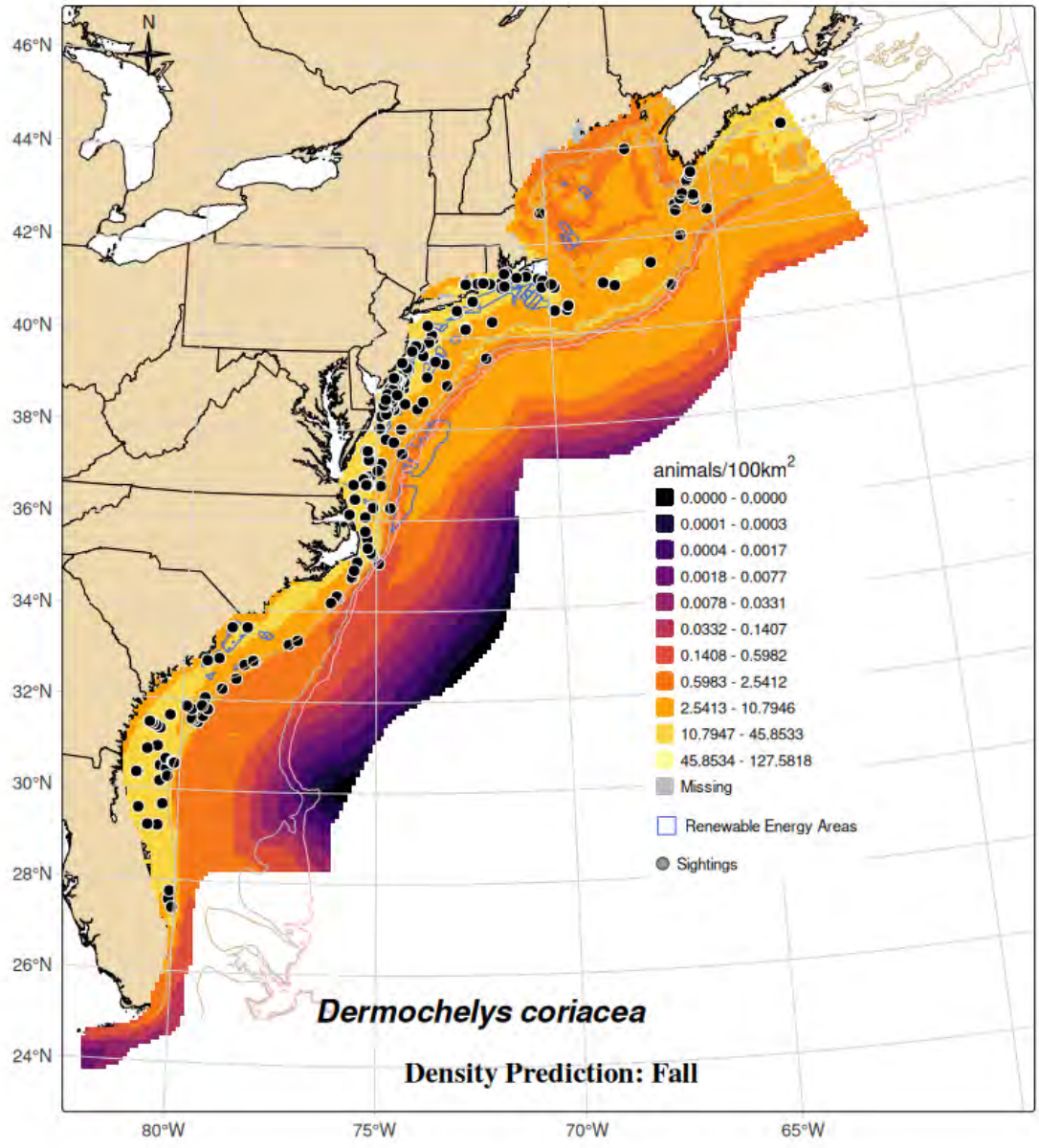

Figure D.3-14. Leatherback turtle fall average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate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

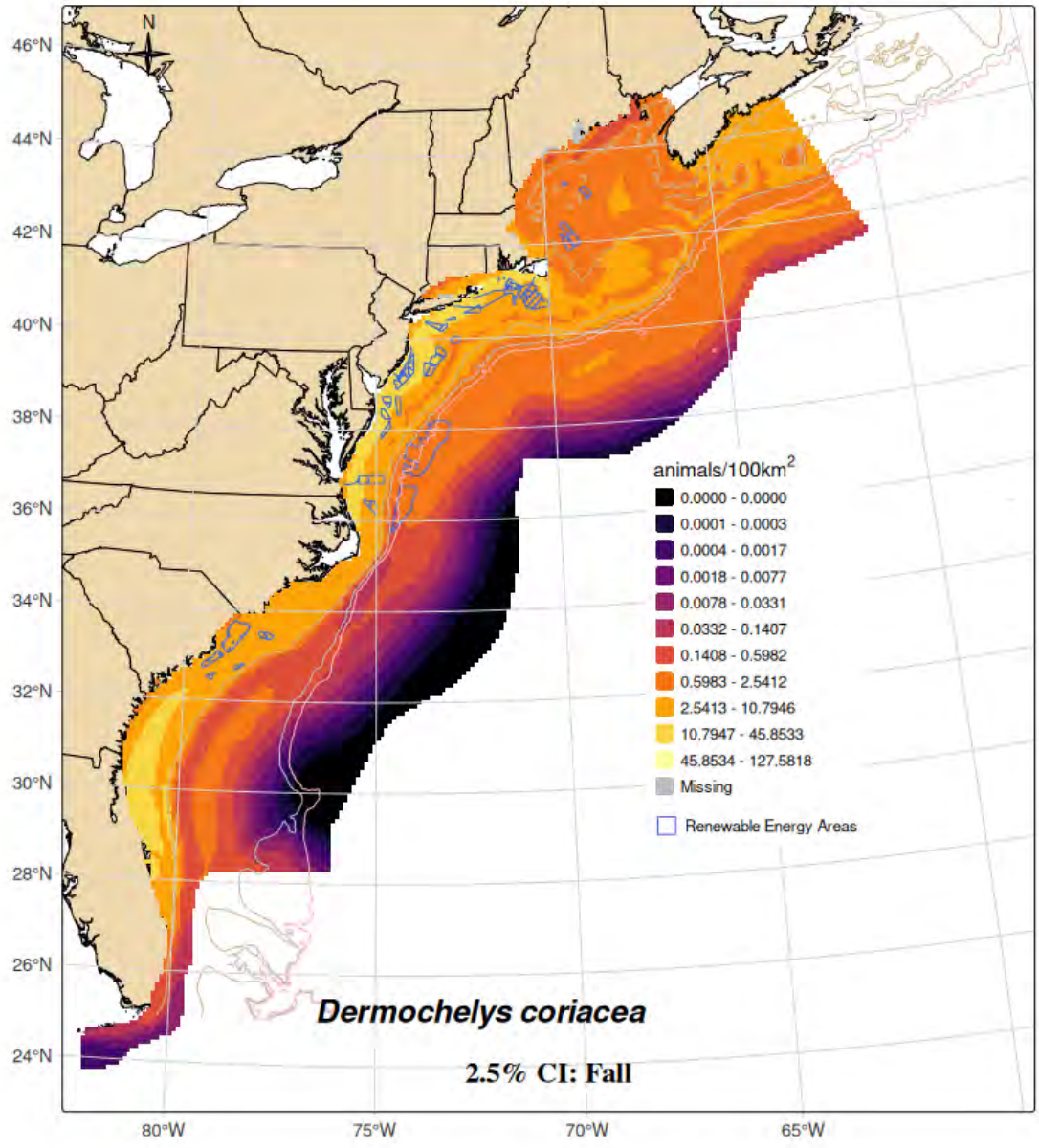

Figure D.3-15. Lower 2.5% confidence interval of the fall leatherback turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

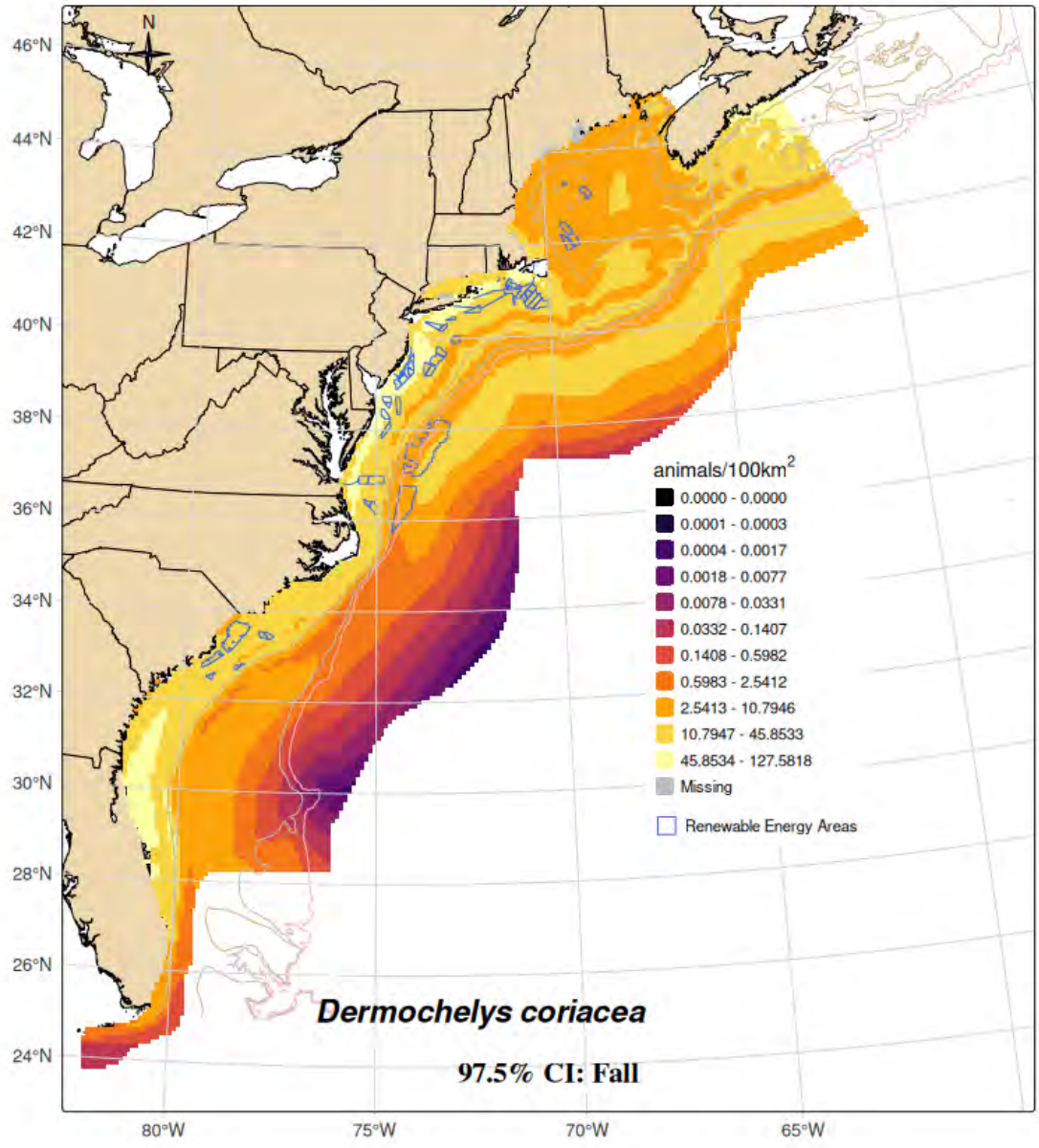

Figure D.3-16. Upper 97.5% confidence interval of the fall leatherback turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

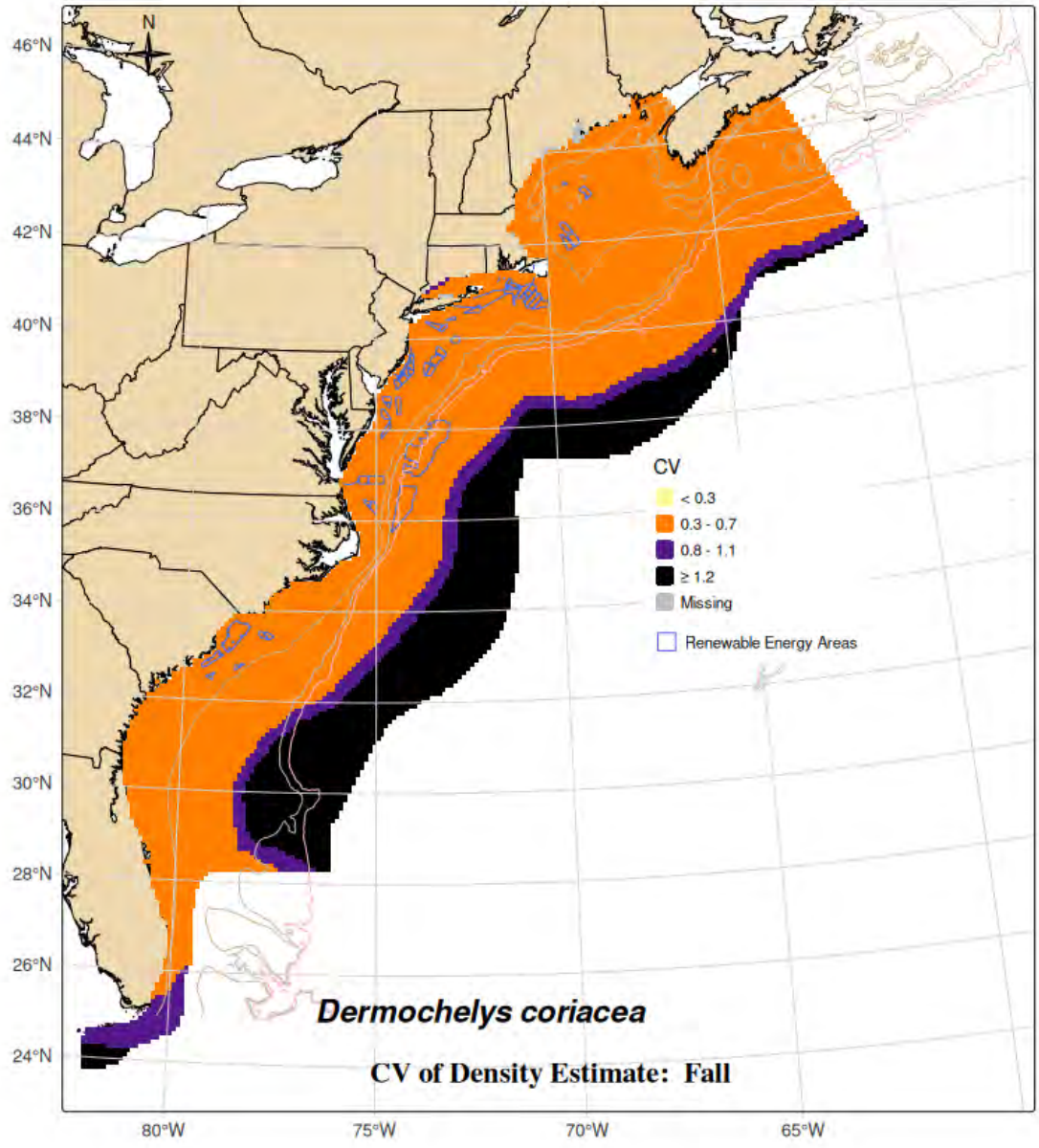

Figure D.3-17. CV of fall leatherback turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

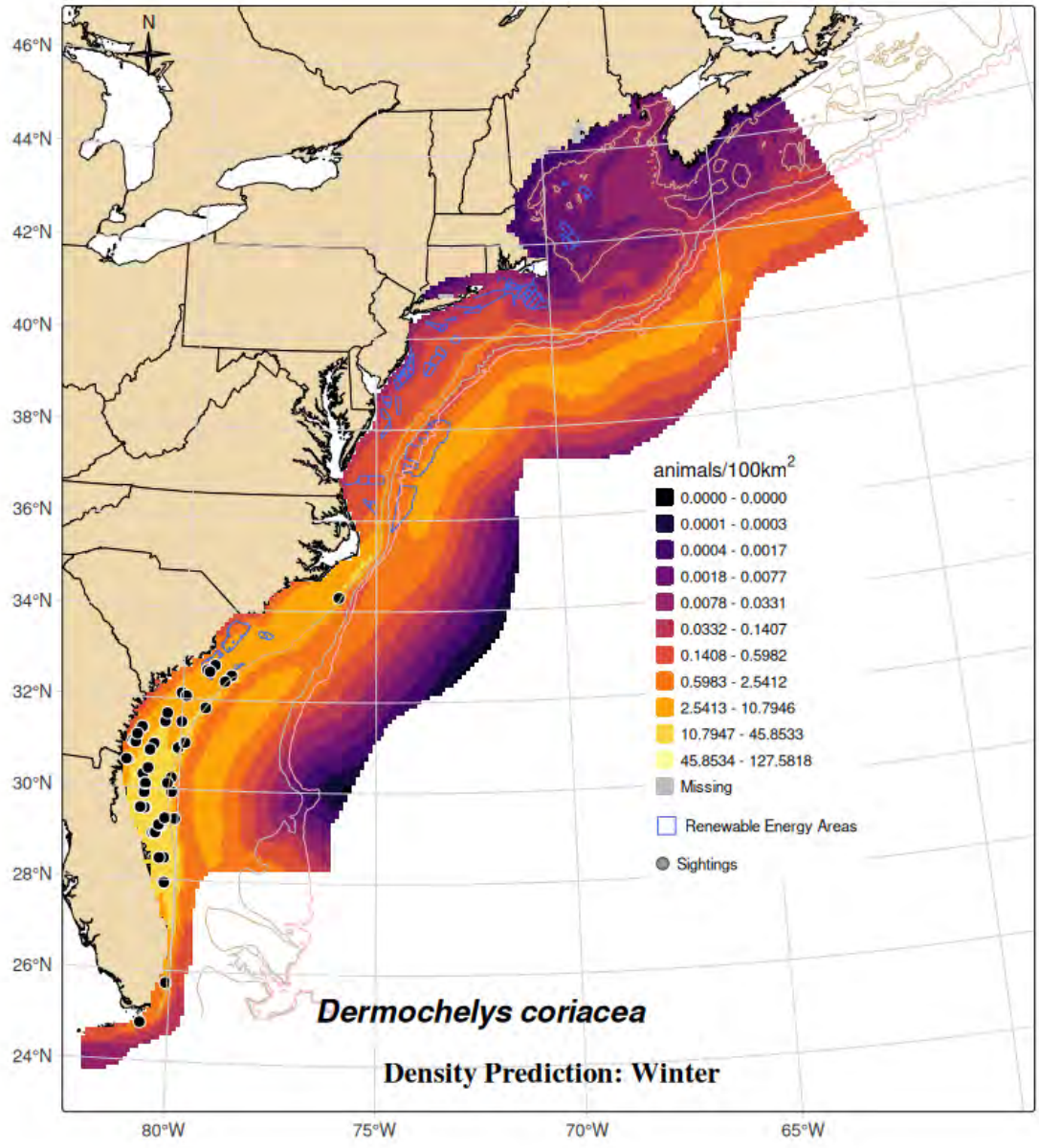

Figure D.3-18. Leatherback turtle winter average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate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

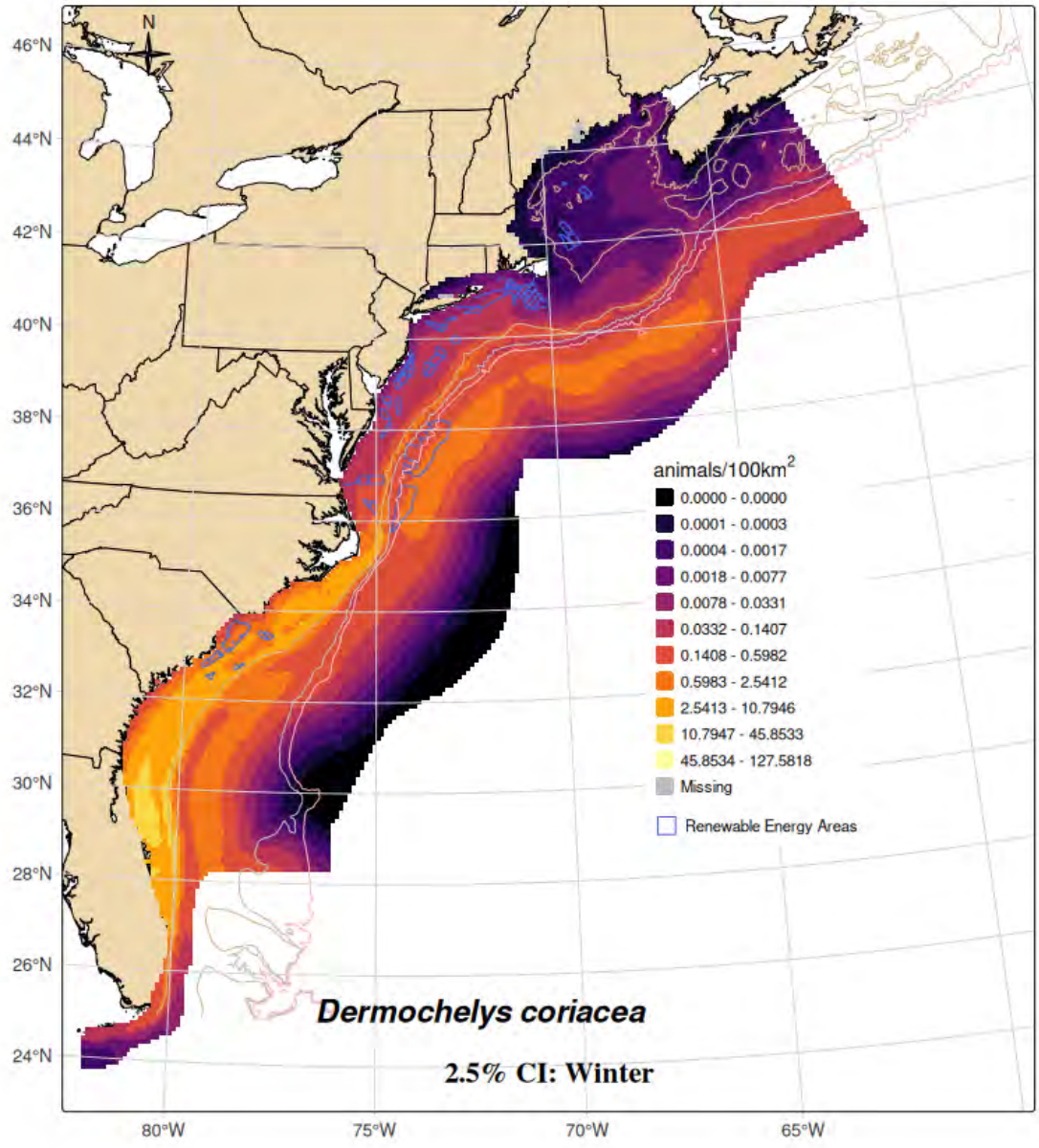

Figure D.3-19. Lower 2.5% confidence interval of the winter leatherback turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

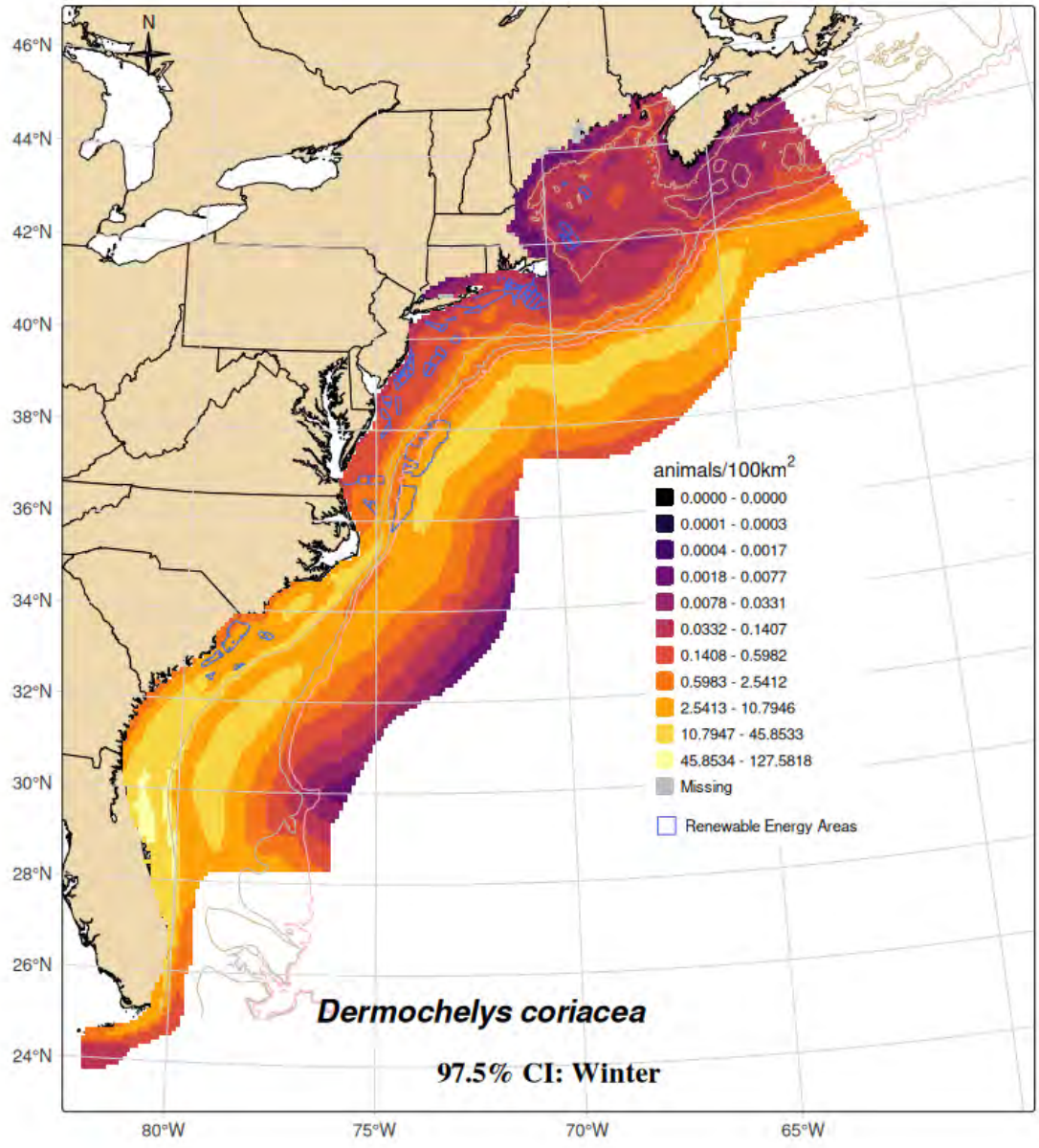

Figure D.3-20. Upper 97.5% confidence interval of the winter leatherback turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

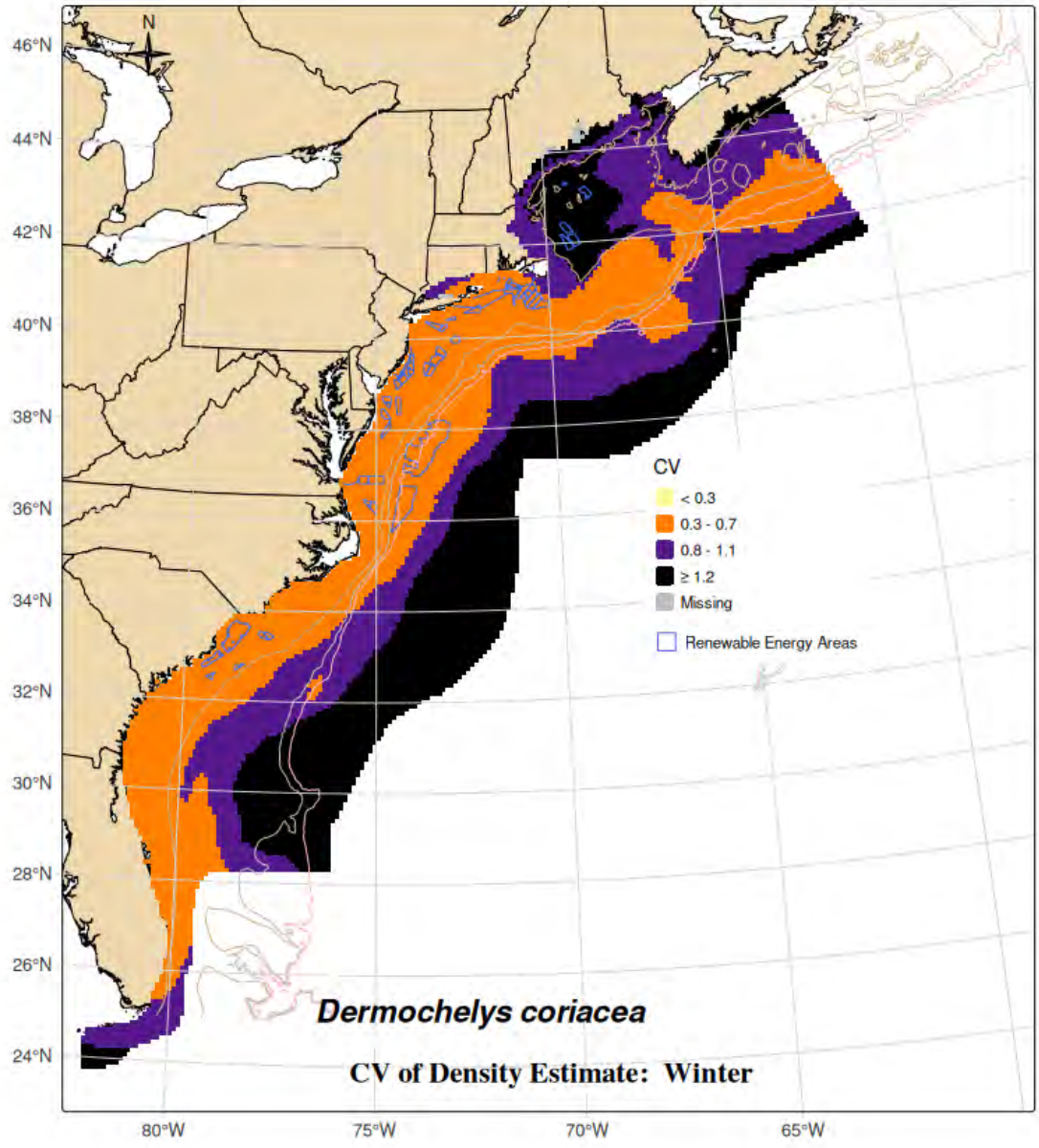

Figure D.3-21. CV of winter leatherback turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

D.3.7 Offshore Energy Development Areas

Table D.3-6. Leatherback turtle abundance estimates for wind-energy study areas

Season	Wind-Energy Study Area	Abundance*	CV	95% Confidence Interval*
Spring (Mar-May)	RI/MA	16.1	0.44	7.1 – 36.5
	NY	21.3	0.37	10.5 – 43.0
	NJ	117.9	0.36	59.9 – 231.8
	DE/MD	98.5	0.35	51 – 190.3
	VA	70.6	0.34	36.9 – 135.1
	NC	71.9	0.37	35.6 – 145.1
	NC/SC	810.7	0.32	440.1 – 1,493.4
	GA	95.1	0.35	49.3 – 183.6
	FL	10.3	0.68	3.1 – 34.2
Summer (Jun-Aug)	RI/MA	1,034.4	0.32	558.9 – 1,914.3
	NY	460.4	0.31	254.2 – 834.0.
	NJ	1,335.4	0.30	754 – 2,365.1
	DE/MD	884.4	0.30	500 – 1,564.5
	VA	356.7	0.30	201.1 – 632.7
	NC	213.7	0.31	118.4 – 385.5
	NC/SC	1,029.3	0.32	553.3 – 1,914.8
	GA	147.1	0.37	72.9 – 296.6
	FL	4.9	0.72	1.4 – 17.6
Fall (Sep-Nov)	RI/MA	1,676	0.32	901.9 – 3,114.6
	NY	734.1	0.32	396.1 – 1,360.6
	NJ	1,762.3	0.32	961.6 – 3,229.8
	DE/MD	1,153.9	0.32	626.3 – 2,125.7
	VA	540.9	0.33	290.4 – 10,07.4
	NC	389.5	0.33	206.9 – 733.3
	NC/SC	1,550.3	0.33	829.5 – 2,897.3
	GA	205.1	0.34	107.4 – 391.5
	FL	8.8	0.71	2.5 - 30.9
Winter (Dec-Feb)	RI/MA	4.4	0.60	1.5 – 13.0
	NY	2.0	0.52	0.8 – 5.1
	NJ	4.6	0.49	1.9 – 11.4
	DE/MD	4.8	0.46	2.0 – 11.3
	VA	7.6	0.41	3.5 – 16.5
	NC	39.4	0.39	18.7 – 83.0
	NC/SC	586.4	0.33	311.3 – 1,104.4
	GA	32.1	0.37	15.8 – 65.2
	FL	11.7	0.70	3.4 – 40.5

***** 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.

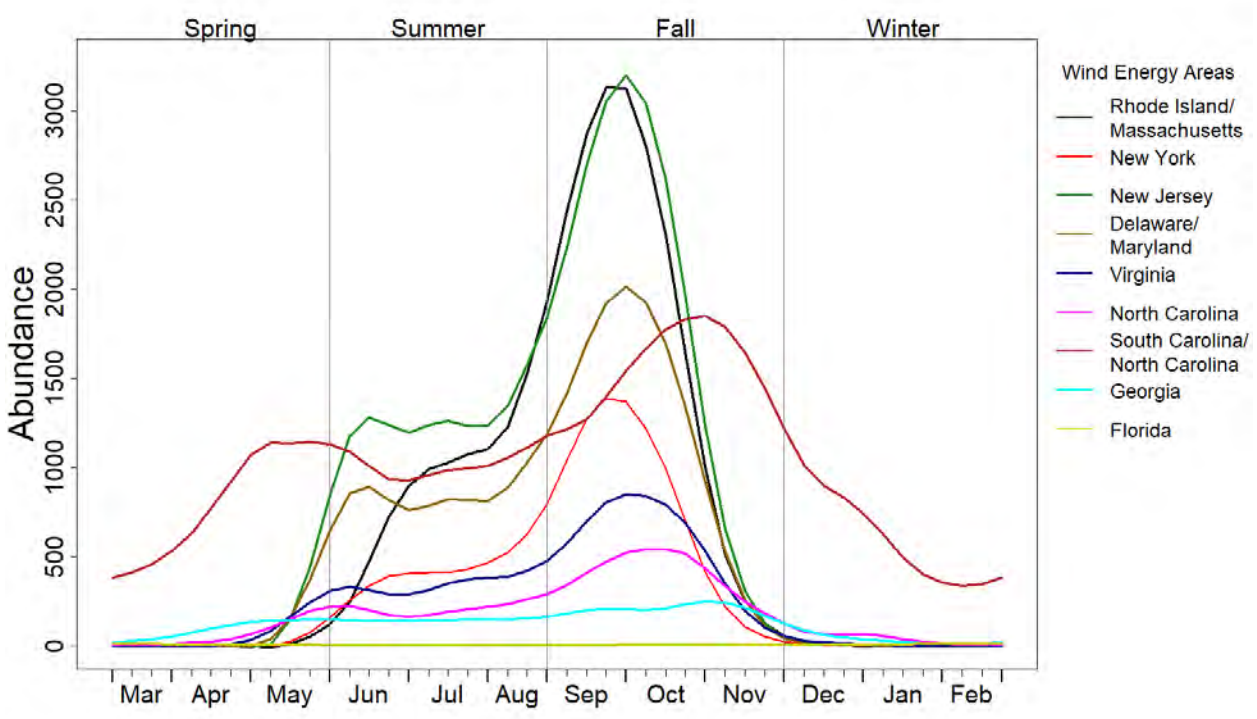

Figure D.3-22. Average seasonal abundance of leatherback turtle in the wind-energy study areas

D.4 Green turtle (*Chelonia mydas*)

Figure D.4-1. Green turtle

D.4.1 Data Collection

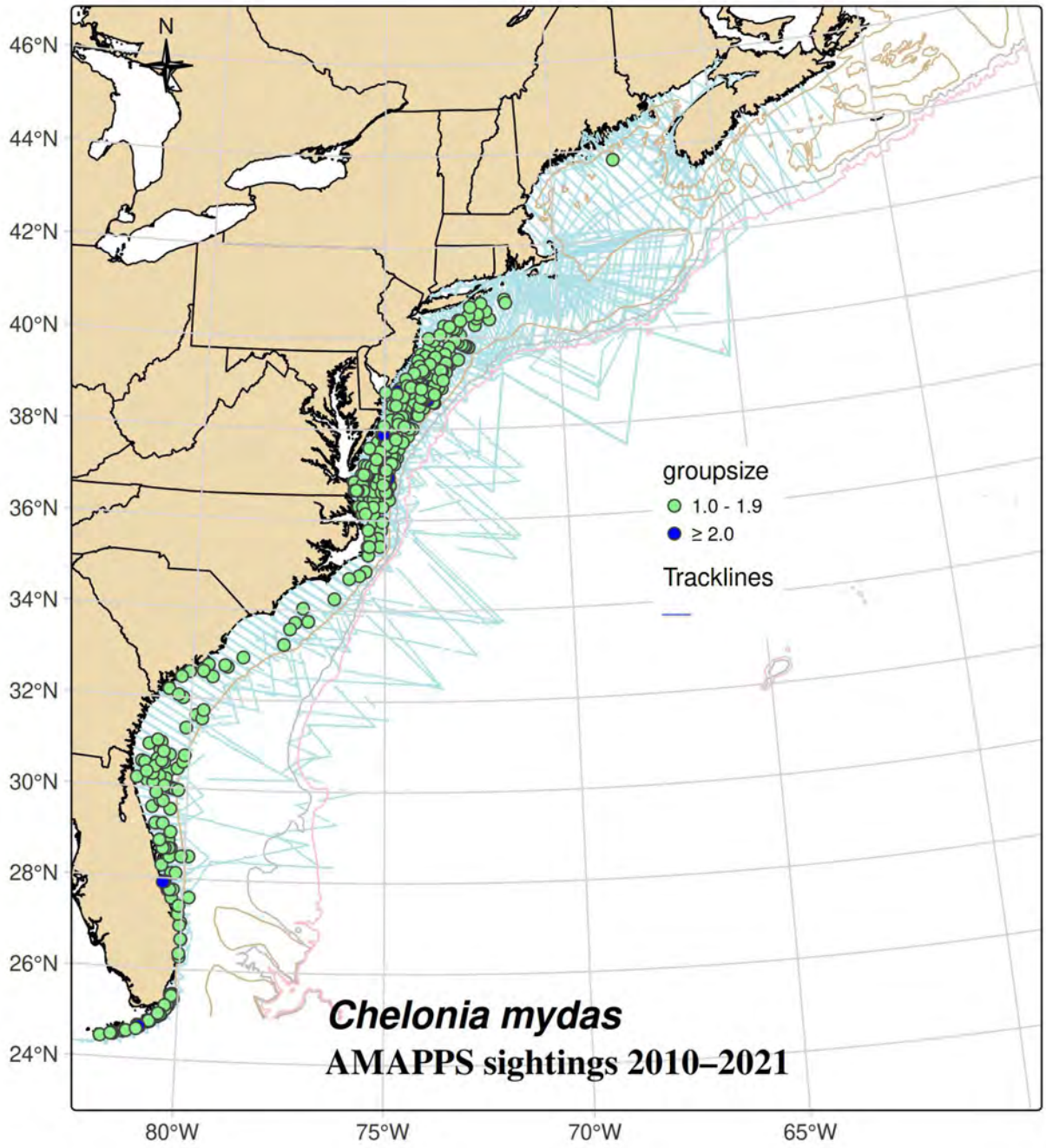

Figure D.4-2. Distribution of track lines and green turtle sightings 2010 to 2021
Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

Table D.4-1. AMAPPS research effort 2010 to 2021 and green turtle sightings

Survey Region and Platform	Season	Effort (km)	Number of Groups	Number of Animals
NE Shipboard	Spring	8,883	-	-
NE Shipboard	Summer	49,064	-	-
NE Aerial	Spring	27,229	-	-
NE Aerial	Summer	41,806	25	25
NE Aerial	Fall	58,178	2	2
NE Aerial	Winter	10,645	-	-
SE Shipboard	Summer	18,331	-	-
SE Shipboard	Fall	2,673	-	-
SE Aerial	Spring	42,185	47	48
SE Aerial	Summer	43,285	359	385
SE Aerial	Fall	21,153	51	53
SE Aerial	Winter	19,152	69	126

D.4.2 Mark-Recapture Distance Sampling Analysis

Table D.4-2. Intermediate parameters in green turtle 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 - air group 8	distance + observer	330	distance	340	HR with Hermite Polynomial Adjustment Order 4	0.488	0.045	-	0.865

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.

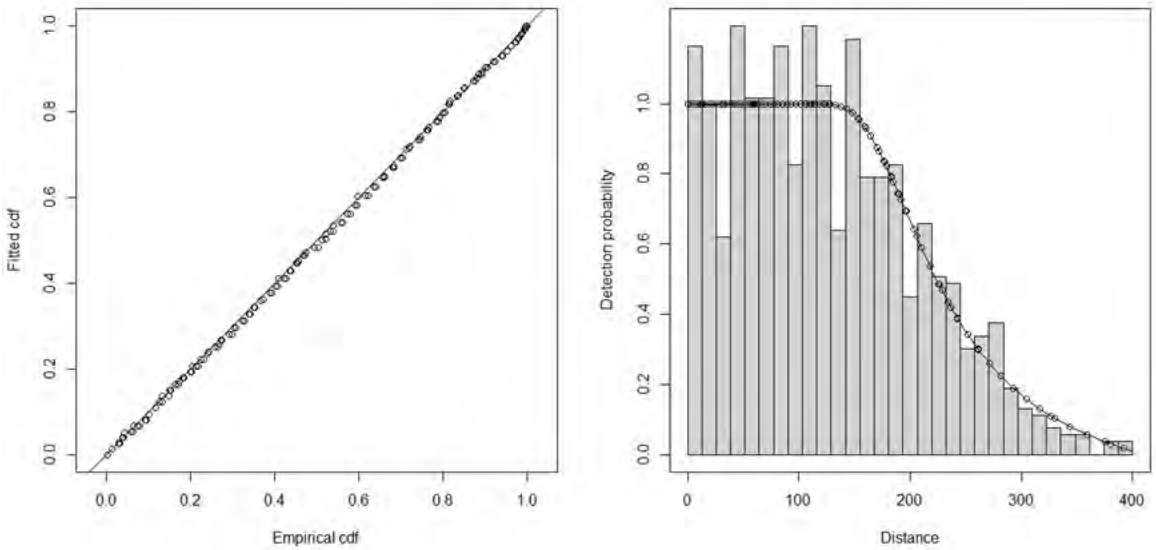

Figure D.4-3. Q-Q plots and detection functions from the green turtle MRDS analyses
SE-aerial analysis, the perpendicular distance is in meters.

D.4.3 Generalized Additive Model Analysis

Table D.4-3.. 2010 to 2021 density-habitat model output for green turtles

Covariates	Edf	Ref.df	F	C.dev	p-value
s(mlp)	1.005	4	21.89	2.38	<0.0001
s(DGSSw)	3.824	4	79.89	14.40	<0.0001
s(dist200)	3.664	4	52.34	6.78	<0.0001
s(dist1000)	2.187	4	15.57	1.42	<0.0001
s(latdd)	2.94	5	161.64	22.03	<0.0001

Adjusted R^2 = 0.0749, Deviance explained = 47%
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.

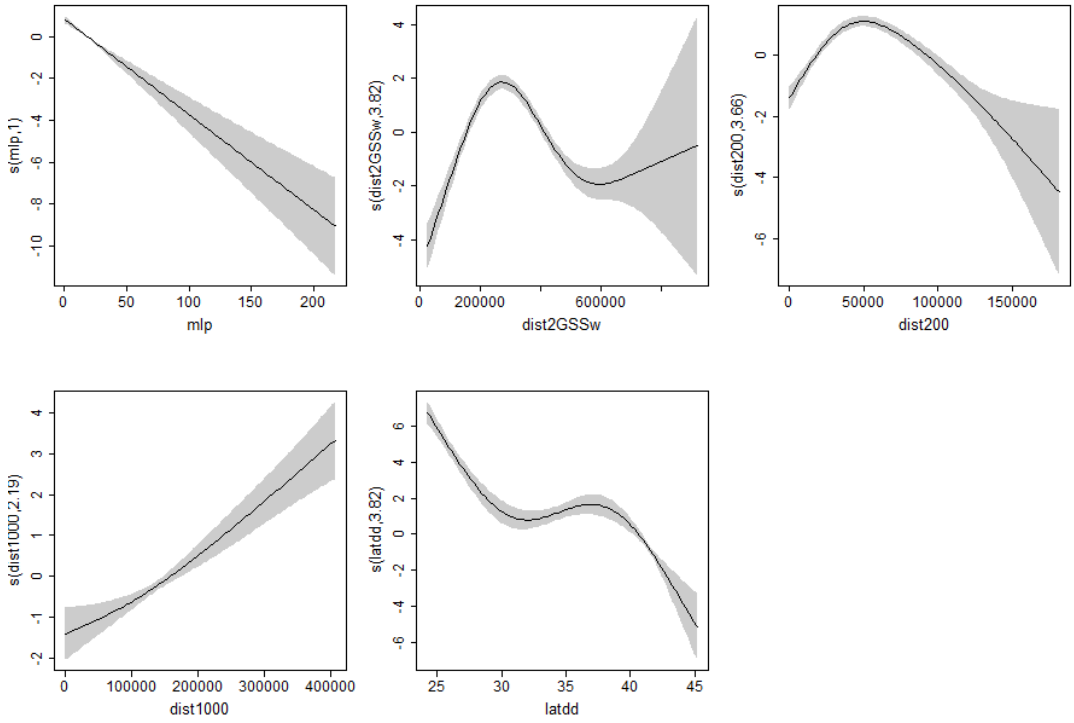

Figure D.4-4. Green turtle density relative to significant habitat covariates
Plots represent the partial smooths and interaction terms of the density-habitat model. Covariate abbreviations explained in main text in Table 4-2.

D.4.4 Model Cross-Validation

Table D.4-4. Diagnostic statistics from the green turtle density-habitat model

Diagnostic Statistic	Description	Calculated with	Model Values (x)	Score
RHO	Spearman rank correlation	Non-zero density	0.301	Excellent
MAPE	Mean absolute percentage error	Non-zero density	83.05	Fair to good
RHO	Spearman rank correlation	All data divided in 25 random samples	0.213	Fair to good
MAPE	Mean absolute percentage error	All data divided in 25 random samples	83.74	Fair to good
MAE	Mean absolute error	All data divided in 25 random samples	0.217	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

D.4.5 Abundance Estimates for AMAPPS Study Area

Table D.4-5. Green turtle average abundance estimates for the AMAPPS study area

Season	Average Abundance	CV	95% Confidence Interval
Spring (March–May)	52,540	0.32	2,8491 – 96,888
Summer (June–August)	73,524	0.28	42,911 – 125,976
Fall (September–November)	44,087	0.33	23,477 – 82,791
Winter (December–February)	39,288	0.26	23,799 – 64,859
Summer 2011 U.S. surveys[1]	-	-	-
Summer 2016 U.S. surveys[1]	-	-	-
Summer 2021 U.S. surveys	-	-	-

[1]Hayes et al. 2024

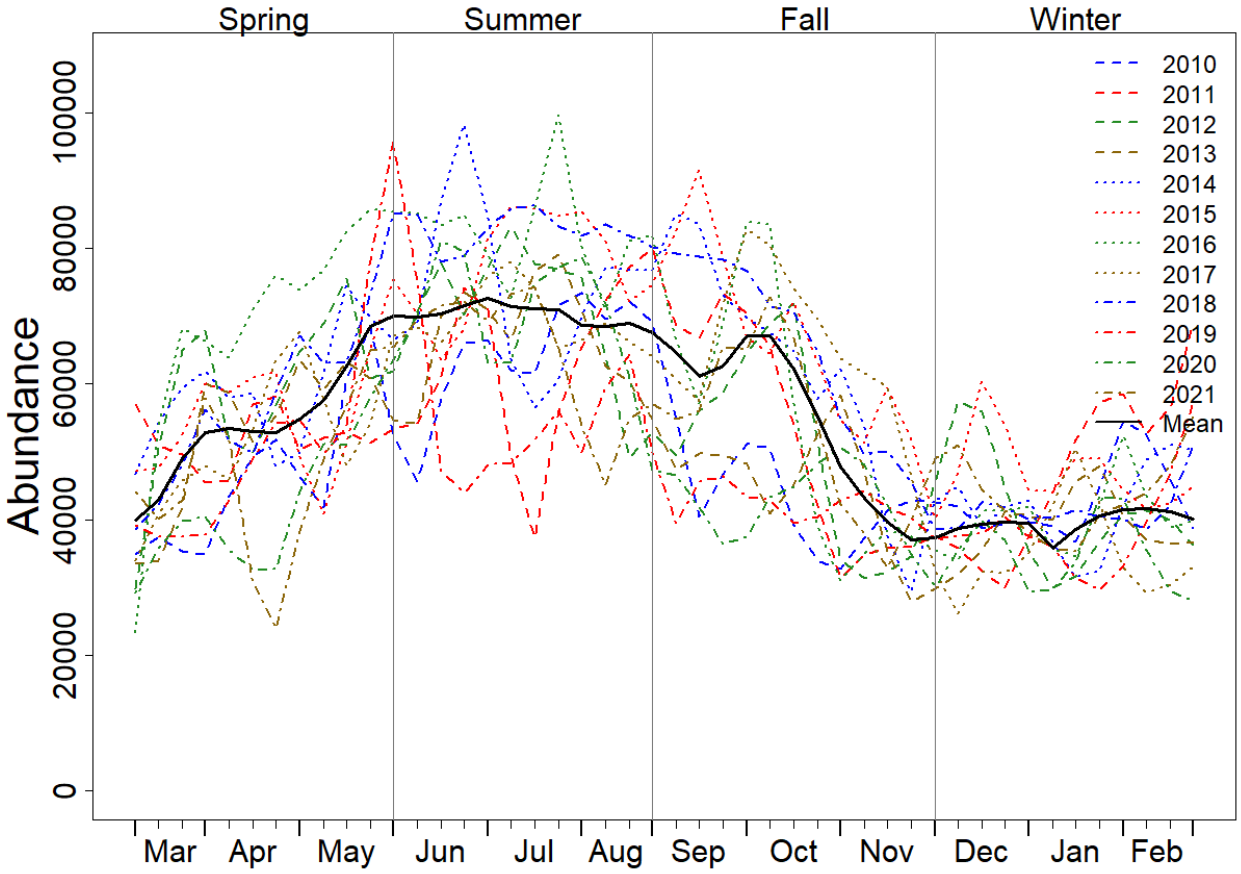

Figure D.4-5. Annual abundance trends for green turtle in the AMAPPS study area

D.4.6 Seasonal Prediction Maps

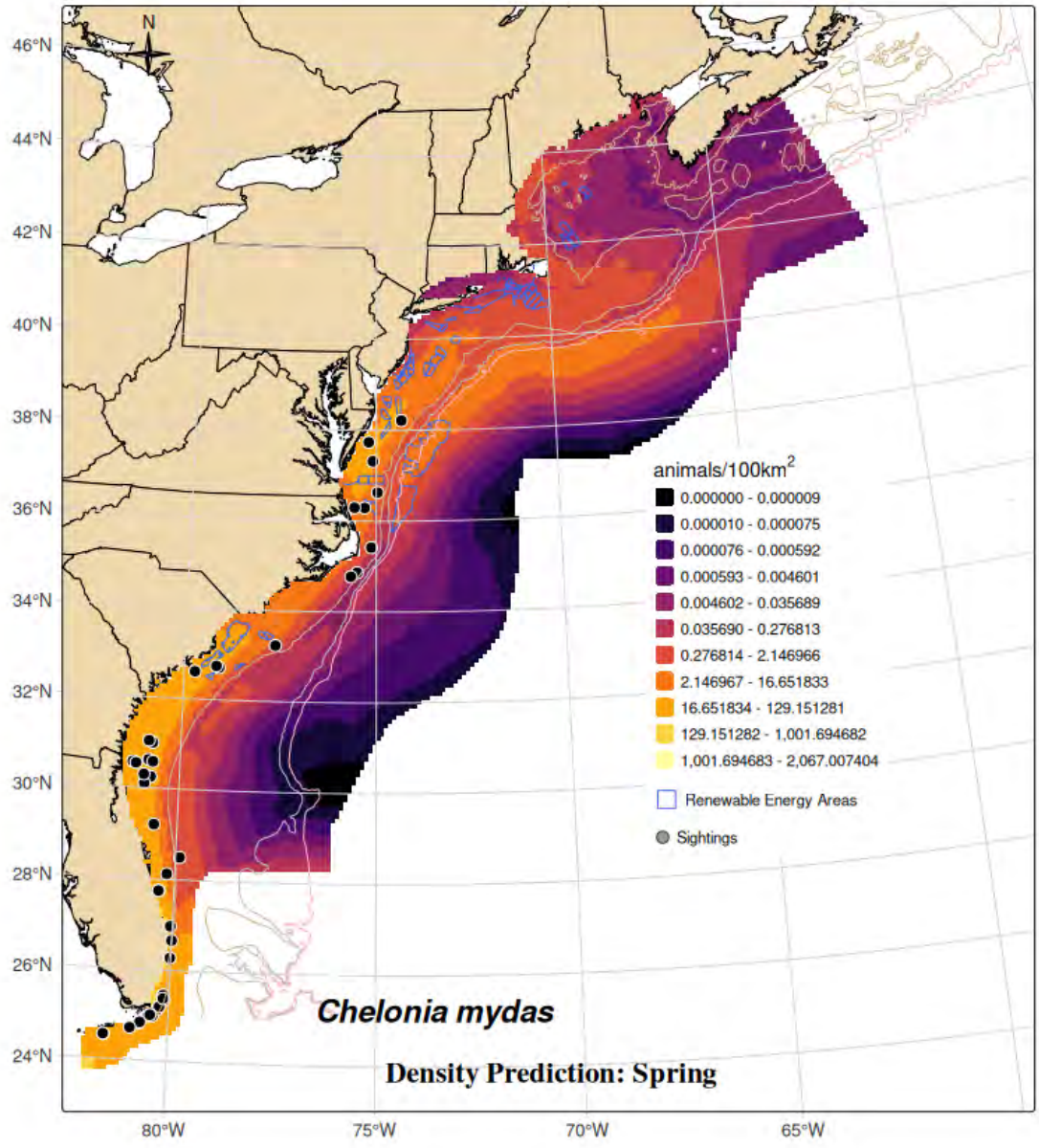

Figure D.4-6. Green turtle spring average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations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

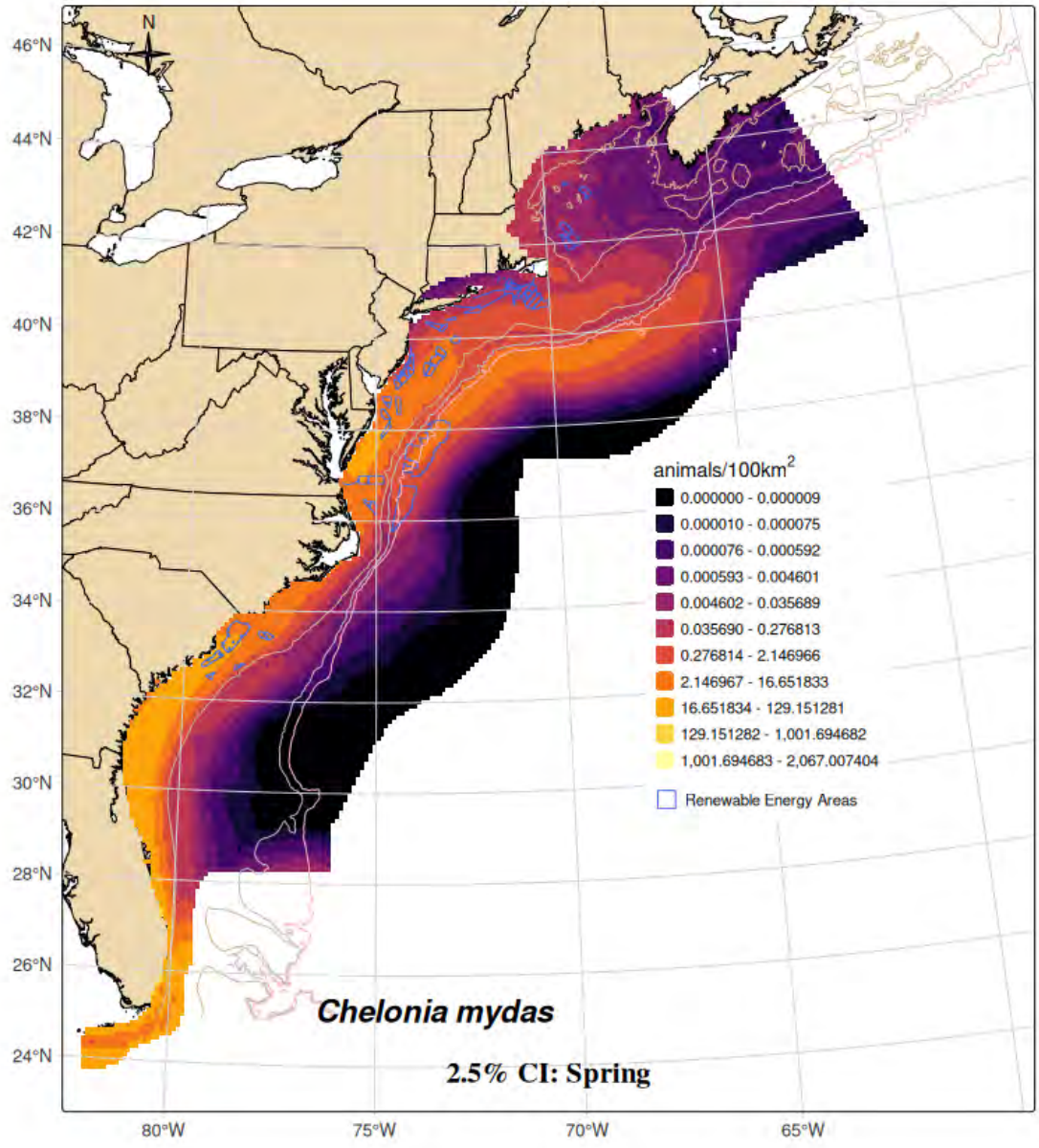

Figure D.4-7. Lower 2.5% confidence interval of the spring green turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

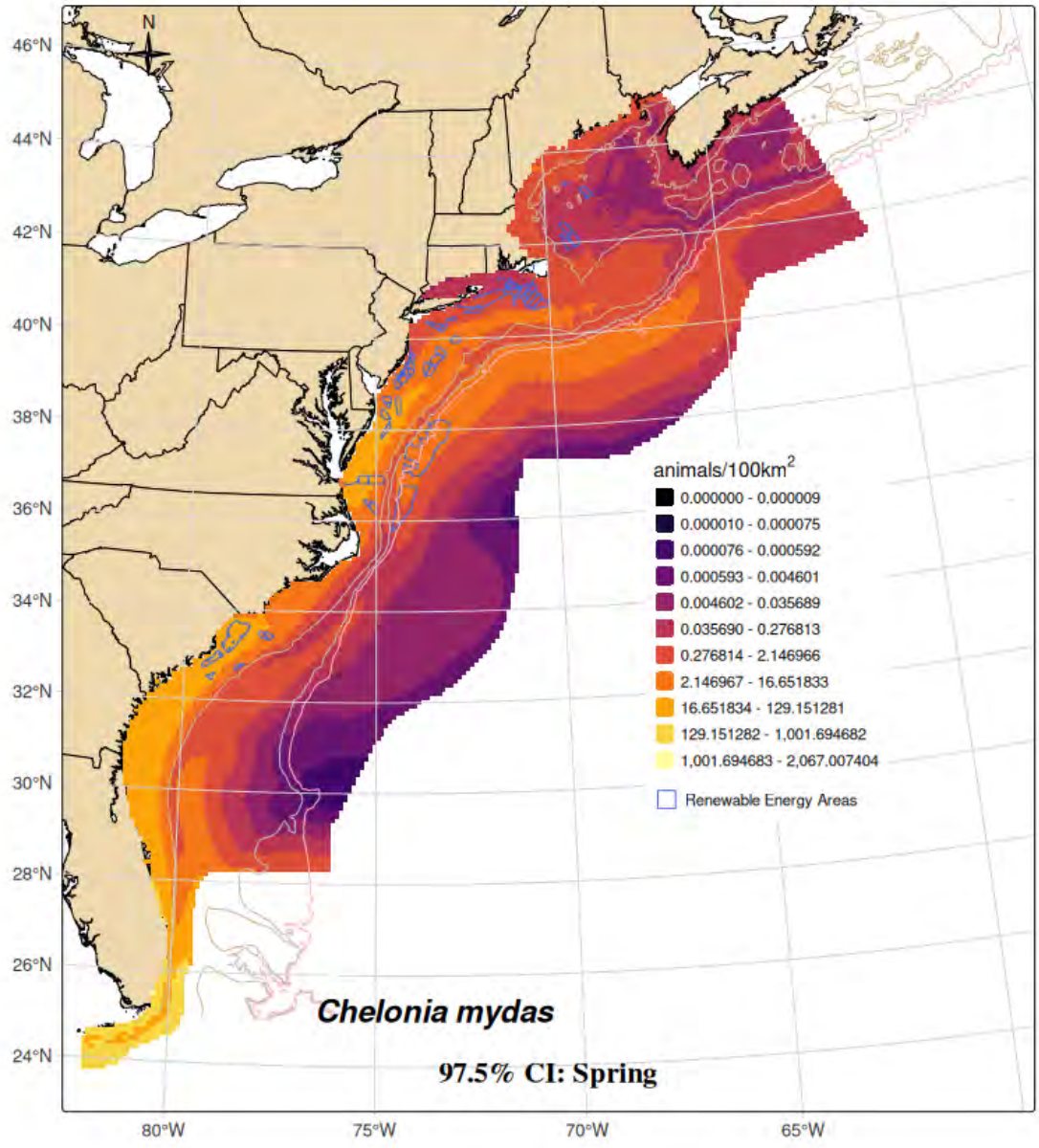

Figure D.4-8. Upper 97.5% confidence interval of the spring green turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

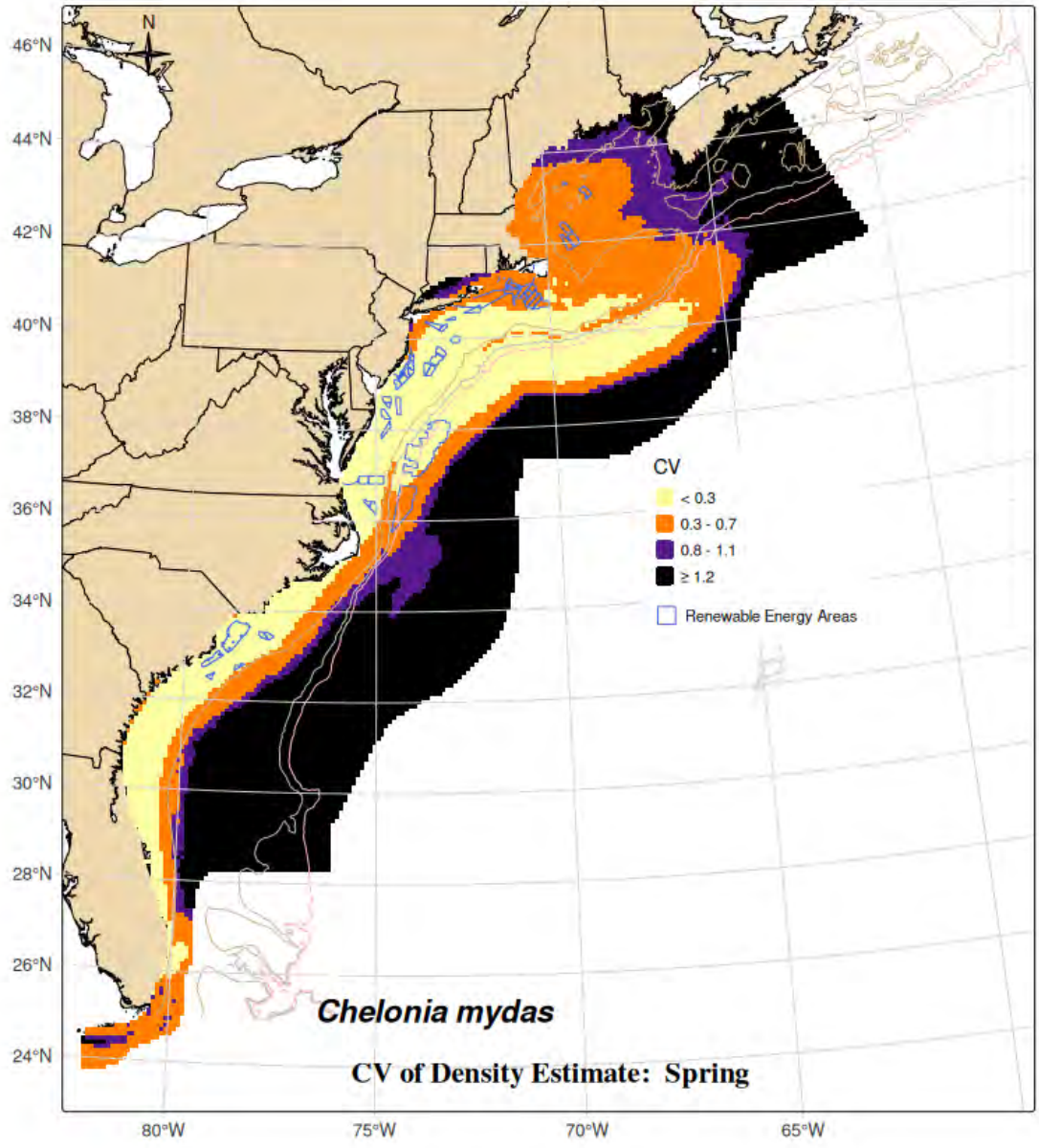

Figure D.4-9. CV of spring green turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

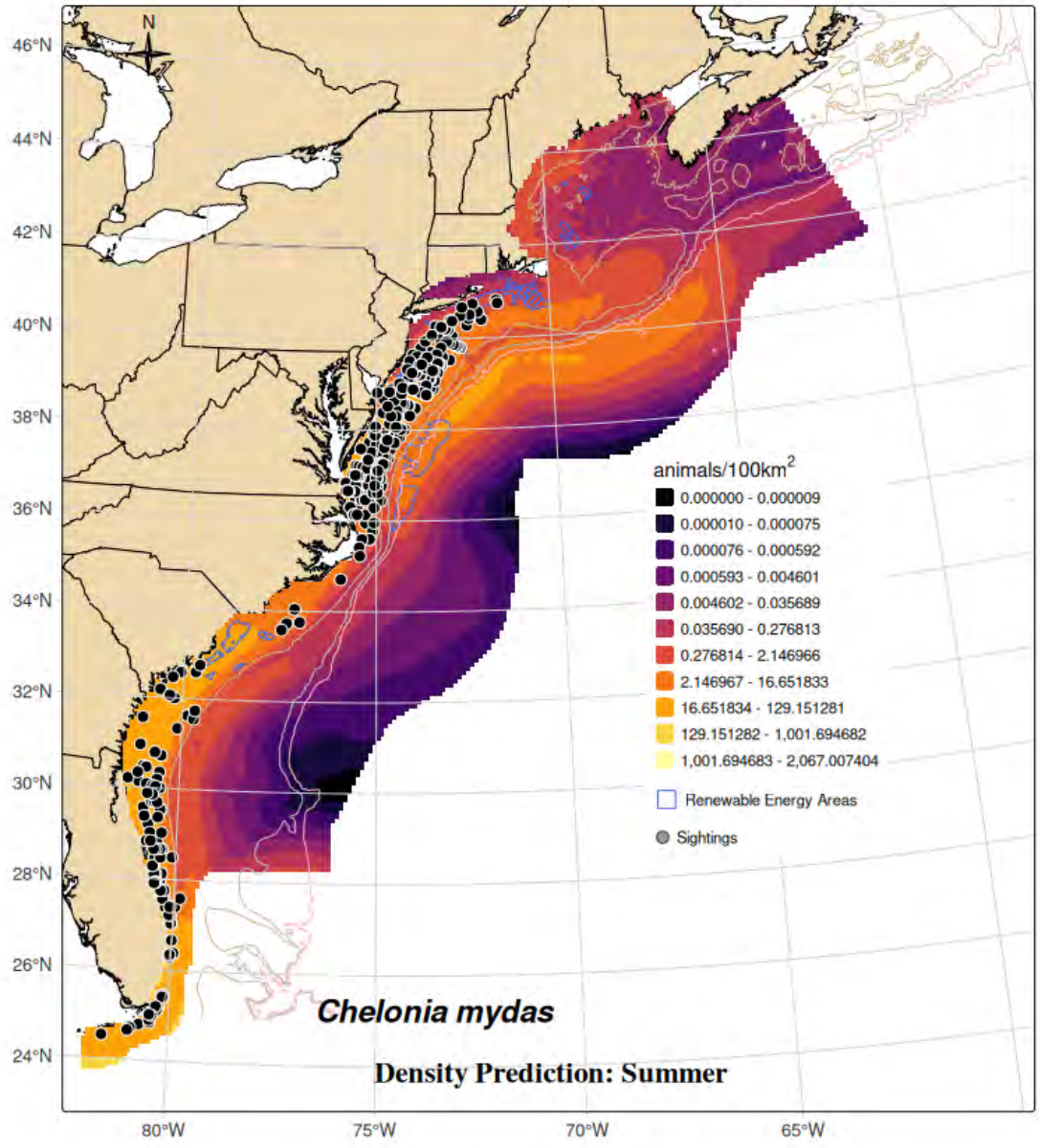

Figure D.4-10. Green turtle summer average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations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

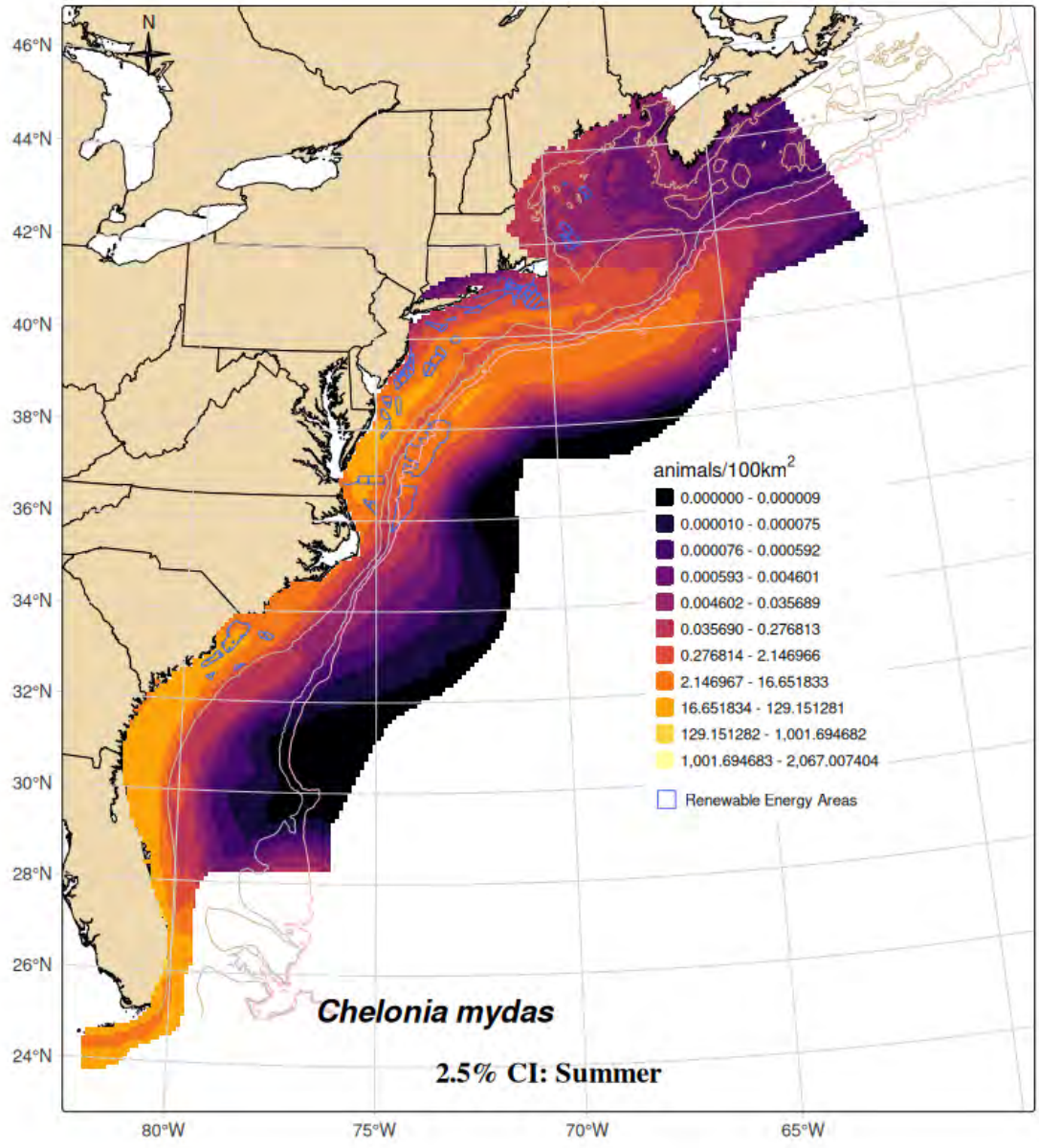

Figure D.4-11. Lower 2.5% confidence interval of the summer green turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

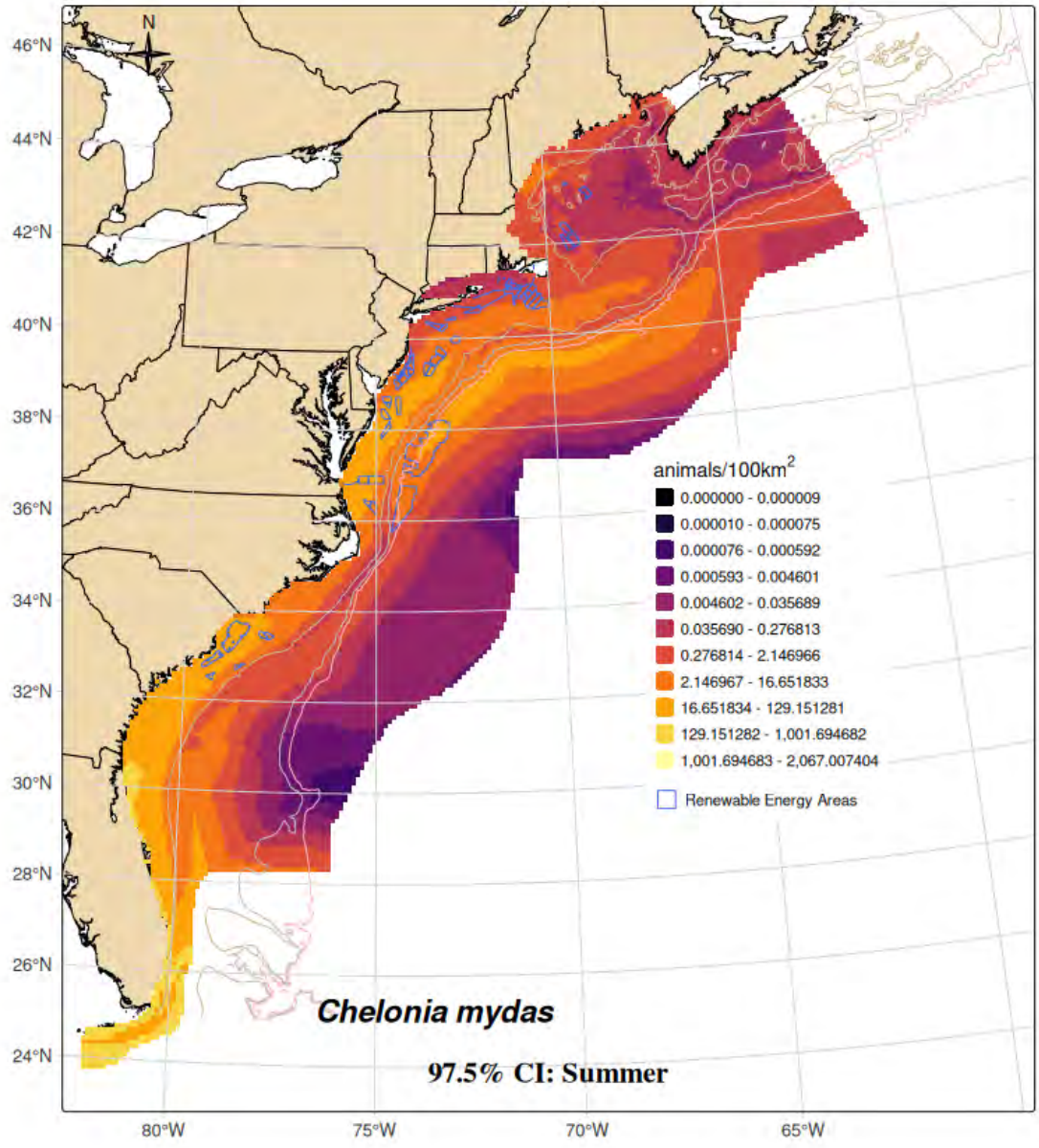

Figure D.4-12. Upper 97.5% confidence interval of the summer green turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

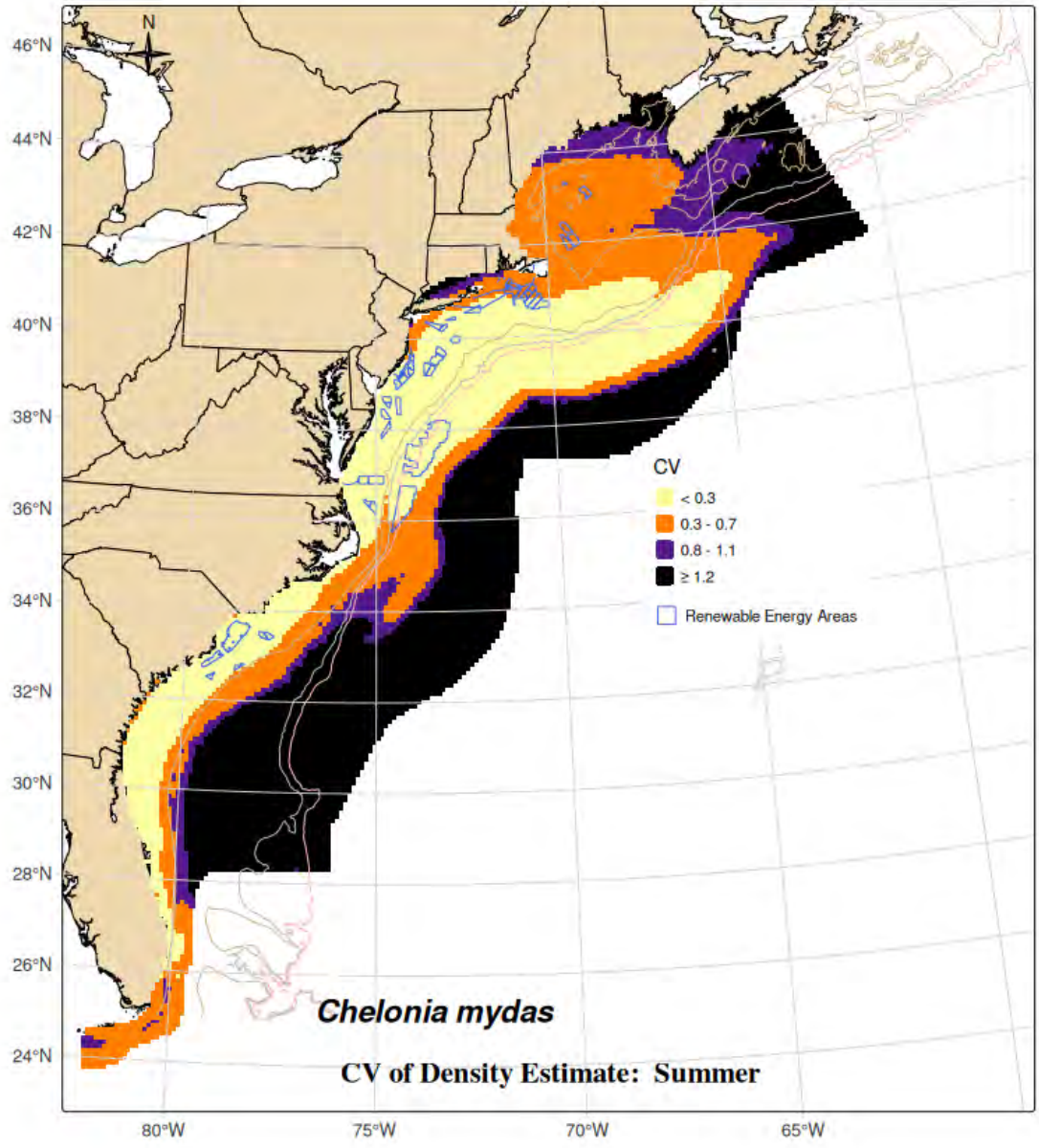

Figure D.4-13. CV of summer green turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

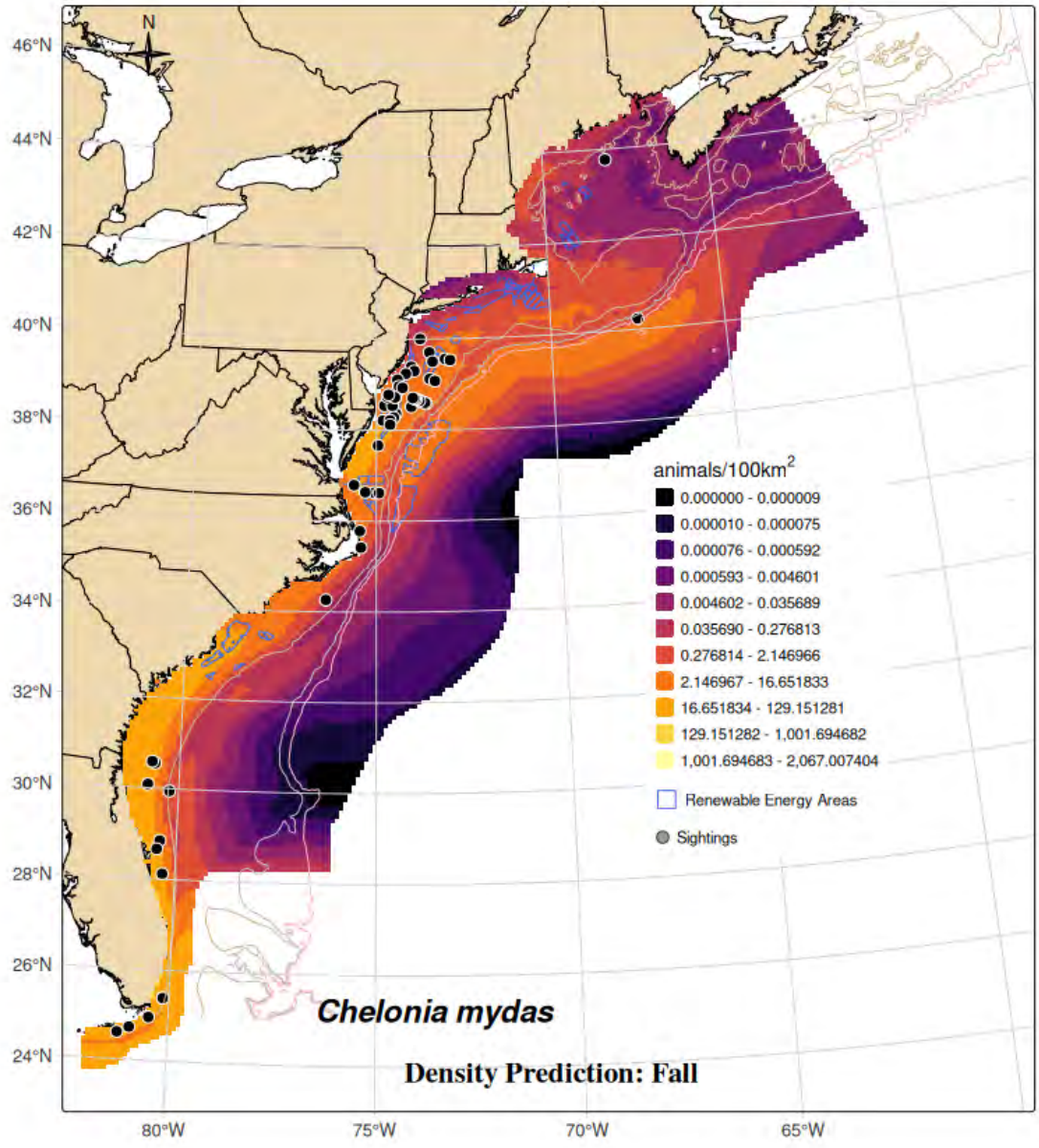

Figure D.4-14. Green turtle fall average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

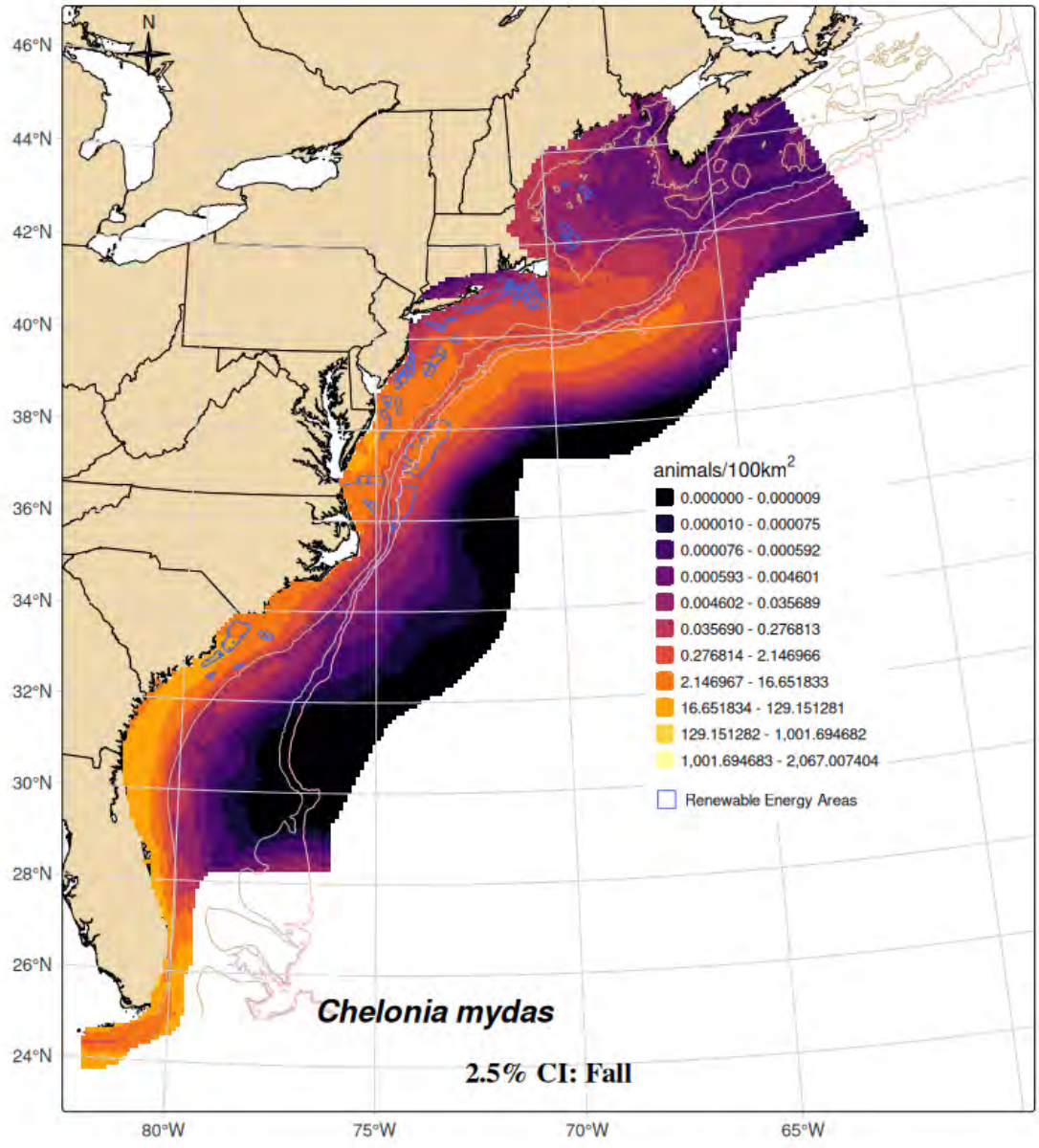

Figure D.4-15. Lower 2.5% confidence interval of the fall green turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

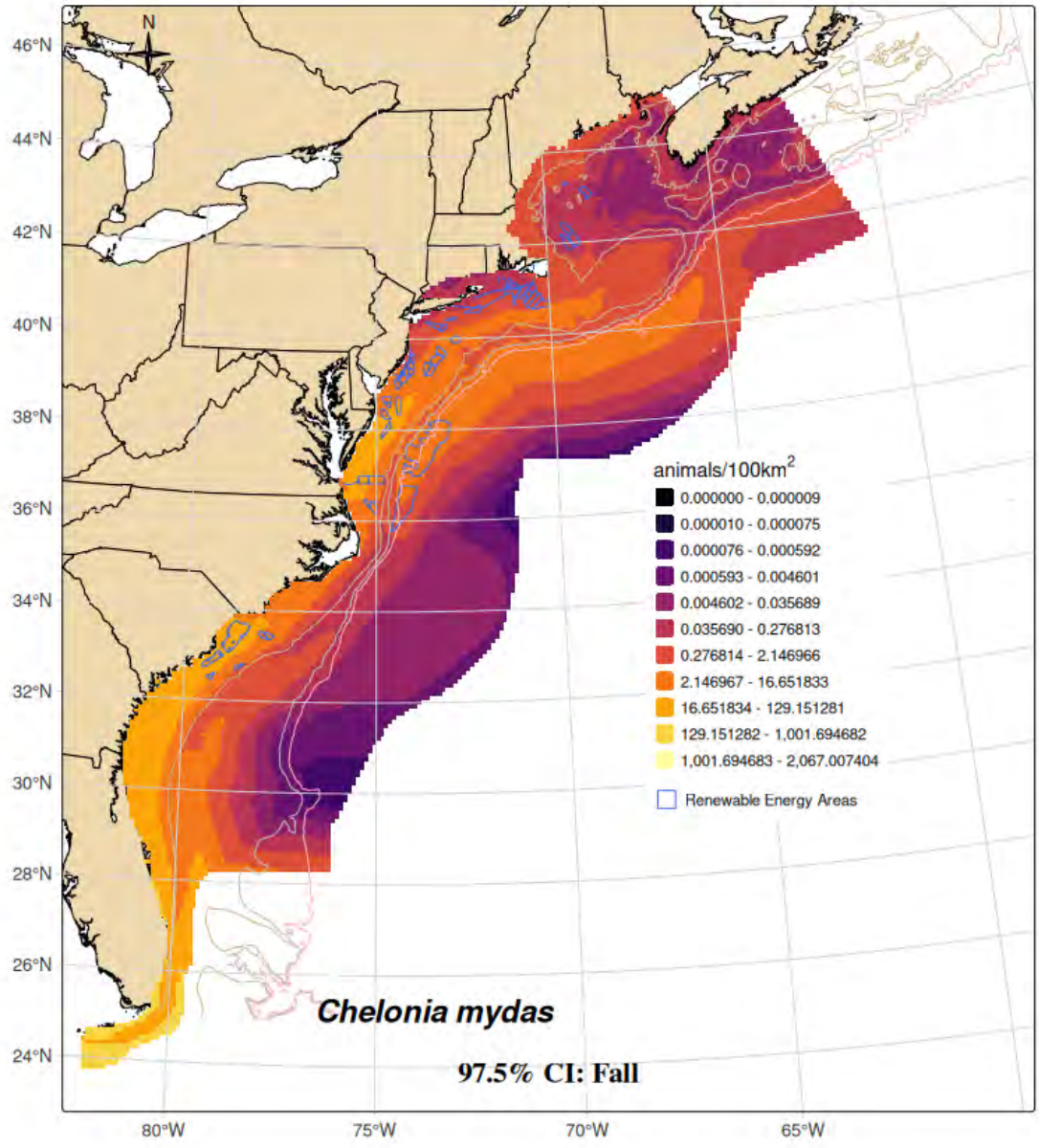

Figure D.4-16. Upper 97.5% confidence interval of the fall green turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

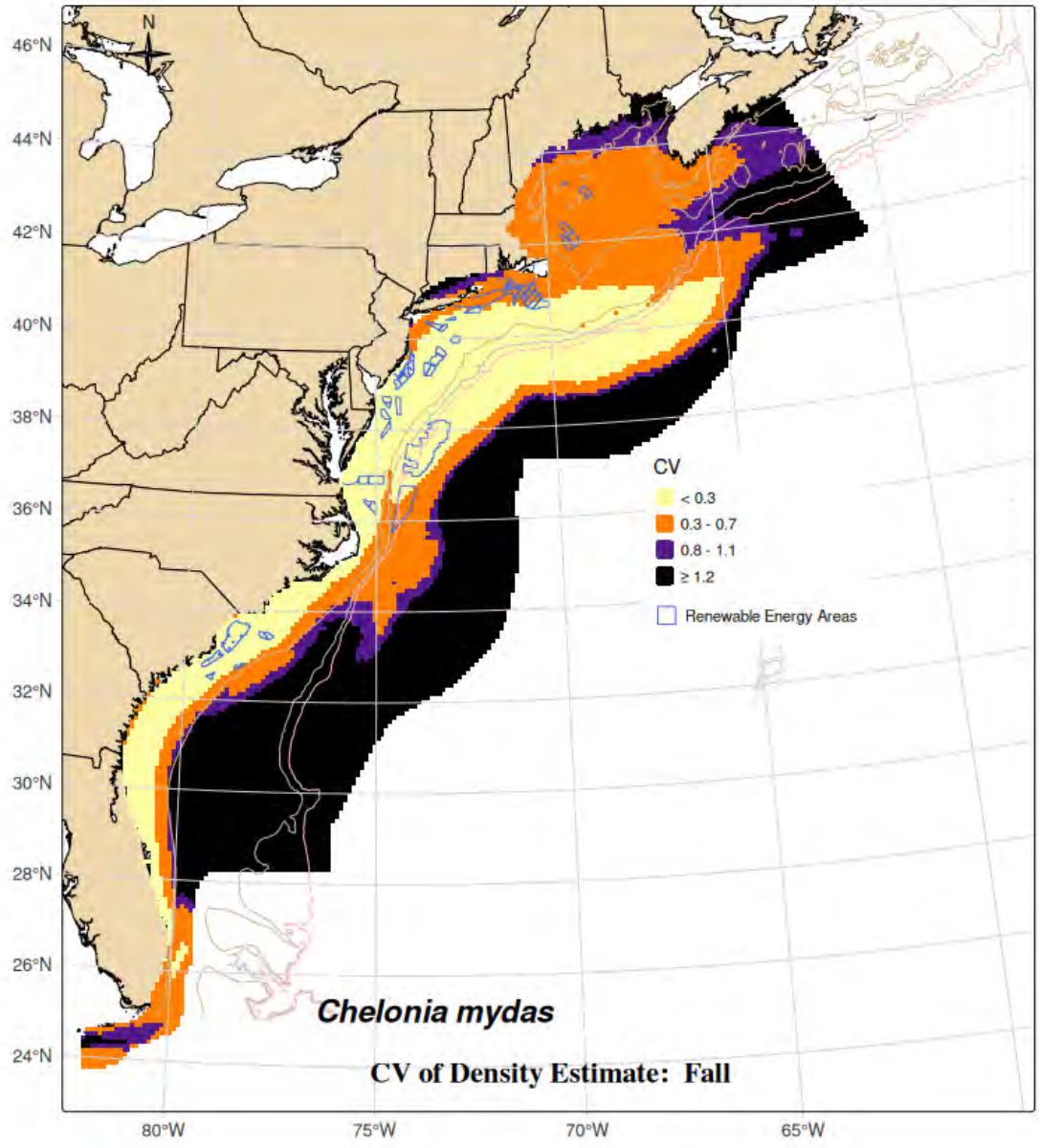

Figure D.4-17. CV of fall green turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

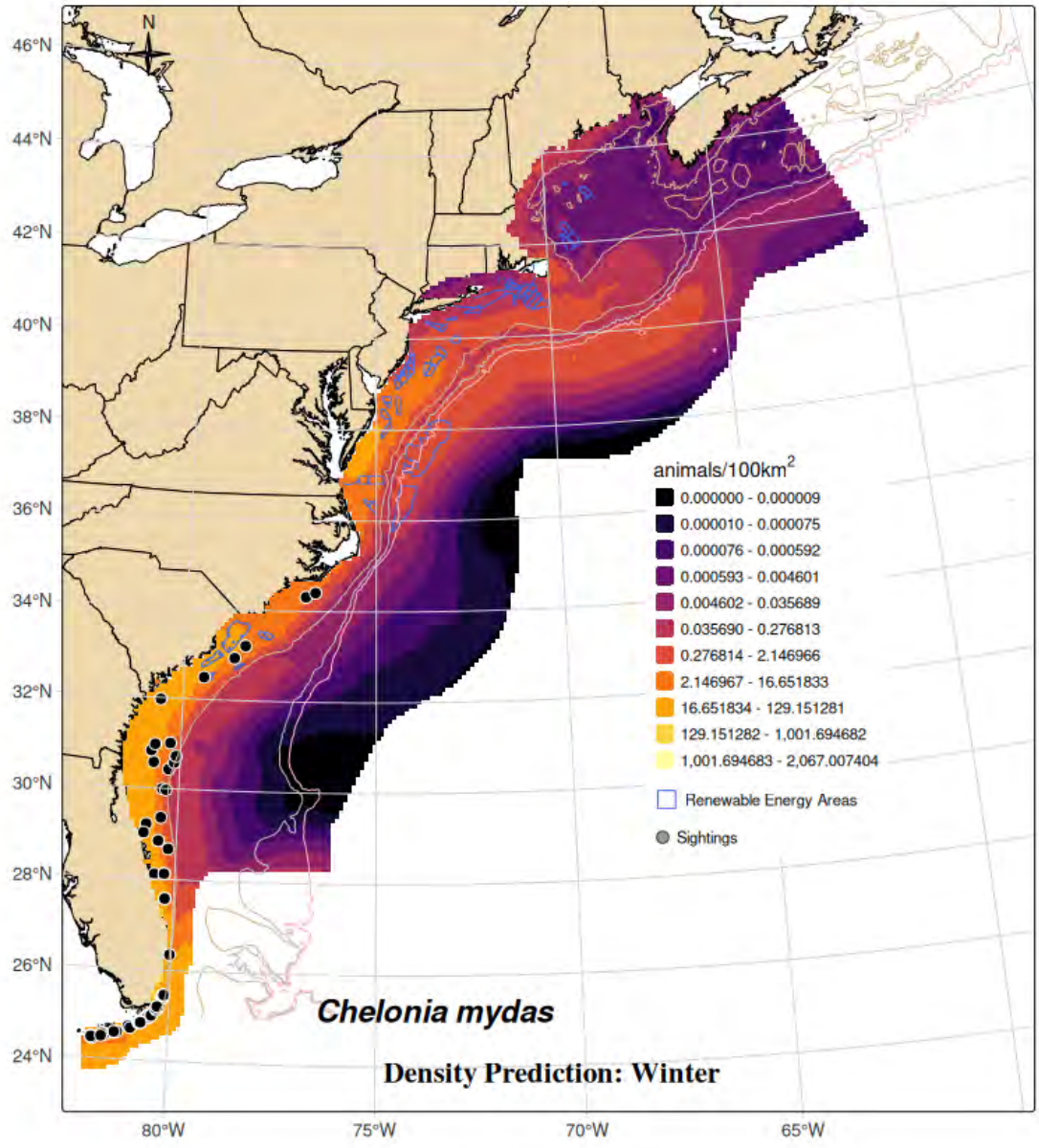

Figure D.4-18. Green turtle winter average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations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

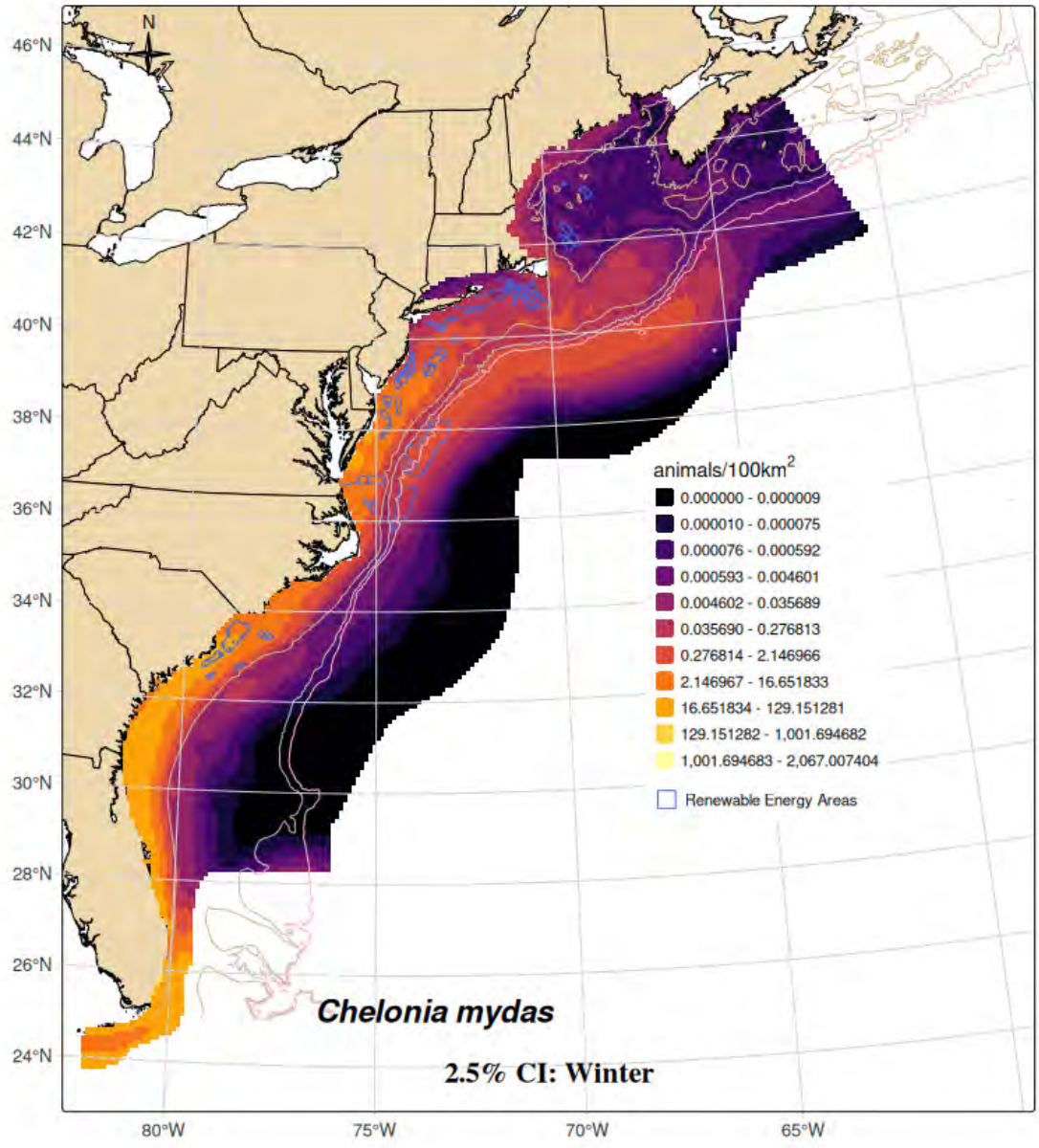

Figure D.4-19. Lower 2.5% confidence interval of the winter green turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

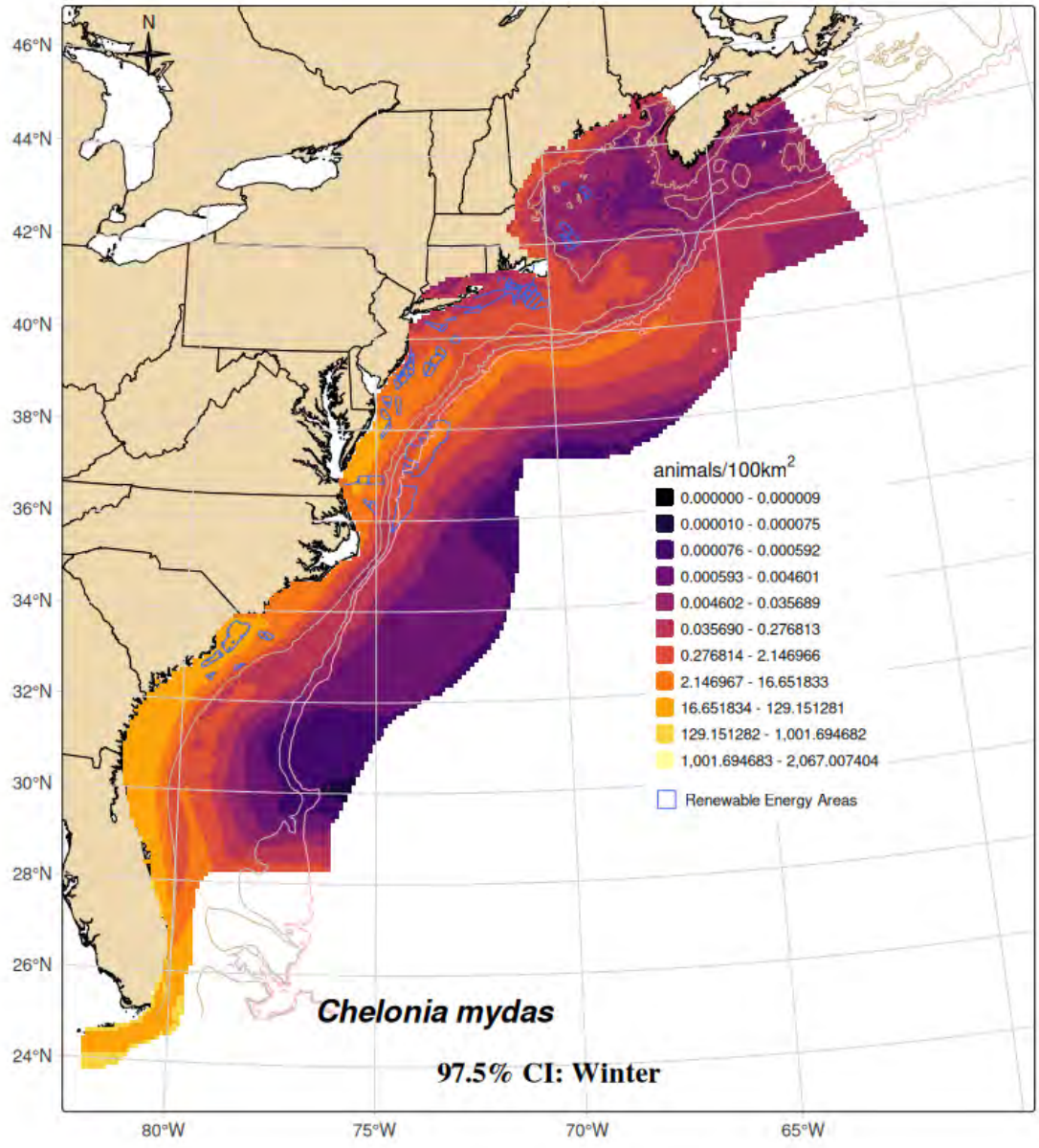

Figure D.4-20. Upper 97.5% confidence interval of the winter green turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy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

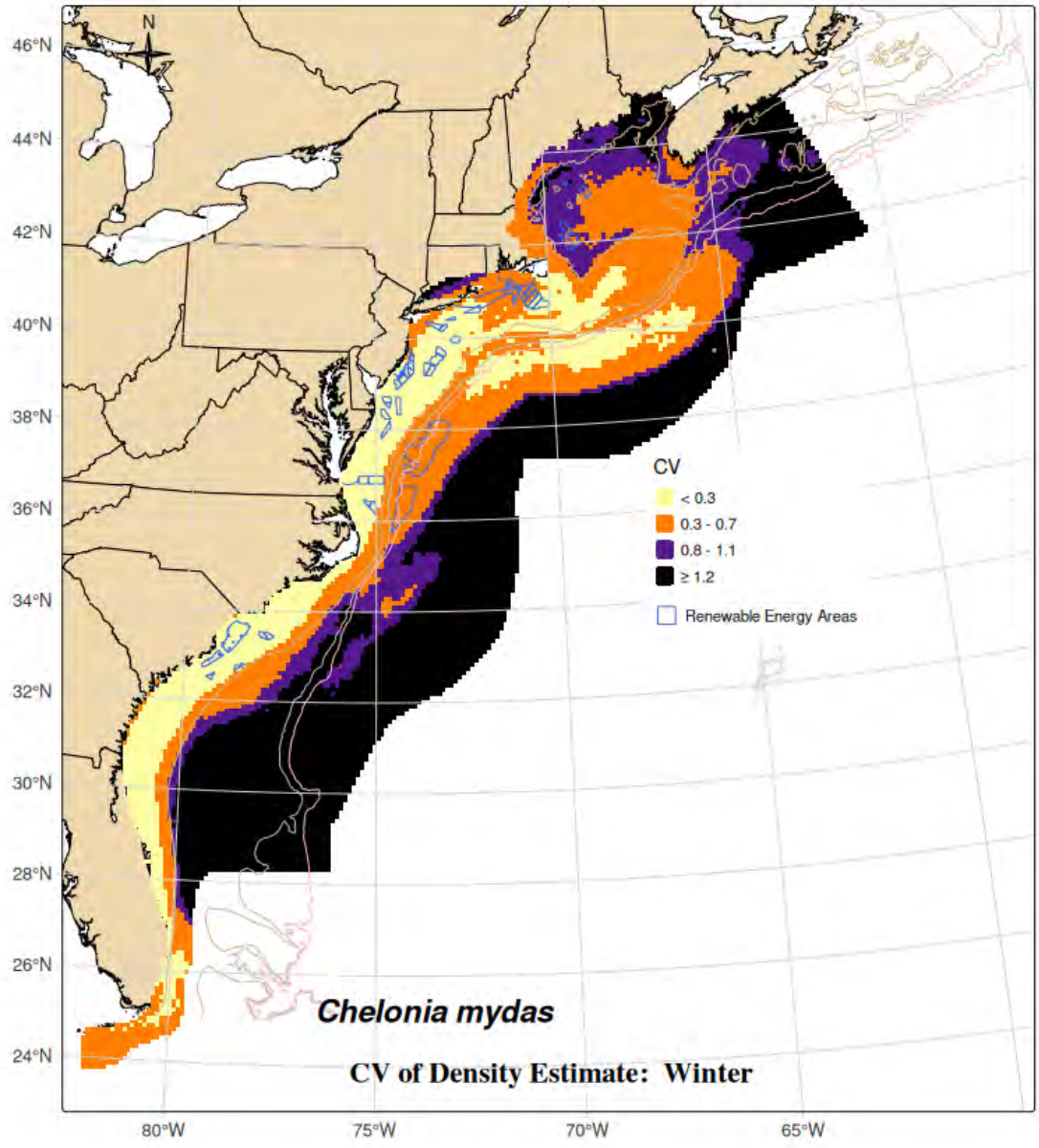

Figure D.4-21. CV of winter green turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

D.4.7 Offshore Energy Development Areas

Table D.4-6. Green turtle abundance estimates for wind-energy study areas

Season	Wind-Energy Study Area	Abundance*	CV	95% Confidence Interval*
Spring (Mar-May)	RI/MA	51.3	0.31	28.5 – 92.3
	NY	20.2	0.26	12.3 – 33.3
	NJ	227.1	0.17	164.6 – 313.4
	DE/MD	523.4	0.13	403 – 679.7
	VA	538.0	0.13	419.2 – 690.5
	NC	161.2	0.17	116.2 – 223.5
	NC/SC	2,997.9	0.13	2,326.1 – 3,863.7
	GA	572.7	0.15	429.9 – 763.0
	FL	837.5	0.31	462.1 – 1518.0
Summer (Jun-Aug)	RI/MA	112.3	0.26	68.5 – 184.2
	NY	27.5	0.23	17.5 – 3.2
	NJ	307.7	0.15	228.6 – 414.1
	DE/MD	807.4	0.12	637.5 – 1,022.7
	VA	844.3	0.12	668.2 – 1,066.9
	NC	283.4	0.14	214.0 – 375.2
	NC/SC	3,372.9	0.13	2,607.5 – 4,363.0
	GA	588.1	0.15	438.4 – 788.9
	FL	865.9	0.38	418.2 – 1,792.9
Fall (Sep-Nov)	RI/MA	60.7	0.28	35.2 – 104.6
	NY	12.4	0.27	7.4 – 20.9
	NJ	174.3	0.18	123.6 – 245.8
	DE/MD	428.9	0.14	323.9 – 568
	VA	441.2	0.13	342.5 – 568.4
	NC	1,330.0	0.16	97.2 – 182.1
	NC/SC	2,653.8	0.14	2,028.3 – 3,472.2
	GA	441.9	0.16	320.6 – 609.2
	FL	548.0	0.31	302.6 – 992.3
Winter (Dec-Feb)	RI/MA	19.3	0.29	11.0 - 33.8
	NY	9.0	0.26	5.5 – 14.7
	NJ	149.0.	0.17	107.1 – 207.3
	DE/MD	362.6	0.14	277.1 – 474.6
	VA	369.9	0.13	286.7 – 477.2
	NC	90.5	0.18	63.6 – 128.8
	NC/SC	2,683.1	0.13	2,097.8 – 3,431.7
	GA	466.0	0.16	343.5 – 632.2
	FL	700.3	0.25	436.1 – 1124.4

***** 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.

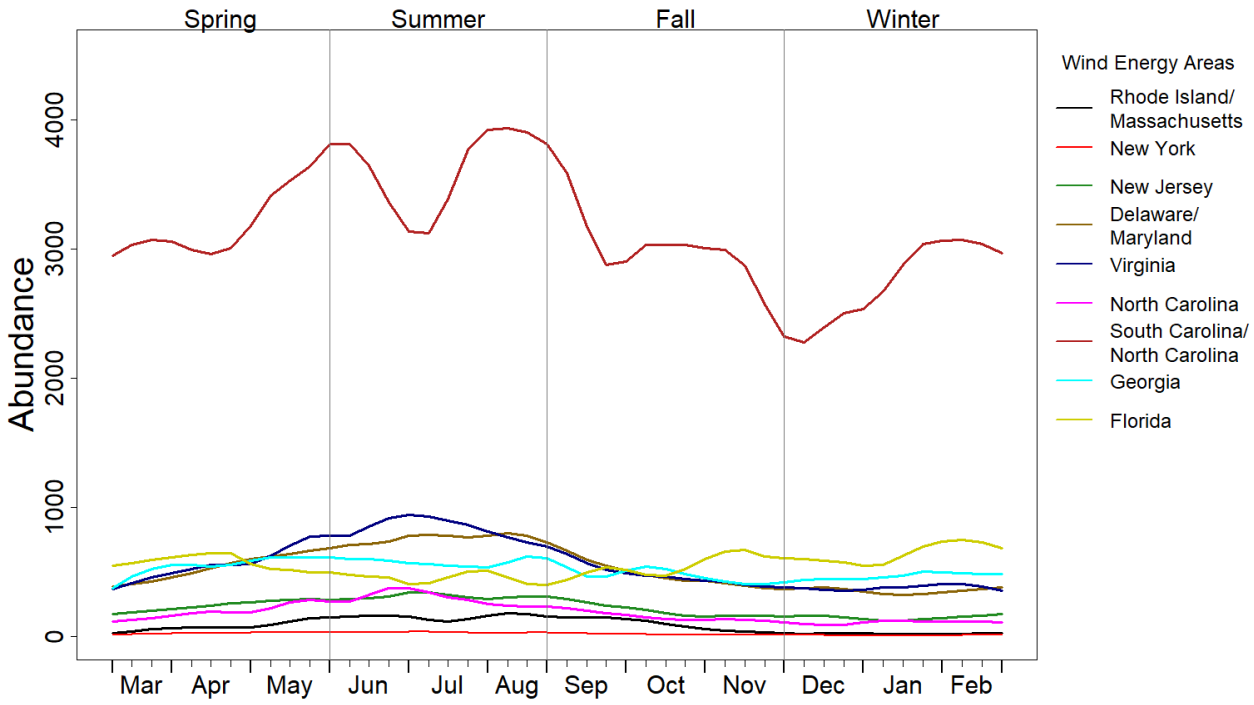

Figure D.4-22. Average seasonal abundance of green turtle in the wind-energy study areas

D.5 Kemp’s ridley turtle (*Lepidochelys kempii*)

Figure D.5-1. Kemp’s ridley turtle

D.5.1 Data Collection

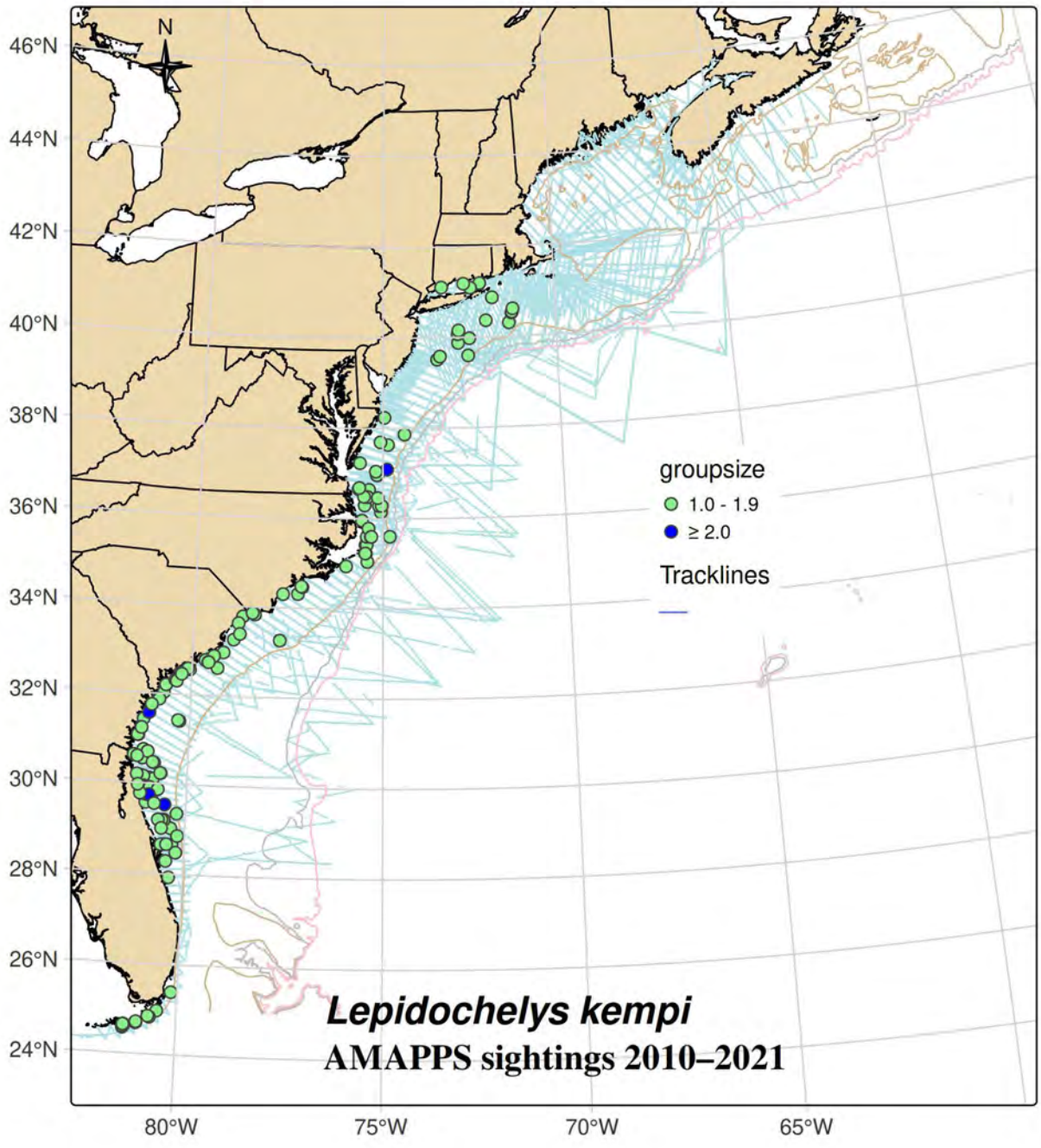

Figure D.5-2. Distribution of track lines and Kemp's ridley turtle sightings 2010 to 2021
Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours.

Table D.5-1. AMAPPS research effort 2010 to 2021 and Kemp's ridley turtle sightings

Survey Region and Platform	Season	Effort (km)	Number of Groups	Number of Animals
NE Shipboard	Spring	8,883	-	-
NE Shipboard	Summer	49,064	-	-
NE Aerial	Spring	27,229	-	-
NE Aerial	Summer	41,806	10	10
NE Aerial	Fall	58,178	4	4
NE Aerial	Winter	10,645	-	-
SE Shipboard	Summer	18,331	-	-
SE Shipboard	Fall	2,673	-	-
SE Aerial	Spring	42,185	52	62
SE Aerial	Summer	43,285	58	60
SE Aerial	Fall	21,153	23	24
SE Aerial	Winter	19,152	23	26

D.5.2 Mark-Recapture Distance Sampling Analysis

Table D.5-2. Intermediate parameters in Kemp's ridley turtle 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 - air group 9	distance + observer+ sighting time	350	distance	350	HN with Hermite Polynomial Adjustment Order 4	0.421	0.092	-	0.945

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

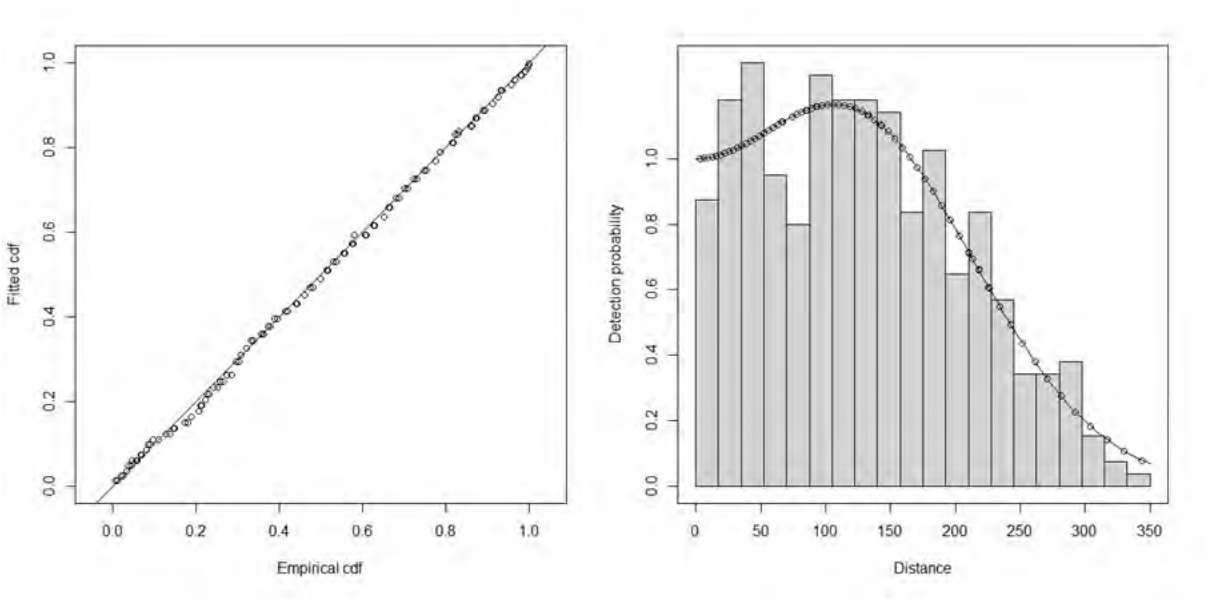

Figure D.5-3. Q-Q plots and detection functions from the Kemp's ridley turtle MRDS analyses
SE-aerial analysis, the perpendicular distance is in meters.

D.5.3 Generalized Additive Model Analysis

Table D.5-3. 2010 to 2021 density-habitat model output for Kemp's ridley turtles

Covariates	Edf	Ref.df	F	C.dev	p-value
s(chlf)	3.2877	4	17.006	1.95	<0.0001
s(mlp)	0.9912	4	11.9	1.57	<0.0001
s(DGSSw)	3.9519	4	336.855	48.49	<0.0001
s(dist2shore)	3.1421	4	10.5	1.22	<0.0001
s(dist200)	3.2794	4	9.194	0.84	<0.0001
s(dist1000)	3.6805	4	36.219	3.8	<0.0001
s(Latdd)	3.9703	4	48.876	5.48	<0.0001

Adjusted R^2 = 0.503, Deviance explained = 63.4%
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.

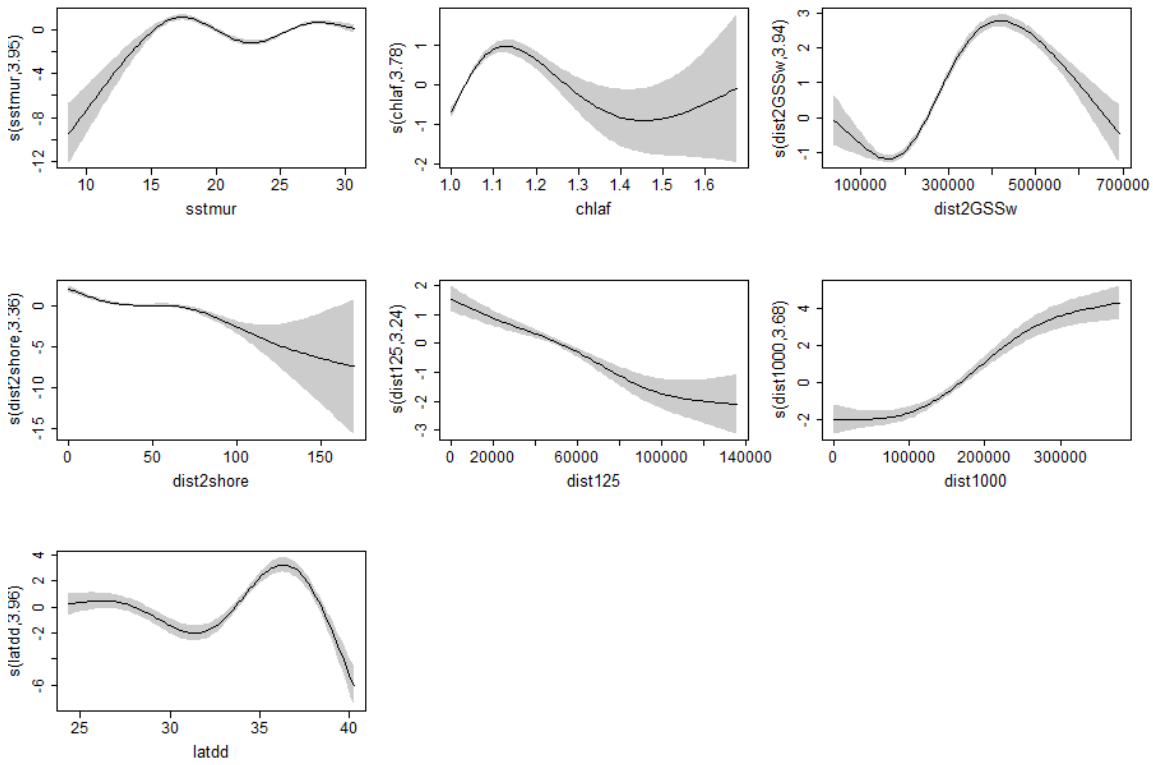

Figure D.5-4. Kemp's ridley turtle density relative to significant habitat covariates
Plots represent the partial smooths and interaction terms of the density-habitat model. Covariate abbreviations explained in main text in Table 4-2.

D.5.4 Model Cross-Validation

Table D.5-4. Diagnostic statistics from the Kemp's ridley turtle density-habitat model

Diagnostic Statistic	Description	Calculated with	Model Values (x)	Score
RHO	Spearman rank correlation	Non-zero density	0.676	Excellent
MAPE	Mean absolute percentage error	Non-zero density	104.02	Fair to good
RHO	Spearman rank correlation	All data divided in 25 random samples	0.493	Excellent
MAPE	Mean absolute percentage error	All data divided in 25 random samples	75.02	Fair to good
MAE	Mean absolute error	All data divided in 25 random samples	1.00	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

D.5.5 Abundance Estimates for AMAPPS Study Area

Table D.5-5. Kemp's ridley turtle average abundance estimates for the AMAPPS study area

Season	Average Abundance	CV	95% Confidence Interval
Spring (March–May)	12,606	0.4	5,924 – 26,823
Summer (June–August)	23,714	0.31	13,097 – 42,939
Fall (September–November)	18,532	0.35	9,518 – 36,081
Winter (December–February)	12,216	0.38	5,947 – 25,093
Summer 2011 U.S. surveys[1]	-	-	-
Summer 2016 U.S. surveys[1]	-	-	-
Summer 2021 U.S. surveys	-	-	-

[1]Hayes et al. 2024

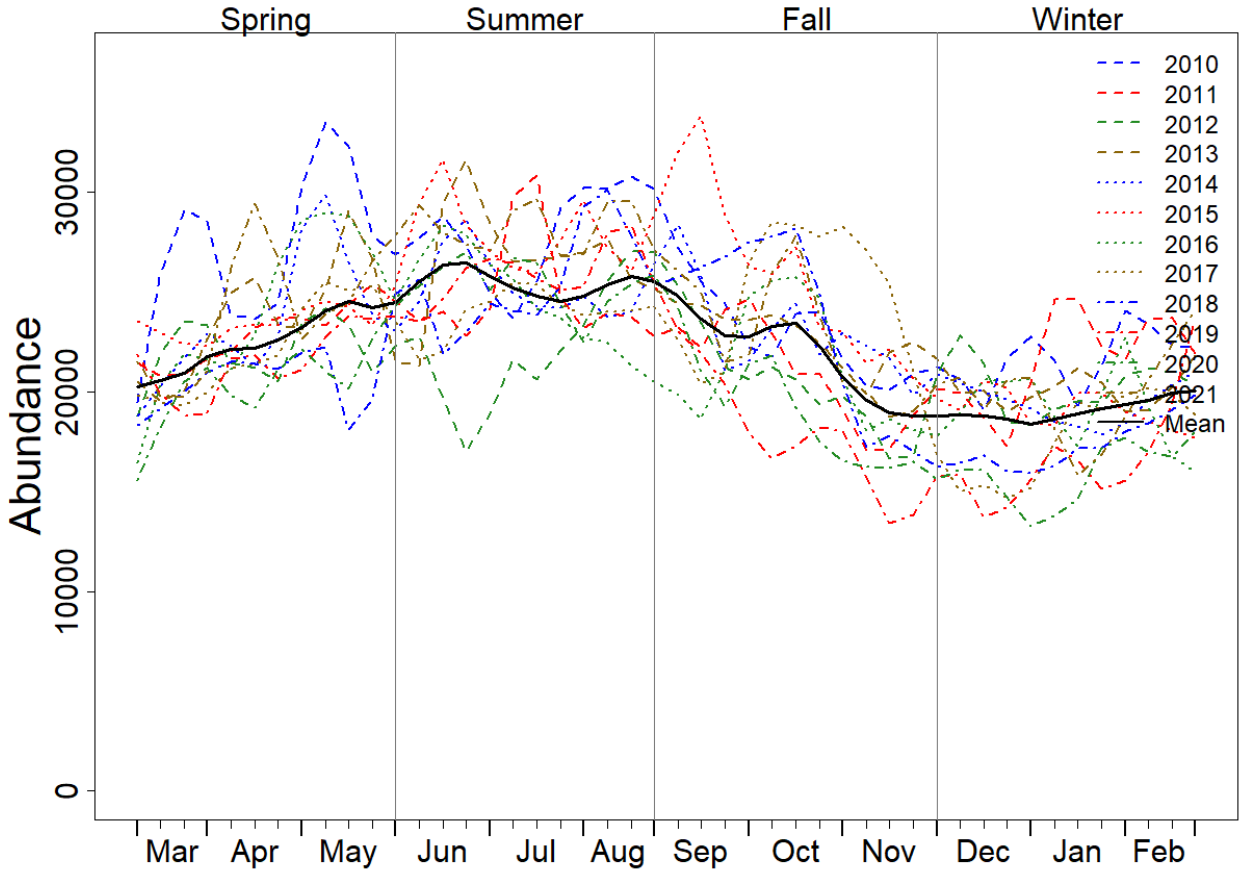

Figure D.5-5. Annual abundance trends for Kemp's ridley turtle in the AMAPPS study area

D.5.6 Seasonal Prediction Maps

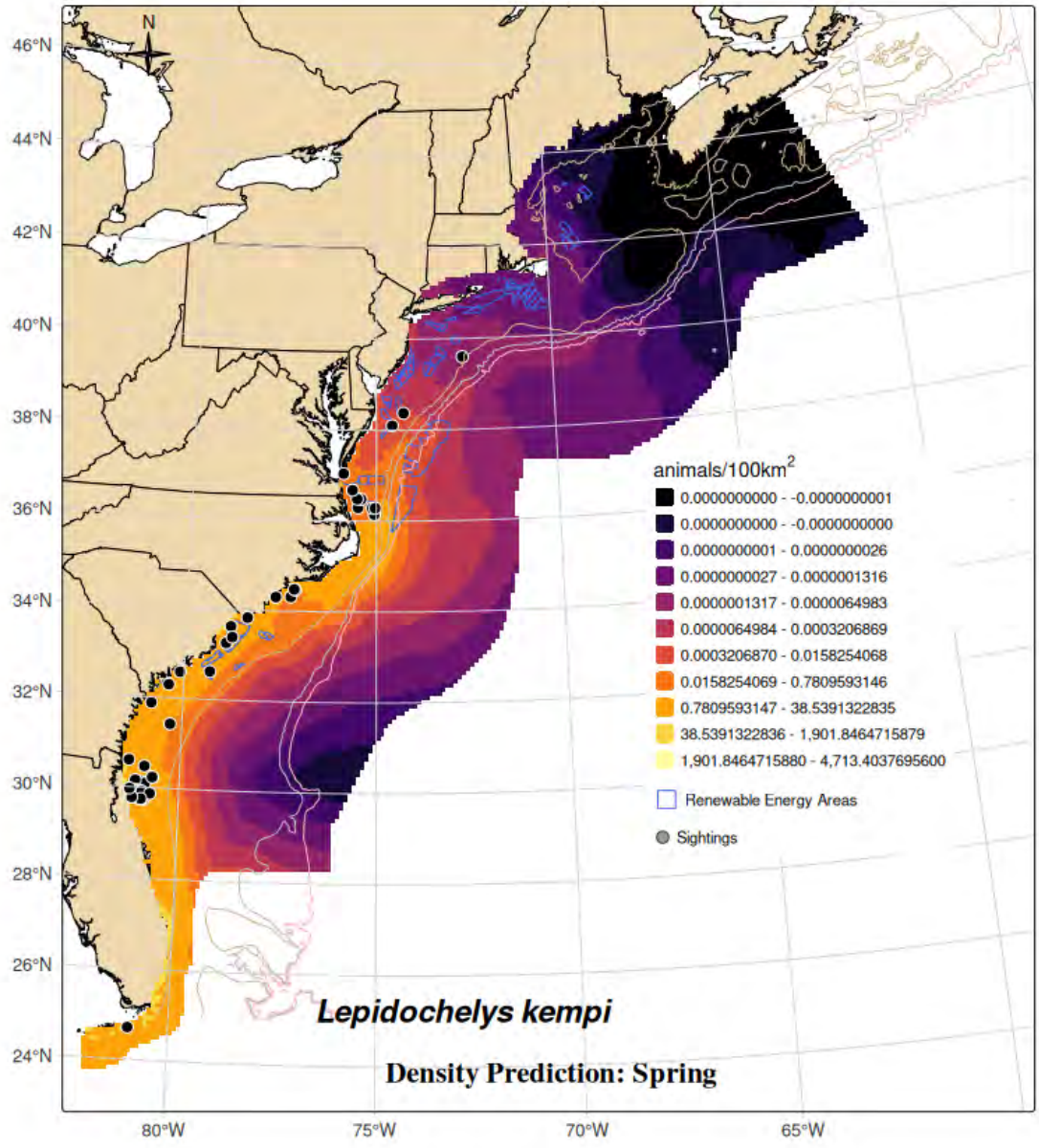

Figure D.5-6. Kemp's ridley turtle spring average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

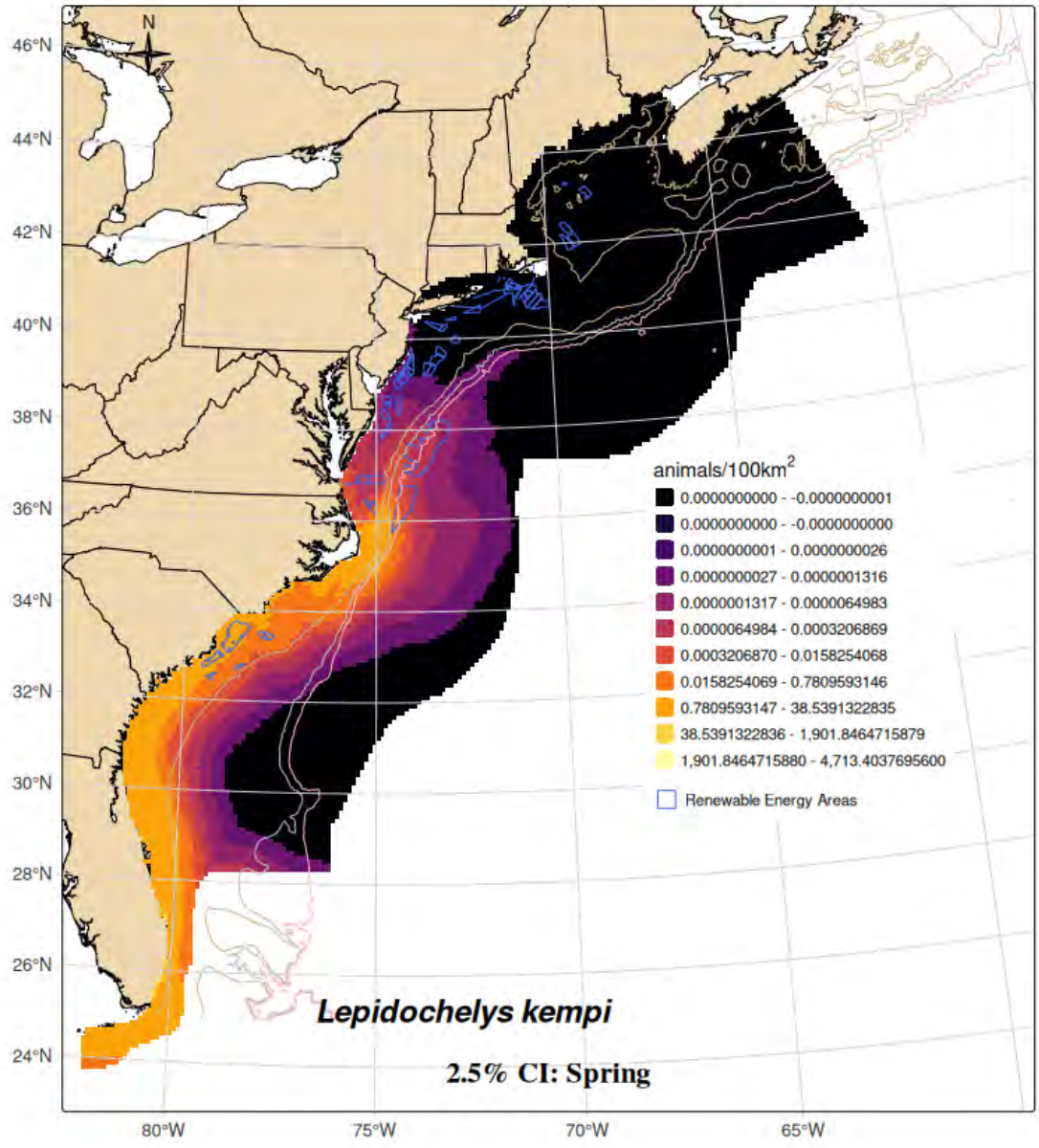

Figure D.5-7. Lower 2.5% confidence interval of the spring Kemp's ridley turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

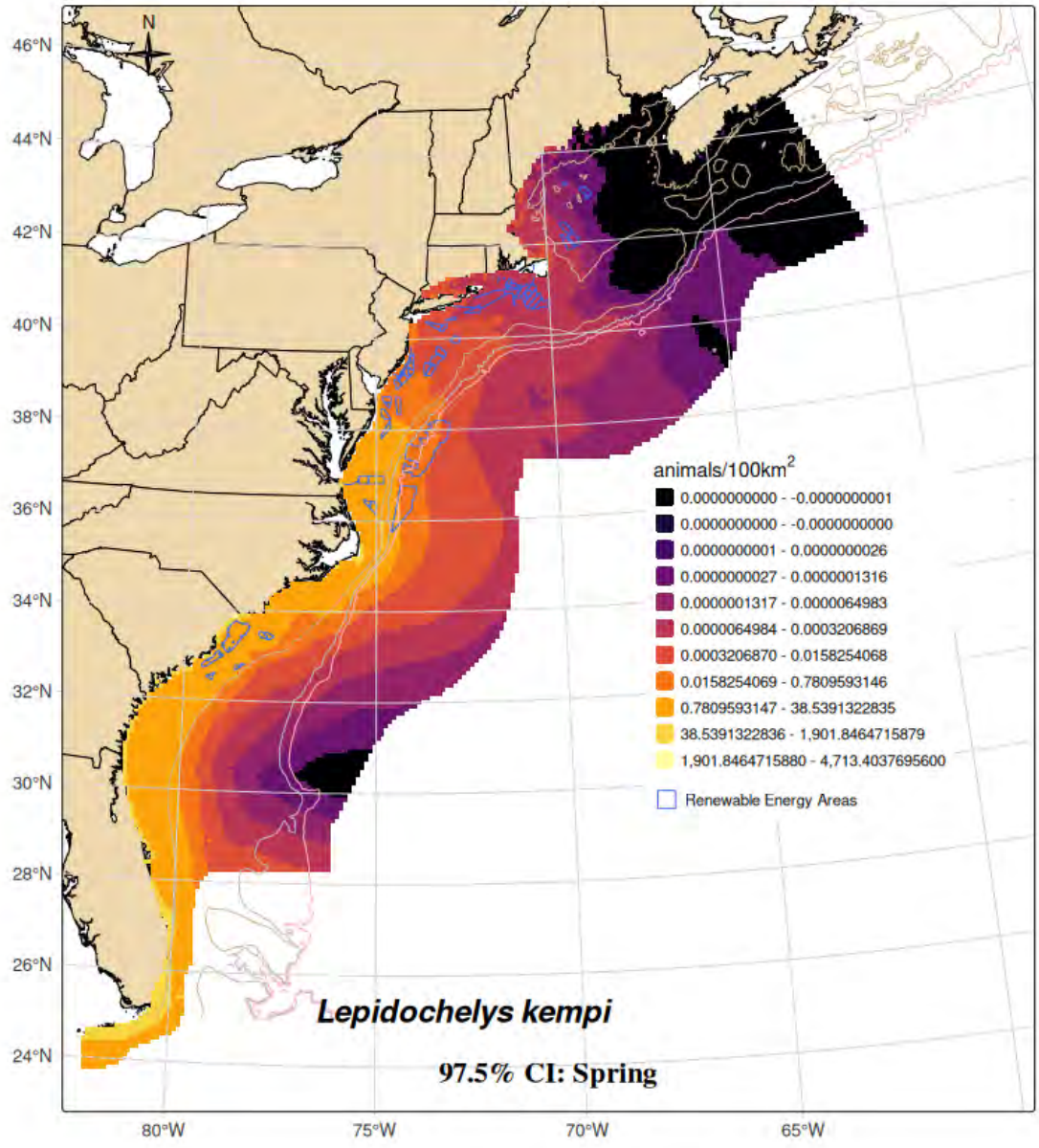

Figure D.5-8. Upper 97.5% confidence interval of the spring Kemp's ridley turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

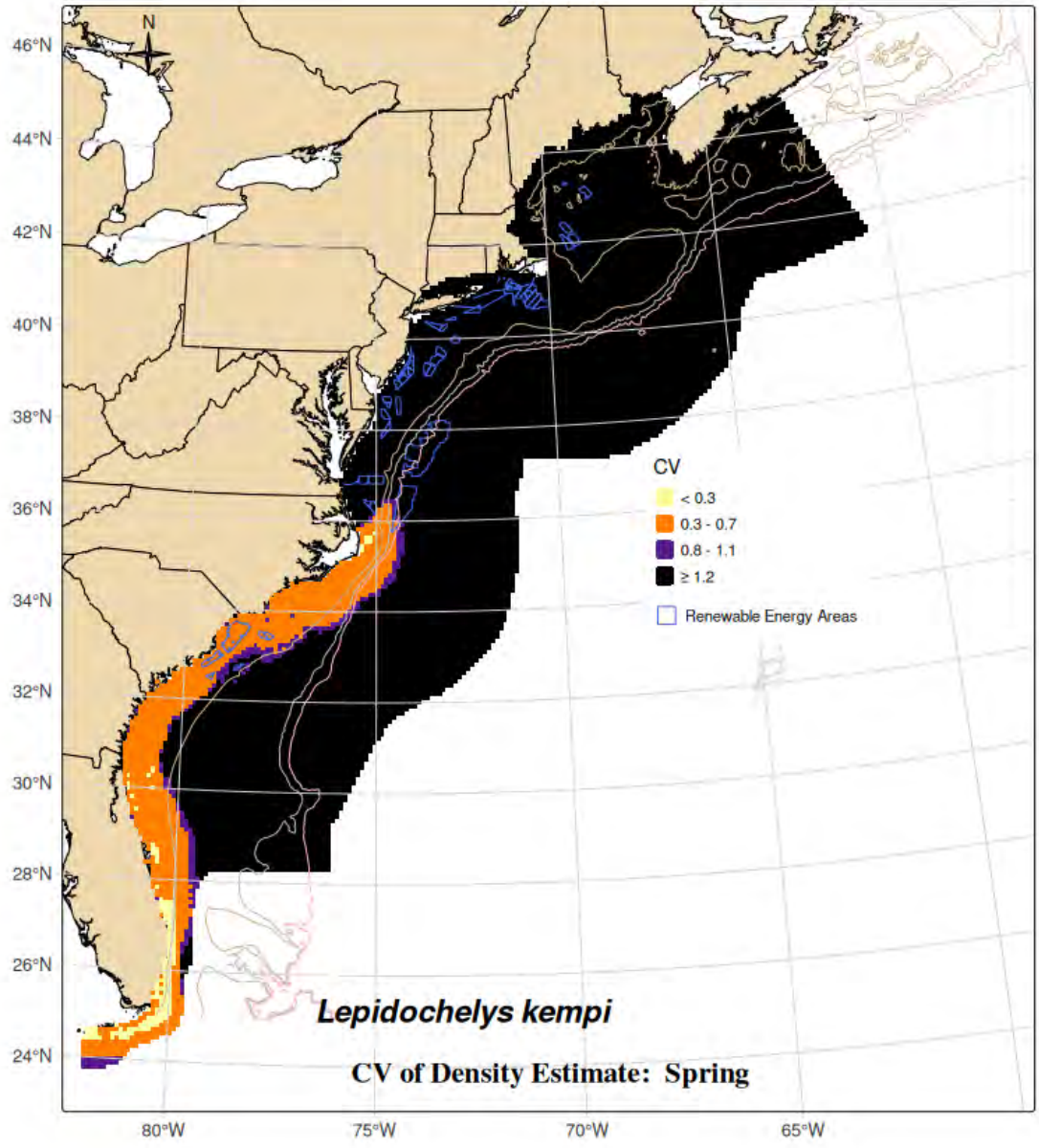

Figure D.5-9. CV of spring Kemp's ridley turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

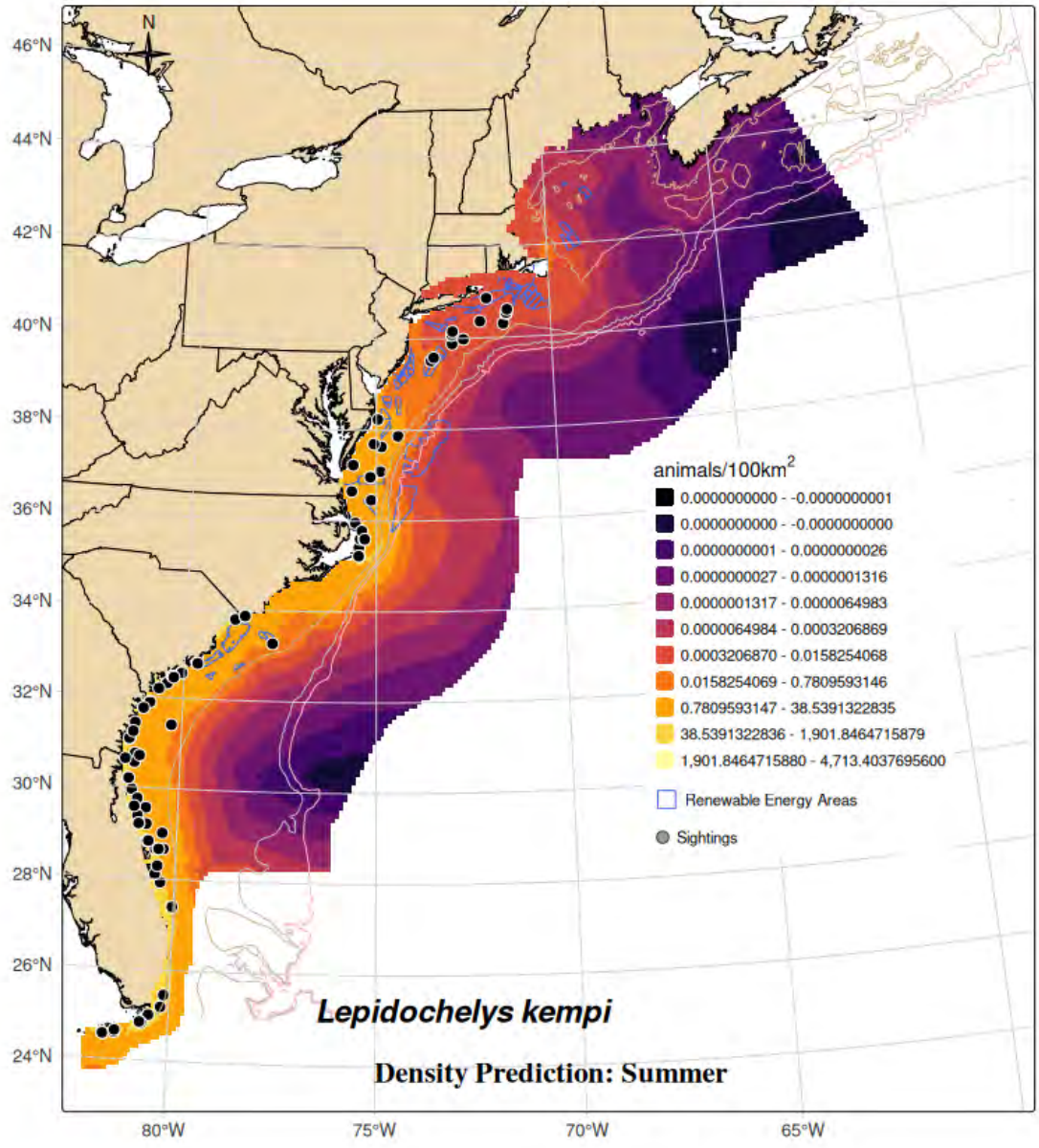

Figure D.5-10. Kemp's ridley turtle summer average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

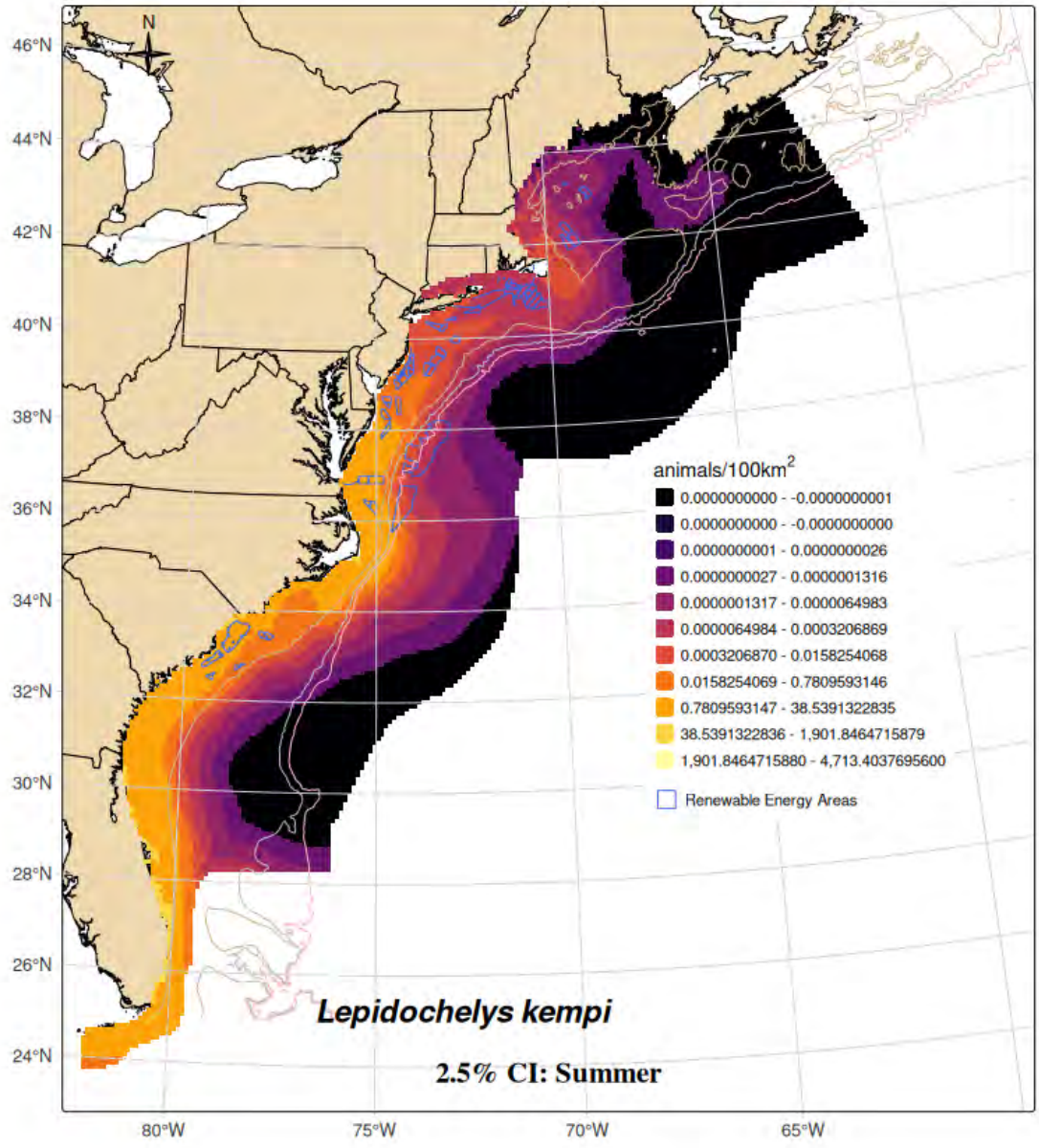

Figure D.5-11. Lower 2.5% confidence interval of the summer Kemp's ridley turtle density estimates

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.

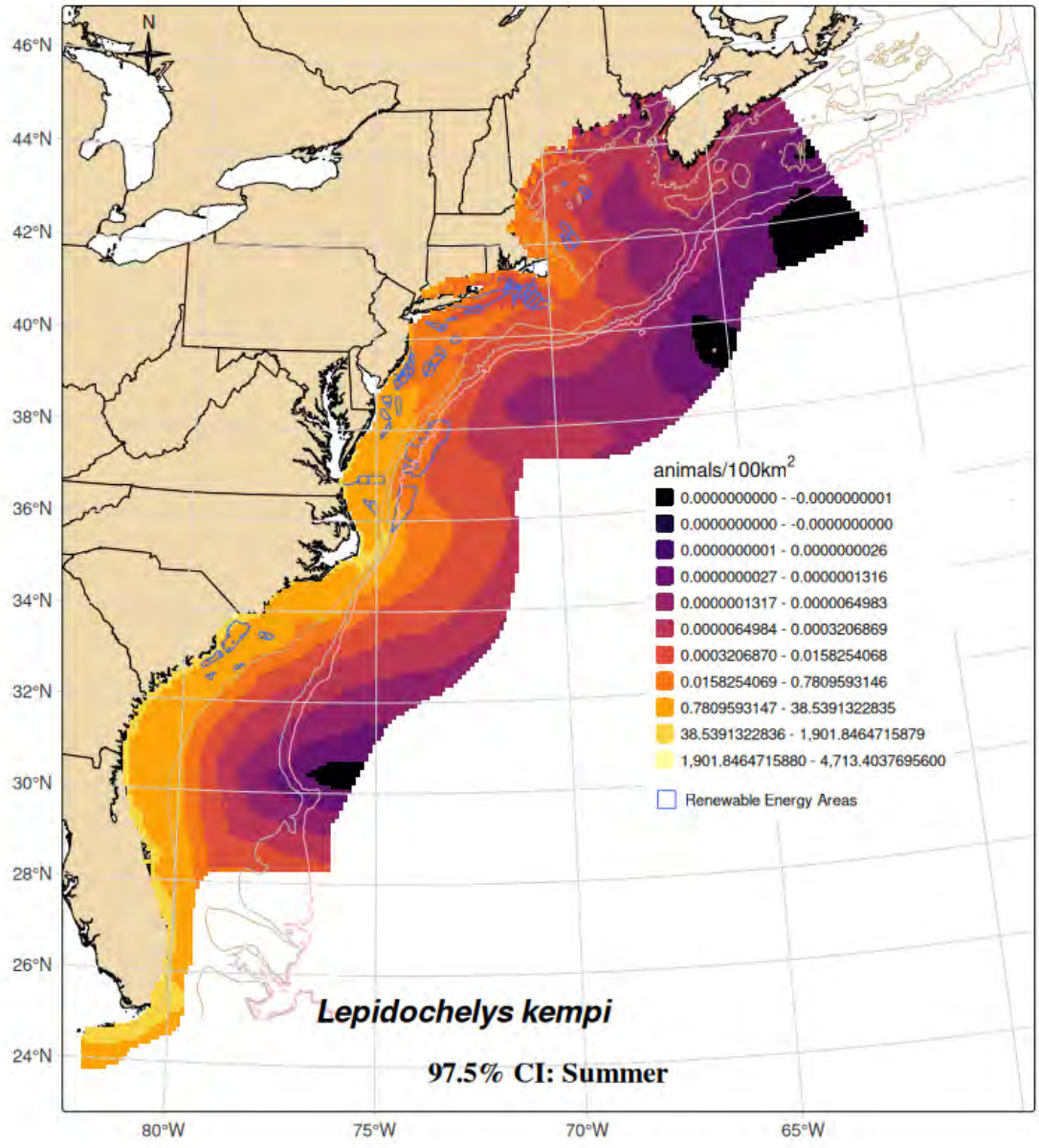

Figure D.5-12. Upper 97.5% confidence interval of the summer Kemp's ridley turtle density estimates

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.

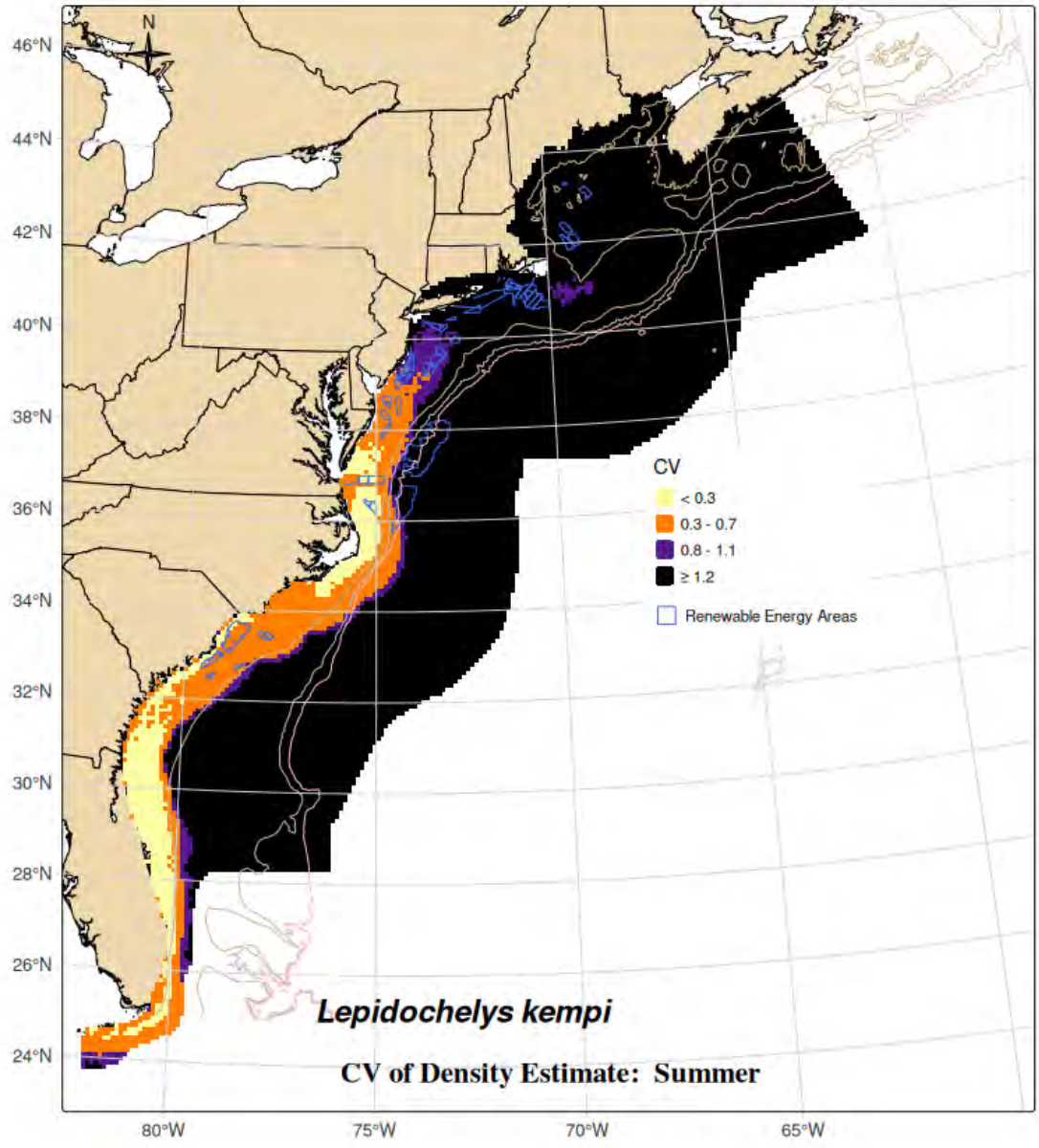

Figure D.5-13. CV of summer Kemp's ridley turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

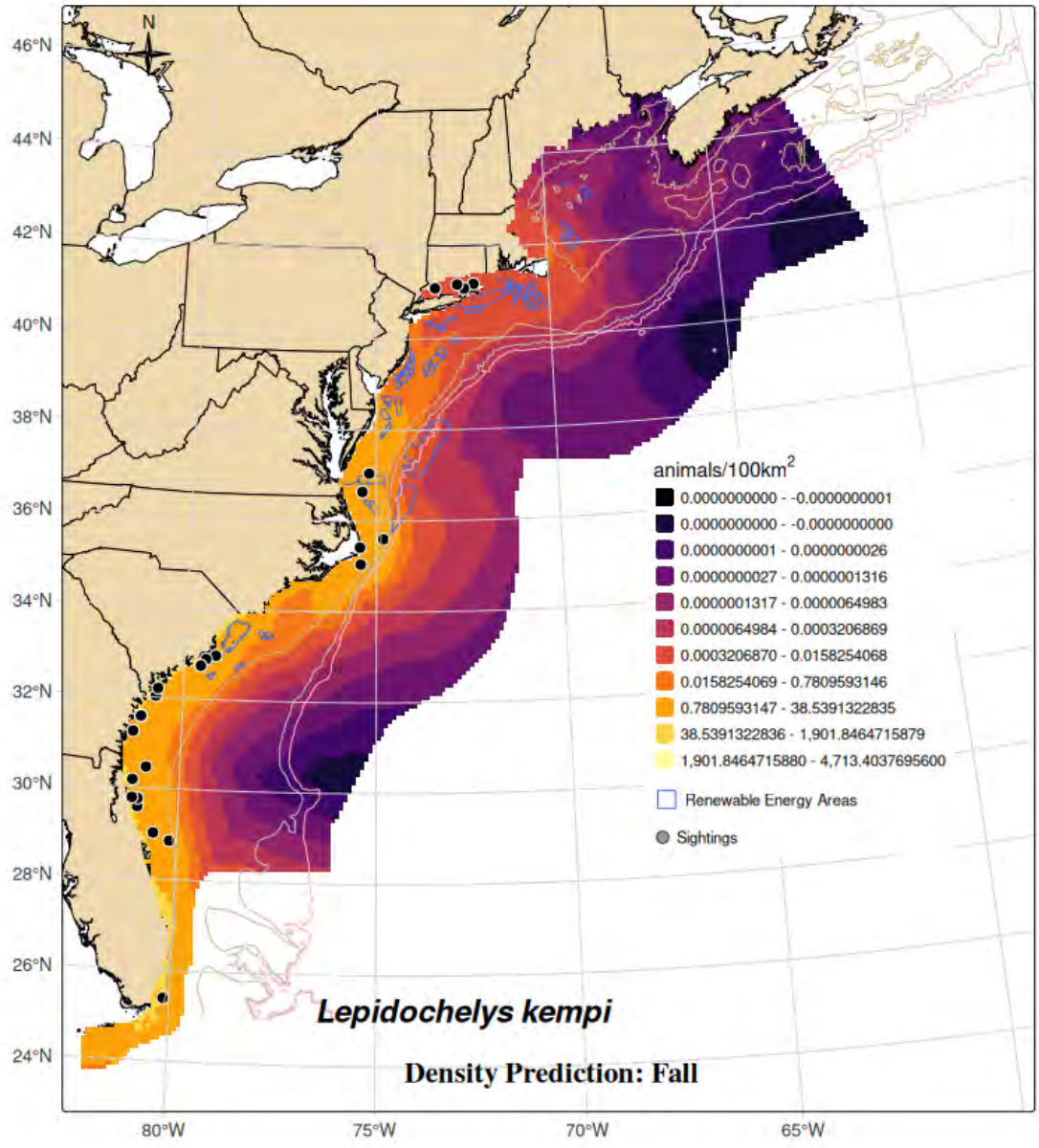

Figure D.5-14. Kemp's ridley turtle fall average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

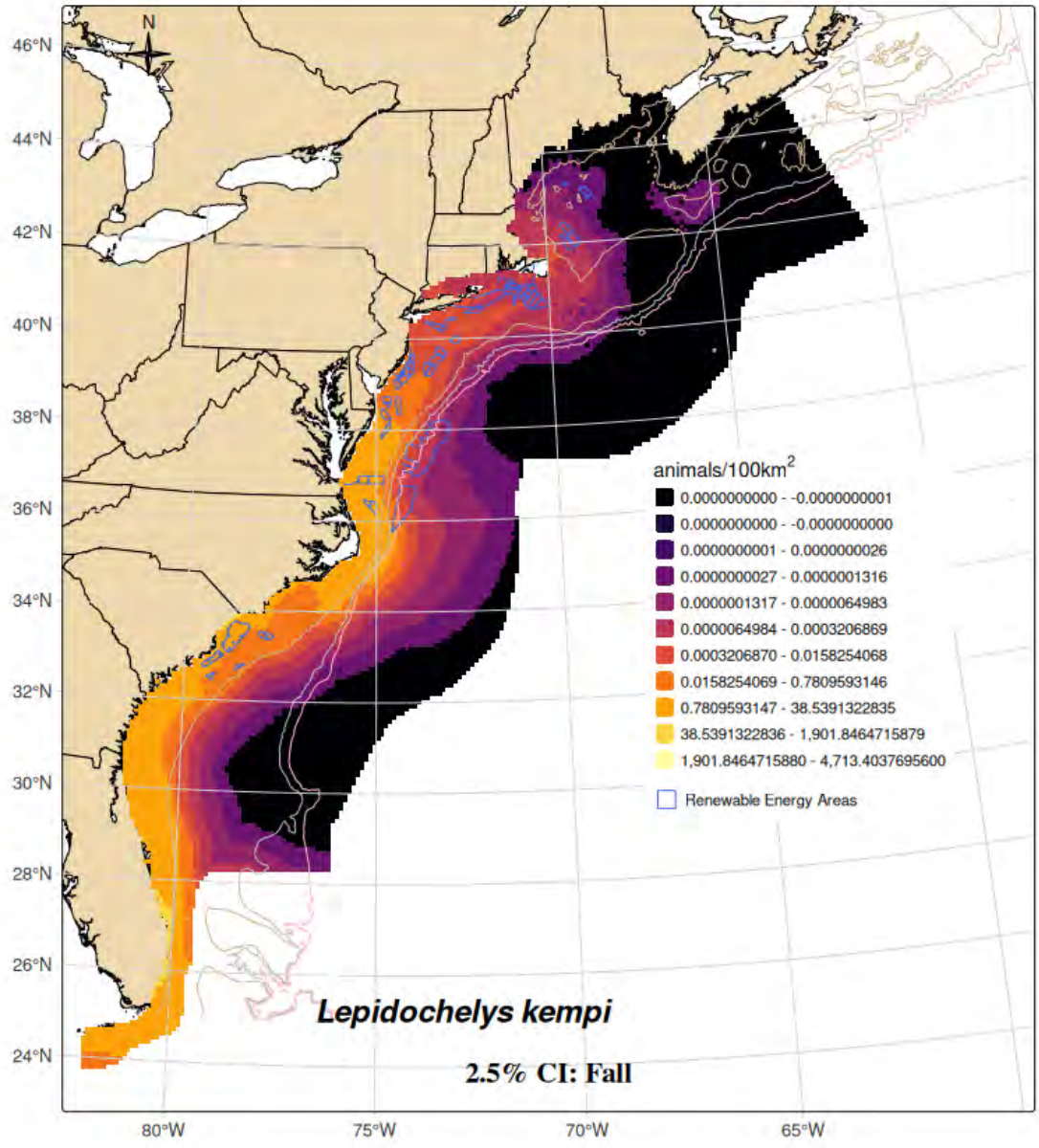

Figure D.5-15. Lower 2.5% confidence interval of the fall Kemp's ridley turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

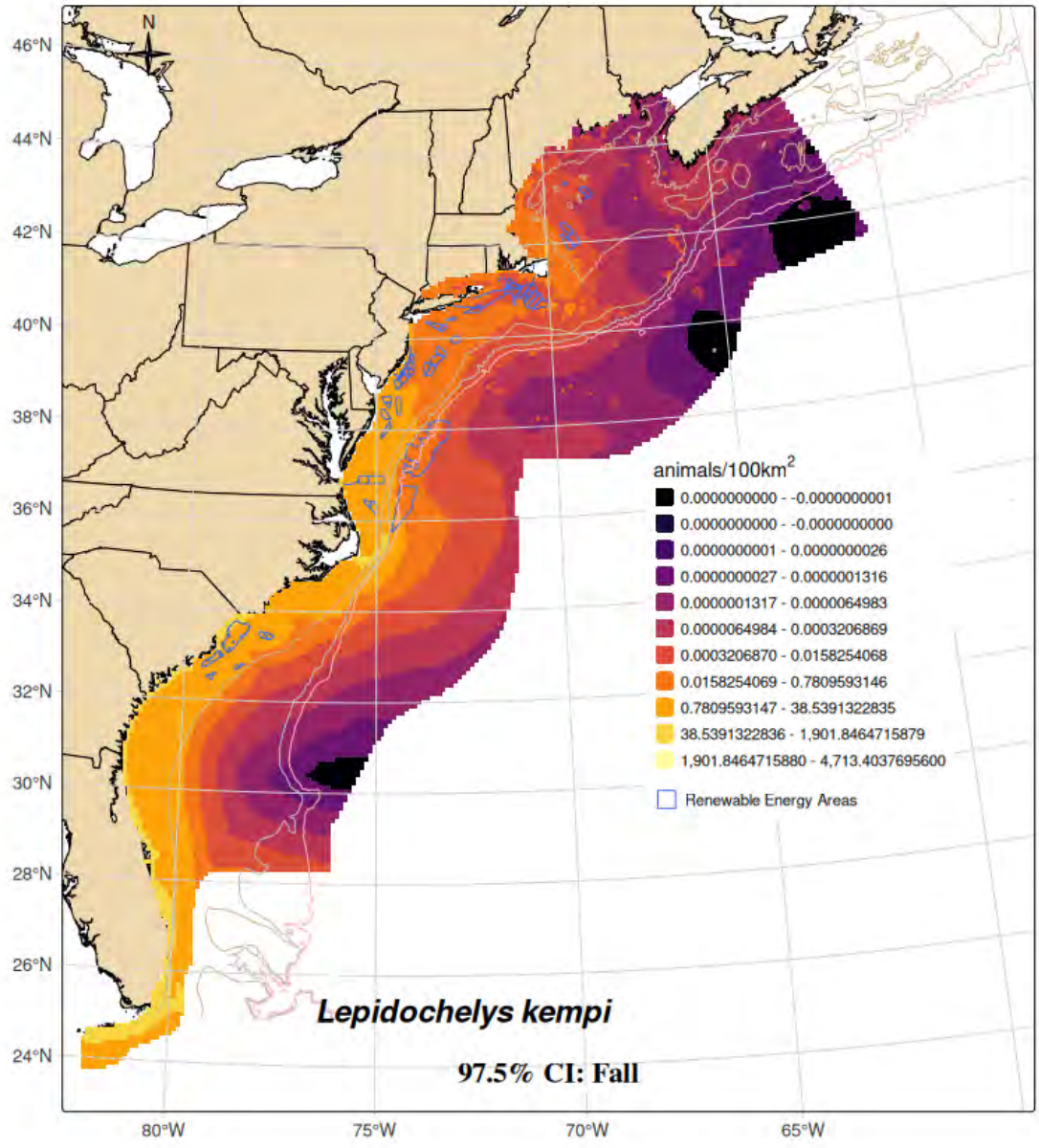

Figure D.5-16. Upper 97.5% confidence interval of the fall Kemp's ridley turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

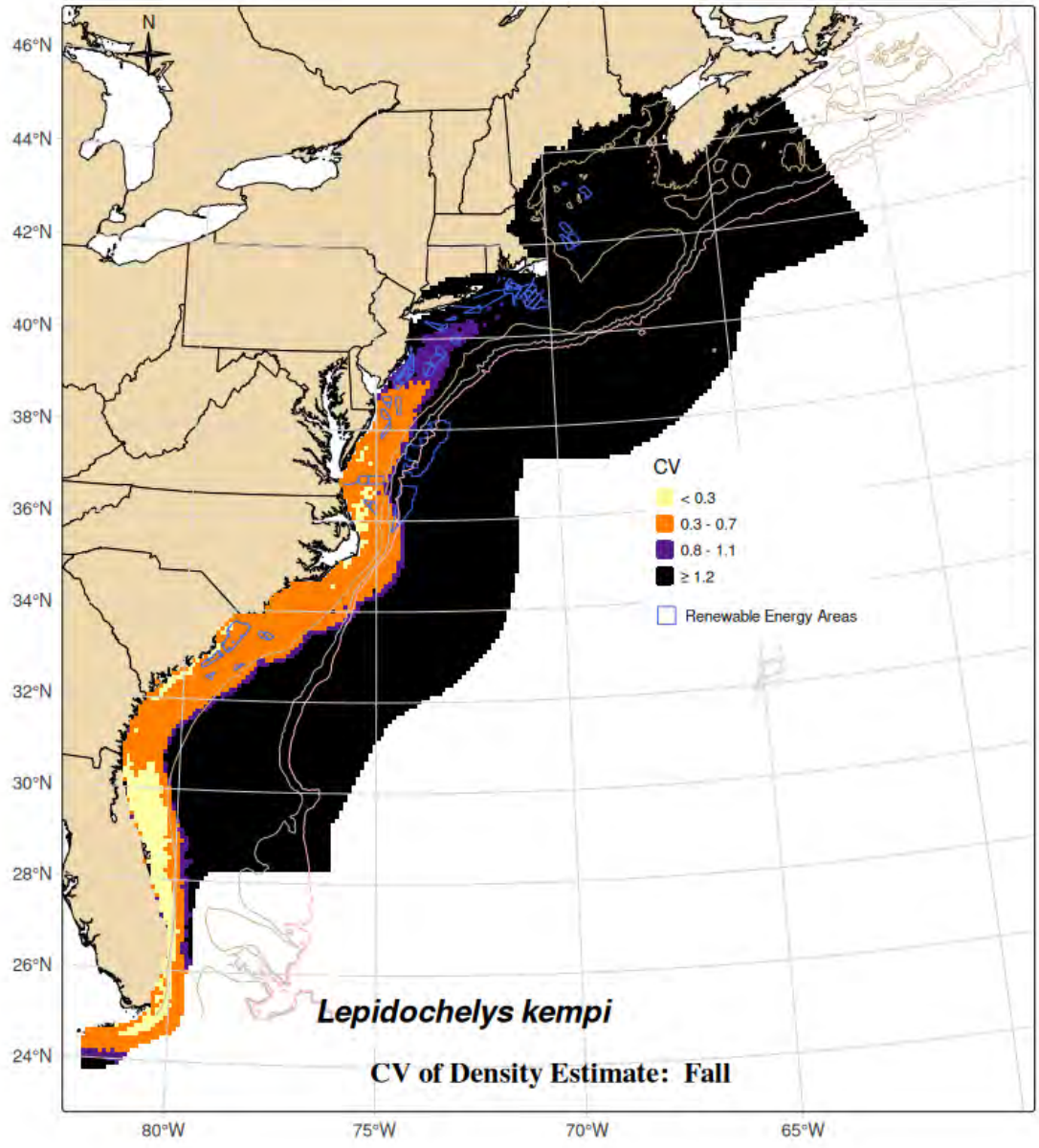

Figure D.5-17. CV of fall Kemp's ridley turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

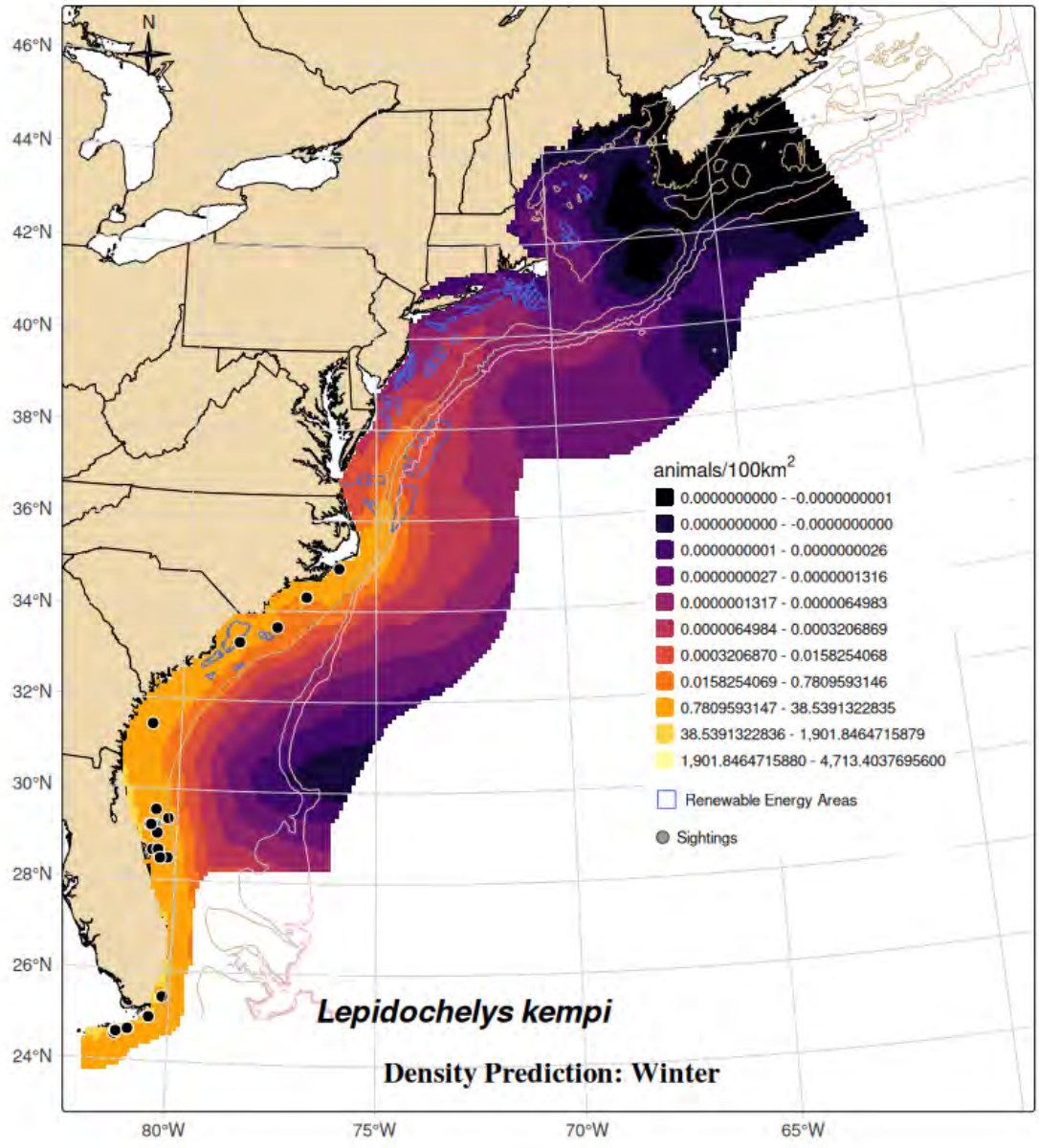

Figure D.5-18. Kemp's ridley turtle winter average density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Circles indicate locations of animal sightings. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

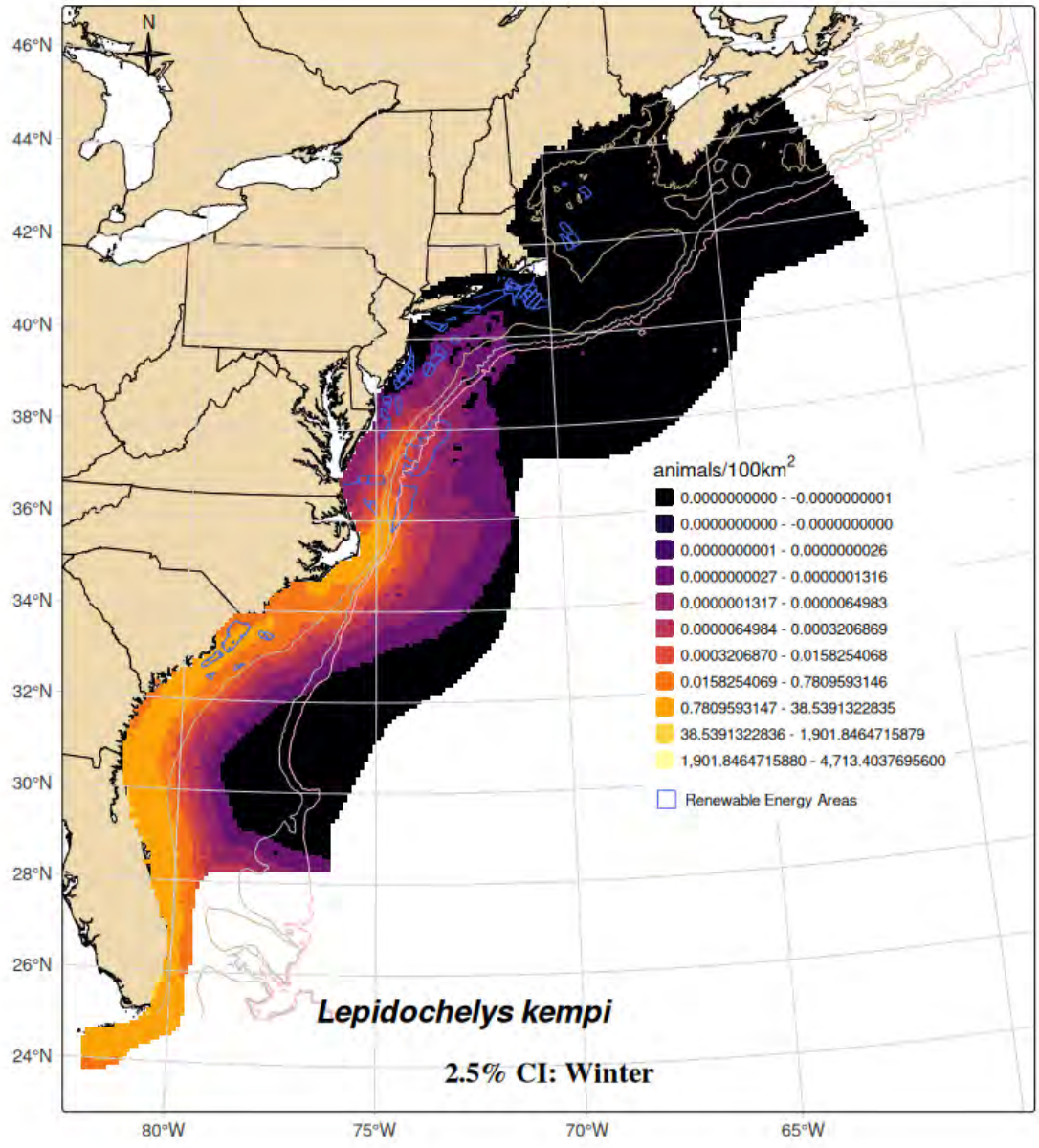

Figure D.5-19. Lower 2.5% confidence interval of the winter Kemp's ridley turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

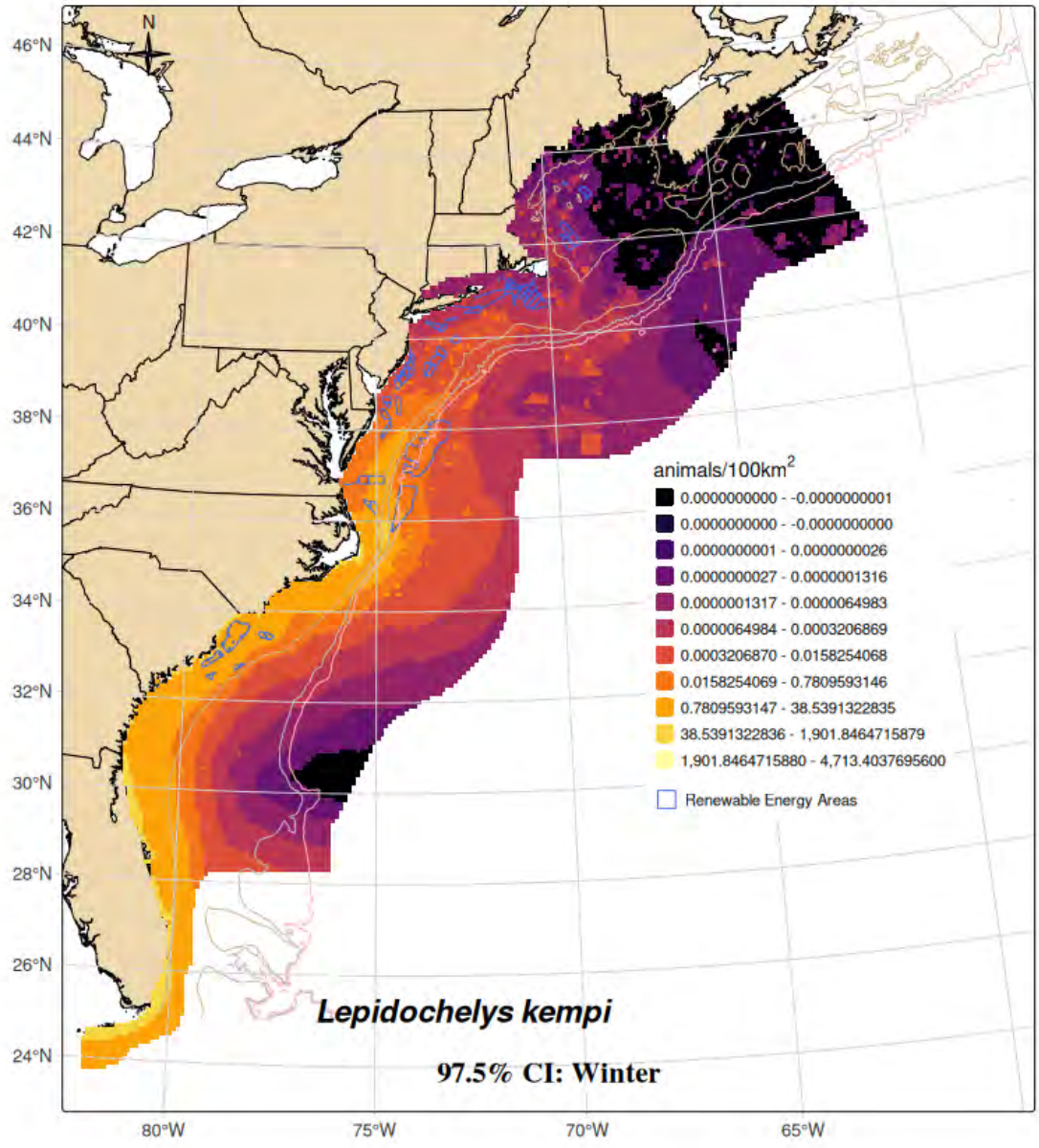

Figure D.5-20. Upper 97.5% confidence interval of the winter Kemp's ridley turtle density estimates
Densities are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

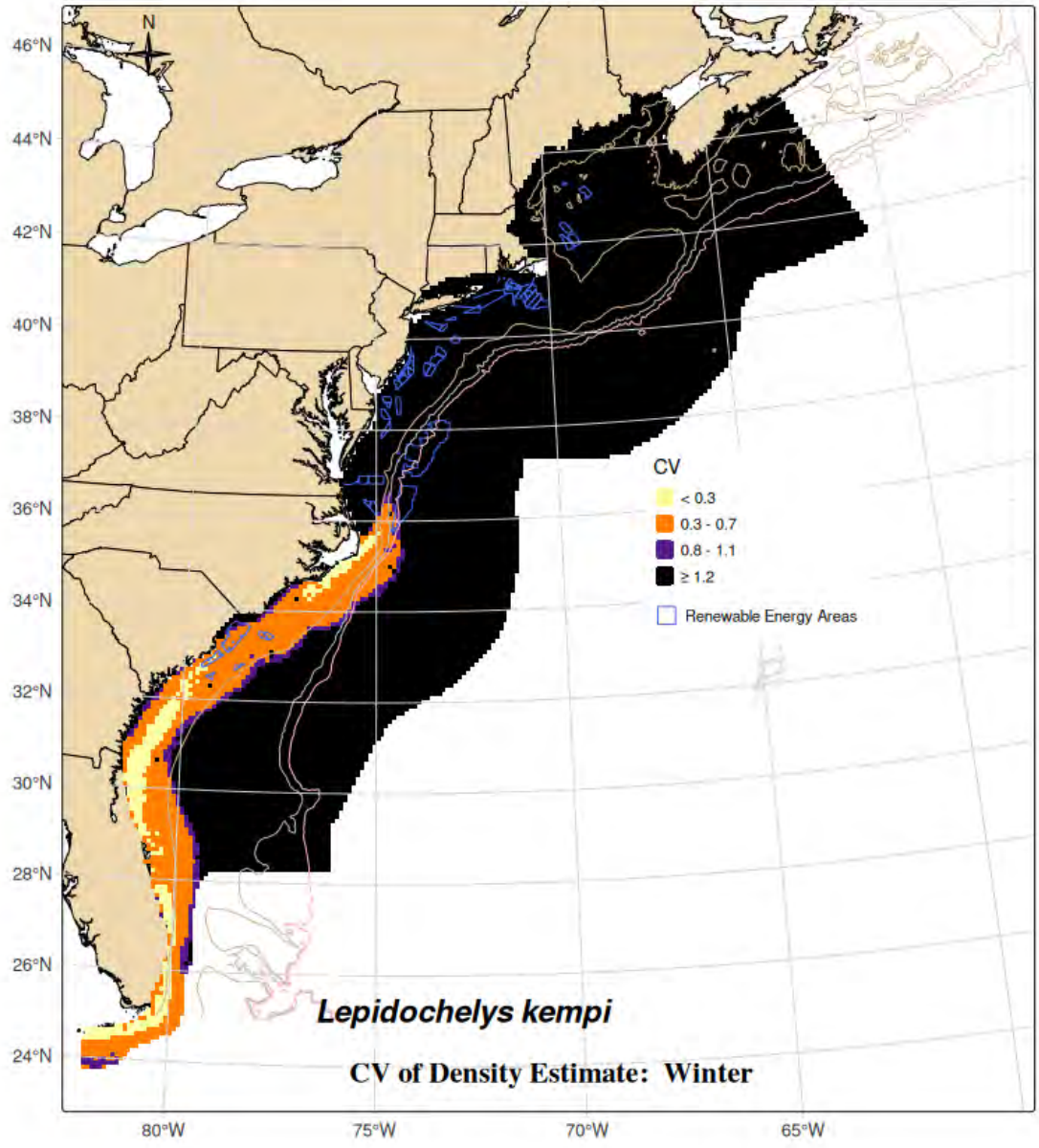

Figure D.5-21. CV of winter Kemp's ridley turtle density estimates
CV's are for grid cells of 10 km x 10 km with the exception of the coastal region. Tan, gray, and pink lines indicate the 100, 1,000 and 2,000 m depth contours. Blue polygons indicate locations of wind-energy study areas.

D.5.7 Offshore Energy Development Areas

Table D.5-6. Kemp's ridley turtle abundance estimates for wind-energy study areas

Season	Wind-Energy Study Area	Abundance*	CV	95% Confidence Interval*
Spring (Mar-May)	RI/MA	0	-	0 – 0
	NY	0	-	0 – 0
	NJ	0	-	0 – 3.8
	DE/MD	0	-	0 – 25.7
	VA	0.7	41.45	0 – 150
	NC	60.8	0.92	13 – 283.5
	NC/SC	749.9	0.47	312.9 – 1,797.5
	GA	118.9	0.47	49.1 – 287.7
	FL	161.1	0.31	88.8 – 292.2
Summer (Jun-Aug)	RI/MA	0.1	1.54	0 – 0.9
	NY	0.2	1.35	0 – 1.6
	NJ	11.1	0.80	2.8 – 43.8
	DE/MD	55.0	0.48	22.6 – 134.2
	VA	144.3	0.29	81.9 – 254.2
	NC	189.3	0.28	110 – 325.7
	NC/SC	1,514.3	0.32	818.8 – 2,800.5
	GA	286.0	0.31	157.2 – 520.4
	FL	218.5	0.35	112.4 – 424.7
Fall (Sep-Nov)	RI/MA	0.2	10.06	0 – 10.6
	NY	0.3	1.72	0 – 2.8
	NJ	10.8	0.98	2.2 – 54.3
	DE/MD	52.2	0.55	19.0 – 143.5
	VA	128.1	0.34	66.9 – 245.5
	NC	174.9	0.38	85.5 – 357.9
	NC/SC	1,083.1	0.37	538.7 – 2,177.8
	GA	176.5	0.36	88.3 – 352.9
	FL	190.1	0.38	92.7 – 389.9
Winter (Dec-Feb)	RI/MA	0	-	0 – 0.2
	NY	0	-	0 – 0.3
	NJ	0	-	0 – 2.3
	DE/MD	0	51.63	0 – 1.7
	VA	0.2	19.96	0 – 20.9
	NC	47.0	0.93	10 – 220.3
	NC/SC	659.4	0.45	283.9 – 1,531.6
	GA	47.2	0.67	14.2 – 156.5
	FL	114.4	0.34	59.8 – 218.8

***** 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.

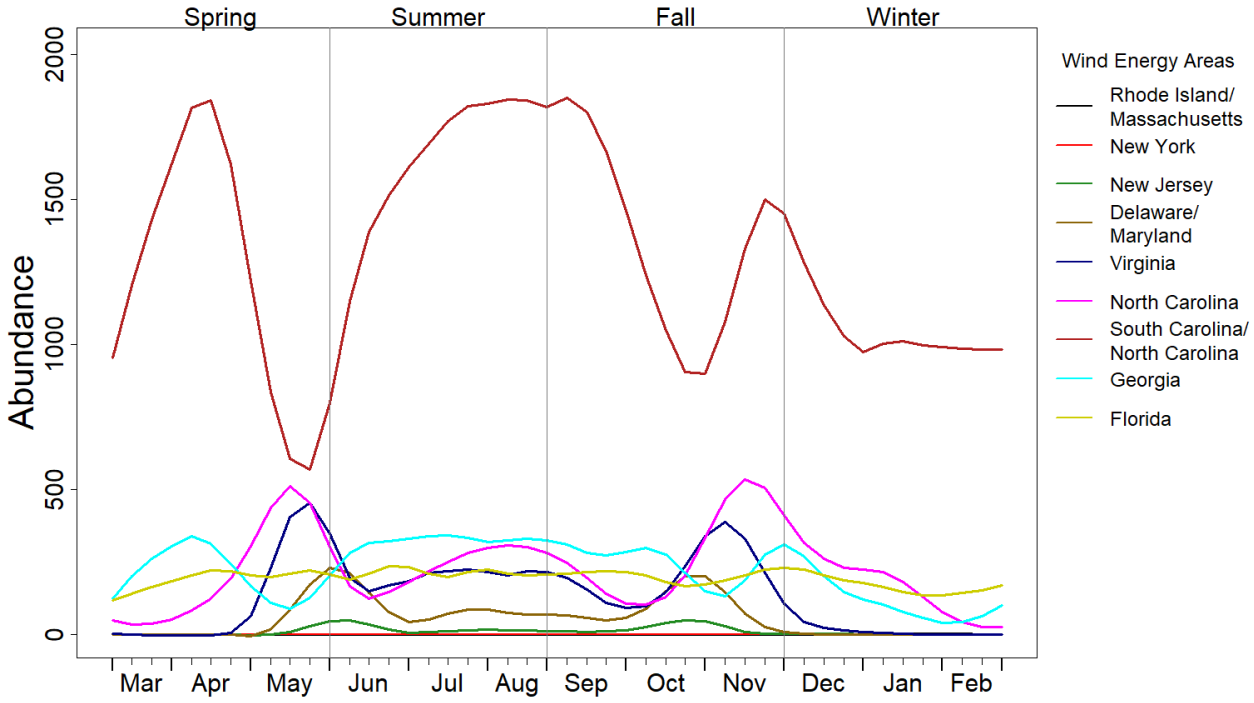

Figure D.5-22. Average seasonal abundance of Kemp's ridley turtle in the wind-energy study areas

D.6 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