Additional File 4: Tag and Study Details

Tag Details

X-Tags (Microwave Telemetry, Inc., Columbia, MD, USA) are pop-up satellite archival tags (PSATs) that collect time-series depth, temperature, and light-level data while deployed on a fish. X-Tags are programmed to detach from the tether (and fish) and float to the surface for data transmission after (1) remaining at constant depth for a specified period of time, (2) reaching extreme depths where the functional integrity of the X-Tag may be compromised, or (3) reaching the programmed pop-off date (Standard Rate tags) or memory-full reason (High Rate tags) after the specified deployment period. Data are then transmitted to the Argos satellite system. The format and sampling rate of the available time-series data depend on the tag programming (High Rate [HR] or Standard Rate [SR]) and if the tag was physically recovered. In the event that a SR tag is recovered, the entire 2-minute set of time-paired depth, temperature, and light-level records can be extracted. Additionally, after a SR tag enters data transmission mode, it switches from 2-minute sampling to 1-minute sampling. Usually this is inconsequential to an analysis because tags transmit from the surface after detaching from the fish. However, in this study, some recovered tags remained consumed during the 1-minute sampling period, providing 1-minute resolution data for additional analyses. Regardless of the tag recovery, HR tags provide time-paired depth, temperature, and light-level records at resolutions <5 minutes. However, all data may not be successfully received through the Argos system, resulting in temporal gaps (concurrent in both the depth and temperature) in the transmitted dataset, and therefore, we linearly interpolated the gaps to ensure consistent sampling throughout deployment. In this application, we used recovered SR datasets (2-minute resolution), recovered HR datasets (<5 minute resolution), and transmitted HR datasets (<5 minute resolution with potential temporal gaps). Therefore, all evaluated data consisted of time-paired, time-series depth, temperature, and light-level data at constant sampling resolutions <5 minutes.

Study Details

Research was conducted under permits MAF/FIS/17 and MAF/FIS/34 from the Bahamian Department of Marine Resources. Animal sampling protocols were aligned with The UK Home Office Animals (Scientific Procedures) Act regulations, and guidelines of the Association for the study of Animal

Behaviour, and Animal Behaviour Society [1]. Permission to capture sharks within the Bahamian Shark Sanctuary was established in accordance with Bahamian Department of Marine Resources Form 20A, Regulation 36D (3), permitting fishing, possession, and exportation of sharks or shark parts. Animal capture and tagging details are presented in other publications [2–4] (O. Shipley, unpublished data). A taxonomic evaluation of genus *Centrophorus* remains ongoing, and distinct ambiguity remains in the western Atlantic species-complex [5, 6], therefore animals were defined as *Centrophorus* spp. based on Brooks et al. [3].

Table S1. Tag deployment information.

Species	ID	Tag Deployment Date	Start Latitude (°N)	Start Longitude (°W)	Fork Length (cm)	Data Percentage	Tag Type
Hexanchus griseus	35545	9/13/2010	24.832	76.379	276	88%	HR X-Tag*
Hexanchus griseus	65821	9/13/2010	24.832	76.379	310	100%	SR X-Tag (Recovered)
Centrophorus spp.	103791	11/9/2010	24.820	76.382	71	100%	HR X-Tag (Recovered)
Centrophorus spp.	103794	12/2/2010	24.827	76.391	89	100%	SR X-Tag (Recovered)
Carcharhinus longimanus	107797	5/1/2011	24.113	75.329	218	100%	SR X-Tag (Recovered)
Carcharhinus perezi	107800	11/10/2011	24.588	76.032	150	100%	SR X-Tag (Recovered)
Carcharhinus perezi	115972	6/27/2013	24.775	76.323	137	100%	SR X-Tag (Recovered)
Squalus cubensis	150489	11/10/2015	24.857	76.417	56	100%	HR X-Tag (Recovered)
Squalus cubensis	150491	10/7/2015	24.843	76.398	71	66%	HR X-Tag*
Squalus cubensis	154727	3/2/2016	24.859	76.417	57	84%	HR X-Tag*

*Time-series depth and temperature profiles were linearly interpolated to fill in gaps of missing data.

References

1. Rollin BE, Kessel ML. Guidelines for the treatment of animals in behavioural research and teaching. Anim Behav. 1998;55:251–257.
2. Howey-Jordan LA, Brooks EJ, Abercrombie DL, Jordan LKB, Brooks A, Williams S, et al. Complex movements, philopatry and expanded depth range of a severely threatened pelagic shark, the oceanic whitetip (*Carcharhinus longimanus*) in the western North Atlantic. PLoS ONE. 2013;8: e56588.
3. Brooks EJ, Brooks AML, Williams S, Jordan LKB, Abercrombie D, Chapman DD, et al. First description of deep-water elasmobranch assemblages in the Exuma Sound, The Bahamas. Deep-Sea Res Pt II. 2015;11:581–91.
4. Shipley ON, Howey LA, Tolentino ER, Jordan LKB, Brooks EJ. Novel techniques and insights into the deployment of pop-up satellite archival tags on a small-bodied deep-water chondrichthyan. Deep-Sea Res Pt 1. In Press.
5. White WT, Ebert DA, Naylor G, Ho H, Clerkin P, Verissimo A, et al. Revision of the genus *Centrophorus* (Squaliformes:Centrophoridae): Part 1— redescription of *Centrophorus granulosus* (Bloch & Schneider), a senior synonym of *C. acus* Garman and *C. niaukang* Teng. Zootaxa. 2013;3752:35–72.
6. Verissimo A, Cotton CF, Buch RH, Guallart J, Burgess GH. Species diversity of the deep-water gulper sharks (Squaliformes: Centrophoridae: Centrophorus) in North Atlantic waters–current status and taxonomic issues. Zool J Lin Soc. 2014;172:803–830.