

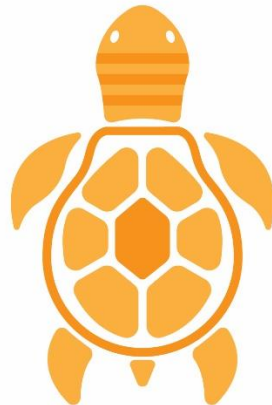


**Department of  
Environment**  
CAYMAN ISLANDS GOVERNMENT

## The State of Turtle Friendly Lighting in the Cayman Islands 2024

May 2024

Prepared by the Department of Environment, Cayman Islands Government



Contributors: A. Rousseau, L. Dombowsky, J. Hardwick, J. Campbell, G. Ebanks-Petrie, T. Austin, J. Bothwell

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## 1 A Brief History of Sea Turtles in the Cayman Islands

Sea turtles are both historically and culturally significant to the Cayman Islands. When Christopher Columbus sailed through Cayman waters and spotted the Islands he called them *Las Tortugas* due to the abundance of turtles. Not long after, settlers and sailors found that they could harvest turtle meat leading to a rapid decline in species numbers<sup>1-2</sup>. Throughout the 1600s, there was intensive turtle fishing (over 10,000 turtles taken per year) by the French, Spanish, English, and British Colony in Jamaica. By the beginning of the 1800s the population was exhausted and it was thought that turtles were extirpated from the Cayman Islands<sup>3</sup>.

Historically, the four main turtle species found in Cayman waters include green (*Chelonia mydas*), loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricate*) and leatherback (*Dermochelys coriacea*) which can be seen in Figure 1 below. Historical records indicate that the Cayman Islands were thought to have hosted one of the world's largest green nesting populations<sup>3</sup> and, nesting by hawksbill, loggerhead and leatherback turtles was considered abundant<sup>1</sup>. Efforts to protect the Cayman Islands turtle population started in 1978 with the first legislation to protect the species in place, and have become more rigorous over time<sup>4</sup>.

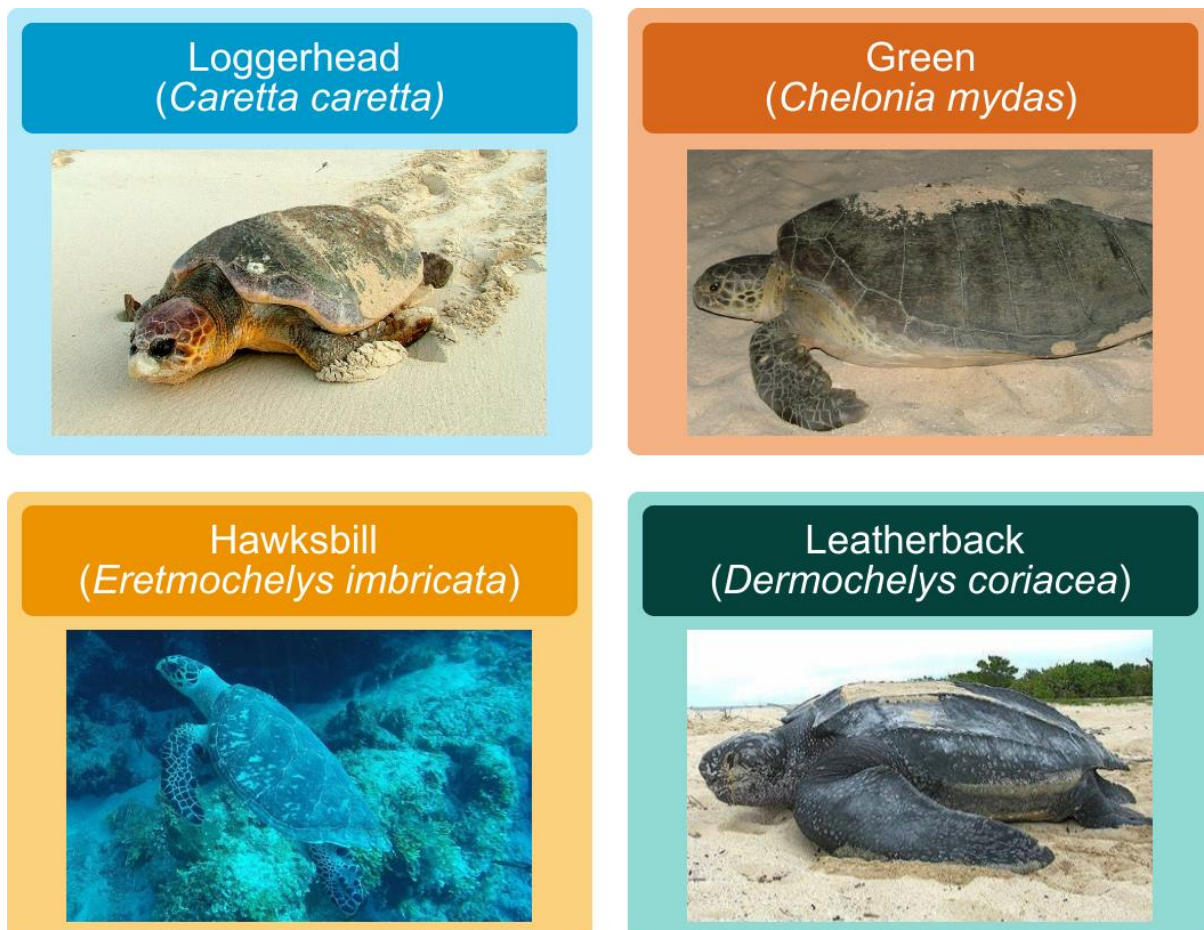


Figure 1. Four species of sea turtle that have been found in Cayman waters<sup>5</sup>.

In 1998, the Department of Environment's (DoE) Sea Turtle Nest Monitoring Programme began, meaning that as of the end of 2023, the DoE has 26 years of nest monitoring data. As shown in Figure 2, turtle nest numbers are increasing in the Cayman Islands and the population is showing signs of recovery for two of the four species (green and loggerhead turtles). This can be attributed

to the DoE’s conservation efforts, as well as the conservation efforts of the Cayman Turtle Centre (CTC). The recovery of green sea turtles has been bolstered by the CTC, which is the only species that has been captive bred and released in the Cayman Islands<sup>4</sup>. The increase in nesting populations of loggerhead turtles can be attributed to *in situ* conservation efforts as this species has not been bred in captivity. The nesting population of hawksbill turtles is critically low, with only one or two nesting females recorded per year. The nesting population of leatherback turtles has likely been extirpated from the Cayman Islands as no leatherback turtle nests have been recorded in 26 years<sup>4</sup>. Turtles that hatch from nest in the Cayman Islands migrate all over the Caribbean and so Cayman’s turtle populations are also affected by the conservation efforts, or lack thereof, in other parts of the region.

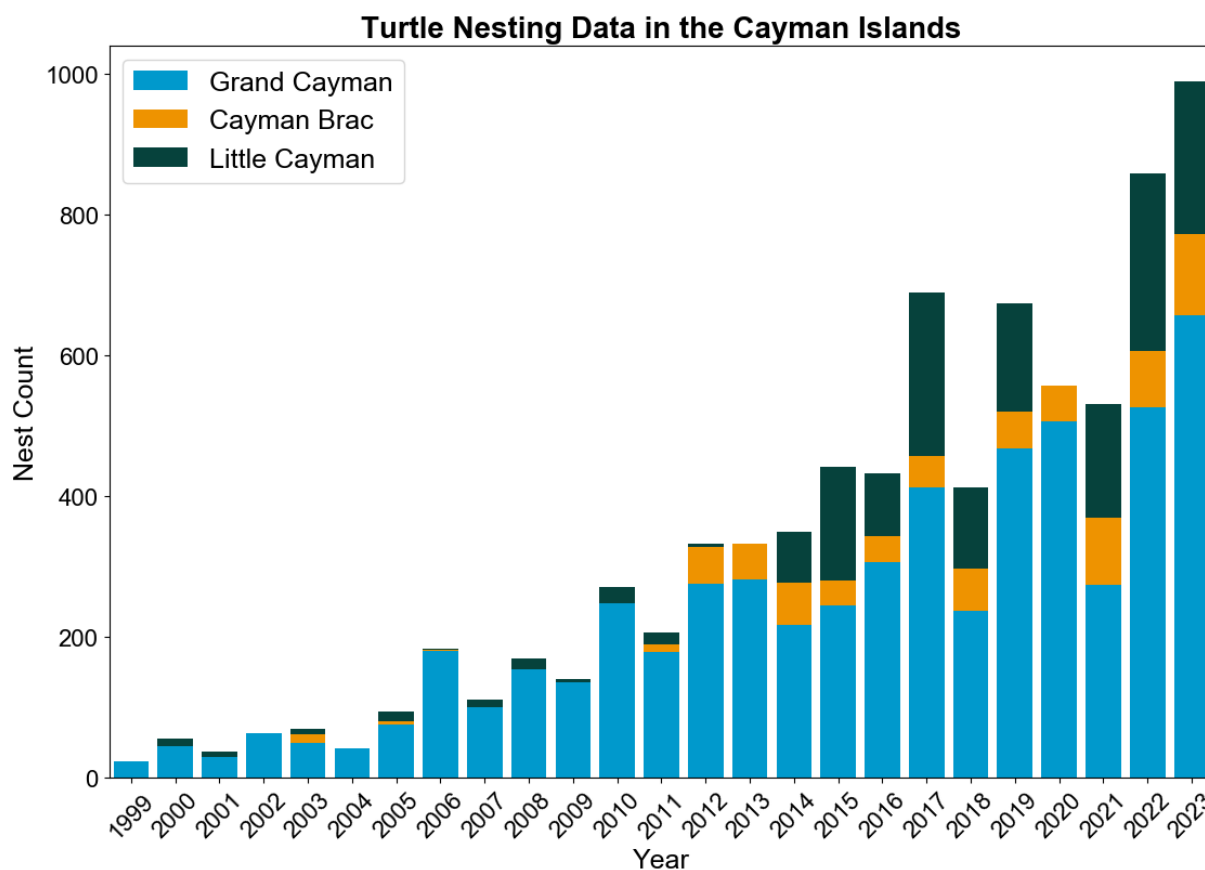


Figure 2. Recorded turtle nests in the Cayman Islands (1998-2023)<sup>5</sup>. \*It should be noted that data was not recorded on the Sister Islands for a number of years in the first decade of the Turtle Monitoring Programme. Data was available for the following years: Grand Cayman (annually 1999-2023), Cayman Brac (2003, 2005-2006, 2011-2023), Little Cayman (1998, 2000-2001, 2003, 2005-2012, 2014-2019, 2021-2023).

## **2 Current Legal Protections for Sea Turtles in the Cayman Islands**

In 2013, the National Conservation Act (NCA) was passed and listed all species of sea turtles as a Part 1 of Schedule 1 Protected Species which means they are *protected at all times*. As part of the legal protection under the NCA, one of the main ambitions of the DoE for turtle conservation has been the adoption of a Sea Turtle Conservation Plan. The DoE has drafted a Conservation Plan for sea turtles which aims to prevent the local extinction of the sea turtle population in the Cayman Islands as well as aiding in the continuing recovery of the species to fulfil ecological roles and buffer against the risk of extinction in the face of global threats such as climate change. It was approved by the National Conservation Council (NCC) and has been with Cabinet since late 2019 but has not yet been adopted.

With the adoption of the Conservation Plan delayed and the increasing approvals of inappropriately sited developments on Grand Cayman's beaches, there was an urgent need to protect Critical Sea Turtle Habitat on Grand Cayman. Section 17(7) of the National Conservation Act provides that until a Conservation Plan has been adopted for a protected species the Council may, on the advice of the Director, make such interim directives as may be urgently required for the immediate protection of that species, including the prohibition of hunting or collecting of specimens and disturbance of its Critical Habitat.

Therefore, in August 2020, the National Conservation Council (NCC) issued an Interim Directive for the designation of Critical Habitat of Green turtles (*Chelonia mydas*), Loggerhead turtles (*Caretta caretta*), Hawksbill turtles (*Eretmochelys imbricata*), Leatherback turtles (*Demochelys coriacea*) and all other species that may occur in Cayman waters including Kemp's Ridley turtles (*Lepidochelys kempii*) and hybrids in accordance with Section 17(7) of the National Conservation Act (2013).

Although the Conservation Plan for sea turtles requires designation of Critical Habitat on all three islands, the Interim Directive relates only to Critical Habitat on Grand Cayman, where the threats associated with development are greatest due to Grand Cayman having the highest volume of development proposals. If the Conservation Plan is adopted, it is proposed that the locations of designated Sea Turtle Critical Habitat may be updated every 5 years to add or remove areas as appropriate.

**Sea Turtle Critical Habitat** is defined as beaches which have had the highest density of turtle nesting over the monitoring period from 1998 to 2018. From hereafter, designated Sea Turtle Critical Habitat will be referred to as Critical Habitat. The width of Critical Habitat is the sea turtle nesting habitat from the low water mark to the vegetation line (defined as the line of woody/permanent vegetation or the closest impermeable structure).

When the DoE began to evaluate the areas to designate as Critical Habitat, the focus was on the areas with the highest density of turtle nesting over the monitoring period from 1998 to 2018 ('nesting hotspots'). Critical Habitat reflects the highest 90% of nest density values for both green and loggerhead sea turtles. These areas are combined to reflect the critical habitat for both of the two main species of nesting sea turtle in the Cayman Islands. Critical Habitat is approximately 7.01 miles of beach in Grand Cayman.

**Sea turtle nesting habitat** is defined as beaches where sea turtle nesting has occurred or is likely to occur. It includes areas where sea turtle nesting has occurred sporadically in the past or will possibly occur in the future. However, nest density values have not been high enough thus far for these areas to qualify as Critical Habitat. Figure 3 below shows the areas of Critical Habitat and turtle nesting beaches in Grand Cayman. Figure 4 below shows the areas of proposed Critical Habitat and turtle nesting beaches in the Sister Islands.

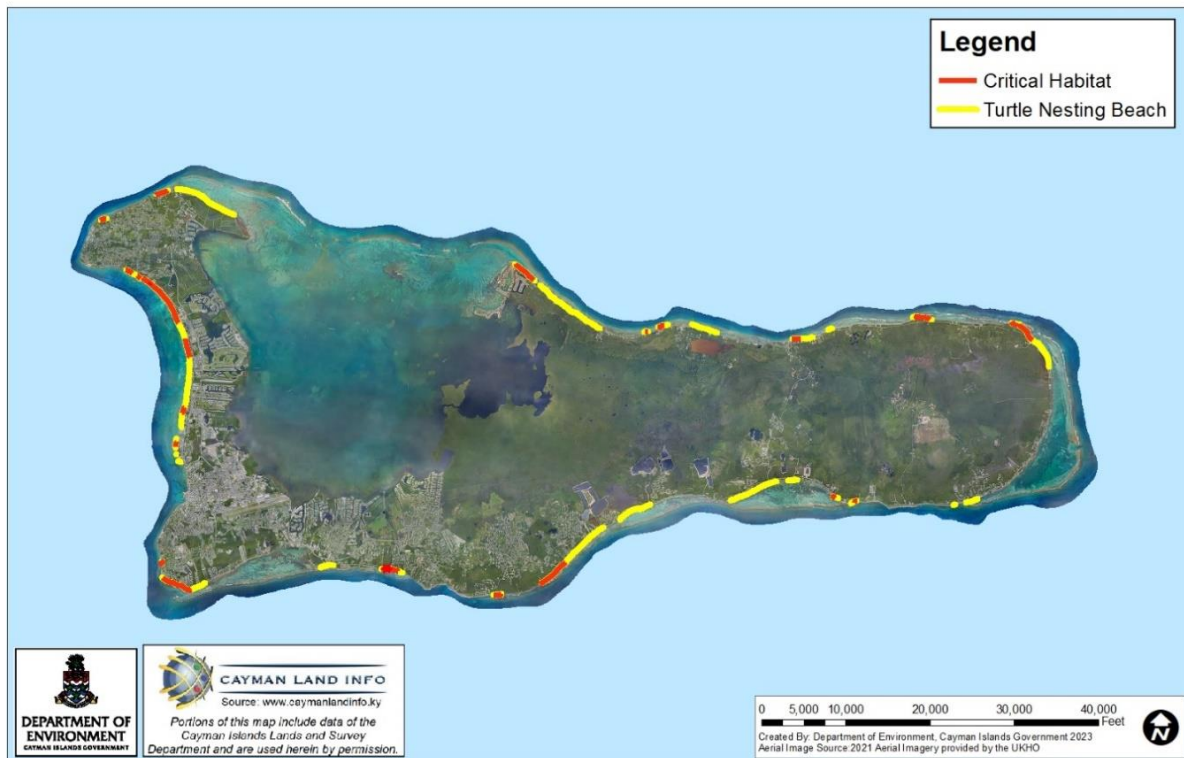


Figure 3. Designated Critical Habitat and nesting beaches for sea turtles in Grand Cayman<sup>5</sup>.



Figure 4. Proposed Critical Habitat and nesting beaches for sea turtles in Cayman Brac (top) and Little Cayman (bottom)<sup>5</sup>.

### **3 Artificial Lighting as a Key Threat to Sea Turtles**

With the legal catch of the sea turtles inactive since 2008, one of the largest threats to the future populations of sea turtles is artificial lighting<sup>6</sup>. The illumination of sea turtle nesting beaches can be considered a form of habitat loss<sup>6</sup>.

Artificial lighting can:

- Reduce turtle nesting by deterring females from emerging from the sea;
- Disrupt the ability of nesting females to find the sea; and
- Prevent hatchlings from finding the sea.

#### **3.1 Deterring Females from Emerging from the Sea**

Sea turtles display philopatry, meaning they will return to their natal beaches, where they hatched from, to lay their eggs<sup>7</sup>. There are various cues that can discourage where exactly a turtle will lay her eggs. Artificial lighting, in particular, can deter turtles from emerging from the water to nest<sup>6</sup>. In addition to evidence pointing to a correlation between lighted beaches and reduced nesting, evidence from experimental field work directly implicates artificial lighting in deterring sea turtles from nesting<sup>6</sup>. Sea turtles choose nesting sites based upon favourable conditions for safe nesting and the production of fit offspring and, therefore, light pollution can force some turtles into suboptimal nesting habitat.

#### **3.2 Disrupting Nesting Females from Finding the Sea**

After a sea turtle has camouflaged her nest, she must orient towards the sea and return there. Artificial lighting can confuse a nesting female and prevent her from finding the sea correctly, as seen in Figures 5-7 below.



*Figure 5. This turtle was misoriented by artificial lighting associated with a single-family home and became trapped in the garden<sup>5</sup>.*



*Figure 6. This turtle misoriented at a property that has turtle-friendly lighting but installed a white pool light. She was trapped in the pool until DoE staff rescued her<sup>5</sup>.*



*Figure 7. This turtle was misoriented by artificial lighting and ended up crawling through the walkway and injuring herself on the pavement<sup>5</sup>.*

### 3.3 Preventing Hatchlings from Finding the Sea

One of the most critical acts a sea turtle must perform takes place immediately after it views the world for the first time, as a hatchling. When sea turtle hatchlings emerge from their nests, they find the ocean by moving away from dark silhouettes and toward the brightest light they can see. In a natural environment, the dark silhouettes would be beach side vegetation or sand dunes and the light would be the moon and stars reflected on the ocean's surface. When artificial lights on land are brighter, hatchling turtles become 'misoriented' and crawl away from the sea which often results in their death (Figure 8-10).



*Figure 8. Hatchlings misoriented at Spotts Beach in 2018 and became stuck in a concrete hole where they started to dehydrate<sup>5</sup>.*



Figure 9. Hatchling misoriented at West Bay Cemetery Beach in 2017<sup>5</sup>.



Figure 10. Hatchling turtles can be misoriented away from the sea and towards artificial lighting<sup>8</sup>.

The DoE's Turtle Monitoring Programme has shown that hatchlings are particularly susceptible to misorient from artificial lighting in Grand Cayman. Every year since the programme started, there have been recorded misorientations. It is likely that the majority of these misorientations result in the death of hatchlings either from dehydration, exhaustion, traffic, or predation. From the DoE's turtle monitoring data, it was found **that at least 25% of misorientations resulted in the confirmed death of one or more hatchlings** during the 2023 nesting season. It should be noted that this number was produced with nests that had confirmed deaths (bodies found) and is likely an underestimation. There were many instances where there were no tracks seen heading towards the sea and only a few or no hatchlings found. The amount of verified hatchling deaths due to misorientations is different for each nest but ranged from 1 to 103 hatchling(s) per nest in the 2023 nesting season. Even in instances where live hatchlings from a misorientation were rescued, their survival rates will likely be reduced due to the amount of energy exerted on land.

The DoE's monitoring programme has confirmed the serious impact of artificial lighting on hatchling sea turtles. Wild loggerhead and green turtles do not reach sexual maturity until they are 25-35 years old<sup>9</sup>. Graphs on species abundance and composition only show limited information. The long time to maturity means that the negative impact of artificial lighting on Cayman's sea turtle hatchlings will affect our nesting population decades later. Figure 11 below indicates that the percentage of nests that experienced misorientations increased over time, peaking in 2016 before the turtle friendly lighting programme was implemented and has been decreasing since then. This is especially noteworthy because, also seen in Figure 11, the number of nests has been increasing every year. This decrease can be attributed to the increase in turtle friendly properties and interventions from DoE staff, interns and volunteers.

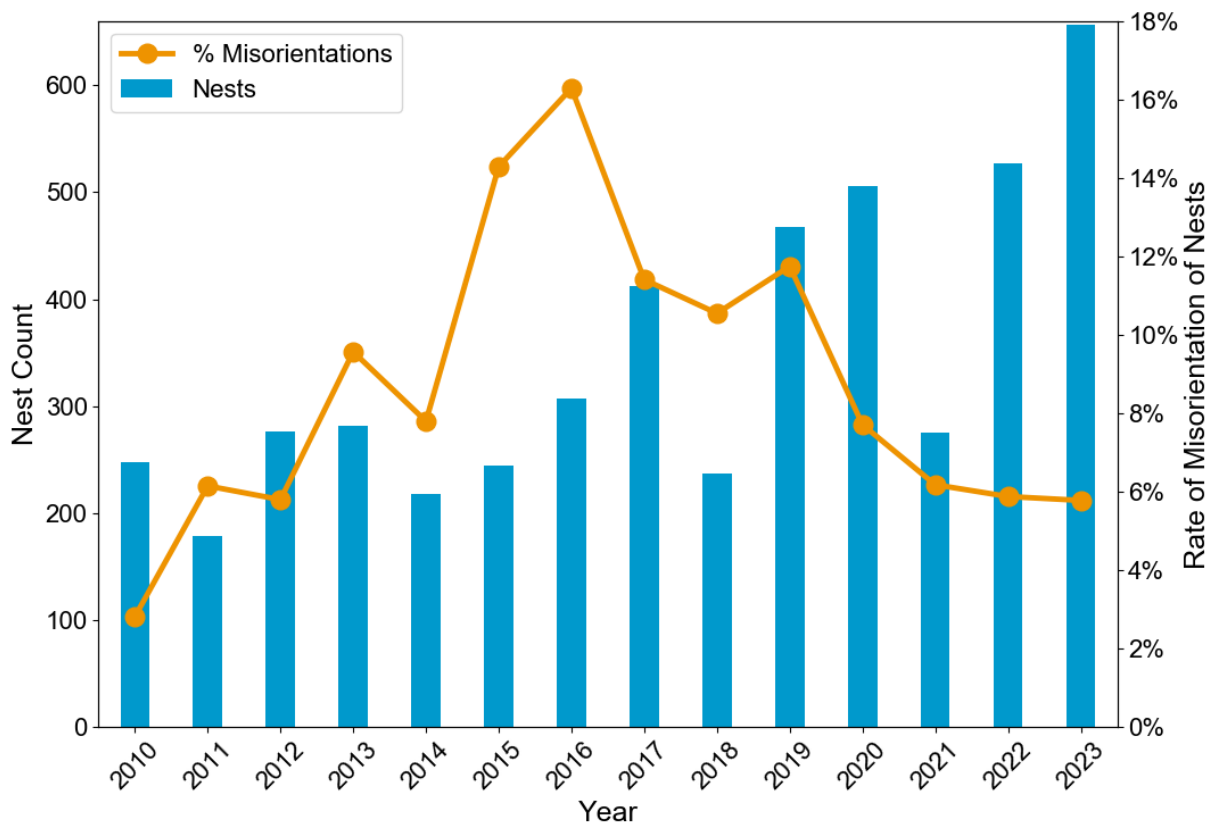


Figure 11. Nesting data and the rate of nests with misorientations in Grand Cayman (2010-2023)<sup>5</sup>.

## 4 Interventions

During every nesting season, the Turtle Monitoring Programme is carried out by DoE staff, interns and volunteers, many of whom have years of experience in turtle conservation and nesting practices. Every turtle nest should be afforded the opportunity to hatch naturally, without human intervention as the impact of human interference to nests may have damaging impacts<sup>6</sup>. However, the DoE will conduct an intervention when the success of a nest is severely at risk in order to prevent misorientations and hatchling deaths. Interventions are a last resort and can be triggered by threats including, but not limited to storms, human disturbance, and artificial lighting. Figure 12 shows the amount of interventions required by the DoE due to threats from artificial lighting only, which has slightly increased over the past decade with the 2023 nesting having a record amount due to the introduction of small barriers which are now used regularly as a precaution.

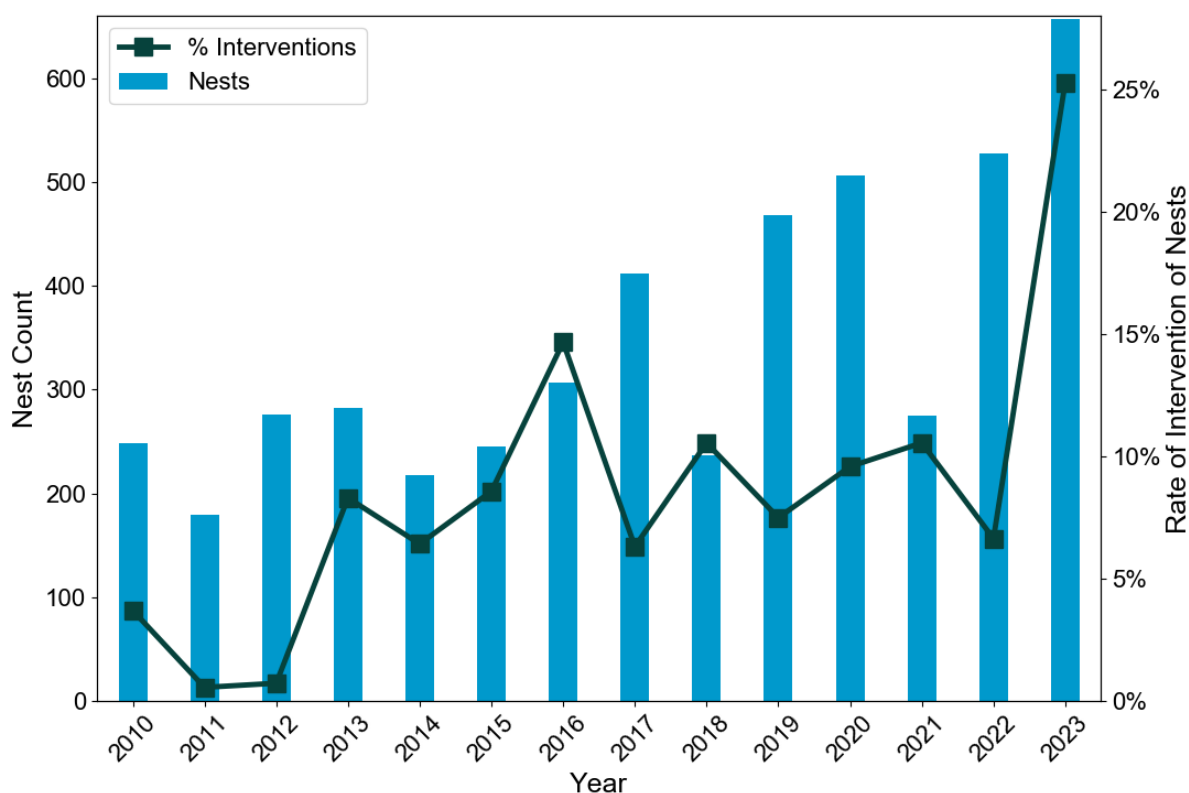


Figure 12. A comparison of the percentage of misorientations and interventions per nest to nesting numbers in Grand Cayman (2010-2023)<sup>5</sup>.

The DoE has two categories of interventions: **invasive** and **non-invasive**. Each intervention varies in the level of disturbance to the eggs and the time required by the DoE to conduct it. Examples of interventions conducted by the DoE can be seen in Table 1 below.

Table 1. Types of interventions conducted by the DoE<sup>5</sup>.

Invasive	Non-Invasive
<ul style="list-style-type: none"> <li>• Removal of hatchlings to a safer (darker) location</li> <li>• Induction of a hatch under supervision</li> </ul>	<ul style="list-style-type: none"> <li>• Installation of tarps around nests to block artificial lighting</li> <li>• Installation of runners/barriers next to nests to block artificial lighting</li> </ul>

<ul style="list-style-type: none"> <li>• Early excavation of a nest and supervised release of the hatchlings</li> <li>• Relocation of the egg clutch to a safer location</li> </ul>	<p>and guide the hatchlings towards the ocean</p> <ul style="list-style-type: none"> <li>• Door-knocking and other means to request that the lights of a property are turned off</li> </ul>
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During the 2023 nesting season, **84% of interventions were required solely because of artificial lighting threats**. Although many of these interventions were non-invasive (see Figure 13 below), they can still cause disturbance to eggs. For example, tarps must be hammered into the sand around a nest and it is unknown how much vibration is experienced by the eggs. Studies have found that vibrations can rupture the embryonic membrane and reduce hatch success<sup>11-14</sup>. In addition, some non-invasive interventions such as requesting that a property turn their lights off are not 100% effective as it leaves room for human error. In 2018, Mascovich et al. conducted a study in Jekyll Island, Georgia assessing the efficacy of a sea turtle friendly education card that asked guests to close their blinds so as to not illuminate the beach. They found that less than half of all hotel guests closed room blinds to minimise artificial light on the nesting beach, and compliance rates seemed to be lower during peak visitation times<sup>15</sup>. In Grand Cayman, during the 2021 nesting season, **24% of recorded misorientations occurred because the owners/occupiers/managers of a property agreed to turn their lights off but either did not turn off lights at all or only partially**.

Invasive interventions result in a greater level of disturbance to the eggs. The different types of invasive interventions result in different levels of disturbance to the eggs. For example, "relocation" causes maximum disturbance and it is against DoE policy to relocate nests because of lighting threats due to the recorded effects on hatch success. Based on the DoE's turtle monitoring data, the hatch success of relocated nests (due to storm inundation threats) is on average 10% lower than *in situ* nests. This is in agreeance with a study done by Eckert & Eckert in 1990 which found that the hatch success rate for relocated eggs was 20-30% lower than *in situ* eggs<sup>15</sup>. This intervention is only done as a true last resort, typically when the entire nest is at risk of being washed away because of storm inundation threats.

### Interventions due to Lighting

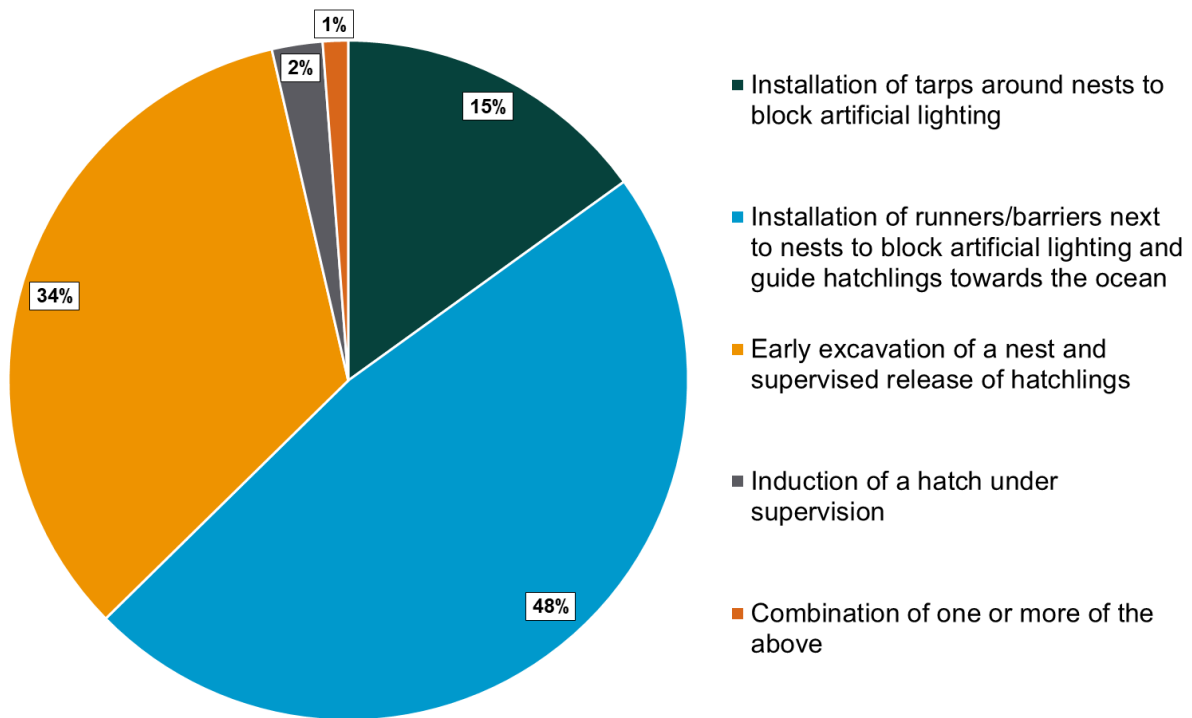


Figure 13. A breakdown of interventions conducted by the DoE in the 2023 nesting season to prevent misorientations from artificial lighting<sup>5</sup>.

Although interventions by the DoE can prevent misorientations, they are not sustainable due to increasing nest numbers and limited DoE staff and resources. Additionally, despite the extensive efforts associated with the monitoring programme, the DoE cannot locate every nest for various reasons. For example, tracks and nest pits may be raked away by beach groomers, the DoE’s volunteer walkers may miss tracks and not report a potential nest, the nest may be too deep to confirm eggs, the nest may be buried under another nest giving the illusion that there is only one nest there, etc. In these cases, the **unknown** nest can only be recorded after it hatches. Unknown nests are becoming more common as nesting numbers increase and beach area decreases. Due to increasing beachfront development, erosion and sea level rise, turtles are having to nest closer together and, sometimes, on top of each other, increasing the likelihood of mistaking two nests for one. The raking of beaches, which is becoming more frequent, is avoidable and the DoE is actively trying to address this issue with beachfront property owners/managers by providing brochures on how to identify tracks and nest pits so beach groomers can avoid them until they have been adequately recorded.

The DoE cannot proactively intervene with an unknown nest to prevent a misorientation. In 2023, **42% of the misorientations that occurred were from unknown nests**. If the DoE had known about these unknown nests, an intervention would have been in place in order to prevent the subsequent misorientation. However, since these nests were unknown, at best the DoE may only be able to assist after the misorientations have occurred (see Figure 14).



*Figure 14. DoE staff collecting hatchlings misoriented by pool lights and trapped in pool on Seven Mile Beach<sup>5</sup>.*

Certain threats to sea turtle nests are unavoidable and unpredictable (i.e. storm inundation). However, the majority of interventions are caused by threats from artificial lighting and can be avoided with turtle friendly lighting. The need for interventions is likely to continue increasing with increased nesting, increased development on the beach, and increased presence and intensity of artificial lighting. Interventions are becoming unsustainable as a practice due to limited DoE staff and available materials.

## 5 Turtle Friendly Lighting as a Proven Solution

Turtles spend most of their lives underwater so their eyes are attuned to blue, green, and yellow wavelengths and they are less sensitive to red and amber wavelengths. Turtle friendly lighting uses long-wavelengths, giving them an amber appearance that resembles candlelight. All lighting, including turtle friendly lighting, should adhere to the following general principle: lighting should not directly, indirectly, or cumulatively illuminate the beach.

To achieve this, turtle friendly lighting fixtures are typically downward directed and the concept of turtle friendly lighting follows three main principles (see Figure 15). Turtles are not completely blind to amber light. If the beach is illuminated, even by turtle friendly lights, the turtle hatchlings may still perceive the land to be brighter than the ocean and follow these lights away from the sea. See Case Study 1 (Supplementary Material) for a Turtle Friendly Lighting Plan that does not adhere to the three main principles.

Florida is an example of turtle friendly lighting legislation and beach-scale implementation. Sea turtle nesting is common on beaches in Florida. As a result of misorientation occurrences, in 1993, Florida's Department of Environmental Protection developed model lighting ordinances for lighting which would not adversely impact sea turtles. As of 2014, turtle friendly lighting has been adopted by more than 82 local governments in Florida<sup>6</sup>.

Due to the critical status of sea turtles worldwide and the increasing nest numbers in the Cayman Islands, the DoE is doing all that it can to incorporate turtle friendly lighting, as part of sustainability, into built developments on Cayman's beaches. The main ways that the DoE can encourage or ensure the use of turtle friendly lighting are:

- **Retrofitting existing properties on Critical Habitat and proposed Critical Habitat** – The DoE applied to the Environmental Protection Fund (EPF) to fund a Turtle Friendly Lighting Retrofit Programme in which the DoE partners with eligible properties to provide on-island examples of turtle friendly lighting. The DoE agrees on a Turtle Friendly Lighting Plan with the property owner/manager, after which the DoE pays for turtle friendly lighting fixtures while the properties pay for the installation of the turtle friendly lighting fixtures.
- **Directing conditions of approval for Planning applications which would affect Critical Habitat** – The DoE, on behalf of the NCC, can direct the inclusion of turtle friendly lighting conditions on a Planning Decision Letter for new development applications on Critical Habitat. In these instances, the Central Planning Authority, or other government entity, must include the requirement for turtle friendly lighting. The DoE cannot direct Cabinet and therefore including turtle friendly lighting is always at the discretion of Cabinet for Coastal Works Permits.
- **Recommending conditions of approval for Planning applications which would affect sea turtle nesting beaches that are not Critical Habitat** - The DoE can recommend turtle friendly lighting conditions for new development applications on sea turtle nesting beaches that are not Critical Habitat. For Grand Cayman, the Central Planning Authority, Cabinet or other government entity can choose whether to include the requirement for turtle friendly lighting. As there is only proposed Critical Habitat on the Sister Islands, the

DoE is not able to direct the inclusion of turtle friendly lighting and it is for the Development Control Board or other government entity to decide whether to include it.

- **Providing advice and suggestions** - The DoE provides advice and suggestions to the owners of existing properties that are interested in turtle friendly lighting. In the past, this has included helping property owners who have properties on nesting beaches that are not Critical Habitat by developing a plan and recommending changes to make their project more turtle friendly.
- **Species Conservation Plan for Sea Turtles** - The adoption of the Species Conservation Plan for Sea Turtles will also aid in the DoE's efforts to implement turtle friendly lighting in two ways. The first being that any every government entity shall require the use of turtle friendly lighting (in accordance with a Turtle Friendly Lighting Plan approved by the DoE) in any application coming before them for permission where the development or activity would be adjacent to or impacting Critical Habitat. The second is that existing properties on Critical Habitat shall replace all lighting that directly, indirectly, or cumulatively illuminates the beach with turtle friendly lighting (in accordance with a Turtle Friendly Lighting Plan approved by the DoE) within three years of the plan coming into force. This will also apply to streetlights that directly, indirectly, or cumulatively illuminates Critical Habitat. Following the expiration of this grace period, any person responsible for a light which "takes" a sea turtle in Critical Habitat is liable for prosecution under the NCA (2013).

# Principles for Effective Turtle Friendly Lighting

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**“Lighting should not directly, indirectly, or cumulatively illuminate the beach”**

## Keep it Low

Mount fixtures as low to the ground as possible to reduce light spillage and use the lowest amount of light (lumens) needed for the area.



## Keep it Long

Use long wavelength light sources (reds, oranges and true ambers) in the appropriate lighting wavelength of 560 nanometers or above.



## Keep it Shielded

Fully shield the point source of light (i.e. the bulb and/or glowing lens) so that it is not directly visible from the beach.

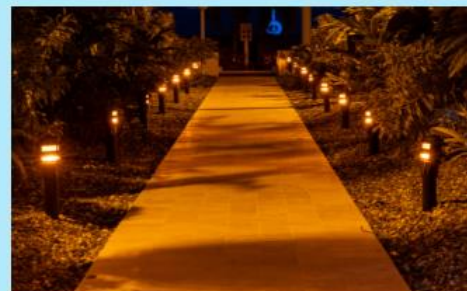


Figure 15. Three main principles to follow for effective turtle friendly lighting<sup>5</sup>.

## 6 Environmental Protection Fund (EPF) Retrofit Programme

### 6.1 Retrofit Programme Outline

In 2018, the DoE applied for and received funding from the Environmental Protection Fund (EPF) to develop a retrofit programme for existing properties on Critical Habitat. The funds in the EPF are collected as part of the environmental departure tax and from fee levies under the National Conservation Act (2013).

The programme was based on successful grant-funded turtle friendly lighting retrofit programmes in Florida. In this programme, the DoE funded lighting plan design and provided certified turtle friendly light fixtures and fittings to eligible properties and properties paid for the cost of the lighting installation.

The retrofit programme was pursued for three key reasons:

- **Direct and immediate conservation benefit** – By providing funds to assist with the retrofit of selected properties and streetlights in the highest density nesting habitats, the survival of endangered sea turtle hatchlings would be immediately increased.
- **To provide local examples of model turtle friendly lighting properties** – The properties that have been retrofitted to-date demonstrate the aesthetic appeal of turtle friendly lighting and the appropriate levels of illumination that it provides. It shows that turtle friendly lighting can meet the needs of both coastal residents and turtle nesting populations. It also showcases a wide range of turtle friendly products that properties can use when designing turtle friendly lighting.
- **To build local turtle friendly lighting capacity** – The DoE aims to assist in the development of local private sector capacity for turtle friendly lighting design, supply, and installation. Turtle friendly lighting is increasingly being required as a condition of approval by the Central Planning Authority, the Development Control Board and Cabinet. Often turtle friendly lighting plans are designed by firms based outside of the Cayman Islands. The DoE hope that by building local capacity, soon more plans can be designed locally and lighting suppliers based in the Cayman Islands will begin to stock turtle friendly lighting products.

Phase 1 of the retrofit programme was funded from 2018 to 2020. This initial phase was restricted to retrofitting existing properties on the highest density nesting beach in Grand Cayman and with the highest rate of hatchling misorientations, to turtle friendly lighting.

Phase 1 of the turtle friendly lighting project also included:

- A free turtle friendly lighting design and installation workshop for local lighting contractors, designers, architects and lighting retailers. The workshops were held in March 2018 and led by Florida-based turtle friendly lighting experts, who have been involved in turtle friendly lighting projects for more than 14 years, and have conducted more than 400 retrofits of beachfront properties; and
- A partnership with DoE, the National Roads Authority and CUC to retrofit existing streetlights to certified turtle friendly ones in areas of Critical habitat in Grand Cayman with the most misorientations historically caused by streetlights.

Phase 2 partnered with more properties located in, or immediately adjacent to, Critical habitat in Grand Cayman, to help make critically important sea turtle beaches more turtle friendly. The funding for this was awarded for the period 2020 to 2021. This phase was also completed with funding being provided under a matched contribution basis.

Phase 3 of the programme saw a continuation of properties identified in Phase 2 as well as the expansion of the project to Cayman Brac and Little Cayman to areas on proposed Critical habitat. The funding for this phase was awarded from 2022 to 2023. The DoE also completed properties identified in Phase 2 which previously missed the funding deadline and re-approach those who declined to participate previously.

Phase 3 also included a display booth at the Builder's Expo in 2023 to highlight the benefits of turtle friendly lighting to the development industry and community.

As a result of the EPF retrofit programme, 15 condominium complexes, 1 apartment building, 1 resort, 3 single family homes and 47 streetlights were retrofitted with turtle friendly lighting.



*Figure 16. A phase 1 EPF retrofit property on Seven Mile Beach before (top) and after (bottom) fully implementing turtle friendly lights (Source: DoE, 2021)*



*Figure 17. A photo showing a phase 1 EPF retrofit property on Seven Mile Beach before (top) and after (bottom) fully implementing turtle friendly lights (Source: DoE,2021).*

## 6.2 Customer Service and Turtle Friendly Lighting Survey

In 2023, the DoE sent out a survey to the EPF retrofit properties inquiring about their experience with the turtle friendly lighting process. The survey questions were worded to keep individuals and properties anonymous to facilitate honest experiences with turtle friendly lighting.

Nine responses were received: **6 Property Owners** and **3 Property Managers**.



Approximately **80% of the customer service survey participants like the turtle friendly lights installed and agreed that the programme met their expectations.** In addition, 90% of the participants were satisfied with the turtle friendly lighting retrofit process in general but were very satisfied with the customer service received from the DoE during the programme. 66% of participants were satisfied with the quality and brightness of their lights. The responses on the colour of the light seems to be influenced by personal preference as some participants thought the amber colour of the lights were “beautiful” while others mentioned that “it took time to get used to it” or it was “difficult to barbecue in”. An encouraging result taken from the survey was that every participant agreed that turtle friendly lights are very important to the conservation of sea turtles.

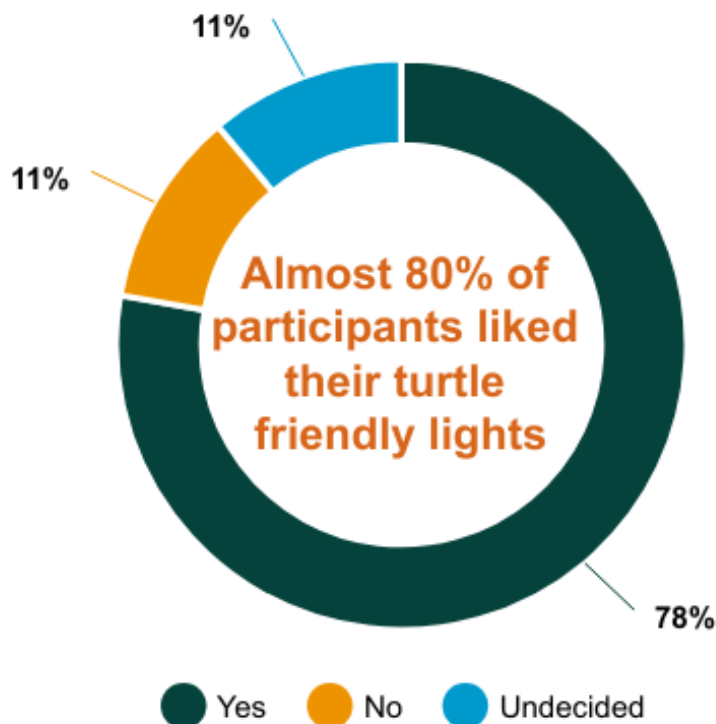


Figure 18. A highlight of the customer service survey indicated that almost 80% of participants liked their turtle friendly lights<sup>5</sup>.

The 20% of participants that did not like their turtle friendly lighting were disappointed with the brightness and quality of their lights. They suggested that some of the turtle friendly lights

installed were not necessary as they are “seldom used” and would be turned off at night during nesting season by the property owner/manager. The DoE does not recommend this approach as it leaves room for human error and has not been effective or consistent enough in the past. As mentioned before, during nesting season the DoE’s turtle team may approach property owners and ask them to turn their lights off if a nearby nest is ready to hatch and the lights are liable to cause a misorientation. If the property owner agrees, this is recorded as a “lights off” intervention in the DoE’s turtle monitoring data. According to the data, this method of intervention is not always effective as, during the 2021 nesting season, **24%** of recorded misorientations occurred because the properties owners agreed to turn their lights off but either did not or partially did.

In line with the Civil Service’s vision to be a World-Class Civil Service with a goal of delivering an outstanding customer experience, the DoE strives to provide quality customer service to everyone who is interested in installing turtle friendly lights. The survey results show that the DoE is achieving good quality customer service.



### **90% of participants were satisfied with the DoE’s customer service.**

Part of good quality customer service is responding, learning and adapting to feedback. Therefore, the DoE will take the results of the survey into consideration as the programme continues to develop. The DoE aims to improve on its programme each year, making changes to the way that Turtle Friendly Lighting Plans are designed and in communication so that it can be more effective. The DoE also plan on developing ways to highlight and promote turtle friendly properties more, so that these properties, who are making voluntary changes towards sustainability, are more thoroughly recognised.

### **6.3 Turtle Monitoring Data at EPF Retrofit Properties**

Studies assessing the impacts of turtle friendly lighting on turtle nesting beaches in other areas of the world have shown that the implementation of turtle friendly lighting not only increases the amount of nesting but also decreases the rate of misorientations<sup>10</sup>. However, these studies assess turtle monitoring data before and after beach-scale implementation of turtle friendly lighting. In the Cayman Islands, there is currently no legislation in place that requires existing properties on Critical Habitat to retrofit to turtle friendly lighting. As a result, the DoE’s EPF retrofit programme implements turtle friendly lighting on a property-level and can only be successful with engagement from the property manager as well as every property owner or resident. Unfortunately, this approach does not guarantee that the entire beach will be turtle friendly. Without beach-scale implementation of turtle friendly lighting, nesting and hatchling turtles on EPF retrofit properties still face threats from artificial lighting. See Case Study 2 (Supplementary Material) for an overview of Cayman’s first turtle friendly beach.

As seen in Figure 19 below, although the majority of misorientations that occurred during the 2023 nesting season were at non-turtle friendly properties, 13% occurred at turtle friendly properties. However, every misorientation that occurred at a turtle friendly property could be

attributed to artificial lighting threats from other sources. As seen in Figure 19 below, misorientations at turtle friendly properties can be attributed to problematic exterior lights that are in the process of being retrofitted to turtle friendly fixtures or bright interior lighting that is visible from the beach.

### Breakdown of Misorientations 2023

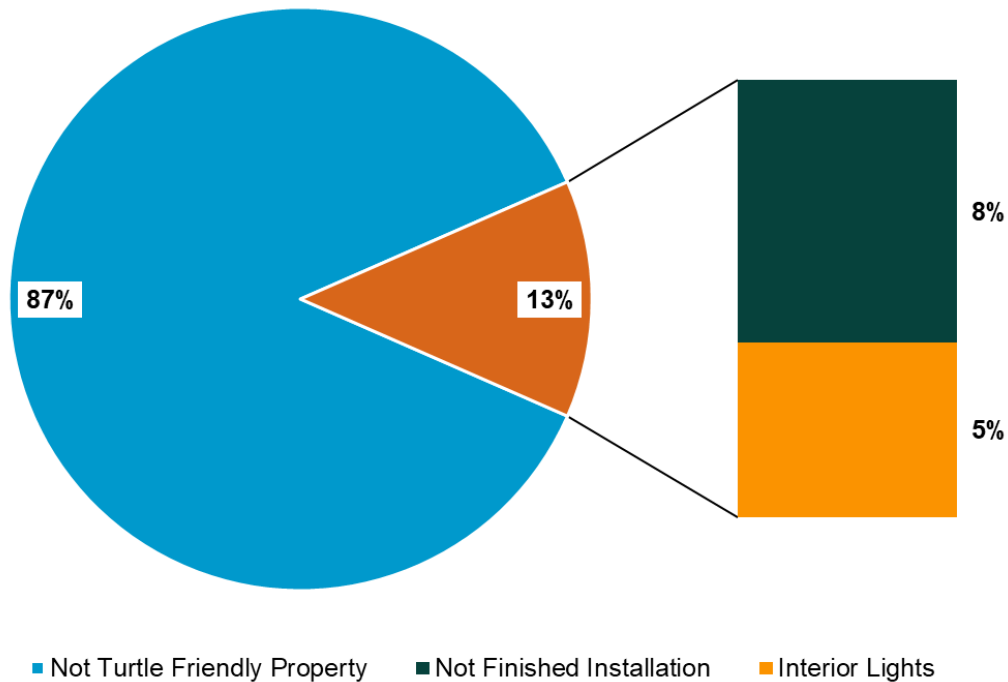
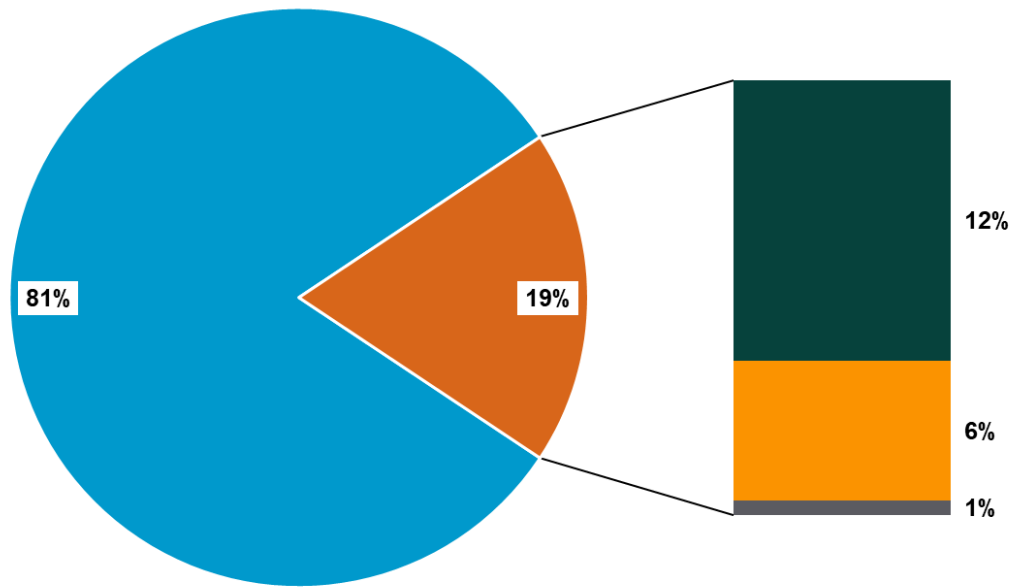


Figure 19. Breakdown property types that experienced misorientations and identified causes of misorientations at turtle friendly properties<sup>5</sup>.

As seen in Figure 20 below, a similar pattern can be seen with interventions. The majority of interventions occur at non-turtle friendly properties and interventions at turtle friendly properties could always be attributed to artificial lighting threats elsewhere. As seen in Figure 20 below, turtle friendly properties that were illuminated by neighbouring light sources accounted for 12% of interventions during the 2023 nesting season. This included non-turtle friendly lights from neighbouring properties, commercial buildings, or streetlights. Neighbouring properties on Critical Habitat were also offered an opportunity to take part in the DoE's EPF retrofit programme but chose not to participate.

## Breakdown of Interventions 2023



■ Not Turtle Friendly Property ■ Problematic Neighbouring Lights ■ Interior Lights ■ Not Finished Installation

Figure 20. Breakdown property types that required interventions and identified causes of interventions at turtle friendly properties<sup>5</sup>.

Nesting and hatchling turtles can still be misoriented by interior lights if they are bright enough to be visible from the beach, especially in Cayman where developments are directly situated on the nesting beach and on-site vegetation is often cleared. The loss of appropriate turtle nesting area to coastal squeeze has resulted in turtles having to nest closer to beachfront properties, increasing the risk of misorientation from interior lights. In order to combat threats from interior lighting, the DoE requires tinted glass or film with a visible light transmittance value of 15% or less for new developments on Critical Habitat. For existing properties such as the EPF retrofits, the DoE can offer tint additions to the existing glass windows and doors. However, it has not been the focus of the programme and it is at the discretion of the property owner/manager whether or not to implement it. Currently, there are no EPF retrofit properties that have windows and/or glass doors with a visible light transmittance of 15%. However, the results show the importance of incorporating this into the retrofit programme.

## 7 Planning Regime

Most physical development requires permission from either the Central Planning Authority (in Grand Cayman) or the Development Control Board (in the Sister Islands). Before a decision is made on any application that meets a trigger outlined in the National Conservation Council’s Section 41 Guidance Notes, the approving entity (e.g. the Planning Department, Central Planning Authority or Development Control Board) must consult with the NCC for comments and guidance on environmental matters.

When a proposal would or would be likely to affect the Critical Habitat of sea turtles, the approving entity must apply for approval of the NCC before granting approval of the overall project. The DoE, under delegated authority from the NCC, can direct conditions of approval which must be included in any approval from the originating entity.

As seen in table 2, there are three categories of beaches:

- Critical Habitat which has legal protection under the National Conservation Act (2013);
- Turtle nesting beaches which do not have legal protection; and
- Other areas where there is no turtle nesting.

The NCC can direct on Critical Habitat and make recommendations for the CPA to consider on turtle nesting beaches which are not designated as Critical Habitat. In other words, the NCC can require turtle friendly lighting on beaches which are Critical Habitat but can only recommend it for turtle nesting beaches.

Since the Interim Directive only applies to Grand Cayman, the NCC can only make recommendations to the Development Control Board because there is no designated Critical Habitat on the Sister Islands at this time.

*Table 2. The three types of beaches on Grand Cayman<sup>5</sup>.*

	<b>Designated Critical Habitat</b>	<b>Turtle Nesting Beaches (not Critical Habitat)</b>	<b>No Turtle Nesting</b>
Beach Length	7.01 miles on Grand Cayman	26.46 miles on Grand Cayman	Approx. 11.34 miles on Grand Cayman
Powers under the National Conservation Act	<b>Can Direct</b>	Cannot Direct	Cannot Direct
Would or would likely be an adverse effect on the Critical habitat (e.g. lighting directly on the beach)	Direct conditions	Recommend only	No recommendations in relation to lighting

Therefore, there are two ways that turtle friendly lighting can be made a requirement of new development.

1. The CPA or DCB can choose to include conditions requiring turtle friendly lighting, or
2. The DoE, on behalf of the NCC, can require turtle friendly lighting **for Critical Habitat on Grand Cayman only**.

When turtle friendly lighting is included as a condition of a Planning permission, the DoE is reliant on the Planning Department to include appropriate gates and checkpoints to ensure that turtle friendly lighting is implemented. The DoE is reliant on the Planning Department, particularly Building Control Unit (BCU), to ensure that a Turtle Friendly Lighting Plan is prepared and submitted to the DoE prior to the issuance of a Building Permit. The DoE is also reliant on BCU requiring an inspection to ensure that turtle friendly lighting is installed before a Certificate of Occupancy or Completion is issued. Through training courses, research on turtle behaviour, experience with retrofit programme, scientific monitoring of turtle nesting, continued learning, as well as relationships and collaborations with the Sea Turtle Conservancy, the Florida Fish and Wildlife Conservation Commission, manufacturers and suppliers of products, researchers on other Caribbean islands and globally, and academic links to refine understanding, the DoE is the only Department with the expertise to review turtle friendly lighting plans and to conduct inspections after installation to ensure that the property is turtle friendly.

## **8 State of Turtle Friendly Lighting in Grand Cayman**

### **8.1 Results of EPF Retrofit Programme**

Out of all the properties that were contacted to participate in the EPF Retrofit Programme since 2018, 40 homeowners/property managers responded to express interest. Since then, **20** of these properties completed the programme and installed as planned. Of the other 20 properties that were identified but didn't install as planned:

- Three properties already posed a low risk to turtles so there was no need for them to change their lighting at this time;
- Two properties have recently received their lighting fixtures and are currently in the process of installing;
- Five properties applied to the programme but a Turtle Friendly Lighting Plan was not prepared due to a lack of resources at the DoE, on-site nesting, and/or homeowner interest;
- Nine properties had a Turtle Friendly Lighting Plan prepared but the homeowner chose not to continue to progress in the programme. One of these properties is interested in installing turtle friendly lighting but are currently in the process of redeveloping; and
- One property had a Turtle Friendly Lighting Plan prepared but the turtle friendly lighting team chose not to progress with the homeowner as they did not want to install in accordance with their plan.

As of 2024, of the 20 properties that completed the programme and installed turtle friendly lighting as planned:

- Nine remain turtle friendly. Some of these properties have seasonal lights which are not turtle friendly but the property owners/managers have agreed to remove them before the start of nesting season;
- One property has installed turtle friendly lights as per their plan but require additional lights which are on order;
- One property installed as per their plans but were sent the wrong fixtures by the manufacturer. The fixtures sent were not true amber and have already been installed. The DoE is currently trying to rectify this issue before turtle nesting season and at minimal cost to the property owner; and
- Nine are not in compliance with their lighting plan and are no longer turtle friendly.

Of the nine EPF retrofit properties which are no-longer in compliance, the majority of properties have had only one or two lights swapped to white lights. This is discouraging to see as even one non-turtle friendly light can cause a misorientation that could potentially result in hatchling deaths. All of these properties were condominium complexes with multiple owners. The installation of even one non-turtle friendly light can undermine the efforts of the other homeowners if it causes a misorientation.

These changes could be due to an individual owner or occupier of a condominium unit swapping the fixture without notifying the strata, property manager or the DoE. It could also be due to lights breaking/reaching their lifespan and needing to be replaced. All turtle friendly lights have

at least a 1-year warranty, and often up to 10-year warranty, and the DoE is more than willing to help property owners with the warranty process. The survey of properties was undertaken outside of turtle nesting season and therefore, it is possible that these owners will switch back to turtle friendly bulbs following requests from the DoE.

## 8.2 Results of Voluntary Properties

Since 2019, there have been 6 properties that were interested in voluntarily swapping to turtle friendly lighting. Of the 6 properties:

- Two chose not to continue for unknown reasons;
- One is still interested in becoming turtle friendly but is currently in the process of expanding the development;
- Two installed their turtle friendly lights but neither are in compliance with their Turtle Friendly Lighting Plans;
- One property applied but was not eligible for funding and a basic lighting plan was presented to the homeowner although they have not yet installed turtle friendly lights.

## 8.3 Results of Planning Regime

Since 2017, the DoE has either recommended or directed turtle friendly lighting conditions for 59 Planning applications. Four of those applications are currently under review by the CPA and one of them has been refused for non-environmental reasons. The results show that out of the 55 concluded applications, the CPA has included the DoE's conditions in 41 Planning Decision Letters (**75%**). However, since 2021 when the current CPA was appointed, conditions to include turtle friendly lighting on Planning applications which may affect turtle nesting beaches have been included **almost every time** whether they were directed or recommended. Since 2021, there were only two instances where the DoE recommended turtle friendly lighting and it was not included in the Planning Decision Letter. However, one was for an addition to a resort and the other was for a deck addition to a single-family home. It should be noted that the submitted plans for the deck did not indicate any lighting fixtures but the DoE included a turtle friendly lighting condition as a precaution.

Based on the above, it is clear that the CPA has embraced and endorsed the protection of sea turtles via the installation of turtle friendly lighting.

Therefore, 41 developments have had conditions for turtle friendly lighting on their Planning Decision Letters. Out of the 41 developments, 32 have prepared a Turtle Friendly Lighting Plan. As of 2024, four developments have been completed and have installed turtle friendly lighting in accordance with their plans. As of January 2024, 12 developments have no record of Building Permit issuance on the Online Planning System (OPS) and therefore it is presumed that construction has not started.

Unfortunately, many developments have been able to start construction, and in some instances able to complete construction, without the installation of turtle friendly lighting, even when it was required by the CPA.

**Three developments were issued Building Permits without preparing a Turtle Friendly Lighting Plan**, even though they had a requirement to do so on their Planning Decision Letter. **Of these three, one has also been issued a Certificate of Occupancy.**

Additionally, **two developments prepared a Turtle Friendly Lighting Plan but were granted their Certificate of Occupancy without installing turtle friendly lighting** as per their approved Turtle Friendly Lighting Plan and **one development prepared a Turtle Friendly Lighting Plan but is currently occupied without installing turtle friendly lighting** as per their approved Turtle Friendly Lighting Plan. By preparing a plan, these developments were aware of the potential to impact turtles and of their obligation to reduce their impact on turtles. However, they chose not to install the lights according to their plan and were granted their Certificate of Occupancy. In these instances, the Planning Department did not check with the DoE to confirm whether the property had complied with their Turtle Friendly Lighting Plan before issuing their Certificate of Occupancy. Once a property has received their Certificate of Occupancy, it's unlikely that they will install turtle friendly lighting. As a result, the DoE will have to intervene nests that could be affected by problematic lights associated with the property. If these lights result in the detriment and/or death of a sea turtle, the only option available to the DoE is to collect evidence that proves in a Criminal Court that these lights have caused the 'take' of sea turtles or sea turtle hatchlings and to prosecute the homeowners under the NCA for 'take' of a protected species. It will be difficult for one arm to government to prosecute when another arm of government has approved the installation as fit for purpose. Homeowners rely on the government to ensure appropriate checks and balances are in place. In addition, it is vastly better to ensure that turtle friendly lighting that meets the needs of both homeowners and turtles is installed *before* an adverse impact on sea turtles occur.

The DoE does not have insight into why the DoE was not consulted before the issuance of a Certificate of Occupancy. Moving forward, the DoE hope to establish a better line of communication with the BCU so that each property with a turtle friendly lighting condition implements lighting in compliance with their Turtle Friendly Lighting Plan before a Certificate of Occupancy is issued.

There are 16 developments that have prepared a Turtle Friendly Lighting Plan but are still under construction and have not yet been completed. Additionally, there are 4 developments that have prepared a Turtle Friendly Lighting Plan but haven't begun construction, although one has been issued a Building Permit. It is the hope of the DoE that they will install turtle friendly lighting.

As summarised in figure 21 below, a total of 41 developments have requirements for turtle friendly lighting via the Planning process. Of those 41 properties:

- Four developments have been completed and have installed turtle friendly lighting, as secured as part of the Planning process;
- Two developments prepared a Turtle Friendly Lighting Plan but did not install it and were granted their Certificate of Occupancy;
- One property prepared a Turtle Friendly Lighting Plan and did not install it but is currently occupied;

- One development did not prepare a Turtle Friendly Lighting Plan and did not install it but were granted their Certificate of Occupancy; and
- **There are 33 properties that have requirements for turtle friendly lighting and have not been issued a Certificate of Occupancy. Therefore, there is still time for them to prepare and/or implement turtle friendly lighting and be in compliance with their Planning condition.**

### Turtle Friendly Lighting via the Planning Process

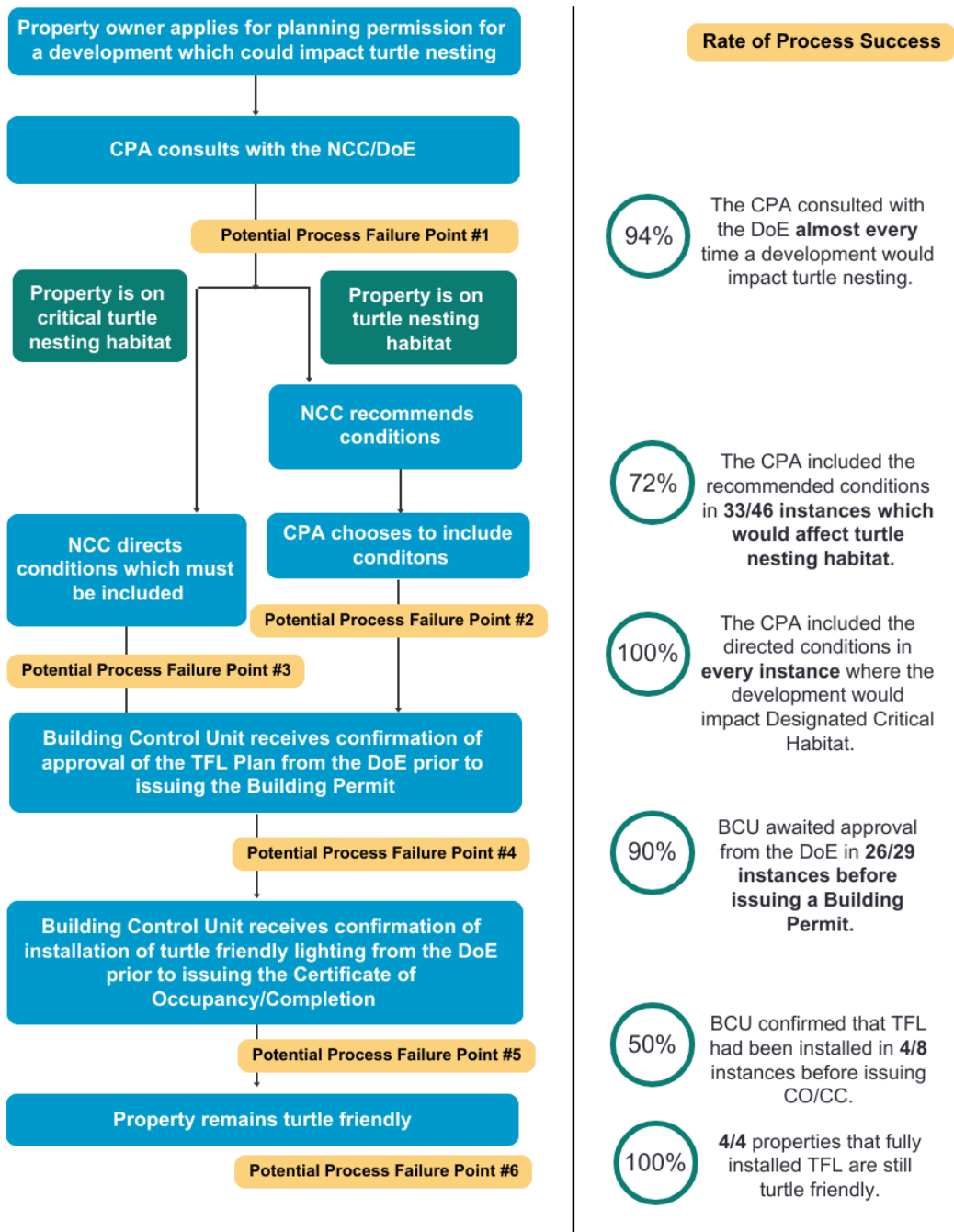


Figure 21. Diagram outlining the process of implementation of turtle friendly lighting in Grand Cayman from 2019 to present day via the Planning process<sup>5</sup>.

## 8.4 Results of Turtle Friendly Streetlights

A streetlight is particularly likely to cause misorientations of hatchling turtles because the lights are tall and bright. They can be visible a long way down the beach and impact a very wide area of turtle nesting habitat. Figure 22 shows the view of a streetlight from a beach, which is very likely to misorient hatchling turtles. Figure 23-25 show two incidents where hatchlings were drawn to a streetlight across the road from the beach and were killed by vehicles.



Figure 22. Roadway lights visible from the beach<sup>5</sup>.



Figure 23. Hatchlings misoriented by roadway lights in South Sound with hatchlings killed by traffic circled in red<sup>5</sup>.



Figure 24. Hatchlings misoriented by roadway lights in South Sound and killed by traffic<sup>5</sup>.



Figure 25. More than 30 hatchlings found dead in the road by the pedestrian crossing at Cemetery Beach<sup>5</sup>.

In 2018, the DoE, Caribbean Utilities Company (CUC), and the National Roads Authority (NRA) signed a collaborative pilot project to reduce sea turtle hatchling mortality while safely

illuminating both roadways and beachfront properties by using turtle friendly streetlights (as shown in Figure 26). The streetlights are certified by the Florida Fish and Wildlife Conservation Commission and use an amber wavelength that is less likely to attract hatchling and nesting turtles away from the sea. As of 2019, 33 turtle friendly streetlights were installed near critical turtle nesting habitat and the 2020 turtle nesting season is the first to have these streetlights installed for the duration of the season. As of 2024, 29 of these streetlights have remained turtle friendly.

In 2021, the second phase the project identified 28 white streetlights that posed a threat to nesting and hatchling turtles. In addition, the DoE identified 9 turtle friendly lights that were installed in the first phase but required alterations to the wattage and/or shield-type of the light. As of 2024, 18 of the 28 streetlights that should be swapped from white lights to turtle friendly lights as part of the second phase, have been changed. The remaining 10 are still white and should be changed.

In summary, there are now 47 turtle friendly streetlights in Grand Cayman but there are still 14 white streetlights that are scheduled to be turtle friendly. The DoE hopes that these streetlights will be swapped to turtle friendly bulbs before they cause a misorientation.



Figure 26. Turtle friendly streetlights visible from the beach<sup>5</sup>.

As seen in Figure 27 below, Spotts beach is a prime example of the importance of turtle friendly streetlights as well as turtle friendly properties. Roadway lights on this stretch of Shamrock Road and within Spotts Public Beach car parking area were visible from the nesting beach, and therefore as part of the collaborative project were swapped to turtle friendly versions.

These lights were swapped after the 2019 nesting season. At the time there were 4 properties on Spotts Beach, none of which had turtle friendly lighting. However, 2 were already turtle friendly without swapping their lights. Since the other 2 properties did not switch to turtle friendly lights until 2021, the decrease in misorientations between 2019 and 2020 can only be attributed to the introduction of turtle friendly streetlights.

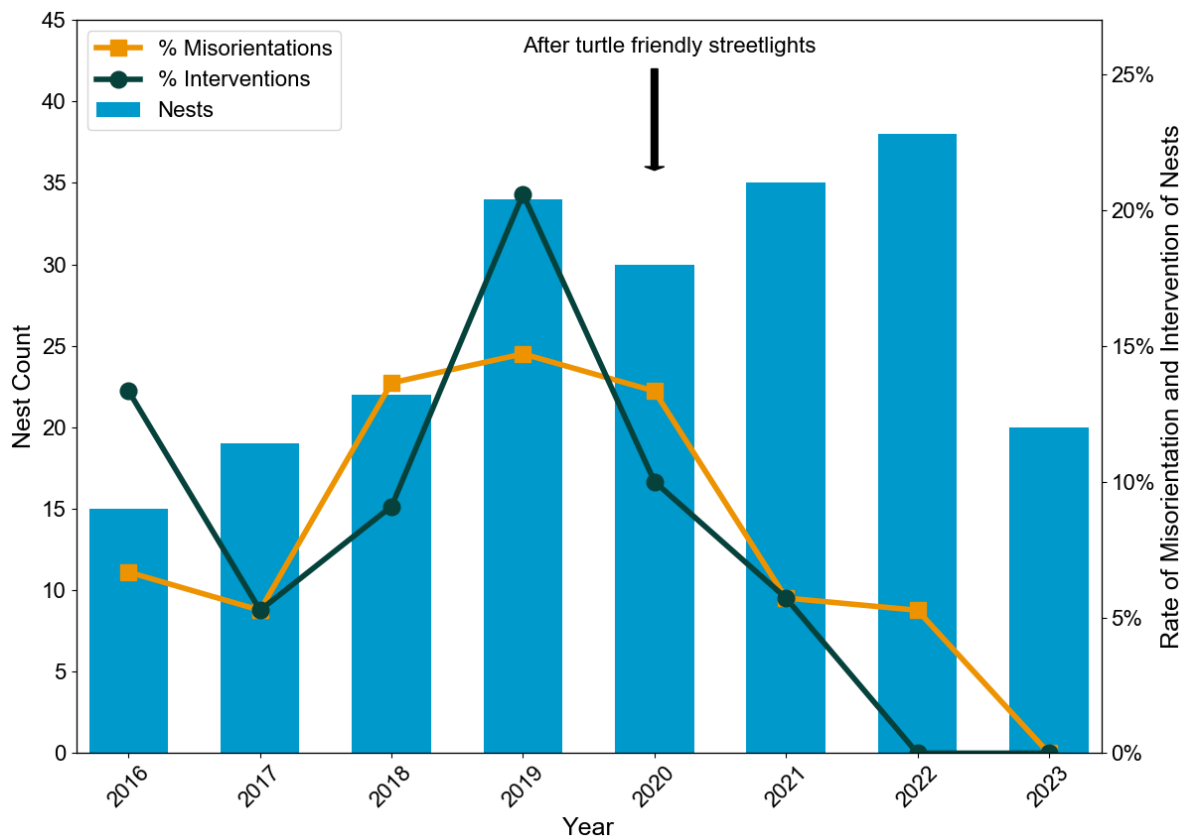


Figure 27. The implementation of turtle friendly streetlights on Spotts Public Beach<sup>5</sup>.

In another case, where some, but not all, problematic streetlights were swapped to turtle friendly luminaires, misorientations continued and resulted in hatchling deaths. The road south of Sundown Close had 3 problematic streetlights but only 2 were changed to turtle friendly luminaires (1 in 2019 and 1 in 2022). During the 2023 nesting season, a nest was laid in the empty lot south of Sundowner condos and misoriented due to the unchanged streetlight. There were no tracks heading towards the water and many tracks seen in the dirt on the edge of the road. Only 2 hatchlings were found alive and released to the water, which means this misorientation resulted in the deaths of over 100 hatchlings based on a hatched egg count from the nest excavation. Due to the location of the nest, which was either landward or in line with the existing beachfront properties, it was determined that the misorientation could have only been caused by the non-turtle friendly streetlight.

## **9 State of Turtle Friendly Lighting in Cayman Brac**

### **9.1 Results of EPF Retrofit Programme**

The Retrofit Programme for Cayman Brac was launched in April 2023. A total of 16 developed properties on proposed Critical Habitat on Cayman Brac were contacted by letter to their Registered Address on the Land Registry. Of those 16:

- Seven properties responded to the initial expression of interest;
  - Of these, two declined to participate before any further action was taken;
  - One is still in discussion;
  - Four have signed up to participate;
    - One has installed their lights; and
    - Three have had their turtle friendly lighting products ordered but they have not yet been shipped and delivered to the properties.

Overall, the DoE remains very optimistic about the success of the EPF Retrofit Programme on Cayman Brac and the uptake of the retrofit programme has been very good. Cayman Brac is just beginning to experience increasing nesting after turtle numbers became critically low. Although there are not many misorientations in Cayman Brac right now, it may not be long until the Brac is facing the same issues seen on Grand Cayman. The DoE is working to create a critical mass of turtle supporters so that all the hatchlings across all three islands have the greatest chance of making it to the sea and starting their incredible life journey.

### **9.2 Results of Planning Regime**

Two Planning applications have been submitted on turtle nesting beaches on Cayman Brac. The DCB included turtle friendly lighting conditions on both permissions. The DoE has not received Turtle Friendly Lighting Plans but construction has not yet started on these developments yet either.

One of these developments is by the Department of District Administration for a new block of public restrooms on the South Side near the existing public beach therefore the DoE would expect that turtle friendly lighting would be included as part of the government's commitment to sustainability.

### **9.3 Future of Streetlights**

A key risk to sea turtles on Cayman Brac is from streetlights.

There has recently been an increased effort by the Cayman Islands Government to purchase oceanfront land on Cayman Brac, which could be beneficial for the conservation of turtles. However, many of these newly-purchased parcels have been cleared by the Department of District Administration, thereby increasing the risk of misorientation by exposing the beaches to more artificial lighting from streetlights.

The DoE has reached out to Brac Power and Light (now Island Energy) to discuss a collaborative project to swap the streetlights to turtle friendly lights at key locations.

## **10 State of Turtle Friendly Lighting in Little Cayman**

### **10.1 Results of EPF Retrofit Programme**

The EPF Retrofit Programme for Little Cayman was launched in September 2023. Fourteen existing properties on proposed Critical Habitat on Little Cayman were contacted by letter to their Registered Address on the Land Registry. Of those 14:

- Three property owners responded to the initial expression of interest, however one did not respond to the follow-up;
- One was deemed to be turtle friendly without requiring any modifications due to the low level of lighting, the setback from the beach, the thick beachfront vegetation and the operational controls; and
- The DoE is in the process of developing turtle friendly lighting for the remaining property.

### **10.2 Results of Planning Regime**

The implementation of turtle friendly lighting via the Planning process reveals a severe lack of development control on Little Cayman.

Since 2018, Planning applications were submitted to the Planning Department for 20 individual developments that could impact turtle nesting beaches. Of these developments:

- One application was adjourned and no decision has been made as of the time of writing;
- One application was refused for reasons unrelated to the environment and turtle nesting;
- Three applications did not include a turtle friendly lighting condition from the DCB;
- Fifteen applications included turtle friendly lighting conditions from the DCB;
  - Five developments included turtle friendly lighting conditions from the DCB but have not been issued a Building Permit yet;
  - Four developments included turtle friendly lighting conditions from the DCB and have been issued a Building Permit but have not started construction yet. Only one of these has prepared a Turtle Friendly Lighting Plan;
  - Five developments included turtle friendly lighting conditions from the DCB and are currently occupied without turtle friendly lighting despite their Planning conditions. Only two of these have prepared a Turtle Friendly Lighting Plan; and
  - One development included turtle friendly lighting conditions from the DCB and has installed turtle friendly lights and is now occupied. This is the first and only turtle friendly property on Little Cayman at the time of writing.

It is very discouraging that, of the six now-completed developments on Little Cayman where the DCB required turtle friendly lighting, only one of them has actually installed turtle friendly lighting. It appears that the current barrier to implementing turtle friendly lighting is within the development control process on the Sister Islands. When the DCB includes a condition for turtle friendly lighting, they are adopting the idea that it should be implemented.

However, three of these developments were not required to prepare a Turtle Friendly Lighting Plan at all before starting construction. In addition, two developments prepared a Turtle Friendly Lighting Plan and then chose not to install turtle friendly lighting during the construction process.

This is particularly puzzling for development on Little Cayman where the community is generally in support of conservation and nature.

The DoE does not have detailed insight into the reasons that these developments were allowed to become operational without turtle friendly lighting but acknowledges that certain aspects of the Development and Planning process are not required on the Sister Islands. Moving forward, the DoE hope to gain more insight on the Development and Planning process in the Sister Islands and establish a better line of communication with the DCB and BCU so that each property with a turtle friendly lighting condition implements lighting in compliance with their Turtle Friendly Lighting Plan before a Certificate of Occupancy is issued.

### **10.3 Future of Streetlights**

As with Cayman Brac, the DoE would like to collaborate with Brac Power and Lighting to install turtle friendly streetlights on Little Cayman.

## 11 Conclusions

The Department of Environment's Turtle Monitoring Programme has been ongoing for the past 26 years. From our data, it can be seen that the nesting turtle populations of the Cayman Islands are gradually recovering from being hunted to near extinction in the 1600s and 1700s. This can be attributed to conservation efforts from the DoE and CTC, the NCA and predecessors which gave sea turtles legal protection at all times, and the establishment of Critical Habitat for sea turtles which is also protected under the NCA.

The biggest threat to turtles now is artificial lighting as it can misorient nesting and hatchling turtles, preventing them from finding the sea. The DoE is trying to combat this with turtle friendly lighting implementation and interventions when the success of a nest is at risk. However, due to increasing nests and limited DoE resources, interventions are not a sustainable practice. During the 2023 nesting season, 84% of interventions were required solely because of artificial lighting threats and could have been avoided with turtle friendly lighting.

Turtle friendly lighting is a proven solution to preventing misorientations. The DoE has implemented turtle friendly lighting through our EPF retrofit programme, recommending or directing turtle friendly lighting conditions in Planning decisions, and the collaborative turtle friendly streetlight project with the NRA, CUC and Port Authority.

Until the adoption of the Species Conservation Plan for Sea Turtles, turtle friendly lighting can only be implemented on a property level as opposed to beach-scale implementation. This means that artificial lighting from neighbouring sources can undermine the efforts of turtle friendly properties. During the 2023 nesting season, 12% of interventions occurred at turtle friendly properties that were illuminated by neighbouring light sources.

In nearly all cases, the CPA has included the DoE's recommendations or directions for turtle friendly lighting. In the majority of cases, the DCB has included the DoE's recommendations for turtle friendly lighting. However, work must be done to ensure compliance with Turtle Friendly Lighting Plans prior to the issuance of the Certificate of Occupancy or occupation of the property, because seven properties were allowed to become occupied without installing turtle friendly lighting despite the requirement to do so.

As of 2024, in Grand Cayman, there are 13 properties that have installed turtle friendly lighting and are still turtle friendly and another 11 are on their way to becoming turtle friendly. There is one turtle friendly property on Little Cayman and one turtle friendly property on Cayman Brac. In addition, there are over 150 properties in the Cayman Islands that are aware of turtle friendly lighting and the DoE hope that they will implement turtle friendly lighting in the future.

There is still work to be done to safeguard future populations of sea turtles in the Cayman Islands. Moving forward, the DoE aim to better understand the Planning and Development process in the Sister Islands while also setting up effective lines of communication with the BCU so that turtle friendly lighting is implemented before construction is finished. In addition, the DoE hope that legislation requiring beach-scale implementation of turtle friendly lighting is adopted (via the Conservation Plan) so that the efforts of turtle friendly properties are not undermined by artificial lighting from neighbouring sources.

## 12 Supplementary Material

### Case Study 1 (CS1): The Importance of a DoE-Approved Turtle Friendly Lighting Plan

Sea turtles spend most of their lives underwater so their eyes are attuned to blue, green, and yellow wavelengths and they are less sensitive to red and amber wavelengths. All lighting, including turtle friendly lighting, should adhere to the following general principle: **lighting should not directly, indirectly, or cumulatively illuminate the beach**. To achieve this, turtle friendly lighting fixtures are typically downward directed and the concept of turtle friendly lighting follows three main principles: “Keep it Low” “Keep it Long” “Keep it Shielded”.

When reviewing and approving Turtle Friendly Lighting Plans, the DoE ensures that any lighting visible from the beach follows these main principles and meets the standards of the Florida Fish and Wildlife Conservation Commission<sup>16</sup>. A property cannot be turtle friendly if these principles are not adhered to. In this case study, an example of a property that did not adhere to these principles is presented.

The applicant submitted a lighting plan to the DoE for review but it did not adhere to the principles outlined in the DoE’s Turtle Friendly Lighting Technical Advice Note and would not have minimised lighting impacts on the now Designated Critical Turtle Habitat. Due to the wording of the Planning condition, the DoE could only recommend that their lighting plan be revised as it was not turtle friendly. Unfortunately, the CPA at the time approved the plan and the property has implemented lighting that does not follow the main principles of turtle friendly lighting and poses a threat to nesting and hatchling sea turtles.

#### **“Lighting Should Not Directly, Indirectly or Cumulatively Illuminate the Beach”**

Although turtles are less sensitive to long wavelength amber lamps, they are not blind to it and strong enough illumination of amber lights can cause a misorientation, especially on a very dark night. A principle of turtle friendly lighting is that the sandy beach shall not be illuminated. The property installed lighting fixtures that directly illuminated the sand with bright lights that did not have a wavelength longer than 560 nanometres. The DoE would not have approved these as they could still cause a misorientation (see Figure CS1.1). Instead of being a true amber colour, these fixtures were full-spectrum yellow making them highly visible to sea turtles. Unfortunately, these lights have caused the misorientation during the 2023 nesting season that resulted in the death of multiple hatchlings (see Figures CS1.2 & CS1.3).



Figure CS1.1. Bright exterior lighting that directly illuminates the sand at the case study site<sup>5</sup>.

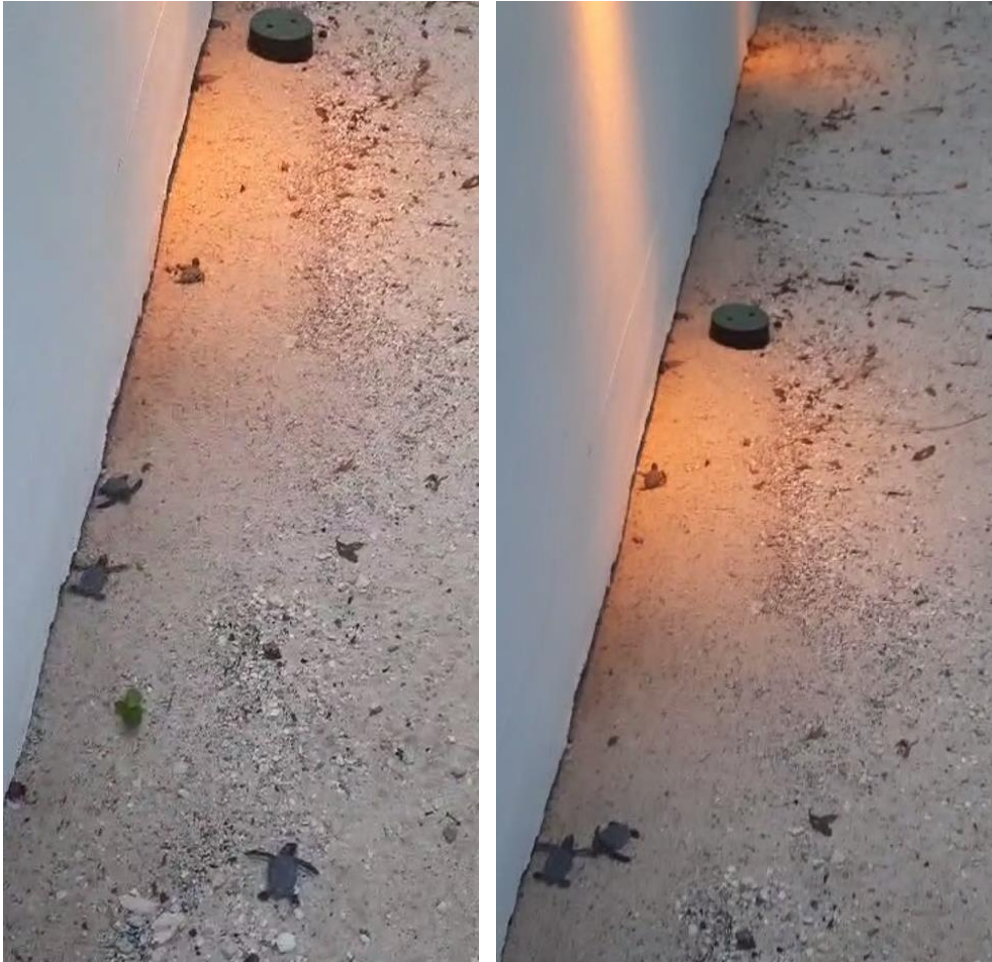


Figure CS1.2. Stills from a video of a hatchling misorientation caused by the case study site<sup>5</sup>.

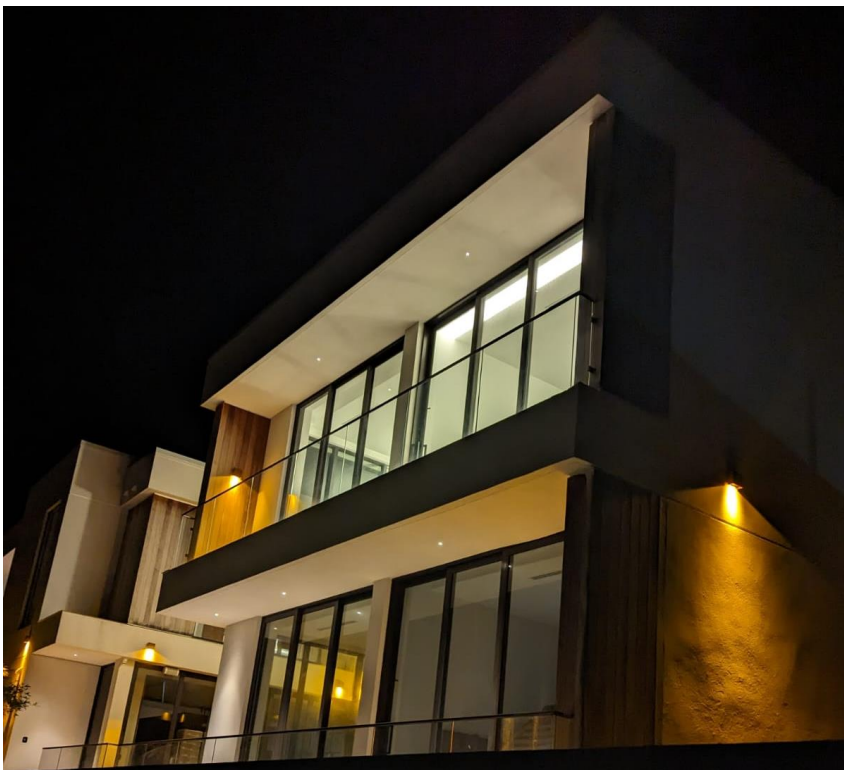


*Figure CS1.3. Sea turtle hatchlings that became misoriented by artificial lighting and then became stuck within the seawall at the case study site<sup>5</sup>.*

In addition, white lights were installed in the roof and balcony overhands (see Figures CS1.4 & CS1.5). The applicant's plan stated that these lights would be disabled during the nesting season and that they have a bespoke lighting control system to ensure compliance so approval was issued by the CPA at the time. The DoE did not recommend this approach as it left room for error and relying on a property owner/manager is not an effective intervention method. Unfortunately, these lights were left on during the entirety of the 2023 nesting season. These white, unshielded, recessed lights are visible from the beach and would not have been approved by the DoE as they have the potential to cause misorientations.



*Figure CS1.4. White exterior lighting that is visible from the beach<sup>5</sup>.*



*Figure CS1.5. White exterior lighting that is visible from the beach and bright interior lights visible as curtains were left open during nesting season<sup>5</sup>.*

## Case Study 2 (CS2): Spotts Beach

This case study highlights how collaboration between property owners, the Department of Environment, CUC, the National Roads Authority, the Planning Department, and the Port Authority has led to meaningful conservation success along Spotts Beach. Spotts Beach is Critical Habitat and is the first completely turtle friendly beach in Cayman. Despite being one of the smaller nesting beaches in Grand Cayman, Spotts Beach hosted approximately 22% of total loggerhead turtle nests recorded in Grand Cayman in 2022 (Figure CS2.1 below).



Figure CS2.1. Historical turtle nests recorded on Spotts Beach from 1999 to 2022<sup>5&17</sup>.

Along Spotts Beach, there are four single-family homes, Coral Bay Village condominiums, and one Public Beach facility.

- Coral Bay Village was an early adopter of turtle friendly lighting and participated in Phase 1 of the EPF retrofit programme.
- One of the single-family homes participated in the EPF retrofit programme in Phase 2.
- Another one of the single-family homes would have participated in the EPF retrofit programme but after site visits and discussions with the landowner, the property was already turtle friendly without turtle friendly fixtures.
- One of the single-family homes implemented turtle friendly lighting as part of the construction of their house under the Development and Planning process.
- One of the single-family homes owned private streetlights on the beachside which were switched to turtle friendly versions following their approval.
- As part of the collaborative project with CUC and the NRA on turtle friendly streetlights, streetlights on this stretch of Shamrock Road which were impacting the beach were changed to turtle friendly versions.

- Lastly, although Spotts Dock is not located directly on Critical Habitat, there were very bright lights on the end of the dock which were impacting turtle nests along Spotts Beach and other adjacent areas. After one particular instance in 2021, where members of the public found hatchling turtles along the rocks by Spotts Dock, the Port Authority very quickly agreed to change to turtle friendly lighting.

The DoE will continue to monitor the beach prior to and during nesting season to ensure that it remains turtle friendly. Figure CS2.2 shows a property that has fully implemented turtle friendly lighting on Spotts Beach as part of a Planning condition. Figure CS2.3 shows a property that implemented turtle friendly lighting as part of the EPF retrofit programme.



*Figure CS2.2. A single-family home that fully implemented turtle friendly lighting after receiving a Planning condition<sup>5</sup>.*



*Figure CS2.3. Condominiums that fully implemented turtle friendly lighting after participating in phase 1 of the EPF Retrofit programme<sup>5</sup>.*

Since 2022, Spotts Beach became fully turtle friendly. As shown in CS2.4 below, misorientations per nest have been decreasing since 2019, most likely due to the increasing presence of turtle friendly lighting on the beach.

In 2022, the misorientations that occurred in 2022 were solely due to bright, white interior lighting. For new developments with a turtle friendly lighting condition in their Planning permission, the DoE requires that windows and glass doors visible from the beach should be designed for a visible light transmittance value of 15% or less through the use of tinted glass, window film, or screens. This ensures that interior lighting will not directly, indirectly, or cumulatively illuminate the beach.

In 2023, no misorientations were recorded.

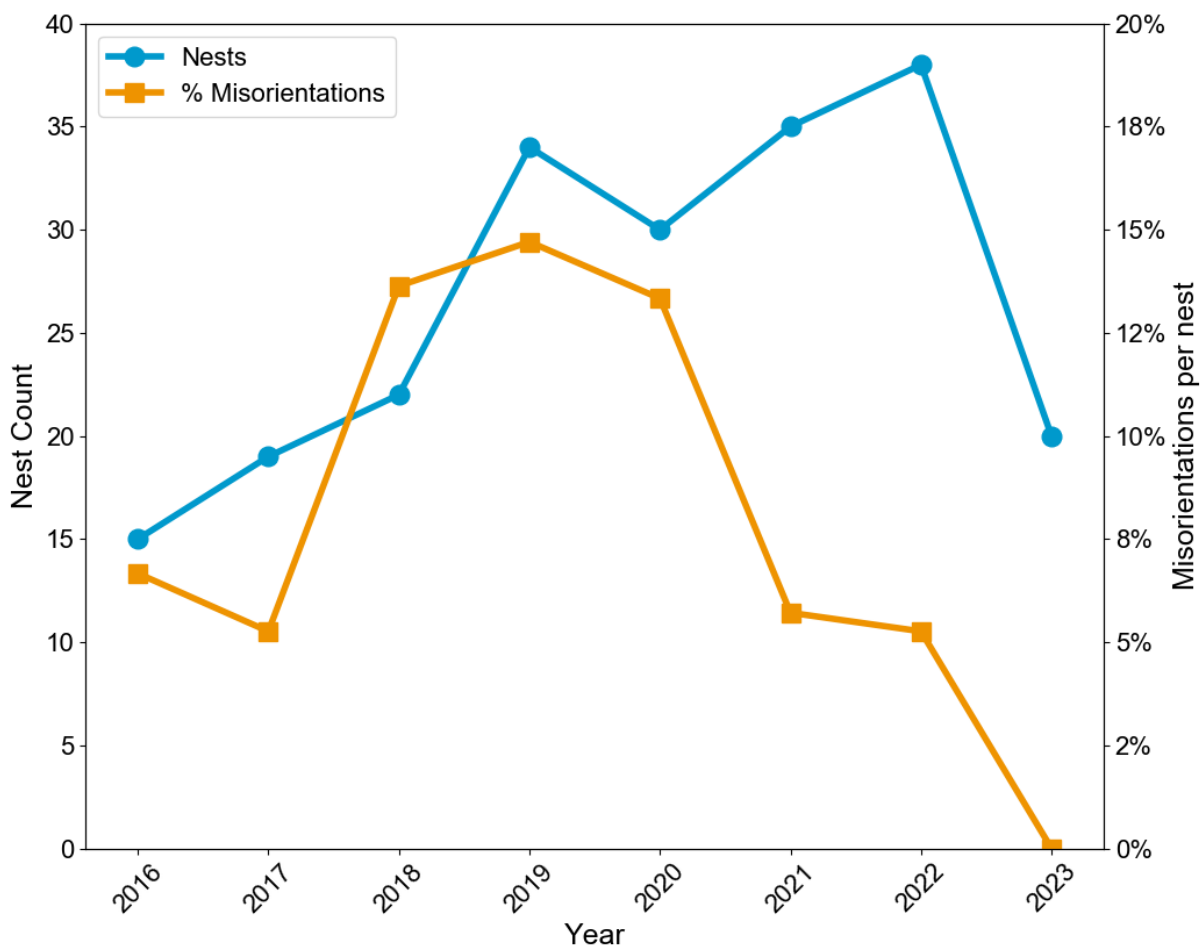


Figure CS2.4. The number of nests and % misorientations recorded at Spotts Beach from 2016 to 2023<sup>5</sup>.

Also, as shown in Figure CS2.4 above, the amount of turtle nesting on Spotts Beach has been increasing over the past 7 years with the exception of 2023. The DoE hypothesizes that this is because 2021 and 2022 had a very high level of nesting for loggerhead sea turtles and loggerheads typically nest every 2 to 3 years<sup>9</sup>. Typically, after two years with very high nesting numbers, there is a decrease in the number of nests the year after while the turtles recover in their foraging grounds and prepare for the big migration back. This pattern can also be seen after 2019, where nesting decreased the year after a year with high levels of nesting (2020).

The implementation of turtle friendly lighting has also been shown to have an effect on the amount of interventions required due to lighting only. As seen in Figure CS2.5 below, the rate of interventions follows a similar pattern to the rate of misorientations, peaking in 2019 and decreasing each year as the threat from artificial lighting along Spotts Beach is reduced through the implementation of turtle friendly lighting. In 2022 and 2023, no interventions were required and all nests were able to hatch successfully and naturally.

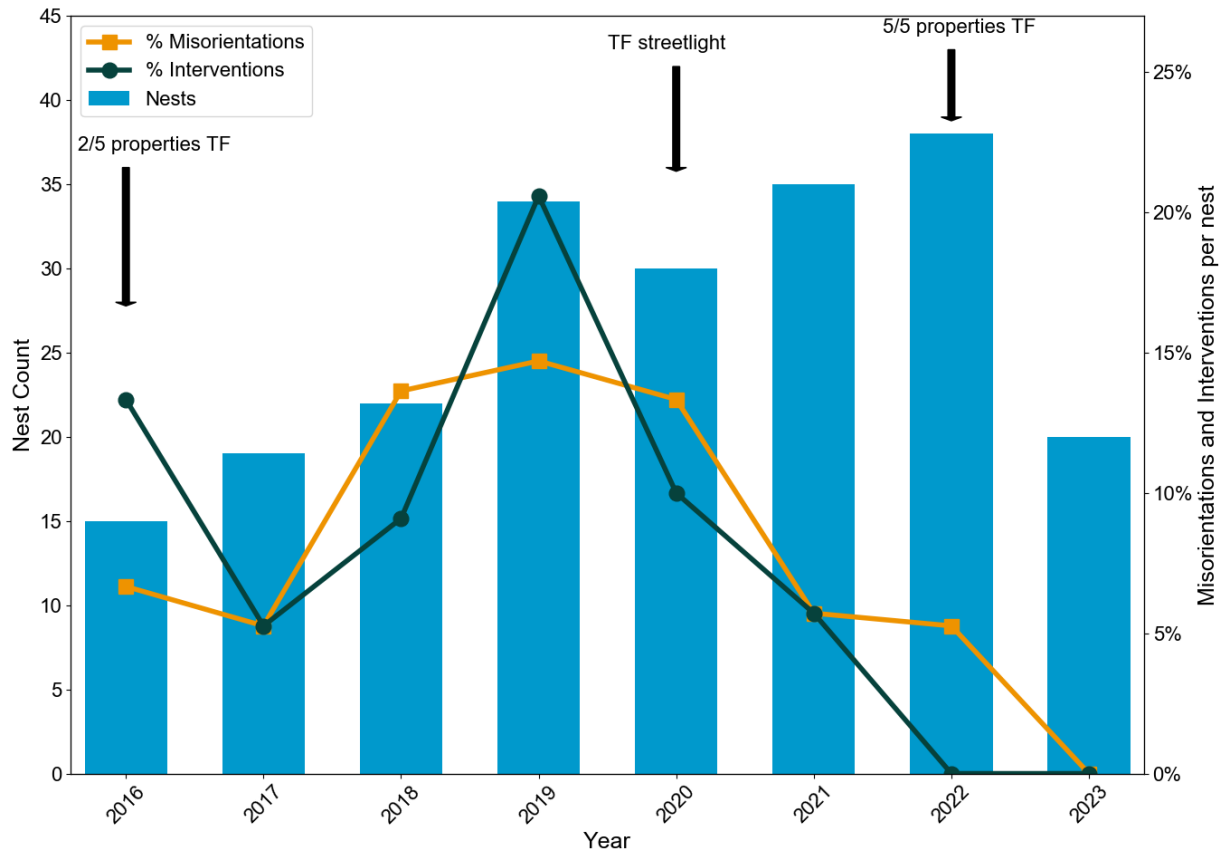


Figure CS2.5. Recorded turtle nests at Spotts Beach from 2016 to 2023 compared to the percentage of misorientations and interventions due to artificial lighting per nest<sup>5</sup>.

Therefore, turtle friendly lighting across Spotts Beach has reduced the rate of misorientations and interventions and can be considered a conservation success story that could only happen as the result of collaboration across government, the private sector and individuals.

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