WORKING PARTY ON NERITIC TUNAS PROGRAM OF WORK (2017–2021)

Table 1. Priority topics for obtaining the information necessary to develop stock status indicators for neritic tunas in the Indian Ocean;

Topic	Sub-topic and project	Priority	Est. budget and/or potential source	Timing				
				2017	2018	2019	2020	2021
1. Stock structure (connectivity)	Genetic research to determine the connectivity of neritic tunas throughout their distributions	High (1)	1.3 m Euro: European Union					
	➢ Determine the degree of shared stocks for all neritic tunas under the IOTC mandate in the Indian Ocean, so as to better equip the SC in providing management advice based on unit stocks delineated by geographic distribution and connectivity. ➢ Genetic research to determine the connectivity of neritic tunas throughout their distributions: Table 2b should be used as a starting point for research project development to delineate potential stock structure for neritic tunas in the Indian Ocean. ➢ The IOTC Secretariat to coordinate a review of the available literature on neritic tuna stock structure across the Indian Ocean to assess the data already available such as the location of spawning grounds to identify potential sub-stocks.		TBD					
2. Biological information (parameters for stock assessment)	Age and growth research; Age-at-Maturity ➢ Quantitative biological studies are necessary for all neritic tunas throughout their range to determine key biological parameters including age-at-maturity and fecundity-at-age/length relationships, age-length keys, age and growth, which will be fed into future stock assessments.	High (2)	CPCs directly					
3. CPUE standardisation	Develop standardised CPUE series for the main fisheries for longtail, kawakawa, Indo-Pacific King mackerel and Spanish mackerel in the Indian Ocean, with the aim of developing CPUE series for stock assessment purposes.	High (4)	CPUE Workshop (TBD)					

#	Topic	Description	Priority	Budget					
		➢ Longtail tuna. Priority fleets: Iran (gillnet), Indonesia (line and gillnet), Malaysia (coastal purse seine), Pakistan, Oman, Thailand (coastal purse seine) and India (all gillnet).		CPCs directly	▓				
		➢ Spanish mackerel. Priority fleets: Gillnet fisheries of Indonesia, India, Iran, Pakistan and Oman.		CPCs directly		▓			
		➢ Kawakawa. Priority fleets: Indonesia (purse seine/ line), Malaysia (coastal purse seine), Thailand (coastal purse seine), India (gillnet), Iran (gillnet) and Pakistan (gillnet).		CPCs directly			▓		
		➢ Indo-Pacific king mackerel. Priority fleets: Gillnet fisheries of India, Indonesia, Pakistan (gillnet/troll) and Iran.		CPCs directly				▓	
4.	Stock assessment / Stock indicators	Develop and compare multiple assessment approaches to determine stock status for longtail tuna, kawakawa and Spanish mackerel (SS3, ASPIC etc). ➢ The Weight-of-Evidence approach should be used to determine stock status, by building layers of partial evidence, such as CPUE indices combined with catch data, life-history parameters and yield-per recruit metrics, as well as the use of data poor assessment approaches. ➢ The following data should be collated and made available for collaborative analysis: 1) catch and effort by species and gear by landing site; 2) operational data: stratify this by vessel, month, and year for the development as an indicator of CPUE over time; and 3) operational data: collate other information on fishing techniques (i.e. area fished, gear specifics, depth, environmental condition (near shore, open ocean, etc.) and vessel size (length/horsepower).	High (3)	IOTC Regular Budget	▓	▓	▓		

WORKING PARTY ON TEMPERATE TUNAS PROGRAM OF WORK (2017–2021)

Table 1. Priority topics for obtaining the information necessary to develop stock status indicators for albacore in the Indian Ocean (2017-2021).

Topic	Sub-topic and project	Priority	Est. budget and/or potential source	2017	2018	2019	2020	2021
				Timing				
1. Stock structure (connectivity and diversity)	1.1 Genetic research to determine the connectivity of albacore throughout its distribution and the effective population size.	High (3)	1.3 m Euro: European Union					
	1.1.1 Determine albacore stock structure, migratory range and movement rates in the Indian Ocean.		TBD	▓	▓			
	1.1.2 Determine the degree of shared stocks for albacore in the Indian Ocean with the southern Atlantic Ocean.		Ifremer					
	1.1.3 Population genetic analyses to decipher inter- and intraspecific evolutionary relationships, levels of gene flow (genetic exchange rate), genetic divergence, and effective population sizes.		TBD	▓	▓	▓		
2. Biological information (parameters for stock assessment)	2.1 Age and growth research (collaborative research to estimate ages across research facilities; stratification of sampling across fishery and stock)	High (1)	TBD					
	2.1.1 China and other CPCs to provide further research reports on albacore biology, including through the use of fish otolith studies, either from data collected through observer programs or other research programs, at the next WPTmT meeting.		CPCs directly					
	2.1.2 Growth curve analysis: Uncertainty about the growth curve is a primary source of uncertainty in the stock assessment. Depending on the shape of the growth curve, it is likely that only limited information about total mortality can be obtained from catch-at-size data. As an additional information source, data on the age structure of the catch may be very informative about total mortality and may considerably reduce uncertainty in the assessment. Research needs to be undertaken to investigate the potential and the best approaches to be used. MSE process will look at improvement in precision of estimates given different amounts of age structure data, depending on fishery, growth curve, and effective sample sizes.		TBD	▓				
	2.2 Age-at-Maturity	High (4)						
	2.2.1 Quantitative biological studies are necessary for albacore throughout its range to determine key biological parameters including age-at-		CPCs directly	▓	▓	▓		

#	Category	Description	Priority	Responsible					
		maturity and fecundity-at-age/length relationships, age-length keys, age and growth, which will be fed into future stock assessments.			▨	▨	▨		
3	Ecological information	3.1 Spawning time and locations	Medium (5)						
		3.1.1 Collect gonad samples from albacore to confirm the spawning time and location of the spawning area that are presently hypothesized for albacore.		CPCs directly	▨				
4	CPUE standardisation	4.1 Develop standardized CPUE series for each albacore fishery for the Indian Ocean, with the aim of developing a single CPUE series for stock assessment purposes (either a combined or single fleet series approved by the WPTmT).	High (2)	CPUE Workshop (TBD)					
		4.1.1 Changes in species targeting is the most important issue to address in CPUE standardizations.		CPCs directly	▨	▨	▨		
		4.1.2 Appropriate spatial structure needs to be considered carefully as fish density (and targeting practices) can be highly variable on a fine spatial scale, and it can be misleading to assume that large areas are homogenous when there are large shifts in the spatial distribution of effort.		CPCs directly		▨			
		4.1.3 If there are many observations with positive effort and zero catch, it is worth considering models which explicitly model the processes that lead to the zero observations (e.g. negative binomial, zero-inflated or delta-lognormal models). Adding a small constant to the lognormal model may be fine if there are few zero's, but may not be appropriate for areas with many zero catches (e.g. north of 10oS). Sensitivity to the choice of constant should be tested.		CPCs directly		▨			
		4.1.4 The appropriate inclusion of environmental variables in CPUE standardization is an ongoing research topic. Often these variables do not have as much explanatory power as, or may be confounded with, fixed spatial effects. This may indicate that model-derived environmental fields are not accurate enough at this time, or there may need to be careful consideration of the mechanisms of interaction to include the variable in the most informative way.		CPCs directly		▨			
		4.1.5 It is difficult to prescribe analyses in advance, and model building should be undertaken as an iterative process to investigate the		CPCs directly		▨			

#	Topic	Sub-topic and project	Priority					
		processes in the fishery that affect the relationship between CPUE and abundance.			▓			
5	Target and Limit reference points	5.1 To advise the Commission, by end of 2016 at the latest on Target Reference Points (TRPs) and Limit Reference Points (LRPs).	High (WPM)	▓				
		5.1.1 Assessment of the interim reference points as well as alternatives: Used when assessing the albacore stock status and when establishing the Kobe plot and Kobe matrices. Agreed to pass this task temporarily to WPM.						
6	Management measure options	6.1 To advise the Commission, by end of 2016 at the latest, on potential management measures having been examined through the Management Strategy Evaluation (MSE) process. Agreed to pass this task temporarily to WPM.	High (WPM)	▓				

WORKING PARTY ON BILLFISH PROGRAM OF WORK (2017–2021)

Table 1. Priority topics for obtaining the information necessary to develop stock status indicators for billfish in the Indian Ocean

Topic	Sub-topic and project	Priority ranking	Est. budget and/or potential source	Timing				
				2017	2018	2019	2020	2021
1. Stock structure (connectivity and diversity)	1.1 Genetic research to determine the connectivity of billfish throughout their distribution (including in adjacent Pacific and Atlantic waters as appropriate) and the effective population size.	High (1)	1.3 m Euro: (European Union)	▓	▓	▓		
	1.1.1 Next Generation Sequencing (NGS) to determine the degree of shared stocks for billfish in the Indian Ocean with the southern Atlantic Ocean and Pacific Ocean, as appropriate. Population genetic analyses to decipher inter- and intraspecific evolutionary relationships, levels of gene flow (genetic exchange rate), genetic divergence, and effective population sizes.	High (1)		▓	▓	▓		
	1.1.2 Nuclear markers (i.e. microsatellite) to determine the degree of shared stocks for billfish (highest priority species: blue, black, striped marlin and sailfish) in the Indian Ocean with the southern Atlantic Ocean and Pacific Ocean, as appropriate.	High (1)		▓	▓	▓		
		High (1)		▓	▓	▓		

	1.1.3 Develop a close-kin mark recapture method (*Bravington et al.* 2016) on marlins to estimates population size and other important demographic parameters. This method includes the sampling of juveniles and adult fish and genetic parenting analyses to estimate the population size from mark-recapture models.			▓	▓	▓		
	1.2 Tagging research to determine connectivity, movement rates and mortality estimates of billfish.	High (2)	US$100,000	▓	▓	▓		
	1.2.1 Tagging studies (PSAT)		(TBD)	▓	▓	▓	▓	▓
2. Biological and ecological information (incl. parameters for stock assessment)	2.1 Age and growth research	High (7)		▓	▓			
	2.1.1 CPCs to provide further research reports on billfish biology, namely age and growth studies including through the use of fish otolith or other hard parts, either from data collected through observer programs or other research programs.		CPCs directly	▓	▓	▓		
	2.2 Age-at-Maturity	High (8)		▓	▓	▓	▓	▓
	2.2.1 Quantitative biological studies are necessary for billfish throughout its range to determine key biological parameters including age-at-maturity and fecundity-at-age/length relationships, age-length keys, age and growth, which will be fed into future stock assessments.		(CPCs directly)	▓	▓	▓	▓	▓
	2.3 Spawning time and locations	High (9)		▓	▓	▓	▓	▓
	2.3.1 Collect gonad samples from billfish to confirm the spawning time and location of the spawning area that are presently hypothesized for each billfish species.		(CPCs directly)	▓	▓	▓	▓	▓
3. Historical data review	3.1 Changes in fleet dynamics							
	3.1.1 Japan and Taiwan,China to undertake an historical review of their longline fleets and to document the changes in fleet dynamics. The historical review should include as much explanatory information as possible regarding changes in fishing areas, species targeting, gear changes and other fleet characteristics to assist the WPB understand the current fluctuations observed in the data.	High (6)	(CPCs directly)	▓				

		Recommendation	Priority	Cost					
	3.2 Species identification								
	3.2.1	The quality of the data available at the IOTC Secretariat on marlins (by species) is likely to be compromised by species miss-identification. Thus, CPCs should review their historical data in order to identify, report and correct (if possible) potential identification problems that are detrimental to any analysis of the status of the stocks.	High (5)	(CPCs directly)	▓	▓			
4. Sports/recreational fisheries	4.1 Fishery trends								
	4.1.1	The catch and effort data for sports/recreational fisheries targeting marlins and sailfish in the Indian Ocean should be submitted to the IOTC Secretariat to assist in future assessments for these species. CPCs with active sports/recreational fisheries targeting marlins and sailfish should undertake a comprehensive analysis for provision to the WPB.	High (Ongoing)	Consultant US$54,000	▓	▓			
5. CPUE standardization	5.1 Develop and/or revise standardized CPUE series for each billfish species and major fisheries/fleets for the Indian Ocean.								
	5.1.1	Swordfish: Priority LL fleets: Taiwan,China, EU(Spain, Portugal, France), Japan, Indonesia	High (10)	(CPCs directly)	▓			▓	
	5.1.2	Striped marlin: Priority fleets: Japan, Taiwan,China	High (11)	(CPCs directly)	▓	▓	▓		
	5.1.3	Black marlin: Priority fleets: Longline: Taiwan,China; Gillnet: I.R. Iran, Sri Lanka	High (13)	(CPCs directly)	▓	▓	▓		
	5.1.4	Blue marlin: Priority fleets: Japan, Taiwan,China	High (14)	(CPCs directly)	▓	▓			
	5.1.5	I.P. Sailfish: Priority fleets: Priority gillnet fleets: I.R. Iran and Sri Lanka; Priority longline fleets: EU(Spain, Portugal, France), Japan, Indonesia;	High (12)	(CPCs directly)	▓	▓			
6. Stock assessment / Stock indicators	6.1 Develop and compare multiple assessment approaches to determining stock status for swordfish (SS3, ASPIC, etc.).		High (15)	US$??	▓				▓
	6.2 Stock assessment on billfish species in 2017 and 2018		High (3)	Consultant/ US$16,250	▓	▓	▓		

#	Topic	Sub-topic and project	Priority ranking	Est. budget (potential source)	2017	2018	2019	2020	2021
		6.3 Workshops on techniques for assessment including CPUE estimations for billfish species from gillnet fisheries in 2017 and 2018.	High (4)	Consultant US$11,750	▓	▓			
7	Target and Limit reference points	7.1 To advise the Commission, by end of 2016 at the latest on Target Reference Points (TRPs) and Limit Reference Points (LRPs).	High (16)						
		7.1.1 Assessment of the interim reference points as well as alternatives: Used when assessing the Swordfish stock status and when establishing the Kobe plot and Kobe matrices. = Agreed to pass this task temporarily to WPM.		WPM	▓	▓	▓		
8	Management measure options	8.1 To advise the Commission, by end of 2016 at the latest, on potential management measures having been examined through the Management Strategy Evaluation (MSE) process.	High (17)						
		8.1.1 These management measures will therefore have to ensure the achievement of the conservation and optimal utilization of stocks as laid down in article V of the Agreement for the establishment of the IOTC and more particularly to ensure that, in as short a period as possible and no later than 2020, (i) the fishing mortality rate does not exceed the fishing mortality rate allowing the stock to deliver MSY and (ii) the spawning biomass is maintained at or above its MSY level.= Agreed to pass this task temporarily to WPM.		WPM	▓	▓	▓		

WORKING PARTY ON ECOSYSTEMS AND BYCATCH PROGRAM OF WORK (2017–2021)

Table 1. Priority topics for obtaining the information necessary to develop stock status indicators for bycatch species in the Indian Ocean

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	Timing				
					2017	2018	2019	2020	2021
SHARKS									
1. Stock structure (connectivity and diversity)	1.1 Genetic research to determine the connectivity of select shark species throughout their distribution (including in adjacent Pacific and Atlantic waters as appropriate) and the effective population size.	High (13)	CSIRO/AZTI /IRD/RITF	1.3 m Euro: (European Union; 20% additional co-financing)	▓	▓	▓		
	1.1.1 Next Generation Sequencing (NGS) to determine the degree of shared stocks for select shark species (highest				▓	▓	▓		

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	2017	2018	2019	2020	2021
	priority species: blue shark, scalloped hammerhead shark, oceanic whitetip shark and shortfin mako shark) in the Indian Ocean with the southern Atlantic Ocean and Pacific Ocean, as appropriate. Population genetic analyses to decipher inter- and intraspecific evolutionary relationships, levels of gene flow (genetic exchange rate), genetic divergence, and effective population sizes.								
	1.1.2 Nuclear markers (i.e. microsatellite) to determine the degree of shared stocks for select shark species (highest priority species: blue shark, scalloped hammerhead shark and oceanic whitetip shark) in the Indian Ocean with the southern Atlantic Ocean and Pacific Ocean, as appropriate.								
	1.2 Connectivity, movements and habitat use								
	1.2.1 Connectivity, movements, and habitat use, including identification of hotspots and investigate associated environmental conditions affecting the sharks distribution, making use of conventional and electronic tagging (PSAT).	High (1)	AZTI, IRD, Others	US$80K each species (TBD)	BSH SMA OCS	SMA OCS			
	1.2.2 Whale sharks (RHN): Connectivity, movements, and habitat use, including identification of hotspots and investigate associated environmental conditions affecting distribution, making use of conventional and electronic tagging (P-SAT).	High (24)	IRD	US$50,000 (available from IRD)	RHN				
2. Fisheries data collection	2.1 Historical data mining for the key species and IOTC fleets (e.g. as artisanal gillnet and longline coastal fisheries) and implementation of Regional Observer Schemes, including:								
	2.1.1 Capacity building of fisheries observers (including the provision of ID guides, training, etc.)	High (20)	WWF-Pakistan/	US$?? (TBD)					

Topic		Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	2017	2018	2019	2020	2021
				ACAP (seabirds)		░	░			
	2.1.2	Define observer scheme (including minimum requirements) for fleets which are believed to have large catches on pelagic sharks (i.e. various longline and gillnet coastal fisheries) and where those statistics are mostly absent	High (21)		US$?? (TBD)	░	░	░	░	
	2.1.3	Historical data mining for the key species, including the collection of information about catch, effort and spatial distribution of those species and fleets catching them	High (5)	TBD	US$80K (CITES)	░				
	2.1.4	Integration of data mining with observer programs to reconstruct species composition and catches of sharks	Medium (26)		US$15k (EU)		░	░		
	2.1.5	Electronic monitoring (NOTING the recommendation from the Scientific Committee (SC17.43) that the Commission considers assigning the IOTC Secretariat, in consultation with interested IOTC scientists, to develop a project on electronic monitoring in the IOTC area of competence, the Commission NOTED that a concept note/proposal should be developed to allow an evaluation of the efficacy of electronic monitoring in the collection of information on catch, discards and fishing effort as a means to supplement scientific observer coverage for large-scale gillnet vessels. The concept note should include a detailed budget and be communicated to a range of potential funding organisations. (para. 41 of the S19 report))	High (12)		US$?? (TBD)	░	░	░	░	░
	2.1.6	Resolution 16/04 On the development of a pilot project for the Regional Observer Scheme. Development of a proposal for review by the SC19	High (X)			░	░	░	░	░

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	Timing 2017	2018	2019	2020	2021
3. Biological and ecological information (incl. parameters for stock assessment)	3.1 Age and growth research (Priority species: blue shark (BSH), shortfin mako shark (SMA) and oceanic whitetip shark (OCS); Silky shark (FAL))			US$?? (TBD)					
	3.1.1 CPCs to provide further research reports on shark biology, namely age and growth studies including through the use of vertebrae or other means, either from data collected through observer programs or other research programs.	High (4)	CPCs directly	US$?? (TBD)	SMA OCS	OCS			
	3.2 Post-release mortality								
	3.2.1 Post-release mortality (electronic tagging), to assess the efficiency of management resolutions on no retention species (i.e. oceanic whitetip shark (OCS) and thresher sharks), shortfin mako shark SMA) ranked as the most vulnerable species to longline fisheries, and blue shark as the most frequent in catches.	High (2)	IRD/ NRIFSF	US$170K per species (EU)	OCS	BSH, SMK			
	3.2.2 Post-release mortality (electronic tagging), to assess the efficiency of management resolutions on no retention species (i.e. oceanic whitetip shark (OCS) for purse seine fisheries	High (3)	IRD/AZTI	US$80K (TBD)	OCS				
	3.2.3 Post-release survivorship (electronic tagging) on whale shark to assess the effect of unintended interaction and efficiency of management resolution of non-intentioned encirclement on purse seine	High (23)	IRD/AZTI	US$50,000 IRD (commenced)	RHN				
	3.3 Reproduction research Priority species: blue shark (BSH), shortfin mako shark (SMA) and oceanic whitetip shark (OCS), and silky shark (FAL))	High (11)	CPCs directly	US$?? (TBD)	SMA OCS FAL	OCS			
	3.4 Ecological Risk Assessment	High (X)			Prep	Full			
4. Shark bycatch mitigation measures	4.1 Develop studies on shark mitigation measures (operational, technological aspects and best practices)								

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	2017	2018	2019	2020	2021
	4.1.1 Longline selectivity, to assess the effects of hooks styles, bait types and trace materials on shark catch rates, hooking-mortality, bite-offs and fishing yield (socio-economics)	High (14)		US$?? (TBD)	▓				
	4.1.2 Gillnet selectivity, to assess the effect of mesh size, hanging ratio and net twine on sharks catches composition (i.e. species and size), and fishing yield (socio-economics)	High (15)	WWF-Pakistan	US$?? (WWF)	▓	▓			
	4.1.3 Develop guidelines and protocols for safe handling and release of sharks caught on longlines and gillnets fisheries	Med (25)				▓	▓		
5. CPUE standardisation / Stock Assessment / Other indicators	5.1 Develop standardised CPUE series for each key shark species and fishery in the Indian Ocean			US$?? (TBD)					
	5.1.1 Blue shark: Priority fleets: TWN,CHN LL, EU,Spain LL, Japan LL; Indonesia LL; EU,Portugal LL	High (17)	CPCs directly	US$?? (TBD)			▓		
	5.1.2 Shortfin mako shark: Priority fleets: Longline and Gillnet fleets	High (19)	CPCs directly	US$?? (TBD)	▓	▓			
	5.1.3 Oceanic whitetip shark: Priority fleets: Longline fleets; purse seine fleets	High (18)	CPCs directly	US$?? (TBD)	▓	▓			
	5.1.4 Silky shark: Priority fleets: Purse seine fleets	Med (27)	CPCs directly	US$?? (TBD)	▓	▓			
	5.2 Stock assessment and other indicators				▓	▓			
	5.2.1 Develop and compare multiple assessment approaches to determining stock status for key shark species (see Table 2)	High (22)	TBD	Part of: 600K Euro (European Union)	▓	▓	▓	▓	▓

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	Timing				
					2017	2018	2019	2020	2021
MARINE TURTLES									
6. Marine turtle bycatch mitigation measures	6.1 Review of bycatch mitigation measures								
	6.1.1 Res. 12/04 (para. 11) Part I. The IOTC Scientific Committee shall request the IOTC Working Party on Ecosystems and Bycatch to: a) Develop recommendations on appropriate mitigation measures for gillnet, longline and purse seine fisheries in the IOTC area; [mostly completed for LL and PS] b) Develop regional standards covering data collection, data exchange and training; c) Develop improved FAD designs to reduce the incidence of entanglement of marine turtles, including the use of biodegradable materials. [partially completed for non-entangling FADS; ongoing or biodegradable FADs)]	High (9)	CPCs directly	US$?? (TBD)					
	6.1.2 Res. 12/04 (para. 11) Part II. The recommendations of the IOTC Working Party on Ecosystems and Bycatch shall be provided to the IOTC Scientific Committee for consideration at its annual session in 2012. In developing its recommendations, the IOTC Working Party on Ecosystems and Bycatch shall examine and take into account the information provided by CPCs in accordance with paragraph 10 of this measure, other research available on the effectiveness of various mitigation methods in the IOTC area, mitigation measures and guidelines adopted by other relevant organizations and, in particular, those of the Western and Central Pacific Fisheries Commission. The IOTC Working Party on Ecosystems and Bycatch will specifically consider the effects of circle hooks on target	Low (28)	CPCs directly	US$?? (TBD)					

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	Timing 2017	2018	2019	2020	2021
	species catch rates, marine turtle mortalities and other bycatch species.				▓	▓	▓	▓	▓
	6.1.3 Res. 12/04 (para. 17) The IOTC Scientific Committee shall annually review the information reported by CPCs pursuant to this measure and, as necessary, provide recommendations to the Commission on ways to strengthen efforts to reduce marine turtle interactions with IOTC fisheries.	High (10)	CPCs directly	Nil	▓	▓	▓	▓	▓
	SEABIRDS								
7. Seabird bycatch mitigation measures	7.1 Review of bycatch mitigation measures								
	7.1.1 Res. 12/06 (para. 8) The IOTC Scientific Committee, based notably on the work of the WPEB and information from CPCs, will analyse the impact of this Resolution on seabird bycatch no later than for the 2016 meeting of the Commission. It shall advise the Commission on any modifications that are required, based on experience to date of the operation of the Resolution and/or further international studies, research or advice on best practice on the issue, in order to make the Resolution more effective.	High (6)	Rep. of Korea, Japan, Birdlife International	US$?? (TBD)	▓	▓			
	DISCARDS								
8. Bycatch mitigation measures	8.1 Review proposal on retention of non-targeted species								
	8.1.1 The Commission requested that the Scientific Committee review proposal IOTC–2014– S18–PropL Rev_1, and to make recommendations on the benefits of retaining non-targeted species catches, other than those prohibited via	High (8)	Consultant	US$?? (TBD)	▓	▓			

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	Timing				
					2017	2018	2019	2020	2021
	IOTC Resolutions, for consideration at the 19th Session of the Commission. (S18 Report, para. 143).								
	Noting the lack of expertise and resources at the WPEB and the short timeframe to fulfil this task, the SC RECOMMENDED that a consultant be hired to conduct this work and present the results at the next WPEB meeting. The following tasks, necessary to address this issue, should be considered for the terms of reference, taking into account all species that are usually discarded on all major gears (i.e., purse-seines, longlines and gillnets), and fisheries that take place on the high seas and in coastal countries EEZs:								
	i) Estimate species-specific quantities of discards to assess the importance and potential of this new product supply, integrating data available at the Secretariat from the regional observer programs,								
	ii) Assess the species-specific percentage of discards that is captured dead versus alive, as well as the post-release mortality of species that are discarded alive, in order to estimate what will be the added fishing mortality to the populations, based on the best current information,iii) Assess the feasibility of full retention, taking into account the specificities of the fleets that operate with different gears and their fishing practices (e.g., transhipment, onboard storage capacity).								
	iv) Assess the capacity of the landing port facilities to handle and process this catch.								
	v) Assess the socio-economic impacts of retaining non-target species, including the feasibility to market those species that are usually not retained by those gears,								
	vi) Assess the benefits in terms of improving the catch statistics through port-sampling programmes,								

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	2017	2018	2019	2020	2021
	vii) Evaluate the impacts of full retention on the conditions of work and data quality collected by onboard scientific observers, making sure that there is a strict distinction between scientific observer tasks and compliance issues.				▓	▓			
9. Ecosystems	9.1 Develop a plan for Ecosystem Based Fisheries Management (EBFM) approaches in the IOTC	High (16)	WPEB	US$?? (TBD)	▓	▓	▓	▓	▓
	9.2 Create an ecosystem model (SEAPODYM) for the main shark species (BSH)	High (7)	Consultant CLS)	43,000€	▓				
	9.3 Assessment of trophic relationships in pelagic bycatch using chemical tracers		SFA	50,000€	▓	▓			

WORKING PARTY ON TROPICAL TUNAS PROGRAM OF WORK (2017–2021)

Table 1. Priority topics for obtaining the information necessary to develop stock status indicators for tropical tunas in the Indian Ocean.

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	2017	2018	2019	2020	2021
1. Stock structure (connectivity and diversity)	1.1. Genetic research to determine the connectivity of tropical tuna species throughout their distribution (including in adjacent Pacific Ocean waters as appropriate) and the effective population size.	MED (on-going)	CSIRO/AZTI/IRD/RITF	1.3 m Euro: (European Union; 20% additional co-financing)	▓	▓	▓		
	1.1.1 Next Generation Sequencing (NGS) to determine the degree of shared stocks for tropical tuna species in the Indian Ocean. Population genetic analyses to decipher inter- and intraspecific evolutionary relationships, levels of gene flow (genetic exchange rate), genetic divergence, and effective population sizes.				▓	▓	▓		

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	2017	2018	2019	2020	2021
	1.1.2 Nuclear markers (i.e. microsatellite) to determine the degree of shared stocks for tropical tuna species in the Indian Ocean with the Pacific Ocean, as appropriate.				▓	▓	▓		
	1.2. Connectivity, movements and habitat use								
	1.2.1 Connectivity, movements, and habitat use, including identification of hotspots and investigate associated environmental conditions affecting the tropical tuna species distribution, making use of conventional and electronic tagging (P-SAT).	MED		US$?? (TBD)	▓	▓	▓	▓	▓
2. Biological and ecological information (incl. parameters for stock assessment)	2.1 Age and growth								
	2.1.1 Design and develop a plan for a biological sampling program to support research on tropical tuna biology. The plan would consider the need for the sampling program to provide representative coverage of the distribution of the different tropical tuna species within the Indian Ocean and make use of samples and data collected through observer programs, port sampling and/or other research programs. The plan would also consider the types of biological samples that could be collected (e.g. otoliths, spines, gonads, stomachs, muscle and liver tissue, fin clips etc), the sample sizes required for estimating biological parameters, and the logistics involved in collecting, transporting and processing biological samples. The specific biological parameters that could be estimated include, but are not limited to, estimates of growth, age at maturity, fecundity, sex ratio, spawning season, spawning fraction and stock structure.	High	CPCs directly	US$?? (TBD)	▓	▓	▓	▓	▓
	2.2 Age-at-Maturity								
	2.2.1 CPCs to provide further research reports on tropical tuna biology, namely age and growth studies including using through the use of fish otoliths, either from data collected through observer programs or other research programs.	High	CPCs directly	US$?? (TBD)	▓		▓	▓	▓
3. Ecological information	3.1 Spawning time and locations								

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	2017	2018	2019	2020	2021
	3.1.1 Collect gonad samples from tropical tunas to confirm the spawning time and location of the spawning area that are presently hypothesised for each tropical tuna species.	Med		US$?? (TBD)	▓				
4. Historical data review	4.1 Changes in fleet dynamics need to be documented by fleet				▓				
	4.1.1 Provide an evaluation of fleet-specific fishery impacts on the stock of bigeye tuna, skipjack tuna and yellowfin tuna. Project potential impact of realizing fleet development plans on the status of tropical tunas based upon most recent stock assessments.	Med	Consultant	US$30K					
5. CPUE standardisation	5.1 Develop standardised CPUE series for each tropical tuna fleet/fishery for the Indian Ocean (numbering check)								
	5.1.1 Further development and validation of the collaborative longline CPUE indices using the data from multiple fleets (see Terms of Reference, Appendix IXa below).	High (on-going)	SC and consultants	US$40K (IOTC)	▓	▓	▓	▓	▓
	5.1.2 That standardised CPUE index for juvenile yellowfin tuna and bigeye tuna caught by the EU purse seiner fleets, be estimated and submitted to the WPTT before the next round of stock assessments of tropical tunas.		CPCs directly	US$?? (TBD)	▓	▓	▓	▓	▓
	5.1.3 Development of minimum criteria (e.g. 10% using a simple random stratified sample) for logbook coverage to use data in standardisation processes; and 2) identifying vessels through exploratory analysis that were misreporting, and excluding them from the dataset in the standardisation analysis.		CPCs directly	US$?? (TBD)	▓	▓	▓	▓	▓
	5.1.4 Vessel identity information for the Japanese fleets for the period prior to 1979 should be obtained either from the original logbooks or from some other source, to the greatest extent possible to allow estimation of catchability change during this period and to permit cluster analysis using vessel level data.		Japan	US$?? (TBD)	▓	▓	▓	▓	▓

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	TIMING 2017	2018	2019	2020	2021
	5.1.5 The standardisation of purse seine CPUE be made where possible using the operational data on the fishery.		CPCs directly	US$?? (TBD)	▓	▓	▓	▓	▓
	Bigeye tuna: High priority fleets	High	CPCs directly	US$?? (TBD)			▓		
	Skipjack tuna: High priority fleets	High	CPCs directly	US$?? (TBD)	▓			▓	▓
	Yellowfin tuna: High priority fleets	High	CPCs directly	US$?? (TBD)		▓			
	5.1.6 That methods be developed for standardising purse seine catch species composition using operational data, so as to provide alternative indices of relative abundance.	High	Consultant and CPCs directly	US$?? (TBD)	▓				
	5.1.7 Investigate the potential to use the Indian longline survey as a fishery-independent index of abundance for tropical tunas.	High	Consultant And CPCs directly	US$30K (TBD)					
6. Stock assessment / stock indicators	6.1 Develop and compare multiple assessment approaches to determine stock status for tropical tunas	Med	Consultant and CPCs directly	US$?? (TBD)		▓	▓	▓	▓
	6.2 Scoping of ageing studies of tropical tunas to provide information on population age structure (based on species and age composition of sampled catches)	Med				▓	▓	▓	▓
	6.3 Develop a high resolution age structured operating model that can be used to test the spatial assumptions including potential effects of limited tags mixing on stock assessment outcomes (see Terms of Reference, Appendix IXb below).	Med		US$60K		▓	▓	▓	▓
	6.4 Stock assessment priorities – detailed review of the existing data sources, including: i. Size frequency data: Evaluation of the reliability of length composition from the longline fisheries (including recent and historical data), review of issues on the use of the (EU) purse seine length composition data prior to 1991, and the need for a thorough review of the size frequency data held by IOTC, in collaboration with	Med		US$?? (TBD)		▓	▓	▓	▓

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	TIMING				
					2017	2018	2019	2020	2021
	the fleets involved, to improve the utilization of these data in tropical tuna stock assessments. ii. Tagging data: Further analysis of the tag release/recovery data set. iii. Alternative CPUE series: a review of the available data from the Indian tuna longline survey data.								
7. Fishery independent monitoring	7.1 All of the tropical tuna stock assessments are highly dependent on relative abundance estimates derived from commercial fishery catch rates, and these could be substantially biased despite efforts to standardise for operational variability (e.g. spatio-temporal variability in operations, improved efficiency from new technology, changes in species targeting). Accordingly, the IOTC should continue to explore fisheries independent monitoring options which may be viable through new technologies. There are various options, among which some are already under test. Not all of these options are rated with the same priority, and those being currently under development need to be promoted, as proposed below: i. Acoustic FAD monitoring, with the objective of deriving abundance indices based on the biomass estimates provided by echo-sounder buoys attached to FADs ii. Longline-based surveys (expanding on the Indian model) or "sentinel surveys" in which a small number of commercial sets follow a standardised scientific protocol iii. Aerial surveys, potentially using remotely operated or autonomous drones iv. Genetics-based tagging techniques using recaptured individuals or identification of closely-related pairs	High High Med Med	CPCs directly	US$?? (TBD)					
8 Target and Limit reference points	8.1 To advise the Commission, on Target Reference Points (TRPs) and Limit Reference Points (LRPs).								

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	TIMING 2017	2018	2019	2020	2021
	8.1.1 Used when assessing tropical tuna stock status and when establishing the Kobe plot and Kobe matrices	High	CPCs directly	US$?? (TBD)					

WORKING PARTY ON DATA COLLECTION AND STATISTICS PROGRAM OF WORK (2017–2021)

Table 1. Priority topics for obtaining the information necessary to deliver the necessary advice to the Commission.

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	Timing 2017	2018	2019	2020	2021
1. Data Collection Standards - ROS	**1.1** Artisanal fisheries	**1**							
	1.1.1 For countries that are known for already having well established sampling systems in place, assess the outcomes / review the projects and proceed with immediate actions and support (if needed).			**(TBD)**	▓	▓			
	1.1.2 Assessment of the status of all countries whose sampling systems are not fully known or established.			**(TBD)**	▓	▓			
	1.1.3 Develop minima data requirements for the routine collection of data at the landing place, through sampling by enumerators			**(TBD)**	▓				
	1.1.4 Develop General Guidelines for data collection from artisanal fisheries; including development of a set of indicators to be used to assess the quality of data collection and management systems for artisanal fisheries			**(TBD)**	▓				
	1.1.5 Develop/Amend Fisheries specific data collection protocols, by country, where necessary			**(TBD)**	▓	▓	▓	▓	▓
	1.1.6 Assist implementation of pilot sampling activities in countries/fisheries not/insufficiently sampled in the past; priority to be given to the following fisheries: 1. Coastal fisheries of Indonesia			**(TBD)**	▓	▓	▓	▓	▓

	2. Coastal fisheries of Pakistan 3. Coastal fisheries of Sri Lanka 4. Coastal fisheries of Yemen 5. Coastal fisheries of Madagascar 6. Coastal fisheries of Comoros 7. Coastal fisheries of Tanzania 8. Coastal fisheries of Thailand 9. Coastal fisheries of Malaysia	
	1.2 Industrial fisheries **1**	
	1.2.1 Develop General Guidelines for data collection by at-sea observers; including development of a set of indicators to be used to assess the quality of data collection and management systems for industrial fisheries	**(TBD)**
	1.2.2 Organize a Regional Workshop on the Implementation of the IOTC Regional Observer Scheme	**US\$ TBD** **(DG-MARE)**
	1.2.3 Develop/Amend fisheries specific at-sea observer data collection protocols, by country, where necessary	**US\$ 20K** **(TBD)**
	1.2.4 Assist implementation of at-sea observer schemes in countries/fisheries not/insufficiently monitored in the past; including: • Evaluation of existing observer schemes and arrangements • Coordination of country/fishery specific Training Sessions and Workshops on the ROS • Assistance to data management and reporting Priority to be given to the following fisheries: 1. Iran (driftnet; purse seine) 2. Sri Lanka (purse seine; drifting gillnet & longline) 3. Indonesia (longline) 4. Pakistan (driftnet) 5. India (longline) 6. Mauritius (purse seine; longline)	**(TBD)**

2.	Assistance to CPCs for the fulfillment of Resolution 16/01 mandate	**2.1** Provide support to identified CPCs to increase their level of monitoring and reporting in accordance with paragraph 8 of Resolution 16/01	**1**	US$ **40K** (**TBD** – **EU grant 2017**)					
3.	Review Size Data Longline Fisheries	**3.1** Assistance to historical review of length frequency data for longline fisheries, in particular longliners from Taiwan,China and Japan.	**1**	US$ **40K** (**TBD**)					
4.	Compliance with IOTC Data Requirements	**4.1** Data support missions	**2**						
		4.1.1 Identification of indicators to assess performance of IOTC CPCs against IOTC Data Requirements; evaluation of performance of IOTC CPCs with those Requirements; development of plans of action to address the issues identified, including timeframe of implementation and follow-up activities required.		US$ **25K** (**EU DG-MARE**)					
5.	Implementation Data Collection Sport Fisheries	**5.1** Produce a catalogue of sport fisheries in the Indian Ocean; facilitate collection and reporting of data from sport clubs; training of local staff.	**4**	US$ **75K** (**EU-DG MARE**)					
6.	IOTC Data access	**6.1** Design and implementation of a metadata catalog to describe information and processes made available by IOTC followed by the development of software libraries (in the most widely adopted languages for statistical analysis, e.g. R, Python etc.) to simplify scientists' access to IOTC Remote data services.	**3**	US$ **20K** (**TBD**)					

WORKING PARTY ON METHODS PROGRAM OF WORK (2017–2021)

The Program of Work consists of the following, noting that a timeline for implementation would be developed by the SC once it has agreed to the priority projects across all of its Working Parties:

Table 1. Priority topics for obtaining the information necessary to deliver the necessary advice to the Commission. Resolution 15/10 elements have been incorporated as required by the Commission.

Topic	Sub-topic and project	Research Priority	Funding Priority	Lead	Est. budget (potential source)	Timing 2017	2018	2019	2020	2021
	1.1 Albacore	High	5	EU (JRC)	Funded (EC JRC)					
1. Management Strategy Evaluation	1.1.1 Revision of Operating Models based on WPM and SC feedback, including possible robustness tests					▓				
	1.1.2 Implementation of initial set of simulation runs and results					▓				
	1.1.3 Revision of Management Procedures and Indicators after presentation of initial set to TCMP and Commission					▓				
	1.1.4 Evaluation of new set of Management Procedures (if required)					▓	▓			
	1.2 Skipjack tuna	High	2	Maldives						
	1.2.1 Review of model implementation and participation in MSE process				$?? (TBD)	▓	▓			
	1.3 Bigeye tuna	High	4	Australia (CSIRO)	$75,000 (ABNJ)					
	1.3.1 Update OM & present preliminary MP results to TCMP, WPTT/WPM review of new OM					▓				
	1.3.2 Present revised MP results to TCMP with target adoption date of 2018; iteratively update development if required)				$?? (TBD)		▓	▓	▓	
	1.4 Yellowfin tuna	High	3	Australia (CSIRO)	$75,000 (ABNJ)					

	Task	Priority	#		Cost						
	1.4.1 Update OM & present preliminary MP results to TCMP, WPTT/WPM review of new OM				$??	▓					
	1.4.2 Present revised MP results to TCMP with target adoption date of 2018; iteratively update development if required)				(TBD)		▓	▓	▓		
	1.5 Swordfish	High	1	TBD	$?? (TBD)						
	1.5.1 Initial OM					▓	▓				
	1.5.2 Conditioning and OM set up					▓	▓	▓			
	1.5.3 Generic MP tests					▓	▓	▓			
	1.5.4 Final Model with MPs					▓	▓	▓	▓		
2. Tier approach for providing stock status advice	2.1 Develop a 'Tier' approach for providing stock status advice, based on the type of indictors used to determine stock status (e.g. CPUE series, stock assessment model)	Medium	6	Consult.							
	2.2 Review of current practices and recommendation for the consideration at WPM08 and SC20.				$10,000 (TBD)	▓					
3. Multiple stock status derived from different model structures	3.1 Develop specific guidance for the most appropriate models to be used or how to synthesize the results when multiple stock assessment models are presented. (*see IOTC-2016-WPTT18-R, para.91*)	Medium	7		$?? (TBD)				▓	▓	