Biological information for most commonly shark species caught in tuna fisheries

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Abstract

This paper presents the biological information for most commonly shark species collated by the EU Projects "Provision of scientific advice for the purpose of the implementation of the EUPOA sharks (MARE/2010/11, 2011-2013) (Murua et al., 2013)" and "Improving scientific advice for the conservation and management of oceanic sharks and rays (SC 01 EASME/EMFF/2016/008, 2016-2018) (Coelho et al., 2018) up to 2018.

The biological information is not up to date but could be used as references for the work of the IOTC Working Party on Ecosystem and Bycatch.

Biological Information

Biological information was collated and summarized for the main shark species caught in large pelagic fisheries of the Atlantic, Indian and Pacific Ocean and Mediterranean Sea. This compilation was carried out preferably to the stock level within each species, in cases where such separation of biological information at the stock level is available. The available literature, as well as manuals and documents, were consulted to obtain the key biological parameters and relationships that are and/or can be used for stock assessment purposes, including age and growth, reproduction, mortality, tagging, and length/weight relationships and other relevant conversion factors.

Data was compiled from the scientific and grey literature, including papers and technical documents presented to the scientific bodies of tuna-RFMOs. The databases from the tuna-RFMOS were also searched.Every piece of information is indexed with number giving the reference. "Other references" mean additional useful references on the biology of the species and the few references that could not be obtained.

Many parameters are lacking; this compilation shows that the biology of the most important pelagic sharks species is largely unknown.

The biological parameters were compiled for the following sharks species:

SHARKS									
FAO code	**Family**	**Scientific name**	**English name**	**French name**	**Spanish name**	**Distribution**			**TL cm**
PTH	Alopiidae	*Alopias pelagicus*	Pelagic thresher	Renard pélagique	Zorro pelagico		Ind.	Pac.	330
BTH	Alopiidae	*Alopias superciliosus*	Bigeye thresher	Renard à gros yeux	Zorro ojon	Atl.	Ind.	Pac.	460
ALV	Alopiidae	*Alopias vulpinus*	Thresher shark	Renard de mer	Zorro	Atl.	Ind.	Pac.	550
FAL	Carcharhinidae	*Carcharhinus falciformis*	Silky shark	Requin soyeux	Tiburón jaquetón	Atl.	Ind.	Pac.	330
OCS	Carcharhinidae	*Carcharhinus longimanus*	Oceanic whitetip shark	Requin océanique	Tiburón oceánico	Atl.	Ind.	Pac.	395

WSH	Lamnidae	*Carcharodon carcharias*	Great white shark	Grand requin blanc	Jaquetón blanco	Atl.	Ind.	Pac.	640
BSK	Lamnidae	*Cetorhinus maximus*	Basking shark	Pélerin	Peregrino	Atl.	Ind.	Pac.	1000
SMA	Lamnidae	*Isurus oxyrinchus*	Shortfin mako	Taupe bleue	Marrajo dientuso	Atl.	Ind.	Pac.	400
LMA	Lamnidae	*Isurus paucus*	Longfin mako	Petite taupe	Marrajo carite	Atl.	Ind.	Pac.	420
POR	Lamnidae	*Lamna nasus*	Porbeagle	Requin-taupe commun	Marrajo sardinero	Atl.	Ind.	Pac.	300
BSH	Carcharhinidae	*Prionace glauca*	Blue shark	Peau bleue	Tiburón azul	Atl.	Ind.	Pac.	380
SPL	Sphyrnidae	*Sphyrna lewini*	Scalloped hammerhead	Requins-marteau halicorne	Cornuda comùn	Atl.	Ind.	Pac.	420
SPK	Sphyrnidae	*Sphyrna mokarran*	Great hammerhad	Grand requin-marteau	Cornuda gigante	Atl.	Ind.	Pac.	610
SPZ	Sphyrnidae	*Sphyrna zyganea*	Smooth hammerhead	Requin-marteau commun	Cornuda cruz	Atl.	Ind.	Pac.	400

Acronyms

TL	Total Length
LF	Fork Length
W	Weight
TW	Total Weight
PCL/PRC	Pre-Caudal Length
$L\infty$	Asymptotic Length or Maximum population length (Von Bertalanffy growth parameters)
k	Growth rate (Von Bertalanffy growth parameters)
t0	Time when the fish has Length = 0 (Von Bertalanffy growth parameters)
% F	Frequency of Occurrence
% N	Percentage in Number
% W	Percentage in Weight
IRI	diet Index of Relative Importance
N^{15}	Stable Isotope of Nitrogen 15
C^{13}	Stable Isotope of Carbon 13

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Table 1. Biological parameters for pelagic thresher (PTH, *Alopias pelagicus*)

Alopias pelagicus *Nakamura, 1935 Pelagic thresher* *FAO code: PTH*	**Atlantic Ocean**	**Ref.**	**Mediterranean Sea**	**Ref.**	**Indian Ocean**	**Ref.**	**West Pacific**	**Ref.**	**East Pacific**	**Ref.**
AGE & GROWTH										
L∞ for female in cm					L∞=362 TL	10	L∞=197 PCL	4		
K for female /year					k=0.13	10	k=0.09	4		
to for female in years						10	t_0=-7.67	4		
L∞ for male in cm					L∞=336 TL	10	L∞=182 PCL	4		
K for male /year					k=0.10	10	k=0.12	4		
to for male in years					Lo=151	10	t_0=-5.48	4		
Longevity in years					25-30 estim. 20-24 obs. male 24-28 obs. female	1-10	20 estim. male 29 estim. female 14 obs. male 16 obs. female	3-4	20 estim. male 29 estim. female	3
Maximum size TL in cm					365 383	1-24 3-5	383	3-4-5	383	3-5
Common size (FL) in cm					120 - 190	1				
Maximum weight in kg										
REPRODUCTION										
Female maturity size in cm					282-292 TL 145-150 SL 280-290 TL	3 24 25	282-292 TL	4	282-292 TL 151 PCL	3-8
Female maturity age in years					8-9 13 8-9 (50%)	1 10 24	8-9	4		
Male maturity size in cm					267-276 TL 220-270 TL 140-145 SL 240-275 TL	3 23 24 25	267-276 TL	4	267-276 TL 144 PCL	3 8
Male maturity age in years					7-8 10 7-8 (50%)	1 10 24	7-8	4		
Birth size TL in cm					130-160 TL up to 190 TL 158-190 TL 130-140 TL	3 24 25	130-160 TL up to 190 TL 158-190 TL 136-142 TL	3 4 8	130-160 TL up to 190 TL	3

Sex ratio					1/1	3	1/1	4	1/1	3
Mode of development					Ovoviviparous	1-2-3	Ovoviviparous	2-3	Ovoviviparous	2-3
Gestation period in months					<12	24			9	8
Spawning & mating periods										
Fecundity: number of embryos per litter					2-4 2 2	1 3 24	2	4	2	3 -8
Nursery ground										
CONVERSION FACTORS										
Length / Weight relationships					$TW=0.001*10^{-4}*FL^{2.15243}$ for males & females	1-24	$W=4.61*10^{-5}*TL^{2.494}$ female $W=3.98*10^{-5}*TL^{2.52}$ males $W+2.5610^{-4}*PCL^{2.511}$ (Lui unpub.)	4-6		
Wet weight / dressed weight ratio										
TL / FL					TL=2*TL	5	TL=2*TL	5	TL=2*TL	5
TL/PCL										
Fins / carcass ratios										
Stables isotopes N^{15} & C^{14}										
POPULATION DYNAMICS										
Stock delineation/range							evidence of separation between East s & West Pac.	19 - 21	evidence of separation between East s & West Pac.	19-21
Natural mortality							0.151 0.132	15 16		
Stepness										
Intrinsic rate of increase (λ or r) ($year^{-1}$)							r=0.041 λ=1.049 λ=1.056-1.066 r=0.055-0.064	15 17 20		
Intrinsic rebound potential ($r_{z(MSY)}$)										
Trophic level										

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Table 2. Biological parameters for bigeye thresher (BTH, *Alopias superciliosus*).

Alopias superciliosus (Lowe, 1839) Bigeye thresher FAO code: BTH	**Atlantic Ocean**	**Ref.**	**Mediter-ranean Sea**	**Ref.**	**Indian Ocean**	**Ref.**	**West Pacific**	**Ref.**	**East Pacific**	**Ref.**
AGE & GROWTH										
L∞ for female in cm	L∞ =284	23					L∞= 224.6	9		
K for female /year	k=0.06	23					k=0.09	9		
to for female in years	L_0=109	23					t_0= -4.21	9		
L∞ for male in cm	L∞=246	23					L∞= 218.8	9		
K for male /year	k=0.09	23					k=0.088	9		
to for male in years	L_0=108 cm	23					t_0= -4.24	9		
Longevity in years	observed: 20-25	2 24	observed: 20	2	observed: 20	2	observed. : 19 (male) observed. : 20 (fem.) estimated : 20-21		observed: 20	2
Maximum size TL in cm	488 461 460.7	2-3 12 15-16	488 461 460.7	2-3 12 15-16	488 461 460.7 461	2-3 12 15-16 23	488 461 460.7	2-3 12 15-16	488 461 460.7	2-3 12 15-16
Common size (FL) in cm										
Maximum weight in kg	363.8	2-3	363.8	2-3	363.8	2-3	363.8	2-3	363.8	2-3
REPRODUCTION										
Female maturity size in cm	294-355 350 206.9 FL 208.6 FL	8 13 14 25	294-355	8	332-355 294-355 310 TL	1-23 8 25	294-355 332-341.1	8 10	294-355	8
Female maturity age in years	12-13	8	12-13	8	12-13	8-23	12-13 12.3-13.4	8 10	12-13	8
Male maturity size in cm	279-300 290-300 159.74 FL 276 159.2	8 13 14 15 25	279-300	8	270-300 279-300 263 TL	1 8 25	279-300 270.1-287.6 TL	8 10	279-300	8
Male maturity age in years	9-10	8	9-10	8	9-10	8-23	9-10 9-10	8 10	9-10	8
Birth size TL in cm	64-106 100-140 100-130 64-105	6 8 12 15 - 17 - 18	64-106 100-140 100-130 64-105	6 8 12 15-17-18	64-140 64-106 100-140 100-130 64-105 118-135 TL	1-23 6 8 12 15-17-18 25	64-106 100-140 135-140 100-130 64-105	6 8 10 12 15-17-18	64-106 100-140 100-130 64-105	6 8 12 15-17-18

Sex ratio	1:1 1.52:1	8 14	1:1	8	1:1	8	1:1	8-10	1:1	8
Mode of development	Ovoviviparous	8-18	Ovoviviparous	8-18	Ovoviviparous	8-18-23	0ovoviviparous	8-18	Ovoviviparous	8-18
Gestation period in months	12	8-18	12	8	12	1-8-23	12	8	12	8
Spawning & mating periods										
Fecundity: number of embryos per litter	2-4 2 2-4	6 15 - 19 15	2-4	6-15	2 2-4	1-26 6-23	2-4 2	6 10	2-4	6
Nursery ground	Strait of Gibraltar	8								
CONVERSION FACTORS										
Length / Weight relationships	$W=9.1069*10^{-6}*TL^{3.0802}$ $W=1.02*10^{-5}*TL^{2.78}$ (females) $W=3.73*10^{-5}*TL^{2.57}$ (males) $W=0.1825*10^{-5}*TL^{3.448534}$	7-8 8 20 - 19	$W=1.02*10^{-5}*TL^{2.78}$ (females) $W=3.73*10^{-5}*TL^{2.57}$ (males)	8	$PT=0.155*10^{-4}*FL^{2.97883}$ $W=1.02*10^{-5}*TL^{2.78}$ (females) $W=3.73*10^{-5}*TL^{2.57}$ (males)	1-23 8	$W=1.02*10^{-5}*TL^{2.78}$ (females) $W=3.73*10^{-5}*TL^{L2.57}$ (males)	8	$W=1.02*10^{-5}*TL^{2.78}$ (females) $W=3.73*10^{-5}*TL^{2.57}$ (males)	8
Wet weight / dressed weight ratio										
TL / FL	LF=0.5598*TL+17.666 TL=1.775*FL-13.007	7-8 11	LF=0.5598*TL+17.666	8	LF=0.5598*TL+17.666	8	TL=13.3.1.69*FL (females) TL=26.3+1.56*FL (males) LF=0.5598*TL+17.666	9 8	LF=0.5598*TL+17.666	8
TL/PCL							TL=15.3+1.81*PCL (females) TL=15.1+1.76*PCL (males)	9		
Fins / carcass ratios										
Stables isotopes N^{15} & C^{14}										
POPULATION DYNAMICS										
Stock delineation/range										
Natural mortality										
Stepness										
Intrinsic rate of increase (λ or r) ($year^{-1}$)										
Intrinsic rebound potential ($r_{z(MSY)}$)					0.002-0.009	23				
Trophic level	4.2	5	4.2	5	4.2	5	4.2	5	4.2	5

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Table 3. Biological parameters for common thresher (ALV, *Alopias vulpinus*).

Alopias vulpinus (Bonnaterre, 1788) Thresher shark FAO code: ALV	**Atlantic Ocean**	**Ref.**	**Mediter-ranean Sea**	**Ref.**	**Indian Ocean**	**Ref.**	**West Pacific**	**Ref.**	**East Pacific**	**Ref.**
AGE & GROWTH										
L∞ for female in cm	L∞=275.5 FL	23							L∞=636 L∞=465	3 4
K for female /year	k=0.09	23							k=0.158 k=0.129	3 4
t_o for female in years									t_0=1.021 t_0=-2.88	3 4
L∞ for male in cm	L∞=225.4 FL	23							L∞=492.7 L∞=465	3 4
K for male /year	k=0.17	23							k=0.215 k=0.129	3 4
t_o for male in years									t_0=1.416 t_0=-2.88	3 4
Longevity in years	45-50 estimated males 22 females 24	7 23 23	45-50 estimated	7	45-50 estimated	7	45-50 estimated	7	45-50 estimated 25 females	7 4
Maximum size TL in cm	760 610	1-3-7 3	760 610	1-3-7 3	760 610	1-3-7 3	760 610	1-3-7 3	760 610 573	1-3-7 3 3
Common size (FL) in cm										
Maximum weight in kg	348	1-2	348	1-2	348	1-2	348	1-2	348	1-2
REPRODUCTION										
Female maturity size in cm	226 FL 315-400 260-426.7 426.7 208-224 FL	5 7 9 17 22	315-400 260-426.7	7 9	315-400 260-426.7 260-330	7 9 11 - 12	315-400 260-426.7 315	7 9 16	315-400 260-426.7 260-315 303 315	7 9 3 4 4-16
Female maturity age in years	3-8 3-9	7 9	3-8 3-9	7 9	3-8 3-9	7 9	3-8 3-9	7 9	3-4 3-8 3-9 5.3	3 7 9 4
Male maturity size in cm	184 FL >152 260-426.7 181-198 FL	5 7 9 22	>252 260-426.7	7 9	>252 260-426.7	7 9	>252 260-426.7	7 9	333 >252 260-426.7 303	3 7 9 4
Male maturity age in years	3-8 3-7	7 9	3-8 3-7	7 9	3-8 3-7	7 9	3-8 3-7	7 9	7 3-8 3-7 4.8	3 7 9 4

Birth size TL in cm	117-150 114-160 100-158	3 7 9	117-150 114-160 100-158	3 7 9	117-150 114-160 100-158 149	3 7 9 11 - 12	117-150 114-160 100-158	3 7 9	158 estimated 117- 150 114-160 100-158	3 3 7 9
Sex ratio										
Mode of development	ovoviviparous	6	ovoviviparous	6	ovoviviparous	6	ovoviviparous	6	ovoviviparous	6
Gestation period in months	9	9	9	9	9	9	9	9	9	9
Spawning & mating periods	Summer / Spring	9			Spring / Summer	10 - 11 - 12			Summer / Spring	7-9
Fecundity: number of embryos per litter	3-7	9- 22	2-4	6- 7	2-4	6- 7	2-4	6- 7	2- 4 up to 6	6-7 7
Nursery ground	Apparently uses inshore nursery areas in temperate waters	7	Apparently uses inshore nursery areas in temperate waters	7	Apparently uses inshore nursery areas in temperate waters	7	Apparently uses inshore nursery areas in temperate waters	7	Apparently uses inshore nursery areas in temperate waters	7
CONVERSION FACTORS										
Length / Weight relationships	$W= 1.8821*10^{-4}*FL^{2.5188}$	5- 7	$W= 1.8821*10^{-4}*FL^{2.5188}$ $W= 1.5*10^{-5}LT^{2.70}$	5- 7 18	$W= 1.8821*10^{-4}*FL^{2.5188}$	5- 7	$W= 1.8821*10^{-4}*FL^{2.5188}$	5- 7	$W= 1.8821*10^{-4}*FL^{2.5188}$	5-7
Wet weight / dressed weight ratio										
TL / FL	FL=0.5474*TL + 7.0262	5- 7	FL=0.5474*TL+ 7.0262	5- 7	FL=0.5474*TL+ 7.0262	5- 7	FL=0.5474*TL+ 7.0262	5- 7	FL=0.5474*TL+ 7.0262	5-7
TL/PCL										
Fins / carcass ratios	2.06	20								
Stables isotopes N15 & C14										
POPULATION DYNAMICS										
Stock delineation/range										
Natural mortality										
Stepness										
Intrinsic rate of increase (λ or r) ($year^{-1}$)										
Intrinsic rebound potential ($r_{z(MSY)}$)										
Trophic level	4.2	8	4.2	8	4.2	8	4.2	8	4.2	8

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Table 4. Biological parameters for silky shark (FAL, *Carcharhinus falciformis*).

Carcharhinus falciformis (Bibron in Müller & Henle, 1839) Silky shark FAO code: FAL	**Atlantic Ocean**	**Ref.**	**Mediter-ranean Sea**	**Ref.**	**Indian Ocean**	**Ref.**	**West Pacific**	**Ref.**	**East Pacific**	**Ref.**
AGE & GROWTH										
L∞ for female in cm	L∞=291	5			L∞=320.4	13	L∞=332	6		
K for female /year	k=0.153	5			k=0.057	13	k=0.0838	6		
t_o for female in years	t_0=2.2	5					t_0=-2.761	6		
L∞ for male in cm	L∞=291	5			L∞=277.3	13	L∞=332	6		
K for male /year	k=0.153	5			k=0.079	13	k=0.0838	6		
t_o for male in years	t0=2.2	5					t0=-2.761	6		
Longevity	25	4	25	4	25 19-20	4 23	25 females 35.8 males 28.6	4 6 6	25	4
Maximum size TL in cm	350 305	2 15	350	2	350	2	350 256	2 6	350	2
Common size (FL) in cm										
Maximum weight in kg	346	3	346	3	346	1-3	346	1-3	346	1-3
REPRODUCTION										
Female maturity size in cm	>225 233 232-245	5 11 11-12			215.6	13	210-220 186 214 #200	6 11 11 18	186 180 (50%) 180	11 22 23
Female maturity age in years	7-9 12	5 11-12			15	13	9.2-10.2 6-7	6 11	6-7	11
Male maturity size in cm	210-220 221 225	5 11 11-12			207.6	13	212.5 200-206 238-250	6 11 11	200-206 182(50%) 190	11 22 23
Male maturity age in years	6-7 10	5 11-12			13	13	9.3 5-6	6 11	5-6	11
Birth size TL in cm	57-87 72 68-84 75-80	2 5 11 12	57-87	2	57-87 81.1	2 13	57-87 63.5-75.5 65-81	2 6 11	57-87 65-81	2 6-11
Sex ratio					1.05	13	1:1	6	48% females	21
Mode of development	viviparous	2	viviparous	2	viviparous	2	viviparous	2	viviparous	2
Gestation period in months	12	5-11-12							11-12	22
Spawning & mating periods	May-June	5			no period	11	no period	11	no period	11

Fecundity: number of embryos per litter	2-14 2-12	2 11- 12	2-14	2	2-14	2- 3	2-14 8-10 1-16 5-8 2-18	2 6 11 18 21	2-14 1-16 2-18 2-9	2 11 21 22
Nursery ground										
CONVERSION FACTORS										
Length / Weight relationships	$W=2.01*10^{-6}TL^{3.23}$ $W=1.5406*10^{-5}FL^{2.9221}$ $W=0.8782*10^{-5}TL^{3.091}$	5 7 9- 16			$W=0.160*10^{-4}*FL^{2.91497}$	10	$W=2.92*10^{-6}TL^{3.15}$ $W=2.887*10^{-5}TL^{2.70}$	6 18		
Wet weight / dressed weight ratio										
TL / FL	TL=1.20*FL -1.16 FL=0.8388 *TL-2.6510	5 7					TL=1.21*FL+ 3.64	6		
TL/PCL							TL=1.31*PCL +3.64 TL=2.08+1.32 *PCL	6 11	TL=2.08+1.3 2*PCL	11
Fins / carcass ratios	FW/DW=2. 5%	14	FW/DW= 2.5%	14	FW/DW=2.5% FW/BW=2.02% (1st set) FB/BW=4.67%	14 19 19	FW/DW=2.5 %	14	FW/DW=2.5 %	14
Stables isotopes N^{15} & C^{14}					C^{13}/N^{15}=2.66- 2.68	20				
POPULATION DYNAMICS										
Stock delineation/range							1 stock in Western Pacific	25	2 stocks in Eastern Pacific : North & South	25
Natural mortality										
Stepness										
Intrinsic rate of increase (λ or r) ($year^{-1}$)										
Intrinsic rebound potential ($r_{z(MSY)}$)										
Trophic level	4.2	8	4.2	8	4.2	8	4.2	8	4.2	8

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Table 5. Biological parameters for oceanic whitetip (OCS, *Carcharhinus longimanus*).

***Carcharhinus longimanus* (Poey, 1861) Oceanic whitetip shark FAO code: OCS**	**Atlantic Ocean**	**Ref.**	**Mediterranean Sea**	**Ref.**	**Indian Ocean**	**Ref.**	**West Pacific**	**Ref.**	**East Pacific**	**Ref.**
AGE & GROWTH										
$L\infty$ for female in cm	$L\infty$=525.4	7					$L\infty$=244.6 $L\infty$=309.4 $L\infty$=316.7	8 23 24		
K for female /year	k=0.0075	7					k=0.1 k=0.085 k=0.057	8 23 24		
t_o for female in years	t_0=-3.342	7					t_0=-2.7 L_0=74.7	8 24		
$L\infty$ for male in cm	$L\infty$=284.9	7					$L\infty$=244.6 $L\infty$=309.4 $L\infty$=315.6	8 23 24		
K for male /year	k=0.996	7					k=0.1 k=0.085 k=0.059	8 23 24		
t_o for male in years	t_0=-3.391	7					t_0=-2.7 L_0=75.1	8 24		
Longevity in years	22	1-4	22	1-4	22 17	1-4 11	22 18 (males) 17 (females)	1-4 24 24	22	1-4
Maximum size TL in cm	396 260 350 395	1 9 8-14 8-14	396	1	396	1	396	1	396	1
Common size (FL) in cm										
Maximum weight in kg	167.4	1	167.4	1	167.4	1	167.4	1	167.4	1
REPRODUCTION										
Female maturity size in cm	189-198 180-190 180-200 181-203 170.0	16 7 10 13 22	180-200	10	180-190 180-200 187 TL (50%)	9 10 25	180-200 170-180 125-135 PCL 175-189 TL 170-180 193 (50°%) 224 TL	10 11 8 8 8 23 24	180-200 125-135 PCL 175-189 TL	10 8 8
Female maturity age in years	6-7	7					4-5 8.5 15.8	8-11 23 24	4-5	8

Male maturity size in cm	180-190 175-198 160-196 170-190	7 10 13 22	175-198	10	185-198 175-198 207 TL (50%)	9 10 25	175-198 170-180 125-135 PCL 175-189 TL 172 (50%) 193 TL	10 11 8 8 23 24	175-198 125-135 PCL 175-189 TL	10 8 8
Male maturity age in years	6-7	7					4-5 8 10.0	8- 11 23 24	4-5	8
Birth size TL in cm	60-65 65-70 65-75	9 7 16	60-65	10	60-65 64-65 TL	9 25	60-65 45-55 PCL 64	10 8 23	60-65 45-55 PCL	10 8
Sex ratio	1:21									
Mode of development	placental viviparous	7	placental viviparous	7	placental viviparous	7	placental viviparous	7	placental viviparous	7
Gestation period in months	12 9-12	10 16	9-12	16	12 9-12	10 16	12 9-12	10 16	12 9-12	10 16
Spawning & mating periods	early Summer	10			early Summer	10	June-July	8	June-July	8
Fecundity: number of embryos per litter	1-15 1-14 1-10	1- 10 13 22	1-15	1- 10	1-15 6-8 3-9	1-10 9-13 25	1-15 1-14 10-11	1-5- 10 8 23	1-15 1-14	1-10 8
Nursery ground										
CONVERSION FACTORS										
Length / Weight relationships	$W=0.7272*10^{-4}$ $TL^{2.678}$	10			$W=0.386*10^{-4}$ $FL^{2,75586}$ $W=0.508*10^{-4}$ $FL^{2.70428}$ fem. $W=0.120*10^{-4}$ $FL^{2.98524}$ males	11- 12 12 12	$W=3.077*10^{-5}$ $PCL^{2.860}$ males $W=5.076*10^{-5}$ $PCL^{2.761}$ fem. $W=1.405*10^{-7}$ $TL^{3.72}$ $W=1.66*10^{-5}$ $TL^{2.891}$	8 8 18 23	$W=3.077*10^{-5}$ $PCL^{2.860}$ males $W=5.076*10^{-5}$ $PCL^{2.761}$ fem.	8 8
Wet weight / dressed weight ratio										
TL / FL	TL=1.224*FL	1	TL=1.224*FL	1	TL=1.224*FL	1	TL=1.224*FL	1	TL=1.224*FL	1
TL/PCL	TL=1.397*PCL	13	TL=1.397*PCL	13	TL=1.397*PCL	13	TL=1.397*PCL	13	TL=1.397*PCL	13
Fins / carcass ratios	FW/BW=7.34	19	FW/BW=7.34	19	FW/BW=7.34	19	FW/BW=7.34	19	FW/BW=7.34	19
Stables isotopes N^{15} & C^{14}										
POPULATION DYNAMICS										
Stock delineation/range										

Natural mortality							catch rate declining 17%/year	21		
Stepness										
Intrinsic rate of increase (λ or r) ($year^{-1}$)										
Intrinsic rebound potential ($r_{z(MSY)}$)										
Trophic level	4.2	6	4.2	6	4.2	6	4.2	6	4.2	6

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Table 6. Biological parameters for great white shark (WHS, *Carcharodon carcharias*).

Carcharodon carcharias **(Linnaeus, 1758) Great White Shark FAO code: WSH**	**Atlantic Ocean**	**Ref.**	**Mediter-ranean Sea**	**Ref.**	**Indian Ocean**	**Ref.**	**West Pacific**	**Ref.**	**East Pacific**	**Ref.**
AGE & GROWTH										
$L\infty$ for female in cm	$L\infty$=776	15	$L\infty$=776	15	$L\infty$=776 $L\infty$=744 $L\infty$=659.8 $L\infty$=497.77	15 11 15-16 28	$L\infty$=776 $L\infty$=659.8 $L\infty$=607	15 15-16 20	$L\infty$=776	15
K for female /year	k=0.058	15	k=0.058	15	k=0.058 k=0.065 k=0.071	15 11 15-16	k=0.058 k=0.071 k=0.159	15 15-16 20	k=0.058	15
t_o for female in years	t_0=-3.5	15	t_0=-3.5	15	t_0=-3.5 t_0=-4.4 t_0=-2.33	15 11 15-16	t_0=-3.5 t_0=-2.33 t_0=-1.8	15 15-16 20	t_0=-3.5	15
$L\infty$ for male in cm	$L\infty$=776	15	$L\infty$=776	15	$L\infty$=776 $L\infty$=744 $L\infty$=659.8 $L\infty$=497.77	15 11 15-16 28	$L\infty$=776 $L\infty$=659.8 $L\infty$=607	15 15-16 20	$L\infty$=776	15
K for male /year	k=0.058	15	k=0.058	15	k=0.058 k=0.065 k=0.071	15 11 15-16	k=0.058 k=0.071 k=0.159	15 15-16 20	k=0.058	15
t_o for male in years	t_0=-3.5	15	t_0=-3.5	15	t_0=-3.5 t_0=-4.4 t_0=-2.33	15 11 15-16	t_0=-3.5 t_0=-2.33 t_0=-1.8	15 15-16 20	t_0=-3.5	15
Longevity in years	23 (females) 27 40-50 30 44 40 (fem. 526 cm FL) 73 (male 493 cm TL)	1 1-2 15 2-19 27 25 25	23 (females) 27 40-50	1 1-2 15	23 (females) 27 40-50 38	1 1-2 15 28	23 (females) 27 40-50	1 1-2 15	23 (females) 27 40-50 30	1 1-2 15 26
Maximum size TL in cm	760 estimated #600 640 -720 792 640	1-2 1 8 9 18	760 estimated #600 640 -720 792	1-2 1 8 9	760 estimated #600 640 -720 792	1-2 1 8 9	760 estimated #600 640 -720 792 602	1-2 1 8 9 24	760 estimated #600 640 -720 792	1-2 1 8 9
Common size (FL) in cm										
Maximum weight in kg	3400	9	3400	9	3400	9	3400 2530	9 24	3400	9
REPRODUCTION										
Female maturity size in cm	400-500 450-500	1 15-17	400-500 450-500	1 15-17	400-500 450-500	1 15-17	400-500 450-500	1 15-17	400-500 450-500	1 15-17

Female maturity age in years	12-14 12-17	1 15	12-14 12-17	1 15	12-14 12-13 12-17	1 11 15	12-14 12-17 7	1 15 20	12-14 12-17 9-10	1 15 2-10
Male maturity size in cm	350-410 366-427 360-380	1 2 15	350-410 366-427 360-380	1 2 15	350-410 366-427 360-380	1 2 15	350-410 366-427 360-380 310	1 2 15 20	350-410 366-427 360-380	1 2 15
Male maturity age in years	9-10	1-2	9-10	1-2	9-10	1-2	9-10	1-2	9-10	1-2
Birth size TL in cm	109-165 120-150	1 15-17	109-165 120-150	1 15-17	109-165 120-150 100-135	1 15-17 11	109-165 120-150	1 15-17	109-165 120-150	1 15-17
Sex ratio	1:1 (embryos)	15	1:1 (embryos)	15	1:1 (embryos)	15	1:1 (embryos) 1:1	15 24	1:1 (embryos)	15
Mode of development	ovoviviparous	1	ovoviviparous	1	ovoviviparous	1	ovoviviparous	1	ovoviviparous	1
Gestation period in months	>12	15-17	>12	15-17	>12	15-17	>12 20	15-17 24	>12	15-17
Spawning & mating periods	Spring/Summer	2-5-14	Spring/Summer	2-14	Spring/Summer	2-14	Spring/Summer	2-14	Spring/Summer	2-14
Fecundity: number of embryos per litter	2-14 up to 10 7-14 2-17	1 8 9 15	2-14 up to 10 7-14 2-17	1 8 9 15	2-14 up to 10 7-14 2-17	1 8 9 15	2-14 up to 10 7-14 2-17 4-10	1 8 9 15 24	2-14 up to 10 7-14 2-17 7	1 8 9 15 10
Nursery ground	females aggregation in coastal waters in Spring/ Summer	22			females aggregation in coastal waters in Spring/ Summer	22			Pont Conception California	14
CONVERSION FACTORS										
Length / Weight relationships	$W=4.34*10^{-6}*TL^{3.14}$ $W=3.026*10^{-6}*TL^{3.188}$ $W=4.804*10^{-6}*TL^{3.095}$ $W=7.5763*10^{-6}*FL^{3.0848}$	1-3 3 1-5 1-7	$W=4.34*10^{-6}*TL^{3.14}$ $W=3.026*10^{-6}*TL^{3.188}$	1-3 3	$W=4.34*10^{-6}*TL^{3.14}$ $W=3.026*10^{-6}*TL^{3.188}$ $W=3.8*10^{-6}*TL^{3.15}$ $W=2.14*10^{-5}*PCL^{2.944}$	1-3 3 1-4 1-6	$W=4.34*10^{-6}*TL^{3.14}$ $W=3.026*10^{-6}*TL^{3.188}$ $W=3.8*10^{-6}*TL^{3.15}$ $W=1.5710*10^{-5}*TL^{2.932}$	1-3 3 1-4 20	$W=4.34*10^{-6}*TL^{3.14}$ $W=3.026*10^{-6}*TL^{3.188}$	1-3 3
Wet weight / dressed weight ratio										
TL / FL	PCL=0.8550*TL -0.0955	11-12	PCL=0.8550 *TL -0.0955	11-12	TL=1.251* PCL + 5.207 PCL=0.8550*TL - 0.0955	11 11-12	PCL=0.8550*TL - 0.0955 TL=1.159*PCL +15.76	11-12 20	PCL=0.8550*TL -0.0955	11-12
TL/PCL										
Fins / carcass ratios										

Stables isotopes N15 & C14										
POPULATION DYNAMICS										
Stock delineation/range									>2000 ind. (California)	23
Natural mortality										
Stepness										
Intrinsic rate of increase (λ or r) (year^{-1})							0.039	29		
Intrinsic rebound potential ($r_{z(MSY)}$)										
Trophic level	4.5	13	4.5	13	4.5	13	4.5	13	4.5	13

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Table 7. Biological parameters for basking shark (BSK, *Cetorhinus maximus*).

Cetorhinus maximus (Gunnerus, 1765) Basking Shark FAO code: BSK	**Atlantic Ocean**	**Ref.**	**Mediter-ranean Sea**	**Ref.**	**Indian Ocean**	**Ref.**	**West Pacific**	**Ref.**	**East Pacific**	**Ref.**
AGE & GROWTH										
$L\infty$ for female in cm	$L\infty$=1314 $L\infty$=1226 $L\infty$=1000	3 3 7	$L\infty$=1314 $L\infty$=1226 $L\infty$=1000	3 3 7	$L\infty$=1314 $L\infty$=1226 $L\infty$=1000	3 3 7	$L\infty$=1314 $L\infty$=1226 $L\infty$=1000	3 3 7	$L\infty$=1314 $L\infty$=1226 $L\infty$=1000	3 3 7
K for female /year	k=0.0357 k=0.045 k=0.062	3 3 7	k=0.0357 k=0.045 k=0.062	3 3 7	k=0.0357 k=0.045 k=0.062	3 3 7	k=0.0357 k=0.045 k=0.062	3 3 7	k=0.0357 k=0.045 k=0.062	3 3 7
t_o for female in years	t_0=-3.4 t_0=-2.9 t_0=-2.26	3 3 7	t_0=-3.4 t_0=-2.9 t_0=-2.26	3 3 7	t_0=-3.4 t_0=-2.9 t_0=-2.26	3 3 7	t_0=-3.4 t_0=-2.9 t_0=-2.26	3 3 7	t_0=-3.4 t_0=-2.9 t_0=-2.26	3 3 7
$L\infty$ for male in cm	$L\infty$=1226 $L\infty$=1000	3 7	$L\infty$=1226 $L\infty$=1000	3 7	$L\infty$=1226 $L\infty$=1000	3 7	$L\infty$=1226 $L\infty$=1000	3 7	$L\infty$=1226 $L\infty$=1000	3 7
K for male /year	k=0.045 k=0.062	3 7	k=0.045 k=0.062	3 7	k=0.045 k=0.062	3 7	k=0.045 k=0.062	3 7	k=0.045 k=0.062	3 7
t_o for male in years	t_0=-2.9 t_0=-2.26	3 7	t_0=-2.9 t_0=-2.26	3 7	t_0=-2.9 t_0=-2.26	3 7	t_0=-2.9 t_0=-2.26	3 7	t_0=-2.9 t_0=-2.26	3 7
Longevity in years	50 > 9.1	2 10	50	2	50	2	50	2	50	2
Maximum size TL in cm	1220 to 1520	1	1220 to 1520	1	1220 to 1520	1	1220 to 1520	1	1220 to 1520	1
Common size (FL) in cm	<980	1	<980	1	<980	1	<980	1	<980	1
Maximum weight in kg	7500 4000	1 4	7500 4000	1 4	7500 4000	1 4	7500 4000	1 4	7500 4000	1 4
REPRODUCTION										
Female maturity size in cm	800-980	1	800-980	1	800-980	1	800-980	1	800-980	1
Female maturity age in years	up to 20	1	up to 20	1	up to 20	1	up to 20	1	up to 20	1
Male maturity size in cm	400-700	1	400-700	1	400-700	1	400-700	1	400-700	1
Male maturity age in years	6-8 12-16	2 1	6-8 12-16	2 1	6-8 12-16	2 1	6-8 12-16	2 1	6-8 12-16	2 1
Birth size TL in cm	150-170 150 150-200 153	1 1 4 2	150-170 150 150-200 153	1 1 4 2	150-170 150 150-200 153	1 1 4 2	150-170 150 150-200 153	1 1 4 2	150-170 150 150-200 153	1 1 4 2
Sex ratio										
Mode of development	ovoviviparous	5	ovoviviparous	5	ovoviviparous	5	ovoviviparous	5	ovoviviparous	5
Gestation period in months	3.5 2.6 1-3.5	2 1 4	3.5 2.6 1-3.5	2 1 4	3.5 2.6 1-3.5	2 1 4	3.5 2.6 1-3.5	2 1 4	3.5 2.6 1-3.5	2 1 4

Spawning & mating periods	early Summer	4	early Summer	4	early Summer	4	early Summer	4	early Summer	4
Fecundity: number of embryos per litter										
Nursery ground										
CONVERSION FACTORS										
Length / Weight relationships	$W=0.0075*TL^3$ $W=0.00494*TL^3$	14	$W=0.0075*TL^3$ $W= 0.00494*TL^3$	14	$W=0.0075*TL^3$ $W= 0.00494*TL^3$	14	$W=0.0075*TL^3$ $W= 0.00494*TL^3$	14	$W=0.0075*TL^3$ $W= 0.00494*TL^3$	14
Wet weight / dressed weight ratio										
TL / FL										
TL/PCL										
Fins / carcass ratios										
Stables isotopes N15 & C14										
POPULATION DYNAMICS										
Stock delineation/range	population estimated to 985 in 2010 and 201 in 2011	11					CPUE close to zero since mi-2000 on east and west coast of New Zealand fluctuating in south islands	12		
Natural mortality										
Stepness										
Intrinsic rate of increase (λ or r) ($year^{-1}$)	0.025	13								
Intrinsic rebound potential ($r_{z(MSY)}$)										
Trophic level	3.2	6	3.2	6	3.2	6	3.2	6	3.2	6

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Table 8. Biological parameters for shortfin mako (SMA, *Isurus oxyrinchus*).

Isurus oxyrinchus (Rafinesque, 1810) Shortfin mako FAO code: SMA	**Atlantic Ocean**	**Ref.**	**Mediter-ranean Sea**	**Ref.**	**Indian Ocean**	**Ref.**	**West Pacific**	**Ref.**	**East Pacific**	**Ref.**
AGE & GROWTH										
L∞ for female in cm	L∞=366 FL L∞=345 FL L∞=247.75	10 10-11 38			L∞=285.4	41-44	L∞=732.41 FL L∞=403.62 FL L∞=349 FL L∞=308.3 FL L∞=239.4 PCL	15 10-16 17 24 50	L∞=321 T L∞=411 TL	2-12 13
K for female /year	k=0.087 k=0.203 k=0.11	10 10-11 38			k=0.113	41-44	k=0.0154 k=0.040 k=0.155 k=0.09 k=0.25	15 10-16 17 24 50	k=0.072 k=0.05	2-12 13
t_o for female in years							t_0=-10.79 t_0=-5.27 t_0=-1.97	15 10-16 17	t_0=-3.75 t_0=-4.7	2-12 13
L∞ for male in cm	L∞=253 FL L∞=302 FL L∞=247.75	10 10-11 38			L∞=285.4	41-44	L∞=302.16 FL L∞=321.8 FL L∞=267 FL L∞=231 FL L∞=274.4 PCL	15 10-16 17 24 50	L∞=321 T L∞=411 TL	2-12 13
K for male /year	k=0.125 k=0.266 k=0.11	10 10-11 38			k=0.113	41-44	k=0.0524 k=0.049 k=0.312 k=0.16 k=0.19	15 10-16 17 24 50	k=0.072 k=0.05	2-12 13
t_o for male in years	t_0=-1	11					t_0=-9.04 t_0=-6.07 t_0=-0.95	15 10-16 17	t_0=-3.75 t_0=-4.7	2-12 13
Longevity in years	45 estimated 32 (females) 29 (males) 31.5 15 (217 cm)	1-2 10 10 38 39	45 estimated	1-2	45 estimated	1-2	45 estimated 28 (females) 29 (males)	1-2 15 15	45 estimated 38 22	1-2 12 46
Maximum size TL in cm	396 396.2 408 estimated	2 25 1	396 408 estimated	2 1	396 408 estimated	2 1	396 408 estimated	2 1	396 408 estimated 350.7	2 1 26
Common size (FL) in cm	207	8	207	8	207	8	207	8	207	8
Maximum weight in kg	505.8	9	505.8	9	505.8	9	505.8	9	505.8 600 (fem. 373 Cm)	9 46
REPRODUCTION										

Female maturity size in cm	275-293 298 273 275 FL 270-300	1 7 10 22	275-293 270-300	1 22	275-293 270-300 273 250 FL 266 TL (50%)	1 22 7 41- 44 43	275-293 280 273 275-285 278 270-300	1 3 7 18 20 22	275-293 273 270-300	1 7- 13 22
Female maturity age in years	18 7 9.8	10 10- 11 38			15	41	19.1-21 18-19 16	15 10- 17 24	7-8 15	12 13
Male maturity size in cm	203-215 185 FL 180 FL 200-220	1 10 21 22	203-215 200-220	1 22	203-215 200-220 190 FL 189 TL (50%)	1 2 41- 44 43	203-215 200-220 195 180-185 FL 210	1 22 3 18 20	203-215 200-220 180 180-195 190.3 TL (50%)	1 22 13- 14 20 48
Male maturity age in years	8 3 9.8	10 10- 11 38			7	41	6.9-9 13-14 6	15 10- 17 24	7-8 7	12 13
Birth size TL in cm	60-70 70-90 70 60-110 60-70	1 2 7 23 32	60-70 70-90 70 60-110	1 2 7 23	60-70 70-90 70 60-110 60-70 74 #70	1 2 7 23 32 20 3	60-70 70-90 70 60-110 60-70	1 2 7 23 32	60-70 70-90 70 60-110 60.5	1 2 7 23 12
Sex ratio	1:1	21	1:1	21	1:1	21	1:1	21	1:1	21
Mode of development	ovoviviparous	21	ovoviviparous	21	ovoviviparous	21	ovoviviparous	21	ovoviviparous	21
Gestation period in months	15-18	1-7	15-18	1- 7	15-18	1- 7- 41	15-18 23-25	1-7 20	15-18	1-7
Spawning & mating periods	late Winter to mid-Summer	1	late Winter to mid-Summer	1	late Winter to mid-Summer	1	late Winter to mid-Summer January to June	1 20	late Winter to mid-Summer	1
Fecundity: number of embryos per litter	4-30 (most. 10-18) 4-25 9-14	1 7 5-7	4-30 (most. 10-18) 4-25 25-30	1 7 7- 27	4-30 (most. 10-18) 4-25 9-14 <25	1 7 5- 7- 44 41	4-30 (most. 10-18) 4-25 9-15 4-16	1 7 20 3	4-30 (most. 10-18) 4-25 2-16	1 7 12
Nursery ground					juveniles use outer continental shelf, slope, canyons and oceanic waters	42			coastal waters	48
CONVERSION FACTORS										
Length / Weight relationships	$W=1.193*10^{-6}$ $*TL^{3.46}$ $W= 1.47*10^{-5}*PCL^{2.95}$ $W=5.2432*10^{-6}*FL^{3.1407}$	1-4 1-5 6 7			$W= 1.47*10^{-5}$ $*PCL^{2.95}$ $W=0.349*10^{-4}*FL^{2.7544}$	1-5 41	$W=4.832*10^{-6}$ $*TL^{3.10}$ $W= 5.755 *10^{-6}$ $*TL^{3.06}$	1-3 3- 31		

	W=7.299 * TL(m)$^{3.224}$									
Wet weight / dressed weight ratio										
TL / FL	FL= 0.9286*TL -1.7101 FL=0.972TL - 9.36 TL= 1.02FL + 11.75 TL=0.0 + 1.127*FL	6 20 20 40					FL=0.918TL - 2.078 FL=0.952 + 0.890TL	15 20		
TL/PCL	FL=5.292 + 1.069*PCL	40					PCL= 0.784+0.816TL PCL=0.84TL - 2.13	20 24		
Fins / carcass ratios	FW/BW=3.14	33	FW/BW=3.14	33	FW/BW=3.14	33	FW/BW=3.14	33	FW/BW=3.14	33
Stables isotopes N^{15} & C^{14}	iso. Ratio 5.2	36								
POPULATION DYNAMICS										
Stock delineation/range										
Natural mortality	0.150	51					0.155 fishing mortality focus in immature stages catch rate declining 7%/year	51 45 49	fishing mortality focus in immature stages catch rate declining 7%/year	45 49
Stepness										
Intrinsic rate of increase (λ or r) ($year^{-1}$)										
Intrinsic rebound potential ($r_{z(MSY)}$)										
Trophic level	4.3 5.0	19 36	4.3	19	4.3	19	4.3	19	4.3	19

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Table 9. Biological parameters for longfin mako (LMA, *Isurus paucus*).

Isurus paucus Quitart Manday, 1966 Longfin mako FAO code: LMA	**Atlantic Ocean**	**Ref.**	**Mediter-ranean Sea**	**Ref.**	**Indian Ocean**	**Ref.**	**West Pacific**	**ref.**	**East Pacific**	**Ref.**
AGE & GROWTH										
L∞ for female in cm										
K for female /year										
t_o for female in years										
L∞ for male in cm										
K for male /year										
t_o for male in years										
Longevity in years										
Maximum size TL in cm	417 426.7	1 7	417 426.7	1 7	417 426.7	1 7	417 426.7	1 7	417 426.7	1 7
Common size (FL) in cm										
Maximum weight in kg										
REPRODUCTION										
Female maturity size in cm	245	1	245	1	245	1	245	1	245	1
Female maturity age in years	14	8	14	8	14	8	14	8	14	8
Male maturity size in cm	245 229	1 7	245 229	1 7	245 229 263 TL (50%)	1 7 10	245 229	1 7	245 229	1 7
Male maturity age in years										
Birth size TL in cm	97-120 122 97	1-7 5 6	97-120 122 97	1- 7 5 6	97-120 122 97	1- 7 5 6	97-120 122 97	1-7 5 6	97-120 122 97	1-7 5 6
Sex ratio										
Mode of development	ovoviviparous	1	ovoviviparous	1	ovoviviparous	1	ovoviviparous	1	ovoviviparous	1
Gestation period in months										
Spawning & mating periods										
Fecundity: number of embryos per litter	2 2-8 2-4 2	2 3-7 8 6	2 2-8 2-4	2 3- 7 8	2 2-8 2-4	2 3- 7 8	2 2- 8 2-4	2 3-7 8	2 2-8 2-4	2 3-7 8
Nursery ground										
CONVERSION FACTORS										
Length / Weight relationships					$W=2.54*10^{-4}*FL^{2.32}$	9				

Wet weight / dressed weight ratio										
TL / FL	FL=0.888*TL based on photo measurements	3	FL=0.888*TL based on photo measurements	3	FL=0.888*TL based on photo measurements	3	FL=0.888*TL based on photo measurements	3	FL=0.888*TL based on photo measurements	3
TL/PCL										
Fins / carcass ratios										
Stables isotopes N^{15} & C^{14}										
POPULATION DYNAMICS										
Stock delineation/range										
Natural mortality										
Stepness										
Intrinsic rate of increase (λ or r) ($year^{-1}$)										
Intrinsic rebound potential ($r_{z(MSY)}$)										
Trophic level	4.5	3	4.5	3	4.5	3	4.5	3	4.5	3

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Table 10. Biological parameters for porbeagle (POR, *Lamna nasus*).

Lamna nasus (Bonnaterre, 1788) Porbeagle FAO code: POR	**Atlantic Ocean**	**Ref.**	**Mediter-ranean Sea**	**Ref.**	**Indian Ocean**	**Ref.**	**West Pacific**	**Ref.**	**East Pacific**	**Ref.**
AGE & GROWTH										
L_∞ for female in cm	L_∞=253 FL L_∞=309.8 FL	3 10 - 21								
K for female /year	k=0.097 k=0.061	3 10 - 21								
t_o for female in years	t_0=-4.89 t_0=-5.90	3 10 - 21								
L_∞ for male in cm	L_∞=253 FL L_∞=257.7 FL	3 10 - 21								
K for male /year	k=0.097 k=0.08	3 10 - 21								
t_o for male in years	t_0=-4.89 t_0=-5.78	3 10 - 21								
Longevity in years	30-45 25 (males) 24 (females) 45-46 (calculated) 26	1 11 11 11 14 - 17 - 18	26	14	26	14	26	14	26	14
Maximum size TL in cm	300 (possibly 370) 355 335	1 14 17	300 (possibly 370) 355	1 14	300 (possibly 370) 355	1 14	300 (possibly 370) 355 208 FL	1 14 17	300 (possibly 370) 355	1 14
Common size (FL) in cm										
Maximum weight in kg	230	5- 10	230	5- 10	230	5- 10	230	5- 10	230	5- 10
REPRODUCTION										
Female maturity size in cm	237 TL 212 FL 210-230 FL 217.5 FL (50%)	1 3 7 21					185-202 170-180 FL 185 TL 165-180 FL	1 6 14 4	185-202 195 TL	1 14
Female maturity age in years	14 13.1	1 3- 21								

Male maturity size in cm	196 TL 150-200 TL 175 FL 162-185 FL 173.7 FL (50%)	1 1 3 7 21	150-200 TL	1	150-200 TL	1	150-200 TL 140-150 FL 165 TL	1 6 14	150-200 TL 165 TL	1 14
Male maturity age in years	7 8.1	1- 3 7- 21								
Birth size TL in cm	60-75 65-75 61-76	1 3 15	60-75 65-75 61-76	1 3 15	60- 75 65-75 61-76	1 3 15	60-75 65-75 61-76 60-80 58-67 FL	1 3 15 1 4	60-75 65-75 61-76 60-80	1 3 15 1
Sex ratio	3:1 embryos	17	3:1 embryos	17	3:1 embryos	17	3:1 embryos	17	3:1 embryos	17
Mode of development	ovoviviparous	1	ovoviviparous	1	ovoviviparous	1	ovoviviparous	1	ovoviviparous	1
Gestation period in months	8-9	1					8-9	1- 4	8-9	1
Spawning & mating periods	late Summer Spring	1			Winter	14	Winter June-Juy	14 4	Winter	14
Fecundity: number of embryos per litter	1-5 4 4	1- 17 3 7	1-5	1- 17	1-5	1- 17	1-5	1- 17	1-5	1- 17
Nursery ground	off the coast of Europe & the British south of 54°12'S and over the continental edge	10 22	may be in continental waters	1	may be in continental waters	1	may be in continental waters	1	may be in continental waters	1
CONVERSION FACTORS										
Length / Weight relationships	$W=1.4823*10^{-6}*FL^{2.9641}$ $W=0.5*10^{-4}*FL^{2.713}$ $W=0.001922*TL^{2.008}$ (males) $W=0.000315*TL^{2.327}$ (females) $W=5e^{-05}*TL^{2.6307}$ $W=6e^{-05}*FL^{2.6535}$	2 3 12 - 13 12 - 13 19 19					W=0.0000286 * $FL^{2.924}$ Log10 W= -5.050 + 3.128 Log10 FL	10 4		
Wet weight / dressed weight ratio										
TL / FL	FL=1.7939 + 0.8971*TL FL=0.99+ 0.885*TL TL=1.12*FL TL=1.1755*FL+0.603 TL=0.742 + 1.147*FL	2 3 3 19 22					TL= 4.165 +1.098*FL F = -0.567 +0.881*TL	4		
TL/PCL	PCL=0.8918*FL-0.7261 FL=2.619 + 1.102*PCL(males) FL=2.082 + 1.102*PCL (female)	19 23 23					PCL= -1.366 +0.907*FL FL= - 1.990 + 1.098*PCL PC = 4.165 +1.098*FL FL= -0.567 +0.881*TL	4		

Fins / carcass ratios										
Stables isotopes N^{15} & C^{14}										
POPULATION DYNAMICS										
Stock delineation/range	migrations 5000 to 13 000 km / year with site fidelity to Bay of Biscay	20			CPUE do not show declining trend	24	CPUE do not show declining trend	24	CPUE do not show declining trend	24
Natural mortality										
Stepness										
Intrinsic rate of increase (λ or r) ($year^{-1}$)	0.223	25								
Intrinsic rebound potential ($r_{z(MSY)}$)	0.0309 - 0.0331	25								
Trophic level	4.2	9	4.2	9	4.2	9	4.2	9	4.2	9

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Table 11. Biological parameters for blue shark (BSH, *Prionace glauca*).

Prionace glauca (Linnaeus, 1758) Blue shark FAO code: BSH	**Atlantic Ocean**	**Ref.**	**Mediter-ranean Sea**	**Ref.**	**Indian Ocean**	**Ref.**	**West Pacific**	**Ref.**	**East Pacific**	**Ref.**
AGE & GROWTH										
L∞ for female in cm	L∞=310 FL L∞=394 L∞=423 L∞=311.6 TL	13 21 - 23 21 - 34 50			L∞=311.6 TL	50	L∞=235.5 L∞=304 L∞=243.3	7 21 16 - 29	L∞=237.5 TL L∞=241.9 L∞=243.3	12 12 - 14 16 - 29
K for female /year	k=0.16 k=0.13 k=0.11 k=0.12	13 21 - 23 21 - 34 50			k=0.12	50	k=0.2297 k=0.16 k=0.144	7 21 16 - 29	k=0.15 k=0.25 k=0.144	12 12 - 14 16 - 29
t_o for female in years	t_0=-1.56 t_0=-0.80 t_0=-1.04 t_0=-1.66	13 21 - 23 21 - 34 50			t0=-1.66	50	t_0=-1.01 t_0=-0.849	21 16 - 29	t_0=-2.15 t_0=-0.79 t_0=-0.849	12 12 - 14 16 - 29
L∞ for male in cm	L∞=282 FL L∞=394 L∞=423 L∞=311.6 TL	13 21 - 33 21 - 34 50			L∞=311.6 TL	50	L∞= 297.18 L∞=369 L∞=289.7	7 21 16 - 29	L∞=299.85 TL L∞=295.3 TL L∞=289.7	12 12 - 14 16 - 29
K for male /year	k=0.18 k=0.13 k=0.11 k=0.12	13 21 - 33 21 - 34 50			k=0.12	50	k=0.1650 k=0.1 k=0.129	7 21 16 - 29	k=0.10 k=0.18 k=0.129	12 12 - 14 16 - 29
t_o for male in years	t_0=-1.35 t_0=-0.80 t_0=-1.04 t_0=-1.66	13 21 - 33 21 - 34 50			t0=-1.66	50	t_0=-1.38 t_0=-0.756	21 16 - 29	t_0=-2.44 t_0=-1.11 t_0=-0.756	12 12 - 14 16 - 29
Longevity in years	>20 16-20	1-3 13	>20	1-3	>20	1-3	>20 22.76 (males) 19.73 (females)	1-3 7 7	>20	1-3
Maximum size TL in cm	383 396.2	2 30	383 396.2	2 30	383 396.2	2 30	383 396.2	2 30	383 396.2	2 30

Common size (FL) in cm	335 93-387 TL 240 FL 156-250	3 20 22 25	335 180-240 FL	3 22	335 170-330 (males) 130-330 (females) 180-240FL	3 22 - 23 22 - 23 22	335 180-240 FL	3 22	335 180-240 FL	3 22
Maximum weight in kg										
REPRODUCTION										
Female maturity size in cm	221 >185 228 TL 180 FL (50%) 194.4 TL 171.1 FL	1 19 25 - 28 35 50 56	221	1	221 194.4 TL	1 50	221 170-190 FL 170-195 FL 186-212 199.2 TL (50%)	1 6 7 16 - 17 58	221 186- 212 199.2 TL (50%)	1 16 58
Female maturity age in years	5-6 6 5-7 5 6 5-6	1 19 28 - 29 25 - 28 50 56	5-7	28 - 29	5-7 6	28 - 29 50	5-7 7-9 5-6	28 - 29 7 16 - 17	5-6 5-7	16 - 17 28 - 29
Male maturity size in cm	182-281? 193-210 FL (50%) 183 FL 225 FL L_{95}=205 FL 201.4 TL 185-241 FL 180.2 FL	1- 3 17 - 18 19 25 - 28 36 50 52 56	182-281?	1- 3	182-281? 201.4 TL 207 TL (50%)	1- 3 50 57	182-281? 190-195 FL 203 190.3 TL (50%)	1- 3 6- 7 16 - 17 58	182-281? 203 190.3 TL (50%)	1- 3 16 - 17 58
Male maturity age in years	4-5 4-6 7	1 28 - 29 50	4-6	28 - 29	4-6	28 - 29	4-6 8 4-5	28 - 29 7 16 - 17	4-6 4-5	28 - 29 16 - 17
Birth size TL in cm	35-44 35-50 40-50	1- 19 29 47 - 47	35-44 35-50 40-50	1- 19 29 47 - 47	35-44 35-50 40-50	1- 19 29 47 - 47	35- 44 35-50 40-50	1- 19 29 47 - 47	35-44 35-50 40- 50 43.5	1- 19 29 46 - 47 14 - 30
Sex ratio	1:1 (embryos)	17 - 35			1:1 (embryos)	1	1:1 (embryos) 4:5	17 46	1:1 (embryos)	17
Mode of development	placental viviparous	1- 19	placental viviparous	1- 19	placental viviparous	1- 19	placental viviparous	1- 19	placental viviparous	1- 19
Gestation period in months	9-12	1- 19 - 29	9-12	1- 29	9-12	1- 29	9-12	1- 29	9-12	1- 29

Spawning & mating periods	Spring to early Summer December/ July pupping group off Azores	1-7 36 54	Spring to early Summer	1	Spring to early Summer	1	Spring to early Summer	1-7	Spring to early Summer	1-7
Fecundity: number of embryos per litter	4-135 4-63 up to 82 30 in average 43-55 33 (median litter)	1 2 3 19 50 56	4-135 4-63 up to 82 30 in average	1 2 3 19	4-135 4-63 up to 82 30 in average 43-55	1 2 3 19 50	4-135 4-63 up to 82 30 in average 1-62 4-57	1 2 3 19 16 - 17 46	4-135 4-63 up to 82 30 in average 1-62	1 2 3 19 16 - 17
Nursery ground	nursery in central North Atlantic where juveniles stay up to 2 years									
CONVERSION FACTORS										
Length / Weight relationships	LogW=-5.396 + 3.134logTL WT=0.0110*$TL^{2.828}$ WT=3.1841*10^{-6}*$FL^{3.1313}$ WT= 0.392 *10^{-6}*$TL^{3.41}$ (males) WT= 0.131*10^{-5}*$TL^{3.20}$ (females)	1 9 10 34 - 37 34 - 37	LogW=-5.396 + 3.134logTL		LogW=-5.396 + 3.134logTL WT=0.159*10^{-4}*$LF^{2.84554}$	1 26	LogW=-5.396 + 3.134logTL WT= 3.8838*10^{-6} *$TL^{3.174}$ (males) WT= 2.328*10^{-6}*$PCL^{3.294}$ (females) W= 3.113*10^{-6}*$TL^{3.04}$	1 37 - 38 37 - 38 46	LogW=-5.396 + 3.134logTL WT= 3.8838*10-6 *TL3.174 (males) WT= 2.328*10-6*PCL3.294 (females) WT= 2.57*10^{-5}*$TL^{3.05}$	1 37 - 38 37 - 38 37 - 40
Wet weight / dressed weight ratio										
TL / FL	FL=0.8313TL+ 1.3908 FL=1.73872 + 0.82995TL TL=1.175*FL +4.103 FL=11.27 + 0.78TL (males) FL=23.52 + 0.73TL FL=-1.2+0.842TL TL=3.8+1.17FL FL=-1.061 + 0.8203TL TL=1.716 + 1.2158FL FL=1.837 + 1.091*PCL males FL=1.837 + 1.086*PCL females TL=2.045 + 1.200*FL males TL=1.694 +1.200*FL females	10 19 22 37 - 39 37 - 39 27 27 35 35 55 55 55 55					FL= -1.615+0.838TL nat	6	FL= -1.615+0.838TL nat	6
TL/PCL	PCL= 3.92 + 0.74TL (males) PCL= 28.95 + 0.63TL (females)	27 - 39			ratio 2.40-2.47	20	PCL=0.762TL - 2.505	37 - 38		
Fins / carcass ratios	FW=65.84BW/0.0888	27	FW/BW=5.65	48	FW/BW=5.65	48	FW/BW=5.65	48	FW/BW=5.65	48
Stables isotopes N^{15} & C^{14}										
POPULATION DYNAMICS										

Stock delineation/range							catch rate declining 5%/ year horizontal & vertical sex-size segregation	59 60	catch rate declining 5%/ year horizontal & vertical sex-size segregation	59 60
Natural mortality										
Stepness										
Intrinsic rate of increase (λ or r) ($year^{-1}$)	0.278	61								
Intrinsic rebound potential ($r_{z(MSY)}$)										
Trophic level	4.1 4.8	32 51	4.1	32	4.1	32	4.1	32	4.1	32

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Table 12. Biological parameters for scalloped hammerhead (SPL, *Sphyrna lewini*).

Sphyrna lewini (Griffith & Smith, 1834) Scalloped hammerhead FAO code: SPL	**Atlantic Ocean**	**Ref.**	**Mediter -ranean Sea**	**Ref.**	**Indian Ocean**	**Ref.**	**West Pacific**	**Ref.**	**East Pacific**	**Ref.**
AGE & GROWTH										
$L\infty$ for female in cm	$L\infty$=329 TL $L\infty$=233.1 FL $L\infty$=300 TL	5 12 16					$L\infty$=319.72 TL	6	$L\infty$=353.3 TL $L\infty$=376 TL	13 17
K for female /year	k=0.073 k=0.09 k=0.05	5 12 16					k=0.249	6	k=0.156	13 17
t_0 for female in years	t_0=-2.2 t_0=-2.2 L_0= 51 cm TL	5 12 16					t_0=0.413	6	t_0=-0.63 t_0=-1.16	13 17
$L\infty$ for male in cm	$L\infty$=329 TL $L\infty$=214.8 FL $L\infty$=266 TL	5 12 16					$L\infty$=320.59 TL	6	$L\infty$=336.4 TL $L\infty$=364 TL	13 17
K for male /year	k=0.073 k=0.13 k=0.05	5 12 16					k=0.222	6	k=0.131 k=0.123	13 17
t_o for male in years	t_0=-2.2 t_0=-1.62 L_0= 51 cm TL	5 12 16					t_0=-0.746	6	t_0=-1.09 t_0=-1.18	13 17
Longevity in years	35 30.5 55	4 12 16	35	4	35	4	35	4	35	4
Maximum size TL in cm	370-420	1	370-420	1	370-420	1	370-420 309	1 18	370-420 309	1 18
Common size (FL) in cm										
Maximum weight in kg	152.4 166	3 9	152.4	3	152.4	3	152.4	3	152.4	3
REPRODUCTION										
Female maturity size in cm	212 250 210-250 240	1 5 11 15	212 210-250	1 11	212 200 210-250 228.5 LT_{50}	1 10 11 13	212 210 200 210-250 228.5	1 6 10 11 13	212 210-250	1 11
Female maturity age in years	15	5					4.1	6		
Male maturity size in cm	140-165 180 140-198 180	1 5 11 15	140-165 140-198	1 11	140-165 150 140-198 175.5 LT_{50}	19 10 11 13	140-165 198 150 140-198 175.6TL_{50}	1 6 10 11 13	140-165 140-198	1 11
Male maturity age in years	10	5					3.8	5		

Birth size TL in cm	42-55 45-50 49 31-57	1 2 5 11	42-55 45- 50 31-57	1 2 11	42-55 45-50 31-57 40	1 2- 10 11 13	42-55 45-50 31.3- 48.9 31-57 40	1 2- 10 6 11 13	42-55 45- 50 31-57	1 2 11
Sex ratio					1:1 (embryos)	10	1:1 (embryos)	10 - 18 - 20 - 21	1:1	18
Mode of development	viviparous	1	viviparo us	1	viviparous	1	viviparous	1	viviparous	1
Gestation period in months	9-10	3	9-10	3	9-10	3- 10	9-10	3- 10	9-10	3
Spawning & mating periods	Spring-Summer	11	Spring- Summer	11	September- December	10	September- December	10	Spring- Summer	11
Fecundity: number of embryos per litter	15-31 12-41 2-21 15-31	1 11 15 10 - 18 - 19	15-31 12- 41 2-21 15-31	1 11 15 10 - 18 - 19	15-31 12-41 14- 41 15-31	1 11 13 10 - 18 - 19	15-31 12-41 2- 21 15-31	1 11 15 10 - 18 - 19	15-31 12-41 15-31	1 11 10 - 18 - 19
Nursery ground	Bulls Bay South Carolina	22					Kaneohe Bay Oahu Hawaii	18	North Gulf California Kaneohe Bay Oahu Hawaii	11 18
CONVERSION FACTORS										
Length / Weight relationships	$W=1.26*10^{-5}*TL^{2.81}$ $WT=7.7745*10^{-6}*FL^{3.0669}$	5 9			$W=3.99*10^{-6}*TL^{3.03}$	10	$W=3.99*10^{-6}*TL^{3.03}$ $W+1.35*10^{-6}*TL^{3.252}$ (males) $W=2.82*10^{-6}*TL^{3.129}$ (females)	10 6 6	$WT=1.05*10^{-5}*TL^{2.87}$ (males) $WT=2*10^{-5}*TL^{2.8}$ (females) $W=4.03*10^{-6}*TL^{3}$ (both sexes)	13 13 17
Wet weight / dressed weight ratio										
TL / FL	TL=1.31*FL-0.64 FL=0.7756*TL-0.3132 TL=1.296*FL+0.516	5 9 12			TL=1.28+1.3*TL	10	TL=1.28+1.3*TL	10		
TL/PCL										
Fins / carcass ratios										
Stables isotopes N15 & C14										
POPULATION DYNAMICS										
Stock delineation/range										
Natural mortality										
Stepness										
Intrinsic rate of increase (λ or r) ($year^{-1}$)										
Intrinsic rebound potential ($r_{z(MSY)}$)										

Trophic level	4.1 4.5	7 8	4.1	7	4.1	7	4.1	7	4.1	7

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Table 13. Biological parameters for great hammerhead (SPM, *Sphyrna mokarran*).

Sphyrna mokarran (Rüppel, 1837) Great hammerhead FAO code: SPK	**Atlantic Ocean**	**Ref.**	**Mediter-ranean Sea**	**Ref.**	**Indian Ocean**	**Ref.**	**West Pacific**	**Ref.**	**East Pacific**	**Ref.**
AGE & GROWTH										
L∞ for female in cm	L∞=307.8 FL	9					L∞=402.7	8		
K for female /year	k=0.11	9					k=0.079	8		
t_o for female in years	t_0=-2.86	9								
L∞ for male in cm	L∞=264.2 FL	9					L∞=402.7	8		
K for male /year	k=0.16	9					k=0.079	8		
t_o for male in years	t_0=-1.99	9								
Longevity in years	44	9								
Maximum size TL in cm	550-610	1	550-610	1	550-610	1	550-610	1	550-610	1
Common size (FL) in cm	<366 240-370	1 2	<366 240-370	1 2	<366 240-370	1 2	<366 240-370	1 2	<366 240-370	1 2
Maximum weight in kg	449.5	3	449.5	3	449.5	3	449.5	3	449.5	3
REPRODUCTION										
Female maturity size in cm	250-300	1	250-300	1	250-300 210	1-6-10 6	250-300 210 227.9	1-6-10 6 8	250-300	1
Female maturity age in years	5-6	9					8.3	8		
Male maturity size in cm	234-269	1	234-269	1	234-269 225	1-6-10 6	234-269 225 227.9	1-6-10 6 8	234-269	1
Male maturity age in years	5-6	9					8.3	8		
Birth size TL in cm	50-70 60-70	1-6-10 - 11 - 13 2	50-70 60-70	1-6-10 - 11 - 13 2	50-70 60-70 65	1-6-10 - 11 - 13 2 6	50-70 60-70 65 70	1-6-10 - 11 - 13 2 6 8	50-70 60-70	1-6-10 - 11 - 13 2
Sex ratio	1:1 (embryos)	1	1:1 (embryos)	1	1:1 (embryos) 45.7% females 54.3% males	1-6 6	1:1 (embryos)	1-6	1:1 (embryos)	1
Mode of development	viviparous	1	viviparous	1	viviparous	1	viviparous	1	viviparous	1
Gestation period in months	7 11	13-7	7 11	13-7	7 11 10-11	13-76	7 11 10-11	13-76	7 11	13-7
Spawning & mating periods	July-September Spring-Summer	6-11	Spring-Summer	1	October-November Spring-Summer	61	Spring-Summer	1	Spring-Summer	1

		6-12								
Fecundity: number of embryos per litter	13-42 18-38 6-42	1-6-10-11-13 27	13-42 18-38 6-42	1-6-10-11-13 27	13-42 18-38 6-42	1-6-10-11-13 27	13-42 18-38 6-42	1-6-10-11-13 27	13-42 18-38 6-42	1-6-10-11-13 27
Nursery ground										
CONVERSION FACTORS										
Length / Weight relationships	$W=1.19*10^{-6}*TL^{3.16}$	5			$W=1.23*10^{-6}*TL^{3.24}$	6	$W=1.23*10^{-6}*TL^{3.24}$	6		
Wet weight / dressed weight ratio										
TL / FL	TL=1.2533*FL+3.472	9			TL=3.58+1.29*FL	6	TL=3.58+1.29*FL	6		
TL/PCL										
Fins / carcass ratios										
Stables isotopes N15 & C14	FW/BW=1.96	14	FW/BW=1.96	14	FW/BW=1.96	14	FW/BW=1.96	14	FW/BW=1.96	14
POPULATION DYNAMICS										
Stock delineation/range										
Natural mortality										
Stepness										
Intrinsic rate of increase (λ or r) ($year^{-1}$)										
Intrinsic rebound potential (rz(MSY))										
Trophic level	4.3	4	4.3	4	4.3	4	4.3	4	4.3	4

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Table 14. Biological parameters for smooth hammerhead (SPZ, *Sphyrna zygaena*).

Sphyrna zygaena (Linnaeus, 1758) Smooth hammerhead FAO code: SPZ	**Atlantic Ocean**	**Ref.**	**Mediter-ranean Sea**	**Ref.**	**Indian Ocean**	**Ref.**	**West Pacific**	**Ref.**	**East Pacific**	**Ref.**
AGE & GROWTH										
L∞ for female in cm	257.25 293.9	22 23							L∞=301.6	15-16
K for female /year	0.13 0.09	22 23							k=0.14	15-16
t_o for female in years	-0.73 L_0= 52.7 cm FL	22 23							t_0=-2.45	15-16
L∞ for male in cm	245.22 284.6	22 23							L∞=301.6	15-16
K for male /year	0.15 0.09	22 23							k=0.14	15-16
t_o for male in years	-0.64 L_0=52.2 cm FL	22 23							t_0=-2.45	15-16
Longevity in years	20	13	20	13	20	13	20	13	20	13
Maximum size TL in cm	370-400 500	1 3-4	370-400 500	1 3-4	370-400 500	1 3-4	370-400 500	1 3-4	370-400 500	1 3-4
Common size (FL) in cm	275-335	2	275-335	2	275-335	2	275-335	2	275-335	2
Maximum weight in kg	400	3-5	400	3-5	400	3-5	400	3-5	400	3-5
REPRODUCTION										
Female maturity size in cm	304	1	304	1	304	1	304	1	304	1
Female maturity age in years	8	22								
Male maturity size in cm	256	1	256	1	256	1	256 >250-260	19	256	1
Male maturity age in years	7	22								
Birth size TL in cm	50-61 #60	1 17	50-61 #60	1 17	50-61 #60	1 17	50-61 #60	1 17	50-61 #60	1 17
Sex ratio	1:1	10					#1:1	9		
Mode of development	viviparous	1	viviparous	1	viviparous	1	viviparous	1	viviparous	1
Gestation period in months										
Spawning & mating periods										
Fecundity: number of embryos per litter	29-37	1	29-37	1	29-37	1	29-37 20-49	19	29-37	1
Nursery ground	coastal waters of southern Brazil & Uruguay	11-12							northern Gulf of California	8
CONVERSION FACTORS										
Length / Weight relationships	$W=1.42*10^{-6}*L^{3.3}$ $W=2.61*10^{-5}*FL^{2.709}$	7 14			$W=1.42*10^{-6}*L^{3.3}$	7	$W=3.0091*10^{-5}*FL^{2.64805}$ $W=5.270*10^{-7}*L^{3.42}$	149	$W=3.0091*10^{-5}*FL^{2.64805}$	14
Wet weight / dressed weight ratio										

TL / FL	FL=0.8*TL TL = 1.279*FL	3 24	FL=0.8*TL	3	FL=0.8*TL	3	FL=0.8*TL	3	FL=0.8*TL	3
TL/PCL	TL= 5.440+ 1.361*PCL	24								
Fins / carcass ratios	FW/BW=5.74	20	FW/BW=5.74	20	FW/BW=5.74	20	FW/BW=5.74	20	FW/BW=5.74	20
Stables isotopes N^{15} & C^{14}										
POPULATION DYNAMICS										
Stock delineation/range										
Natural mortality										
Stepness										
Intrinsic rate of increase (λ or r) ($year^{-1}$)										
Intrinsic rebound potential (rz(MSY))										
Trophic level	4.2	6	4.2	6	4.2	6	4.2	6	4.2	6

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