



Northeast Fisheries Science Center Reference Document 22-02

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(*Tursiops truncatus truncatus*) Gillnet Bycatch
Estimates Along the U.S. Mid-Atlantic Coast,
2014-2018

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by Marjorie C. Lyssikatos¹

¹ NOAA Fisheries, Northeast Fisheries Science Center, 166 Water Street, Woods Hole, Massachusetts 02543, USA

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This report provides bycatch estimates, calculated using mortality and serious injuries combined, for 8 common bottlenose dolphins (*Tursiops truncatus*) assigned to 4 Atlantic coastal migratory and estuarine stocks. Fisheries observers documented incidental bycatch (takes) of dolphins during mid-Atlantic gillnet fishing operations from 2014-2018, estimates of which are documented in this report to support the U.S. Atlantic and Gulf of Mexico 2020 marine mammal stock assessment reports. These estimates provide an update to the Lyssikatos and Garrison (2018) report that covered mid-Atlantic gillnet fishing operations from 2011-2015.

Dolphin bycatch rates are estimated with both an annual ratio estimator (ARE) and a pooled ratio estimator (PRE). The ARE dolphin bycatch rate, by stock, is defined as the ratio of observed takes divided by the number of observed trips from within times and areas occupied by each stock. The PRE dolphin bycatch rate reflects the same data on observed takes and trips described above but combined over the 5-year period (2014-2018; Table 1). ARE and PRE bycatch rates for each stock are expanded by total annual effort (fishing trips) to estimate mean annual bycatch of dolphins attributed to mid-Atlantic gillnet fisheries. To minimize uncertainty, the final mean estimate of bycatch is the average of the 5-year mean mortality estimate from both the ARE and PRE methods weighted toward the method with the lowest coefficient of variation (Table 2). For additional details on the bycatch estimation, please refer to Lyssikatos and Garrison (2018). The bycatch estimation methodology does not differ from earlier years dating back to 2007.

The weighted mean annual maximum bycatch across years and methods (ARE and PRE) for 2014-2018 was 28.21 (CV=0.15) for the northern North Carolina (NN) estuarine stock, 19.51 (CV=0.14) for the northern migratory (NM) stock, and 16.33 (CV=0.23) for the southern migratory (SM) stock (Table 2). There were no observed takes for the regions occupied by the southern North Carolina (SN) estuarine stock; however, observer coverage was too low to detect a bycatch event (Figure 1). The maximum estimate is reported to address uncertainty in assigning observed takes to each of the 4 individual stocks (Lyssikatos and Garrison 2018).

Observer coverage, defined as the percentage of gillnet trips in which an observer was onboard the fishing vessel, averaged 2.17% across internal (bays, sounds, estuaries), state (0-5.6 km from shore, excluding internal waters), and federal (>5.6 km and <12-27 km from shore) water bodies within coastal bottlenose dolphin habitat (Table 3; Figure 2). Observer coverage in ocean-side waters only averaged 6.47%, ranging from a low of 3.57% in 2014 to a high of 9.82% in 2016 (Table 3). Total annual gillnet effort (trips) by water body was highest in internal waters (mean=20,269) and lowest in federal waters (mean=1,869). In contrast, observer coverage was highest in federal waters (mean=9.95%) and lowest in internal waters (mean=0.61%; Table 3). Observer coverage by stock region was highest for the NM region (mean=5.40%) and lowest in the SM region (mean=3.01%). Total gillnet fishing effort (trips) by stock was also highest in the NM stock region (mean=8,280) and lowest in SN stock (mean=606). Total gillnet trips declined between 2014 and 2016, peaked in 2017, and declined again in 2018. Observer coverage increased annually among all 4 stock regions between 2014 and 2016 followed by a decline in 2017 and 2018, except for the SN stock region (Figure 3).

The 2014-2018 mid-Atlantic bycatch estimates are based on 8 observed bycatch events (mortalities and serious injuries) that were assigned to stocks based on the time and location of the observed bycatch events (Tables 4 and 5). Five of the 8 takes occurred inside nearshore coastal regions adjacent to Dare, Hyde, Hatteras, and Carteret counties in North Carolina. The remaining 3 takes occurred in nearshore waters adjacent to Northampton County, Virginia, and Ocean County, New Jersey (Table 5; Figure 4). With the exception of November and December, takes were observed in all bimonthly time periods (Table 5). Five of the 8 takes occurred in small mesh

(<= 5") and 3 in medium mesh (>5" to <7") gillnet gear. Five of the 8 takes occurred in gillnets with soak durations <3 hours and 3 in gillnets with soak durations >=24 hours. Four of the 8 takes were observed in smooth (*Mustelis canis*) or spiny (*Squalus acanthias*) dogfish fisheries, 3 in Spanish mackerel (*Scomberomorus maculatus*), and 1 in southern kingfish (*Menticirrhus americanus*) fisheries (Table 4).

Two of the 8 observed takes were released alive, 1 in 2017 and 1 in 2018 (Table 4). Final determinations on the type of injuries sustained by the 2 animals released alive could not be determined. See Maze-Foley and Garrison (2020) for more details.

Out of the 8 observed takes, 5 were assigned to NN, 0 to SN, 2 to SM, and 5 to NM. Due to month and location of observed takes, 3 out of the 5 NM and 1 out of 5 NN were purely assigned to these stocks (i.e., they were assigned to only 1 stock; Table 5). From 2014-2018, stratum 7 had the most observed takes (4 dolphins), where the NN stock overlaps with NM stock between January and February and the SM stock between July and October. The remaining observed takes were taken in stratum 2 (2 dolphins), stratum 5 (1 dolphin), and stratum 12 (1 dolphin) (Table 5; Figure 2).

Overall, mean annual bycatch estimates per stock from 2014-2018 were higher than the 2011-2015 time period reported in Lyssikatos and Garrison (2018). This report documents the first minimum bycatch estimate for the NN stock arising from the 2018 observed take purely assigned to this stock (Table 4). From 2014-2018, the weighted mean annual maximum bycatch estimate for the NN stock is 362% of its potential biological removal (PBR). In contrast, both NM and SM stocks weighted mean annual maximum bycatch estimates are 41% and 71% of their PBR's, respectively. PBR is unknown for the SN stock. Stranding data will continue to be a useful indicator to detect fishery interactions with dolphins from the SN stock where observer coverage is too low to detect bycatch events.

TABLES AND FIGURES

Table 1. Annual ratio estimator (ARE) and pooled ratio estimator (PRE) maximum observed (Obs) bycatch, trips, and rates (coefficient of variation in parentheses) used to estimate total bycatch by stock (Northern Migratory [NM], Southern Migratory [SM], and Northern North Carolina Estuarine [NN]). NM and NN had 3 and 1 pure stock assignments (minimum estimate), respectively, not included in the table below.

Method	Year	NM			SM			NN		
		Obs Bycatch	Obs Trips	Bycatch Rate	Obs Bycatch	Obs Trips	Bycatch Rate	Obs Bycatch	Obs Trips	Bycatch Rate
ARE	2014	0	252		1	103	0.0097 (1.00)	1	181	0.0055 (1.00)
	2015	2	380	0.0053 (0.70)	0	112		1	184	0.0054 (1.00)
	2016	0	615		0	205		0	293	
	2017	2	540	0.0037 (0.70)	1	263	0.0038 (1.00)	2	322	0.0062 (0.70)
	2018	1	348	0.0029 (0.96)	0	91		1	122	0.0082 (0.95)
PRE	Total 2014-2018	5	2135	0.0023 (0.44)	2	774	0.0026 (0.72)	5	1102	0.0045 (0.47)

Table 2. For 2014-2018, the minimum and maximum mean gillnet bycatch and coefficient of variation (CV) by stock (NM = Northern Migratory, SM = Southern Migratory, NN = Northern North Carolina Estuarine) and method (ARE = annual ratio estimator, PRE = pooled ratio estimator). CI = 95% Confidence Interval, PBR = potential biological removal level (% is relative to weighted mean maximum mortality estimate). Minimum refers to pure stock identification, which is when observed bycaught animals were either genetically identified to be affiliated with 1 stock or were taken in a specific bimonthly regional stratum known to be occupied by only 1 stock. Maximum refers to pure stock identification plus mixed stock identification, which is when observed bycaught animals were taken in bimonthly regions occupied by more than 1 stock.

	NM				SM				NN			
	Min		Max		Min		Max		Min		Max	
Year	ARE	PRE	ARE	PRE	ARE	PRE	ARE	PRE	ARE	PRE	ARE	PRE
2014	0.00 (NA)	13.21 (0.57)	0.00 (NA)	22.03 (0.44)	0.00 (NA)	0.00 (NA)	64.35 (1.00)	17.13 (0.72)	0.00 (NA)	6.06 (1.05)	36.89 (1.00)	30.30 (0.47)
2015	18.32 (1.03)	9.78 (0.57)	36.65 (0.70)	16.31 (0.44)	0.00 (NA)	0.00 (NA)	0.00 (NA)	10.71 (0.72)	0.00 (NA)	4.32 (1.05)	25.88 (1.00)	21.61 (0.47)
2016	0.00 (NA)	9.25 (0.57)	0.00 (NA)	15.42 (0.44)	0.00 (NA)	0.00 (NA)	0.00 (NA)	8.46 (0.72)	0.00 (NA)	3.44 (1.05)	0.00 (NA)	17.19 (0.47)
2017	19.86 (1.03)	15.07 (0.57)	39.73 (0.70)	25.12 (0.44)	0.00 (NA)	0.00 (NA)	33.87 (1.00)	23.02 (0.72)	0.00 (NA)	7.52 (1.05)	51.49 (0.70)	37.61 (0.47)
2018	22.27 (0.96)	10.89 (0.57)	22.27 (0.96)	18.15 (0.44)	0.00 (NA)	0.00 (NA)	0.00 (NA)	14.71 (0.72)	45.61 (0.95)	5.05 (1.05)	45.61 (0.95)	25.25 (0.47)
Mean	12.09 (0.58)	11.64 (0.26)	19.73 (0.44)	19.41 (0.20)	0.00 (NA)	0.00 (NA)	19.64 (0.74)	14.81 (0.34)	9.12 (0.95)	5.28 (0.49)	31.97 (0.45)	26.39 (0.22)
Weighted Mean Mortality Estimate	11.78 CV=0.18 95% CI = 7.64-15.92		19.51 CV=0.14 95% CI = 14.24-24.77		0.00 CV=NA 95% CI = NA		16.33 CV=0.23 95% CI=8.86-23.80		6.58 CV = 0.32 95% CI = 2.43-10.73		28.21 CV = 0.15 95% CI = 20.09-36.32	
PBR	48 (weighted mean maximum mortality estimate is 41% PBR)				24 (weighted mean maximum mortality estimate is 68% PBR)				7.8 (weighted mean maximum mortality estimate is 362% PBR)			

Table 3. Summary table of total and observed gillnet trips by year and water body. Mean annual calculations are shown for years 2014-2018. Water bodies considered part of coastal bottlenose dolphin (*Tursiops truncatus*) habitat: Internal = bays, sounds, and estuaries; State = 0-5.6 km from shore (excludes internal waters); Federal (Fed) = >5.6 km from shore and within bottlenose dolphin habitat (<12-27 km from shore; Figure 1).

Year	Water Body	Total Trips	Observed Trips	Coverage (%)	Coastal (State & Fed) Coverage only
2014	Internal	24039	44	0.18	
	State	7042	216	3.07	
	Fed	2237	115	5.14	
	Total	33318	375	1.13	
2015	Internal	18144	128	0.71	
	State	5696	270	4.74	
	Fed	1744	149	8.54	
	Total	25584	547	2.14	
2016	Internal	16015	166	1.04	
	State	5370	445	8.29	
	Fed	2064	285	13.81	
	Total	23449	896	3.82	
2017	Internal	24803	265	1.07	
	State	5751	313	5.44	
	Fed	1664	202	12.14	
	Total	32218	780	2.42	
2018	Internal	18345	13	0.07	
	State	4827	235	4.87	
	Fed	1636	179	10.94	
	Total	24808	427	1.72	
Five Year Mean 2014-2018	Internal	20269	123	0.61	
	State	5737	296	5.16	
	Fed	1869	186	9.95	
	Total	27875	605	2.17	

Table 4. Descriptive characteristics for observed takes of coastal bottlenose dolphin (*Tursiops truncatus truncatus*) from 2014-2018.

Key ¹	Yr	Mo	Obs Prog ²	Target Species	NEFSC Tag Number	Sample status ³	Stock (O/C) ⁴	State	County	Depth (m)	Coastal Habitat	Mesh Size (inches)	Soak Time (hrs)	Twine Size (mm)	String Length (feet)	Stock ID	Stratum # ¹	Comments
v	2014	9	SE	Spanish Mackerel (<i>Scomberomorus maculatus</i>)	no tag	NA	unk	NC	Hyde	11.5	state	3.3	2.1	0.52	900	SM or NN	7	released dead-distance from shore = 0.9km
w	2015	1	NE	Spiny Dogfish (<i>Squalus acanthius</i>)	DO-5666	C	tbd	NC	Hatteras	3.6	state	5.8	2.5	0.81	900	NM or NN	7	released dead-distance from shore = 0.23km
x	2015	8	NE	Smooth Dogfish (<i>Mustelus canis</i>)	no tag	NA	unk	NJ	Ocean	21.9	state	6.0	24.0	0.90	300	NM	2	released dead-distance from shore = 5.4km
y	2017	2	NE	Southern Kingfish (<i>Menticirrhus americanus</i>)	released alive	NA	unk	NC	Dare	9.1	state	2.5	1.9	unk	1200	NM or NN	7	injury determination could not be determined; distance from shore = 1.8km
z	2017	7	NE	Spanish Mackerel (<i>Scomberomorus maculatus</i>)	no tag	NA	unk	NC	Dare	3.7	state	3.1	0.4	0.47	990	SM or NN	7 or 8	no lat-lon, debrief notes-very close to shore, training trip
aa	2017	10	NE	Smooth Dogfish (<i>Mustelus canis</i>)	no tag	NA	unk	NJ	Ocean	57.0	state	6.0	25.0	unk	2000	NM	2	released dead-distance from shore = 0.74km
ab	2018	4	NE	Spiny Dogfish (<i>Squalus acanthius</i>)	DOA-0670	C	tbd	VA	Northampton	14.6	federal	5.0	24.0	0.90	920	NM	5	released dead-distance from shore = 14.4km
ac	2018	5	NE	Spanish Mackerel (<i>Scomberomorus maculatus</i>)	released alive	NA	unk	NC	Carteret	7.3	state	3.3	0.9	0.52	600	NN	12	injury determination could not be determined; distance from shore = 7.4km

¹ Key letter and stratum number correspond with ArcMap shapefiles that delineate temporal and spatial habitat regions occupied by coastal bottlenose dolphins (see Table 1 and Figure 1)

² Takes observed by the Southeast (SE) or Northeast (NE) observer program

³ Sample status NA = no sample was collected; C = collected

⁴ Stock = Offshore (O) or Coastal (C) determined by genetic analysis. If no sample collected, then stock affiliation cannot be confirmed by genetic analysis. All unknowns (unk) are presumed to be coastal animals based on the time of year

(i.e., month) and location of take (i.e., region). TBD = to be determined
⁵Wenzel et al. 2015.

Table 5. Matrix depicting temporal and spatial distribution and overlap of 4 coastal bottlenose dolphin (*Tursiops truncatus*) stocks (NM = gray, SM = pink, NN = blue, SN = yellow, stock overlap = cross-hatched) based on bimonthly periods and 16 geographic regions (Figure 1). The 16 strata were developed using telemetry, biopsy, and stable isotope data (Waring et al. 2016). Labels ‘v’ through ‘ac’ identify specific gillnet takes described in Table 3 that were observed between 2014 and 2018 and shown in Figure 2.

Geographic Region	Stratum Type	Stratum No.	Jan/ Feb	Mar/ Apr	May/ Jun	Jul/ Aug	Sep/ Oct	Nov/ Dec
Delaware	Estuary (Delaware Bay)	1						
New Jersey, Delaware, Maryland	Coastal & Offshore	2				x	aa	
Maryland & Virginia	Estuary (Chesapeake Bay)	3						
Virginia & North Carolina	Coastal	4						
Virginia & North Carolina	Offshore	5		ab				
North Carolina	Estuary (Pamlico Sound)	6						
North Carolina – Dare & Hyde Counties	Coastal	7	w,y					
						z	v	
	w,y			z	v			
	Offshore	8						
						z		
North Carolina – Carteret County	Coastal	9						
	Offshore	10						
North Carolina – Onslow County	Estuary (Bogue Sound & New River)	11						
	Coastal	12			ac			
	Offshore	13						
North Carolina – Pender, New Hanover, Brunswick Counties	Estuary (Cape Fear River)	14						
	Coastal	15						
	Offshore	16						

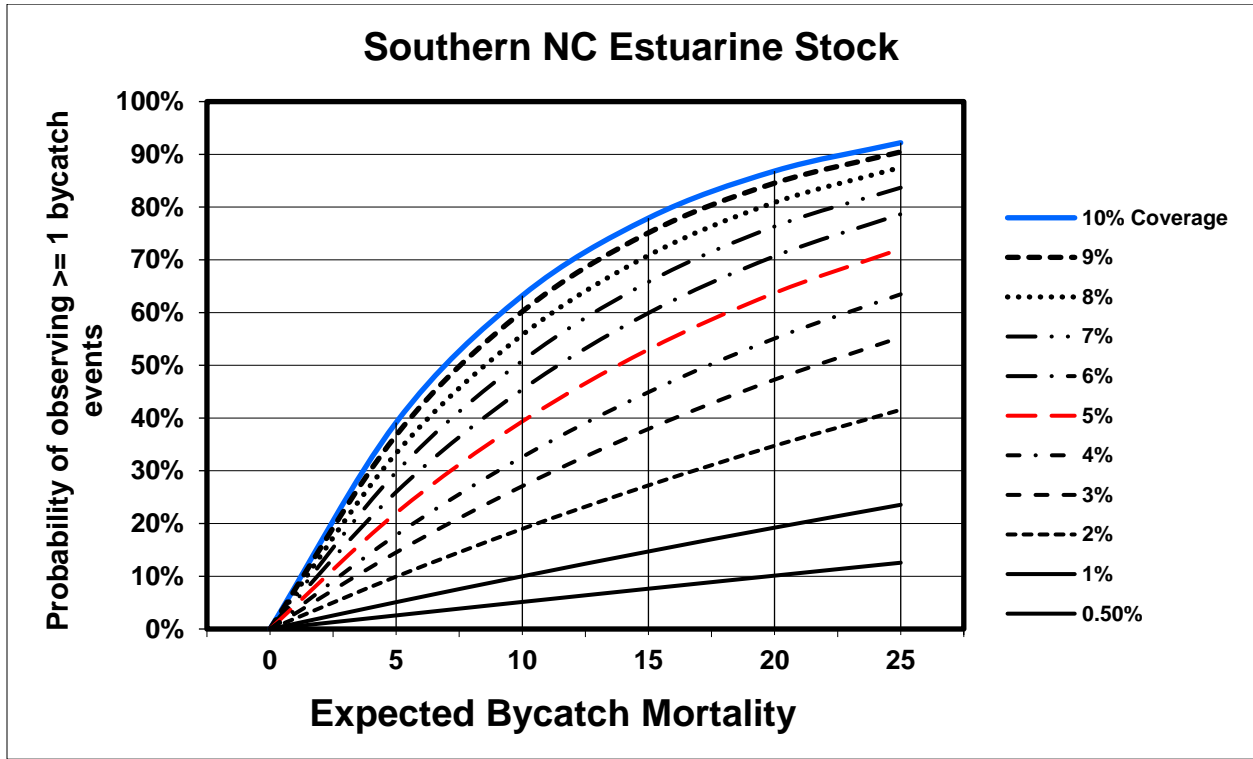


Figure 1. Probability of observing at least 1 bycatch event in the habitat occupied by southern North Carolina (SN) estuarine animals as a function of 2018 effort (385 trips) from the SN stock range (excluding North Carolina (NC) internal waters), expected bycatch estimates, and varying levels of observer coverage.

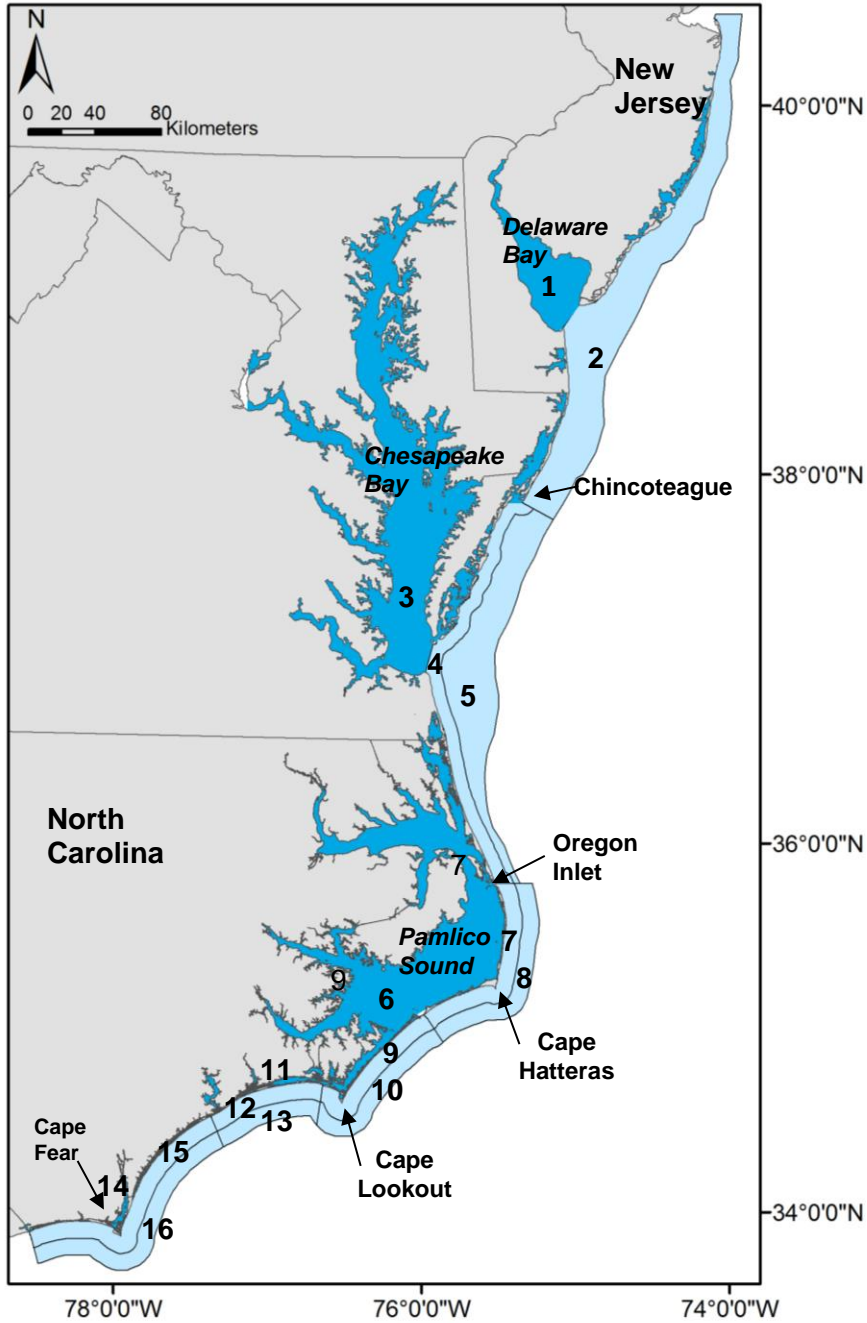


Figure 2. Range of coastal bottlenose dolphin (*Tursiops truncatus*) habitat from New Jersey to North Carolina, including estuarine (royal blue) and ocean waters (light blue). The range is divided into 16

geographic regions (see Table 5) where dolphins are assigned to stock(s) based on bimonthly periods. Note: for visual purposes, the ocean regions directly adjacent to shore south of Chincoteague, VA, were artificially stretched to 10 km-wide from 3 km south of the Oregon Inlet and 1 km north of the Oregon Inlet so they could be seen on the map.

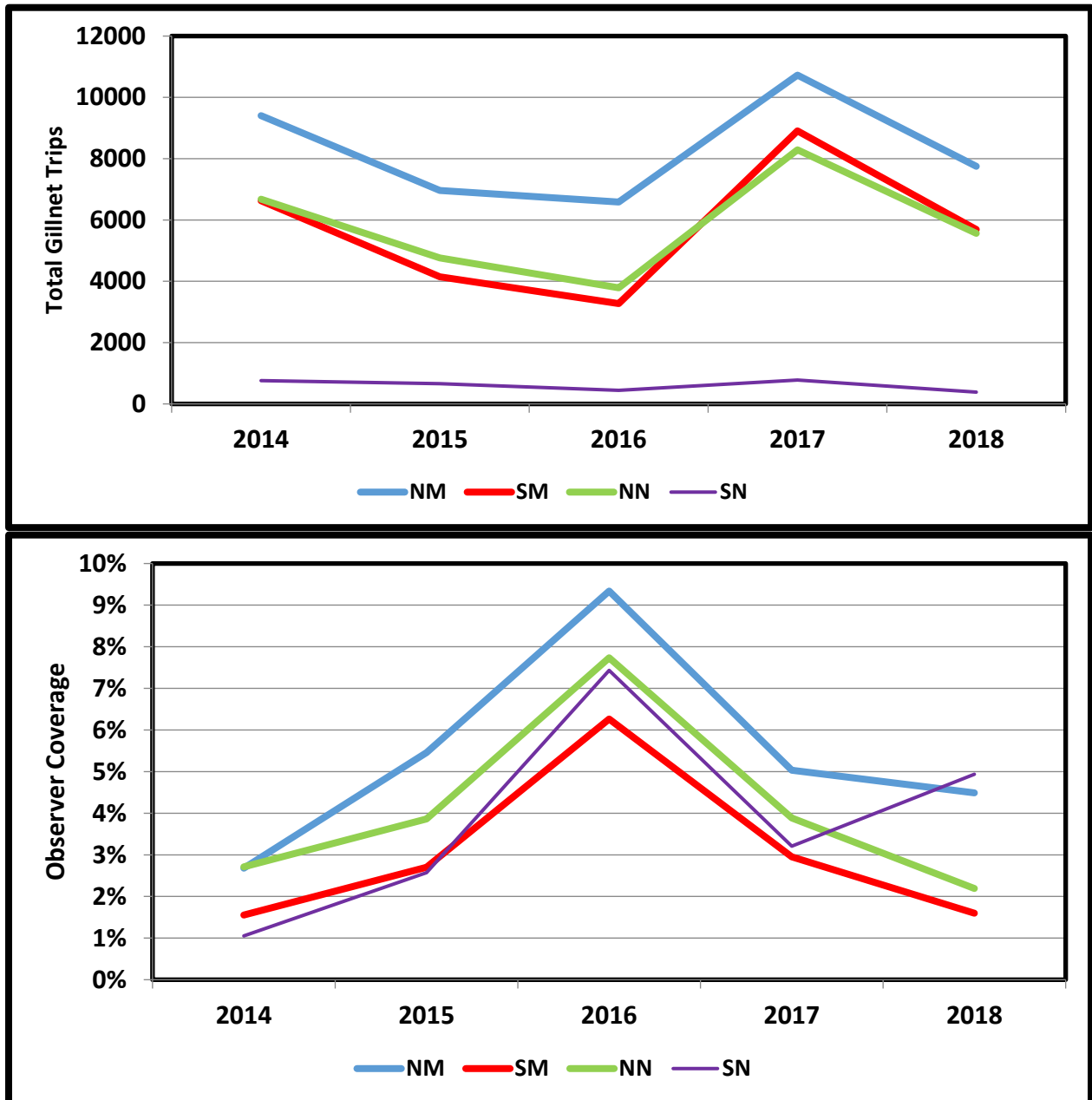


Figure 3. Annual total commercial gillnet fishing trips (top) and percent observer coverage (bottom) from 2014-2018 by stock (NM = northern migratory, SM = southern migratory, NN = northern North Carolina estuarine, SN = southern North Carolina estuarine), excluding North Carolina estuarine waters (Figure 1).

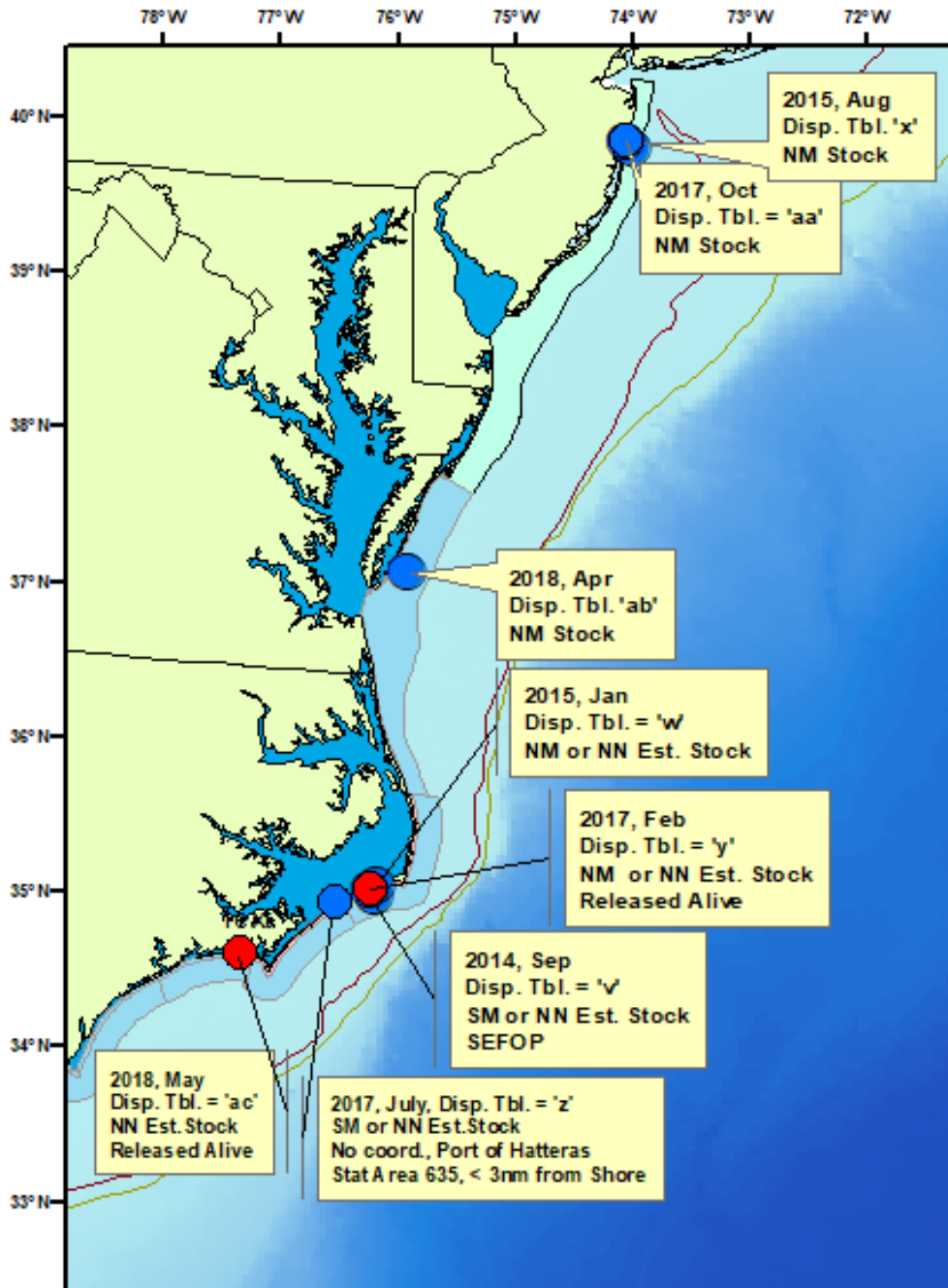


Figure 4. Spatial distribution of incidental common bottlenose dolphin (*Tursiops truncatus truncatus*) takes, their disposition, and their stock assignments (see Table 4) observed by the Northeast Fisheries Observer Program from 2014-2018.

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