SUGGESTIONS FOR A FEASIBLE AND SIMPLE ECOSYSTEM INDICATOR OF SEA TURTLES AND AVAILABLE DATA

D. Ochi[1], S. Ueno[1], K. Okamoto[1] and S. Tsuji[1]

SUMMARY

With regard to the indicator for sea turtle bycatch in the Ecosystem Report Card, the SC-ECO has been discussing the method of creating the indicator, but currently there is no consensus on the indicator values. Therefore, this document attempts to organize the conditions necessary for an appropriate sea turtle indicator and the data necessary for the development of the indicator in order to facilitate the discussion. The most important thing is to be clear on the targets of the indicators you will be updating on an ongoing basis—how can the pressure of fishing on the sea turtle population be measured? Since many CPCs are regularly involved in the calculation of indicators, it is desirable to use data that is as simple as possible and does not require additional data collection efforts to calculate indicators. The document presents and discusses candidate management targets targeted by the sea turtle indicator and the data currently available.

RÉSUMÉ

En ce qui concerne l'indicateur des prises accessoires de tortues marines dans la fiche informative sur les écosystèmes, le Sous-comité des écosystèmes a discuté de la méthode de création de l'indicateur, mais il n'existe actuellement aucun consensus sur les valeurs de l'indicateur. Par conséquent, ce document tente d'organiser les conditions nécessaires à un indicateur approprié pour les tortues marines et les données nécessaires à l'élaboration de l'indicateur afin de faciliter la discussion. Le plus important est d'être clair sur les objectifs des indicateurs qui seront mis en jour en permanence - comment mesurer la pression de la pêche sur la population de tortues marines ? Comme de nombreuses CPC participent régulièrement au calcul des indicateurs, il est souhaitable d'utiliser des données aussi simples que possible et ne nécessitant pas d'efforts supplémentaires de collecte de données pour calculer les indicateurs. Le document présente et examine les objectifs de gestion possibles visés par l'indicateur sur les tortues marines et les données actuellement disponibles.

RESUMEN

Con respecto al indicador de captura fortuita de tortugas marinas que figura en la ficha informativa sobre ecosistemas, el SC-ECO ha estado debatiendo el método de creación del indicador, pero actualmente no hay consenso sobre los valores del indicador. Por consiguiente, en el presente documento se procura organizar las condiciones necesarias para un indicador apropiado sobre las tortugas marinas y los datos necesarios para la elaboración del indicador a fin de facilitar el debate. Lo más importante es tener claros los objetivos de los indicadores que se actualizarán de forma continua, ¿cómo se puede medir la presión de la pesca sobre la población de tortugas marinas? Dado que muchas CPC participan regularmente en el cálculo de los indicadores, es conveniente utilizar datos que sean lo más sencillos posible y que no requieran esfuerzos adicionales de recopilación de datos para calcular los indicadores. En el documento se presentan y examinan los objetivos de ordenación candidatos a los que se dirige el indicador de tortugas marinas y los datos de que se dispone actualmente.

KEYWORDS

Tuna fisheries, Sea turtle, Bycatch, Ecosystem indicator, Ecosystem report card

[1] National Research Institute of Far Seas Fisheries, Japan Fisheries Research and Education Agency, 5-7-1 Orido, Shimizu 424-8633, Japan, otthii@affrc.go.jp

1. Introduction

In the ecosystem report card discussions that started in 2017, sea turtles were also included in the ecosystem indicators, and there has been an ongoing debate on what kind of indicator would be good. In the meeting in 2018, it was agreed that BPUE should be used as an indicator, but in 2019, the possibility of an indicator that also takes into account the trend of the sea turtle population was raised and the discussion will continue. However, discussions on the development of appropriate indicators for sea turtle bycatch are currently stalled and consensus has not been reached. This document therefore summarizes the conditions for the indicators to be desirable in terms of implementation of EBFM, with the aim of rebooting the discussion on the development of feasible indicators for sea turtles. In addition, we have summarized the availability and potential bias of information related to the ICCAT fisheries and sea turtle ecology and potential biases.

2. Appropriate and feasible indicator conditions

The most necessary part of indicator development is deciding where to go with the implementation of EBFM. In the case of sea turtles, the goal would be to reduce the pressure on the sea turtle population from the ICCAT fishery to a possible level. The seabird indicator is already under discussion, and it is recognized that a four-factor indicator will be used for management: 1) trend of target for management, 2) trend of pressure on target situation (e.g., fishing effort), 3) trend of management implementation and 4) response of target to management actions. 1 and 4 will be evaluated by a single indicator, e.g., total bycatch number, BPUE, bycatch mortality and population dynamics of target species, while 2 and 3 will be evaluated by the amount of effort that may be bycatch and the use of avoidance measures. The selection of indicators that have these elements will be important in planning EBFM management.

Another important factor is that each CPC should make use of data sets that do not require additional effort to collect information during the indicator development process. It is desirable to be able to create indicators using only available data within the existing framework, because it is a burden for CPCs to update indicators periodically and prepare data for indicator creation each time. In addition, considering that each CPC analyzes the data preparation, it is necessary to make the analysis method as simple as possible. Since it is important to track trend changes in the implementation of EBFM, the calculation method should be consistent, but the accuracy of indicators is not so important.

Another important factor is that it is easy for managers to understand the meaning of the indicators. The use of indicators that are difficult to interpret or biased can be confusing and misleading to managers. For example, in the case of sea turtles, bycatch events themselves do not mean the certain mortality of sea turtles, so bycatch numbers and BPUE are considered to be indicators that are a bit difficult to interpret as they are. Mortality rate would need to be considered if a more appropriate indicator is to be sought. It is also important to use time-series comparable figures, since trend changes in indicators by time series are an important evaluation criterion for management. Also, something like the relative risk calculated in the Ecological Risk Assessment may not be very appropriate.

In practice, it is unlikely that there is an ideal indicator that satisfies all of the above conditions in practice, so some factors may need to be compromised in order to prioritize

3. Available data list

As in the case of seabirds, data from the ICCAT fishery and data from the study of sea turtle ecology are used to develop the sea turtle index. Therefore, the data sets that can be used for the sea turtle index development and are already considered to be available are listed below.

3.1 Fishery data

All but the amount of effort is taken from observer data.

3.1.1 Total bycatch number

It should be noted that the accuracy of species discrimination varies depending on the CPC. Also, it is different from the number of deaths, which can lead to bias.

3.1.2 Total bycatch mortality

Direct as an impact on the sea turtle population. On the other hand, the accuracy is reduced depending on the data set being collected in each CPC, as bycatch numbers require information on life and death.

3.1.3 Standardized BPUE

Bycatch rates can be assessed by averaging the effects of fishing methods. On the other hand, as with the number of bycatch, there is a problem that mortality rate cannot be assessed correctly, and it is difficult to interpret because it is also affected by the density distribution of sea turtle distribution in the operating area.

3.1.4 Fishing effort

Effective effort for bycatch can be calculated by combining with information on sea turtle distribution.

3.1.5 Mitigation technique

There is not much information on sea turtles, so it is difficult to evaluate them at this point.

3.2 Ecological data

The information that is currently available is summarized in **Table 1**.

3.2.1 Number of nests

Can be used as an indicator of annual recruitment. However, these effects need to be taken into account because mortality and recruitment itself can fluctuate due to factors other than fisheries (human disturbance, hunting, climate change etc.).

3.2.2 Number of nesting females

There is also an attempt to estimate the total population size from the number of nesting females (Ceriani *et al.*, 2019), but this should not be used because of the large uncertainty.

3.2.3 Offshore distribution data

It can be used to estimate bycatch numbers and effective effort. However, there is an unevenness in the waters covered.

References

Abreu-Grobois, A. and P. Plotkin 2008. *Lepidochelys olivacea*. The IUCN Red List of Threatened Species 2008: e.T11534A3292503.

Broderick, A. and Patricio, A. 2019. *Chelonia mydas* (South Atlantic subpopulation). The IUCN Red List of Threatened Species 2019. e.T142121866A142086337.

Casale, P. and Marco, A. 2015. *Caretta caretta* (North East Atlantic subpopulation). The IUCN Red List of Threatened Species 2015. e.T83776383A83776554.

Casale, P. and Margaritoulis, D. 2010. Sea turtle in the Mediterranean: Distribution, threats and conservation priorities. IUCN, Gland, Switzerland. pp.294

Ceriani, S. A., Casale, P., Brost, M., Leone, E. H. and Witherington, B. E. 2019. Conservation implications of sea turtle nesting trends: elusive recovery of a globally important loggerhead population. Ecosphere 10(11): e02936.

Chapman, R. and Seminoff, J. A. 2016. Status of loggerhead turtle (*Caretta caretta*) within Nations of the Inter-American Convention for the protection and conservation of sea turtles. Inter-American Convention for the protection and conservation of sea turtles (IAC), Technical Document CIT-CC13-2016-Tec. 13. pp.46

Kelle, L., Gratiot, N. and Thoisy, D. B. 2009. Olive ridley turtle *Lepidochelys olivacea* in French Guiana: back from the brink of regional extirpation? Oryx 43(2): 243-246.

Mazaris, A. D., Schofield, G., Gkazinou, C., Almpanidou, V. and Hays, G. C. 2017. Global sea turtle conservation successes. Science advance 3(9): e1600730.

Marco, A., Abella, E., Liria-Loza, A., Martins, S., López, O., Jiménez-Bordón, S., Medina, M., Oujo, C., Gaona, P., Godley, B. J. and López-Jurado, L. F. 2012. Abundance and exploitation of loggerhead turtles nesting in Boa Vista island, Cape Verde: the only substantial rookery in the eastern Atlantic. Animal conservation 15: 351-360.

Metcalfe. K., Agamboue', P. D., Augowet, E., Boussamba, F., Cardiec, F., Fay, J. M., Formia, A., Kema Kema, J. R. K., Kouerey, C., Koumba Magert, B. D., Maxwell, S. M., Minton, G., Mounguengui Mounguengui, G. A., Moussounda, C., Moukoumou, N., Churley Manfoumbi, J., Megne Nguema, A., Nzegoue, J., Parnell, R. J., Plessis P. D., Sounguet, G. P., Tilley, D., Verhage, S., Viljoen, W., White, L., Witt, M. J. and Godley, B. J. 2015. Going the extra mile: Ground-based monitoring of olive ridley turtles reveals Gabon hosts the largest rookery in the Atlantic. Biological conservation 190: 14-22.

The Northwest Atlantic Leatherback Working Group. 2019. *Dermochelys coriacea* (Northwest Atlantic Ocean subpopulation). The IUCN Red List of Threatened Species 2019. e.T46967827A83327767.

Tiwari, M., Wallace, B. P. and Girondot, M. 2013. *Dermochelys coriacea* (Southwest Atlantic Ocean subpopulation). The IUCN Red List of Threatened Species 2013. e.T46967838A46967842.

Wibbels, T. and Bevan, E. 2019. *Lepidochelys kempii* (errata version published in 2019). The IUCN Red List of Threatened Species 2019. e.T11533A155057916.

Table 1. Literature on the nesting sites of sea turtles in the ICCAT convention areas.

Species	Region	Nesting sites	Reference
Loggerhead turtle	NW ATL	US, Mexico, Belize, Netherlands Caribbean, Venezuela, Netherlands Antilles	Chapman and Seminoff, 2016; Mazaris et al., 2017
	SW ATL	Brazil	Chapman and Seminoff, 2016; Mazaris et al., 2017
	Mediterranean	Turkey, Greece, Cyprus, Israel, Lebanon, Tunisia	Mazaris et al., 2017; Casale and Margaritoulis, 2010
	NE ATL	Cape Verde, Mauritania, Guinea	Casale and Marco, 2015; Marco et al., 2012
Leatherback turtle	NW ATL	French Guiana, Trinidad and Tobago, US, Costa Rica, Virgin Islands (UK and US), Grenada, Panama, Puerto Rico, Netherlands Caribbean, Suriname	Mazaris et al., 2017; The Northwest Atlantic letherback working group, 2019
	SW ATL	Brazil	Tiwari et al., 2013
	SE ATL	Gabon, Congo, Guinea	Tiwari et al., 2013
Olive ridley	NW ATL	French Guiana, Suriname	Mazaris et al., 2017; Abreu-Grobois and Plotkin, 2008; Kelle et al., 2009; Metcalfe et al., 2015
	SW ATL	Brazil	
	NE ATL	Guinea	
	SE ATL	Congo, Gabon	
Kemp's ridley	NW ATL	Mexico, US	Mazaris et al., 2017; Wibbels and Bevan, 2019
Green turtle	NW ATL	US, Mexico, Cuba, Costa Rica, Virgin Islands (US), Venezuela, Suriname	Mazaris et al., 2017; Broderick and Patricio, 2019
	SW ATL	Guiana, Brazil, French Guiana	Mazaris et al., 2017; Broderick and Patricio, 2019
	Mediterranean	Cyprus, Egypt, Greece, Italy Lebanon, Syria,Turkey	Casale and Margaritoulis, 2010
	NE ATL	Guinea-Bissau, Equatorial Guinea, Principe Island	Broderick and Patricio, 2019
	SE ATL	Ascension Island	Mazaris et al., 2017; Broderick and Patricio, 2019
Hawksbill turtle	NW ATL	Mexico, Cuba, Costa Rica, Antigua, Barbados, Netherlands Antilles, Netherlands Caribbean, Nicaragua, Panama, Puerto Rico, Suriname, Trinidad and Tobago, Virgin Islands	Mazaris et al., 2017
	SW ATL	Brazil	Mazaris et al., 2017