Promoting the Survival of Leatherback Turtles in the Greater Atlantic Ocean by Eliminating Capture and Mortality Associated with Coastal Gillnets in Trinidad

Final Report 2008

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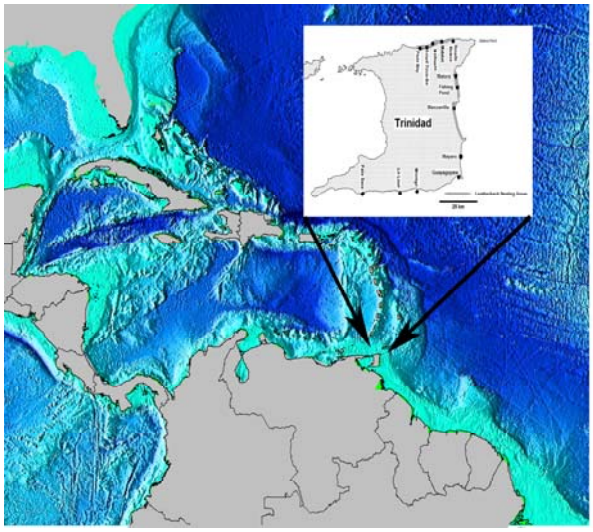
Background

The accidental capture and drowning of leatherback sea turtles (*Dermochelys coriacea*) in coastal gillnet fisheries represents a serious threat to the recovery of this Critically Endangered (cf. IUCN Red List) species. While the leatherback is primarily an oceanic species, ranging up to 10,000 km per year across entire ocean basins (e.g. Eckert et al. 2006, Eckert 2006), it also spends a significant proportion of its life in coastal waters to reproduce or feed. In many places, including Trinidad, West Indies, males and females congregate for mating in waters near the nesting area – males remain through the peak of the nesting season (James et al. 2005) and females remain throughout the entire nesting season. Residency in coastal waters can, therefore, exceed six months per year on an annual or (typically) semi-annual basis for males and females, respectively. It is during this time that the turtles have the greatest potential to interact with coastal fishing gear and become entangled and drown, or be killed by fishers in an attempt to reduce net damage. Compounding the conservation challenge is the fact that these are reproductively active adults whose intrinsic value to the population is extremely high (Frazer 1983, Crouse et al. 1987). Given that coastal artisanal fishers represent 50 of the 51 million fishers worldwide (Berkes et al. 2001) and that most use gillnets, the potential for leatherback interactions with gillnets in coastal waters near nesting beaches – in Trinidad and elsewhere – is extremely high.

The island of Trinidad, located at the southern end of the Antilles in the Caribbean Sea, supports one of the world's largest nesting colonies of leatherback sea turtles. Between 8,000–10,000 females nest on the island each year from March to August (S. Eckert, unpubl. data). Trinidad also sustains an important coastal fishing fleet along its north and east coasts for which gillnets are the primary fishing gear. An estimated 3,000 leatherback entanglements occur each season, with a mortality rate of 30% (Eckert and Lien 1999, Lee Lum 2006).



Gillnet interactions represent the single largest source of mortality for leatherbacks in Trinidad.

Recognition that coastal gillnet bycatch of leatherbacks is Trinidad's most serious conservation threat – and that this bycatch threatens the sustainability of coastal fishing due to gear damage – led us to the develop a mitigation strategy to eliminate bycatch of sea turtles (Eckert and Eckert 2005, Gearhart and Eckert 2007, Eckert et al. 2008).

Between 2006 and 2007, in a series of stakeholder guided and conducted experiments, it was shown that reducing the profile of surface set gillnets from more than 100 meshes deep to 50 (i.e. reducing the depth of the bottom of the net from10 meters to 5 meters) can reduce the number of turtles captured and enhance target species catch rates (Eckert et al. 2008). Shallow

profile nets also reduced gear repair costs (Eckert et al. 2008) due to the lower frequency of turtle entanglement. We also demonstrated that modernizing troll fishing methods with out-riggers, down-planers and fish finders provided economic return equal to that of traditional gillnets and had the advantage of sustaining no turtle bycatch (Eckert et al. 2008).

Results of the 2006 – 2007 gillnet tests left some need to refine and repeat earlier experiments. Specifically, we needed to resolve a discrepancy in gillnet turtle capture between two ports, Toco and Matelot. During 60 net sets in 2007, a total of 119 leatherback turtles were captured between the contract fishing vessels operating from these two fishing depots; only 29 of those turtles were captured in the experimental nets (nets with a 50 mesh profile).

While this represents a significant improvement in turtle catch rates, the ratio of reduction between the two ports was quite different. Matelot caught a total of 17 turtles, 9 in the 100 mesh net and 8 in the 50 mesh nets (no statistical difference: Eckert et al. 2008). Fishers operating from the Toco depot caught 104 turtles, 83 in the 100 mesh net and 21 in the 50 mesh net.

In post-experiment interviews with fishers, Matelot fishers noted that they use light standards attached to their nets to warn approaching boats away from their gear. Fishers in Toco note that they do not use lights out of fear of piracy. Experiments in 2008 were designed to resolve this differential in catch rates as well as to improve our understanding about the economic performance of the lower profile experimental nets.

For 2008 we were also interested in further refining our data on the effectiveness of troll fisheries in fish catch. While the 2007 results promised a good economic return, fishers often reported that the spoon baits (#3) were too large and caused a high rate of fish strikes without hooking. It was felt that reducing the spoon size would increase hooking rates, as well as increase the catch rate of valuable smaller species (e.g. Crevalle).

2008 Methods

Two sets of fishing trials were initiated in 2008 from 3 ports along the north and east coasts of Trinidad. Two boats were contracted from Matelot, Toco and Mayaro fishing depots with one vessel from each port to fish nets and one to fishing trolling gear for 60 days.

Project 2008-001: Effect of marker lights on drift gillnet turtle bycatch

Using a paired experimental design, fishers were provided with net panels of 4.25 inch mesh size, 100 m long measuring 50 meshes deep. Each boat fished 10 panels (e.g. total length 1000 m) each night for up to 8 hr. For light standards we designed floating light stands using battery powered white or red LED equipped electralume lights (Pitman-Lindgren Inc).

Research has shown that leatherbacks have highly limited capacity to detect higher wavelength light (e.g. red) (Crognale et al. 2008), so we used white LED lights as our control and red LED lights as our experimental variable. Lights were placed in standard locations along the net, 1 m above the water's surface. Two lights of each color were used and the location switched daily between each end of the net to control for possible effects of the fishing vessel.

As in previous experiments, fish and turtle catch were carefully monitored. Data collected included date, port, time of setting and retrieval, lat/long at setting and retrieval, location of lights and their color, and in what panel of the net any turtle capture occurred.

Condition of turtle and flipper tag numbers were also recorded. If untagged, at least one flipper tag was applied (when feasible).

Fish catch was kept separate between control and experimental net sections; number of fish, species and weight were recorded in port. Fuel consumption and price received per each pound of fish were also recorded.

Project 2008-002: Catch rate comparison of two different sized spoon-baits in the mackerel troll fishery

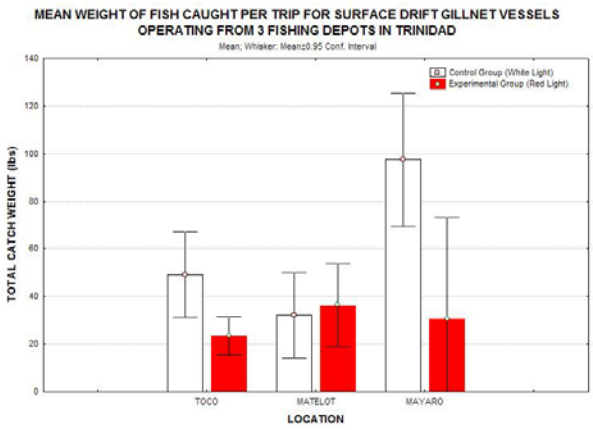
Each of 3 vessels, one from Matelot, Toco and Mayaro were equipped with bamboo outriggers, bandit reels, fish finder/GPS (Lowrance model LMS527) and 16 oz planers. In a paired test, one outrigger was equipped with a #2 drone spoon and the other outrigger equipped with a #3 drone spoon as bait. A 1.5 oz "seawitch" kingfish lure was rigged for surface trolling to a hand-cranked bandit reel. Each vessel fished for 30 days. Data recorded included date, time of departure and time of return as well as fuel consumed and hours fished. Fish catch was kept separate between the bait types. Catch was identified to species, number, weight and cost per pound were also recorded.

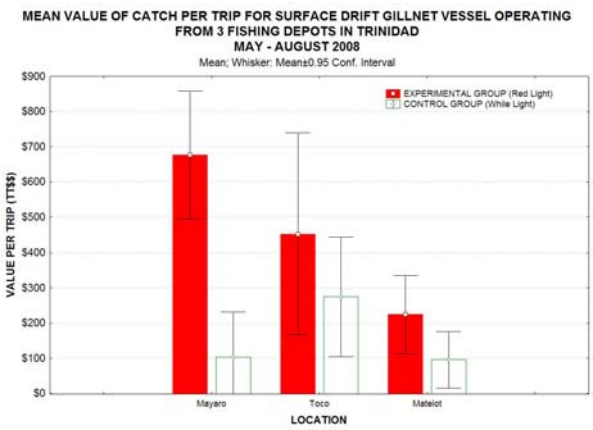
2008 Results

Project 2008-001: Effect of marker lights on drift gillnet turtle bycatch

A total of 65 drift gillnet sets were made with vessels operating from the ports of Matelot, Toco and Mayaro to test the difference between nets equipped with white LED marker lights and those with red LED marker lights. In one port (Toco) a further 15 sets compared white lit net panels to panels with no light.

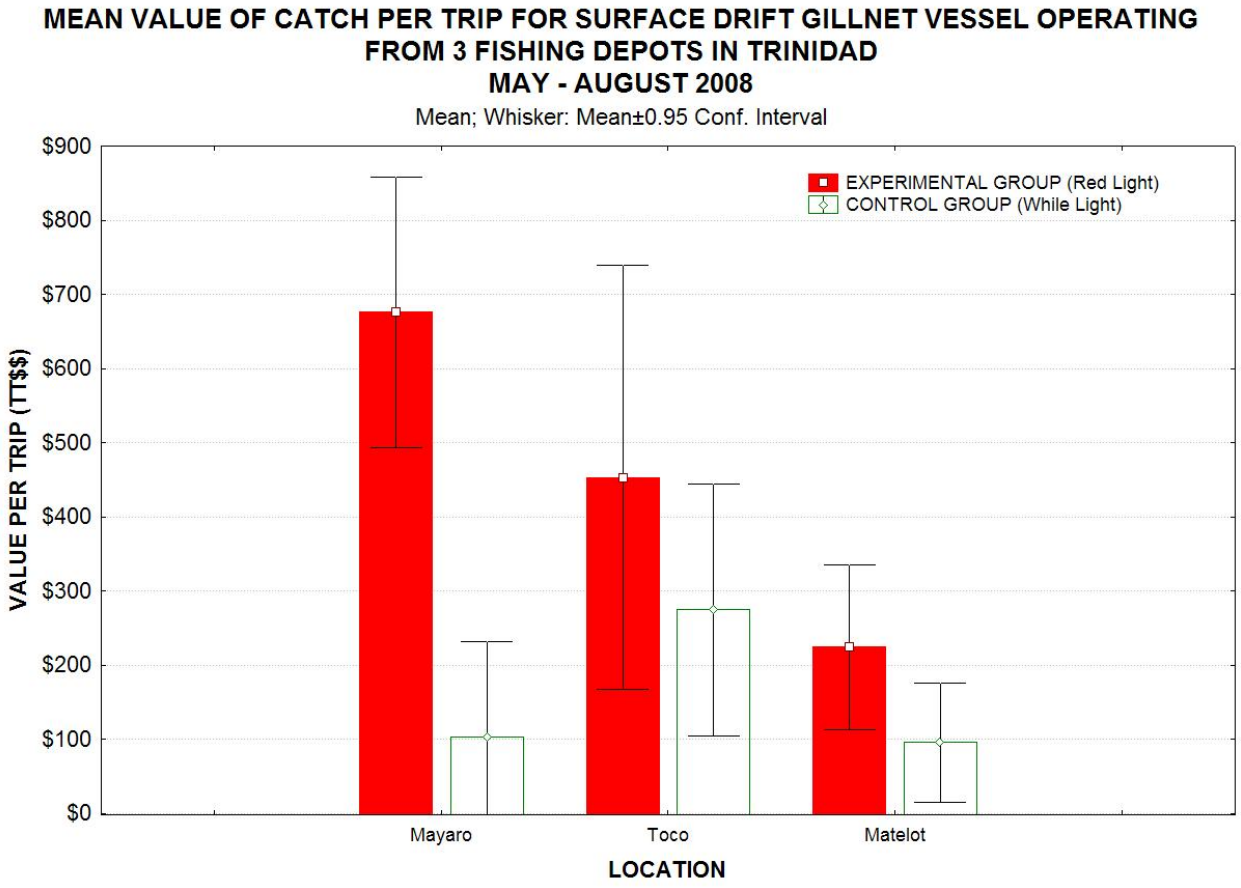
A total of 67 turtles were caught during the 65 white light / red light gillnet sets during a total of 805 hours of net soaking time. There was no statistically significant difference in turtle catch rate between control and experimental nets (Mann-Whitney U test: n=63, p=0.792). From Toco, where 15 sets also compared no light to red light, 6 turtles were caught in the control net (white light) and 10 were caught in the no light net. However there was no significant difference between numbers of turtles caught per set and treatment (Kruskal-Wallis test, n=156, p=0.4352) for all treatments (red light, white light or no light). The effect of red and white lights on fish catch show mixed results. While the mean total fish catch weight per fishing day appear different for most ports, only Mayaro was statistically different (Wilcoxon matched pair test p=0.003185; Matelot: p=0.0765199; Toco: p=0.1020840). In contrast, the value of catch returned per trip from two of the ports were significantly different (Mayaro p=0.000293; Matelot p=0.001561, Wilcoxon matched pair test) with the experimental (red light) nets showing higher return.





An evaluation of leatherback catch per unit effort rates (CPUE) can be derived for the 50 mesh nets on a per-hour per-square-meter of net basis. For all treatments, there were 490.48 h of fishing effort in which 85 turtles were caught for a catch rate of 0.173 turtles per hour of soak time with 1000 linear meters of 50 mesh net. This can be also calculated as 0.0000347 turtles per hour per square meter of net. Mean soak duration was 6.127h (± 2.40). In 2007 we also calculated the CPUE of turtles from both the 50 and 100 mesh nets. CPUE per square meter of net per hour for the 50 mesh net was 0.0000309 and for the 100 mesh net was 0.0000452.

Based on catch statistics and price paid per pound of fish we calculated a simple economic return model for the experimental and control nets. Mean income for each day of fishing ranged from $95 - $676 (TT) with an overall mean of $426.50 (TT) ± 449.38 (TT) for 500 meter nets using red light, and $147.16 (TT)± 276.90(TT) for white light nets. It should be noted that these income values should double to ($853 or $294) when using traditional 1000 meter long nets. Mayaro and Matelot both showed a statistically higher daily income when fishing with red light . Net repair costs were 14.8% of gross income in 2008. Thus the daily income must be reduced by 14.8% to between $727TT - $251TT per day for drift gillnets.



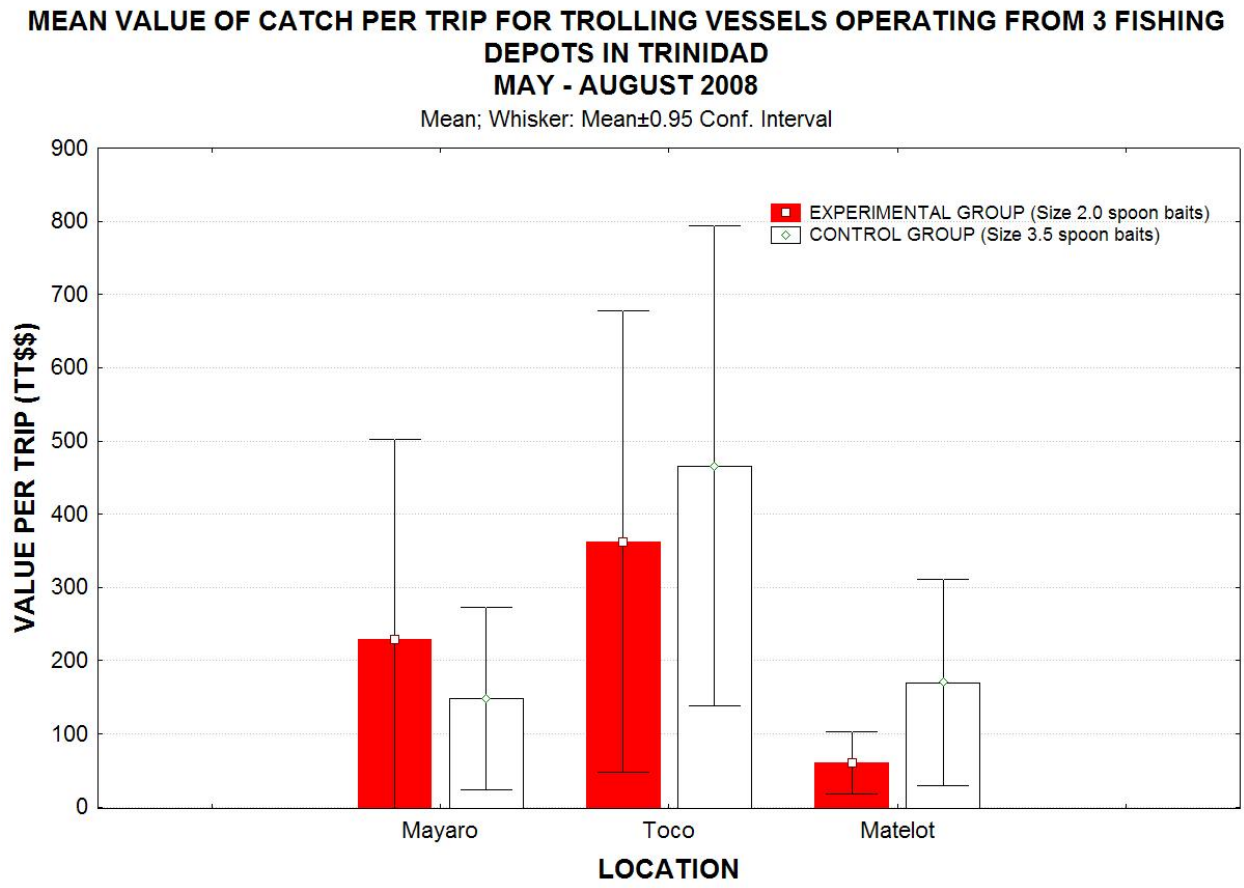
Another aspect of cost per trip is fuel expenses. Mean daily fuel consumption was 12.18 (± 18.729, n=63) or 1.47 (± 1.41, n=65) gallons per hour. There was no statistically significant difference between ports in fuel consumption (ANOVA: p=0.113833).

We also calculated an equipment cost for each vessel, excluding boat and engine purchase. Netting, floats, weight and construction costs were $24,000 TT ($4,000 USD) per boat plus $1,200 TT ($200 USD) for illumination lights. Thus, gear costs were $25,200 TT ($4200 USD) per vessel.

Project 2008-002: Catch rate comparison of two different sized spoon-baits in the mackerel troll fishery

Three vessels, one in each port (Matelot, Toco and Mayaro) made 86 days and 335 h of fishing effort using trolling gear along the north and east coasts between 5 May and 9 July. Mean time of trolling was 6.3h (± 1.88) per trip. Mean fuel consumption was 10.77(± 18.39) gallons per trip or 1.08 (± 0.276) gallons per hour.

Mean fish catch total weight per trip (n=86) for the larger #3.0 spoon baits was 13.55 (±33.460 lbs per trip, while the mean catch total per trip for the smaller #2.0 spoon baits was 18.480 (±30.125) lbs. However, these values are not significantly different (Student's t test, p=0.3107). In reviewing the catch data it was noticed that catch rates improved significantly after about 10 days of fishing by vessels working from Matelot and Mayaro. In these two ports fishing crews were inexperienced in the use of this troll gear (in contrast to the vessel crew working in Toco) and we attribute this poorer performance to the crew learning to use the equipment. Thus we re-evaluated the data in which we do not include the time spent learning to fish this gear. Total trips are reduced to 64 and yield a mean fish catch per day by weight of 17.91 (±37.817) for the larger spoons (control group) and 22.234 (±32.875) for the smaller spoons. These values are also not statistically different (Student's t test, p=0.4916).



An economic assessment of fish catch using trolling gear gives a mean income when using the smaller spoon bait (experimental group) of $246.10 (TT) (±$594.75) and with a larger spoon (control group) of $304.35 (TT) (±$597.29). There was no statistically significant difference between treatments (Student's t test p=0.9751); therefore, we estimate that a trolling vessel with two outriggers (standard configuration) would average $550.44 TT ± 1,132.78 (TT) per day.

Gear costs per vessel, including fish finders, line, baits, hooks, outriggers, planers and bandit reels totaled $13,440TT (2,240 USD) per vessel.

Discussion

For 2008, there were two primary experimental goals. The first was to test whether the use of net lighting would affect turtle catch; the second evaluated whether the use of smaller spoon-baits would increase the catch of fish when trolling.

In 2007, our sea turtle bycatch results were somewhat in disagreement between Toco and Matelot ports, with Matelot showing little reduction in bycatch, and Toco exhibiting a dramatic reduction in bycatch using experimental nets. Interviews with fishers revealed that Matelot fishers used marker lights on their nets to prevent boat strikes, while those at Toco did not use lighting. Our intention was to try to define if our bycatch differences were a result of the confounding effect of lighting.

Using the narrow 50 mesh nets developed in 2007, we built light standards illuminated by either red or white LEDs. Four lights were deployed on each net (except for a series of deployments at Toco where the white light were also tested against no lights) in a configuration that insured that each end of the net was lit by a different light source.

Results suggest no difference in turtle bycatch between different lighting regimes. Similarly, lighting had no effect on fish catch by weight, though using red light increased catch value. It is

likely that this discrepancy is due to catch composition, and we are reviewing the data to determine if this is case.

Overall cost structure for gillnets showed that initial investment in gear is high, at a cost of about $25,200TT ($4,200 USD) per vessel, and that daily earnings using full length (1000 m) nets would average $852 per day when using red lights. Fuel consumption averaged 12 gallons per day.

We also reviewed bycatch data in terms of catch-per-unit-effort or CPUE for 2008 and compared that catch rate to 2007. There was a slight increase in turtle catch rate of the 50 mesh nets for 2008 that could be attributed annual variation; however, it still remains well below the rate calculated for traditional 100 mesh nets in 2007.

Noteworthy is the fact that there were no turtle mortalities despite the entanglement of 85 turtles in the gillnet tests. Fishers reported that turtles were far easier to remove from the 50 mesh nets and 13 turtles were reported to "bounce out" or un-entangle themselves.

Finally, one other observation by the fishers was on the effect of using red LED headlamps. We provided these headlamps and asked that fishers use them to prevent biasing our lighting experiment. Leatherback have poor sensitivity to long wavelength (e.g. red) light. Fishers reported that turtles remained calm in the nets and were far easier to untangle if they used red light when disentangling them.

Our second experiment evaluated whether the use of smaller spoon-baits would increase the catch of fish when trolling. In 2007, some of the fishers had suggested that the larger spoons were restricting catch to only larger fish species and thus catch rates were lower than might otherwise be expected. To respond to their request, we tested the catch rate of the #3.0 spoons against #2.0 spoons in paired trials. Catch rate in terms of total weight or value showed no overall statistical difference between the two bait types. Thus we conclude that fishers can select either size – according to their own best expertise and should not see reduced catch levels.

An economic evaluation of trolling showed that the initial gear investment, including a GPS / fish finder was $13,440TT ($2,240 USD). Daily income averaged $550.44 TT ± 1,132.78 (TT) for trollers. Fuel consumption averaged 10.77 gallons per trip.

Conclusions

The 2008 experiments further improved the effectiveness of narrow (50 mesh) gillnets by increasing their economic return, while continuing to reduce turtle bycatch and mortality over traditional nets. We found that those fishers who chose to place marker lights on their nets to warn other vessels away from these nets should use long wavelength (e.g. red) lights because this improves the value of their fish catch, although it did not seem to affect sea turtle catch. Fishers

were fond of the lights developed for the project and have asked to purchase them. Interestingly, anectdotal information suggests that fishers should use long wavelength lights (e.g. red LED headlamps) to illuminate entangled turtles as the turtles remain calm under this light source.

In experiments to test the effectiveness of different sized spoon-baits with troll fishing, we found no statistical difference between two spoon sizes. However, we refined our economic analysis of this fishery and showed that it will average $550.44 TT ± 1,132.78 (TT) per day. When compared to 50 mesh gillnet fishers working under optimal conditions (as occurred using red lights in our experimental fishery) this is lower by approximately $300 TT per day. However, trolling also requires about ½ of the capital investment as the gillnet fishery and has lower operational costs.

While trolling completely eliminates turtle bycatch, and has a lower cost of startup and operation, it provides a reduced income to fishers when compared to gillnetting. Since trolling is more sensitive to weather and sea conditions, it may be possible to enhance fishing revenues for troll fishers, by making available other fishing methods that can be used when trolling it impractical. For example, hook and line bottom fishing, known locally at banking, could be improved with the use of fish finders to locate promising bottom topography, or even locate fish schools, and the bandit reel can improve the capacity of fishers to retrieve catch.

Our future direction must focus on moving fishers toward more "turtle safe" fishing methods. To date the project has clearly demonstrated that methods do exist that both reduce sea turtle bycatch in Trinidad's surface drift gillnet fishery and maintain fisher income at levels similar or higher to current earnings.

While we still have some work to do in proving scientifically the effectiveness of the 50 mesh nets over more traditional 100-150 mesh nets, using 50 mesh nets appears to provide an easy by-catch reduction solution for fishers comfortable with gillnets. Narrow nets are not as effective as trolling at eliminating turtle catch, but they have the advantage of higher economic return and are less of a radical change in technique for fishers. Nonetheless, trolling has great merit as an affordable and efficient method of fishing that completely eliminates the capture of turtles and a

number of other non-target species. Thus our goal must be to promote both of these methods and create incentives for fishers to make the change.

In all interviews, fishers are in favor of changing to turtle safe methods and improving their fishing efficiency. However, experience shows that fishers will rarely adopt new unfamiliar methods without some incentive. The 2009 research program should include development and testing of an incentive system, whether it be regulatory or promotional (or both).

Literature Cited

Berkes, F., R. Mahon, P. McConney, R. Pollnac, and R. Pomeroy. 2001. Managing small-scale fisheries: Alternative Directions and Methods. IDRC.

Crognale, M. A., S. A. Eckert, D. H. Levenson, and C. A. Harms. 2008. Leatherback sea turtle *Dermochelys coriacea* visual capacities and potential reduction of by-catch by pelagic longline fisheries. Endangered Species Research 5:249-256.

Crouse, D. T., L. B. Crowder, and H. Caswell. 1987. A stage-based population model for loggerhead sea turtles and implications for conservation. Ecology 68:1412-1423.

Eckert, S., D. Bagley, S. Kubis, L. Ehrhart, C. Johnson, K. Stewart, and D. Defreese. 2006. Internesting, post-nesting movements and foraging habitats of leatherback sea turtles (*Dermochelys coriacea*) nesting in Florida. Chelonian Conservation and Biol. 5:239-248.

Eckert, S. A. 2006. High-use areas for Atlantic leatherback sea turtles (*Dermochelys coriacea*) as identified using satellite telemetered location and dive information. Marine Biology 149: 1247-1257.

Eckert, S. A., and K. L. Eckert. 2005. Strategic Plan for Eliminating the Incidental Capture and Mortality of Leatherback Turtles in the Coastal Gillnet Fisheries of Trinidad and Tobago: Proceedings of a National Consultation. Port of Spain, 16–18 February 2005. Ministry of Agriculture, Land and Marine Resources, Government of the Republic of Trinidad and Tobago, in collaboration with the Wider Caribbean Sea Turtle Conservation Network (WIDECAST). WIDECAST Technical Report No. 5. Beaufort, NC. 30 pp. + appendices.

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

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 - 001. 6pp.

Frazer, N. B. 1983. Survivorship of adult female loggerhead sea turtles, *Caretta caretta*, nesting on Little Cumberland Island, GA. Herpetologica 39:436-447.

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.

James, M. C., S. A. Eckert, and R. A. Myers. 2005. Migratory and Reproductive Movements of Male Leatherback Turtles (*Dermochelys coriacea*). Marine Biology 147:845-853.

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

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