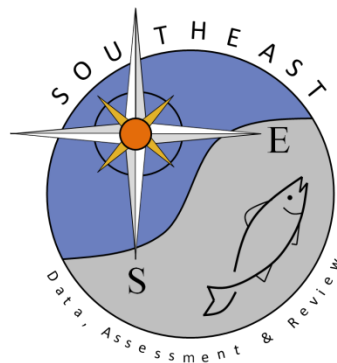# Hammerhead post-release mortality data summary for SEDAR

N.M. Whitney, K.O. Lear, H.M. Marshall, J. Morris, A.M. Andres, C.F. White, T. Driggers, B. Prohaska, J. Gelsleichter, B. Frazier, R.D. Grubbs

Hammerhead post-release mortality data summary for SEDAR, 12/17/2021

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Data summary:

Between 2014 and 2019 Scalloped and Great Hammerhead sharks (*Sphyrna lewini* and *Sphyrna mokarran*) were tagged with a combination of acceleration data-loggers (ADLs; model G6A+, Cefas, Inc., Lowestoft UK) and Pop-up Satellite Archival Tags (PSATs; model PSATLIFE, Lotek, Ontario, CAN) to determine their post-release survival from commercial longline fisheries (Table 1). Sharks were caught on longlines in collaboration with commercial fishermen in the Gulf of Mexico near Madeira Beach, FL, Naples, FL, and Galveston, TX, and in Florida Bay near Key West, FL. In most cases (excluding sets fished near Galveston, TX), hook timers were deployed on the gangions with each hook, so that the actual time each shark was hooked before capture was known. Relatively short soak times were used in order to land live animals for tagging, with the result that the majority of hook times are under three hours.

A total of 25 tags were deployed and data recovered from Scalloped Hammerheads (Table 2), while 20 were deployed and recovered from Great Hammerheads (Table 3). Great Hammerheads appeared much more vulnerable to the stress of longline capture, with a post-release mortality rate of 45% compared to a post-release mortality rate of 8% for Scalloped Hammerheads (Table 1). The likelihood of mortality did not strongly correlate with hook time in Great Hammerheads, with animals hooked for as little as 22 minutes succumbing to the effects of capture stress, while the two individuals hooked for over three hours survived the capture process. Unfortunately, hook times were not available for the two Scalloped Hammerheads that died after release, although the sets that these individuals were caught in were soaked for 4:48 (2016-05-18_AO1) and 1:59 (2018-09-22_176512).

Since the PSATs used in this study did not transmit light or temperature data, it is possible that some PSAT animals could have died and been scavenged, but falsely interpreted as survivors, with two extreme examples noted with asterisks in Table 2. Double-tagging ten animals with PSATs and ADL tags revealed three cases (out of N=10) in which the satellite tag indicated the animal survived when the more fine-scale ADL data indicated that it had likely died and been consumed by another predator. If light or temperature data had been available from the PSATs, this could've provided additional clarity on animal fate. Still, considering consistent depth data for 6-8 days in these two animals before abrupt pattern changes, we believe it is most likely that they survived.

Table 1:

Species	Number tagged (with data recovered)	PCL range (cm)	Hook time range	PRM rate
Sphyrna lewini	25	94 – 170	0:06 – 2:08	8%
Sphyrna mokarran	20	139 – 244	0:22 – 3:23	45%

Table 2: Tagging metadata and post-release outcomes for all Scalloped Hammerheads (*Sphyrna lewini*) caught during sampling.

Date	Location	Water temp	Hook time	Sex	PCL	Tag type	Tag ID	Outcome
2014-10-14	Florida Bay	29.22	2:20	M	135			At-vessel mortality
2015-12-11	GoM: Madeira Beach	21.2	6:22	M	161			At-vessel mortality
2016-05-18	GoM: Madeira Beach	26.5	3:14	M	101			At-vessel mortality
2017-04-26	GoM: Madeira Beach	24.4	2:41	M	154			At-vessel mortality
2018-05-17	GoM: Madeira Beach	25.1	1:23	M	133			At-vessel mortality
2014-10-13	Florida Bay	29.22	1:47	M	158	ADL	GS3	Survivor
2015-12-11	GoM: Madeira Beach	21.2	0:25	M	152	ADL	RK25	Survivor
2015-12-11	GoM: Madeira Beach	21.2	1:40	M	170	ADL	RK28	Survivor
2016-05-18	GoM: Madeira Beach	26.5	NA	M	129	ADL	AO1	Post-release mortality
2016-05-18	GoM: Madeira Beach	26.5	2:13	M	114	ADL	AO12	Survivor
2017-01-25	Florida Bay	22.15	0:27	M	152	PSAT	167486	Survivor
2017-01-26	Florida Bay	22.4	0:58	F	159	PSAT	167489	Tag reporting error
2017-01-26	Florida Bay	22.4	1:15	F	130	PSAT	167492	Survivor*
2017-01-26	Florida Bay	21.9	2:16	F	118	PSAT	167491	Survivor
2017-01-26	Florida Bay	21.9	1:56	M	142	PSAT	167487	Survivor*
2017-01-27	Florida Bay	21.9	0:06	F	97	PSAT	167483	Survivor
2017-01-27	Florida Bay	21.9	1:48	M	154	PSAT	167484	Survivor
2017-04-26	GoM: Madeira Beach	24.4	0:37	M	112	ADL	RK19	Survivor
2017-05-22	GoM: Madeira Beach	28.45	2:04	M	107	ADL	RK26	Survivor
2017-05-22	GoM: Madeira Beach	28.45	0:10	M	109	ADL	RK29	Survivor
2017-05-22	GoM: Madeira Beach	28.45	2:26	M	110	ADL	AO1	Survivor
2018-04-14	Florida Bay	23.3	0:54	F	112	PSAT	167488	Did not report
2018-04-24	GoM: Madeira Beach	24.06	2:08	M	170	ADL+PSAT	RK19/174469	Survivor
2018-05-14	GoM: Madeira Beach	25.1	0:06	M	167	ADL+PSAT	RK9/174468	Survivor
2018-05-14	GoM: Madeira Beach	25.1	2:18	M	124	ADL+PSAT	AO13/174461	Survivor
2018-05-14	GoM: Madeira Beach	25.1	2:07	M	132	ADL+PSAT	RK29/174464	Survivor
2018-05-14	GoM: Madeira Beach	25.1	0:33	M	145	ADL+PSAT	AO3/174466	Survivor
2018-05-17	GoM: Madeira Beach	25.1	1:52	M	153	ADL	CFW1	Survivor
2018-07-28	Florida Bay	22.66	0:25	M	137	PSAT	167490	Survivor
2018-09-20	GoM: Galveston		NA	M	139	PSAT	176514	Survivor
2018-09-22	GoM: Galveston		NA	M	162	PSAT	176512	Post-release mortality
2019-07-08	Florida Bay	30.4	NA	M	94	PSAT	167485	Did not report

* These two animals showed changes in depth (using exclusively shallower areas) after 6-8 days post-release that could indicate a predation event with the predator inhabiting the shallow depths, but there are no light or temperature data available to help determine this and thus these have been labelled as Survivors in the absence of more detailed information.

Table 3: Tagging metadata and post-release outcomes for all Great Hammerheads (*Sphyrna mokarran*) tagged during sampling.

Date	Location	Water temp	Hook time	Sex	PCL	Tag type	Tag ID	Outcome
2014-05-14	Offshore Key West	27.2	2:18	F	199			At-vessel mortality
2014-07-09	GoM: Madeira Beach	29.78	2:22	F	177			At-vessel mortality
2015-04-08	GoM: Madeira Beach	23.6	8:58	F	159			At-vessel mortality
2015-08-20	GoM: Madeira Beach	31.04	NA	M	148			At-vessel mortality
2015-08-20	GoM: Madeira Beach	31.04	2:32		NA			At-vessel mortality
2015-08-21	GoM: Madeira Beach	31.04	1:49		NA			At-vessel mortality
2017-11-28	GoM: Naples	23.5	2:38		NA			At-vessel mortality
2018-05-16	GoM: Madeira Beach	25.1	NA	M	133			At-vessel mortality
2015-07-09	GoM: Madeira Beach	31.25	0:22	F	207	ADL	GWS10	Post-release mortality
2015-07-09	GoM: Madeira Beach	31.25	3:20	M	141	ADL	RK14	Survivor
2015-07-10	GoM: Madeira Beach	31.25	0:23	F	158	ADL	RK17	Survivor
2015-08-20	GoM: Madeira Beach	31.04	1:09	F	175	ADL	GS3	Post-release mortality
2015-08-20	GoM: Madeira Beach	31.04	1:41	F	155	ADL	GS5	Post-release mortality
2016-05-16	GoM: Madeira Beach	26.5	2:06	F	200	ADL	RK14	Survivor
2016-05-17	GoM: Madeira Beach	26.5	2:27	M	179	ADL	RK25	Post-release mortality
2016-05-18	GoM: Madeira Beach	26.5	3:23	F	172	ADL	AO9	Survivor
2017-04-27	GoM: Madeira Beach	24.4	1:46	F	169	ADL	RK21	Post-release mortality
2017-04-27	GoM: Madeira Beach	24.4	1:30	F	159	ADL	RK22	Survivor
2017-05-23	GoM: Madeira Beach	28.45	2:47	F	244	ADL	RK18	Post-release mortality
2017-11-29	GoM: Naples	23.5	1:18	F	144	ADL	A03	Survivor
2018-04-24	GoM: Madeira Beach	24.06	1:41	F	169	ADL+PSAT	RK9/174467	Post-release mortality
2018-04-25	GoM: Madeira Beach	24.06	1:30	M	173	ADL+PSAT	RK26/174470	Survivor
2018-05-14	GoM: Madeira Beach	25.1	NA	M	139	ADL+PSAT	RK28/174463	Post-release mortality
2018-05-14	GoM: Madeira Beach	25.1	1:35	F	173	ADL+PSAT	RK2/174462	Post-release mortality
2018-05-14	GoM: Madeira Beach	25.1	1:01	M	159	ADL+PSAT	AO4/174465	Survivor
2018-05-17	GoM: Madeira Beach	25.1	2:18	M	149	ADL	CFW2	Survivor
2018-09-19	GoM: Galveston		NA	F	168	PSAT	176513	Survivor
2018-09-24	GoM: Galveston		NA	F	189	PSAT	176511	Survivor