1 November 2022

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Robbin Trindell, Ph.D.
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Florida Fish and Wildlife Conservation Commission
620 South Meridian Street
Tallahassee, Florida 32399-1600

References: 1. Watson, K.P and Lamont, M.M. 2021. Temperature-based modeling of incubation period to protect loggerhead hatchlings on an urban beach in Northwest Florida. Journal of Experimental Marine Biology and Ecology. 546. 10.1016/j.jembe.2021.151647.
2. Hirama, S., 2018. Evaluation of the impact of artificial lighting on sea turtle hatchling orientation. Ph.D. dissertation, University of Florida, Gainesville, FL, 127 pages.

Dear Robbin:

This letter summarizes results of disorientation incidents during the 2022 nesting season on Panama City Beach under Permit 271. The survey area extends 17.5 miles between St. Andrews State Park and Camp Helen State Park and is covered by two lighting ordinances. Major results are as follows:

- Volunteers checking nests at night from July 22 to October 20 documented 2237 of 2828 hatchlings (79%) disoriented by artificial lights from 29 loggerhead nests and one green nest. This is the highest disorientation rate since local lighting ordinances went into full effect in 2013.
- Disorientation reports were filed for 28 loggerhead nests where at least 5 hatchlings were disoriented. Two reports were filed for adult nesting turtles documented during morning surveys.
- 1977 disoriented hatchlings were collected during night monitoring and released on a nearby dark beach within the survey area. None required rehabilitation. Three dead hatchlings were collected.
- New stringent nighttime monitoring procedures were implemented under FWC Permit 271.

All disorientation reports have been provided to local code enforcement and submitted into FWC's web-based system. The following provides detailed results and includes a description of the methodology to quantify disorientations and types of lights contributing to the incidents.

Monitoring Procedure. All nests identified during the morning surveys were marked with four stakes, flagging tape, and an informational sign with the nest number. They were checked for evidence of emergence each morning (6-8 am), early evening (7-9 pm), and late night (10-12 pm). The early morning checks were done by paid surveyors starting immediately after the nest was found. Volunteers performed the nightly checks beginning on a date determined from measured sand temperatures in the vicinity of the nest (Reference 1). These nighttime "spot checks" were subject to new monitoring requirements by FWC as described in Permit 271. Major changes from previous years are as follows:

- Maximum of two volunteers monitoring nests with each check taking no longer than 10 minutes.
- Monitoring personnel required to maintain a log of each spot check.
- Results reported to FWC include start and end times of spot checks, disoriented live and dead hatchlings collected, number of bystanders, and any turtles taken to a rehab facility (Table 1).

Method to Quantify Hatchling Disorientation. We used two methods to estimate hatchling disorientation. The methodology is summarized below:

- Direct Observation. Disorientation was documented during nighttime monitoring through direct observation of hatchlings during emergence or from hatchling tracks and live turtles collected shortly after the emergence. The number of disoriented hatchlings included those crawling in the wrong direction away from the water (misoriented) and those showing uncertainty by changing direction or circling (disoriented), regardless of whether they eventually reached the water. Disorientation was confirmed by allowing hatchlings to crawl at least 20 feet before they were collected and released on a nearby dark beach within the survey area. Lights contributing to disorientation incidents were documented mostly during night surveys, immediately after the emergence event. See Reference 1 for more information.
- HOI Method. We also estimated hatchling disorientation using a method called the Hatchling Orientation Index (HOI), continuing a practice that began on our beach in 2015. Three types of data were collected with a phone compass at the nest site, shown in Figure 1. Ocean direction is the angle of a line perpendicular to the shoreline at the nest location, pointing toward the water. Mode is the bearing of the most frequent direction of hatchling tracks. Angular range is the difference between two angles representing bearings of the most widely separated hatchling tracks. Mode and angular range were measured from the nest location to the point where tracks cross a 33 ft (10 meter) radius circle centered on the nest or sometimes at smaller distances when tracks were hard to see. Disorientation was determined by comparing modal measurements with the ocean direction. For this report, nests were considered disoriented if the mode differed by more than ±45 degrees from the ocean direction (angular range not considered). See Reference 2 for more information.

Method to Quantify Hatchling Mortality. We quantified mortality of disoriented turtles using direct and indirect methods. The direct method involved collecting dead hatchlings which were typically found in the dunes but sometimes on the road after an emergence. This number underestimates actual mortality, because disoriented hatchlings are difficult to find once they enter dune vegetation, where they are vulnerable to predation by ghost crabs and feral cats prevalent on our beach. Therefore, we also used an indirect method that assumed mortality occurred for any turtle track entering the dune without exiting and where no hatchling was found. Adding this value to the count of dead turtles collected provides a more realistic estimate of mortality from artificial lights.

Data Set. Of the 44 nests found this season, disorientation was estimated for 30 nests that hatched at night, including those at which no disorientation occurred (29 loggerhead, 1 green). Fourteen (14) nests were excluded from the data set. Of these, 4 failed to hatch due to flooding or wash-out (26,34,39,43), one hatched during daylight hours (40), six hatched nests (29,30,32,35,36,44) were excluded because disorientation could not be quantified or only a small number emerged (<5), and three (20,21,28) produced no hatchlings and may not have been nests (unable to find eggs at excavation attempt).

Hatchling Disorientation Results. Table 2 shows main emergence results for nests that hatched at night. The column "Total Emerged" represents the main emergence excluding small numbers that may have emerged before or after. Also provided is information on the time of emergence, number of live disoriented hatchlings collected, dead disoriented hatchlings collected, and whether a disorientation report was filed. Results are as follows:

- Combined hatchling disorientation rate was 79% using the direct observation method (29 loggerhead nests and 1 green) and 85% using the HOI method (20 loggerhead nests).
- 1977 disoriented hatchlings were collected during monitoring and released on a dark beach within our survey area.

- Three dead loggerhead hatchlings were collected on the road from a nest near Ramsgate Condo, 23011 Front Beach Rd. At two other nests, disoriented hatchlings may have been lost in the dune or taken by predators, but mortality was hard to estimate due to many tracks that entered the dune and eventually re-emerged onto the beach, most leading to the water after much wandering. Up to 178 turtles from the two nests suffered sub-lethal effects from lost energy reserves caused by lights leading them away from the water.
- Figure 2 and Table 3 show HOI results for 20 loggerhead nests. Modal direction deviated over ±45 degrees from the ocean direction for 17 of 20 nests, giving a combined disorientation of 85%.
- Figure 3 shows lights contributing to 28 disorientation incidents where 5 or more hatchlings were affected. Condo lights were the largest contributor at 45% (interior and exterior). Urban glow and parking lot lights contributed 22%.
- Log sheet results of nighttime monitoring (Table 1) are available at https://docs.google.com/spreadsheets/d/1swGBlzeaDcmy1vU2qx1mOxt_pRkFNf39bFZ4kvHEgks/edit?usp=sharing

Adult Disorientation Results. Adult females became disoriented at one nest and one false crawl. Disorientation was assessed by examining the crawl during the morning survey after the turtle had returned to the water. Reports were filed for both incidents.

If you have questions on this material, please contact me during business hours at (850) 238-9895 or at pcbturtle@yahoo.com. Thanks.

Sincerely,

Kennard Watson

Kennard Watson
Turtle Watch Director

cc: Meghan Koperski (FWC Tequesta), Shigetomo Hirama (FWRI Gainesville), Patty Kelly (FWS Panama City), Justin Lashley (COE Mobile), Joseph Scarola (EAI Jensen Beach), Timothy Justice (Bay County Code Enforcement), Lanie Smith (PCB Code Enforcement), Mel Leonard (PCB), Drew Whitman (PCB), Dan Rowe (TDC), Lisa Armbruster (Sustainable Beaches)

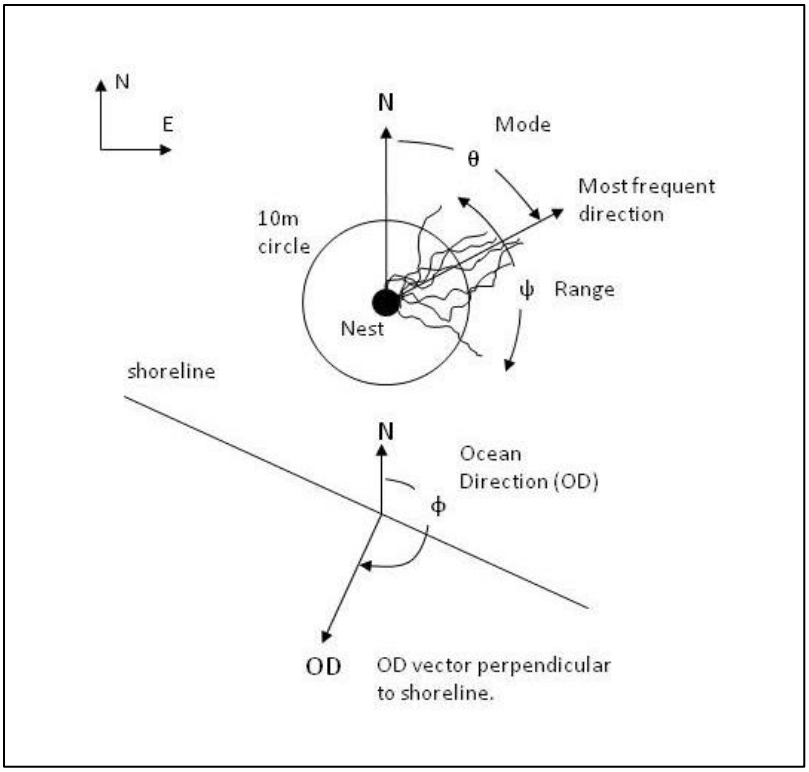

Figure 1. Hatchling Orientation Index (HOI) definition of variables.

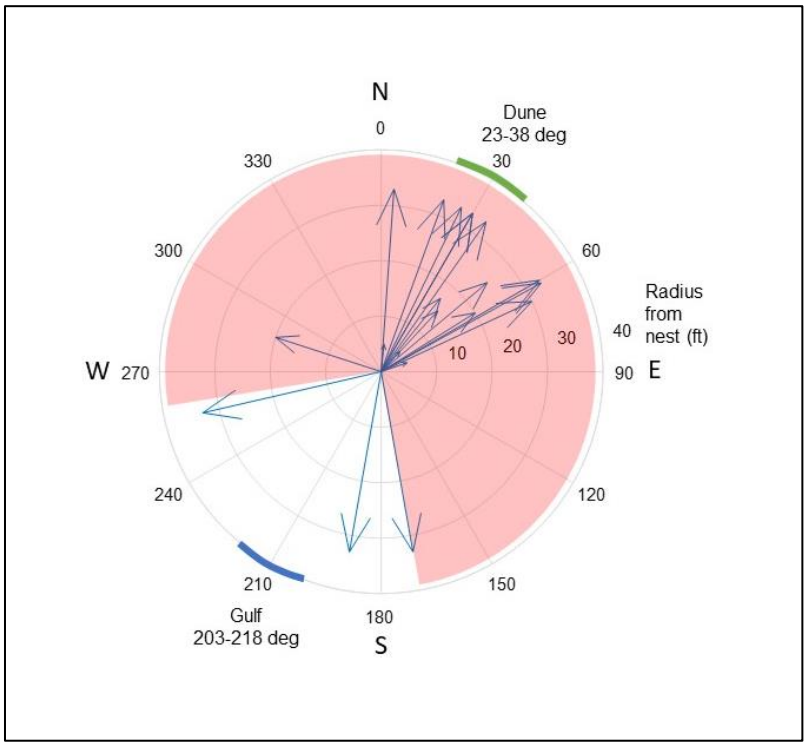

Figure 2. HOI results for hatchling emergences on Panama City Beach in 2022 (20 loggerhead nests). Modal direction shown for each nest with arrows in red area indicating disoriented nests.

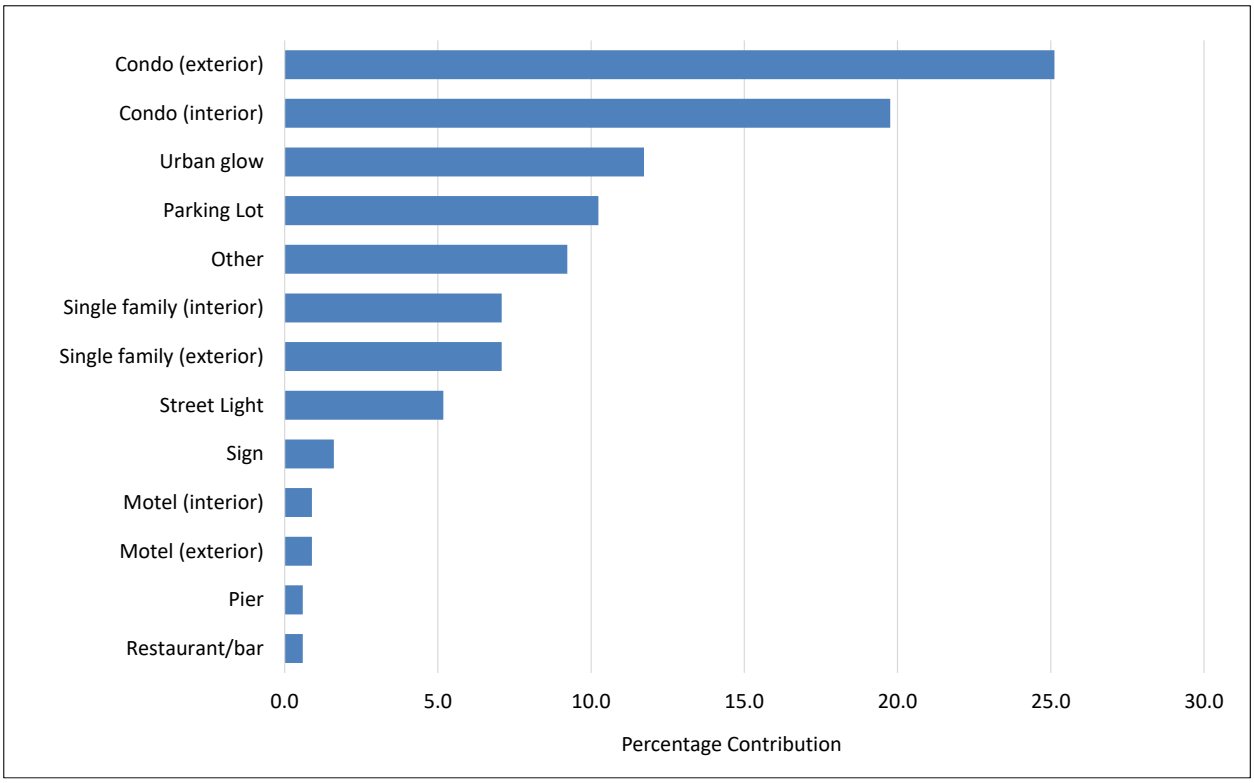

Figure 3. Lights contributing to hatchling disorientation incidents on Panama City Beach in 2022 (28 loggerhead nests).

Table 1. Reporting requirements for nighttime hatchling monitoring under MTP-271.

Item	Requirement
1	Date disoriented hatchling recovery activities were initiated
2	Date disoriented hatchling recovery activities were terminated
3	Total number of disorientation events documented
4	Spreadsheet providing information related to each nest check; a spreadsheet related to each disorientation event response and an evaluation of the 2022 season. The spreadsheet of nest checks must list for each nest subject to nest checks, minimally: a. nest ID; b. date nest discovered; c. projected hatch date; d. date and time (i.e., HH:MM) of arrival for each nest check; e. date and time (i.e., HH:MM) of departure from each nest check; f. nest status at each check
5	Disorientation event spreadsheet in the summary must list for each disorientation event, minimally: a. date of the event; b. form of event notification (i.e., call, text or nest check); c. time of the notification if call or text (i.e., HH:MM); d. time Authorized Personnel arrived at the nest (i.e., HH:MM); e. time Authorized Personnel departed the nest (i.e., HH:MM); f. time of the event (e.g., HH:MM if observed in progress, prior to first nest check at HH:MM; after last nest check at HH:MM); g. number of Authorized Personnel present at the event; h. number of public present at the event; i. number of live disoriented hatchlings recovered; j. number of dead disoriented hatchlings recovered; k. number of disoriented hatchlings released; l. number of disoriented turtles transported to a FWC-authorized sea turtle rehabilitation facility
6	Summary sent to MTP@MyFWC.com or uploaded as a report to this permit within FWC's Online Permit System

Table 2. Nighttime hatchling emergences on Panama City Beach in 2022 (29 Cc loggerhead nests, 1 Cm green nest).

Nest No.	Species	Nearest Landmark	Incident Date	Emergence Time	Total Emerged	Number Disoriented	Percent Disoriented	Live Collected	Dead Collected	Report Filed
1	Cc	Laguna Beach Christian Retreat, 20225 Front Beach Rd	29-Jul	9:10 PM to 10:19 PM	101	100	99%	100	0	Y
2	Cc	House, 9618 Beach Blvd	27-Jul	9:20 PM	141	137	97%	137	0	Y
3	Cc	Pinnacle Port Condo, 23223 Front Beach Rd	26-Jul	8:49 PM	95	68	72%	69*	0	Y
4	Cc	Latitude 29 Condo, 21703 Front Beach Rd	29-Jul	10:20 PM to dawn	102	102	100%	0	0	Y
5	Cc	Long Beach Resort, 10509 Front Beach Rd	31-Jul	8:45 PM	81	77	95%	77	0	Y
6	Cc	Boardwalk Beach Hotel and Convention Center, 9600 S Thomas Dr	7-Aug	10:30 PM - 10:37 PM	73	32	44%	18	0	Y
7	Cc	Townhouse, 17135 Front Beach Rd	2-Aug	10:17 PM	61	57	93%	57	0	Y
8	Cc	Moonspinner Condo, 4425 Thomas Dr	31-Jul	10:03 PM	80	70	88%	70	0	Y
9	Cc	Seachase Condo, 17351 Front Beach Rd	6-Aug	11:50 PM - 12:10 AM	89	89	100%	92**	0	Y
10	Cc	Moondrifter Condo, 8815 Thomas Dr	3-Aug	8:25 PM	108	108	100%	108	0	Y
11	Cc	Ramsgate Condo, 23011 Front Beach Rd	7-Aug	9:07 PM	87	81	93%	81	0	Y
12	Cc	The Shores Condo, 22519 Front Beach Rd	6-Aug	11:30 PM - 6:22 AM	90	76	84%	0	0	Y
13	Cc	House, 20804 Front Beach Rd	12-Aug	10:23 PM	110	99	90%	99	0	Y
14	Cc	Sugar Sands Motel, 20723 Front Beach Rd	10-Aug	11:05 PM	113	28	25%	28	0	Y
15	Cc	Russell-Fields City Pier, 16201 Front Beach Rd	10-Aug	9:55 PM	112	112	100%	112	0	Y
16	Cc	Ramsgate Condo, 23011 Front Beach Rd	16-Aug	8:15 PM to 9:32 PM	79	0	0%	0	0	N

17	Cc	House, 21619 Front Beach Rd	21-Aug	9:28 PM	95	95	100%	95	0	Y
18	Cc	House, 22339 Front Beach Rd	18-Aug	10:22 PM to morning survey	100	10	10%	0	0	Y
19	Cc	Continental Condo, 15413 Front Beach Rd	16-Aug	10 PM to 10:25 PM	75	70	93%	70	0	Y
22	Cc	Ramsgate Condo, 23011 Front Beach Rd	24-Aug	sunset to 8:53 PM	102	62	61%	62	3	Y
23	Cc	Summerwinds Condo, 6323 Thomas Dr	24-Aug	8:10 PM	105	102	97%	102	0	Y
24	Cc	Townhouse, 19108 Front Beach Rd	1-Sep	8:30 PM to 9:20 PM	103	97	94%	97	0	Y
25	Cc	Ocean Reef Condo, 14415 Front Beach Rd	28-Aug	11:14 PM	115	115	100%	119**	0	Y
27	Cc	Shoreline Villas, 23007 Front Beach Rd	3-Sep	10:19 PM to 12:20 AM	109	70	64%	70	0	Y
31	Cc	Polynesian Village Condo, 16621 Front Beach Rd	7-Sep	9:28 PM	122	121	99%	121	0	Y
33	Cc	Treasure Island Resort, 5004 Thomas Dr	5-Sep	9:40 PM	106	55	52%	55	0	Y
37	Cc	House, 21809 Front Beach Rd	14-Sep	10:15 PM to 12 AM	97	29	30%	29	0	Y
38	Cm	Townhouse, 17807 Front Beach Rd	13-Sep	UNK	5	3	60%	3	0	N
41	Cc	Long Beach Resort, 10509 Front Beach Rd	30-Sep	9:35 PM to 6:45 AM	70	70	100%	0	0	Y
42	Cc	Mariner East Condo, 6211 Thomas Dr	27-Sep	11:17 PM	102	102	100%	104**	0	Y
				TOTAL	**2828**	**2237**	**79.1%**	**1975*** **	**3**	

* live collected exceeds total disoriented due to one hatchling collected prior to main emergence

** live collected exceeds total emerged from excavation results. Source of error unknown.

*** total excludes 2 hatchlings from nest 36 where disorientation couldn't be determined, thus excluded from table.

Table 3. Hatchling Orientation Index results for hatchling emergences on Panama City Beach in 2022 (20 loggerhead nests). Nest is considered disoriented if the mode differs by more than ±45 degrees from the ocean direction.

Nest No.	Nearest Landmark	Collection Date	Ocean Direction (deg)	Mode (deg)	Angular Range (deg)	Disoriented?
1	Laguna Beach Christian Retreat, 20225 Front Beach Rd	22-Jul	207	65	109	Y
2	House, 9618 Beach Blvd	28-Jul	210	6	83	Y
3	Pinnacle Port Condo, 23223 Front Beach Rd	31-Jul	206	43	151	Y
4	Latitude 29 Condo, 21703 Front Beach Rd	29-Jul	206	43	302	Y
5	Long Beach Resort, 10509 Front Beach Rd	1-Aug	212	71	44	Y
7	Townhouse, 17135 Front Beach Rd	2-Aug	210	61	124	Y
8	Moonspinner Condo, 4425 Thomas Dr	1-Aug	223.5	257	52	N
9	Seachase Condo, 17351 Front Beach Rd	8-Aug	240.5	35	83	Y
10	Moondrifter Condo, 8815 Thomas Dr	4-Aug	217	288	126	Y
12	The Shores Condo, 22519 Front Beach Rd	6-Aug	229	20	242	Y
14	Sugar Sands Motel, 20723 Front Beach Rd	10-Aug	204	190	106	N
15	Russell-Fields City Pier, 16201 Front Beach Rd	10-Aug	209	58	239	Y
17	House, 21619 Front Beach Rd	22-Aug	210	170	80	N
23	Summerwinds Condo, 6323 Thomas Dr	26-Aug	222	4	101	Y
24	Townhouse, 19108 Front Beach Rd	1-Sep	205	30	80	Y
25	Ocean Reef Condo, 14415 Front Beach Rd	28-Aug	230	50	40	Y
27	Shoreline Villas, 23007 Front Beach Rd	4-Sep	224	30	20	Y
31	Polynesian Village Condo, 16621 Front Beach Rd	8-Sep	211.5	26	79	Y
33	Treasure Island Resort, 5004 Thomas Dr	6-Sep	221	39	88	Y
37	House, 21809 Front Beach Rd	14-Sep	205	60	136	Y