SEDAR65-RD20 - An Updated Literature Review of Post-release Live-discard Mortality Rate Estimates in Sharks for use in SEDAR 65

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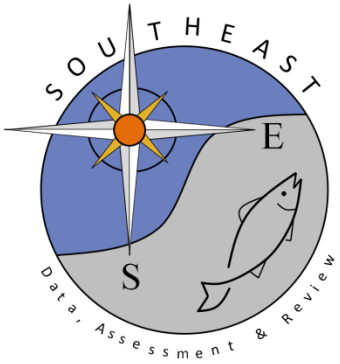
SEDAR77-RD41

Received: 9/23/2021



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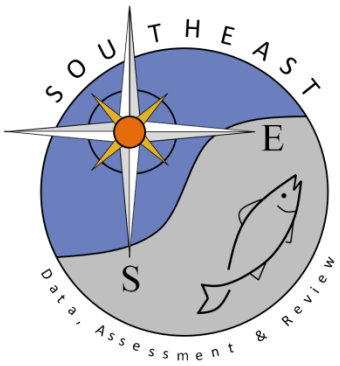
SEDAR65-DW20

recieved: 11/1/19
Revised: 12/4/19



Please cite this document as:

Courtney, Dean and Alyssa Mathers. 2019. An Updated Literature Review of Post-release Live-discard Mortality Rate Estimates in Sharks for use in SEDAR 65. SEDAR65-DW20. SEDAR, North Charleston, SC. 20 pp.

An Updated Literature Review of Post-release Live-discard Mortality Rate Estimates in Sharks for use in SEDAR 65

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December, 2019

SUMMARY

This working paper summarizes literature reviewed for estimates of delayed discard-mortality rates (M_D) in sharks (Tables 1 – 3), and identifies those available for blacktip sharks (*Carcharhinus limbatus*). Estimates of immediate (i.e. at-vessel or acute) discard-mortality rates (M_A) are also identified. Previous SEDAR shark Assessment Process (AP) and Data Workshop (DW) post-release live-discard mortality (PRLDM) rate decisions are provided in Table 4.

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Table 1. Literature reviewed for post-release live-discard mortality (PRLDM) rate estimates.

Primary Literature	Species		Gear type					Study type				Notes
	Blacktip	Other	Pelagic longline	Demersal longline	Hook and Line	Gillnet	Trawl	Physi-ological	Electronic tagging	Lab.	Other	
Longline (pelagic)												
Bromhead et al. (2012)		Pelagic sharks - Tropical Pacific	X								Commercial fisheries research	GAM analysis of factors influencing catch rates
Campana et al. (2016)		Blue, porbeagle, shortfin mako	X						X		Observer data	At-vessel mortality and PRLDM
Campana et al. (2009a, 2009b)		Blue	X						X			PRLDM
Coelho et al. (2012)		Pelagic sharks - Atlantic	X								Observer data	At-vessel mortality rate models GLM and GAM
Coelho et al. (2013)		Blue	X								Observer data	At-vessel mortality rate models GLM and GEE
Dapp et al. (2016a)		Bronze whaler	X	X				X			Research longline	At-vessel mortality
Dapp et al. (2016b)		Blue and tiger	X								Commercial logbook	At-vessel mortality
Diaz (2011)	X	Many	X								Observer data	At-vessel mortality
Gallagher et al. (2014a)		Pelagic sharks - Atlantic	X								Observer data	At-vessel mortality - logistic regression, integrated with reproductive potential
Moyes et al. (2006)		Blue	X					X	X			PRLDM
Musyl et al. (2009)		Blue	X					X	X			PRLDM
Musyl et al. (2011)		Blue, mako, others	X						X		Meta-analysis	PRLDM

Table 1. Continued.

Primary Literature	Species		Gear type					Study type				Notes
	Blacktip	Other	Pelagic longline	Demersal longline	Hook and Line	Gillnet	Trawl	Physi-ological	Electronic tagging	Lab.	Other	
Longline (demersal)												
Afonso and Hazin (2014)		Tiger		X						X		PRLDM
Brooks et al. (2015)		Deep-water elasmobranch assemblage - Bahamas		X						X	Research longline	At-vessel mortality and PRLDM
Butcher et al. (2015)	X	Many		X				X			Commercial fisheries research	At-vessel mortality, stress response
Gallagher et al. (2014b)	X	5 species of coastal sharks						X		X	Drum-line	PRLDM, stress response
Gallagher et al. (2017)	X	Blacktip, nurse, tiger		X							Drum-line	Behavioral response to capture measured with accelerometers attached to the fishing gear
Gulak et al. (2015)	X	Many		X							Commercial fisheries research	At-vessel mortality
Marshall et al. (2015)		Dusky, sandbar		X						X	Commercial fisheries research	At-vessel mortality, PRLDM
Morgan and Burges (2007)	X	Many		X							Observer data	At-vessel mortality
Morgan and Carlson (2010)	X	Many		X							Research/ commercial longline	At-vessel mortality
Morgan et al. (2010)	X	Many		X							Observer data	Bycatch composition
Rogers et al. (2017)		School shark		X						X	PAT	PRLDM

Table 1. Continued.

Primary Literature	Species		Gear type					Study type				Notes
	Blacktip	Other	Pelagic longline	Demersal longline	Hook and Line	Gillnet	Trawl	Physi-ological	Electronic tagging	Lab.	Other	
Hook and line												
Bullock et al. (2015)		Lemon			X					X	Net pen	Post-release behavior of tagged sharks in net pens and in situ
Danylchuk et al. (2014)		Lemon (majority neonate)			X			X		X	Reflex indices	PRLDM - 15 min. Not clear how sharks were tracked
French et al. (2015)		Shortfin mako			X			X		X	sPAT	PRLDM
Gurshin and Szedlmayer (2004)		Atlantic sharpnose			X					X		PRLDM
Heberer et al. (2010)		Common thresher			X			X		X	PSAT	PRLDM
Heupel and Simpfendorfer (2002)	X	Blacktip			X					X		PRLDM
Holland et al. (1999)		Tiger			X					X		Movement rates
Holts and Bedford (1993)		Shortfin mako			X					X		Movement rates
Mandelman and Farrington (2007a)		Spiny dogfish			X		X				Captured and held in net-pen (72 hrs.)	PRLDM
Sepulveda et al. (2015)		Common thresher			X						PSAT	PRLDM
Whitney et al. (2016 and 2017)	X	Blacktip			X					X		PRLDM

Table 1. Continued.

Primary Literature	Species		Gear type					Study type				Notes
	Blacktip	Other	Pelagic longline	Demersal longline	Hook and Line	Gillnet	Trawl	Physi-ological	Electronic tagging	Lab.	Other	
Gillnet												
Bell and Lyle (2016)		Australian swellshark (*Cephaloscyllium laticeps*)				X					Tank trials	PRLDM
Braccini et al. (2012)		Many species				X					Risk assessment	Post Capture Survival (PCS)
Francis (1989)						X	X				Large scale tagging study	Noted that recapture rates were lower for trawl than set-net
Hueter and Manire (1994)	X	Many				X				X	Tagging study	PRLDM
Hueter et al. (2006)	X	Bonnethead and Blacktip				X						PRLDM
Rulifson (2007)		Spiny dogfish				X	X				Captured and held in net-pen (48 hrs.)	PRLDM
Thorpe and Frierson (2009)	X	Many species				X					Bycatch mitigation	At-vessel mortality
Trawl												
Stobutzki et al. (2002)		Many species					X					At-vessel mortality
Purse seine												
Eddy et al. (2016)		Silky, scalloped hammerhead								X	Tuna purse seine around FAD	At-vessel mortality, PRLDM
Hutchinson et al. (2015)		Silky						X		X	Tuna purse seine	At-vessel mortality, PRLDM
Poisson et al. (2014)		Silky								X	Tuna purse seine	At-vessel mortality, PRLDM

Table 1. Continued.

Primary Literature	Species		Gear type					Study type				Notes
	Blacktip	Other	Pelagic longline	Demersal longline	Hook and Line	Gillnet	Trawl	Physi-ological	Electronic tagging	Lab.	Other	
Physiology												
Barham and Schwartz (1992)											X	
Brooks et al. (2011)		Lemon						X			X	
Brooks et al. (2012)		Caribbean reef		mid-water longlines				X				
Cain et al. (2004)		Southern stingray					X	X				
Cicia et al. (2012)		Skates						X			X	Aerial exposure and acute thermal stress
Cliff and Thurman (1984)		Dusky			X			X				
Frick et al. (2009)		Benthic sharks				X		X			X	
Frick et al. (2010a)		Benthic sharks		X		X		X			X	
Frick et al. (2010b)		Benthic sharks					X	X			X	
Frick et al. (2012)		Benthic sharks				X		X			X	
Hight et al. (2007)		Pelagic sharks	X		X			X				
Hoffmayer and Parsons (2001)		Atlantic sharpnose			X			X				
Hoffmayer et al. (2012)		Atlantic sharpnose			X			X				Seasonal component
Hyatt et al. (2016)		Bonnethead, bull				X		X				behavioral release condition score (BRCS)
Hyatt et al. (2012)		Bonnethead, bull, lemon						X				Stress response
Mandelman and Farrington (2007b)		Spiny dogfish					X	X				
Mandelman and Skomal (2009)	X	Carcharhinid sharks		X				X				Stress response
Marshall et al. (2012)	X	Eleven pelagic and coastal species	X	X				X				Stress response
Manire et al. (2001)	X	Bonnethead, blacktip, bull				X		X				Behavioral and serological response
Skomal (2007)		pelagic species						X		X		Review article
Skomal and Mandelman (2012)		Many species						X				Review article

Table 1. Continued.

Primary Literature	Species		Gear type					Study type				Notes
	Blacktip	Other	Pelagic longline	Demersal longline	Hook and Line	Gillnet	Trawl	Physi-ological	Electronic tagging	Lab.	Other	
General review												
Dapp et al. (2016c)	X	Many									Meta-analysis	Reviews published results of PRLDM and at-vessel-mortality
Ellis et al. (2017)	X	Many									Review article	Reviews published results of PRLDM and at-vessel-mortality
Godin et al. (2012)		Pelagic sharks	X								Review	meta-analysis and analysis of covariance to test the effects of circle hooks on catchability and at-vessel mortality rates
Musyl and Gilman (2019)		Pelagic									Meta-analysis	
Oliver et al. (2015)	X	Many									Review article	Reviews published results of PRLDM and at-vessel-mortality
Poisson et al. (2016)	X	Many	X								Review article	bycatch-mitigation
Raby et al. (2013)											Review	
Renshaw et al. (2012)		Many species						X			Review article	
Worm et al. (2013)											Review	PRLDM pelagic longline
Government report												
Campana et al. (2011)		Blue, porbeagle, shortfin mako	X								Review	Estimation of bycatch mortality in Canadian pelagic longline
Clarke (2011)		Pelagic sharks									Review report	Status of sharks WCPFC
McLoughlin and Eliason (2008)		Many species			X						Review report	
Non-governmental agency(NGO) report												
Clarke et al. (2013)		Many species									Review report	Studies of mortality to Sharks
Cosandey-Godin and Morgan (2011)	X	Many species									Review report	Fisheries bycatch of sharks

Table 2. Delayed discard-mortality rates, M_D, by gear type obtained from a review of the primary scientific literature (Table 1).

	Species				
Gear/Source	Blacktip	genus	Other species	Delayed discard mortality rate (M_D)	Notes
Longline (pelagic)					
Campana et al. (2016)			Blue, porbeagle, shortfin mako	9.8% (s.e. = 4.7%); 27.2% (s.e. = 12%); 31.3% (s.e. = 18%)	Tagged injured and healthy animals with PRLDM expanded by the proportion of each category observed in the fishery. Authors indicate that the blue shark estimate is likely a minimum estimate.
Campana et al. (2011)			Blue	19%	Estimation of blue shark total bycatch mortality in pelagic longline fisheries based on PRLDM of 19% citing Campana et al. (2009b)
Campana et al. (2009b)			Blue	19%* (10 – 29%)	Tagged both injured and healthy animals; Range is 95% confidence interval.
Musyl et al. (2011)			Blue shark	15% (8.5 – 25.1%)	Meta-analysis; Range is 95% confidence interval.
Worm et al. (2013)			All sharks	15%	Assumed 15% post-release mortality of all sharks released alive based on PRLDM of pelagic sharks from Campana et al. (2011) and Musyl et al. (2011).
Longline (demersal)					
Brooks et al. (2015)			Deep-water elasmobranch assemblage - Bahamas	NA	16 PSATs deployed, only two reported via the Argos system. Consequently, the exact proportion of PRLDM by species is unknown.
Afonso and Hazin (2014)			Tiger	0%	Tiger sharks (19) captured with demersal longline, tagged with PSAT, and tracked for up to 30 days
Frick et al. (2010a)			Mustelus sp	Average within captive lab study of 8%	The average delayed mortality (M_D, up to 72 hr. after treatment) for *M. antarcticus* captured in longlines under laboratory conditions (8.3%) was calculated here from simulated longline fishing under laboratory conditions for 30 min (M_D = 12.5%), 120 min (M_D = 12.5%), and 360 min (M_D = 0.0%); May not reflect commercial fishery.
Gallagher et al. (2014b)			5 species of coastal sharks	Tiger (0%), bull (25.9%, and great hammerhead (42.9%)	Gallagher et al. (2014b) noted that the use of research drum-lines with long gangions (23m) may have allowed for a higher potential for ram-ventilating than in other studies (citing Brooks et al. 2012).
Marshall et al. (2015)			Dusky, sandbar	29% (Dusky) 20% (Sandbar)	Dusky sharks exhibited 29% (n = 6) post-release mortality, with 11% of sharks dying after time-on-the-line ≤3-hours and 42% >3-hours; Sandbar sharks exhibited 20% (n = 2) post-release mortality, with 100% survival if captured up to 3 h on the longline, but showing mortalities at ~7–8 h.
Rogers et al. (2017)			School shark	0%	All (10) satellite tags released prematurely and tag retention periods ranged between 5 and 44 days (average = 24 ± 13.7 d). Tags were deployed on uninjured sharks.

Table 2. Continued.

	Species				
Gear/Source	Blacktip	genus	Other species	Delayed discard mortality rate (M_D)	Notes
Hook and line					
Bullock et al. (2015)			Lemon	0%	Post-release behavior of tagged sharks in net pens and in situ
Danylchuk et al. (2014)			Lemon (majority neonate)	12.5%	Four sharks (12.5%) died following release during the 15 min tracking period following catch-and release angling. Not clear how sharks were tracked.
French et al. (2015)			Shortfin mako	10% (3 – 20%)	Three mortalities (10%) were observed after 30 days at liberty. All mortalities occurred within 24 h of release. Range is 95% confidence interval obtained from the program Release Mortality version 1.1.0 developed by Goodyear (2002) as described by Kerstetter and Graves (2006)
Gurshin and Szedlmayer (2004)			Atlantic sharpnose	10%*	Tagged both injured and healthy animals (n = 10).
Heberer et al. (2010)			Common thresher	26%	Five mortalities (26%) were observed over 10 day PSAT deployment.
Heupel and Simpfendorfer (2002)	X	*C. limbatus*		About 5%	Five of 92 sharks died within 24 hrs. of release; May reflect stress from anesthetic, tagging and resuscitation, as well as hook and line capture.
Holts and Bedford (1993)			Shortfin mako	0%	Tagged large healthy sharks (n = 3).
Mandelman and Farrington (2007a)			Spiny dogfish	24 ± 6% (mean ± S.D.)	Five squid-baited standard circle hooks hung in the water-column and retrieved in 3 min; Mandelman and Farrington (2007a) concluded that the M_D estimate reflected both the stress of hook and line capture plus the additional stress of being held in a net-pen after capture (72 hrs.).
Sepulveda et al. (2015)			Common thresher	78% (with trailing tail hook gear) 0% (with mouth hook and release)	Six mortalities within 5 days and one mortality after 81 days (78%) with trailing tail hook gear. No mouth-hooked mortalities (n=7) within 10 days.
Whitney et al. (2016 and 2017)	X	*C. limbatus*		9.7%	(Whitney et al. 2016 and 2017) used acceleration data loggers (ADLs) for blacktip sharks (n=31) caught on rod and reel by recreational fishermen. Mortalities (n=3; 9.7%) all occurred within 2 h after release.

* Previous SEDAR AP panels considered the delayed discard mortality rate estimates, M_D, provided by Campana et al. (2009b) and by Gurshin and Szedlmayer (2004) to be the best available estimates for post-release live-discard mortality, PRLDM, in pelagic longlines and hook and line, respectively, because both studies included injured as well as healthy animals (NMFS 2012, 2013a, 2013b).

Goodyear CP (2002) Factors affecting robust estimates of the catch-and-release mortality using pop-off tag technology. In Lucy JA, Studholme AL, eds, Catch and Release in Marine Recreational Fisheries. American Fisheries Society, Bethesda, MD, USA, pp 172–179.

Kerstetter DW, Graves JE (2006) Survival of white marlin (Tetrapturus albidus) released from commercial pelagic longline gear in the western North Atlantic. Fish B-NOAA 104: 434–444.

Table 2. Continued.

	Species				
Gear/Source	Blacktip.	Genus	Other species	Delayed discard mortality rate (M_D)	Notes
Gillnet					
Bell and Lyle (2016)			Australian swellshark (*Cephaloscyllium laticeps*)	0%	Tank trial mortality up to 3 days post capture (n = 39 condition 1 and n = 32 condition 2)
Braccini et al. (2012)			*Mustelus antarcticus*	Average risk analysis result of 36.2%	The average risk of delayed PCS of *M. antarcticus* in a southern Australia commercial gillnet shark fishery (S_D = 63.8%, n = 3,726) was obtained from Braccini et al. (2012 their Table 2); PRLDM was then calculated as $M_D = (1- S_D)$ = 36.2%.
Frick et al. (2010a)			*Mustelus antarcticus*	Average within captive lab study of 31%	The average delayed mortality (M_D, up to 72 hr. after treatment) for *M. antarcticus* captured in gillnets under laboratory conditions (30.7%) was calculated here from gillnet fishing under laboratory conditions for 30 min (M_D = 70%), 120 min (M_D = 0%), and 180 min (M_D = 22%); May not reflect commercial fishery.
Frick (2012)			*Mustelus antarcticus*	Average within captive lab study of 6.5% (2/31 = 0.065)	The average delayed mortality (M_D, up to 72 hr. after treatment) for *M. antarcticus* captured in gillnets under laboratory conditions was calculated here from simulated gillnet fishing under laboratory conditions for 60 min; May not reflect commercial fishery.
Hueter and Manire (1994)	X		Coastal sharks	34.8%	Tag return data was used to estimate delayed mortality for all juvenile and small adult sharks, combined, captured with research gillnets in Florida Gulf Coast estuaries.
Hueter et al. (2006)	X		Blacktip Bonnethead	31% (blacktip); 40% (bonnethead)	Juvenile and small adult sharks captured with research gillnets in Florida estuaries.
Rulifson (2007)			Spiny dogfish	33%	Held in net-pen after capture (48 hrs. North Carolina).

Table 2. Continued.

	Species				
Gear/Source	Blacktip	Genus	Other species	Delayed discard mortality rate (M_D)	Notes
Trawl					
Francis (1989)			*Mustelus lenticulatus*	NA	Francis (1989) noted that reported recapture rates of trawl-tagged rig, *M. lenticulatus,* were lower than those of set-net tagged *M. lenticulatus,* suggesting that delayed mortality of *M. lenticulatus* was higher in trawls than set-nets.
Frick et al. (2010b)			*Mustelus antarcticus*	Average within captive lab study of 27%	The average delayed mortality (M_D, up to 72 hr. after treatment) for *M. antarcticus* captured in trawl-nets under laboratory conditions (26.9%) was calculated here from simulated trawl-net fishing under laboratory conditions for 30 min (M_D = 37.5%), 60 min (M_D = 0.0%), 120 min (M_D = 85.7%), 60 min + air (M_D = 0.0%), and 60 min + crowding (M_D = 11.1%); May not reflect commercial fishery.
Mandelman and Farrington (2007a)			Spiny dogfish	29 ± 12% (mean ± S.D.)	Mandelman and Farrington (2007a) concluded that post-release mortality was significantly affected by the weight of the trawl catch and also likely reflected both the stress of trawl capture plus the additional stress of being held in a net-pen after capture (72 hrs.).
Rulifson (2007)			Spiny dogfish	0%	Held in net-pen after capture (48 hrs.); Rulifson (2007) noted that the research trawl used in this study were probably not comparable to commercial trawls – especially large New England trawl gear.
Purse seine					
Eddy et al. (2016)			Silky, scalloped hammerhead	62%, 100%	Eight silky sharks (62 %) showed evidence of post-release mortality and three scalloped hammerhead (100%) showed evidence of immediate post-release mortality.
Hutchinson et al. (2015)			Silky	36%	Percentage of satellite tagged sharks that died after being released alive (tag deployment ≥10 d, n = 9) and those that died post release (0−9 d, n = 5). However, total mortality (at-vessel plus live post release) was much higher (84.2%).
Poisson et al. (2014)			Silky	48% (brailed) 0% (entangled)	Percentage of satellite tagged sharks that died after being released alive. However, total mortality (at-vessel plus live post release) was much higher (81%).

Table 3. Delayed discard-mortality rates, M_D, by gear type obtained from primary scientific literature reviews (Panel A) and meta-analyses (Panel B).

A

	Species				
Gear/Source	Blacktip.	genus	Other species	Delayed discard mortality rate (M_D)	Notes
Reviews					
Dapp et al. (2016c)	X	*C. limbatus*	Many	Table S3. Contains published results of post-release and total discard mortality studies on elasmobranchs. e.g., Blacktip Gillnet PRLDM 31% Hueter et al. (2006)	Model predicted mean total discard mortality as combined immediate and post-release mortality to obtain percentages of obligate ram-ventilating elasmobranchs caught in longline, gillnet and trawl gear types as 49.8, 79.0 and 84.2%, respectively, and total discard mortality percentages of stationary-respiring species as 7.2, 25.3, and 41.9%, respectively.
Ellis et al. (2017)	X	*C. limbatus*	Many	e.g., Blacktip Gillnet PRLDM 31% Hueter et al. (2006)	Review published results of PRLDM and at-vessel-mortality
Oliver et al. (2015)	X	*C. limbatus*	Many		Develop global shark bycatch estimates from a literature review of shark bycatch and estimates of post-release mortality
Poisson et al. (2016)	X	*C. limbatus*	Many		Review shark bycatch mitigation measures in pelagic tuna fisheries

B

Meta-analyses					
Musyl and Gilman (2019)					
	Species	Gear	Estimate	LCI	UCI
	Blue shark		0.17	0.107	0.259
	Silky shark	Purse-seine	0.475	0.31	0.645
	Silky shark	Longline	0.164	0.008	0.819
	Common thresher		0.353	0.072	0.793
	Shortfin mako		0.254	0.137	0.42
	Oceanic white-tip		0.163	0.008	0.831
	Bigeye thresher		0.225	0.081	0.49
	Scalloped hammerhead		0.875	0.266	0.993
	Overall		0.268	0.193	0.36
	Species	Condition	Estimate	LCI	UCI
	Pelagic sharks	Healthy	0.199	0.148	0.263
	Pelagic sharks	Unhealthy	0.647	0.507	0.763

Table 4. Previous SEDAR shark post-release live-discard mortality (PRLDM) rate decisions from recent stock assessments.

Working group	Discard mortality rates by gear type: Longline	Hook and line	Gillnet	Trawl
		A. SEDAR 21[1]		
		Sandbar shark		
LH WG	38.24%	3.25%	NA	NA
Catch WG	2% (Pelagic longline); 5% (Bottom longline)	NA	5%	NA
DW*	28.5% (Pelagic longline); 28.5 – 38.0% (Bottom longline)	3.2%	5 – 10%	NA
		Blacknose shark		
LH WG	71.18%	6.6%	NA	67.0%
Catch WG	50% (Bottom longline)	NA	50% (Drift gillnet); 5% (Strike gillnet); 25% (Sink gillnet)	NA
DW*	50 – 71% (Bottom longline)	6.6%	Same as Catch WG	67.0%
		Dusky shark		
LH WG	65.17%	6.0%	NA	NA
Catch WG	5% (Pelagic longline); 35% (Bottom longline)	NA	50%	NA
DW*	44.2% (Pelagic longline); 44.2 – 65% (Bottom longline)	6.0%	50%	NA
		B. SEDAR 29[2]		
		Gulf of Mexico blacktip shark		
	31% (Base)	10% (Base)		
AP *	19 – 73% (Range)	5 – 15% (Range)	31% (Base)	NA
		C. SEDAR 34[3]		
		Atlantic sharpnose shark		
	35% (Base)	10% (Base)	58.5% (Base)	
AP *	19 – 82% (Range)	5 – 15% (Range)	35 – 82% (Range)	NA
		Bonnethead shark		
	40% (Base)	10% (Base)	65.5% (Base)	
AP *	19 – 91% (Range)	5 – 15% (Range)	40 – 91% (Range)	NA
		D. SEDAR 29 Update[4]		
		Gulf of Mexico blacktip shark		
AP *	31% (Base)	9.7% (Base)	31% (Base)	NA
AP *	NA	10 – 19% (Range)	NA	NA

*Final decisions adopted for stock assessment.

[1]SEDAR 21 life history (LH) working group (WG) decisions adopted by NMFS (2011a, 2011b, 2011c, 2011d their sections II Data Workshop Report, sub-section 2.5 Discard Mortality); SEDAR 21 catch WG and final data workshop (DW) panel decisions adopted by NMFS (2011a, 2011b, 2011c, 2011d their sections II Data Workshop Report, sub-section 3.4.2. Post Release Mortality); [2] SEDAR 29 assessment process (AP) decisions adopted by NMFS (2012 their sections 2.2.2.3—Commercial Discards Datasets—and 2.2.2.5—Recreational Discards Datasets and Decisions); [3] SEDAR 34 assessment process (AP) decisions adopted by NMFS (2013a, 2013b their sections 2.2.2.3 and 2.2.2.4); [4] SEDAR 29 update assessment process (AP) decisions adopted by NMFS (2018).