Report on
The Effect of Net Marking Lights
on the Interaction Rates of
Leatherback Sea Turtles (*Dermochelys coriacea*)
in Trinidad's Artisanal Mackerel Gillnet Fishery
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ABSTRACT

The single largest threat to the critically endangered leatherback turtle (*Dermochelys coriacea*) in Trinidad, is the accidental capture in coastal gillnet fisheries. The entanglement problem also places a severe strain on the ability of fishers to operate. It is estimated that as many as 3,000 entanglements occur each year in Trinidad and that as much as 35% of those entanglements result in mortalities (Fournillier and Eckert 1999; Eckert and Lien 1999; Lee Lum 2003; Gass 2005). Traditional surface drift gillnets used along the Northern and Eastern coasts of Trinidad have the highest bycatch rates. These nets are used to target King mackerel (*Scomberomorous cavalla*) and Serra Spanish mackerel (*Scomberomorus brasiliensis*). In 2007, a cooperative study between the National Marine Fisheries Service (NMFS) and the Wider Caribbean Sea Turtle Conservation Network (WIDECAST) determined that reducing the fishing depth or "profile" of the nets used in this fishery to a level that targets the most productive portion of the water column, the upper 3 to 5 meters, maximizes target catch, while reducing unwanted bycatch of sea turtles. However, results of the study differed between ports with the experimental net reducing turtle bycatch by 5.5% in one port and 37% in another. These differences may have been attributed to the use of net marking lights used in one port, which may have attracted turtles to a specific portion of the gear thereby biasing results. To examine the net marking light effect on both sea turtle bycatch and target catch, two studies were conducted during the 2008 fishing season comparing white and red marking lights and no light vs. white marking lights. Results indicate that there was no significant difference in leatherback bycatch between treatments for each study. However, target catch was reduced by experimental red light and white light treatments in each study.

INTRODUCTION

The single largest threat to the Critically Endangered leatherback turtles in Trinidad, and arguably through-out the Atlantic Ocean, is the accidental capture of the species in coastal gillnet fisheries. The entanglement problem in Trinidad also places a severe strain on the ability of fishers to operate economically, and is so severe that many are unable to fish during the leatherback nesting season. In a number of studies, it is estimated that as many as 3,000 entanglements occur each year in Trinidad and that as much as 35% of those entanglements result in the death of the turtle (Fournillier and Eckert 1999; Eckert and Lien 1999; Lee Lum 2003; Gass 2005).

In response to this problem, a National Consultation was hosted by the international Wider Caribbean Sea Turtle Conservation Network (WIDECAST) and the Fisheries Division, Ministry of Agriculture, Land and Marine Resources of the Government of the Republic of Trinidad and Tobago. Invited participants included stakeholders from the fishing communities in Trinidad and Tobago; non-government conservation organizations; international fishing and conservation experts; Trinidad and Tobago government natural resource management agencies; the Foreign Affairs Ministry. The objective of the consultation was to develop a plan to reduce the interaction of leatherback turtles in the fishery without reducing the ability of fishers to support themselves. The output of the consultation was a document that describes a series of investigations to be undertaken in bycatch reduction with the eventual objective that one or more of the reduction methods could be adopted by the fishery (Eckert and Eckert, 2005).

The Trinidadian fishery with the highest leatherback sea turtle bycatch rate is the surface drift gillnet fishery prosecuted along nesting beaches on the Northern and Eastern coasts. Nets used in this fishery are 10 to 15 meters deep and are often fished in waters less than 25 meters deep. These nets are very effective at capturing a number of species but king mackerel (*Scomberomorous cavalla*) and Serra Spanish mackerel (*Scomberomorus brasiliensis*) bring the highest price and are the most sought after species. Mackerel tend to spend most of their time in the upper portion of the water column, which is why surface drift gillnets are the preferred gear. However, gillnets employed in this fishery may fish deeper than required to catch mackerel, resulting in bycatch of many other species including sea turtles.

In 2006, NOAA Fisheries Southeast Fisheries Science Center (SEFSC) and WIDECAST initiated cooperative research to examine the effect of fishing depth and net depth or “profile” on target catch and leatherback bycatch rates in the mackerel drift gillnet fishery. The first study compared identical nets fished at different depths (Gearhart and Eckert 2007). Although no sea turtles were captured during this study, results indicated that the upper five meters of the water column was the most productive portion for targeting mackerel. In 2007, a second study was conducted during peak leatherback nesting in areas with the highest bycatch rates and examined the effect of net depth or “profile” on target catch and leatherback bycatch rates. Traditional nets 10 meters deep were compared to five meter deep experimental nets designed to target the most productive portion of the water column. Both nets were fished at the surface and were intermingled in strings of net in a matched pair experimental design. The experimental net captured 32.2% fewer turtles than the control. However, results differed between ports with the experimental net reducing sea turtle bycatch by 37% in the eastern port and only 5.5% in the northern port. Upon further investigation, the use of net marking lights was identified as the potential cause for the disparity observed between ports. The eastern port did not use lights while the northern port used a single light to mark the end of the string of nets. The light was placed in between two experimental nets, which may have confounded results.

Following the 2007 study, an informal survey of local fishermen found that many often use lights to mark their nets when fishing near shipping lanes to prevent large vessels from running through their gear. Anecdotal information from several fishermen indicates that they observe many of the interactions in the last portions of the gear where the lights are usually placed. In addition, residents employed by a local conservation organization to monitor the leatherback nesting populations in the area have long been aware of the leatherback's attraction to white light. Only red or amber lights are allowed on the beach during nesting to prevent temporarily blinding the turtles. However, if turtles stray into rivers or other undesirable nesting areas, white lights are used to consistently lead them back to the beach. This information suggests that removing or changing the color of the lights used to mark nets may reduce leatherback sea turtle bycatch in the drift gillnet fishery.

METHODS

The goal of this study was to compare target catch, finfish bycatch, and leatherback sea turtle bycatch of low profile gillnets with different lighting treatments. Comparisons consisted of:

1) No Light (Control) vs. White Light (Experimental)
2) White Light (Control) vs. Red Light (Experimental)

The hypotheses tested were:

Ho: CPUE control = CPUE experimental;
No difference observed for target catch, finfish bycatch, or sea turtle bycatch between control and experimental nets.

Ha: CPUE control ≠ CPUE experimental;
A significant difference observed for target catch, finfish bycatch, or sea turtle bycatch between control and experimental nets.

Eighty fishing trips were conducted between 7 May and 20 July 2008 on traditional fishing grounds along the North and East coast of Trinidad, West Indies. This time period encompassed the peak of the leatherback nesting season. Three commercial gillnet vessels were chartered from two ports along the east coast, Toco and Mayaro, and one port on the north coast, Matelot (Figure 1). Vessels were contracted to set and retrieve nets daily. Up to two sets were made per trip with initial sets beginning at dusk and soaking up to eight hours. Vessels from Toco and Matelot tested both white lights vs. red lights and no lights vs. white lights, while the vessel from Mayaro tested only red lights vs. white lights. Low profile nets, 5 meters deep, were used throughout the study to minimize potential for turtle mortality (Table 1).

A matched pair experimental design was used throughout the study with each vessel setting ten 100 meter nets connected to form a single string of nets. The first five and last five contiguous nets served as two separate experimental units. Treatments were applied to each unit separately with lights mounted at opposing ends and in the middle of each unit to minimize confounding effects (Figure 2). Treatments were switched between experimental units as often as possible to account for potential vessel proximity bias. Lights were mounted to standardized net marking poles at fixed distances off the water (Figure 3). Light treatments consisted of either white or red Lindgren-Pitman Electralume® LED lights.

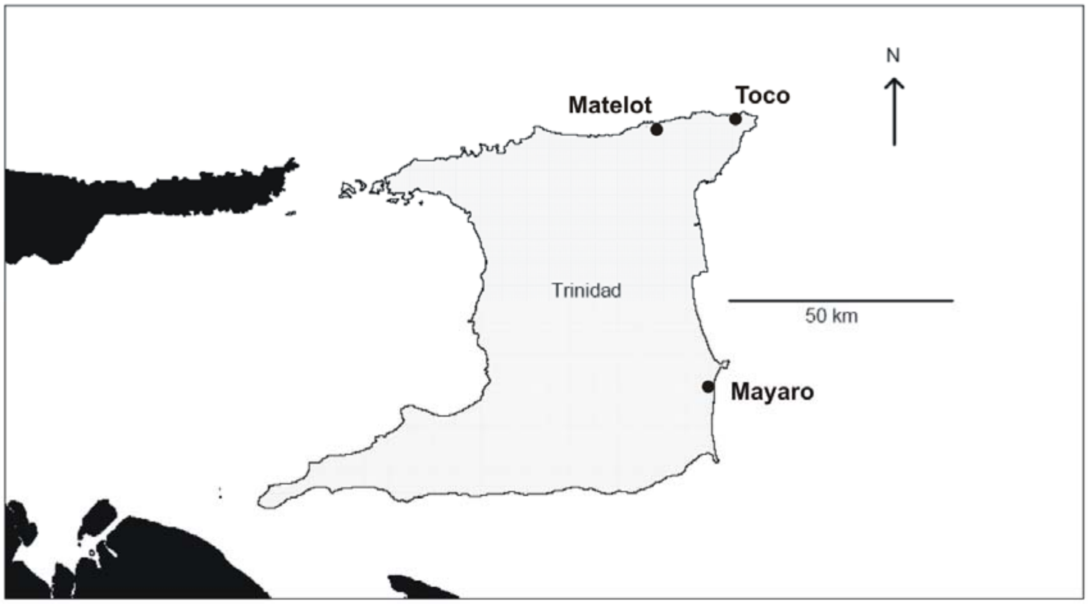

Figure 1. Map of Trinidad and location of fishing ports used during the 2008 net marking light study.

Table 1. Summary of net characteristics for gillnets used to test net marking light treatments during 2008 in Trinidad's mackerel gillnet fishery.

Net Characteristics		
Webbing		
	Mesh Size (inches)	4.25 in
	Material	Nylon
	Twine Size	#15
	Mesh Depth	50
Floatline		3/8-inch poly with one float/fathom
Lead line		3/8 poly-inch with one 8oz lead/three fathoms
Fishing Depth (meters)		Surface to ~ 5 m
Overall Length (meters)		100 m

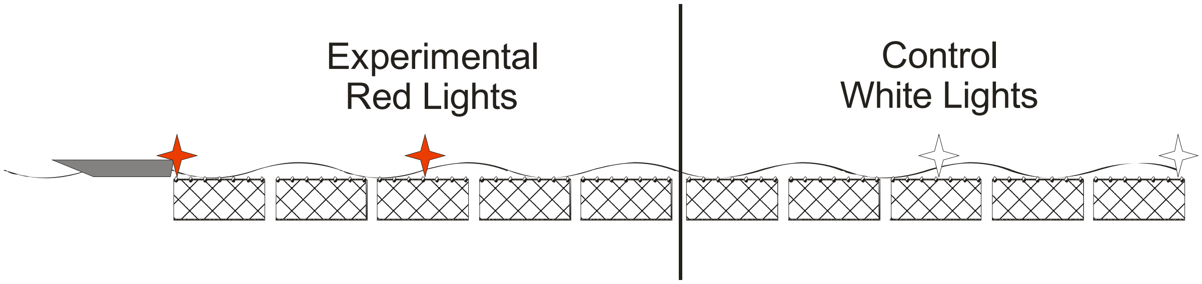

Figure 2. Experimental (red light or no light) treatment arrangement for proposed 2008 leatherback gillnet bycatch study.

Figure 3. Standardized net marking light stands used to mount Lindgren-Pitman Electralume® white (control) and red (experimental) LED lights.

Observers and port samplers were contracted from the local sea turtle and environmental conservation group, Nature Seekers. Observers were present during each trip and collected net set and retrieve times and locations. Observers also collected sea turtle bycatch information including; species, location, condition, inconel tag and pit tag numbers. Observers also assisted with disentanglement of incidentally captured sea turtles.

Fishermen retained the entire catch and kept catches separate on board for each light treatment. After catches were landed, port samplers collected total counts and weights by species for each treatment and also collected price per pound for each species and amount of fuel consumed for each trip.

Catch rates for both target finfish species (mackerel) and bycatch finfish species, and sea turtles were calculated as CPUE (catch/100 meters of gillnet/hour soaked). Pair-wise comparisons for control and experimental treatments were conducted using Wilcoxon Signed Rank tests to detect significant differences.

RESULTS

A total of 78 matched pairs were collected during the study. Collections by port were 26 from Matelot, 32 from Toco, and 20 matched pairs from Mayaro (Table 2). Among these,18 matched pairs were collected for no light/white light comparisons, while 60 were collected for red light/white light comparisons. A total of 94 leatherback sea turtles were captured during the study, with 19 captured during the no light/white light comparisons and 75 during white light/red light comparisons.

White Light vs. Red Light

Sea Turtle Bycatch

Results varied among ports with no significant difference observed in sea turtle bycatch for Matelot and Toco trials (Table 2). Significantly fewer leatherbacks were caught in nets marked with red lights in Mayaro. When data from all ports were pooled there was a non-significant 20.6% increase in leatherback catch for nets marked with red lights (Table 2).

Fish Catch

Due to their high value, Serra Spanish mackerel and King mackerel are the primary target species for this fishery. Catches of these species were reduced in nets marked with red lights in Toco (33.4%) and Mayaro (87.9%) with the reductions observed in Mayaro being significant (Table 3). Total catch followed similar trends with reductions observed for red lights in Toco and Mayaro and only significant reductions detected in Mayaro (67.3%, Table 3). Catches of other species also reflected these results with significant reduction detected in Mayaro (39.7%) and non-significant reductions observed in Toco (43.4%, Table 3).

No Light vs. White Light

Sea Turtle Bycatch

Leatherback bycatch was not significantly different between treatments for the individual ports of Matelot and Toco (Table 2). The same was true for pooled data with a non-significant reduction of 27.3% observed for nets marked with white lights (Table 2).

Fish Catch

Target catch was significantly reduced in nets marked with white lights in Toco (81.7%, Table 3). Total catch followed similar trends with significant reductions revealed for nets marked with white lights in Toco (69.5%, Table 4). The same was true for other species catch comparisons with significant reductions observed in Toco (63.2%, Table 4).

Table 2. Number of leatherback sea turtles captured by port and treatment for no light (control) vs. white light (experimental) comparisons and white light (control) vs. red light (experimental) comparisons. P values indicate the results of Wilcoxon Signed Rank tests with bold numbers indicating significant differences (P < 0.05). %Diff = Percent difference ((Exp/Con - 1)*100).

	No vs. White					White vs. Red				
Port	**n**	**No Light**	**White Light**	**%Diff**	**Prob>S**	**n**	**White Light**	**Red Light**	**%Diff**	**Prob>S**
Matelot	4	2	2	0.0%	1.0000	22	19	21	10.5%	0.6699
Toco	14	9	6	-33.3%	0.4531	18	9	20	122.2%	0.1243
Mayaro						20	6	0	-100.0%	**0.0313**
Total	18	11	8	-27.3%	0.5078	60	34	41	20.6%	0.5893

Table 3. Kilograms of total catch, target catch (Serra Spanish and King mackerel), and catch of other species by port and comparison for control and experimental nets employed during the 2008 fishing season in north and east Trinidad. P values indicate the results of Wilcoxon Signed Rank tests with bold numbers indicating significant differences (P < 0.05). %Diff = Percent difference ((Exp/Con -1)*100).

		Total Catch					Target (Mackerel)					Other Species				
Port	**Comparison**	**N**	**Con**	**Exp**	**%Diff**	**p value**	**N**	**Con**	**Exp**	**%Diff**	**p value**	**N**	**Con**	**Exp**	**%Diff**	**p value**
Matelot	**White vs Red**	18	266	296	10.9%	0.8502	16	153	182	18.8%	0.6592	18	114	114	0.2%	0.8057
Toco	**White vs Red**	15	323	197	-39.1%	0.0976	12	138	92	-33.4%	0.2139	15	185	105	-43.4%	0.1241
Mayaro	**White vs Red**	20	846	277	-67.3%	**0.0019**	20	484	59	-87.9%	**0.0006**	20	362	218	-39.7%	**0.0374**
Matelot	**No vs White**	4	112	121	7.5%	1.0000	3	1	10	616.7%	0.5000	4	111	111	0.0%	1.0000
Toco	**No vs White**	12	384	117	-69.5%	**0.0005**	12	131	24	-81.7%	**0.0088**	12	253	93	-63.2%	**0.0059**

Matelot

A total of 18 matched pair collections were made for the white light/red light study and only four collections for the no light/red light study. Species composition of the catch for each study was similar among treatments

White Light vs. Red Light
Total catch for the control net was 266 kg, while the experimental net caught 296 kg (Tables 4 and 5). Species composition was similar between treatments with each net type having comparable relative biomasses for the top four species of fish caught (Tables 4 and 5). No difference in leatherback bycatch was observed between treatments (Table 2).

No Light vs. White Light
Total catch for the control net was 112 kg, while the experimental net caught 121 kg (Tables 6 and 7). Species composition was similar between treatments with each net type having comparable relative biomasses for the top three species of fish caught (Tables 6 and 7). No difference in leatherback bycatch was observed between treatments (Table 2).

Table 4. Relative biomass (kgs) and number of individuals collected by 400 meters of the control (white light) gillnet during 18 trips in northeastern Trinidad from the port of Matelot during the 2008 fishing season. All species are ranked by relative biomass (% weight).

Common Name	Scientific Name	Biomass (kgs)	% Biomass	Number	% Number
Serra Spanish mackerel	*Scomberomorus brasiliensis*	101.83	38.21	68	32.23
Brazilian sharpnose shark	*Rhizoprionodon lalandii*	55.34	20.77	75	35.55
King mackerel	*Scomberomorus cavalla*	51.03	19.15	17	8.06
Crevalle jack	*Caranx hippos*	16.78	6.30	5	2.37
Ladyfish	*Elops saurus*	14.51	5.45	8	3.79
Blacktip shark	*Carcharhinus limbatus*	8.16	3.06	1	0.47
Atlantic bumper	*Chloroscombrus chrysurus*	7.26	2.72	27	12.80
Coco sea catfish	*Bagre bagre*	6.35	2.38	5	2.37
Bonito	*Euthynnus alletteratus*	3.40	1.28	1	0.47
Lookdown	*Selene vomer*	1.81	0.68	4	1.90
	Totals	**266.49**		**211**	

Table 5. Relative biomass (kgs) and number of individuals collected by 400 meters of the experimental (red light) gillnet during 18 trips in northeastern Trinidad from the port of Matelot during the 2008 fishing season. All species are ranked by relative biomass (% weight).

Common Name	Scientific Name	Biomass (kgs)	% Biomass	Number	% Number
Serra Spanish mackerel	*Scomberomorus brasiliensis*	141.29	47.81	91	41.36
Brazilian sharpnose shark	*Rhizoprionodon lalandii*	62.14	21.03	81	36.82
King mackerel	*Scomberomorus cavalla*	40.37	13.66	12	5.45
Crevalle jack	*Caranx hippos*	25.85	8.75	9	4.09
Coco sea catfish	*Bagre bagre*	15.42	5.22	12	5.45
Palometa	*Trachinotus goodei*	4.54	1.53	7	3.18
Ladyfish	*Elops saurus*	3.63	1.23	2	0.91
Rainbow runner	*Elagatis bipinnulata*	1.36	0.46	4	1.82
Lookdown	*Selene vomer*	0.45	0.15	1	0.45
Atlantic bumper	*Chloroscombrus chrysurus*	0.45	0.15	1	0.45
	Totals	**295.52**		**220**	

Table 6. Relative biomass (kgs) and number of individuals collected by 400 meters of the control (no light) gillnet during four trips in northeastern Trinidad from the port of Matelot during the 2008 fishing season. All species are ranked by relative biomass (% weight).

Common Name	Scientific Name	Biomass (kgs)	% Biomass	Number	% Number
Crevalle jack	*Caranx hippos*	64.86	57.66	50	51.55
Brazilian sharpnose shark	*Rhizoprionodon lalandii*	46.27	41.13	46	47.42
Serra Spanish mackerel	*Scomberomorus brasiliensis*	1.36	1.21	1	1.03
	Totals	**112.49**		**97**	

Table 7. Relative biomass (kgs) and number of individuals collected by 400 meters of the experimental (white light) gillnet during four trips in northeastern Trinidad from the port of Matelot during the 2008 fishing season. All species are ranked by relative biomass (% weight).

Common Name	Scientific Name	Biomass (kgs)	% Biomass	Number	% Number
Crevalle jack	*Caranx hippos*	68.04	56.29	47	44.76
Brazilian sharpnose shark	*Rhizoprionodon lalandii*	42.18	34.90	50	47.62
Serra Spanish mackerel	*Scomberomorus brasiliensis*	7.03	5.82	6	5.71
King mackerel	*Scomberomorus cavalla*	2.72	2.25	1	0.95
Hammerhead shark	*Sphyrna tiburo*	0.91	0.75	1	0.95
	Totals	**120.88**		**105**	

Toco

A total of 27 matched pair collections were made in Toco with 15 white light/red light collections and 12 collections for the no light/red light study. Species composition of the catch among treatments differed within each study.

White Light vs. Red Light
Total catch for the control net was 323 kg, while the experimental net caught 197 kg (Tables 8 and 9). Catches were lower for experimental red light nets across most species with the collective catch of pelagics including bonito, King mackerel, and Serra Spanish mackerel reduced the most (Tables 8 and 9). A total of nine leatherbacks were observed in white light nets while 20 were observed in nets marked with red lights. However, no significant difference was detected between treatments (Table 2).

No Light vs. White Light
Total catch for the control net was 384 kg, while the experimental net caught 117 kg (Tables 10 and 11). Catches were lower for experimental white light nets across most species with the collective catch of pelagics including King mackerel and Serra Spanish mackerel reduced by large amounts (Tables 10 and 11). No difference in leatherback bycatch was observed between treatments (Table 2).

Table 8. Relative biomass (kgs) and number of individuals collected by 400 meters of the control (white light) gillnet during 15 trips in northeastern Trinidad from the port of Toco during the 2008 fishing season. All species are ranked by relative biomass (% weight).

Common Name	Scientific Name	Biomass (kgs)	% Biomass	Number	% Number
King mackerel	*Scomberomorus cavalla*	126.55	39.19	55	25.94
Brazilian sharpnose shark	*Rhizoprionodon lalandii*	120.66	37.36	107	50.47
Bonito	*Euthynnus alletteratus*	38.56	11.94	23	10.85
Crevalle jack	*Caranx hippos*	12.70	3.93	6	2.83
Serra Spanish mackerel	*Scomberomorus brasiliensis*	11.79	3.65	8	3.77
Coco sea catfish	*Bagre bagre*	4.99	1.54	5	2.36
Ladyfish	*Elops saurus*	2.72	0.84	2	0.94
Palometa	*Trachinotus goodei*	2.72	0.84	5	2.36
Bonefish	*Albula vulpes*	2.27	0.70	1	0.47
	Totals	**322.96**		**212**	

Table 9. Relative biomass (kgs) and number of individuals collected by 400 meters of the experimental (red light) gillnet during 15 trips in northeastern Trinidad from the port of Toco during the 2008 fishing season. All species are ranked by relative biomass (% weight).

Common Name	Scientific Name	Biomass (kgs)	% Biomass	Number	% Number
Brazilian sharpnose shark	*Rhizoprionodon lalandii*	80.74	41.06	75	54.35
King mackerel	*Scomberomorus cavalla*	74.84	38.06	32	23.19
Serra Spanish mackerel	*Scomberomorus brasiliensis*	17.24	8.77	12	8.70
Crevalle jack	*Caranx hippos*	15.42	7.84	12	8.70
Ladyfish	*Elops saurus*	3.40	1.73	2	1.45
Palometa	*Trachinotus goodei*	2.27	1.15	3	2.17
Bonito	*Euthynnus alletteratus*	1.36	0.69	1	0.72
Coco sea catfish	*Bagre bagre*	1.36	0.69	1	0.72
	Totals	**196.63**		**138**	

Table 10. Relative biomass (kgs) and number of individuals collected by 400 meters of the control (no light) gillnet during 12 trips in northeastern Trinidad from the port of Toco during the 2008 fishing season. All species are ranked by relative biomass (% weight).

Common Name	Scientific Name	Biomass (kgs)	% Biomass	Number	% Number
Brazilian sharpnose shark	*Rhizoprionodon lalandii*	150.59	39.24	156	50.00
Serra Spanish mackerel	*Scomberomorus brasiliensis*	91.63	23.88	50	16.03
Coco sea catfish	*Bagre bagre*	87.54	22.81	81	25.96
King mackerel	*Scomberomorus cavalla*	39.46	10.28	16	5.13
Crevalle jack	*Caranx hippos*	13.15	3.43	8	2.56
Ladyfish	*Elops saurus*	1.36	0.35	1	0.32
	Totals	**383.74**		**312**	

Table 11. Relative biomass (kgs) and number of individuals collected by 400 meters of the experimental (white light) gillnet during 12 trips in northeastern Trinidad from the port of Toco during the 2008 fishing season. All species are ranked by relative biomass (% weight).

Common Name	Scientific Name	Biomass (kgs)	% Biomass	Number	% Number
Brazilian sharpnose shark	*Rhizoprionodon lalandii*	53.98	46.12	46	43.81
Coco sea catfish	*Bagre bagre*	31.30	26.74	36	34.29
Serra Spanish mackerel	*Scomberomorus brasiliensis*	15.88	13.57	14	13.33
King mackerel	*Scomberomorus cavalla*	8.16	6.98	3	2.86
Ladyfish	*Elops saurus*	7.71	6.59	6	5.71
	Totals	**117.03**		**105**	

Mayaro

A total of 20 matched pair collections were made in Mayaro for white light/red light comparisons. Species composition of the catch among treatments differed.

White Light vs. Red Light

Total catch for the control net was 846 kg, while the experimental net caught 277 kg (Tables 12 and 13). Catches from this port were highly variable with a few large catches skewing species composition data. Fish catch was lower for experimental red light nets across most species but pelagics were reduced the most (Tables 12 and 13). One large catch of 181.44 kgs of bonito accounted for the entire experimental net catch for that species represented in Table 13. If this catch is removed, it is clear that bonito along with King and Serra Spanish mackerel were reduced by significant amounts (Tables 12 and 13). A significant reduction in leatherback bycatch was detected for red light nets with six leatherbacks captured in nets marked with white lights and none in red light nets (Table 2).

Table 12. Relative biomass (kgs) and number of individuals collected by 400 meters of the control (white light) gillnet during 20 trips in northeastern Trinidad from the port of Mayaro during the 2008 fishing season. All species are ranked by relative biomass (% weight).

Common Name	Scientific Name	Biomass (kgs)	% Biomass
Serra Spanish mackerel	*Scomberomorus brasiliensis*	422.29	49.89
Crevalle jack	*Caranx hippos*	288.48	34.08
Bonito	*Euthynnus alletteratus*	73.48	8.68
King mackerel	*Scomberomorus cavalla*	62.14	7.34
	Totals	**846.40**	

Table 13. Relative biomass (kgs) and number of individuals collected by 400 meters of the experimental (red light) gillnet during 20 trips in northeastern Trinidad from the port of Mayaro during the 2008 fishing season. All species are ranked by relative biomass (% weight).

Common Name	Scientific Name	Biomass (kgs)	% Biomass
Bonito	*Euthynnus alletteratus*	181.44	65.57
Serra Spanish mackerel	*Scomberomorus brasiliensis*	54.43	19.67
Crevalle jack	*Caranx hippos*	32.21	11.64
Coco sea catfish	*Bagre bagre*	4.54	1.64
King mackerel	*Scomberomorus cavalla*	4.08	1.48
	Totals	**276.69**	

DISCUSSION

Results varied among ports for both leatherback bycatch and fish catch for each study. Catch data from Matelot showed slight increases for experimental treatments in each net marking light study, while Toco and Mayaro exhibited decreases for experimental treatments (Table 3). These inconsistencies illustrate the variability in catch rates associated with this fishery and the need for larger sample sizes when conducting these types of studies.

The largest fish catch reductions observed were pelagic species catches in the no light/white light study in Mayaro. For nets marked with white lights, mackerel catches were reduced by 87.9% (Table 3). These results indicate that supra-surface lighting of nets may illuminate the gear allowing these highly visual predators to successfully avoid capture. In addition, the dramatic results observed in the no light/white light study may be attributed to the type of lights used. Fishermen that participate in this fishery typically mark nets with relatively low intensity flashlights with incandescent bulbs, while we used high intensity Electralume® LED lights. This may have provided greater illumination of the gear causing fish avoidance.

For leatherback bycatch, no difference was detected across treatments and ports except for significantly fewer turtles captured during the white light/red light study in Mayaro with nets marked with red lights (Table 2). However, due to the low catch rates in Mayaro, these results should be interpreted with caution. When data were pooled across ports for each study there were no significant differences detected. These results indicate that the inconsistency in turtle reduction rates between ports in the 2007 low profile gillnet study were not caused by the presence of a net marking light and were probably an artifact of the low turtle CPUE in Matelot during the 2007 season (Gearhart and Eckert 2008).

Although we found no effect of net marking lights on sea turtle bycatch, our observers did report that the use of red light headlamps eased sea turtle disentanglement substantially. This discovery was an artifact of our protocol, which required all persons on the vessel to be equipped with red headlamps to minimize vessel effect and potential confounding effects of other light sources. Over the past two seasons the observer contracted for the port of Toco has disentangled over 140 leatherbacks. This observer reported that turtles remained calm when approached with red headlamps versus thrashing violently when approached with white headlamps. He also suggested other techniques such as touching the animals in specific areas when disentangling them and cutting gear away from the animals in a specific manner to keep turtles calm and minimize sea turtle mortality and potential injury to the fishermen.

CONCLUSIONS

This project continued the very successful gear testing program established in Trinidad in 2005, which brings fishermen and turtle conservation groups together to achieve the common goal of developing methods to reduce bycatch of leatherbacks in coastal gillnets. This was the third year of testing and although our results indicated there was no advantage to marking nets with various types of lights, we did provide an answer to industry suspicions about net lighting and sea turtle bycatch. In addition, we unintentionally identified disentanglement techniques that could be useful in Trinidadian fisheries and other fisheries around the world. Future work should include the development of disentanglement tools and training for Trinidadian fishermen participating in coastal gillnet fisheries. Disentanglement tools used by U.S. East Coast large whale disentanglement teams and longline fishermen could be adapted for use in this fishery. Minimizing disentanglement time and ensuring that all gear is removed from animals would significantly reduce sea turtle mortality and minimize potential injuries to fishermen.

LITERATURE CITED

Eckert, S. A. and J. Lien. 1999. Recommendations for Eliminating Incidental Capture and Mortality of Leatherback Turtles, *Dermochelys coriacea*, by Commercial Fisheries in Trinidad and Tobago: A Report to the Wider Caribbean Sea Turtle Conservation Network (WIDECAST). WIDECAST Information Document 1999 – 2001 January.

Eckert, S. A. and K.L Eckert. 2005. Strategic Plan for Eliminating the Incidental Capture and Mortality of Leatherback Turtles in Trinidad and Tobago, Proceedings of the “National Consultation: Reducing the Incidental Capture and Mortality of Leatherback Sea Turtles in Gillnets in Trinidad and Tobago”. WIDECAST Technical Report No. 5.

Eckert, S.A., Gearhart, J., Bergmann, C., and Eckert, K.L. 2008. Reducing Leatherback Sea Turtle Bycatch in the Surface Drift-Gillnet Fishery in Trinidad. Bycatch Communication Newsletter 8: 2-6.

Fournillier, K., D. Sammy and T. Clovis. 2008. Draft WIDECAST Sea Turtle Recovery Action Plan for Trinidad and Tobago (K.L. Eckert, Editor). CEP Technical Report No. 48. UNEP Caribbean Environment Programme, Kingston, Jamaica. 120 pp.

Gass, J. 2006. Bycatch Mortality Of Leatherback Turtles in Trinidad's Artisanal Gillnet Fishery. Masters project submitted in partial fulfillment of the requirements for the Master of Environmental Management degree in the Nicholas School of the Environment and Earth Sciences of Duke University 2006. Nicholas School of the Environment, Duke University. 29pp.

Gearhart, J. and S. A. Eckert. 2007. Field Tests to Evaluate the Target Catch and Bycatch Reduction Effectiveness of Surface and Mid-Water Drift Gillnets in Trinidad. WIDECAST Information Document 2007-01. Beaufort, North Carolina. 21 pp.

Lee Lum, L. 2006. An assessment of incidental turtle catch in the gillnet fishery in Trinidad and Tobago, West Indies. Applied Herpetology. 3: 357-368.

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