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Sea Turtles Nesting at Melbourne Beach, Florida, II. Post-nesting Movements of *Caretta caretta*

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ABSTRACT

Recaptures of 34 loggerhead turtles Caretta caretta *tagged at Melbourne Beach, Florida, indicate post-nesting dispersal to widely distributed foraging grounds in the Bahamas, Cuba, the Dominican Republic, along the eastern seaboard of the United States, in the Florida Keys, and in the Gulf of Mexico. The most distant recovery was made 1500 km from Melbourne Beach in the Dominican Republic. Three turtles were captured in the Port Canaveral Ship Channel, which was recently discovered to be a hibernation site for* Caretta. *Travel against the Gulf Stream current is suggested by the recapture of a loggerhead on the north coast of Pinar del Río, Cuba, 11 days after it was tagged at Melbourne Beach. A minimum speed of travel of 70 km day*$^{-1}$ *is indicated by this return, which constitutes the most rapid migratory speed reported for* Caretta. *At least 14 of the 34 turtles were captured in nets intended for other marine species.*

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INTRODUCTION

Post-nesting dispersal patterns of few sea turtle colonies are well known, despite considerable scientific interest and the obvious practical importance of such knowledge to conservation. Individual recaptures of tagged loggerhead turtles *Caretta caretta* reported by Caldwell *et al.* (1959), Hughes & Mentis (1967), Hughes *et al.* (1967) and by Bustard & Limpus (1970, 1971) established at an early date that this species was a long-distance traveller, but knowledge of the actual patterns and schedules of the migration of various loggerhead populations has had to await the accumulation of more substantial bodies of tag-return evidence. The most extensive data on the migratory movements of this species have been gathered from studies of those populations nesting at Tongaland, South Africa (Hughes, 1974, 1982), and at Bundaberg and the Capricorn/Bunker Group Islands, Australia (Bustard, 1974, 1976; Limpus, 1978, 1982). A summary of tag-return evidence from these and other tagging projects involving *Caretta* is given by Meylan (1982).

Little is known of the dispersal movements of the loggerhead colony nesting in the southeastern United States, although it is considered to be the second largest in the world (Ross, 1982), and is currently the subject of over a dozen tagging investigations in four states. Caldwell *et al.* (1955) reported one rather localised post-nesting movement of a loggerhead along Florida's east coast. The first long-distance recapture was that of a loggerhead tagged on the east coast of Florida, and captured in the Gulf of Mexico (Caldwell *et al.*, 1959). Bell & Richardson (1978) described the post-nesting movements of 43 loggerheads tagged at Little Cumberland Island, Georgia. Recoveries of five loggerheads tagged in Florida, and captured in the Bahamas, constitute the only international recaptures of US loggerheads (Ehrhart, 1976, 1980; Fletemeyer, 1980).

The present paper describes the post-nesting movements of 34 loggerheads tagged at Melbourne Beach, Florida. The data resulted from a tagging project that was initiated and directed by Turner, and carried out by him and local volunteers from 1972 to 1978. A total of 2910 loggerheads and 18 green turtles was tagged with monel metal tags (size 49, National Band and Tag Company, Newport, KY) as they came up to nest on the 11.2 km stretch of beach between Spessard Holland Park and Floridana Beach, Brevard County, Florida. Aspects of the nesting biology of *Caretta* as revealed by this project are discussed by Bjorndal *et al.* (1983). The initial design of the project was provided by Dr Archie

Carr, and all tag-return data were handled by his office. Meylan and Bjorndal analysed the data and prepared the manuscript.

RESULTS AND DISCUSSION

Thirty-four loggerheads tagged at Melbourne Beach have been captured or sighted at sea, or have washed ashore injured or dead. Recovery sites and circumstances surrounding the recaptures are given in Fig. 1 and Table 1. None of the recaptures involved nesting turtles.

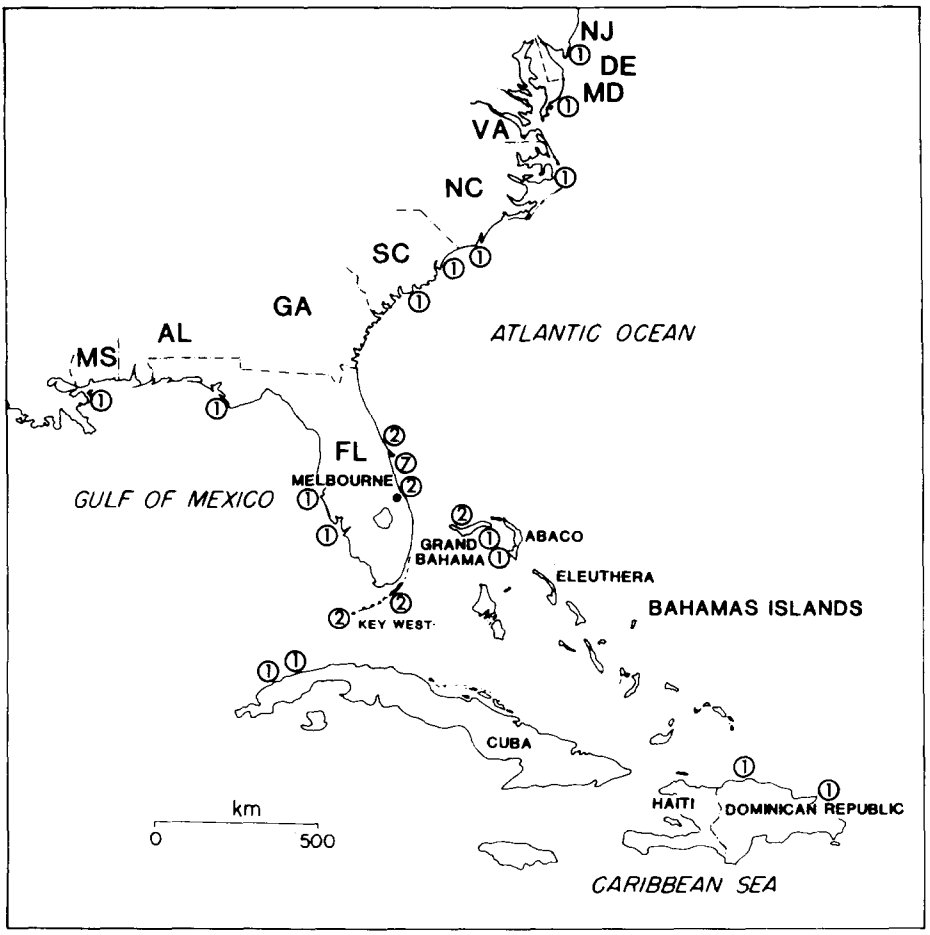

Fig. 1. Recaptures of loggerhead turtles *Caretta caretta* tagged at Melbourne Beach, Florida, 1972–1978. All turtles were captured or sighted at sea or washed ashore injured or dead.

TABLE 1

Recaptures of loggerhead turtles (*Caretta caretta*) tagged at Melbourne Beach, Florida, 1972–1978
(All turtles were captured or sighted at sea, or washed ashore injured or dead; none was found nesting. Unless otherwise indicated, turtles were alive at the time of observation.)

Tag no.	*Place of recovery*	*Date of recovery*	*Time (months)*	*Distance travelled (km)*	*Circumstances of capture*
International					
B3313	16 km NE Mangrove Cay, Grand Bahama	21 Sep. 80	49	250	Caught by diver
C1629	Grand Bahama	17 Dec. 74	29·5	300	
C1907	'Bara de Pense Vibmere', Bahamas	Oct. 74	26	?	
C2945	Sandy Point, Abaco, Bahamas	4 Jul. 75	40 days	380	Depth 5·5 m
E9152	11 km NE Water Cay, Grand Bahama	Aug. 76	14	250	
B2214	Bahia Honda, Cuba	Jul. 75	57 days	720	Floating net
C1963	Puerto Esperanza, Cuba	25 Aug. 72	11 days	770	'Net'
C3287	Bay of Semana, Dominican Republic	18 Dec. 77	5	1 500	Divers; depth 10 m
H1398	Sosua, Dominican Republic	3 Aug. 81[a]	61	1 322	
United States					
C3363	Cape May, NJ	12 Nov. 77	5	1 440	Bottom trawl; depth 33·5 m
C2130	Between Wachapreague & Chincoteague, VA	Jul. 74	12	1 300	Otter trawl for flounder
G1252	Pamlico Sound, NC	20 Jul. 79	14	1 030	'Net'

C3328	Southport, NC	6 Sep. 78[a]	2·5	750	Shrimp trawl
C2750	Pawleys Island, SC	May 75	11	640	Shrimp trawl
C1635	Charleston Harbor, SC	18 Aug. 76	48	580	Floating, dead
C3246	Daytona, FL	18 Jun. 78	12	150	Washed ashore dead
C2840	New Smyrna Beach, FL	18 Sep. 74	3	130	Washed ashore dead
B3575	Port Canaveral Ship Channel, FL	20 Jul. 79	25	48	Shrimp trawl, NMFS[b] research vessel
C3193	Port Canaveral Ship Channel, FL	18 Mar. 80	21	48	Shrimp trawl, NMFS[b] research vessel
C3230	Port Canaveral Ship Channel, FL	25 Jun. 80	35·5	48	Shrimp trawl, NMFS[b] research vessel
C1754	Port Canaveral, FL	24 Jan. 73	7	48	Shrimp trawl; depth 42·1 m
C1776	Cape Kennedy, FL	15 Feb. 73	8	52	Shrimp trawl; depth 45·7–54·9 m
C3168	Cape Canaveral AF Station, FL	20 Aug. 81	60	52	Washed ashore dead
B3410	0·6 km E Cocoa Beach, FL	24 Jun. 79	36	38	Floating; propeller injury
C2224	5 km N Sebastian Inlet, FL	Sep. 73	1	8	
C3257	10 km E Ft. Pierce Inlet, FL	11 Mar. 78	9	65	Shot while sleeping at surface
C1980	Molasses Reef, Key Largo, FL	20 Aug. 73	45 days	330	
C1816	Upper Matecumbe Key, FL	12 Aug. 72	35 days	360	2·4 km offshore; depth 4·6 m
C3169	Loggerhead Light, Key West, FL	Jan. 78	17	480	Shrimp trawl; depth 39·6 m; near death
C2024	WNW of NW Channel, Key West, FL	9 Feb. 81	79	519	
B3593	20 km W Charlotte Harbor, FL	12 Jan. 81	42	671	Shrimp trawl
C14633	Longboat Key, FL	10 Feb. 81	55	780	Shrimp trawl; depth 21·9–23·8 m
B3547	19 km W Port St. Joe, FL	18 Jun. 80	23	1 110	Washed ashore dead; shot?
C14651	6–10 km WSW Horn Island, MS	12 Aug. 80	49	1 400	Shrimp trawl

[a] Date of tag-return letter.

[b] National Marine Fisheries Service.

Five of the nine international recaptures of Melbourne loggerheads were made in the Bahamas. It is notable that all five previously published records of international recaptures of US loggerheads have involved this island group (Ehrhart, 1976, 1980; Fletemeyer, 1980). There are, in addition, a number of unpublished Bahamian recoveries of loggerheads tagged in Florida at Sebastian Inlet (C. LeBuff, pers. comm.) and Jupiter Island (F. Lund, pers. comm.). The capture of Florida loggerheads in the Bahamas is not unexpected, considering the proximity of these islands to the nesting beaches and the fact that *Caretta* is a familiar resident in foraging habitats there (Carr *et al.*, 1982). However, it is puzzling why turtles that forage in the Bahamas would undertake migrations to Florida's beaches when nesting habitat is locally available. Nesting has been reported on all of the islands where recaptures were made (Carr *et al.*, 1982). Other tagging studies of marine turtles have reported similar, anomalous migratory patterns, in which local nesting beaches are passed up for more distant ones (Limpus, 1978; Balazs, 1980).

All Bahamian recovery sites reported here are in the northern islands, with the possible exception of 'Bara de Pense Vibmere', which we have been unable to locate. This latter site was described as being 30 km NW of Granisa. Recaptures in the Bahamas reported by Ehrhart (1976, 1980) and Fletemeyer (1980) were also made in the northern islands. This recapture distribution may be an artefact of small sample size, it may reflect differential fishing pressure in the various islands, or it may represent a real feature of the foraging distribution. Bjorndal found that loggerheads were not commonly seen around Great Inagua, in the extreme southern end of the island chain, except during the nesting season.

No loggerheads tagged in Georgia (Bell and Richardson, 1978) or the Carolinas have been recovered in the Bahamas. This, again, may be an artefact of small sample sizes, or it may indicate the existence of separate feeding grounds for different contingents of the US colony.

Direct travel from Melbourne Beach to the northern Bahamas would involve crossing the powerful Gulf Stream, which, between peninsular Florida and the Bahamas, flows northward in August at approximately $5\,km\,h^{-1}$ (Anon., 1975). Intervals elapsed prior to recoveries of Melbourne turtles in the Bahamas range from 40 days to 49 months, and thus do not preclude the possibility that more circuitous routes are travelled. Ehrhart (1980) reported the recapture of a loggerhead from Kennedy Space Center, Florida, at Abaco, only 48 days after the turtle

had last been observed on the nesting beach; and a loggerhead tagged at Lauderdale-by-the-Sea, Florida, was taken after 37 ($\pm$ 7) days at Walker's Cay (Fletemeyer, 1980). These are maximum intervals, because after nesting, turtles may remain for an undeterminable time in the area of the breeding shore. Thus, the possibility of direct travel to the Bahamas cannot be ruled out.

Two turtles tagged at Melbourne Beach have been recovered from the extreme northwestern shore of Cuba. Loggerhead No. C1963 was caught only 11 days after being tagged, indicating a minimum speed of travel of 70 km day^{-1}. This is the most rapid migratory travel speed yet recorded for *Caretta*; the previous record was 40·2 km day^{-1} (Bell & Richardson, 1978). Representative speeds of travel for *Caretta* and other sea turtles are summarised by Carr *et al.* (1978). A second recovery from Cuba was also prompt—after a maximum elapsed time of 57 days.

Perhaps the most noteworthy feature of the journey of No. C1963 is that travel was almost undoubtedly against, or at least across, the Gulf Stream. During the month of August, the current flows east around the tip of the Florida peninsula at 3·7 km h^{-1}, then north along the east coast at 5–5·6 km h^{-1} (Anon., 1975). Considering that the maximum travel time was only 11 days, it seems unlikely that an alternative route could have been followed. Against-current travel by *Caretta* has been previously suggested by Bustard & Limpus (1970) and by Bustard (1974, 1976).

The most distant recovery of a Melbourne turtle was made in the Dominican Republic, a straight-line distance of 1500 km. The turtle was caught in the Bay of Semana, less than ten months after being tagged. A second recovery in the Dominican Republic was also made on the northern shore of the island.

Six turtles tagged at Melbourne Beach have been captured along the eastern seaboard of the United States. All recaptures occurred between May and November. The distribution and dates of the recoveries fit the dispersal pattern postulated by Bell & Richardson (1978) for loggerheads tagged while nesting at Little Cumberland Island, Georgia. On the basis of their tag-return data, they suggested that Cumberland loggerheads move north towards Cape Hatteras and the Chesapeake during the summer and autumn, then depart from the area as water temperatures decline. Their hypothesis was later reinforced by Shoop *et al.* (1981), whose intensive year-round aerial surveys of the region from Cape Hatteras to Nova Scotia documented a northward extension of the range of loggerheads through September, and a southward contraction in

autumn. Shoop *et al.* (1981) suggested that loggerheads were moving north to forage as water temperatures permitted.

By the onset of winter, relatively few loggerheads remain in the waters off the eastern seaboard (Bell & Richardson, 1978; Lee & Palmer, 1981; Shoop *et al.*, 1981). No recaptures of Melbourne turtles were made north of Florida in winter months. However, one loggerhead in apparently healthy condition was taken in a bottom trawl off Cape May, New Jersey, in mid-November. The departure routes and destinations of these loggerheads from the eastern coast of the United States remain completely unknown.

Eleven turtles tagged at Melbourne Beach were captured or sighted off the east coast of Florida. Three were taken in the Port Canaveral Ship Channel, in the trawls of a National Marine Fisheries Service research vessel. Carr *et al.* (1980) reported finding this artificial channel to be an apparent hibernation site for loggerheads, and discussed the possibility that Florida loggerheads follow dichotomous strategies—some overwintering, some emigrating—in coping with cold winter temperatures. Loggerhead No. C3193 was caught in the ship channel in mid-March, and thus may have been overwintering there. Nos B3575 and C3230 were taken in summer months, during nesting seasons two and three years after they were tagged. The proximity of the Port Canaveral Ship Channel to the nesting beach, and the fact that two and three years are the predominant remigration intervals for US loggerheads (Richardson *et al.*, 1978; Bjorndal *et al.*, 1983) suggest the possibility that besides serving as an overwintering habitat, the channel may be an internesting refuge. Two other loggerheads tagged at Melbourne were captured in the Cape Canaveral area by private shrimp boats, but it is not known whether the turtles were taken within the confines of the ship channel. Both were taken in winter months in the year after they had nested at Melbourne Beach.

There have been four recaptures in the Florida Keys. Two of the turtles were recovered only 35 and 45 days after being tagged on Melbourne Beach. Although there is no proof that the Florida Keys was the final destination of the four turtles recovered there, their capture in appropriate habitats, their presence in non-nesting months long after departure from the nesting beach, and the known occurrence of this species in the area, suggest this possibility.

The importance of the Gulf of Mexico as a foraging ground for loggerheads that nest on Florida's east coast remains unclear. In 1959, Caldwell *et al.* reported the recapture of a loggerhead tagged while nesting

at Hutchinson Island, Florida, from near the mouth of the Mississippi River, a shoreline distance of 1600 km. Moderately intensive tagging along the eastern seaboard during the last decade has only yielded two additional recaptures in the Gulf. A loggerhead tagged at Kennedy Space Center was found dead in San Carlos Bay, Sanibel Island, Florida (Ehrhart, 1980), and another tagged at Little Cumberland Island, Georgia, was found at Tampa Bay (Bell & Richardson, 1978). We report here the recapture of four Melbourne loggerheads from the Gulf of Mexico. Elapsed times prior to recovery were relatively long: 23–55 months. Three of the turtles were captured in shrimp trawls, and appeared healthy. Recoveries off Charlotte Harbour and Longboat Key, on the west coast of Florida, were both made in winter months. The recovery at Horn Island, Mississippi, represents the westernmost dispersal record for Melbourne turtles.

One important defect of the evidence of migration received from tag returns is its failure to reveal details of the actual routes of travel. We have learned of one extremely interesting observation which may have bearing on the routes followed by loggerheads bound for nesting beaches in the southeastern US. Luis Rivas, National Marine Fisheries Service, was flying an aerial survey of giant bluefin tuna in the Straits of Florida on 24 May 1977, when he sighted 'hundreds' of reddish-brown turtles along the outer reefs of the Florida Keys and Cay Sal Bank (pers. comm. to Larry Ogren, National Marine Fisheries Service). The turtles, including at least six copulating pairs, were seen both within the outer reefs, and over the deep blue water at the drop-off of the continental shelf and Cay Sal Bank. Only an occasional turtle had been observed by Rivas during three previous aerial surveys made between 27 April and 10 May 1977. Lt Commander William Barker, US Coast Guard Air Station, Opa Locka, Florida, reported to Ogren that he had seen a similar phenomenon in mid-May 1976, when he counted 150–200 turtles between Marathon Key and Key West. These turtles were in approximately the same ecological situation as those seen by Rivas—along the outer reefs and over the deep blue water at the edge of the shelf. Although there is no certainty that the turtles seen by Rivas and Barker were loggerheads bound for Florida beaches, that such was the case seems likely. Careful surveillance of the Florida Straits at the beginning of future nesting seasons seems clearly warranted.

An alarming feature of the recapture data we report is that at least 14 (41 %), and very likely several more, of the 34 turtles sighted after leaving

the nesting beach were taken at sea in nets intended for other marine species. Eleven were definitely taken in shrimp trawls; one was caught in an otter trawl being used for flounder; and two were taken in nets of unspecified type (not turtle nets). Several turtles found dead on shore may have been drowned in shrimp nets. The habit of loggerheads to feed on benthic invertebrates undoubtedly makes them targets for bottom trawls of all types. As shown in Table 1, several of the turtles were recaptured at considerable depths; the maximum reported was 46–55 m.

None of the green turtles tagged during the project was recaptured.

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