AN ASSESSMENT OF MARINE TURTLE INTERACTIONS WITH LONGLINE GEAR IN THE NORTH ATLANTIC OCEAN

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SUMMARY

The assessment of marine turtle interactions/captures with ICCAT fisheries was restricted to loggerhead and leatherback turtle captures by U.S. longliners in the northwest Atlantic and nesting data from beaches bordering the north Atlantic and Gulf of Mexico. The nesting data provided useful context for interpreting the trend in capture rates which were low for both species despite increases in total hooks and nest number.

RÉSUMÉ

L'évaluation des interactions/captures de tortues marines avec les pêcheries de l'ICCAT a été limitée aux captures de tortues caouannes et de tortues luth par les palangriers des États-Unis dans l'Atlantique Nord-Ouest et aux données de nidification sur les plages bordant l'Atlantique Nord et le golfe du Mexique. Les données de nidification ont fourni un contexte utile pour l'interprétation de la tendance des taux de capture qui étaient faibles pour les deux espèces en dépit de l'augmentation du nombre total de hameçons et de nids.

RESUMEN

La evaluación de interacciones/capturas de tortugas marinas con las pesquerías de ICCAT se restringió a las capturas de tortuga boba y tortuga laúd por los palangreros estadounidenses en el Atlántico noroeste y a los datos de anidación de las playas que bordean el Atlántico norte y el golfo de México. Los datos de anidación proporcionaron un contexto útil para interpretar la tendencia en las tasas de captura que fueron bajas para ambas especies a pesar del incremento en el número de nidos y de anzuelos totales.

KEYWORDS

Marine turtles, longline, capture rate, North Atlantic, indicators

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1. Introduction

In 2017 the ICCAT Sub-committee on Ecosystems developed a work plan that included a proposal to develop a prototype Ecosystem report card for the ICCAT Commission to review in 2018. The inter-sessional exercise involved groups of the Sub-committee to assess the status of 10 ecosystem components (Assessed Retained Species, Non-Assessed Retained Species, Seabirds, Marine Turtles, Marine Mammals, Non-Retained Sharks, Trophic Relationships, Socio Economic, Fishing Pressure and Habitat). The indicators described in the ten assessment documents will form the basis for a prototype report card and provide information towards implementing ecosystems based fisheries management (EBFM) in ICCAT in accordance with Resolution 15-11.

The work presented here relates to the Marine turtles component and its objective is to create an indicator that shows the degree to which ICCAT's fisheries and management actions of assessed stocks is affecting their status.

2. Methods

2.1 Indicators

While the idea to develop indicators for marine turtle populations caught by ICCAT fisheries is important, one must be cognizant of the potential to over-simplify and/or misinterpret the relationship between fisheries impacts and population sizes. There are numerous factors affecting population sizes of marine turtles globally, including both threats and conservation efforts at nesting beaches, oceanographic/climate pressure, as well as changes in fishing gear/type/effort specific to each region that complicate the interpretation of populations trends and fishing impacts.

Specific concerns regarding the use of nesting data to reflect the impact of fishing include: unquantified effects of changes in nesting beach protection effort, large time lag between hatchling emergence and return to nesting beaches, vulnerability to bycatch could begin sometime between 12-20 years after emergence and uncertainty regarding the origin/natal beaches of populations most vulnerable to the fishing gears in the different regions.

Nesting data interpreted in conjunction with turtle bycatch data may reveal a causal relationship where the direction of causation shows changes in bycatch affecting nesting. In order to detect an effect on nesting, the bycatch would need to be mainly of sub-adult to adult turtles, the incidental mortality would need to be a fairly constant fraction (with equal sex ratios) of the total interactions and the fisheries source of mortality would need to be large relative to all others. The causation can also work in the other direction but there are likely to be long lags before changes in the population abundance will manifest itself in the bycatch data.

Consequently, the bycatch data is the better source of an indicator with which to assess the potential impact of fishing and because few fisheries have 100% observer coverage, the determination of total captures requires effort data in order to produce standardized estimates of the interaction rates (BPUE). Monitoring BPUE should reveal the effect of mitigation measures (Swimmer et al. 2017) but may also reflect distributional shifts in the fisheries relative to the seasonal distribution of the species and changes in the overall abundance.

An indicator representative of the bycatch of all marine turtle species was not considered in preference of showing trends for the two most common species (loggerhead TTL and leatherback DKK) observed by the U.S. fishery operating in the northeast distant area (NED) of the northwest Atlantic. In the future, approaches will be considered for integrating the trends from multiple species.

Alternative indicators can be found here:

https://www.medqsr.org/common-indicator-3-species-distributional-range-marine-turtles

2.2 Data

The loggerhead and leatherback captures in the northwest Atlantic (NED area) was provided by U.S. observer program and represents a portion of their Atlantic Ocean/Gulf of Mexico swordfish-targeted and mixed longline fishing sets (see Swimmer et al. 2017). The data was used to estimate bycatch per 1000 hooks (Swimmer et al. 2017) in the NED from 1992 to 2014. The time series is not complete due to the lack of fishing in some years. Complementary data on the total number of hooks reported by Canada and the U.S was extracted from the

ICCAT Task II catch effort data for the northwest Atlantic region of quadrant 4. Similar bycatch data is likely available from CPCs that have onboard observers and would require a special data request in order to obtain access. However, a request for estimates of annual bycatch rates per species and the corresponding effort would be preferable. Where it exists, information on the mortality associated with the interactions should also be provided as these rate reflect interactions/captures only.

Only the Task II data was available online at the ICCAT. Access to the other components (BPUE, mortality rates) via the ICCAT website would greatly improve the development and updates of indicators for marine turtles.

2.3 Regions

Figure 1 shows two options for regionalizing the reporting of the impacts of ICCAT fisheries and management. If CPCs contribute the bycatch data with a high degree of spatial resolution, then partitioning the data using either option is relatively easy to do.

2.4 Goals and Objectives

Goal: Minimizing the interactions and mortality as practically as possible.

Objective: Determine if the number of interactions and/or total mortality is reduced.

Following review by the Ecosystems Subcommittee, it was discussed that a bycatch rate would be a preferred indicator as it could be used to detect reductions in interactions caused by the implementation of mitigation measures. However, it was also noted that the bycatch rate is also sensitive to fluctuations in abundance. Nevertheless the objective was changed to be to determine if the BPUE estimates for TTL and DKK is increasing.

3. Interpretation

Mandated gear changes in U.S. longline fisheries that are known to interact with marine turtles took effect in 2004, and may have some relationship to the increases in nest abundance across nesting sites observed since then (**Figure 2**, see Swimmer et al. 2017).

Since the 1990's gross trends in loggerhead turtle nest abundance have been fairly consistent across Florida nesting sites, with a reduction during years 2005 to 2010 (**Figure 2**). Nesting in Georgia showed an increase since ~2005.

Leatherback nest abundance at the local level shows high inter-annual variability and an increasing trend since 1990 (**Figure 2**). The trends for Florida and Costa Rica were less variable probably as they represent the integrated signal from a number of beaches. Costa Rica has witnessed a decrease in nest abundance while Florida abundance increased. (Sources: Mansfield et al., Pers. Comm., FWS/US, north Florida)

Estimated total loggerhead and leatherback captures by the U.S. and Canadian Swordfish longline fisheries operating in the northwest Atlantic Ocean and Gulf of Mexico (**Figure 3**) show regular synchronous fluctuations for both species and a general decline in interactions after the implementation of gear changes in 2004.

The standardized indicator of effort (**Figure 4**) shows a steady increase since 2004 and may be entirely an effect caused by the addition of Canadian data which only begins in 2007.

Standardized indicators of marine turtle capture rates are at historic lowsdespite the increasing effort (**Figure 4**). Capture rates post 2004 are generally lower but exhibit regular fluctuations gear changes Given the increasing nest counts for each species (**Figure 2**),the capture rates may increase in the coming years.

References

Swimmer Y, Gutierrez A, Bigelow K, Barceló C, Schroeder B, Keene K, Shattenkirk K, Foster D. (2017). Sea Turtle Bycatch Mitigation in U.S. Longline Fisheries. *Frontiers in Marine Science*, 4. DOI: 10.3389/fmars.2017.00260.

Table 1. Estimated Loggerhead and leatherback captures rates and the total number of hooks fished in the NW Atlantic by Canadian and US longliners. Note that the bycatch rates have been redacted but are available upon request.

Year	*Leatherback*	*Loggerhead*	*Hooks*
1982	NA	NA	NA
1983	NA	NA	NA
1984	NA	NA	NA
1985	NA	NA	NA
1986	NA	NA	NA
1987	NA	NA	NA
1988	NA	NA	NA
1989	NA	NA	NA
1990	NA	NA	NA
1991	NA	NA	NA
1992	NA	NA	7640721
1993	NA	NA	8258136
1994	NA	NA	6913325
1995	NA	NA	7977366
1996	NA	NA	7228773
1997	NA	NA	8437876
1998	NA	NA	7108072
1999	NA	NA	7169251
2000	NA	NA	7394236
2001	NA	NA	7333739
2002	NA	NA	6828638
2003	NA	NA	6954241
2004	NA	NA	7240725
2005	NA	NA	5911266
2006	NA	NA	5691356

2007	NA	NA	6508074
2008	NA	NA	7824435
2009	NA	NA	8290312
2010	NA	NA	6617728
2011	NA	NA	7221817
2012	NA	NA	9215894
2013	NA	NA	8073583
2014	NA	NA	8294214
2015	NA	NA	8294214
2016	NA	NA	NA
2017	NA	NA	NA

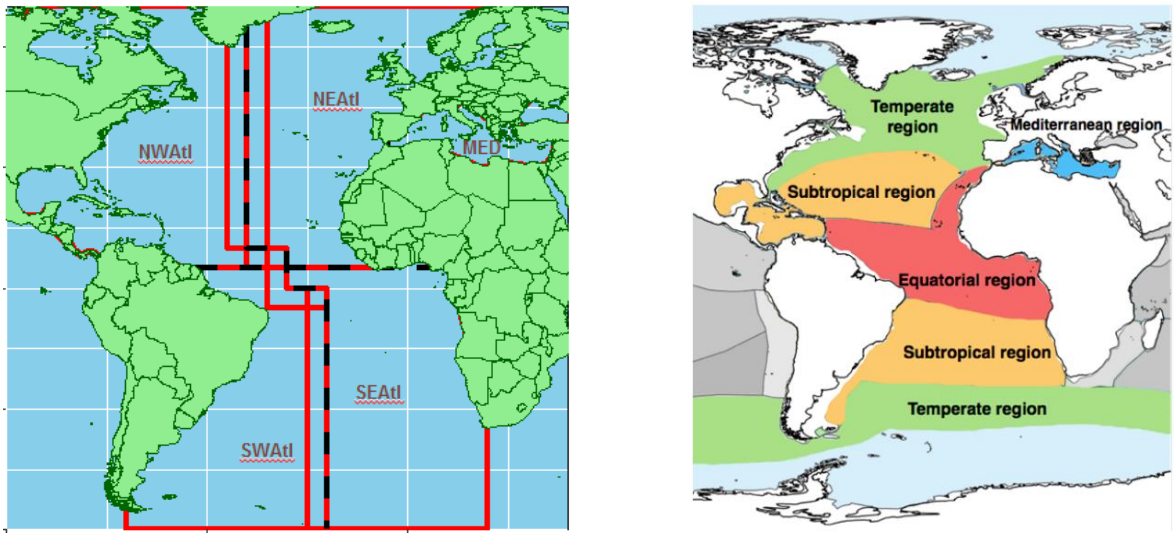

Figure 1. Proposed ecological divisions of the ICCAT convention area. The regions in the left plot are based on existing ICCAT partitions (red and black line) while those on the right are based on ecological provinces and ICCAT species occurrence.

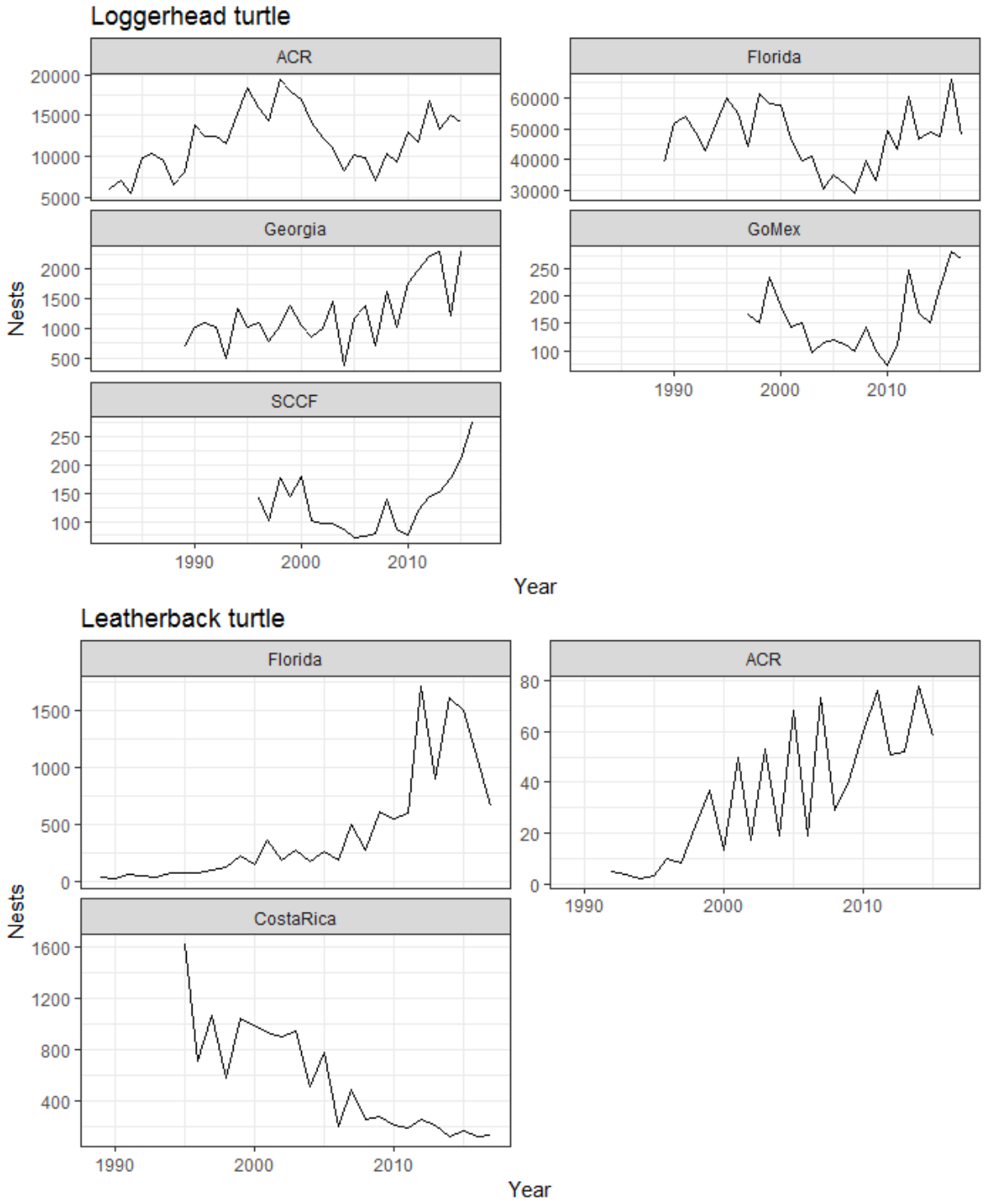

Figure 2. Trends in the number of loggerhead (top) and leatherback (bottom) nests by Region, State and Country.

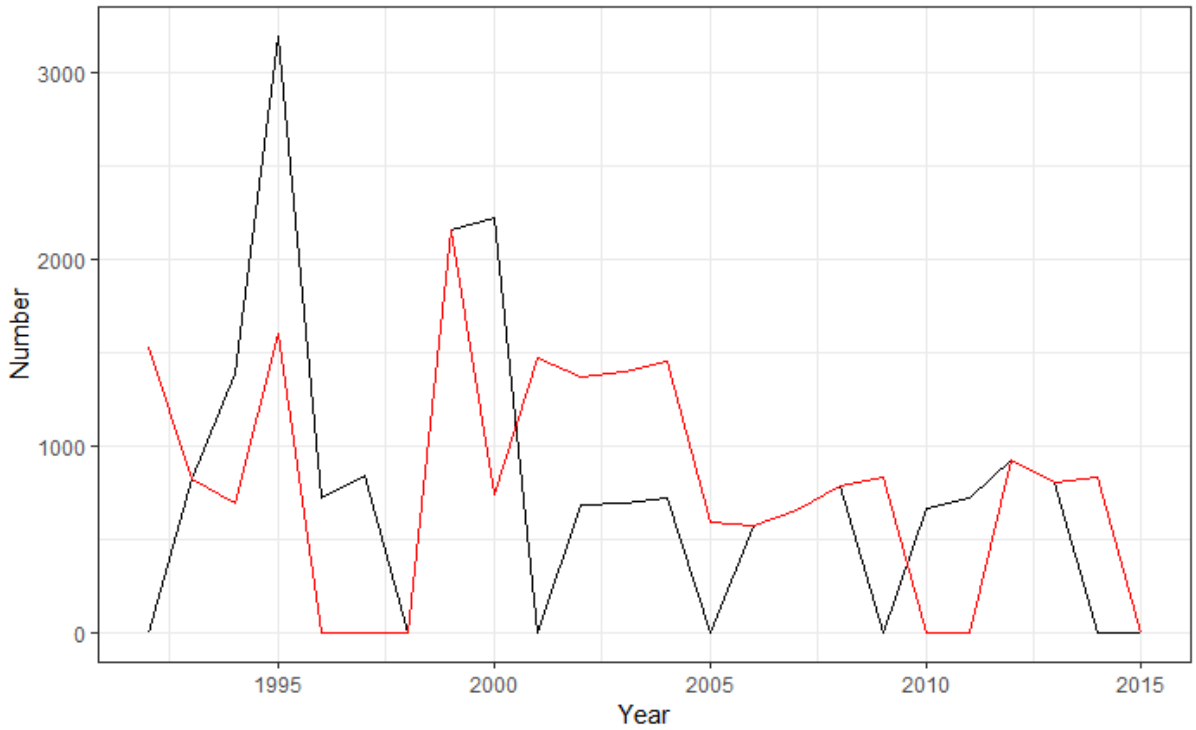

Figure 3. Trends in the estimated loggerhead (black) and leatherback (red) captures by U.S. and Canadian longline fleets operating in the northwest Atlantic Ocean and Gulf of Mexico.

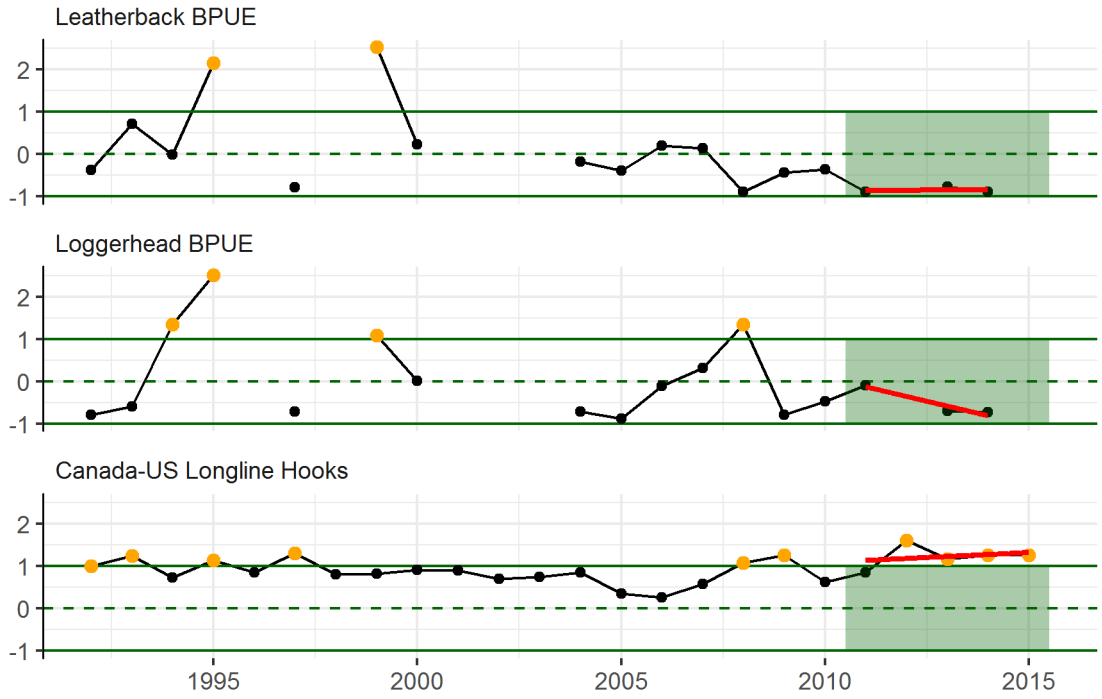

Figure 4. Indicators of marine turtle bycatch rates scaled and centered on 0 and effort scaled and centered on 5000 hooks. Values >= 1 std are orange. Values <= -1 std are blue. Red trend lines are for the last 5 years and were fit with a linear model.