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

Dear Robbin:

This letter summarizes results of disorientation incidents during the 2017 nesting season on Panama City Beach (Permit 038). The survey area extends 17.5 miles between St. Andrews State Park and Camp Helen State Park. This entire area is under two lighting ordinances, passed in 2009 by the City of Panama City Beach and Bay County. The ordinances became effective in 2013. We estimated a combined disorientation rate of 72% for hatchlings that emerged at night from 23 loggerhead nests and one green nest. Additionally, we documented disorientation of adult females at 6 loggerhead nests, 4 loggerhead false crawls, and 2 green nests. All disorientation reports have been provided to local code enforcement with copies to the Florida Fish and Wildlife Conservation Commission (FWC). The following provides detailed results and includes a description of the methodology to quantify disorientations and types of lights contributing to the incidents.

Nest Marking and Monitoring Procedure (Loggerhead and Leatherback). All loggerhead and leatherback nests were marked with four stakes, orange survey tape and caution tape, and an informational sign with the nest number. These nests were checked for signs 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 the nesting surveyors, while volunteers performed the early evening and late-night checks. Early morning checks were done daily starting immediately after the nest was found. The start date for nighttime monitoring was determined from the measured sand temperature in the vicinity of the nest (typically after incubation day 50). Nighttime monitoring of the nests is not required by our permit but is performed due to the serious lighting problems in our survey area.

Nest Marking and Monitoring Procedure (Green). In addition to the markings described above, plastic screen was added to 4 green nests to contain disoriented hatchlings. The screen performs the same function as metal restraining cages used previously on our beach. As shown in Figure 1, the barrier consists of plastic aquaculture mesh extending about 12 inches above the ground and held in place with wooden stakes. The mesh forms a circle of sufficient diameter to ensure that the clutch is inside the protected area (~9 feet as shown). It can be opened to allow escape of hatchlings during daylight hours. The sole purpose of the mesh is to contain disoriented hatchlings, not to provide a light barrier or to protect hatchlings from predators. Two advantages of this approach compared to metal cages are that we

can avoid digging to verify the clutch location and the materials are non-metallic, causing no disturbance to the local magnetic field. The plastic mesh is flimsier than metal hardware cloth used for cages but only has to be strong enough to contain the hatchlings. It is buried a few inches below the surface to prevent escape, with hand-buried wooden stakes keeping the mesh upright when hatchlings are pushing against it. FWC provided approval (9/5/17 email from you to me) with the recommendation that a "top" be placed over the circular enclosure, but no guidance was given on the intended function of the top. We tried landscape fabric but found it was too fragile in wind or rain. We ended up creating a top with plastic fencing material which held up better in bad weather (see Figure 1). Regarding the monitoring procedure, we used the same approach as that for restraining cages: screen opened during morning survey, closed during late afternoon check, and checked at night between 11 pm and 1 am.

Method to Quantify Hatchling Disorientations. We submit disorientation reports only for main emergences and not for small numbers of hatchlings that may emerge before or after. Reports are submitted electronically to local code enforcement officers and FWC during the season, usually within three days of the incident. Most are documented during night surveys by volunteers who are at the nest when the hatchlings emerge or arrive shortly after the emergence while hatchlings are still on the beach and tracks are fresh. Volunteers collect disoriented hatchlings and estimate the number of turtles reaching the water by observing the animals or counting tracks. Volunteers note the location of lights affecting the hatchlings and document the sky condition at the time of emergence, including the presence or absence of moonlight. When volunteers are present during the emergence, the number of disoriented hatchlings is determined by how many the volunteers collect, in addition to any turtles observed reaching the water after wandering. Nest excavation data are occasionally used to adjust disorientation estimates. For example, if volunteers arrive after an emergence and see all tracks leading away from the water, the nest is assumed to have 100% disorientation and the number of disoriented hatchlings is obtained from the excavation data. Disoriented turtles collected at the nest site are released the same night at Sunnyside Beach, the darkest part of our survey area.

Hatchling Orientation Index. In addition to the above approach, we also collected hatchling disorientation data using a method called the Hatchling Orientation Index (HOI), continuing a practice that began on our beach in 2015. The procedure uses a phone app provided by Shigetomo Hirama of FWC to obtain compass measurements at the nest site. Three types of data were collected with the phone compass, as shown in Figure 2. 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, as estimated by the observer. Finally, angular range is the difference between two angles representing bearings of the most widely separated hatchling tracks. Mode and angular range are measured from the nest location to the point where tracks cross a 10-meter radius circle centered on the nest. Additional information can be found in the paper "A Hatchling Orientation Index for Assessing Orientation Disruption from Artificial Lighting," by Witherington, Crady, and Bolen (1996).

Hatchling Disorientation Results. Main emergence results for 23 loggerhead nests and one green nest that hatched at night are shown in Table 1, including those at which no disorientation occurred. Thirty three (33) nests were excluded from the sample. Of these, 20 failed to hatch due to flooding or wash-out from storms, three hatched during daylight hours, three produced no hatchlings and may not have been nests (unable to find eggs at excavation), and seven hatched nests were excluded because disorientation could not be quantified or only a small number of hatchlings emerged (<10). The column for "Total Emerged" represents the main emergence which excludes stragglers that may have emerged before or after. Information also is provided on the time of hatchling emergence, if known, and the method used to document the emergence. Results show that 1294 of 1808 hatchlings were disoriented by artificial lights, giving a combined disorientation of 72%. Turtle Watch personnel observed the main emergence at 14 nests. The remaining 10 were documented by tracks observed and hatchlings collected after the emergence, either at night or during the morning survey. Mortality was documented at four nests (6, 16,

49, 50) with disoriented hatchlings lost in dunes, taken by ghost crabs, or found dead on the road. Most of the mortality estimates were documented by tracks ending in the dune or on the beach at crab holes. One dead loggerhead hatchling was found in the road at nest 49, and one dead green hatchling was found in the dune at nest 50. Figure 3 is a map showing locations of all hatchling disorientation incidents in 2017.

Hatchling Orientation Index Results. Table 2 shows results for 15 loggerhead nests for which HOI data were collected. Information consists of the measured ocean direction, mode, and angular range of the hatchling tracks. The data were used to classify hatched nests as either disoriented or not disoriented using the following criteria. A nest was not disoriented if the mode was within ±45 degrees of the ocean direction and the angular range also was within ±45 degrees. Otherwise, the nest was classified as disoriented. None of the nests met both criteria, giving an overall disorientation rate of 100%. Table 2 includes results using our standard method, showing a combined disorientation rate of 58.5%.

Adult Disorientation Results. Adult females became disoriented at 12% of the loggerhead nests (6 of 48) and 40% of the green nests (2 of 5). Also, 4 loggerheads became disoriented without nesting. Table 3 shows results of the incidents. Each was assessed based on a wandering track found during the morning survey after the turtle had returned to the water, except for one nest where volunteers assisted a disoriented loggerhead back to the water (nest 14). The most serious incident occurred at nest 50, located at 21429 Front Beach Rd, where a disoriented green encountered numerous obstacles along the entry and exit tracks, including volleyball poles, beach furniture, and a storm water ditch.

Lights Contributing to Hatchling Disorientation. Figure 4 shows the types of lights contributing to hatchling disorientation incidents this year. Indirect lighting from urban glow was the largest contributor at 24%, followed by exterior condo lights (17%), parking lot lights (16%), and street lights (16%). Unshielded lights at Carillon Beach walkovers have caused problems in the past and continued to do so this season, contributing to one disorientation incident.

Discussion. Hatchling disorientation rates remain high and are nearly identical to last year's results. Problem lights identified in Figure 4 indicate that efforts should focus on reducing beachfront lighting from condos, street lights, parking lots, and dune walkovers. To encourage compliance, oil spill grant funds to retrofit lights at beachfront developments are available from the Sea Turtle Conservancy (STC). STC continues to work with several developments on Panama City Beach to change their exterior light fixtures. Finally, we will continue to work with Mr. Hirama of FWC to develop improved methods to measure hatchling disorientation on our urban beach.

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
Turtle Watch Coordinator

cc: Tomo Hirama FWC, Tonya Long FWC, Lauryn Wright STC

Table 1. Nighttime hatchling emergences on Panama City Beach in 2017 (23 loggerhead nests, 1 green nest). Species Cc loggerhead, Cm green. UNK=unknown

Nest No.	Species	Nearest Landmark	Incident Date	Emergence Time	Night Emerged	Number Disoriented	Percent Disoriented	Method Used to Document Hatchling Emergence	Report Filed
3	Cc	House, 21605 Front Beach Rd	7-Aug	~10 PM	80	80	100%	Night survey: tracks identified	Y
6	Cc	358 Beachside Dr, Carillon Beach	16-Aug	UNK	90	90	100%	Morning survey: tracks identified	Y
11	Cc	Top of the Gulf Condo, 8817 Thomas Dr	27-Aug	8:35 PM	67	67	100%	Night survey: hatchlings observed emerging from nest	Y
12	Cc	House, 8408 Surf Dr	25-Aug	9:45 PM	80	43	54%	Night survey: hatchlings observed emerging from nest	Y
13	Cc	Oceanna Condo, 8000 Surf Dr	27-Aug	7:45 PM	60	37	62%	Night survey: hatchlings observed emerging from nest	Y
14	Cc	House, 8404 Surf Dr	26-Aug	8:25 PM to 9:25 PM	76	0	0%	Night survey: tracks identified	N
16	Cc	House, 20816 Front Beach Rd, Sunnyside Beach	25-Aug	9 PM to 12:15 AM	124	60	48%	Night survey: tracks identified and hatchlings collected	Y
19	Cc	Hidden Dunes Condo, 7115 Thomas Dr	27-Aug	9:43 PM	71	71	100%	Night survey: hatchlings observed emerging from nest	Y
20	Cc	House, 5421 Gulf Dr	26-Aug	7:30 PM to 8 PM	75	20	27%	Night survey: tracks identified and hatchlings collected	Y
21	Cc	Pinnacle Port Condo, 23223 Front Beach Rd	21-Aug	10:52 PM	134	134	100%	Night survey: hatchlings observed emerging from nest	Y
22	Cc	Sterling Beach Condo, 6627 Thomas Dr	1-Sep	10:15 PM to 11:30 PM	49	0	0%	Night survey: tracks identified	N
23	Cc	Thomas Donut & Snack Shop, 19208 Front Beach Rd	5-Sep	9:14 PM	71	71	100%	Night survey: hatchlings observed emerging from nest	Y
31	Cc	Townhouse, 13407 Oleander Dr	7-Sep	10 PM to 7 AM	1	1	100%	Morning survey: tracks identified	N
32	Cc	House, 14210 Front Beach Rd	7-Sep	9:00 PM	71	71	100%	Night survey: hatchlings observed emerging from nest	Y
34	Cc	Beachcomber Resort, 17101 Front Beach Rd	4-Sep	10:25 PM	88	19	22%	Night survey: hatchlings observed emerging from nest	Y
36	Cc	House, 318 Beachside Dr, Carillon Beach	8-Sep	11:03 PM	121	6	5%	Night survey: hatchlings observed emerging from nest	N

40	Cc	House, 19104 Front Beach Rd	20-Sep	7:57 PM	24	20	83%	Night survey: hatchlings observed emerging from nest	Y
43	Cc	Townhouse, 17867 Front Beach Rd	18-Sep	9:38 PM	77	77	100%	Night survey: hatchlings observed emerging from nest	Y
44	Cc	Moonspinner Condo, 4425 Thomas Dr	16-Sep	9:30 PM	95	87	92%	Night survey: hatchlings observed emerging from nest	Y
45	Cc	Beachside Resort, 21905 Front Beach Rd	17-Sep	10:42 PM	70	66	94%	Night survey: hatchlings observed emerging from nest	Y
48	Cc	Townhouse, 22331 Front Beach Rd	24-Sep	8:10 PM	81	71	88%	Night survey: hatchlings observed emerging from nest	Y
49	Cc	Edgewater Beach Resort, 11212 Front Beach Rd	30-Sep	11 PM to 8 AM	70	70	100%	Morning survey: tracks identified	Y
50	Cm	Surfside Christian Retreat, 21429 Front Beach Rd	25-Sep	11 PM to 7 AM	103	103	100%	Morning survey: tracks identified and hatchlings collected	Y
52	Cc	Dunes of Panama Condo, 7205 Thomas Dr	6-Oct	10 PM to 7:30 AM	30	30	100%	Morning survey: tracks identified	Y
			TOTAL		**1808**	**1294**	**71.6%**		

Table 2. Hatchling Orientation Index results for loggerhead hatchling emergences on Panama City Beach in 2017 (15 nests).

Nest Data			**Hatchling Orientation Index**				**Turtle Watch Method**		
Nest No	**Emergence Date**	**Emergence Time**	**Ocean Direction (deg)**	**Mode (deg)**	**Range (deg)**	**Disoriented (Yes or No)**	**Night Emerged**	**Number Disoriented**	**Percent Disoriented**
6	16-Aug	UNK	206.5	54	230	Y	90	90	100%
11	27-Aug	8:35 PM	216	21	-35	Y	67	67	100%
13	27-Aug	7:45 PM	193.5	273	42	Y	60	37	62%
14	26-Aug	8:25 PM to 9:25 PM	193.5	281	25	Y	76	0	0%
19	27-Aug	9:43 PM	215.5	358	291	Y	71	71	100%

20	26-Aug	7:30 PM to 8 PM	200	274	22	Y	75	20	27%
21	21-Aug	10:52 PM	208.5	75	117	Y	134	134	100%
22	1-Sep	10:15 PM to 11:30 PM	219.5	222	64	Y	49	0	0%
34	4-Sep	10:25 PM	208.5	209	69	Y	88	19	22%
36	8-Sep	11:03 PM	186.5	227	219	Y	121	6	5%
40	20-Sep	7:57 PM	190.5	11	-267	Y	24	20	83%
43	18-Sep	9:38 PM	213.5	47	247	Y	77	77	100%
44	16-Sep	9:30 PM	201.5	320	39	Y	95	87	92%
45	17-Sep	10:42 PM	207.5	31	-45	Y	70	66	94%
52	6-Oct	10 PM to 7:30 AM	193.5	67	106	Y	30	30	100%
					TOTAL	**100%**			**58.5%**

Table 3. Adult disorientation incidents on Panama City Beach in 2017 (6 loggerhead nests, 4 loggerhead false crawls, 2 green nests).

Crawl No.	Species	Crawl Type	Nearest Landmark	Incident Date	Observations	Report Filed
1	Cc	False Crawl	Edgewater Beach Resort, 11212 Front Beach Rd	22-May	Track made figure 8	Y
15	Cc	False Crawl	House, 20816 Front Beach Rd	18-Jun	Track wandered about 50 ft parallel to shore and crossed over itself twice	Y
37	Cc	False Crawl	Gulf Crest Condo, 8715 Surf Dr	4-Jul	Track showed turtle became disoriented while crawling through rows of lounge chairs	Y
41	Cc	False Crawl	Pinnacle Port Condo, 23223 Front Beach Rd	13-Jul	Track looped over itself twice before returning to water	Y
1	Cc	Nest	House, 20816 Front Beach Rd, Sunnyside Beach	18-May	Track wandered over 100 ft parallel to shore after nesting	Y
14	Cc	Nest	House, 8404 Surf Dr	25-Jun	Turtle required assistance from volunteers while returning to water after nesting	Y
31	Cc	Nest	Townhouse, 13407 Oleander Dr	6-Jul	Track showed disorientation after nesting	Y
34	Cc	Nest	Beachcomber Resort, 17101 Front Beach Rd	10-Jul	Track wandered parallel to shore after nesting, encountering obstacles along the way	Y
39	Cc	Nest	House, 358 Beachside Dr, Carillon Beach	14-Jul	Severe disorientation after nesting, crawling 267 ft and encountering beach chairs and trash can	Y
41	Cm	Nest	House, 21507 Front Beach Rd	16-Jul	Track wandered over 100 ft parallel to shore after nesting, obstacles may have contributed to disorientation	Y
48	Cc	Nest	Townhouse, 22331 Front Beach Rd	23-Jul	Track wandered over 100 ft parallel to shore after nesting	Y
50	Cm	Nest	Surfside Christian Retreat, 21429 Front Beach Rd	29-Jul	Entry track showed severe disorientation with track crossing itself multiple times and encountering numerous obstacles along the way	Y

Step 1. Install wooden stakes inside marked nest area with diameter sufficient to include clutch. Hand-dig stakes.

Step 2. Install plastic mesh around stakes and secure with nylon ties. Hand-dig mesh.

Step 3. Create access that can be opened each morning allowing hatchlings to escape during day.

Step 4. Install top consisting of plastic open-mesh material which is resistant to rain and wind.

Figure 1. Pictures of screened enclosure for green nests.

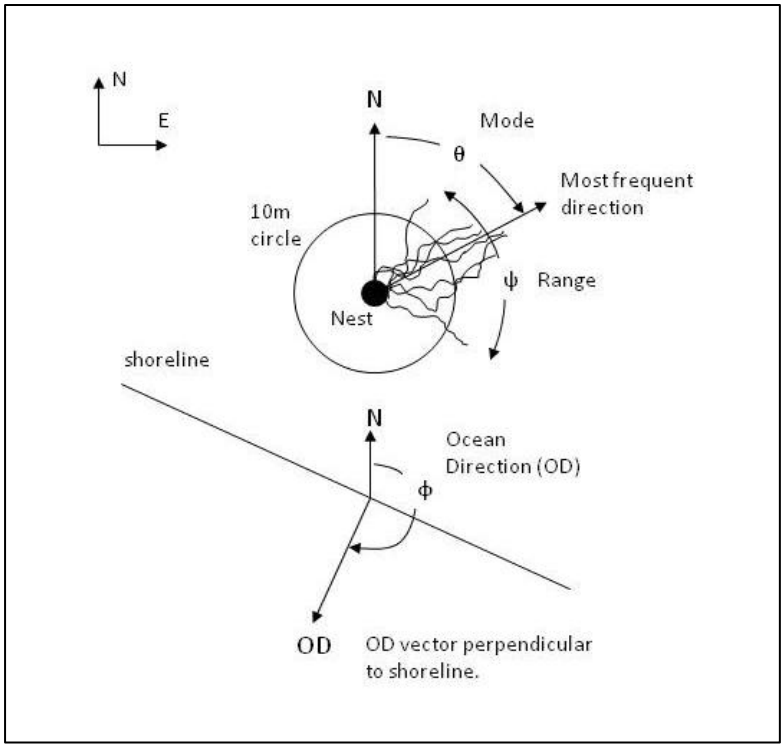

Figure 2. Definition of variables used in the Hatchling Orientation Index.

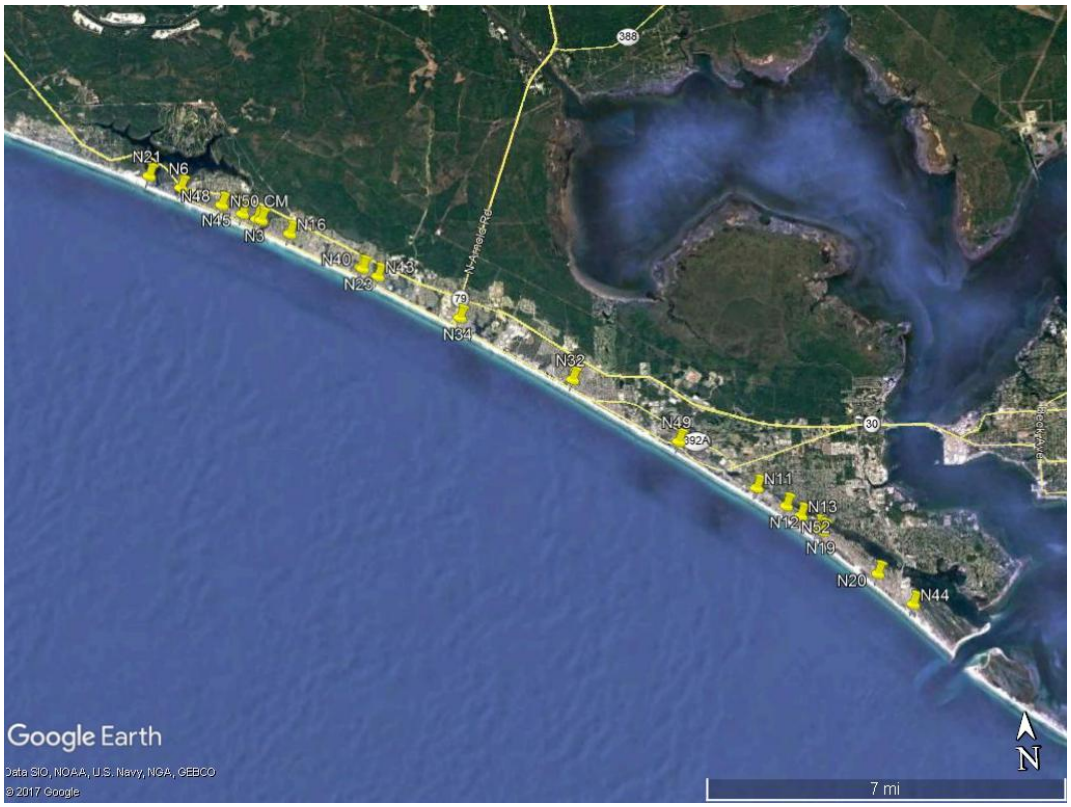

Figure 3. Map showing locations of hatchling disorientation incidents on Panama City Beach in 2017 (19 loggerhead nests, 1 green nest).

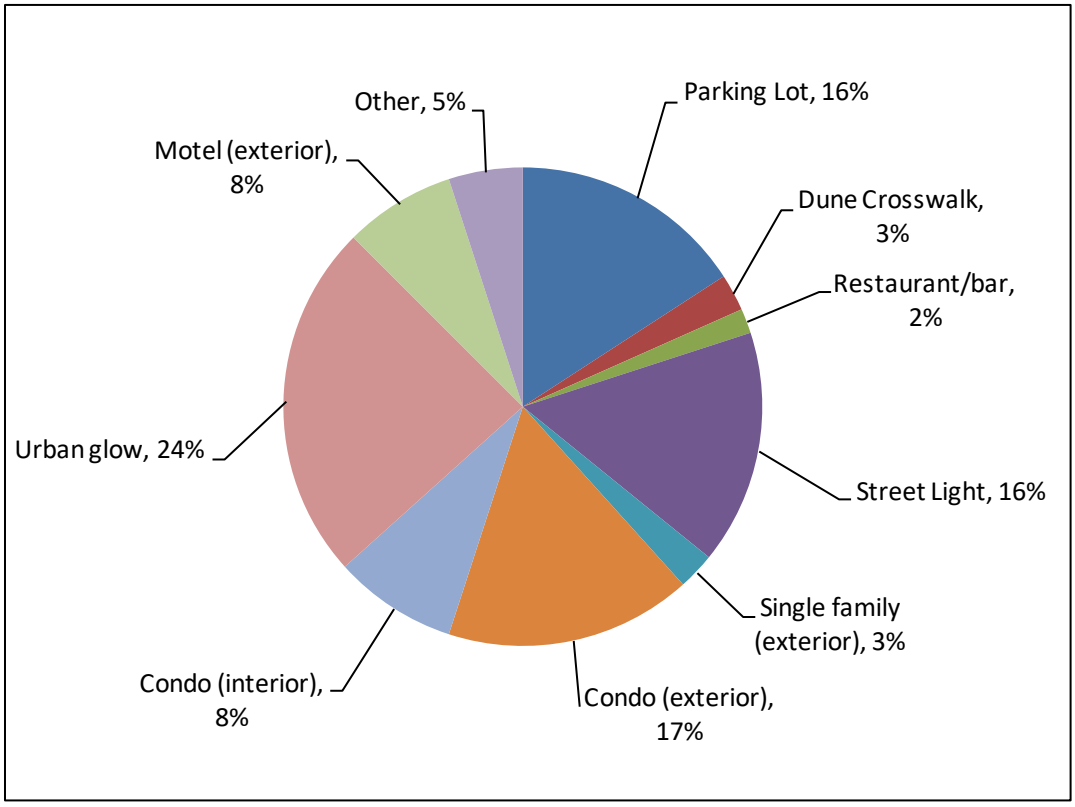

Figure 4. Lights contributing to hatchling disorientation incidents on Panama City Beach in 2017 (19 loggerhead nests, 1 green nest).