Cape Henry to Key West

(1) The Atlantic Coast of the United States from Cape Henry to Cape Florida is low and sandy, backed by woods. From Cape Florida to Key West the coast is formed by a long chain of small islands known as the Florida Keys. The Florida Reefs extend seaward of the keys and are nearly parallel to them.

(2) The coastline of Virginia from Cape Henry southward to the boundary of North Carolina is firm land for 13 miles; then it becomes a barrier beach, covered with sand dunes for 11 miles. The boundary between Virginia and North Carolina is the only marked boundary on this section of the coast. The easternmost boundary monument is a granite shaft 6 feet high about 0.5 mile west of the beach.

(3) The coastline of North Carolina is a long barrier beach. The islands are known as the **Outer Banks.** The banks are constantly shifting sand dunes varying in height. Three capes, with their offshore shoals, project from the islands, namely: Hatteras, Lookout and Fear. Behind the barrier beach a chain of sounds, including Currituck, Roanoke, Albemarle, Pamlico, Core and Bogue, stretch along the entire 300 miles of coastline of the state.

(4) Bordering the sounds on the mainland is a belt from 30 to 80 miles wide, where the land is level and sometimes swampy. On the north a portion of the Dismal Swamp spreads across the border of Virginia into North Carolina. Between Albemarle Sound and Pamlico River the swamplands are locally known as **Dismals** and **Pocosins**. They occur on the divides or watersheds between the rivers and sounds. In the southeast section of North Carolina are the **Savannas**, treeless prairie land with a thick growth of grass and wild flowers; they have been formed by a lack of drainage and a close impervious soil.

(5) The coastline of South Carolina from Little River Inlet to Winyah Bay is practically an unbroken beach. Cape Romain, just south of Winyah Bay, and the shoal extending seaward from it, form the southern point of indentations that have their northern point at Cape Fear. From Winyah Bay to Savannah River, the boundary between South Carolina and Georgia, the coastline is a border of sandy barrier islands. The large sounds so characteristic of the North Carolina coast are missing.

(6) The coastline of Georgia between Savannah River on the north and St. Marys River on the south is partly submerged at flood tide and is broken by tidal rivers and marshes covered with dense grasses. The most important sandy islands off the coast are Tybee, Wassaw, Ossabaw, St. Catherines, Sapelo, St. Simons, Jekyll and Cumberland.

(7) The coastline of Florida is a long, low, barrier beach from the border of Georgia south to Cape Florida. Many of the leading tourist resorts have been built on this beach, while the business districts are often on the mainland.

(8) Under the sand and the lagoons is a limestone called **Coquina**, which is soft while in its native state but becomes a hard building stone when exposed to the air.

(9) Below Cape Florida the Florida Keys and Florida Reefs extend for about 134 miles in a southwesterly curve to Sand Key Light and about 58 miles in a westerly direction to Loggerhead Key. These keys and reefs are of sand, shell and coral formation. The keys are generally low and covered with mangrove.

(10)

Disposal sites and dumping grounds

(11) These areas are rarely mentioned in the Coast Pilot but are shown on the nautical charts. (See Dump Sites and Dumping Grounds, chapter 1, and charts for limits.)

(12)

Aids to navigation

(13) Lights are on or near the dangerous capes, at the entrance to the harbors, and along the Florida Reefs. The critical dangers are buoyed. Radar, though always a valuable navigational aid, is generally of less assistance in navigation along this coast due to the relatively low relief; the accuracy of radar ranges to the beach cannot be relied upon. Coastal buoys equipped with radar reflectors are of help in this regard. It is sometimes possible to obtain a usable radar return from the larger lighthouses, but positive target identification is usually difficult. There are numerous aerolights along the coast that are useful for navigation, but they should not be confused with the marine lights.

(14)

COLREGS Demarcation Lines

(15) Lines have been established to delineate those waters upon which mariners must comply with the International Regulations for Preventing Collisions at Sea, 1972 (72 COLREGS) and those waters upon which mariners must comply with the Inland Navigation Rules Act of 1980 (Inland Rules). The waters inside of the lines are **Inland Rules Waters**, and the waters outside of the lines are **COLREGS Waters**. (See **33 CFR Part 80**, chapter 2, for specific lines of demarcation.)

(16)

Ports and Waterways Safety

(17) (See **33 CFR Part 160**, chapter 2, for regulations governing vessel operations and requirements for notification of arrivals, departures, hazardous conditions, and certain dangerous cargoes to the Captain of the Port.)

(18)

Harbor entrances

(19) The entrance to every harbor on this stretch of the coast is more or less obstructed by a shifting sandbar over which the channel depth is changeable. The entrance channels of the larger and more important harbors have been improved by dredging; in some cases jetties have been built from both sides of the entrance. Many of the dredged channels in this area have a tendency to shoal soon after dredging because of the shifting sandy bottom.

(20) The buoys on many of the bars are not charted because they are moved from time to time to indicate the changing channel. They are liable to be dragged out of position and cannot always be replaced immediately, so a stranger must use the greatest caution. If possible, a stranger should enter a harbor or inlet on a rising tide.

(21) The tidal currents have considerable velocity in all of the entrances, and their direction is affected by the force and direction of the wind; sailing vessels entering the harbors and sounds require a fair working breeze during the ebb. See the Tidal Current prediction service at *tidesandcurrents.noaa.gov* for specific information about times, directions, and velocities of the current at numerous locations throughout the area. Links to a user guide for this service can be found in chapter 1 of this book.

(22) Strangers should not attempt to enter the harbors without the assistance of a pilot during easterly gales when the sea breaks on most of the bars.

(23)

Depths

(24) Between Cape Henry and Jupiter Inlet frequent soundings will give the mariner timely warning of his approach to the land from seaward.

(25) Northward of Cape Hatteras the 20-fathom curve is from 13 to 45 miles offshore, but inside of 15 fathoms the depths are irregular and many holes of limited extent are inside the general limits of corresponding depths; 10 to 14 fathoms are found in places only 1.5 miles offshore. This irregularity of depth is apt to confuse the mariner and lead him into danger in thick weather; the greatest caution should therefore be used inside of a depth of 20 fathoms. By keeping over 6 miles from the beach all dangers will be avoided, but the strong currents that sometimes set along the shore must be considered, especially after a gale.

(26) Southeastward of Cape Hatteras, and off the end of the shoals that extend seaward about 8 miles, the 20-fathom curve is from 12 to 15 miles offshore, and the 30-fathom curve is only a short distance farther. In thick weather, soundings of 20 fathoms or less should warn the mariner to keep offshore.

(27) From Cape Hatteras to Jupiter Inlet, the 20-fathom curve is fairly regular and for a greater part of the distance is from 40 to 55 miles offshore. Northward of St. Johns River, the water shoals uniformly to the 10-fathom curve, which, excepting in the two great bights between Cape Hatteras and Cape Fear, is from 10 to 30 miles offshore. Vessels bound for any of the harbors between Cape Fear and St. Johns River should approach the land with caution when in 10 fathoms of water; inside the 10-fathom curve depths are irregular and spots of 5 fathoms or less will be found from 6 to 12 miles offshore. In thick weather vessels standing along the coast should keep a general depth of 10 fathoms between Cape Fear and St. Johns River.

(28) In a heavy sea, depths of less than 6 fathoms show discolored water; deep-draft vessels should be cautious about passing over such spots.

(29) Southward of St. Johns River, the 20-fathom curve draws inshore gradually and at Jupiter Inlet is only 4 miles from the beach, and the 100-fathom curve a little over 8 miles. Southward of Jupiter Inlet, both curves draw closer inshore, and along the Florida Reefs the 20-fathom curve is close in to the reefs, while the 100-fathom curve is at an average distance of about 7 miles outside the reefs. The 10-fathom curve between St. Johns River and Jupiter Inlet is irregular and of no use in determining distance from shore. Approaching Florida Reefs southward of Jupiter Inlet, soundings are of little use unless taken frequently as the water shoals rapidly from seaward.

(30) In the approach to the Bahama Banks along the Straits of Florida, the discolored water is the best indication the mariner has to warn him of shoal water; the 100-fathom curve at some points is only 1 or 2 miles from the shoal water of the banks.

(31)

Tropical waters

(32) The most remarkable feature is the exceeding clarity of the sea water, enabling the bottom to be seen from aloft at considerable depths and at some distance. The navigation of the banks is consequently conducted almost entirely by the eye, but care must be taken not to run with the sun ahead of the vessel as that prevents the banks from being seen.

(33) The charts indicate clearly the positions of the many shoal heads, but considerable experience is required in identifying the patches by the color of the water. Small clouds, moving slowly and known to the pilots as **Flyers**, are apt to deceive the inexperienced, their reflection on the surface of the sea over the clear white sandy bottom has every appearance of rocky shoals. It is prudent to avoid a dark spot.

(34) **Bank Blink** is a phenomenon in tropical waters described as a bright reflected light hanging over the clear white sandbanks, serving to point them out from a considerable distance. From experience, it has been

found to be untrustworthy, however, and should not be depended on in place of a lookout aloft. Soundings, dead reckoning, and fixes should be carefully checked and evaluated.

(35)

Anchorages

(36) Vessels may find refuge at a number of places along the coast according to draft. The more important places are Lookout Bight, Beaufort Inlet, Cape Fear River, Winyah Bay, Charleston Harbor, Port Royal Sound, Savannah River, Sapelo Sound, St. Simons Sound, Cumberland Sound, St. Johns River, Fort Pierce Inlet, Lake Worth Inlet, Port Everglades, Miami and Key West. A number of anchorage areas have been established by federal regulations within the area of this Coast Pilot. (See **33 CFR Part 110**, chapter 2, for limits and regulations.)

(37)

Dangers

(38) Along the coast are a number of wrecks that are obstructions to navigation. Most of the dangerous wrecks are marked with lighted buoys. A careful check should be made of the chart to ensure that dangerous wrecks are not along the routes selected.

(39) Trawlers or other vessels should exercise caution while dragging the ocean floor within a 25-mile radius of Cape Canaveral, FL, since it is known that missile debris exist in the area, some of which may contain unexploded ordnance.

(40) Mariners are also cautioned against possible hazards of a weather rocket impact area that extends more than 50 miles offshore at Cape Canaveral, FL. Falling rocket casings may be hazardous during the hours of 1930-2100 e.s.t., Monday through Friday.

(41)

Pipelaying barges

(42) With the increased number of pipeline-laying operations, operators of all types of vessels should be aware of the dangers of passing close aboard, close ahead, or close astern of a jetbarge or pipelaying barge. Pipelaying barges and jetbarges usually move at 0.5 knot or less and have anchors that extend out about 3,500 to 5,000 feet in all directions and that may be marked by lighted anchor buoys. The exposed pipeline behind the pipelaying barge and the area in the vicinity of anchors are hazardous to navigation and should be avoided. The pipeline and anchor cables also represent a submerged hazard to navigation. It is suggested, if safe navigation permits, for all types of vessels to pass well ahead of the pipelaying barge or well astern of the jetbarge. The pipelaying barge, jetbarge and attending vessels may be contacted on VHF-FM channel 16 for passage instructions.

(43) **Danger zones** have been established within the area of this Coast Pilot. (See **33 CFR Part 334**, chapter 2, for limits and regulations.)

(44)

Drawbridges

(45) The general regulations that apply to all drawbridges are given in **33 CFR 117.1** through **117.49**, chapter 2, and the specific regulations that apply only to certain drawbridges are given in **33 CFR Part 117, Subpart B**, chapter 2. Where these regulations apply, references to them are made in the Coast Pilot under the name of the bridge or the waterway over which the bridge crosses.

(46) The drawbridge opening signals (See **33 CFR 117.15**, chapter 2) have been standardized for most drawbridges within the United States. The opening signals for those few bridges that are nonstandard are given in the specific drawbridge regulations. The specific regulations also address matters such as restricted operating hours and required advance notice for openings.

(47) The mariner should be acquainted with the general and specific regulations for drawbridges over waterways to be transited.

(48)

Area to Be Avoided

(49) The **Florida Keys Particularly Sensitive Sea Area (PSSA)** is an IMO-designated zone that encircles the sea area around all of the Florida Keys. The PSSA includes the entire Florida Keys National Marine Sanctuary as well as Biscayne National Park at the northeastern end of the Keys. The PSSA is bounded by a line connecting the following points:

(50)

In the Vicinity of the Florida Keys	
1	25°45.00'N., 080°06.10'W
2	25°38.70'N., 080°02.70'W
3	25°22.00'N., 080°03.00'W
4	25°06.35'N., 080°10.47'W
5	24°56.35'N., 080°19.25'W
6	24°37.90'N., 080°47.30'W
7	24°29.20'N., 081°17.30'W
8	24°22.30'N., 081°43.17'W
9	24°28.00'N., 081°43.17'W
10	24°28.70'N., 081°43.50'W
11	24°29.80'N., 081°43.17'W
12	24°33.10'N., 081°35.15'W
13	24°33.60'N., 081°26.00'W
14	24°38.20'N., 081°07.00'W
15	24°43.20'N., 080°53.20'W
16	24°46.10'N., 080°46.15'W
17	24°51.10'N., 080°37.10'W
18	24°57.50'N., 080°27.50'W
19	25°09.90'N., 080°16.20'W
20	25°24.00'N., 080°09.10'W

21	25°31.50'N., 080°07.00'W
22	25°39.70'N., 080°06.85'W
23	25°45.00'N., 080°06.10'W
In the Vicinity of Key West Harbor	
24	24°27.95'N., 081°48.65'W
25	24°23.00'N., 081°53.50'W
26	24°26.60'N., 081°58.50'W
27	24°27.75'N., 081°55.70'W
28	24°29.35'N., 081°50.00'W
29	24°27.95'N., 081°48.65'W
Area Surrounding the Marquesas Keys	
30	24°26.60'N., 081°59.55'W
31	24°23.00'N., 082°03.50'W
32	24°23.60'N., 082°27.80'W
33	24°34.50'N., 082°37.50'W
34	24°43.00'N., 082°26.50'W
35	24°38.31'N., 081°54.06'W
36	24°37.91'N., 081°53.40'W
37	24°36.15'N., 081°51.78'W
38	24°34.40'N., 081°50.60'W
39	24°33.44'N., 081°49.73'W
40	24°31.20'N., 081°52.10'W
41	24°28.70'N., 081°56.80'W
42	24°26.60'N., 081°59.55'W
Area Surrounding the Dry Tortugas	
43	24°32.00'N., 082°53.50'W
44	24°32.00'N., 083°00.05'W
45	24°39.70'N., 083°00.05'W
46	24°45.60'N., 082°54.40'W
47	24°45.60'N., 082°47.02'W
48	24°42.80'N., 082°43.90'W
49	24°39.50'N., 082°43.90'W
50	24°35.60'N., 082°46.40'W
51	24°32.00'N., 082°53.50'W

(51) The **Dry Tortugas** are a group of small keys and reefs 63 miles west from Key West. The group is about 11 miles long, in a northeast to southwest direction, and 6 miles wide. **Pulaski Shoal**, at the northeast end of the group, is 12 miles northwest of Rebecca Shoal. **Pulaski Shoal Light** (24°41'36"N., 82°46'23"W.), 56 feet above the water, is shown from a small black house on a hexagonal pyramidal skeleton tower on piles on the east side of the shoal.

(52) The keys are low and irregular, and have a thin growth of mangrove. In general, they rise abruptly from deep water and have fairly good channels between them. They are continually changing in size and shape. (Dry Tortugas is described in United States Coast Pilot 5.)

(53)

Coral Reefs

(54) The Florida Reef Tract and its associated ecosystems extend in a sweeping arc north and east from Tortugas Bank near Key West, Florida, to St. Lucie Inlet on the southeast coast of Florida. Much of the southern reef tract, from Biscayne Bay south, is managed by **Biscayne National Park (BNP)** and the **Florida Keys National Marine Sanctuary (FKNMS)**. The **Florida Department of Environmental Protection (FDEP)** manages the northern reef tract from the northern border of Biscayne National Park northward to St. Lucie Inlet and includes all state waters from the mean high water line out to 3 miles. The seaward extent of the reef tract north of Biscayne National Park is approximately 3 miles from the shoreline. The reefs may be difficult to identify topside and can be hazardous because they are not marked by breakers in smooth weather.

(55) Vessel grounding and anchoring incidents can cause significant damage to reef habitats, potentially changing their biological composition and, as a result, the environmental health of coral reefs. Mariners are urged to use caution when navigating in these areas and to use mooring buoys (if available) for anchoring or anchor in sand beyond the reef edge. For additional information on the Florida Reef Tract, visit *dep.state.fl.us/coastal/programs/coral/ripr.htm* (FDEP) and *floridakeys.noaa.gov* (FKNMS).

(56)

North Atlantic Right Whales

(57) The North Atlantic right whale is one of the world's most endangered large whale species. North Atlantic right whales are found primarily in continental shelf waters between Florida and Nova Scotia. They migrate annually along the east coast between the feeding grounds off New England and Canada and the calving grounds off Florida, Georgia and South Carolina. Because right whales mate, rest, feed and nurse their young at the surface and often do not move out of the way of oncoming ships, they are highly vulnerable to being struck. Pregnant females and females with nursing calves appear to be particularly vulnerable to collisions with ships. Ship strikes and fishing gear entanglements are the two known sources of human-related mortality. Intentionally approaching within 500 yards of right whales is prohibited and is a violation of federal law. (See **50 CFR 224.103**, chapter 2 for limits, regulations and exceptions.)

(58) **Description of North Atlantic right whale:** Right whales are large baleen whales. Adults are generally 45 to 55 feet in length and can weigh up to 70 tons. The body

(59)

North Atlantic right whale
1
2
3
4
5
1) Whitish patches of raised and roughened skin (called callosities) on top of the head (see arrows)
2) V-shaped blow easily visible from in front or behind the whale
3) No dorsal fin on the back
4) Tail flukes often lifted vertically when the animal dives
5) All black tail on the top and underside
Callosities
No dorsal fin
Flukes

Images courtesy of Center for Coastal Studies

is mostly black, but irregularly shaped white patches may be present on the ventral surface. The best field identification marks are a broad back with no dorsal fin, irregular bumpy white patches (callosities) on the head, and a distinctive two-column V-shaped blow when viewed from directly behind or in front of the whale. The whales have broad, paddle-shaped flippers and a broad, deeply notched tail. (See diagrams and photographs.) Right whales are slow moving and seldom travel faster than 5 or 6 knots. They can stay submerged for 10 to 20 minutes and may appear suddenly when surfacing to breathe. They are often seen alone or in small groups. At times, right whales form large courtship groups of 20 to 30 animals.

(60) **Seasonal occurrence of North Atlantic right whales**–During seasons and in areas where right whales may occur, vessel operators should maintain a sharp lookout for whales and reduce speeds when consistent with safe navigation. In any given year oceanographic variability may affect the seasonal distribution of right whales. In 1986, right whales were frequently sighted within the Stellwagen Bank National Marine Sanctuary throughout the summer, and in the early spring of 1998 a large number of right whales were documented near the Narragansett/Buzzards Bay Traffic Separation Scheme. Two areas in U.S. waters have been designated as critical habitats for North Atlantic right whales; the northeastern foraging area and southeastern calving area. (See **50 CFR 226.203**, chapter 2 for limits, regulations and exceptions).

(61)

Seasonal occurrence of North Atlantic right whales

Location	Season	Comments
Central Gulf of Maine (Jordan Basin, Cashes Ledge)	April to June October to December	
Cape Cod Bay	December to May	
Great South Channel, northern edge of Georges Bank	March to July	
Bay of Fundy, Scotian Shelf (Browns Bank, Roseway Basin)	July to October	Most of the population can be found in this area during this time.
Jeffreys Ledge	October to December	Whales are frequently sighted in this area.
Stellwagen Bank National Marine Sanctuary	Year-round	Peak sightings occur in the early spring with infrequent sightings in the summer.
New York to North Carolina	November to April	The migration corridor between right whale habitats is within 30 miles of the Atlantic coast.
South Carolina, Georgia and Florida calving area	November to April	Calving right whales have been sighted as far north as Cape Fear, NC and as far south as Miami, FL with rare sightings in the Gulf of Mexico.

(62) **Mandatory Speed Restrictions:** Vessels 65 feet or greater in length overall (LOA) are subject to mandatory speed restrictions of 10 knots or less in seasonal management areas (SMA) along the U.S. East Coast during times when right whales are likely to be present (See following maps for locations of SMAs). The Northeastern SMA speed restrictions are in place from January 1 through May 15 in Cape Cod Bay, from March 1 through April 30 off Race Point and from April 1 through July 31 in the Great South Channel. Speed restrictions in the Mid-Atlantic U.S. SMAs are in place from November 1 to April 30 and include Block Island Sound, entry into the Ports of New York/New Jersey, Delaware Bay, Entrance to Chesapeake Bay, and the Ports of Morehead City and Beaufort, NC, and within a continuous boundary approximately 20 nautical miles from shore around the major ports of Wilmington, NC, Charleston, SC, and Savannah, GA. Speed restrictions are in place in the Southeastern U.S. SMA from November 15 to April 15; this area extends from shore approximately 30 nautical miles eastward and contains the major ports of Brunswick, GA, Fernandina Beach, FL, and Jacksonville, FL. (See **50 CFR 224.105**, chapter 2 for regulations, limitations and exceptions and complete description of the SMAs.) Boundaries of the SMAs are shown on NOAA Electronic Navigational Charts US2EC02M, US2EC03M, US2EC04M and US2GC12M. NOAA Fisheries may also establish voluntary Dynamic Management Areas (DMAs) when right whales are present in areas and times not covered by the SMAs. Information about established DMAs will be announced over NOAA's customary maritime communication media. Mariners are encouraged to avoid or reduce speeds to 10 knots or less while transiting through DMAs.

(63)

Area to be avoided

(64) In order to significantly reduce the risk of ship strikes to the North Atlantic right whale, an area to be avoided was established in the Great South Channel, east of the Boston Harbor traffic lanes. Ships of 300 gross tons and above should avoid the area bounded by lines connecting the following geographical positions:

(65) 41°44'08"N., 69°34'50"W.;

(66) 42°10'00"N., 68°31'00"W.;

(67) 41°24'53"N., 68°31'00"W.; and

(68) 40°50'28"N., 68°58'40"W. between the period of April 1 through July 31.

(69) **Early Warning and Sighting Advisory Systems:** As weather and conditions permit, dedicated seasonal programs of aerial and vessel surveys are conducted in the northeast and southeast U.S. to provide whale sighting information to mariners. Surveys typically occur in the following locations at the specified times: a) Cape Cod Bay, the Gulf of Maine, the Great South Channel, and Rhode Island, Block Island and Long Island Sounds from January through July; b) South Carolina/North Carolina border south to Crescent Beach, FL, from December through March. Survey planes occasionally use VHF-FM channel 16 to contact ships directly if whales have been spotted in close proximity to that vessel. However, many right whales go undetected by surveys. Seasonal right whale advisories and sighting reports are broadcast periodically for these and surrounding areas by Coast Guard Broadcast Notice to Mariners, NAVTEX, NOAA Weather Radio, Cape Cod Canal Vessel Traffic Control and the Bay of Fundy Vessel Traffic Control and are included in the return message from the Right Whale Mandatory Ship Reporting (MSR) systems. General sighting information may be obtained by sending an e-mail to *ne.rw.sightings@noaa.gov* (northeast) or *se.rw.sightings@noaa.gov* (southeast).

(70) **Precautions when transiting right whale habitat and areas of recently reported right whale sightings:** NOAA recommends the following precautionary measures be taken to avoid adverse interactions with North Atlantic right whales:

(71) Before entering right whale habitat (See "Seasonal Occurrence" table), check Coast Guard Broadcast Notices to Mariners, NAVTEX, NOAA Weather Radio, Mandatory Ship Reporting (MSR) system, Cape Cod Canal Vessel Traffic Control and the Bay of Fundy Vessel Traffic Control as well as other sources for recent right whale sighting reports. Local ship pilots also have information on whale sightings and safe local operating procedures.

(72) Review right whale identification materials and maintain a sharp watch with lookouts familiar with spotting whales. Although right whales are large, their dark color and lack of a dorsal fin can make them difficult to spot.

(73) Avoid transiting through the right whale habitats and areas where right whales have recently been sighted. If transiting between ports within critical habitats, minimize transit distance. Route around observed or recently reported right whales and anticipate delays due to prudent seamanship in response to whale sightings. Avoid transits at night or during periods of low visibility.

(74) If a right whale is sighted from the ship or reported along the intended track of the ship, mariners should exercise caution, post a lookout and reduce speed to 10 knots when consistent with safe navigation. If a right whale is sighted, a vessel must steer a course away from the right whale and immediately leave the area at slow safe speed. Do not assume right whales will move out of the way of an approaching vessel. Mariners should keep in mind that it is illegal to approach a right whale closer than 500 yards. (See **50 CFR 224.103**, chapter 2 for limits, regulations and exceptions.)

(75) Any whale accidentally struck, dead whale carcass, and sighting of an injured or entangled whale should be reported immediately to the Coast Guard or NOAA National Marine Fisheries Service noting the precise location, date and time of the accident or sighting. Call 866–755–6622 for reports to NOAA for the area from Virginia to Maine or 877–942–5343 (877–WHALE–HELP) for the area from North Carolina to Florida. In the event of a strike or sighting of a dead, injured or entangled whale, the following information should be provided:

(76) location, date, and time of the accident or sighting of a carcass or an entangled whale,

(77) speed and course of the vessel,

(78) vessel specifications such as size and propulsion,

(79) water depth,

(80) environmental conditions such as visibility, wind speed and direction,

(81) description of the impact,

(82) fate of the animal, and

(83) species and size, if known.

(84) **Recommended two-way routes to avoid whales:** To reduce the possibility of vessel strikes with right whales, two-way routes were developed for vessels entering and transiting through Cape Cod Bay and arriving and departing the ports of Brunswick, GA, Fernandina Beach, FL, and Jacksonville, FL. The routes were developed from an analysis of historical right whale sightings and are designed to reduce the likelihood of adverse interactions between large vessels and right whales. The routes are found on the latest NOAA Nautical Charts. In July 2007, the northern leg of the Boston Traffic Separation Scheme (TSS) was shifted to direct ship traffic away from an area of high whale density. Use of the modified TSS is expected to considerably reduce the risk of striking a whale.

(85)

Mandatory Ship Reporting systems (MSR) WHALESNORTH and WHALESSOUTH

(86) Mandatory Ship Reporting (MSR) systems require all vessels 300 gross tons or greater to report to the U.S. Coast Guard upon entering two designated reporting areas off the east coast of the United States. (See **33 CFR 169**, chapter 2, for limits and regulations.) Sovereign immune vessels are exempt from the requirement to report but are encouraged to participate.

(87) The two reporting systems will operate independently of each other. The system in the northeastern United States will operate year round, and the system in the southeastern United States will operate each year from November 15 through April 15. Reporting ships are only required to make reports when entering a reporting area during a single voyage (that is, a voyage in which a ship is in the area). Ships are not required to report when leaving a port in the reporting area nor when exiting the system.

(88) Mariners should check all MSR messages carefully before transmittal to ensure the message includes the correct address and format. Additional greeting or comments in the message will preclude message receipt by the MSR system. Failure to receive a timely return message from the MSR system that provides locations of recent right whale sightings and precautionary guidance should be reported to the local Sector Office of the U.S. Coast Guard.

(89) **Northeastern reporting system/southeastern reporting system** (See **33 CFR 169.105** and **169.115**, chapter 2, for limits.)

(90) Vessels shall make reports in accordance with the format in IMO Resolution A.858 (20) in accordance with the International Convention for the Safety of Life at Sea 1974 (SOLAS 74). (See **33 CFR 169.135** and **169.140**, chapter 2, for additional information.) Vessels should report via INMARSAT C or via alternate satellite communications to one of the following addresses:

(91) Email: RightWhale.MSR@noaa.gov or Telex: 48156090.

(92) Vessels not equipped with INMARSAT C or Telex should submit reports to the U.S. Coast Guard's Communication Area Master Station Atlantic (CAMSLANT) via HF voice frequencies on 4125 kHz, 6215 kHz, 8291 kHz, 12290 kHz and 16420 kHz or by calling 1-800-742-8519x0. Vessels equipped only with VHF-FM voice communications should submit reports to the nearest U.S. Coast Guard Sector Office.

(93)

Right Whale MSR - Mandatory Ship Reporting
Example report:

WHALESNORTH

WHALES?NORTH//
M/487654321//
A/CALYPSO/NRUS//
B/031401Z APR//
E/345//
F/10.0//
H/031410Z APR/4104N/06918W//
I/BOSTON/032345Z APR//
L/WP/4104N/06918W/15.5//
L/WP/4210N/06952W/15.5//
L/WP/4230N/07006W/15.5//

WHALESSOUTH

WHALESSOUTH//
M/412345678//
A/BEAGLE/NVES//
B/270810Z MAR//
E/250//
F/10.0//
H/270810Z MAR/3030N/08052W//
I/MAYPORT/271215Z MAR//
L/RL/17.0//

Vessels should report via **INMARSAT C** or via alternate satellite communications to one of the following addresses:
Email: RightWhle.MSR@noaa.gov
Telex: 48156090

(94) Mariners should check all MSR messages carefully before transmittal to ensure the messages include the correct address and correct format. Additional comments in the message will preclude message receipt by the MSR system. Failure to receive a timely return message from the MSR system, providing locations of recent right whale sightings and precautionary guidance, should be reported to the local Sector Office of the U.S. Coast Guard.

(95)

Inside navigation

(96) Navigation on the waterways covered by this volume requires a knowledge of the channel conditions and other factors restricting navigation. General items of interest to the vessel operator are indicated in the paragraphs that follow; details are given in the text.

(97)

Speed

(98) Regulations are given in **33 CFR 162.65**, chapter 2.

(99)

Bends or curves

(100) In the Intracoastal and adjoining waterways there are many sharp bends that are dangerous to vessels meeting or passing. On approaching a bend, a vessel should reduce speed sufficiently to be able to stop within half the distance to a ship coming from the opposite direction. Under no circumstances should a vessel attempt to overtake and pass another at a bend. Even with sufficient view of the channel ahead and after proper exchange and understanding of signals, the overtaken vessel may suddenly veer from current action. This is even more pronounced with larger vessels and tows.

(101)

Crosscurrents

(102) Where two streams cross, the current will have a greater velocity in the deeper channel. This is noticeable along the Intracoastal Waterway where it follows a dredged canal cutting across a winding stream. Crosscurrents will also be noticed where either an inlet from the ocean or a drainage canal enter the waterway.

(103) Crosscurrents are especially strong at New River Inlet and Bogue Inlet, NC. Failure to allow for cross currents when passing these and other inlets is the cause of many rescue calls to the Coast Guard.

(104)

Spoil banks

(105) Nature quickly covers her scars. This is true of the spoil banks made by dredging. In the northern areas when awash these banks are often covered by grass, while in the southern areas they are covered by bushes and sometimes fairly large trees.

(106) **Water hyacinth** is a floating freshwater plant which infests numerous streams tributary to the South Atlantic and Gulf coasts. It has bright green leaves and a purple flower. It propagates from seeds and suckers, spreads quickly in most localities and may cause complete suspension of navigation if not removed. The hyacinths form in mats or jams and float around driven by the wind or current. In open water these mats often resemble small islands. At times some of the bays and tributaries may be changed in appearance because of hyacinth jams. Where the water is apt to be brackish, an attempt can be made to force a boat through the mat. In doing so, however, care should be taken that any logs that might be floating in the weeds are not struck with force enough to damage the hull. Snakes may also be found on the hyacinth mats. The work of removing this growth is undertaken by the various Corps of Engineers districts and the State of Florida by the processes of spraying and cutting and the use of booms.

(107)

Mangrove

(108) Three distinct types of mangrove are found in the southern section of this area. Yellow or white mangrove grows to a height of about 4 feet and is found principally on the sand flats in front of the fast land. Along the shores of Biscayne Bay, the red mangroves commonly grow to a height of 20 to 30 feet, with occasional stands 40 to 50 feet tall along the mainland coast south of Miami. Along the shores of Florida Bay, red mangroves generally grow 10 to 15 feet tall but occasionally grow to 25 feet. They are rooted in water most of the time. Black mangrove grows on sand ridges and higher ground that cover only at very high water or storm tides. The black mangrove sometimes grows to a height of 50 to 60 feet.

(109)

Stumps and sunken logs

(110) Reports are frequently made that vessels have struck shoals or rocks in rivers that have later proved to be stumps or sunken logs. Mariners are warned against navigating too close to the banks of streams where submerged stumps are known or may be expected to exist.

(111)

Hurricane moorings

(112) On receiving advisory notice of a tropical disturbance small boats should seek shelter in a small winding stream whose banks are lined with trees, preferably cedar or mangrove. Moor with bow and stern lines fastened to the lower branches; if possible snug up with good chafing gear. The knees of the trees will act as fenders and the branches, having more give than the trunks, will ease the shocks of the heavy gusts. If the banks are lined only with small trees or large shrubs, use clumps of them within each hawser loop. Keep clear of any tall pines as they generally have shallow roots and are more apt to be blown down.

(113)

Manatees

(114) The West Indian manatee is a herbivorous marine mammal that is protected at the federal level by the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. These acts make it illegal to harass, hunt, capture or kill any marine mammal, including all dolphins, whales and manatees. The manatee is a large (approximately 8 to 10 feet in total length) and slow-moving marine mammal with a torpedo-like body and a paddle-shaped tail. These animals mainly inhabit the estuarine and inland waters of Florida, although they have been sighted in the Atlantic Ocean and Gulf of Mexico and have been seen as far north as Massachusetts and as far west as Texas. Due to their sensitivity to colder temperatures, in the winter manatees move from cooler waters and congregate, sometimes in large numbers, in warmer rivers and springs, streams and canals and near the cooling water discharge outlets of power plants and other industrial sources. During the spring and autumn months, many manatees undertake extensive migrations along the Atlantic and Gulf Coasts. Manatee distribution in the warmer months of the year is typically more widespread.

(115) Manatees need to surface regularly to breathe, approximately every 2 to 10 minutes, but are capable of holding their breath for up to 20 minutes. Calves are approximately 3 feet in length at birth and stay with the mother for a period of up to 2 years. During this time, they nurse regularly from the mother and take more frequent breaths than a larger adult. This mother-calf bond is very important and critical to the survival of the calf; it is very important that the mother and calf do not become separated. Manatees are typically solitary in nature, found as a cow-calf pair or found in small groups. However, when a female is in estrus, she may be accompanied by large numbers of males, typically referred to as a mating herd.

(116) Statewide aerial surveys (synoptic surveys) are conducted following significant cold weather to provide a minimum population estimate for manatees in Florida waters. In January 2009, the synoptic survey resulted in a total count of 3,802 manatees on both the east and west coasts of Florida. This is a minimum count, and it is reasonable to assume that some manatees were not detected during the surveys. Manatees are quite docile and have no natural enemies but are an endangered species, mostly due to collisions with boats that have caused as many as 95 deaths per year. Watercraft-related mortality may result from injuries caused by the propeller and/or impact from a collision with a vessel. As such, manatee protection speed zones (ranging from no entry zones to

30 miles per hour zones) exist around the State of Florida to provide additional protection in areas of high manatee use and high watercraft-related mortality.

(117) The Florida Manatee Sanctuary Act authorizes the Florida Fish and Wildlife Conservation Commission (FWC) and, in some cases, local governments to regulate motorboat speed and operation in areas frequently used by manatees. The **regulated zones** are marked by large reflective signs or buoys. In these zones, boat operators must operate their vessels at or below the established limits, and no person may intentionally or negligently annoy, molest, harass, disturb, collide with, injure or harm manatees. Maps of the state zones are available on the internet at *MyFWC.com*. Questions about the state regulations should be directed to the FWC Imperiled Species Management Section, 620 South Meridian Street, Tallahassee, FL 32399. **Regulated zones** within the area covered by this Coast Pilot are in the St. Johns River generally between Lake George and Lake Monroe (includes the area around Blue Springs Run) and in the northern stretch of the river generally between the river mouth at Mayport and the Doctors Lake and Julington Creek area; and throughout most of the Atlantic Coast counties between Duval and Miami-Dade (as well as in many of the Gulf Coast counties between Collier and Citrus).

(118) The U.S. Fish and Wildlife Service has established **regulated zones** within the Merritt Island National Wildlife Refuge to protect the large number of manatees that occupy these waters from April through mid-November. "Idle speed" and/or "slow speed/minimum wake" areas are in Haulover Canal, Bairs Cove on the southeast side of Haulover Canal, Banana Creek at the north end of Merritt Island and in the channel and basin at the Kennedy Athletic and Recreation Society marina on the west side of Banana River 1.5 miles north of Canaveral Barge Canal. The area on the east side of Banana River immediately south of the NASA Parkway is closed to all motorized craft from April 1 through November 14 annually. The **regulated zones** are well marked by signs that indicate the speed limit. The regulations are contained in **50 CFR 26** (not carried in this Coast Pilot). Maps delineating the **regulated zones** are available from the Merritt Island National Wildlife Refuge, P.O. Box 6504, Titusville, FL 32780.

(119)

Tides

(120) On the outer coast the mean range of tide increases from 2.8 feet at Cape Henry to 5.9 feet at Edisto Beach. In the sounds and rivers south to Florida the range is generally greater, reaching 8.0 feet or more at some locations. Along the east coast of Florida the average tide range is about 2.5 feet, and in the Florida Keys the ranges vary from 0.2 feet to 2.4 feet. See the Tidal Current prediction service at *tidesandcurrents.noaa.gov* for specific information about times, directions, and velocities of the current at numerous locations throughout the area. Links to a user guide for this service can be found in chapter 1 of this book.

(121)

Currents

(122) It appears that, except during northerly and northeasterly winds, a current of about 0.5 knot average velocity, setting northeastward with the trend of the coast, may be expected outside the 10-fathom curve between Cape Canaveral and Cape Hatteras. Farther offshore the velocity of the northeastward flow increases as the axis of the Gulf Stream is approached.

(123) Strong currents are produced by the wind along the coast during northeasterly and southerly gales, reversing or greatly increasing the normal current. Their velocity and direction depend upon the direction, strength and duration of the wind. See the Tidal Current prediction service at *tidesandcurrents.noaa.gov* for specific information about times, directions, and velocities of the current at numerous locations throughout the area. Links to a user guide for this service can be found in chapter 1 of this book.

(124) The **Gulf Stream System** is the most famous of the principal ocean currents. The name was first used by Benjamin Franklin in 1769. In general, as the swift current of the Gulf Stream issues into the sea through Straits of Florida, its waters are characterized by a deep blue color, high salinity, high temperature in the upper stratum and presence of phosphorescence. Except near shoals where waves may stir up bottom sediments, Gulf Stream water is very clear, enabling visual penetration to unusually great depths. At its junction with coastal seawater, the edges may frequently be recognized in moderate weather by ripples, as well as by the difference in color. Northward, in the cooler regions, the evaporation from its surface, when the temperature of the air is lower than that of the water, is apparent as "sea smoke." In addition, the stream may carry with it some **Gulf weed** (Sargassum), which is olive brown, branched seaweed with berrylike air vessels.

(125) The upstream extent of the Gulf Stream System can be traced to the Yucatan Strait where a well-established current enters the Gulf of Mexico. The current in the Gulf of Mexico is called the **Loop Current.** The position of the Loop Current is quite variable, but there is some evidence of a cyclical pattern of about 290 days. The Loop Current begins with a short flow pattern protruding into the Gulf of Mexico, then it slowly builds up, gradually protruding northward and westward into the Gulf and reaching as far as 28°N and 90°W before shedding a large warm ring. The remaining Loop Current has a shortened flow path and begins the process anew. The large detached warm ring will drift about 1.5 miles per day west to southwestward into the western Gulf of Mexico where it will eventually dissipate. Gulf of Mexico warm rings average about 120 miles in diameter. The warm ring has a clockwise flow with a maximum current close inside its periphery of 0.5 to 1.5 knots.

(126) After entering the Straits of Florida between Cuba and the Florida Keys, the Gulf Stream System's path becomes much more stable. The major variation of the current from off Key West to off Little Bahama Bank appears to be a meandering of the axis of the current within the narrow confines of the Straits. The current within the Straits and slightly to the north is frequently referred to as the **Florida Current**.

(127) Shortly after emerging from the Straits of Florida, the Gulf Stream is joined by the **Antilles Current**, which flows northwesterly along the open ocean side of the West Indies. The Antilles Current, like the Gulf Stream, carries warm, highly saline waters of clear indigo blue. The union of the two currents gives rise to a broad and deep current possessing about the same characteristics as the Florida Current except that the velocity is somewhat reduced. The Gulf Stream from the Florida Straits flows northward, then northeastward, paralleling the general trend of the 100-fathom contour up to Cape Hatteras. From 32°N to Cape Hatteras the stream shows some lateral meandering that does not generally exceed one stream width, or about 40 miles.

(128) Beyond Cape Hatteras the Gulf Stream flows eastward away from the coast and into much deeper water. As it moves into progressively deeper water, the stream is subject to increased meandering that can have as large a north-south extent as 270 miles. The wavelike meanders of the stream propagate eastward at speeds of about 3 to 5 miles per day. These meanders occasionally shed detached current rings or eddies that are found north and south of the stream and that are respectively warmer and cooler than the surrounding waters. Rings are generally formed east of 65°W.

(129) Warm rings average about 70 miles in diameter and are found north of the stream between it and the continental shelf. Warm rings rotate in a clockwise direction with a maximum flow of about 1.6 knots located about 2/3-3/4 from the center of the eddy. Warm rings generally move about 1.5 miles per day westward after formation in the region between the stream and the continental shelf to about 70°W. From 70°W the rings generally move southwestward along the continental shelf and eventually are absorbed into the stream near Cape Hatteras. Many warm rings are absorbed by the stream well before they reach Cape Hatteras. About 20 warm rings are formed each year and average about a 20-week life cycle. Cold rings average about 60 miles in diameter and are found south of the stream in the Sargasso water region. Cold rings rotate in a counterclockwise direction with a maximum flow of about 1.6 knots located 2/3-3/4 from the center. Cold ring velocities can be significantly higher than 1.6 knots. Cold rings tend to move about 1.5 miles per day southwestward after formation and are eventually absorbed back into the Gulf Stream. About 20 cold rings are formed each year and average about a 1.5-year life cycle.

(130) Eastward of the Grand Banks of Newfoundland, the whole surface is slowly driven eastward and northeastward by the prevailing westerly winds to the coastal waters of northwestern Europe. For distinction, this broad and variable wind-driven surface movement is sometimes referred to as the **North Atlantic Drift.**

(131) On its western or inner side, the Gulf Stream is separated from the coastal waters by a zone of rapidly falling temperature, to which the term **north wall (west wall** from Georgia south) has been applied. The abrupt change in the temperature of the waters separated by the north wall (west wall) is frequently very striking and is a definite indication of the edge of the stream. It is most clearly marked north of Cape Hatteras but extends, more or less well defined, from the Straits of Florida to the Grand Banks of Newfoundland. In the vicinity of the Grand Banks, the north wall represents the dividing line between the warm current of the Gulf Stream and the cold waters of the **Labrador Current**, which according to observations, turns sharply, between 42°-43°N and 51°-52°W, and flows parallel to the Gulf Stream.

(132) Throughout the whole stretch from the Florida Keys to past Cape Hatteras the stream flows with considerable velocity. Characteristic average surface speed is on the order of 2.5 knots, increasing to about 4.5 knots off Cape Florida where the cross-sectional area of the channel is least. These values are for the axis of the stream where the current is a maximum, the speed of the stream decreasing gradually from the axis as the edges of the stream are approached. The axis of the stream is estimated to be about 3 to 15 miles seaward of the north wall. Both the speed and position of the axis of the stream fluctuate from day to day, hence description of both position and speed are averages.

(133) Crossing the stream at Jupiter or Fowey Rocks, an average allowance of 2.5 knots in a northerly direction should be made for the current.

(134) Crossing the stream from Habana, a fair allowance for the average current between 100-fathom curves is 1 knot in an east-northeasterly direction.

(135) A vessel bound from Cape Hatteras to Habana, or the Gulf ports, crosses the stream off Cape Hatteras. A fair allowance to make in crossing the stream is 1 to 1.5 knots in a northeasterly direction for a distance of 40 miles from the 100-fathom curve.

(136) Earlier systematic observations on the Gulf Stream dealt with the temperature of the water rather than its motion, and the axis was taken to be along the line of highest temperature obtained. Later the axis was taken to mark the line of greatest velocity. Ordinarily it is assumed that these two axes coincide, but this is by no means certain. The thermometer, although it indicates the limits of the stream in a general way, is therefore only an approximate guide to the velocity of the currents.

(137) The lateral boundaries of the current within the Straits of Florida are fairly well fixed, but as the stream crosses 32°N its eastern boundary becomes somewhat vague. On the western side the limits can be defined approximately since the waters of the stream differ in color, temperature, salinity, and flow from the inshore coastal waters. On the east, however, the Antilles Current

combines with the Gulf Stream so that its waters here merge gradually with the waters of the open Atlantic. Observations of the National Ocean Service indicate that, in general, the average position of the inner edge of the Gulf Stream from the Straits of Florida to Cape Hatteras lies inside the 100-fathom curve.

(138) At the western end of the Straits of Florida the limits of the Gulf Stream are not well defined. Between Fowey Rocks and Jupiter Inlet the inner edge lies very close to the shoreline.

(139) Along the Florida Reefs between Alligator Reef and Dry Tortugas the distance of the northerly edge of the Gulf Stream from the edge of the reefs gradually increases toward the westward. Off Alligator Reef it is quite close inshore, while off Rebecca Shoal and Dry Tortugas it is possibly 15 to 20 miles south of the 100-fathom curve. Between the reefs and the northern edge of the Gulf Stream the currents are ordinarily tidal and are subject at all times to considerable modification by local winds and barometric conditions. This neutral zone varies in both length and breadth; it may extend along the reefs a greater or lesser distance than stated, and its width varies as the northern edge of the Gulf Stream approaches or recedes from the reefs.

(140)

Location of the Gulf Stream

(141) The approximate position of the Gulf Stream for various regions is shown on National Ocean Service charts for Straits of Florida; the Gulf of Mexico; Cape Canaveral to Key West; and Havana to Tampa Bay. The axis and the position of the inner edge of the Gulf Stream is depicted from Cape Hatteras to Straits of Florida.

(142) Up-to-date information on the location, width, and maximum surface temperature of the Gulf Stream System is available in a variety of ways. Such information is broadcast by NOAA Weather Radio stations from Key West, Florida, to Cape Hatteras, North Carolina. The times of these broadcasts and their formats vary from station to station, but in general, all give the distance to the inshore edge of the Stream with reference to a navigational light or buoy, the width of the Stream when that is known and the maximum temperature. This information is derived largely from infrared satellite imagery, and it is unfortunately not available during the warmer summer months south of about Jupiter Inlet. (See Appendix A for a list of NOAA Weather Radio stations.)

(143) Gulf Stream System analysis from the Gulf of Mexico to Cape Hatteras can be accessed through NOAA's Operational Model Archive and Distribution System (NOMADS) at *ecowatch.ncddc.noaa.gov*.

(144) Gulf Stream location information is included in the coastal waters forecast synopsis, generated by the National Weather Services Weather Forecast Offices in Florida. These offices are in Melbourne, Miami and Key West, and the synopsis is available on their respective websites at *nws.noaa.gov/om/marine/marine_map.htm*.

(145) **Wind-driven currents** are very complicated. Their velocities and directions depend upon a number of factors such as the velocity, direction and duration of the wind, the proximity of the coast and the direction of the coastline. Generally in the Northern Hemisphere the wind-driven current sets somewhat to the right of the wind, but in coastal waters there are many exceptions to this general rule, the current often setting to the left of the wind, due to the tendency of the current to follow the direction of the coastline or to other local conditions.

(146) The velocity of the wind current relative to that of the wind also varies with the locality. See the Tidal Current prediction service at *tidesandcurrents.noaa.gov* for specific information about times, directions, and velocities of the current at numerous locations throughout the area. Links to a user guide for this service can be found in chapter 1 of this book.

(147)

Weather

(148) From hurricanes to "Nor'easters" these coastal waters are plagued with potential weather hazards year round. The Gulf Stream, local currents and numerous shoals complicate matters. The following text describes the weather problems that face the mariner. The individual chapters contain information on local weather hazards. Government radio stations that transmit weather information and National Weather Service offices are listed in Appendix A. Climatological tables for coastal locations and ocean areas, compiled from ship observations, follow Appendix A. This text was produced by the National Oceanographic Data Center.

(149)

Extratropical cyclones

(150) One of the more frequent weather features the mariner encounters along the coast is the winter storm or "Nor'easter." These extratropical systems can develop in any month. Their size can vary from an insignificant wave along a front to a gigantic circulation that covers most of the western North Atlantic. Winds can reach hurricane force and seas of 40 feet (12 m) and more have been encountered. While these storms are usually well forecasted they can develop or deepen explosively, particularly off Cape Hatteras, over the Gulf Stream, giving rise to the term "Hatteras Storms."

(151) These winter storms, present in all months, are most frequent and intense from November through March. December, January and February are the heart of the season, when an average of four to six storms per month roam these waters. Many systems develop in the Gulf of Mexico, move across central or northern Florida, then up the East Coast. Some of the most intense storms have developed early and late in the season. In March 1962 a slow-moving, late winter coastal storm combined with spring tides and wrought tremendous destruction from Florida to New England. Persistent northeasterlies and a long fetch raised spring tides to near record levels and generated high seas in the open ocean. Several ships were

caught, including a tanker that broke in two off Cape Hatteras. During the Veterans Day storm in November 1968 a ship near Ocracoke Inlet ran into 35-foot seas in 60-knot winds.

(152) In March 1993, the "Storm of the Century," a slow-moving late winter coastal storm, combined with spring tides and wrought tremendous destruction from Florida to New England. From hurricane-type storm surge and winds along the upper Gulf Coast of Florida to record snowfalls in the southern and central Appalachians and a first-time-ever interruption of air travel at every airport east of the Mississippi, the March 1993 extratropical low pressure system will be a storm long remembered.

(153)

Cold fronts

(154) These often sharp boundaries between relatively warm air ahead and cold air behind usually approach this coast from the west through north. Ahead of the front, winds are usually squally and often blow out of the south through southwest. Cirrus clouds give way to Altocumulus or Altostratus and Nimbostratus, then Cumulonimbus. Pressure falls moderately, and showers, and perhaps thunderstorms, occur. Seas become choppy. With the frontal passage winds shift rapidly to the west and northwest. Strong gusts and squalls continue. Clearing usually occurs a short distance behind the front as the cold air moves in. Cold fronts can move through the northern part of the area quite rapidly. Their speeds vary from about 10 to 20 knots in summer up to 40 knots in winter. Often, cold fronts remain north of this coast. Their frequency decreases with latitude. During the winter season strong arctic and polar outbreaks occasionally push southward to Florida and in rare instances cold fronts reach the Florida Keys. In other seasons these outbreaks are not strong enough to reach the southern part of this coast.

(155) During the spring and summer when the air ahead of the cold front may be very unstable, a line of thunderstorms, known as a squall line, may develop. These instability lines can form 50 to 300 miles (93 to 555 km) ahead of a fast-moving front. They may even contain tornadoes or waterspouts. These storms can inflict considerable damage on fishing vessels and small craft.

(156)

Tropical cyclones

(157) A tropical cyclone is a warm-core, low-pressure system that develops over tropical oceans. It exhibits a rotary, counterclockwise circulation in the Northern Hemisphere around a center or "eye." In small tropical cyclones the diameter of the area of destructive winds may not exceed 25 miles (46 km), while in the greatest storms the diameter may reach 500 miles (925 km). At the center is a comparatively calm, sometimes clear, area known as the eye. The diameter of the eye can vary from about 5 to 25 miles (9 to 46 km). Winds are usually strongest near the center. They can reach 175 knots or more in an intense hurricane. In the North Atlantic Region (West Indies, Caribbean Sea, Gulf of Mexico and waters off the U.S. east coast) the following terminology is used in tropical cyclone warnings issued by the National Hurricane Center (National Weather Service):

(158) (1) Tropical Depression. A tropical cyclone in which the maximum sustained surface wind (1-minute mean) is 33 knots or less.

(159) (2) Tropical Storm. A tropical cyclone in which the maximum sustained surface wind (1-minute mean) ranges from 34 knots to 63 knots.

(160) (3) Hurricane. A tropical cyclone in which the maximum sustained surface wind (1-minute mean) is 64 knots or more.

(161) While the following term is not normally used in tropical cyclone advisories it may appear in related products.

(162) Tropical wave–A minor cyclonic circulation in the easterly tradewinds, which could develop into a tropical depression but lacks evidence of a closed circulation; also known as easterly wave.

(163) With the advances in observations through satellite, a hybrid storm, called a subtropical cyclone, has been discovered. The character of this storm lies between the tropical and extratropical cyclone. It is often short lived and dissipates without developing beyond the depression stage. Those that intensify occasionally change character and become tropical storms or hurricanes. While subtropical they are designated as a depression or storm (no upper wind limit) similar to tropical systems.

(164) Along the coast greater damage may be inflicted by water than by wind. Prolonged winds blowing toward shore can increase water levels from about 3 to 10 feet (1 to 3 m) above normal. This storm tide may begin when the tropical cyclone center is 500 miles (925 km) or more away. It gradually increases until the winds change direction. On top of this the low pressure in the storm's center can create a ridge or wall of water known as a surge. This will move in the direction of the storm's movement and can be disastrous. The effect may be similar to that of a tsunami (seismic sea wave) caused by earthquakes in the ocean floor. Storm surges can push these tides to 20 feet (6 m) or more above normal. About 3 or 4 feet (0.9 or 1.2 m) of this is due to the decrease of atmospheric pressure and the rest to the strong winds. Additional water damage results from the pounding of sea and swell. Torrential rains, generated by tropical cyclones, can cause both flash floods and river floods from inland rains.

(165)

Tropical cyclone climatology

(166) In an average season nine or ten tropical cyclones develop and five of these reach hurricane strength; about two hurricanes reach the U.S. While they may develop in any month, June through November is generally considered the tropical cyclone season, with a peak in August, September and October. Early and pre-season

storms, from May through mid-July, are most likely to originate in the western Caribbean Sea and Gulf of Mexico. From mid-July through late September this development is spread through the main basin of the tropical Atlantic and a much more persistent westerly movement is noticeable. From late September through November, activity gradually confines itself to the Caribbean and Gulf of Mexico. A northerly movement, similar to early season storms, becomes more apparent. However, because of the large reservoir of heat available at the end of the season, these storms are often more intense than their early-season counterparts.

(167) The most common path is curved, the storms first moving in a general westward direction, turning later to the northwestward and finally toward the northeast. A considerable number, however, remain in low latitudes and do not turn appreciably toward the north. Freak movements are not uncommon, and there have been storms that described loops, hairpin-curved paths, and other irregular patterns. Movement toward the southeast is rare, and, in any case, of short duration. The entire Caribbean area, the Gulf of Mexico, the coastal regions bordering these bodies of water and the Atlantic coast are subject to these storms during the hurricane season.

(168) The average speed of movement of tropical cyclones is about 10 to 15 knots. This speed, however, varies considerably according to the storm's location and development and the associated surface and upper air patterns. The highest rates of speed usually occur in the middle and higher latitudes and range up to 40 to 50 knots. Storms are slowest during recurvature or when looping. They can also become stationary in the absence of steering currents.

(169)

Hurricane warnings and forecasts

(170) The civilian hurricane warning service for the North Atlantic is provided by the National Hurricane Center/Tropical Prediction Center, Miami, Florida. They collate ship, aircraft, radar and satellite data to produce and issue tropical cyclone warnings and forecasts for the North Atlantic Ocean, including the Caribbean Sea and Gulf of Mexico. The principal product is the Tropical Cyclone Advisory message especially tailored for marine, aviation, military and public interests. They are issued every 6 hours with intermediate bulletins provided when needed.

(171) For tropical storms and hurricanes threatening to cross the coast of the U.S., coastal warnings are issued to the public by the National Hurricane Center through local Hurricane Warning Offices in order that defense against damage, and perhaps evacuation, can be implemented. Two levels of warnings are employed. The "Hurricane Watch" is a preliminary alert that a hurricane may threaten a specified portion of the coast. It is issued approximately 36 hours before landfalls could occur. The second level is the "Hurricane Warning," which indicates that hurricane conditions are expected within 24 hours in advance of landfall. It is aimed at providing the best compromise between timeliness and accuracy for civil defense purposes to allow for ocean-going vessels to get underway and complete a successful evasion in open water. To compensate for this, the Marine Advisory contains additional guidance in the form of probabilities of hurricane strikes, for coastal locations and even offshore coordinates, and storm position forecasts for up to 72 hours in advance.

(172)

Hurricane havens

(173) The text for this section has been condensed from the **Hurricane Havens Handbook for the North Atlantic Ocean**, published by the Marine Meteorology Division, Naval Research Laboratory, Monterey, CA 93943, and available at *nrlmry.navy.mil/pubs.htm*. The navigational information may be applied to extratropical cyclones as well. Summaries for individual ports, where available, can be found in the appropriate chapters. The complete publication is available through the National Technical Information Service, Springfield, VA 22161 (*ntis.gov*).

(174) The classical doctrine held by most mariners is that ocean-going ships should leave ports that are threatened by a hurricane. Despite this natural caution, ships continue to be damaged in port or after leaving port, as a result of tropical cyclone encounters. This often stems from the difficulty in forecasting tropical cyclone movement, although these forecasts have improved significantly in the past two decades. In addition to evaluating the forecast it is necessary to assess the risks of remaining in port or putting to sea according to the circumstances of the threat, the facilities of the port and the capabilities of the vessel and crew. For an evaluation as to a course of action several factors are important. The risk of a particular port experiencing a hurricane is often dependent on seasonal and geographic influences. Forecasts of hurricane movements are more reliable in some areas, particularly the lower latitudes. In the midlatitudes where storms are often recurving, the difficulty increases. It is important to know the sheltering capabilities of the port that is being considered and the speed of advance of tropical cyclones in the latitudes that you may be sailing. When the tropical cyclone speeds approach or exceed vessel speed, options become limited.

(175) Large changes in the balance of these factors that may affect a leave/stay decision are evident all along the Atlantic coast. At Charleston, SC, for example the threat of a hurricane is moderate as is the average forecast error. The speed of storm advance is relatively low for both average and extreme values. These factors suggest a relatively low risk of damage at sea if an evasion is executed as early as possible. Ports in the Mayport area have the potential of being fairly good hurricane havens despite their conspicuous lack of shelter, because of the rarity of serious hurricane threats and the prospects of a safe escape to sea when needed; this is due to the low speeds of advance of near-coastal storms and relatively

low forecast error. Two ports with a high risk of hurricane threats, Key West and Morehead City, show a large contrast in the remaining leave/stay decision factors. Hurricanes at Key West appear predictable and easy to evade at sea. However, the combination of unpredictability and relatively high speed of advance of near-coastal storms affecting North Carolina marks Morehead City as a less secure port to occupy during the hurricane season than Key West, and one from which evasion at sea carries a higher risk of damage.

(176) In the northeast, certain ports have the potential to offer good hurricane haven qualities because of the low risk of a hurricane threat in conjunction with topographic shelter. In addition the risk of misjudging the threat, due to relatively large forecast errors, is considerable. Furthermore, the risk of sustaining damage in attempting to evade at sea is increased by the usually fast-moving storms. This combination should encourage mariners in this region to regard evasion at seas as a last resort.

(177) Along the U.S. Gulf of Mexico coast there is a reduced flexibility in evasion options created by the shape of the Gulf. This biases the leave/stay decision in favor of an early departure, which effectively reduces the accuracy of the threat prediction. The large range of possible speeds of storms affecting the coast from Pensacola to New Orleans should encourage even earlier departure. The net result is that Gulf ports should be considered "high risk" ports similar to Key West and Morehead City. Additionally, local factors in the Gulf area further diminish the security of many ports. For example, the strong impact of the storm surge, in many places, leads to the closure of ports due to sudden silting of their long, dredged approach channels.

(178) A sudden unexpected change in the speed or direction of movement of a tropical cyclone, or a change in its intensity, may call for a hasty departure from port in deteriorating weather.

(179) However, limitations in manpower, port tug facilities or the state of readiness of the ship's machinery will increase the risk of the vessel being damaged during departure. Furthermore, the chances of gaining sufficient sea room in heavy weather to avoid damage after leaving port are also decreased. The odds for preventing serious damage to the vessel in these circumstances swing in favor of using the resources available to secure the ship firmly to her berth. These measures should include laying anchors into the channel or basin to hold her away from the pier or wharf face. This is particularly important in preventing damage to both vessel and pier if storm tides flood the wharf. These tidal effects will require lines to the pier to be tended until the hurricane threat is well passed. Certain merchant vessels may also consider ballasting down if the bottom at the berth is likely to be clear of obstacles. Under pressure of these circumstances, proceeding to anchor or moor is a less attractive alternative unless both the resources to accomplish the move safely and the assurance of an authenticated hurricane mooring or anchorage are available.

(180) Of the 81 tropical cyclones that threatened Cape Hatteras (came within 50 nautical miles (93 km)) during the period 1842–1995, 67 occurred during the months of August, September and October. As with the entire Atlantic basin, the main threat is in September. Due to the location of the Cape, its extension out into the Atlantic from the mainland, the predominant direction from which storms arrive is from the south or southeast. Since 1950, 32 storms have come within 50 nm (93 km) of the Cape. Perhaps the two most memorable storms of recent times are hurricane Donna in 1960 and hurricane Gloria in 1985. Donna, in September 1960, came ashore near Morehead City with highest sustained winds of 95 knots and passed about 50 nm miles (93 km) west of Cape Hatteras while maintaining that intensity. Gloria passed directly over the Cape on September 27, 1985, with 90-knot winds. The maximum wind at Cape Point was 64 knots.

(181) Of the 60 tropical cyclones that threatened Charleston during the period 1842-1995, 46 occurred during the months August, September, and October. By far the greatest threat is in September. The predominate direction from which the storm arrives is from the Southwest and usually has weakened greatly since making initial landfall along the Gulf Coast and crossing several hundred miles (> 450 km) of land. Since 1950, 23 storms have come within 50 nm (93 km) of Charleston. Perhaps the two most memorable storms of recent times are hurricane David in 1979 and hurricane Hugo in 1989. David came ashore near Savannah Beach, Georgia and raked the Charleston area with gusts of 85 knots. Ten years later, Hugo came ashore at Sullivans Island, just north of Charleston, with peak winds of 120 knots. Downtown Charleston reported winds of 76 knots with gusts to 94 knots while the airport had sustained winds of 68 knots with gusts to 85 knots. The maximum one-minute wind at Bulls Bay, near the point of impact, was estimated in excess of 120 knots.

(182) Of the 59 tropical cyclones that threatened Daytona Beach during the period 1842–1995, 47 occurred during the months August, September and October. By a narrow margin, the greatest occurrence is in September. The predominant direction from which the storm arrives is from the south or southwest. Since 1950, 22 storms have come within 50 nm of Daytona Beach. Hurricane Donna is likely the most memorable storm to affect the Daytona Beach area in recent memory. On September 11, 1960, Donna crossed the central Keys moving to the northwest and abruptly turned northward crossing the southwest Florida coast near Naples. From there, Donna continued north-northeastward, up the spine of the peninsula, moving back out over open water north of Daytona Beach. The maximum wind at landfall was estimated near 135 miles per hour (60 m/s) with gusts to 150 miles per hour (67 m/s), and winds were still 90 miles per hour (40 m/s) by the time the storm reached the Daytona Beach area.

(183) Of the 58 tropical cyclones that threatened Miami during the period of 1842–1995, 52 occurred during the months of August, September and October. At this

latitude, along with the proximity of the Caribbean Sea and much warmer water, October is the most likely month of occurrence. The predominant direction from which the storm arrives is from the south or southeast. Since 1950, approximately 24 storms have come within 50 nm of Miami. Hurricane Cleo in 1964 and Hurricane Andrew in 1992 are likely the most noteworthy storms to impact Miami. Hurricane Cleo was a very small storm and did little damage. Cleo passed near Miami on August 27, 1964 with maximum winds of 110 miles per hour (49 m/s) and gusts to 135 miles per hour (60 m/s). Hurricane Andrew passed just south of Miami on August 24, 1992. Andrew ravaged Homestead, Florida in the early morning hours with winds in excess of 150 knots on a path that traveled across south Florida in approximately four hours.

(184)

Tropical cyclones at sea

(185) Few experiences rival that of encountering a full-blown hurricane at sea. However, even if there were no transmitted advisories, nature provides its own tropical warnings. Several days before its arrival, the hurricane heralds its existence.

(186) Swells that were passing the ship at ten to fifteen per minute increase in length and now pass at about two to five per minute. The direction from which they arrive marks the relative bearing of the storm.

(187) A second rough fix may be obtained by adding 115° (Northern Hemisphere) to the direction from which the wind is blowing.

(188) Another indicator is the barometer. In the tropics there is a normal rise and fall of barometric pressure with the high points at about 1000 and 2100 LST. When the storm is 500 to 1,000 miles (925 to 1850 km) away the barometer may rise slightly and then a pumping action may begin. When it starts a steady fall, activity is brewing.

(189) When the storm is about 300 to 600 miles (555 to 1,110 km) away, white, fibrous, cirrus clouds ("mare's tails") appear in a nearly cloudless sky. These seem to converge in the direction from which the storm is approaching, particularly at sunrise and sunset. The barometer continues to fall. The cirrus gives way to a veil of cirrostratus followed by altostratus, then stratocumulus. Mist-like rain is interrupted by an occasional shower as the barometer drops about 4 millibars. Winds become gusty and increase to about 22 to 40 knots. On the horizon appears a dark wall of heavy cumulonimbus, the bar of the storm. Portions of this cloud occasionally break off and drift across the sky accompanied by gusty rain squalls. As the bar approaches, from the direction of the storm's center, the barometer falls more rapidly. Windspeeds increase. Seas become steeper. Squall lines sweep past in ever-increasing number and intensity.

(190) The arrival of the bar is accompanied by dark skies, nearly continuous squalls, a steep-falling barometer and rapidly increasing winds. The hurricane center may still be 100 miles (185 km) away. As the center approaches, winds whip through the superstructure. Seas become mountainous. Wave tops are blown off to mingle with torrential rain that fills the air with water. Visibility drops to near zero. Survival becomes the prime consideration.

(191) The eye brings a sudden drop in winds. Rain stops and skies may clear enough to see the sun. Mountainous seas approach from all sides. The barometer reaches its lowest point, which may be 50 to 100 millibars below normal. As the wall cloud on the opposite side of the eye arrives, the full fury of the storm returns as suddenly as it ceased, with winds blowing from the opposite direction. The sequence of conditions is reversed and passes more quickly as the circulation is usually smaller in the rear of the storm.

(192)

Maneuvering for a tropical cyclone

(193) Knowledge is the most important aid when a tropical cyclone is threatening. It is vital to know the storm's position, intensity and projected movement and how to react to this information. By plotting the center as provided in the warnings, possibly even adjusting its position with a radar fix or local signs, its position in relation to the vessel can be determined.

(194) Shipboard radar provides the mariner with an advantage, and if radio-facsimile charts are available the advantage is even greater. The mariner is even more fortunate if his ship has the appropriate satellite receiving-recorder, either facsimile or photographic, to position the cloud patterns of the storm as it moves. If, despite warning systems and forecasts, a storm catches up with the ship, prepare for the worst.

(195) There are three major schools of thought concerning ship handling in hurricanes. They may be described as active, passive and defensive:

(196) Active: Take an evasive course and get out of the storm.

(197) Passive: Shut down and wallow.

(198) Defensive: Just maintain steerageway, keeping the wind and seas either off the bow or the quarter.

(199) The course of action will depend on the size and intensity of the storm, the nature and condition of the ship, the proximity to shoal water, and other factors that can only be determined by the master. While the vessel can still make considerable way through the water, a course should be selected to take it as far as possible from the center. If the vessel can move faster than the storm, it is a relatively simple matter to outrun the storm if sea room permits. But when the storm is faster, the solution is not as simple. In this case, the vessel, if ahead of the storm, will pass closer to the center. The problem is to select a course that will produce the greatest possible minimum distance. This is best determined by means of a relative movement plot.

(200) In the Northern Hemisphere, that part of the circulation to the right of the storm track (facing in the direction toward which the storm is moving) is called the dangerous semicircle. It is considered dangerous because (1) the actual wind speed is greater than that

due to the pressure gradient alone, since it is augmented by the forward motion of the storm, and (2) the direction of the wind and sea is such as to carry a vessel into the path of the storm (in the forward part of the semicircle). The circulation to the left of the storm track is known as the navigable semicircle, where the wind is slowed by the storm's motion and vessels are pushed away from the path. Seas are usually lower in this portion. In an ideal situation the following general guidelines could be used:

(201)

Right or dangerous semicircle

(202) Bring the wind broad on the starboard bow (045° relative), hold course and make as much way as possible. If obliged to heave to, do so with head to the sea.

(203)

Left or navigable semicircle

(204) Bring the wind onto the starboard quarter (135° relative), hold course and make as much way as possible. If obliged to heave to, do so with stern to the sea.

(205)

On storm track, ahead of center

(206) Bring the wind two points abaft the starboard quarter (157½° relative), hold course and make as much way as possible. When well within the navigable semicircle, maneuver as indicated above.

(207)

On storm track, behind center

(208) Avoid the center by the best practical course, keeping in mind the tendency of tropical cyclones to curve northward and eastward.

(209) If the storm maintains its direction and speed, the ship's course should be maintained as the wind shifts. In all cases, one should be alert to changes in the direction of movement of the storm center, particularly in the area where the track normally curves toward the north.

(210) If it becomes necessary for a vessel to heave to, the characteristics of the vessel should be considered. A ship is concerned primarily with damage by direct action of the sea. A good general rule is to heave to with head to the sea in the dangerous semicircle or stern to the sea in the navigable semicircle. This will result in the greatest amount of headway from the storm center, and the least amount of leeway toward it. If a vessel handles better with the sea astern or on the quarter, it may be placed in this position in the navigable semicircle or in the rear half of the dangerous semicircle; movement should be slow. It has been reported that when the wind reaches hurricane speed and the seas become confused, some ships ride out the storm best if the engines are stopped and the vessel is permitted to seek its own position. In this way, it is said, the ship rides with the storm instead of fighting against it.

(211) In a sailing vessel, while attempting to avoid a storm center, one should steer courses as near as possible to those prescribed above for power vessels. However, if it becomes necessary for such a vessel to heave to, the wind is of greater concern than the sea. A good general rule always is to heave to on whichever tack permits the shifting wind to draw aft. In the Northern Hemisphere this is the starboard tack in the dangerous semicircle and the port tack in the navigable semicircle.

(212)

Waves

(213) In early March of 1980 a series of frontal atmospheric waves moved across Florida from the Gulf of Mexico. One persisted until it reached the Gulf Stream where it deepened rapidly into a powerful extratropical storm as it headed east-northeastward. Off Cape Hatteras three ships reported 40-foot seas (12 m) while several others encountered wave heights of 25 to 35 feet (8 to 11 m). The National Data Buoy Center's buoy 41001 (35.0°N., 72.0°W.) recorded a maximum wave height of 33 feet (10 m). Extratropical and tropical cyclones are responsible for potentially similar conditions in the deep waters off this entire coast year-round. Fortunately these situations are infrequent. However, it has been calculated that in an average 5-year period, significant wave heights of 40 to 50 feet (12 to 15 m) and extremes of 70 to 90 feet (21 to 27 m) are possible. These figures decrease with latitude (40 feet and 70 feet (12 and 21 m) off southern Florida).

(214) The table below (extracted from Marine Weather of Western Washington, Kenneth E. Lilly, Jr., Commander, NOAA, Starpath School of Navigation, 1983), shows the relationship between significant and other wave heights.

(215)

Wave Heights from Significant Wave Heights (SWH)	
Most frequent wave heights	0.5 x SWH
Average wave heights	0.6 x SWH
Significant wave height (average height of highest 33%)	1.0 x SWH
Height of highest 10% of the waves	1.3 x SWH
One wave in 1,175 waves	1.9 x SWH
One wave in 300,000 waves	2.5 x SWH

(216) This table can be used to project a range of wave heights that might be expected in deep water. If significant wave heights of 10 feet (3 m) are forecast then the most frequently observed waves should be in the 5 to 6 foot (2 to 3 m) range while one wave in 100 should reach 17 feet (5 m). A giant or rogue wave might reach 25 feet (8 m) in these circumstances. These rogue or "killer" waves occur when the large number of different waves that make up a sea occasionally reinforce each other. This action creates a wave that is much steeper and higher than the surrounding waves. These rogue waves often occur in a stormy sea and are described by mariners who have experienced them, as coming out of nowhere and disappearing just as quickly. If significant wave heights are observed at 20 feet (6 m) then a rogue wave could reach 50 feet (15 m) if the water depth could support it.

(217) In general, sea conditions are roughest from about October through March or April. Seas of 8 feet (>2 m) or more can be expected along deep water coastal routes north of Florida about 15 to 30 percent of the time and 5 to 15 percent of the time off Florida.

(218) Steep waves are often more dangerous than high waves with a gentle slope. Waves appear menacing when the ratio of wave height to length reaches about 1/18. They begin to break when this ratio is about 1/10. Steepest waves develop when strong winds first begin to blow or early in a storm's life. The ship no longer rides easily but is slammed. Steep waves are particularly dangerous to small craft. When wave heights are greater than 5 feet (1.5 m), periods of less than 6 seconds can create problems for boats under 100 feet (30 m) in length. Waves of 10 feet (3 m) or more with periods of 6 to 10 seconds can affect comfort in vessels 100 to 200 feet (30 to 60 m) in length and provide a rough ride for larger ships.

(219) Waves moving into shallow water become steeper and break when the depth is about 1.3 times the wave height. Areas such as Diamond Shoals and Mantilla Shoal are dangerous in heavy weather as are most of the inlets along this coast. Wave steepness is also increased by tidal currents, particularly when they oppose the wind. See the Tidal Current prediction service at *tidesandcurrents.noaa.gov* for specific information about times, directions, and velocities of the current at numerous locations throughout the area. Links to a user guide for this service can be found in chapter 1 of this book.

(220) Swells can create problems for larger vessels. About one-half of the waves of 10 feet (3 m) or more, in these waters, are swells from distant storms. They are uncomfortable to ships that roll or pitch in sympathy. Swells with 500- to 1,000-foot (152 to 305 m) wave lengths affect ships of these lengths. When steaming into such swells a resonance is set up until the bow digs into the waves. The resulting pitch will cause more of a power loss than a roll caused by a sea. Swells with wave lengths that range from about three-fourths to twice the ship's length can have this effect. Pitching is heaviest when the ship's speed produces synchronism between the period of encounter and the ship's natural pitching period. This often occurs at or near normal ship speeds.

(221) When running before a following sea the greatest danger arises when your speed is equal to that of the waves or when the waves overtake the ship so slowly that an almost static situation is created with the vessel lying on the wave crest. In this latter case, stability is so reduced that a small vessel could capsize. Waves on the quarter or astern can also result in very poor steering quality. As seas move along the vessel from aft to forward the rudder is less effective and the boat may be slewed across the face of a sea filling the decks with water as she broaches. She could lose her stability and capsize, particularly if the boat is trimmed by the head.

(222) The Gulf Stream not only affects the winds of coastal storms but modifies waves by their interaction with the currents. This interaction is enhanced in the North Wall, a narrow, horizontal band of extreme water temperature change marking the north edge of the Gulf Stream. The North Wall also indicates the region where strong northeasterly currents will be encountered; they reach a maximum value 10 to 20 miles (19 to 37 km) farther into the Gulf Stream. Particularly during February and March, when water temperature gradients are steepest to the north, a coastal storm may draw cold Arctic air across the slope water and along the coast to Cape Hatteras by strong northeasterly winds.

(223) An 18° to 20°F (10° to 11°C) jump in water temperature occurs creating highly unstable air and increased surface winds with more gustiness and turbulence. Higher waves are generated by the windspeed increase, and these waves are likely to be more confused due to the turbulence. In addition to this wave height increase, more serious changes in the wave characteristics are produced by the currents. Northeasterly seas encounter opposing currents of 3 to 5 knots and, as is commonly observed in inlets when incoming waves encounter an ebbing tide, the result is sharply increased wave heights and much steeper wave slopes. If the opposing current is sufficiently strong the waves will even break. This steepening action causes problems for small craft navigating inlets with waves only a few feet high; with 20- to 30-foot (6 to 9 m) waves the result may be dangerous to any ship.

(224) To avoid this problem it is suggested that in late winter and spring mariners cross the Gulf Stream as far east as possible, where it is likely that the cold air would have modified somewhat and thus reduce the instability effect.

(225)

Visibilities

(226) Visibilities are generally good throughout the year, particularly offshore south of Charleston. Fog is the principal restriction to visibility. Onshore and along the coast this is often a radiation type fog, which forms shortly after sunset on cool, calm, clear nights. These fogs generally do not extend any great distance seaward, but may seriously restrict harbor activities. They often burn off during the morning hours. Sea fogs occasionally drift onshore on hot summer days, persisting for many hours in a shallow layer along the coast. Foggy conditions vary widely at coastal locations depending upon exposure. In general, the number of days that visibilities fall to ¼ mile or less ranges from 20 to 40 days annually, north of Cape Canaveral. These conditions are most likely from October through April.

(227) West of the Gulf Stream sea fog may occur over cooler waters when warm air is brought in from the south. These conditions are most likely over coastal waters from Norfolk to Charleston during January, February and March. During these months visibilities drop below ½ mile on 1 to 5 percent of all ship observations. Conditions are worst from Cape Henry to Cape Hatteras. In addition to fog, precipitation occasionally reduces visibility over both land and water while haze and smoke sometimes restrict it over land.

(228)

Winds

(229) Along most of the southern Atlantic Coast, winds are determined by migratory high and low pressure systems; in summer the semipermanent Azores High is an important factor. Most of the Florida coast lies in the easterly trade wind system at least part of the year. Other influences include the Appalachian Mountains and local coastal topography. Strongest winds are generated by the tropical and Extratropical low pressure systems and cold fronts. Locally, thunderstorms can cause short periods of strong, gusty winds.

(230) In the offshore waters, gales are most likely from October through April. North of about 30°N., along the coastal routes, they can be expected 5 to 10 percent of the time. Winds are variable although those with northerly and westerly components are most frequent. To the south, gale frequencies drop off to about 5 percent or less, decreasing with latitude; south of 30°N., winds in the 22- to 33-knot range are encountered about 10 to 15 percent of the time. Winds are variable but southwesterlies through northeasterlies are common. Easterlies become increasingly frequent south of Jacksonville. Summer winds in offshore waters are steadier but weaker, mainly due to the dominance of the Azores High. North of 30°N., southerlies and southwesterlies prevail. Gales are infrequent and even windspeeds in the 22- to 33-knot range occur less than 10 percent of the time. South of Jacksonville, easterlies and southeasterlies predominate with average speeds of about 8 to 10 knots. It isn't usually until late September, when the Azores High recedes, accompanied by an increase in migratory pressure systems, that winds become stronger and more variable.

(231) Coastal winds are more complex due to topographical influences and the land-sea breeze effect. Along the coast a daily shift in wind direction is often observed. During the warmest part of the day winds blow from the ocean toward shore (known as a sea breeze), and during the coolest, from the land toward the sea (land breeze). Offshore winds, unless they are exceptionally strong, are generally considered most favorable for coastal navigation. Onshore winds have a more pronounced effect upon the surface, particularly when they have been blowing from the same direction for a long period of time. A strong sea breeze can cause heavy or choppy seas and swells, and frequently makes navigation difficult for small vessels.

(232) Windspeeds along the southeastern coast of the U.S. are generally moderately light, averaging 8 to 12 knots over the year. Monthly averages vary in summer from 6 to 10 knots and 8 to 15 knots in winter. Wide departures from these averages should be expected in all seasons. In the immediate coastal area, the windward side of the promontories may be lashed by gales and heavy seas, while the lee side is relatively protected. Averages do not show these variations. The area from Cape Hatteras to Cape Henry, exposed as it is to the ocean, is subject to severe northeasterly ocean storms as well as migratory continental pressure systems. Cape Hatteras is particularly exposed to the winds, with open sea from north through east to southwest. South of Cape Hatteras gales are much less frequent, occurring generally on less than 15 days annually. The frequency of calms is dependent upon season, exposure, and time of day. They are least frequent during the afternoon when they occur less than 5% of the time along the entire southeastern Atlantic coast; in many locations calms are recorded less than 2% of the time. During the morning hours, particularly in summer and fall, they occur 5 to more than 15% of the time. Calms are least frequent at Cape Hatteras. Daytona Beach records the largest range in July, August and September, when morning calms occur about 25% of the time, compared to less than 2% of the time during the afternoon.

(233) Extreme windspeeds are a hazard in any month. Though winds greater than 34 knots are infrequent, they have been recorded all along the southeastern U.S. coast almost any time of the year. Gales usually accompany sharply defined frontal systems, tropical storms, hurricanes and severe local thunderstorms.

(234)

Temperature

(235) The temperature regime of the southern Atlantic coast varies from temperate in the north to subtropical in the south. The gradation from north to south is regular, increasing with decreasing latitude. Another interesting variation is the general modification process of the ocean and coastal temperatures by each other. Along the coast, sheltered land stations have warmer summers and cooler winters than stations with greater exposure to the water.

(236) Temperatures along the southeastern seaboard region are conducive to a long season of small-craft operation. The southern Atlantic coast annual mean air temperatures range from 59.5°F (15.3°C) at Norfolk, VA, to 77.7°F (25.4°C) at Key West, FL. January is the coldest month at most stations; July the warmest. Mean monthly air temperatures range from 39.9°F (4.4°C) at Norfolk in January to 84.5°F (29.2°C) at Key West in July.

(237) Over the water the coldest month is February and the warmest is August. Exposed coastal stations experience mean air temperatures more like those over the water. The daily variation in temperature ranges from 10° to 17°F (5.6° to 9.5°C) at coastal stations throughout the year and is less over the water. The largest daily variation occurs during the winter and early spring and the smallest during late summer and fall.

(238) Very little data on extreme temperatures for the ocean areas are available. At coastal stations temperatures above 100°F (37.8°C), while not common, have been recorded. The highest during the period of record considered was 105°F (40.6°C) at Jacksonville, FL, in July. The lowest recorded temperature was 5°F (-15°C) at Norfolk, VA, in January.

(239)

Precipitation

(240) Along the southeastern Atlantic coast precipitation is moderately heavy, averaging about 45 to 60 inches (1,143 to 1,524 mm) a year. Monthly departures may be large in any individual year, but over a long period of record, a fairly uniform pattern prevails. Since the area is within both temperate and subtropical regions, the precipitation pattern shows differences in both type and amount from north to south. Irregularities are often due to differences of exposure at the observing stations. Year-to-year variation is caused by overall departures from the average, general circulation.

(241) In the northern part of the area, maximum rainfall occurs normally during July and August, with a minimum in November. In the southern section, however, maximums occur in September or October and the least in February. Average monthly totals at most stations range from 2 to 6 inches (51 to 152 mm) throughout the year. During the months of greatest hurricane frequency, excessive rains of 9 to 15 inches (229 to 381 mm) in a 24-hour period have recorded. These may occur at any point along the coast, but are most common in the southern part of the area.

(242) The monthly mean number of days with 0.01 inch (0.254 mm) or more of precipitation in the northern part of the area ranges from about 8 days per month in the fall to 10 to 12 days per month in the summer and winter. In the central part of the area the most rainy days are in summer, 11 to 16 days per month, and the least in spring and fall, 6 to 9 days per month. The most rainy days along the Florida coast, 14 to 18 days per month, generally occur in late summer and early fall, and the minimum number, 5 to 8 days per month, from February through April.

(243) Much of the precipitation, like cloudiness, is associated with cyclonic activity throughout the year. During the winter, precipitation is usually steady but may come with an occasional thunderstorms along a front. Frontal systems originating or developing in the Gulf region result from the interaction of a moist tropical air mass with colder continental masses. They move eastward or northeastward and bring extensive precipitation to the seaboard region. During the summer, when the area is dominated by the Azores High and cumulus clouds predominate, precipitation is localized and is showery in nature. Heaviest precipitation occurs over land and near coastal waters in the afternoon; over open water it is most likely during the night.

(244) Thunderstorms along the coast occur on an average of from 40 days per year in the north to 80 days per year in the south. Maximum occurrence is June through August, and an average of 7 to 18 thunderstorms per month occur during this season. In summer, cumulus clouds frequently develop into thunderstorms over the land and drift seaward late in the afternoon.

(245) Snow falls from December through March in the northern part of the area on 1 or 2 days per month. So far as coastal operations are concerned, snow conditions are not significant since most of the area is entirely free from snow year round.

(246)

Cloudiness

(247) Mean cloudiness over the area is moderate to moderately high throughout the year, averaging from 35 to 65 percent sky cover. In general, however, the cloudiest month is January in the northern sections and over most of the water areas and may be any month from June through September in the south. At most locations in the north the least cloudiness occurs in October, and in the extreme southern part in February or March. Since the air is usually moist, only a small decrease in temperature may cause condensation and cloud formation. At the edge of the warm, northward-moving Gulf Stream and the cool, southward-moving countercurrent that skirts the shore from Cape Hatteras, NC, to Jacksonville, FL, sharp contrasts in temperatures result in the formation of heavy stratus clouds thay may appear very much as a cold front. These clouds may persist for days at a time if the wind is light and may be carried inland by northeasterly winds. Such cloudiness is common during the spring when the gradient between shore water and Gulf Stream temperatures are steepest. The fact that maximum cloudiness for the year occurs during the winter at the northern coastal stations may be explained by the maximum frequency of storms passing northward or northeastward from the central or south-central section during the season. These rarely affect the extreme southern part of the area.

(248) Much of the cloudiness over the entire area is of the cumulus type, resulting from either the unstable conditions that accompany cyclonic activity in all seasons, or the general air mass instability during the summer. Such clouds frequently form over land during the day and drift seaward at night.

(249)

Immersion hypothermia

(250) Immersion hypothermia is the loss of heat when a body is immersed in water. With few exceptions, humans die if their normal rectal temperature of approximately 99.7°F drops below 78.6°F. Cardiac arrest is the most common direct cause of death. Except in tropical waters warmer than 68° to 77°F, the main threat to life during prolonged immersion is cold or cold and drowning combined.

(251) Cold lowers body temperature, which in turn slows the heartbeat, lowers the rate of metabolism and increases the amount of carbon dioxide in the blood. Resulting impaired mental capacity is a major factor in death by hypothermia. Numerous reports from shipwrecks and accidents in cold water indicate that people can become confused and even delirious, further decreasing their chances of survival. The length of time that a human survives in water depends on the water temperature and, to a lesser extent, on a person's behavior. The table below

shows the approximate human survival time in the sea. Body type can cause deviations, since thin people become hypothermic more rapidly than fat people. Extremely fat people may survive almost indefinitely in water near 32°F if they are warmly clothed.

(252)

Survival Time Versus Water Temperature

Water Temperature	Exhaustion or Unconsciousness	Expected Time of Survival
32°F	15 minutes	15 to 45 minutes
32° – 41°F	15 to 30 minutes	30 to 90 minutes
41° – 50°F	30 to 60 minutes	1 to 3 hours
50° – 59°F	1 to 2 hours	1 to 6 hours
59° – 68°F	2 to 7 hours	2 to 40 hours
68° – 77°F	3 to 12 hours	3 hours – indefinite
77°F and above	indefinite	indefinite

(253) The cooling rate can be slowed by the person's behavior and insulated gear. In a study that closely monitored more than 500 immersions in the waters around Victoria BC, temperatures ranged from 39°F to 60°F. Using this information it was reasoned that if the critical heat loss areas could be protected, survival time would increase. The Heat Escape Lessening Posture (HELP) was developed for those in the water alone and the Huddle for small groups. Both require a life preserver. HELP involves holding the upper arms firmly against the sides of the chest, keeping the thighs together, and raising the knees to protect the groin area. In the Huddle, people face each other and keep their bodies as close as possible. These positions improve survival time in 48°F water to 4 hours, approximately two times that of a swimmer and one and one-half times that of a person in the passive position. The U.S. Coast Guard has an easy to remember rule of thumb for survival time: 50 percent of people submersed in 50°F water, will die within 50 minutes.

(254) Near-drowning victims in cold water (less than 70°F) show much longer periods of revivability than usual. Keys to a successful revival are immediate cardiopulmonary resuscitation (CPR) and administration of pure oxygen. Don't bother with total rewarming at first. The whole revival process may take hours and require medical help. Don't give up!

(255)

Wind chill and frostbite

(256) When the body is warmer than its surroundings it begins to lose heat. The rate of loss depends on barriers such as clothing and insulation, the speed of air movement and the air temperature. Heat loss increases dramatically in moving air that is colder than skin temperature (91.4°F). Even a light wind increases heat loss while a strong wind can actually lower the body temperature if the rate of loss is greater than the body's heat replacement rate.

(257) The equivalent wind chill temperature relates a particular wind and temperature combination to whatever temperature would produce the same heat loss at about 3 knots, the normal speed of a person walking. At extremely cold temperatures, wind and temperature effect may account for only two-thirds of the heat loss from the body. For example, in 40°F temperatures about one-third of the heat loss from the body occurs through the lungs in the process of breathing. On the other hand, heat loss is not as great in bright sunlight.

(258) When the skin temperature drops below 50°F, there is a marked constriction of the blood vessels leading to vascular stagnation, oxygen want and some cellular damage. The first indication that something is wrong is a painful tingling. Swelling of varying extent follows, provided freezing has not occurred. Excruciating pain may be felt if the skin temperature is lowered rapidly, but freezing of localized portions of the skin may be painless when the rate of change is slow. Cold allergy is a term applied to the welts which may occur. Chilblains usually affect the fingers and toes and appear as reddened, warm, itching, swollen patches. Trench foot and immersion foot present essentially the same picture. Both result from exposure to cold and lack of circulation. Wetness can add to the problem as water and wind soften the tissues and accelerate heat loss. The feet swell, discolor and frequently blister. Secondary infection is common and gangrene may result.

(259) Injuries from the cold may, to a large extent, be prevented by maintaining natural warmth through the use of proper footgear and adequate, dry clothing; by avoiding cramped positions and constricting clothing; and by active exercise of the hands, legs and feet.

(260) Frostbite usually begins when the skin temperature falls within the range of 14°F to 4°F. Ice crystals form in the tissues and small blood vessels. Once started, freezing proceeds rapidly and may penetrate deeply. The rate of heat loss determines the rate of freezing, which is accelerated by wind, wetness, extreme cold and poor blood circulation. Parts of the body most susceptible to freezing are those with surfaces large in relation to their volume, such as toes, fingers, ears, nose, chin and cheeks.

(261)

Dew point

(262) The temperature at which condensation to water droplets occurs is called the dew point. If this dew point is above freezing, condensation will be in the form of water. When the dew point reaches freezing, ice crystals will be deposited on cold surfaces. Knowledge of the dew point along the cargo temperature and moisture content is vital for hold ventilation decisions. It is also a parameter used in forecasting fog formation.

(263)

Cargo care

(264) When free air has a dew point temperature higher than the temperature of the surface with which it comes in contact, the air is often cooled sufficiently below its dew point to release moisture. When this happens on board ship, condensation will take place on relatively cold cargo or on the ship's structure within the hold where

it later drips onto the cargo. Thus, if cargo is stowed in a cool climate and the vessel sails into warmer waters, ventilation of the hold with outside air will likely lead to sweat damage in any cargo sensitive to moisture. Under such conditions external ventilation should, as a rule, be closed off entirely, unless the cargo generates internal heat, that hazard being greater than sweat damage. In the opposite case, when a vessel is loaded during a warm period, and moves into cooler weather, vulnerable cargo should be ventilated.

(265) A safe rule for ventilation directed toward moisture control may be stated as follows: Whenever accurate measurements show the outside air has a dew point below the dew point of the air surrounding the cargo to be protected, such outside air is capable of removing moisture from the hold and the ventilation process can be safely started. Whenever the reverse is true, and the outside dew point is higher than the dew point temperature around the cargo, then ventilation will increase the moisture content of the hold and may readily result in sweating within the ship. The above does not take into account possible fumes or gases in the compartment. In such case discretion must be used.

(266)

Principal ports

(267) The ports within the area of this Coast Pilot that have deep-draft commercial traffic are Morehead City, NC; Wilmington, NC; Georgetown, SC; Charleston, SC; Port Royal, SC; Savannah, GA; Brunswick, GA; Fernandina Beach, FL; Jacksonville, FL; Port Canaveral, FL; Fort Pierce, FL; Port of Palm Beach (near West Palm Beach), FL; Port Everglades (Fort Lauderdale), FL; Miami, FL; and Key West, FL. The larger ports of the group are Wilmington, Charleston, Savannah, Jacksonville, Port Everglades and Miami. Jacksonville is the largest port on the east coast south of Hampton Roads and is a major ship repair center.

(268)

Pilotage, general

(269) Pilotage is compulsory for all foreign vessels and U.S. vessels under register in the foreign trade at the ports where state pilots are available. Pilotage is optional for coastwise vessels who have on board a pilot properly licensed by the Federal Government. Only at Wilmington, Charleston, Savannah and Jacksonville is there a pilot station that is manned 24 hours daily; at the other ports, arrangements for pilots must be made well in advance. Detailed information on pilotage procedures is given in the text for the ports concerned.

(270) Local boatmen or fishermen competent to act as pilots for parts of the Intracoastal Waterway and interior waters can usually be found at the larger cities and towns along the route or near the entrances to the various tributaries.

(271)

Towage

(272) Tugs are available at most of the major ports; they can usually be obtained for the smaller ports on advance notice if none are available locally. Arrangements for tugs should be made in advance through the ships' agents or the pilots. See the text for the ports concerned as to the availability of tugs.

(273)

Vessel arrival inspections

(274) Quarantine, customs, immigration and agricultural quarantine officials are stationed in most major U.S. ports. (See Appendix A for addresses.) Vessels subject to such inspections generally make arrangements in advance through ships' agents. Unless otherwise directed, officials usually board vessels at their berths.

(275) **Harbormasters** are appointed for some of the principal ports. They have charge of enforcing harbor regulations and in some instances are in charge of the anchorage and berthing of vessels.

(276)

Supplies

(277) Fuel oil, diesel oil and all other supplies and services for large vessels are available at Morehead City, Wilmington, Charleston, Savannah, Jacksonville, Port Everglades and Miami. Fuel oil and diesel oil are available locally, or can be barged or trucked in from another port, at Georgetown, Port Royal, Brunswick, Fernandina Beach, Fort Pierce, Port of Palm Beach and Key West; other supplies and services for ships are limited at these ports.

(278)

Repairs

(279) Large oceangoing vessels can be drydocked and have major repair work done at Cainhoy (Near Charleston), Savannah and Jacksonville with the largest drydock capacity of 33,000 tons (Jacksonville). Smaller vessels from 300 to 1,200 tons may also be drydocked at New Bern, Wilmington, Johns Island, Mayport and Miami and at Safe Harbor. (See text for details.)

(280)

Small-craft facilities

(281) Supplies and repair facilities for small craft are at all the ports and at numerous places along the Intracoastal Waterway and on the tributaries branching from it. For isolated places and small cities, the Coast Pilot describes the more important of these facilities; for large port areas, where individual facilities are too numerous to mention, the information given is more general. Additional information may be obtained from the series of small-craft charts published for the many places and from various local small-craft guides.

(282) **A vessel of less than 65.6 feet (20 meters) in length or a sailing vessel shall not impede the passage of a vessel that can safely navigate only within a narrow channel or fairway. (Navigation Rules, International-Inland Rule 9(b).)**

(283)

Standard time

(284) The area covered by this Coast Pilot uses eastern standard time (e.s.t.), which is 5 hours slow of Coordinated Universal Time (UTC). For example, when it is 1000 UTC, it is 0500 along this coast.

(285)

Daylight saving time

(286) Throughout the area of this Coast Pilot, clocks are advanced 1 hour on the second Sunday of March and are set back to standard time on the first Sunday of November.

(287)

Legal public holidays

(288) New Year's Day, January 1; Martin Luther King, Jr.'s Birthday, third Monday in January; Washington's Birthday, third Monday in February; Memorial Day, last Monday in May; Independence Day, July 4; Labor Day, first Monday in September; Columbus Day, second Monday in October; Veterans Day, November 11; Thanksgiving Day, fourth Thursday in November; and Christmas Day, December 25. The national holidays are observed by employees of the Federal Government and the District of Columbia, and may not be observed by all the states in every case.

(289) In the areas covered by this Coast Pilot, other holidays are observed: Lee-Jackson Day, third Monday in January, in Virginia; Robert E. Lee's Birthday, January 19, in all states except Virginia; Arbor Day, third Friday in January, Florida; Good Friday, Florida; Easter Monday, North Carolina; April 2, Pascua Florida Day, Florida; April 12, Halifax Day, North Carolina; April 14, Pan American Day, Florida; April 26, Confederate Memorial Day, Georgia and Florida; May 10, Confederate Memorial Day, North Carolina and South Carolina; May 20, Mecklenburg Day, North Carolina; June 3, Jefferson Davis' Birthday, South Carolina, Georgia, and Florida; General Election Day, first Tuesday after the first Monday in November, all states.