



# Cape Lookout National Seashore Sea Turtle Monitoring and Management Program

*2018 Annual Report*



**ON THE COVER**

Loggerhead hatchlings emerge from a nest at Cape Lookout National Seashore.  
Photography by NPS

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*2018 Annual Report*

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# Abstract

Cape Lookout National Seashore (Seashore), located on the southern Outer Banks of North Carolina from Ocracoke Inlet to Beaufort Inlet, contains many ecologically important habitats including those that support threatened and endangered sea turtle species. Sea turtle nesting activity is monitored annually from May through September. In 2018, 169 nests (159 loggerhead, 6 green, 3 Kemp's ridley, and 1 leatherback) and 206 false crawls were documented at the seashore. The first nesting activity was documented on May 18 and the last nesting activity was documented on August 26. The mean clutch size was 111 eggs. Mean hatch success for all nests was 62% while mean emergence success was 60%. Mean incubation was 60 days. Erosion from significant storm and tide events, primarily Hurricane Florence, resulted in 49 nests washed away. The seashore documented 99 stranded sea turtles in 2018.

# Introduction

## Sea Turtles

Cape Lookout National Seashore (Seashore) was established to preserve the natural resources of a natural barrier island system off the North Carolina coast from Ocracoke Inlet to Beaufort Inlet. The Seashore's 56 miles consist of three main barrier islands that are subject to ocean overwash and inlet formation. North Core Banks is approximately 23 miles long extending from Ocracoke Inlet to Ophelia Inlet. South Core Banks extends southward from Ophelia Inlet almost 24 miles to Barden Inlet. The Core Banks have a northeast to southwest orientation, exhibit a low profile landscape, and face the Atlantic Ocean on the east side and the Pamlico and Core Sounds on the west side. The third island, Shackleford Banks is nine miles long and has an east-west orientation with a higher dune system and larger areas of vegetation. Shackleford Banks faces the Atlantic Ocean on the south side and the Back Sound on the north side.

The Seashore contains ecologically important habitats, such as beaches, estuarine waters, and submerged aquatic vegetation that are important

to sea turtles. The Seashore is a significant northern nesting beach and supports among the highest number of loggerhead sea turtle (*Caretta caretta*) nests in North Carolina. Nesting habitat for leatherback (*Dermochelyes coriacea*), green (*Chelonia mydas*), and Kemp's ridley (*Lepidochelys kempii*) sea turtles are also present at the Seashore. The hawksbill sea turtle (*Eretmochelys imbricata*) is only known to have stranded on the Seashore. The leatherback, Kemp's ridley, and the hawksbill are listed under the Endangered Species Act as endangered and the loggerhead and green as threatened.

The Seashore began monitoring marine turtles in 1976. Baseline data were collected for a portion of South Core Banks during an extensive six-year study from 1978 to 1983. Nesting turtles were tagged and nests were marked during nightly patrols. Since 1984, the Seashore has conducted daytime monitoring to document nesting activity and strandings, protect nest sites and hatchlings, and relocate nests in danger of being flooded. In 1990, the Seashore adopted the U.S. Fish and Wildlife Service (USFWS) Index Nesting Beach program to standardize monitoring. Sea



A Kemp's ridley sea turtle nesting at Cape Lookout National Seashore. NPS



A leatherback hatchling crawling to the ocean at Cape Lookout National Seashore. NPS

turtle monitoring and management at the Seashore follows management guidelines defined by the North Carolina Wildlife Resources Commission (NCWRC) Handbook for Sea Turtle Volunteers in North Carolina (NCWRC 2006), USFWS species recovery plans (NMFS and USFWS 1991, 1992, 1993, 2008; NMFS, USFWS, and SEMARNAT 2011) and the Cape Lookout National Seashore Interim Protected Species Management Plan (NPS 2006).

### **Cape Lookout National Seashore Interim Protected Species Management Plan**

The Interim Protected Species Management Plan (IPSMP) was adopted in 2006 and provides requirements for monitoring and managing protected species in the Seashore. The IPSMP includes establishment of temporary nesting closures, buffer distances, and wildlife protection zones. The IPSMP also outlines a required monitoring schedule for the protected species of concern. In 2017, the Seashore established an Educational Permit requirement for ORV users to drive on the beach. ORV users must sign the permit attesting to their understanding of the ORV routes, rules, and management for protected species.

### **Cooperating Agencies and Organizations**

The Seashore cooperates with numerous agencies on sea turtle protection, including the NCWRC, the National Marine Fisheries Service, and the USFWS. The North Carolina Sea Turtle Program Coordinator at NCWRC receives all original stranding and nesting activity reports and all nesting activity data through the [www.seaturtle.org website](http://www.seaturtle.org). NCWRC, under the authority of the USFWS, issues the Seashore an Endangered Species permit for possession and disposition of stranded marine turtles and relocation of nests. The Center for Marine Sciences and Technology receives, evaluates, stabilizes, and arranges longer term care of live stranded sea turtles found on the Seashore. The Karen Beasley Sea Turtle Rescue and Rehabilitation Center, and the Pine Knolls Shore and Roanoke Island aquariums receive and rehabilitate these live stranded sea turtles. The University of Georgia analyzes and reports results from an ongoing genetic mark-recapture population demographics study of the loggerhead Northern Recovery Unit within North Carolina, South Carolina, and Georgia. The United States Department of Agriculture (USDA) Wildlife Services assists with predator management.



# Methods

## Nest Monitoring and Management

Per the Cape Lookout National Seashore IPSMP, staff patrolled North Core Banks and South Core Banks daily searching for nesting activity from May 1 to September 15. Each patrol began early in the morning so that the island was checked for turtle activity by 12:00 PM. Shackleford Banks was monitored three times per week. Sea turtle crawl activities were recorded as nests if eggs were confirmed, as possible nests if it appeared to be a nest crawl, but eggs were not located, or as a false crawl that contained no eggs.

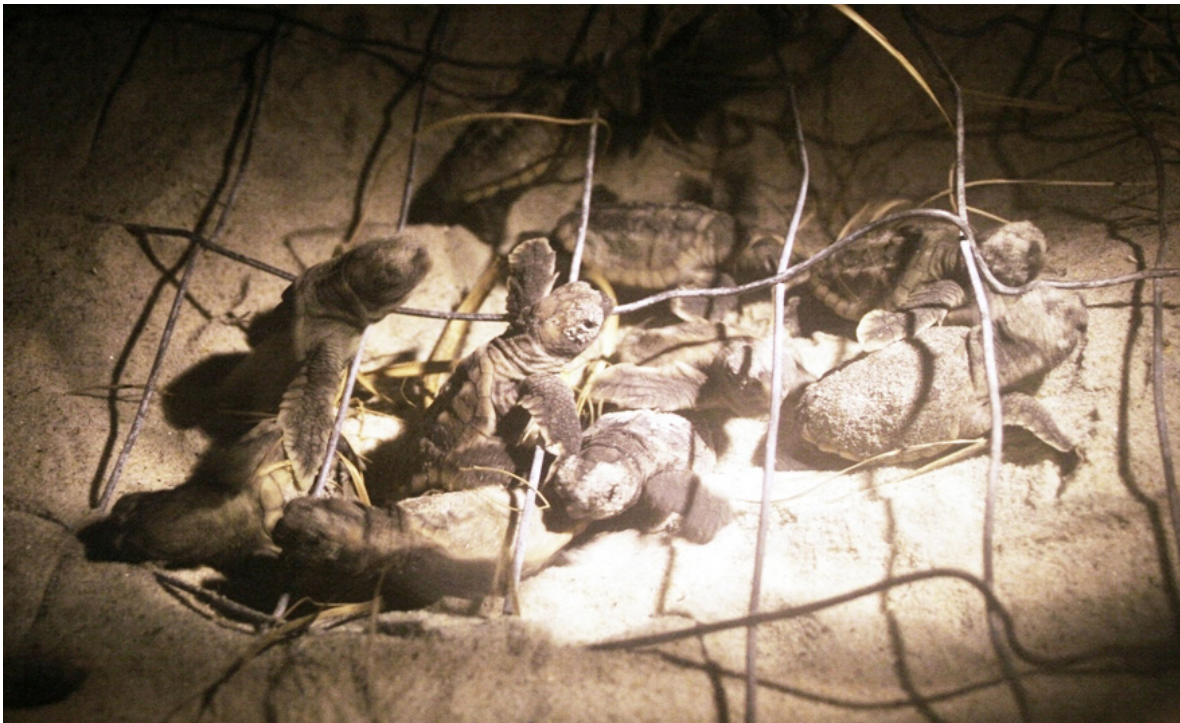
Each activity location was recorded using a Global Positioning System (GPS) unit and the mile location rounded to the nearest tenth of a mile. Nest and possible nests were marked with 2-inch PVC poles that were 4 feet in length. One pole was placed 2 feet from the egg chamber on the ocean-facing side and the other pole was placed 3 feet from the egg chamber on the dune-facing side. The Seashore participated in a genetic mark-recapture study of nesting female loggerheads using DNA derived from

eggs. The study was coordinated by the NCWRC for North Carolina and included the other Northern Recovery Unit states of Georgia and South Carolina. One egg from each nest was collected and preserved so DNA could be analyzed at the University of Georgia genetic laboratory. As part of this study, sea turtle crawl and nest activity was reported to the [seaturtle.org website](http://seaturtle.org).

Nest losses to tidal flooding and predation are the primary threats to nesting success at Cape Lookout National Seashore. Nests laid in the tidal wash zone, primary berm, and back swale are considered in danger of erosion or tidal flooding. Nests laid in locations subject to repeated flooding were relocated to a higher elevation on the primary dune in accordance with the NCWRC Handbook for Sea Turtle Volunteers in North Carolina (NCWRC 2006). Relocated nests were moved into the nearest of six designated areas. At day 50 of incubation, or earlier if hatching activity is observed, vehicles were detoured to the back road around areas where nests are located on the primary dunes. Vehicle detours were also erected



A loggerhead sea turtle crawl at Cape Lookout National Seashore. NPS



Loggerhead hatchlings emerge from a nest with a wire screen that was placed over the nest to discourage raccoon and coyote predation of the eggs. NPS

around nests that were on the beach where vehicles could pass 15 feet directly west. Vehicle-free zones provide a rut-free corridor from the nest site to the ocean, preventing hatchlings from being run over or becoming entrapped in tire ruts and dying from predation or desiccation (Hosier et al. 1981; Lamont et al. 2002; Van de Merwe et al. 2012). Camping and campfires were not permitted in the protection zones to prevent disturbance of hatchlings by artificial lights (Peters and Verhoeven 1994).

Any signs of predation were noted and the approximate numbers of eggs or hatchlings destroyed were recorded. To discourage raccoon (*Procyon lotor*) and coyote (*Canis latrans*) predation, wire screens or boxes anchored by rebar were placed over all nests. Nests and possible nests were monitored for hatching activity through November. Nests were excavated five days after hatching to determine nest success. Possible nests were treated similarly. If a possible nest hatched, it was added to the nest category. If a nest failed to show hatching activity after 75 to 80 days, the site was excavated, and then classified as a nest if eggs were found or as a crawl if no eggs were found.

## Stranding Activity

Collecting information from stranded turtles is also an important phase of the Seashore Sea Turtle Monitoring Program. The Seashore documents strandings, collects data for the NCWRC Sea Turtle Project Coordinator and the National Marine Fisheries Service, and assists in the transportation of live strandings to rehabilitation facilities. Live strandings are immediately reported to the NCWRC to coordinate transport to a wildlife veterinarian at the Center for Marine Sciences and Technology. Cold weather patterns and soundside water temperatures in the winter months of November through January can trigger live strandings of hypothermic (“cold stunned”) sea turtles. Based on winter weather conditions, searches for cold stunned sea turtles were prioritized at the Cape Lookout Bight shoreline, inlet shorelines, and other exposed soundside shorelines where cold stunned turtles have been found in the past.

# Results

## Nest Monitoring and Management

The first recorded nesting activity in 2018 was on May 18 and the last was on August 26, for a 100-day nesting season. A total of 375 activities were documented, of which 169 were nests and 206 were false crawls (Table 1). There were 159 loggerhead nests, six green nests, three Kemp’s ridley nests and one leatherback nest. Figure 1 illustrates the daily nesting activity for the season along with hatching activity. Mapped original nest locations are in Appendix A.

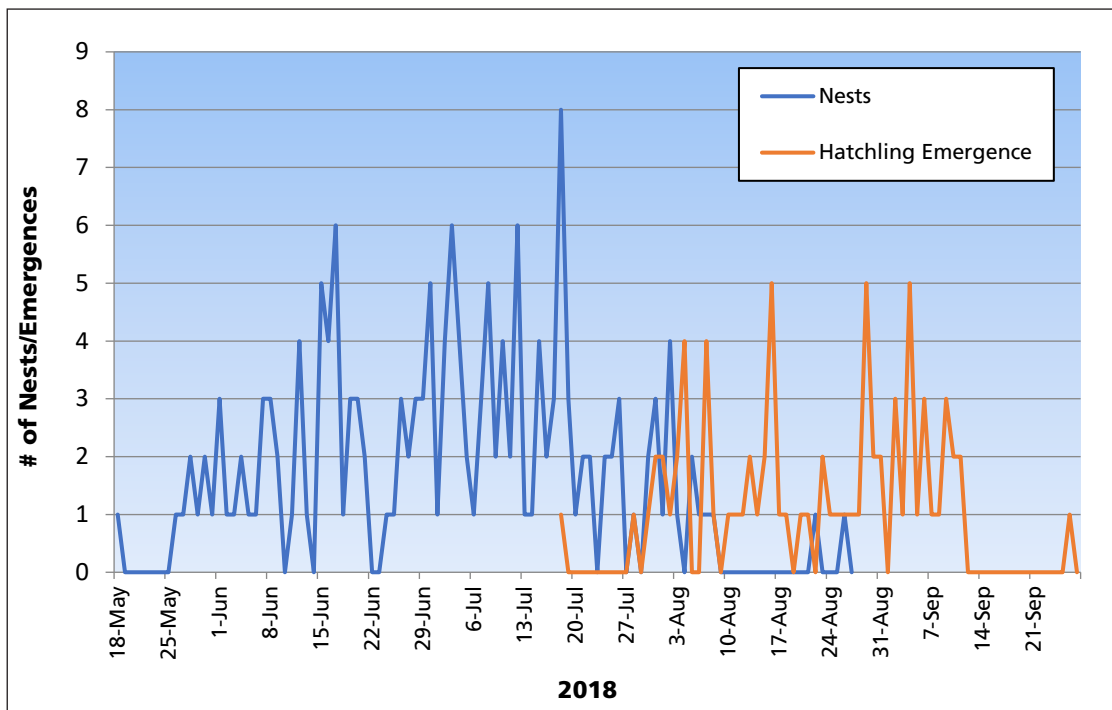
The number of nests found in 2018 (169) was above the annual average of 152 nests for Cape Lookout National Seashore (Figures 2 and 3). South Core Banks continued to have more nests than the other islands in 2018.

## Hatching

The nest hatching period for 2018 began July 18 and ended September 26 for a total of 71 days. The last nest was inventoried on October 6 at day 90 of incubation on South Core Banks. A total of 14,439 eggs, 8,955 hatchlings, and 301 hatched dead were counted. The total hatch success was 62% (number of total hatched eggs divided by number of total eggs). Emergence success was calculated by subtracting the total hatched dead from the total hatched and dividing by the total number of eggs (Table 2). Total emergence success was 60% (8654 emerged) in 2018. The emergence success for an individual nest ranged from 0% to 99%, and the average clutch size was 111 eggs. Incubation time ranged from 52 to 68 days, with an average of 60 days. Forty-nine nests were lost to erosion events, primarily Hurricane Florence.

**Table 1.** Sea turtle activities by study area in 2018.

Activity	North Core Banks	South Core Banks	Shackleford Banks	Seashore Total
Nests	60	98	11	169
Crawls	120	79	7	206



**Figure 1.** The daily number of nests from May 18 to August 26 and hatchling emergence from July 18 to September 26.

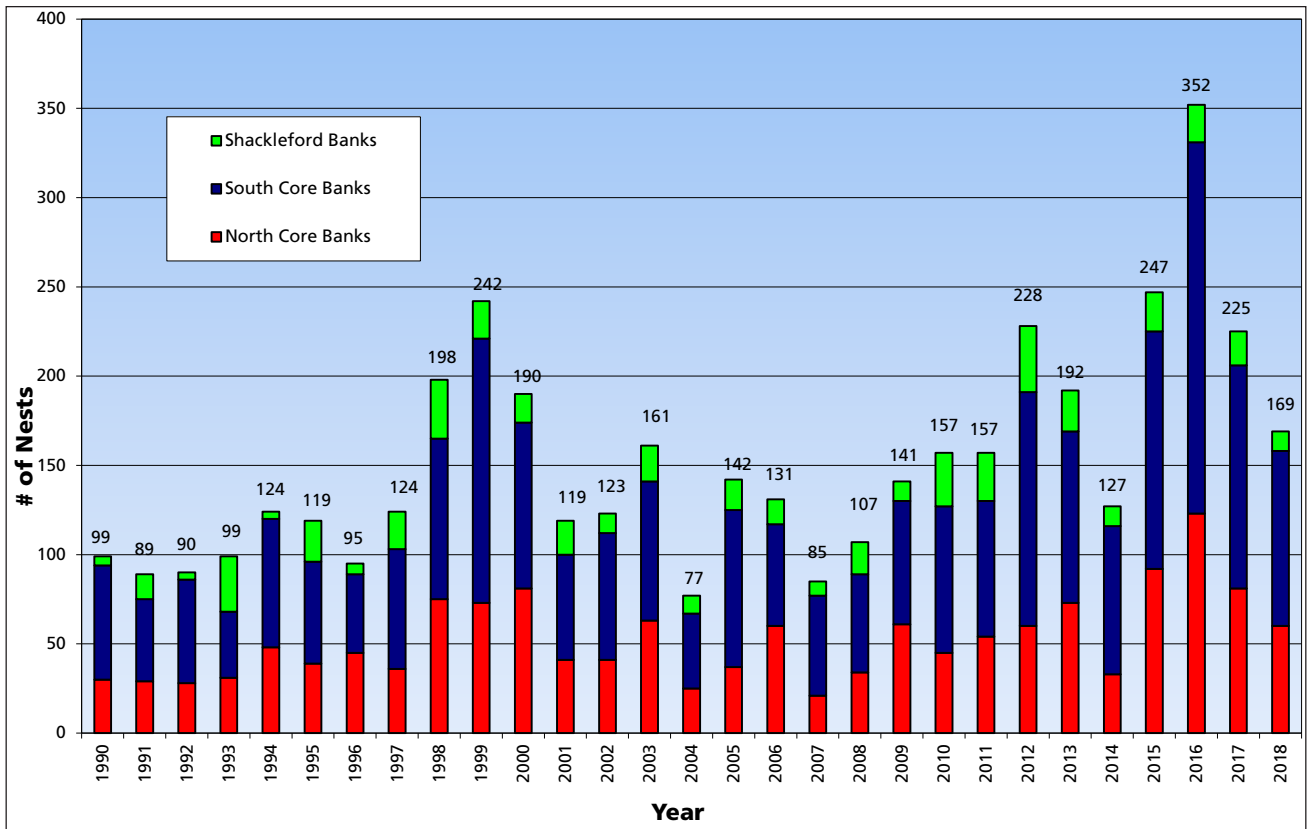


Figure 2. Cape Lookout National Seashore sea turtle activities, 1990–2018.

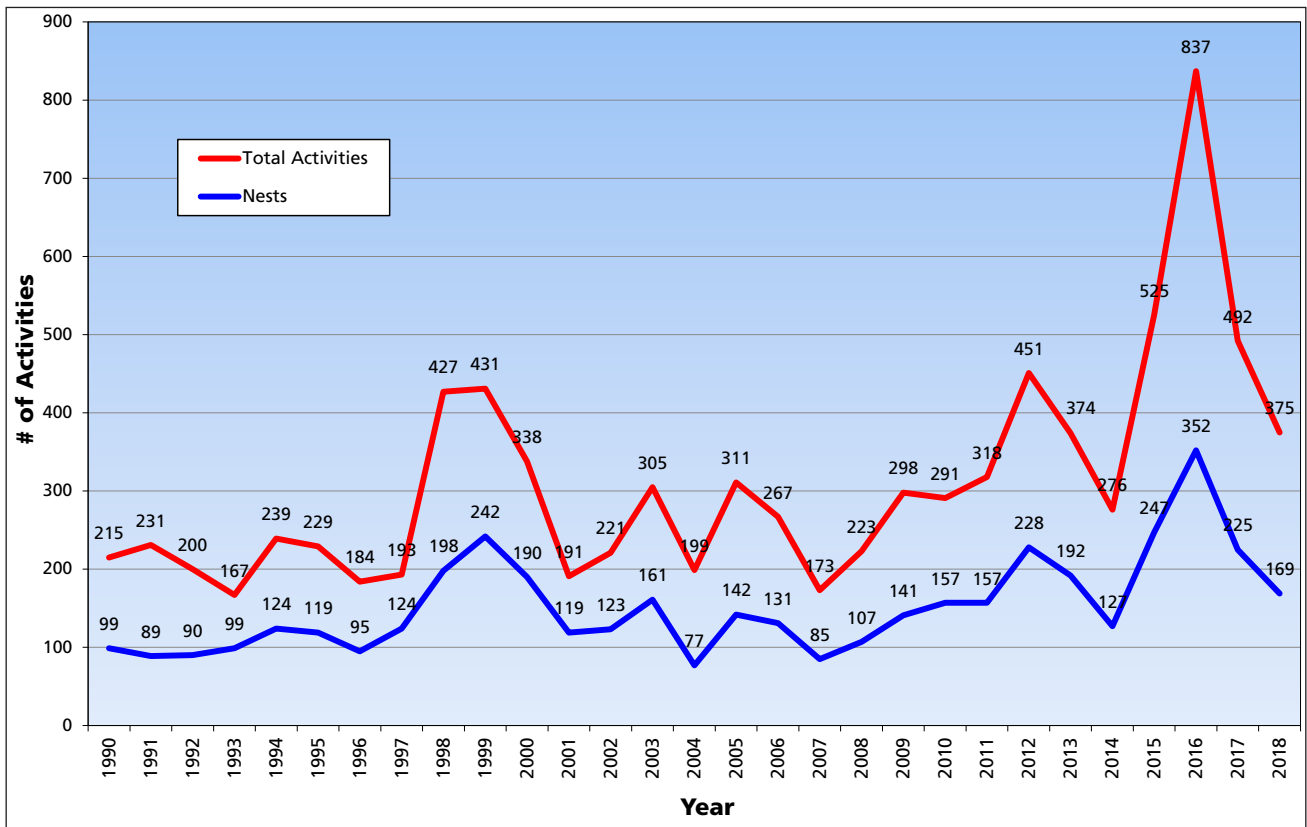


Figure 3. Cape Lookout National Seashore sea turtle nests, 1990–2018. Total activities includes false nest crawls and nest crawls.

**Table 2.** Sea turtle hatch summary, 1990–2018.

Year	Nests	Mean Clutch	Flooded	Mean Incubation	Eggs	Emerged	Emergence %
1990	99	115	1	57	10,376	7,369	71%
1991	89	115	6	62	8,393	5,197	62%
1992	90	114	4	63	9,419	6,791	73%
1993	99	115	9	59	10,365	7,544	74%
1994	124	120	3	62	14,459	11,296	79%
1995	119	115	38	57	12,357	6,157	51%
1996	95	115	16	65	10,091	5,602	57%
1997	124	122	3	63	14,824	10,740	73%
1998	198	114	39	62	19,672	13,315	69%
1999	242	116	90	62	23,224	11,751	53%
2000	190	111	2	67	19,527	13,471	69%
2001	119	113	5	65	12,358	9,555	79%
2002	123	119	7	61	13,657	10,758	79%
2003	161	119	45	65	16,440	10,067	61%
2004	77	104	36	64	7,309	3,139	43%
2005	142	111	54	60	12,423	6,569	53%
2006	131	125	19	61	14,808	10,843	73%
2007	85	109	19	60	8,759	6326	72%
2008	107	111	60	60	11063	6868	62%
2009	141	116	77	64	15130	7574	50%
2010	157	105	80	57	14666	7956	54%
2011	157	114	30	56	12910	8186	63%
2012	228	111	84	62	25293	16,188	64%
2013	192	108	35	64	19,744	13,409	68%
2014	127	114	52	65	13,077	7,028	54%
2015	247	112	121	59	26,160	14,935	57%
2016	352	107	109	55	36,047	23,169	64%
2017	225	111	102	62	22,292	14,070	63%
2018	169	111	45	60	14,542	8,654	60%

A total of 45 nests were overwashed by the ocean at least once, and 34 of these nests hatched. The emergence success for the 45 flooded nests was 49%. Eight nests were overwashed after they were relocated and 11 were lost to erosion after relocation.

In 2018, a total of 44 (26%) nests were relocated. The emergence rate for relocated nests was 53% and the emergence rate for non-relocated nests was 63% (Table 3). Of the 169 nests, 120 were inventoried and 49 nests were washed away or predated with an unknown egg count and/or unknown success.

Since 1990, the twenty-nine-year average emergence success rate is 64% for relocated nests and 64% for non-relocated nests (Table 3).

### **Predation**

In 2018, staff recorded total or partial nest predation by coyotes at 10 nests. All recorded coyote predation events took place on South Core Banks. Ghost crab predation took place throughout the Seashore affecting six nests. Predation by raccoon was not recorded in 2018.

**Table 3.** Emergence success for relocated versus non-relocated nests, 1990–2018.

Year	Percent of Nests Relocated	Emergence Rate Relocated	Emergence Rate Non-Relocated	Percent of Nests Inventoried
1990	69%	71%	74%	94%
1991	63%	57%	76%	97%
1992	43%	71%	76%	97%
1993	54%	74%	73%	90%
1994	79%	80%	73%	96%
1995	55%	61%	38%	86%
1996	73%	56%	64%	89%
1997	74%	69%	86%	95%
1998	59%	77%	55%	85%
1999	51%	49%	59%	79%
2000	63%	66%	74%	93%
2001	50%	81%	76%	89%
2002	45%	73%	84%	93%
2003	41%	47%	75%	86%
2004	44%	63%	23%	97%
2005	34%	42%	61%	79%
2006	39%	85%	64%	90%
2007	24%	79%	70%	95%
2008	30%	57%	64%	92%
2009	25%	61%	46%	92%
2010	13%	75%	51%	89%
2011	27%	36%	78%	62%
2012	22%	74%	61%	99.5%
2013	28%	61%	71%	95%
2014	29%	69%	46%	90%
2015	16%	54%	58%	94%
2016	26%	60%	66%	96%
2017	31%	64%	62%	89%
2018	26%	53%	63%	71%
Mean	42%	64%	64%	90%

**Human Disturbance**

Off-road vehicles disregarding beach closures threaten the survival of hatchlings. Hatchlings are at risk of being directly crushed and/or becoming trapped in tire ruts. At night, vehicle lights could disorientate hatchlings (Cox et al. 1994). Eleven nests had disorientation hatchling tracks recorded in 2018. Only nine vehicles were recorded violating sea turtle protection zones.

**Genetic Mark-Recapture Study**

The Seashore continued to participate in the genetic mark-recapture study of the Northern Recovery Unit of sea turtles in 2018. Preliminary results can be viewed at the [www.seaturtle.org](http://www.seaturtle.org) website. The study has 93.4% of the DNA samples assigned with 77 individual nesting females documented in 2018. The mean nest per female was 2.35 nests with a maximum of six nests assigned to one female.

The mean inter-nesting period (time between nests laid by the same female) was 13.6 days. There were 25 potential unobserved nests reported. The Seashore should continue to participate in this study to learn more about the Northern Recovery Unit loggerhead population.

## Strandings

In 2018, 99 strandings occurred at Cape Lookout National Seashore. All strandings were reported to NCWRC using a NCWRC “Sea Turtle Stranding and Salvage Network” stranding form. Green turtles accounted for the majority of the strandings (57). Strandings also included 20 loggerheads, 15

Kemp’s ridleys, 1 leatherback, and 5 unknowns. Forty-two turtles were stranded on the inshore soundside and 57 turtles were stranded on the offshore oceanside. There were only 16 live strandings and this occurred primarily around a cold stun event in March. Cold stun turtles were transported out of the park, assessed by wildlife veterinarians at the North Carolina State Center for Marine Sciences and Technology and sent to The Karen Beasley Sea Turtle Rescue and Rehabilitation Center or the North Carolina Aquarium at Pine Knolls Shore for rehabilitation. All stranded turtles were scanned for external and Passive Integrated Transponder (PIT) tags, no tags were found in 2018. Figures 4 and 5, and Table 4 provide stranding data at the Seashore.

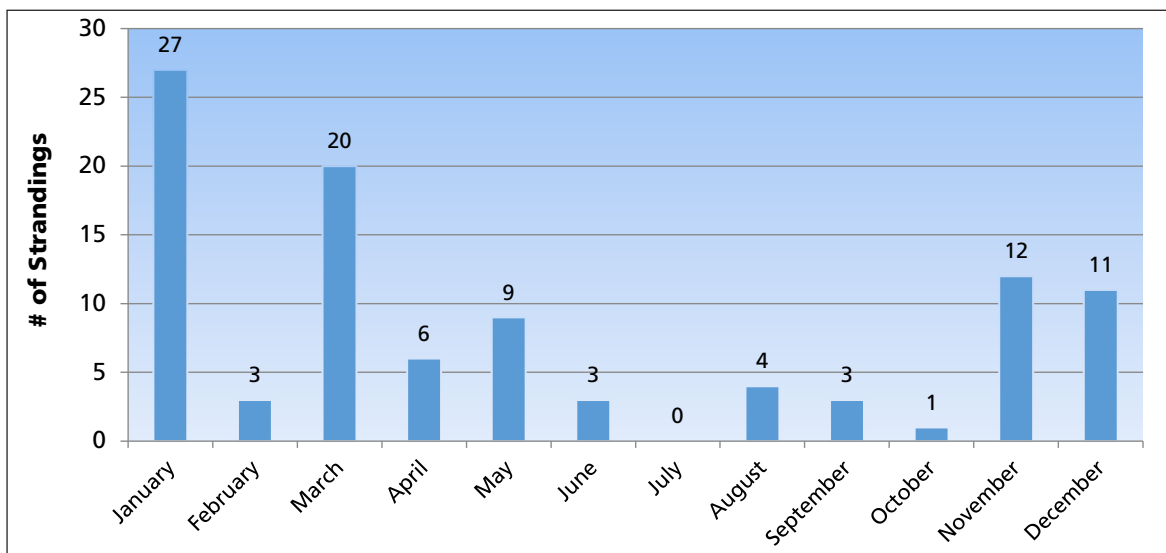


Figure 4. Sea turtle strandings at Cape Lookout National Seashore by month, 2018.

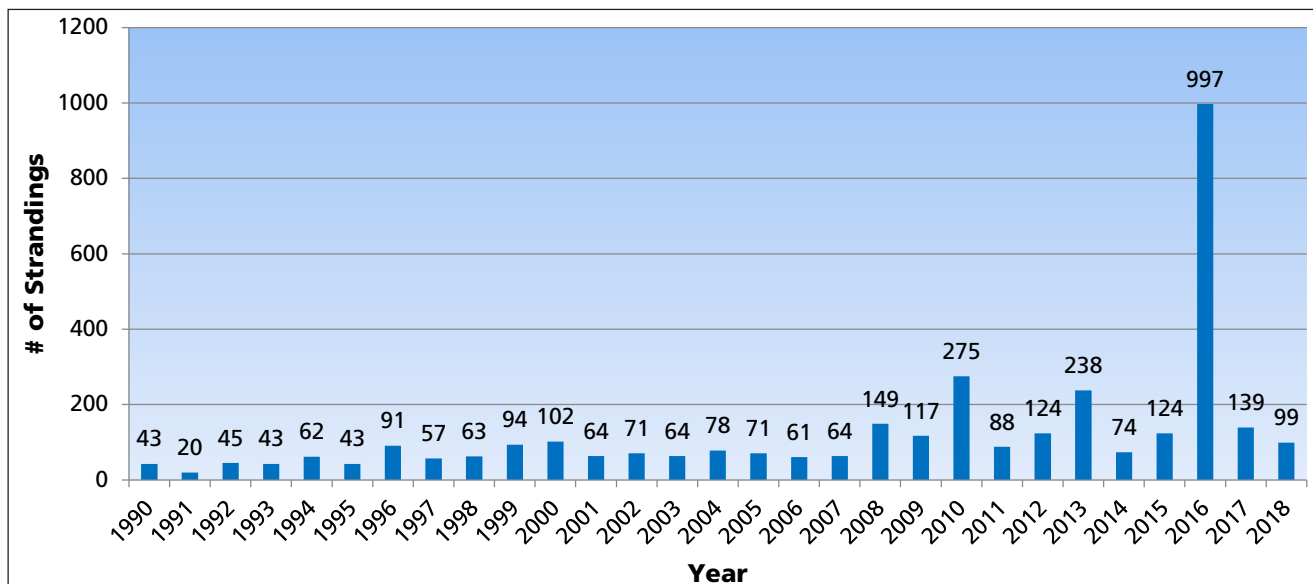


Figure 5. Sea turtle stranding totals at Cape Lookout National Seashore, 1990–2018.

**Table 4.** Cape Lookout National Seashore sea turtle strandings, 1990–2018.

<b>Year</b>	<b>Stranding Totals</b>	<b>Loggerhead</b>	<b>Green</b>	<b>Kemp's Ridley</b>	<b>Leatherback</b>	<b>Hawksbill</b>	<b>Unknown</b>
1990	43	33	7	1	2	0	0
1991	20	16	2	1	0	0	1
1992	45	30	13	1	1	0	0
1993	43	29	6	5	2	0	1
1994	62	30	24	5	2	0	1
1995	43	27	7	6	1	0	2
1996	91	63	21	4	3	0	0
1997	57	49	1	7	0	0	0
1998	63	43	8	12	0	0	0
1999	94	36	41	15	2	0	0
2000	102	46	40	11	4	0	1
2001	64	38	15	9	2	0	0
2002	71	33	26	5	7	0	0
2003	64	44	9	7	2	1	1
2004	78	45	28	4	1	0	0
2005	71	37	21	6	0	2	5
2006	61	35	16	8	0	0	2
2007	64	19	38	1	0	0	6
2008	149	29	116	2	0	0	3
2009	117	36	66	14	0	0	1
2010	275	131	116	27	0	0	0
2011	88	18	44	26	0	0	0
2012	124	25	73	25	1	0	0
2013	238	26	187	23	1	0	1
2014	74	24	32	17	0	0	1
2015	124	23	78	21	1	0	1
2016	997	40	938	12	2	0	5
2017	139	10	113	13	3	0	0
2018	99	20	57	15	1	0	5



## Discussion

The nesting and hatching season started on May 18 and ended on September 26 for a total of 131 days. This was 29 days shorter than the 2017 season, primarily due to Hurricane Florence making landfall on September 14, 2018. Though eight nests survived the storm and two hatched after the storm, 46 nests were washed away. The average incubation rate was 60 days in 2018. The earliest hatch was at day 52 of incubation. The management plan calls for closed areas around the nests at day 50 to allow for tire ruts to smooth out before hatching. However, there needs to be flexibility in barricade application to allow for higher summer temperatures that speed up incubation. The incubation period decreases with increasing ambient temperature (Bustard and Greenham 1968). Barricades should be erected between day 40 and day 45 of incubation if nesting season air temperatures are above average and nests are showing signs of early hatching.

Nest depredation by coyotes and raccoons are a major concern. A coyote's ability to dig further and deeper under wire screens makes protection of nests difficult. Working through an interagency agreement, the United States Department of Agriculture

Wildlife Services was able to remove 5 coyotes and 33 raccoons from the Seashore through targeted trapping in spring and summer. This limited removal of coyote and raccoons meets objective 7 in the 2008 USFWS sea turtle recovery plan. Predator control should continue in future years to reduce predation on sea turtle nests.

The Seashore continued to participate in the genetic mark-recapture study of the Northern Recovery Unit of sea turtles in 2018. Preliminary results can be viewed at the [www.seaturtle.org website](http://www.seaturtle.org). The study has 93.4% of the DNA samples assigned with 77 individual nesting females documented in 2018. The mean nest per female was 2.35 nests with a maximum of six nests assigned to one female. The mean inter-nesting period was 13.6 days. There were 25 potential unobserved nests reported. The Seashore should continue to participate in this study to learn more about the Northern Recovery Unit loggerhead population.

Hurricane Florence storm surge flattened the dune-line and caused extensive overwash on the Core Banks. These geomorphic changes to the nesting



Loggerhead sea turtle eggs in a nest at Cape Lookout National Seashore. NPS



A loggerhead sea turtle hatchling reaches the ocean after crawling from its nest on the beach, Cape Lookout National Seashore. NPS

habitat could influence nesting patterns and the effect of ambient light on sea turtles in the coming years. Recreational night activity on Seashore beaches and the amount of artificial light on nesting beaches are poorly understood. In the summer of 2017, a study on Shackleford Banks and Bogue Banks revealed that the highest densities of nests occurred in areas of Shackleford Banks with the lowest light levels (Windle et al. 2018). A light pollution study is needed for the Core Banks in order to effectively manage for nesting sea turtles.

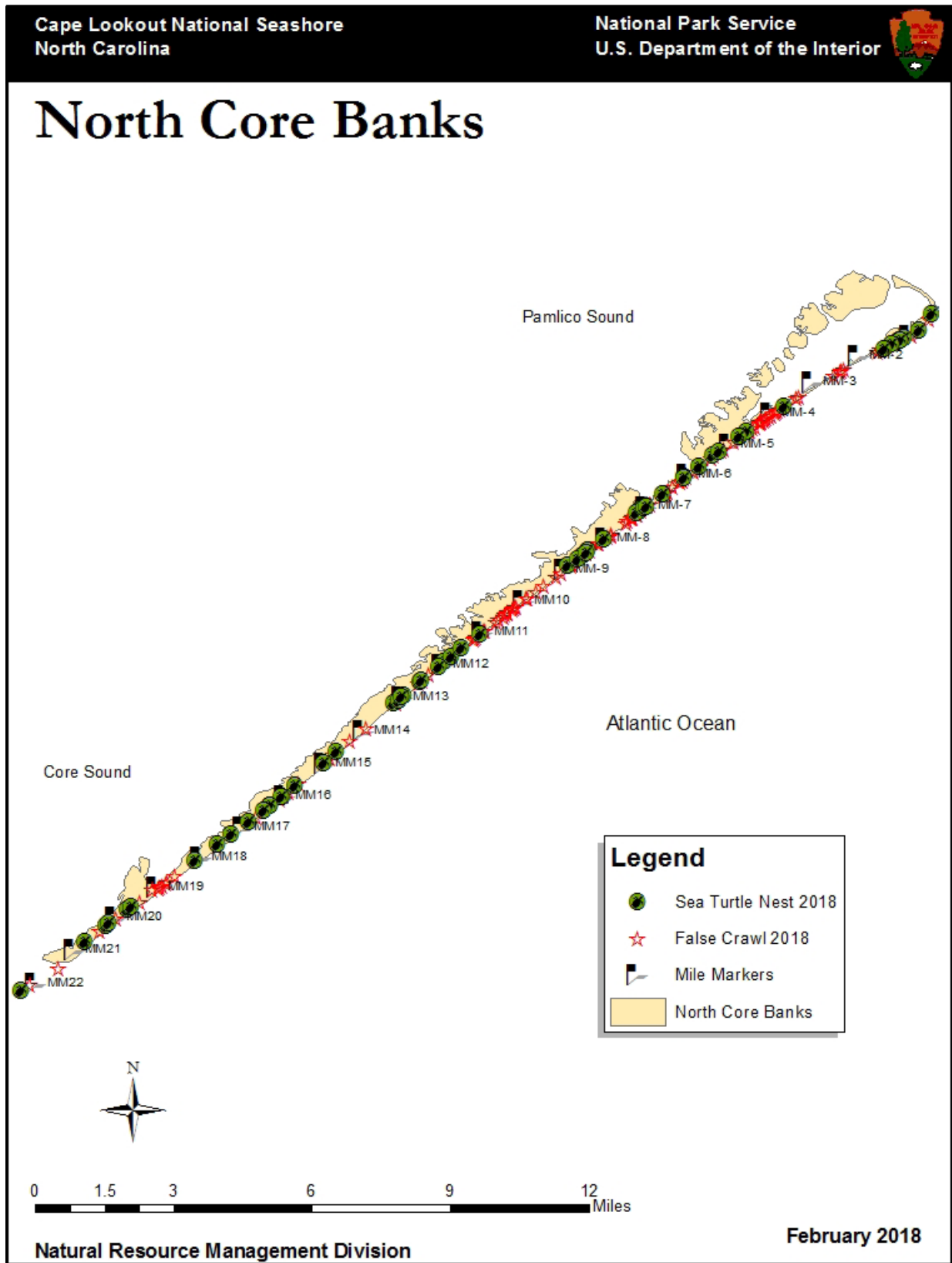
The USFWS provided a biological opinion to Cape Lookout National Seashore that included two performance measures on sea turtles for the 2006 Interim Protected Species Management Plan. The first performance measure requires that the sea turtle false crawl to nest ratio is less than or equal to 1:1 (annually). In 2018, there were 206 false crawls and 169 nests for a ratio of 1.2:1.0. It is thought that the

wide and flatter beaches of the Seashore, particularly North Core Banks, result in a greater occurrence of false crawls. Nighttime disturbance of nesting sea turtles could also cause a higher false crawl rate. More research is needed on the amount of light and nighttime recreational use of the nesting beaches to help determine if there are impacts on the false crawl rate. The second performance measure states that Cape Lookout National Seashore should have 20% or greater of the state's total sea turtle nests for the last five years. There was an average of 1,106 nests for the last five years in North Carolina. In 2018, the Seashore had 15% of the state's total sea turtle nests for the previous five years. This rate is influenced by record high sea turtle nesting in 2015 and 2016 and low sea turtle nesting in 2018. As a result, the rate can change year to year without any management differences. As recently as 2016, the Seashore had 30% of the sea turtle nests in North Carolina.

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# Appendix A. Sea Turtle Activity Maps



Map 1. North Core Banks sea turtle nesting activity in 2018.



# South Core Banks



Natural Resource Management Division

February 2019

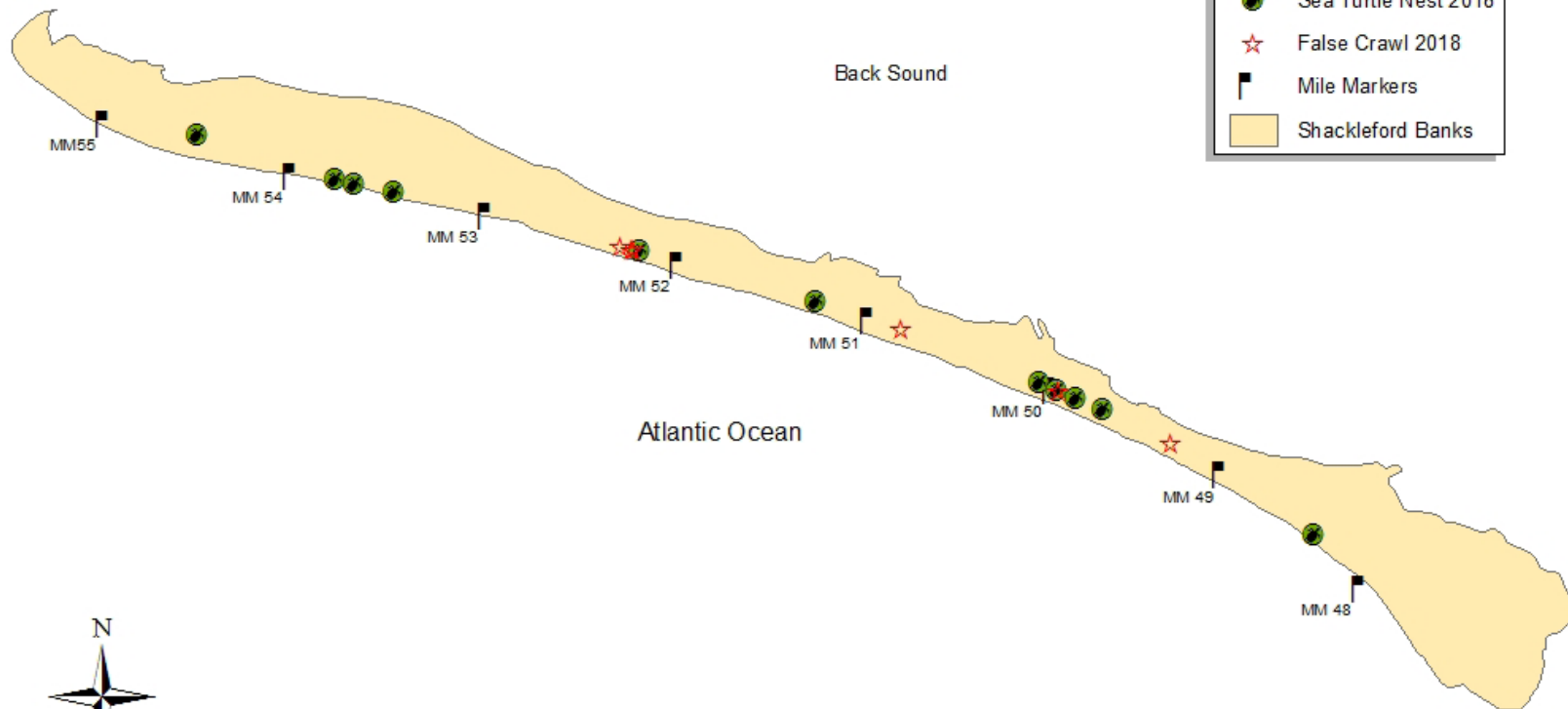
Map 2. South Core Banks sea turtle nesting activity in 2018.



# Shackleford Banks

## Legend

- Sea Turtle Nest 2018
- False Crawl 2018
- Mile Markers
- Shackleford Banks



Natural Resource Management Division

February 2019

Map 3. Shackleford Banks sea turtle nesting activity in 2018.



National Park Service  
U.S. Department of the Interior



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**Cape Lookout National Seashore**

131 Charles St.  
Harkers Island, NC 28531