



**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**  
NATIONAL MARINE FISHERIES SERVICE  
West Coast Region  
Sustainable Fisheries Division  
501 West Ocean Boulevard, Suite 4200  
Long Beach, California 90802

150413SWR2013SF00161:TD

July 2, 2018

Dr. Guillermo Compeán  
Director, Inter-American Tropical Tuna Commission  
8901 La Jolla Shores Drive  
La Jolla, California 92037-1508

Re: Submission of sea turtle report

Dear Dr. Compeán:

NOAA's National Marine Fisheries Service (NMFS) has prepared the attached report summarizing the available information regarding interactions with sea turtles by U.S. longline and drift gillnet fishing vessels in the Eastern Pacific Ocean in 2017. This report is submitted under both Resolution C-07-03 (Resolution to Mitigate the Impact of Tuna Fishing on Sea Turtles) and Paragraph 4 of Resolution C-04-05 (Consolidated Resolution on Bycatch).

The attached report addresses (1) observed and estimated bycatch rates for the U.S. Pacific longline fisheries, except for the Hawaii deep set longline fishery for which 2017 data are not yet available<sup>1</sup>, and the U.S. west coast drift gillnet fishery; (2) information on efforts to reduce sea turtle bycatch and mortality in the longline and drift gillnet fisheries, including outreach activities, technical workshops, and gear research; and (3) an update on U.S. efforts to promote sea turtle conservation around the world.

Please contact Taylor Debevec at 562-980-4066 or [Taylor.Debevec@noaa.gov](mailto:Taylor.Debevec@noaa.gov) if there are any questions regarding the United States data reporting in accordance with Resolutions C-07-03 and C-04-05.

Sincerely,

Heidi Taylor  
Highly Migratory Species Branch Chief

cc w/ enclosure:

Barry Thom, U.S. Commissioner to the IATTC  
David Hogan, U.S. Department of State  
William Fox, U.S. Commissioner to the IATTC  
Edward Weissman, U.S. Commissioner to the IATTC  
Ryan J. Wulff, NMFS, West Coast Region  
Penny Ruvelas, NMFS, West Coast Region  
Christofer Boggs, NMFS, Pacific Islands Fisheries Science Center

Enclosure

<sup>1</sup> An update to this report will be sent once data are available.



# **Sea Turtle Interactions in the U.S. Pacific Longline and Drift Gillnet Fisheries**

A Report Submitted to the Inter-American Tropical Tuna Commission as Required  
by the Resolution to Mitigate the Impact of Tuna Fishing Vessels on Sea Turtles  
(Resolution C-07-03)  
and the  
Consolidated Resolution on Bycatch (Resolution C-04-05)

**Prepared by NOAA's National Marine Fisheries Service (NMFS)  
West Coast Region  
Long Beach, CA**

**June 2018**

## Sea Turtle Interactions in the U.S. Pacific Longline and Drift Gillnet Fisheries

### Preface

Under the June 2007 *Resolution to Mitigate the Impact of Tuna Fishing Vessels on Sea Turtles* (Resolution C-07-03), and voluntarily under Resolution C-04-05 (*Consolidated Resolution on Bycatch*), Parties agreed to submit available information on interactions of vessels flying their flag with sea turtles in fisheries under the competence of the Inter-American Tropical Tuna Commission (IATTC). Additionally, Parties agreed to report on both progress in the development of technology to reduce sea turtle bycatch and the actions taken to provide their vessels with the necessary equipment for appropriate release of incidentally caught sea turtles. Therefore, the United States has prepared this annual report on the interactions of U.S. fishing vessels with sea turtles in and adjacent to the eastern Pacific Ocean (EPO). The report also discusses the conservation measures taken by the United States to reduce sea turtle bycatch.

The United States has limited the scope of fishery interaction data discussed in this report to longline and drift gillnet fisheries in the Pacific Ocean. Some of these fisheries, such as Hawaii longline fisheries, range across the Pacific Ocean and include fishing effort that occurs outside the IATTC Convention Area. Where possible, this report makes an effort to distinguish and highlight activities that specifically occur within the IATTC Convention Area, or EPO, although it is not always possible to do so. The United States is also monitoring takes of sea turtles by large purse seine vessels in the EPO, including entanglement in fish aggregating devices. However, we obtain these data from the IATTC staff; therefore, we do not include this fishery in this report, as there is no benefit in providing these data back to the IATTC.

Lastly, this report is an update to the report submitted in 2017 pursuant to Resolutions C-04-05 and C-07-03. Unchanged background information is not repeated here.

### Swordfish/Tuna Longline Fisheries

Please refer to pages 3-6 of the report submitted in 2014 for a thorough background on the operation and management of West Coast and Hawaii U.S. longline fisheries targeting tunas and swordfish. Updates are described here:

#### *U.S. West Coast-Based Deep-set Longline (DSL) Fishery*

There were no sea turtle interactions in the DSL fishery operating out of California in 2017 (NMFS West Coast Region observer program, unpublished data, 2018).

#### *Hawaii-based Pelagic Longline Fishery*

##### *Shallow-Set*

In 2017, the fishery interacted with 3 leatherback, 10 loggerhead, and 1 Olive Ridley sea turtles within the IATTC Convention Area.

## *Deep-Set*

The estimated incidental take of sea turtles in the DSLL fishery in 2017 within the IATTC Convention Area was not available at the time of this submission. The data will be sent in an updated report to the IATTC as soon as they are available.

### Swordfish/Thresher Shark Drift Gillnet Fishery

Please refer to pages 8-9 of the report submitted in 2014 for a thorough background on the operation and management of the U.S. drift gillnet fishery targeting swordfish and thresher shark. Updates are included here.

**Table 1: Sea Turtle Interactions observed in the U.S. West Coast Drift Gillnet Fishery 2009-2015. Sources: the West Coast Region Observer Program and SAFE reports 2006-2014, available at: <http://www.pcouncil.org/highly-migratory-species/stock-assessment-and-fishery-evaluation-safe-documents/>**

Year	Active Vessels	Swordfish (mt)	Thresher shark (mt)	Observed Sets	Estimated Total Sets	% Observer Coverage	Observed Turtle Takes	Take per 100 obs. sets
2009	35	252	38	101	761	13.3	1 <sup>†</sup>	0.93
2010	26	62	41	59	492	12.0	0	0
2011	22	119	55	85	435	19.5	0	0
2012	17	118	37	83	445	18.7	1 <sup>†</sup>	1.20
2013	18	95	48	176	470	37.4	0	0
2014	15	127	26	113	379	29.8	0	0
2015	17	95	31	74	361	20.5	0	0
2016	20	171	28	134	737	18.2	0	0
2017	17	176	39	114	598	19.0	0	0

<sup>†</sup> Leatherback, released alive  
All data are preliminary

### **Conservation Measures**

Please refer to previous U.S. sea turtle reports for a thorough background on the history of sea turtle conservation and mitigation measures the United States has implemented in both the longline and drift gillnet fisheries. Those pages also include past trainings, outreach events, conferences, workshops, collaborations with other nations and organizations, as well as research publications. Recent developments include:

#### Species in the Spotlight – Pacific Leatherback

Of all the species NMFS protects under the Endangered Species Act (ESA), eight are considered to be among the most at-risk of extinction in the near future. As a result, the “Species in the Spotlight: Survive to Thrive” initiative was created - a concerted agency-wide effort to spotlight and save these highly at-risk species. One of these “Species in the Spotlight” is the Pacific

leatherback sea turtle (*Dermochelys coriacea*) which are globally listed under the ESA as endangered.

Throughout the Species in the Spotlight campaign, NMFS will engage public and private sector partners in collaborative actions to spur recovery for these species. On February 10, 2016, NMFS released 5-Year Action Plans for the eight "Species in the Spotlight." These plans outline efforts vital for stabilizing their populations and preventing their extinction, and serve as road maps for their recovery. In October, 2016, NMFS hosted California Leatherback Day in La Jolla, California, with over 200 participants.

Under this special designation, leatherback sea turtles will be prioritized for directed funding and competitive grant award programs. One such program is the ESA Section 6 grant program which provides funds to the states and recognized tribes to support research and conservation programs that aide in the recovery of endangered species. The states of Washington, Oregon, and California have included leatherback sea turtles in their Section 6 Agreements and are eligible to submit proposals for this species.

#### Participation in Seminars, Meetings, Conferences, Symposiums, etc.

- 37<sup>th</sup> International Sea Turtle Symposium, Las Vegas, Nevada, April, 2017
  - Yonat Swimmer of Pacific Islands Fisheries Science Center, presented at the International Sea Turtle Symposium in (April 2017 (in Las Vegas, NV) on "Sea Turtle Bycatch Mitigation in U.S. Longline Fisheries".
- Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC) , Eighth Conference of the Parties, Buenos Aires, Argentina, June 2017
- IATTC Bycatch Working Group meeting, La Jolla, California, May, 2017
- North Pacific Trilateral Loggerhead Recovery Plan Meeting, La Jolla, CA, January, 2016; Honolulu, Hawaii, August 2016; La Jolla, CA, March, 2017; and Washington D.C., August, 2017, with participation from NMFS, Japan and Mexico.
- NMFS has included training on sea turtle safe handling, release, and identification as part of each AIDCP Seminar for Fishing Captains. Attendance at this seminar is one of the requirements to receive an ETP operator's permit and be placed upon the AIDCP list of qualified captains. Several workshops are offered each year, both in-person or via webinar.
- NMFS has included training on sea turtle safe handling, release and resuscitation to participants in the California drift gillnet fishery, an experimental deep-set buoy gear fishery, and the Hawaii-based longline fishery.

#### Gear Experiments

Technical advice has been provided for ongoing and new studies (2016-2017) on sea turtle bycatch mitigation experiments, underway in Indonesia, Brazil, Spain, Peru, Chile, and Mexico.

#### Published Research from U.S. Government Scientists and Managers

Piovano S, Swimmer Y. 2017. Effects of a hook ring on catch and bycatch in a Mediterranean swordfish longline fishery. *Journal of Aquatic Conservation: Marine and Freshwater Ecosystems*.

Guabe P, Barcelo C, McGillicuddy Jr. DJ, Miller P, Domingo A, Marcovaldi N, Giffoni B, Swimmer Y. (2017). The Use of Mesoscale Eddies by Juvenile Loggerhead Sea Turtles (*Caretta caretta*) in the Southwestern Atlantic. *PLoS ONE*. 1;12(3):e0172839.

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*.

Carretta, J.V., J.E. Moore, and K.A. Forney. 2017. Regression tree and ratio estimates of marine mammal, sea turtle, and seabird bycatch in the California drift gillnet fishery: 1990-2015. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-568. 83 p. doi:10.7289/V5/TM-SWFSC-568.

Casale Paola, Gaspard Abitsi, Marie Pierre Aboro, Pierre Didier Agamboue, Laureen Agbode, Nontsé Lois Allela, Davy Angueko, Jean Noel Bibang Bi Nguema, Francois Boussamba, Floriane Cardiec, Emmanuel Chartrain, Claudio Ciofi, Yves Armand Emame, J. Michael Fay, Brendan J. Godley, Carmen Karen Kouerey Oliwiwina, Jean de Dieu Lewembe, Donatien Leyoko, Georges Mba Asseko, Pulcherie Mengue M'adzaba, Jean Herve Mve Beh, Chiara Natali, Clauvice Nyama-Mouketou, Jacob Nzegoue, Carole Ogandagas, Richard J. Parnell, Guy Anicet Rerambyath, Micheline Schummer Gnandji, Guy-Philippe Sounguet, Manjula Tiwari, Bas Verhage, Raul Vilela, Lee White, Matthew J. Witt, Angela Formia. 2017. A first estimate of sea turtle bycatch in the industrial trawling fishery of Gabon. *Biodiversity Conservation*. DOI: [10.1007/s10531-017-1367-z](https://doi.org/10.1007/s10531-017-1367-z).

Gaos, Alexander R., Michael J. Liles, Velkiss Gadea, Alejandro Peña de Niz, Felipe Vallejo, Cristina Miranda, Jodie Jessica Darquea, Ana Henriquez, Eduardo Altamirano, Alejandra Rivera, Sofía Chavarría, David Melero, José Urteaga, Carlos Mario Pacheco, Didiher Chácon, Carolina LeMarie, Joanna Alfaro-Shigueto, Jeffrey C. Mangel, Ingrid L. Yañez and Jeffrey A. Seminoff. *In press*. Living on the edge: Hawksbill turtle nesting and conservation along the eastern Pacific Rim. *Latin American Journal of Aquatic Research*.

Ramirez, M.D., L. Avens, J.A. Seminoff, L.R. Goshe, and S.S. Heppel. 2017. Growth dynamics of juvenile loggerhead sea turtles undergoing an ontogenetic habitat shift. *Oecologia*, doi:[10.1007/s00442-017-3832-5](https://doi.org/10.1007/s00442-017-3832-5).

Robinson, Nathan J., Kelly R. Stewart, Peter H. Dutton, Ronel Nel, Frank V. Paladino and Pilar Santidrián Tomillo. 2017. Standardising curved carapace length measurements for leatherback turtles, *Dermochelys coriacea*, to investigate global patterns in body size. *Herpetological Journal* 27 (April 2017): 231–234.

Turner Tomaszewicz, C, Seminoff, J A, Peckham, S H, Avens, L, and Kurle, C M. 2017. Intrapopulation variability in the timing of ontogenetic habitat shifts in sea turtles revealed using  $\delta^{15}\text{N}$  values from bone growth rings. *Journal of Animal Ecology*.



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The attached report addresses (1) observed and estimated capture and mortality rates for the U.S. Pacific longline fisheries; (2) observed bycatch and management in the drift gillnet fishery off the U.S. West Coast; (3) information on efforts to reduce sea turtle bycatch and mortality in the longline and drift gillnet fisheries, including outreach activities, technical workshops, and gear research; and (4) an update on U.S. efforts to promote sea turtle conservation around the world.

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**Prepared by NOAA's National Marine Fisheries Service (NMFS)  
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**June 2017**



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Lastly, this report is an update to the report submitted in 2016 pursuant to Resolutions C-04-05 and C-07-03. Unchanged background information from previous reports is not repeated here.

## **Swordfish/Tuna Longline Fisheries**

### *U.S. West Coast-Based Deep-set Longline (DSLL) Fishery*

There were no sea turtle interactions in the DSLL fishery operating out of California in 2016.

A new biological opinion for this fishery was completed in August of 2016. This report reviews the fishery's impact on species listed as endangered under the U.S. Endangered Species Act. The biological opinion concluded that the fishery will likely adversely affect Pacific leatherback, loggerhead, olive ridley, and green sea turtles but that it is not likely to jeopardize these species. The biological opinion also set incidental take levels for these species. If the fishery reaches any of these levels over ten years the fishery will close while its impacts are re-evaluated.

**Table 1.** Incidental take numbers for a ten-year time period, both entanglements and mortalities, for sea turtle species that interact with the west coast longline fishery.

<b>Species</b>	<b>Entanglements -- Mortalities</b>
green	Up to 1 -- 1
leatherback	4 -- 2
Olive ridley	6 -- 6
Loggerhead	1 -- 1

*Hawaii-based Pelagic Longline Fishery*

Tables 2 and 3 provide bycatch estimates for sea turtles for all longline trips landing in the specified years, 2015 or 2016. A fishing operation was considered within the IATTC Convention Area if at least one of the recorded locations (begin set, end set, begin haul, or end haul) was within the region.

A. Shallow-Set

**Table 2.** Number of observed incidental interactions of sea turtles for the Hawaii shallow-set longline fishery in 2015 and 2016, where the Hawaii shallow-set longline fishery had 100% observer coverage. Counts are provided for all species with an observed interaction in 2015 or 2016 and species of concern because of their endangered species status and history of past interactions. Counts are given for waters within the IATTC Convention Area.

Species of Sea Turtle	Year	Observed Takes
Loggerhead	2016	14
	2015	11
Leatherback	2016	2
	2015	2
Olive Ridley	2016	0
	2015	0
Green	2016	0
	2015	0

B. Deep-Set

**Table 3.** Estimates of the number of incidental interactions of sea turtles for the Hawaii deep-set longline fishery in 2015 and 2016. Estimates are provided for all species with an observed interaction in 2015 and 2016 and species of concern because of their endangered species status and history of past interactions. Estimates are given for waters within the IATTC Convention Area.

Species of Sea Turtle	Year	Observed Takes	Estimates	Standard Error
Loggerhead	2016	0	0	2.48
	2015	1	3	2.62
Leatherback	2016	0	0	2.82
	2015	0	0	3.69
Olive Ridley	2016	1	5	4.19
	2015	1	3	2.62
Green	2016	0	0	2.06
	2015	0	0	2.34
Unidentified Hard Shell	2016	0	0	2.06
	2015	0	0	1.67

## **Swordfish/Thresher Shark Drift Gillnet Fishery**

### *New Regulations for Monitoring, Control, and Surveillance*

NMFS published a final rule<sup>1</sup> to establish a vessel monitoring system by January 1, 2016, as required under IATTC Resolution C-14-02, to enforce time/area closures.

**Table 4:** Sea Turtle Interactions observed in the U.S. West Coast Drift Gillnet Fishery 2009-2016. Sources: the West Coast Region Observer Program and SAFE reports 2006-2016, available at: <http://www.pcouncil.org/highly-migratory-species/stock-assessment-and-fishery-evaluation-safe-documents/>

<b>Year</b>	<b>Active Vessels</b>	<b>Swordfish (mt)</b>	<b>Thresher shark (mt)</b>	<b>Observed Sets</b>	<b>Estimated Total Sets</b>	<b>% Observer Coverage</b>	<b>Observed Turtle Takes</b>	<b>Take per 100 obs. sets</b>
2009	35	252	38	101	761	13.3	1 <sup>†</sup>	0.93
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All data are preliminary

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Of all the species NMFS protects under the Endangered Species Act (ESA), eight are considered to be among the most at-risk of extinction in the near future. As a result, the “Species in the Spotlight: Survive to Thrive” initiative was created - a concerted agency-wide effort to spotlight and save these highly at-risk species. One of these “Species in the Spotlight” is the Pacific leatherback sea turtle (*Dermochelys coriacea*) which are globally listed under the ESA as endangered.

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<sup>1</sup> 80 FR 60533, October 7, 2015 - <https://www.gpo.gov/fdsys/pkg/FR-2015-10-07/pdf/2015-25474.pdf>

Throughout the Species in the Spotlight campaign, NMFS will engage public and private sector partners in collaborative actions to spur recovery for these species. On February 10, 2016, NMFS released 5-Year Action Plans for the eight "Species in the Spotlight." These plans outline efforts vital for stabilizing their populations and preventing their extinction, and serve as road maps for their recovery. In October, 2016, NMFS hosted California Leatherback Day in La Jolla, California, with over 200 participants.

Under this special designation, leatherback sea turtles will be prioritized for directed funding and competitive grant award programs. One such program is the ESA Section 6 grant program which provides funds to the states and recognized tribes to support research and conservation programs that aide in the recovery of endangered species. The states of Washington, Oregon, and California have included leatherback sea turtles in their Section 6 Agreements and are eligible to submit proposals for this species.

Participation in Seminars, Meetings, Conferences, Symposiums, etc.

- 35<sup>th</sup> International Sea Turtle Symposium, Turkey (April, 2015).  
-Fisheries observer workshop with emphasis on sea turtle handling and release
- International Commission for the Conservation of Atlantic Tunas (ICCAT) Subcommittee on Ecosystems and Bycatch, Madrid, Spain (June 2015).
- Inter-American Convention on Sea Turtles in Vina del Mar, Chile, (October 2015).
- North Pacific Loggerhead Plan Meeting, La Jolla, CA, (January, 2016).
- 36<sup>th</sup> International Sea Turtle Symposium, Lima, Peru, (February, 2016).
- Areas Beyond National Jurisdiction (ABNJ, or Common Oceans) Tuna Project held a Joint RFMO Technical Working Group-Bycatch on sea turtle bycatch mitigation, Honolulu, Hawaii USA (February 2016 and November 2016).
- Yonat Swimmer served on the ICCAT Ecosystems and Bycatch Working Group to discuss sea turtle bycatch in ICCAT fisheries and attempts for mitigation. (September 2016).
- NMFS has included training on sea turtle safe handling, release, and identification as part of each AIDCP Seminar for Fishing Captains. Attendance at this seminar is one of the requirements to receive an ETP operator's permit and be placed upon the AIDCP list of qualified captains. Several workshops are offered each year, both in-person or via webinar.
- NMFS has included training on sea turtle safe handling, release and resuscitation to participants in the California drift gillnet fishery, an experimental deep-set buoy gear fishery, and the Hawaii-based longline fishery.

### Gear Experiments

- Technical advice has been provided for ongoing and new studies (2016-2017) on sea turtle bycatch mitigation experiments, underway in Indonesia, Brazil, Spain, Peru, Chile, and Mexico. The following gear trials are ongoing:
  - Gillnet modification studies aimed to reduce turtle bycatch in Indonesia, Mexico, and Peru and Chile. (2015-2016)
  - Continuation of studies with the University of Central Florida regarding loggerhead and hawksbill turtle movements in relation to oceanic currents in the Atlantic.
- Research conducted in Peru, Chile, Indonesia and Mexico during 2015-2016 to test the influence of gillnet illumination on incidental capture rates of loggerhead sea turtles.
- Study in Baja California Sur, Mexico in 2015-2016 to test an acoustic deterrent device in a gillnet fishery to reduce sea turtle bycatch.

### Sea Turtle Tracking Studies

- Sea turtle tracking studies have also provided information on turtles' high use areas in the Atlantic and Pacific Oceans, and have elucidated turtles' use of oceanic fronts and other environmental features such as chlorophyll *a* and sea surface temperatures.

### Published Research from U.S. Government Scientists and Managers

Liles MJ, Peterson MJ, Seminoff JA, Altamirano E, Henríquez AV, Gaos AR, Gadea V, Urteaga J, Torres P, Wallace BP, Peterson TR. 2015. One size does not fit all: Importance of adjusting conservation practices for endangered hawksbill turtles to address local nesting habitat needs in the eastern Pacific Ocean. *Biological Conservation* 184:405–413.

Seminoff, J. A., C. D. Allen, G. H. Balazs, P. H. Dutton, T. Eguchi, H. L. Haas, S.A. Hargrove, M. P. Jensen, D. L. Klemm, A. M. Lauritsen, S. L. MacPherson, P. Opay, E. E. Possardt, S. L. Pultz, E. E. Seney, K. S. Van Houtan, and R. S. Waples. 2015. Status Review of the Green Turtle (*Chelonia mydas*) Under the U.S. Endangered Species Act. NOAA Technical Memorandum, NOAA-NMFS-SWFSC-539. 571pp.

Benaka LR, Sharpe L, Abrams K, Campbell M, Cope J, Darby F, Dick EJ, Hyde J, Linton B, Lunsford C, Rioux D and Y. Swimmer. (2016) Action Plan for Fish Release Mortality Science. US Department of Commerce, NOAA, 34 p. NMFS-F/SPO-161.

Gilman E, Chaloupka M, Swimmer Y, Piovano S (2016) A cross-taxa assessment of pelagic longline bycatch mitigation measures: conflicts and mutual benefits to elasmobranchs. *Fish and Fisheries*. 10.1111/faf.12143.

Ortiz N, Mangel JC, Wang J, Alfaro-Shigueto J, Pingo S, Jimenez A, Suarez T, Swimmer Y, Carvalho F & BJ Godley (2016) Reducing green sea turtle bycatch in small-scale fisheries

using illuminated gillnets: The Cost of Saving a Sea Turtle. *Marine Ecology Progress Series* 545: 251-259.

Huang H, Swimmer Y, Bigelow K, Gutierrez A, Foster D (2016) Influence of hook type on catch of commercial and bycatch species in an Atlantic tuna fishery. *Marine Policy* 65: 68–75.

Williard A, Parga M, Sagarminaga R, Swimmer Y (2015) Physiological ramifications for loggerhead turtles captured in pelagic longlines. *Biology Letters* 21: 20150607.

Swimmer Y and A Gutierrez (2015) Analysis of United States longline fishing regulations and effects on sea turtles. International Commission on the Conservation of Atlantic Tunas. Subcommittee on Ecosystems & Bycatch June 2015. Madrid, Spain. SCRS 027.

Monteiro D, Estima SE, Gandra T, Silva AP, Bugoni L, Swimmer Y, Seminoff J, Secchi, E. (In press) Long-term spatial and temporal patterns of sea turtle strandings in southern Brazil. *Marine Biology*.

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