INVESTIGATION INTO TURTLE MITIGATION STRATEGIES WITH TSHDS

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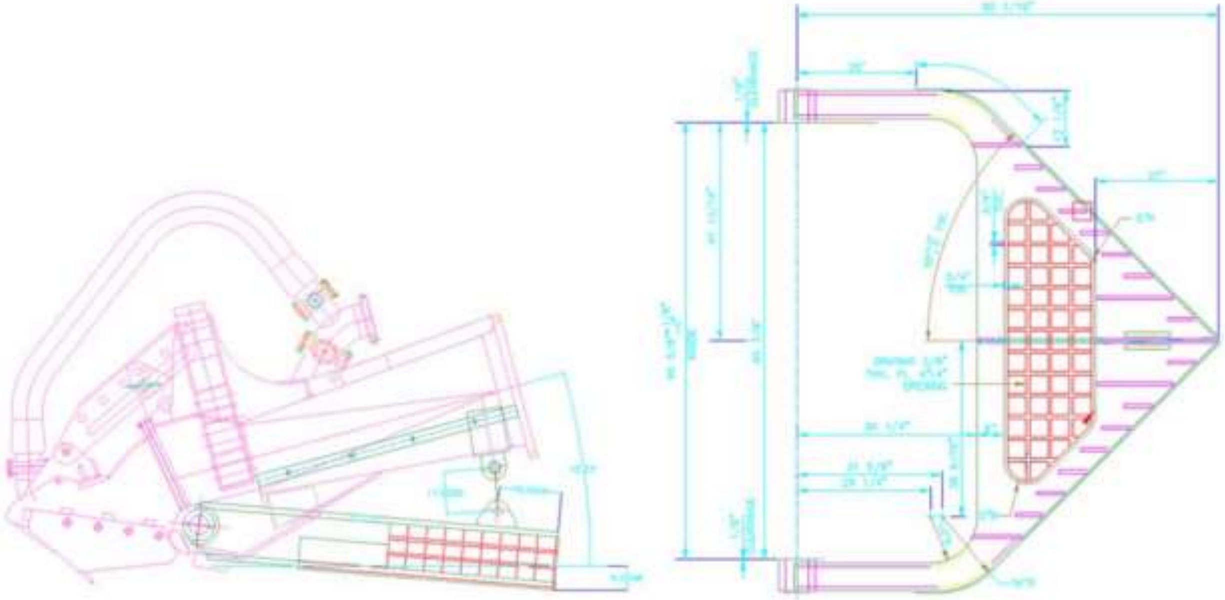
Contents

Introduction: Research Question

- TSHD (Trailing Suction Hopper Dredge) projects are influenced by environmental and contractual obligations that act as safeguards to protect marine wildlife during vulnerable periods of their life cycle; nesting/breeding and migration.
- During these windows, TSHD work is either fully prohibited or allowed to continue with a series of mitigation measures in order to prevent interaction between the dredge work and wildlife.
- Research was conducted on the effectiveness, application, and concerns of standard and alternative sea turtle mitigation measures to prevent their entrainment and mortality by hopper dredges

Physical Cues: Turtle Excluder Device (TED)

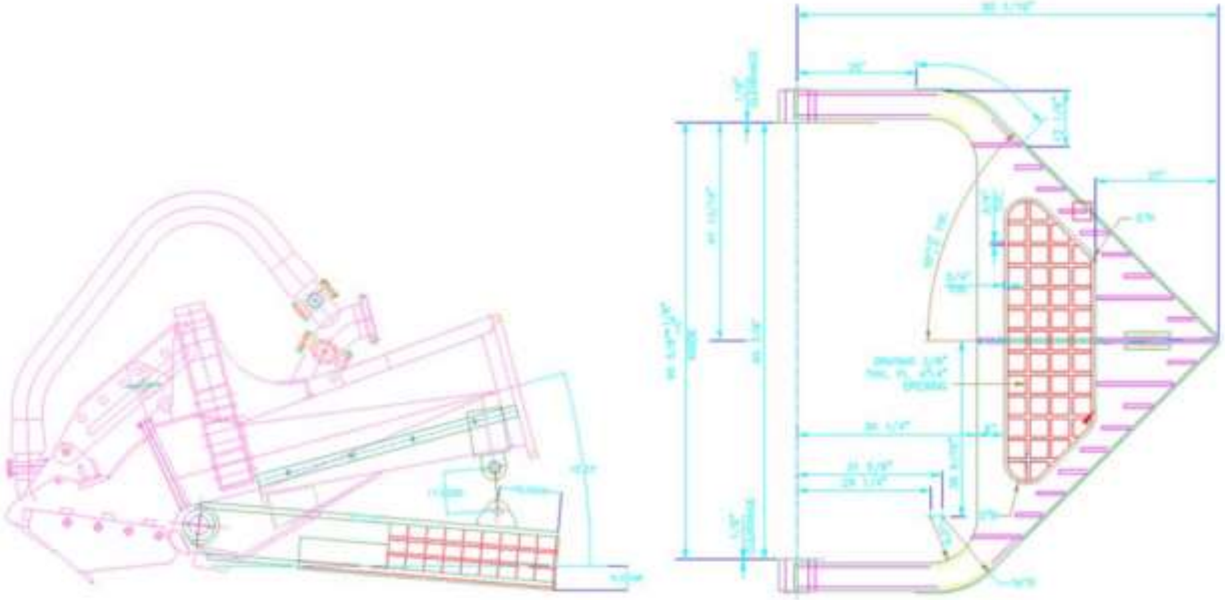


Profile and Plan View of GLDD TED Design.

Description

- Dragged along the seafloor, the TED produces a sediment wave that encourages turtles to move away from the draghead.
- TEDs of various design are widely used in the dredging industry

Physical Cues: Turtle Excluder Device (TED)

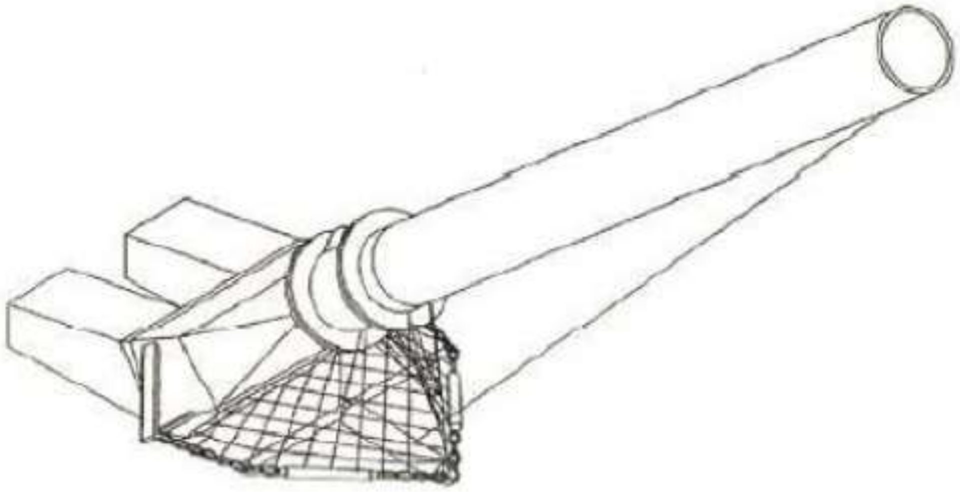


Profile and Plan View of GLDD TED Design.

Application Concerns

- TED’s have excellent success rate
- Large rocks or obstacles have potential to damage the TEDs
- Detached pieces can be sucked into the draghead and cause further damage
- Dredge Production is also hindered

Physical Cues: Turtle Excluder Skirt (TES)

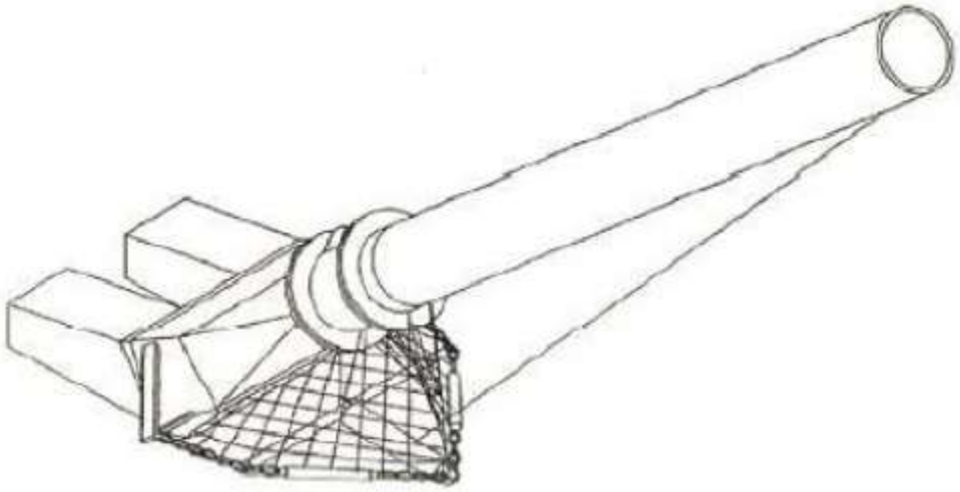


USACE "Combined Chain Deflector" Design (Henriksen et al .2015)

Description

- TES is an attachment to hopper draghead creating sediment waves to remove sea turtles from the path of the draghead, similar to TEDs
- A flexible network of weighted chains held in a V-shape by a centrally placed cable connecting the leading edge of the "skirt"

Physical Cues: Turtle Excluder Skirt (TES)



USACE “Combined Chain Deflector” Design (Henriksen et al .2015)

Application Concerns

- Less susceptible to damage from encountering obstacles, but the chains are a more fragile material than the forged metal plates of the TEDs
- Integrity of the device could negatively impact production schedules due to frequent repairs
- Pieces of broken chain could be left on the seafloor or enter the draghead causing damage
- This less-robust design could achieve less penetration of the seafloor than TEDs. Reducing the system’s efficiency

Physical Cues: Turtle Tickler Chains (TTC)

Curtain TTC
TSHD Ellis Island

Description

- Curtain provides a wider spread and increased contact points to the seafloor
- Curtain position and chain length are dredge-specific and influenced by site conditions

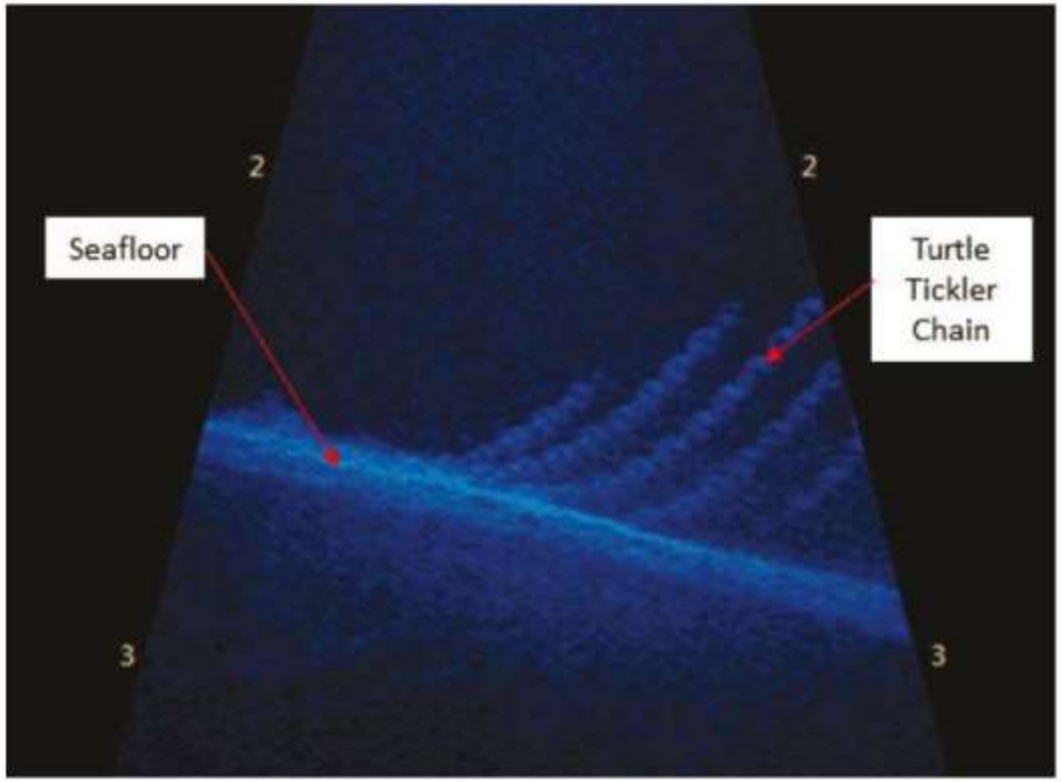
Physical Cues: Turtle Tickler Chains (TTC)

Draped TTC
(Wheatstone Project LNG)

Description

- Draped assembly does not share the same installment flexibility as the curtain assembly, being installed to the draghead rather than along the drag arm

Physical Cues: Turtle Tickler Chains (TTC)

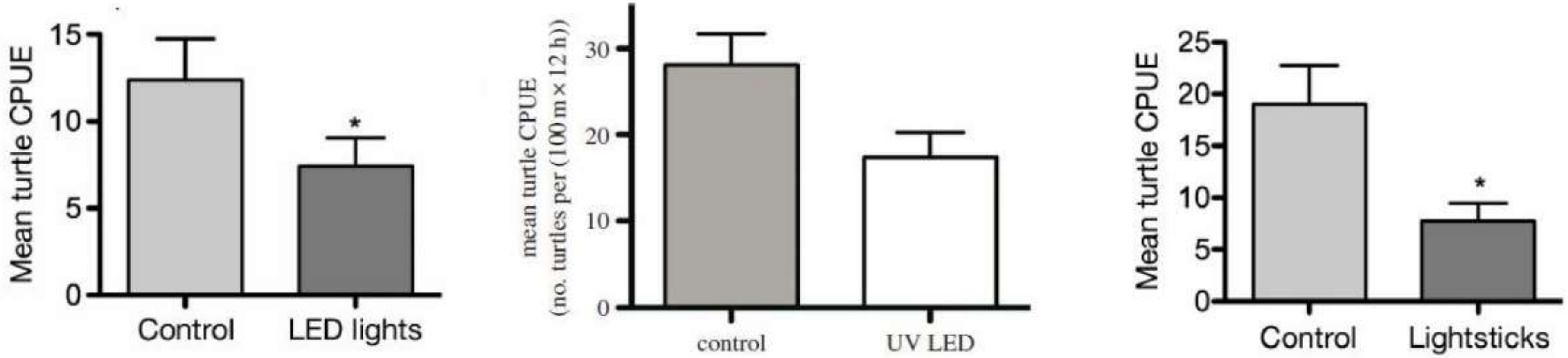


Acoustic Camera of
TCC Curtain
(Dickerson et al. 2018)

Application Concerns

- During testing the curtain maintained contact with the seafloor
- The efficiency of this system is influenced by the composition of the seafloor, greater vertical and horizontal fluctuation on soft, silty bottoms compared to sandy
- Physical interaction between the system and the ship would have to be addressed to ensure no damage to either the ship or the apparatus itself

Visual Cues: Light Sticks, LED', & UV LED



Mean turtle catch rates for light source experiments (Wang et al. 2009 & 2013)

Description

- Efficacy of using illumination as a turtle mitigation strategy has been verified through experiments in the Americas and Mediterranean
- LEDs and chemical light sticks were chosen based on the spectral range of sea turtles, with green being the most effective deterrent
- Theorized that success is achieved using this mitigation technique because the light sources illuminate the hazard

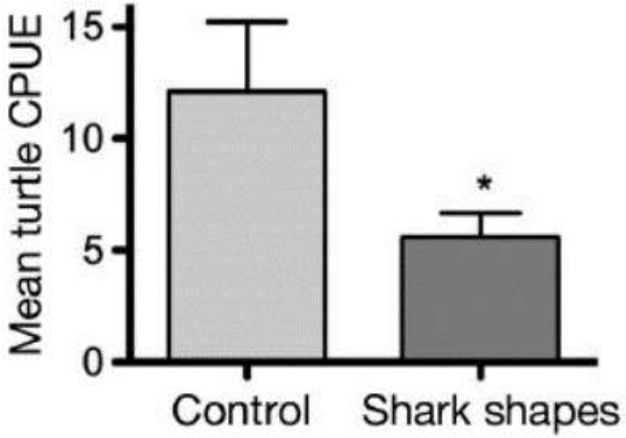
Visual Cues: Light Sticks, LED', & UV LED

TSHD Ellis Island outfitted with green lights

Application Concerns

- Concern that juvenile turtles may be attracted to light sources – Note: laboratory experiments performed with juvenile loggerhead turtle hatchlings have shown an observed aversion to light within some spectral ranges
- Chemical Sticks 24hr life or Battery UV LED requiring to be changed monthly
  Cost and waste of the method must be heavily considered

Visual Cues: Shark/Predator Silhouettes



Effect of shark silhouettes on mean green turtle (Wang et al. 2009)

Description

- Sharks are sea turtles' primary predator and seeing their image triggers an ingrained "flight" response
- There are no published studies on the methods or effectiveness of deploying predator silhouettes in dredging operations
- Two methods were considered: attaching silhouettes directly to the dredging equipment and towing silhouettes using underwater unmanned vehicles

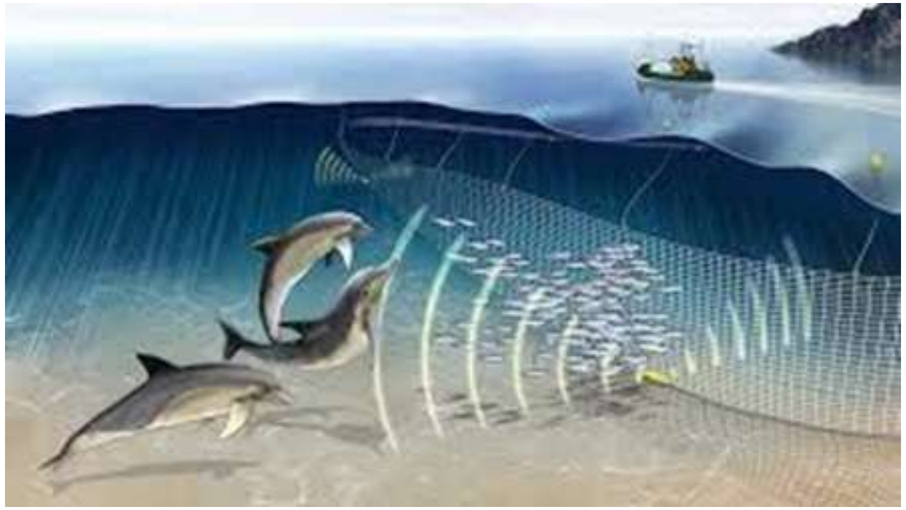
Visual Cues: Shark/Predator Silhouettes

3D Predator silhouette examples
(Reef Doctor 2017)

Application Concerns

- Installation onto the dragarm could vary in difficulty
- Using an underwater drone to tow the silhouette reduces the risk of damaging the equipment, but introduces concerns about navigating safely around operations
- During operations, water transparency and time of day can affect the efficiency of these silhouettes could be impacted

Auditory Cues: Acoustic Deterrent Devices

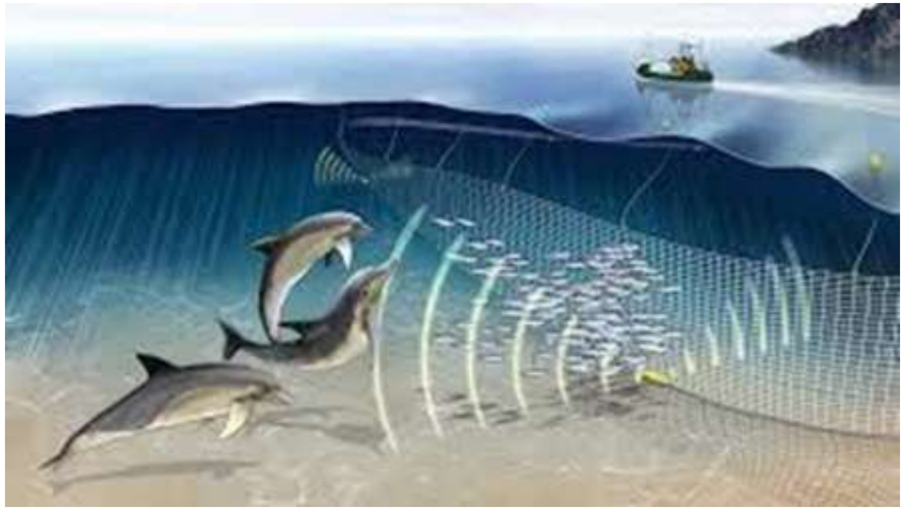


Acoustic Deterrent Devices (Crosby et al 2013)

Description

- Sounds alert sea turtles to the presence of a threat, be that a fishing net, power plant, or dredging equipment
- Frequencies can be adjusted isolating the impact to a single type of marine animal
- Using sound as instead of light could be attractive because sound waves can move easier underwater unhindered by environmental changes like water clarity

Auditory Cues: Acoustic Deterrent Devices



Acoustic Deterrent Devices (Crosby et al 2013)

Application Concerns

- Auditory devices on netting has demonstrating great success in reducing sea turtle entrainment by up to 65%
- Studies have shown that while sea turtles may be initially deterred, they are likely to grow used to the sound
- Alarmingly, during some fishing net experiments, sea turtles became attracted to the sound, associating it with a food source

Auditory Cues: FaunaGuard

FaunaGuard transducers and hydrophone
(Van der Meij et al. 2015)

Description

- Unlike other ADDs, FaunaGuard is “designed and tested scientifically for specific marine fauna species or groups of species”
- Designed predominantly to be deployed in an area prior to underwater operations

Auditory Cues: FaunaGuard

FaunaGuard transducers and hydrophone
(Van der Meij et al. 2015)

Application Concerns

- FaunaGuard as a marine life deterrent has proven successful in the wild with fish and porpoises, but experiments with wild sea turtles have yet to achieve similar results
- Data shows that the signal emitted by the equipment is still too quiet to be an effective/reliable deterrent

Conclusion

- Most effective strategies utilize the physical, visual, and auditory cues recognized by sea turtles influencing them to leave and/or avoid an area
- Physical and visual cues were the most successful in causing these desired behaviors
- Following applications should be investigated further: TTC curtains, shark silhouettes, and UV LED light sources
- Cooperation from local/federal environmental groups as well as dredging experts is encouraged to limit any adverse effects on wildlife while maintaining a realistic implementation of dredging equipment/operations

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