

# FAD fishery indicators

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Floating object (FOB) fishery, which includes man-made fish aggregating devices (FADs) and natural objects (logs), continues to increase globally. However, the vast majority of activities conducted by purse seiners (e.g. sets, deployments) are on FADs since mid-90s. Because of this, the indicators below refer mainly to FADs, unless the contrary is specified. FAD fishing may impact ecosystems and tuna populations in several ways, and therefore, the fishery must be monitored through a series of comprehensive metrics that help interpretation and inform consistency. Using a wide variety of indicators can improve both the evaluation of the impacts of a fishery and the utility of the results. Single indicators, instead, can be misleading, and lead to conservation measures that do not meet management objectives.

The following document is a first draft of a list of FAD indicators developed by the joint t-RFMO technical working group on FADs, with about 40 potential metrics ranging from catch and effort to ecosystem indicators. It will form the basis for the discussion and adoption of a set of minimum FAD indicators for global use during the 2<sup>nd</sup> joint t-RFMO FAD Working Group meeting in May 2019. It will also serve shaping data collection and reporting needs and prioritizing the estimation of indicators for a holistic assessment of the FAD fishery.

Note 1: some of the indicators listed in the table below may require harmonization of definitions.

Note 2: some of the indicators listed in the table below may require additional data collection and reporting. Annex 1 shows data availability to estimate the proposed indicators at t-RFMO level.

Note 3: differences exist at t-RFMO management, structural and functioning level that may affect data collection, reporting, access and analysis.

Note 4: the column in the right defines the preliminary level of priority for the set of indicators, as well as at individual indicator level, and will be used to facilitate discussion.

<b>1. Catch and effort indicators</b>					<b>P:1</b>
Ideally, catch indicators should be estimated separately for both the owned and not-owned objects components of the fishery. <b>Data:</b> estimated from a variety of data sources, including, but not limited to FAD logbooks, official reports, fishing logbooks. <b>Spatial scale:</b> when possible, the indicators in this section should also be estimated at a spatial scale of 1°x1°.					
<b>Indicator</b>	<b>Time-scale</b>	<b>By (aggregation level)</b>	<b>Unit</b>	<b>Description-Utility</b>	<b>Priority level</b> (1 Major; 2 Moderate; 3 Minor)

<i>Catch</i> 1.a	Number of sets	Annual	CPC EEZ/High seas Ocean Total	No. sets/year	A proxy of floating object-oriented general fishing activity and its evolution	1
1.b	Number of sets	Per day at sea (min, mean, max)	CPC Ocean Total	No. sets/day at sea	A proxy of floating object-oriented daily fishing intensity and its evolution, estimated in an annual basis	1
1.c	Proportion of set types	Annual/Seasonal/Monthly	CPC Ocean Total	% of sets	A proxy of relative floating object-oriented fishing activity at different time-scales and its evolution. A monthly component is suggested to detect seasonality of fishing strategies, if any	1
1.d	Catch per set	Annual (mean, max)	CPC Ocean Total	t/set	A proxy of floating object-oriented catch rates and its evolution.	1
1.e	Catch per positive set	Annual (min, mean, max)	CPC Ocean Total	t/positive set	A proxy of floating object-oriented catch rates, specific to positive sets, and its evolution. Also, an indicator of community/aggregation size at floating-objects	1
1.f	Proportion of null/skunk sets	Annual (min, mean, max)	CPC Ocean Total	% of sets	A proxy of catchability, technology developments and fleet efficiency	3
<i>Effort</i> 1.g	Days at sea	Annual (min, mean, max)	CPC Ocean Total	Days	A proxy of general fishing effort and capacity available to be used and its evolution	1
1.h	Fishing time	Annual (min, mean, max)	CPC Ocean Total	Hours/day	A proxy of the time devoted to actual fishing operations (i.e. end of fishing operation – start of fishing operation) and its evolution	3

1.i	Searching time	Annual	CPC Ocean Total	Hours/day	A proxy of the time devoted to look for target species and its evolution. Often linked to efficiency and effort creep too	1
1.j	Number of explored grid cells	Annual	CPC Ocean Total	grids/year	A proxy of fleet behavior/fishing strategy and its evolution. Particularly important to identify persistency of explored fishing grounds and expansion of the fishery	2
1.k	Number of fished grid cells	Annual	CPC Ocean Total	grids/year	A proxy of fleet behavior/fishing strategy and its evolution. Particularly important to identify persistency of fishing grounds and expansion of the fishery	1
1.l	Number of supply vessels	Annual	CPC Ocean Total	No. of supply vessels /year	Supply vessels assist fishing vessels in FAD related activities, increasing their efficiency. A proxy of potential assistance in the region and its evolution, linked to efficiency	
<b>2. Activity indicators</b> <b>Data:</b> mainly estimated through observer fine-scale data or FAD logbooks. <b>Spatial scale:</b> when possible, the indicators in this section should also be estimated at a spatial scale of i) 1°x1° and ii) fishing zone (i.e. statistical areas)						<b>P:1</b>
<b>Indicator</b>		<b>Time-scale</b>	<b>By (aggregation level)</b>	<b>Unit</b>	<b>Description-Utility</b>	<b>Priority level</b> (1 Major; 2 Moderate; 3 Minor)
2.a	Number of deployments	Annual/Seasonal/Monthly (min, mean, max)	CPC Ocean Total	No. deployments / temp. scale	A proxy of an entity's (vessel, CPC, etc.) effort and investment on FAD-oriented fishery and its evolution	1

2.b	Number of visits	Annual/Seasonal/Monthly (min, mean, max)	CPC Ocean Total	No. visits / temp. scale	A proxy of an entity's (vessel, CPC, etc.) effort on FAD-oriented fishery and its evolution. Also, a proxy of school size at FADs and local density. Note: only visits not followed by a fishing set	1
2.c	Number of retrievals	Annual/Seasonal/Monthly (min, mean, max)	CPC Ocean Total	No. retrievals / temp. scale	A proxy of an entity's interest reusing FOBs and its evolution. Also, an important component to estimate total FOBs at sea	2
2.d	Log densities	Annual/Seasonal/Monthly/Daily (min, mean, max, sd)	Ocean Total	Log/cell	A proxy of natural floating-object density in an area, using observer data. The only information about FOBs without satellite-buoys attached. Overall density of FOBs (including both logs and FADs) can be estimated through a combination with indicator 3.d	3
<b>3. Buoy/FAD use indicators</b> <b>Data:</b> mainly estimated through buoy fine-scale data and FAD logbooks <b>Spatial scale:</b> when possible, the indicators in this section should also be estimated at a spatial scale of i) 1°x1° and ii) fishing zone (i.e. statistical areas)						<b>P:1</b>
<b>Indicator</b>		<b>Time-scale</b>	<b>By (aggregation level)</b>	<b>Unit</b>	<b>Description-Utility</b>	<b>Priority level</b> (1 Major; 2 Moderate; 3 Minor)
3.a	Number of active buoys	Annual/Seasonal/Monthly/Daily (min, mean, max, sd)	CPC Ocean Total	No. buoys/tem p. scale	A proxy of the number of active FADs an entity disposes at certain time scale. Particularly important efficiency, fishing strategy and fleet behavior	1

3.b	Proportion of buoys with echo-sounder	Annual (min, mean, max, sd)	CPC Ocean Total	% of echo-sounder buoys	A proxy of an entity's access to near real time remote biomass data at FADs, directly linked with efficiency, fishing strategy and fleet behavior	2
3.c	Number of shared buoys	Annual (min, mean, max, sd)	CPC Ocean Total	No. of companies	Number of companies allowing their vessels to share satellite-buoy information among them. A proxy of vessels' fishing efficiency	2
3.d	Buoy densities	Annual/Seasonal/Monthly/Daily (min, mean, max, sd)	CPC Ocean Total	Buoys/grid cell	A proxy of FAD density in an area, using buoy data. Particularly important for catch rates, efficiency and fish behavior	1
3.e	Number of abandoned / lost buoys	Annual/Seasonal/Monthly/Daily (min, mean, max, sd)	CPC Ocean Total	No. buoys / temp. scale	A proxy of FADs that are out of the system. Particularly important to estimate total FADs at sea	1
<b>4. Biological, ecological and behavioral indicators</b> <b>Data:</b> ideally estimated from port sampling, logbooks, tagging and observer information <b>Spatial scale:</b> N/A except for ecological indicators, that could be estimated for each fishing zone (i.e. statistical area)						<b>P:3</b>
<b>Indicator</b>		<b>Time-scale</b>	<b>By (aggregation level)</b>	<b>Unit</b>	<b>Description-Utility</b>	<b>Priority level</b> (1 Major; 2 Moderate; 3 Minor)
<i>Biological</i> 4.a	Average/median weight	Annual	Ocean Total	kg.	Average weight of species by set type and its evolution. A proxy of species' exploitation rate	3
4.b	Average/median size	Annual	Ocean Total	cm.	Average size of species by set type and its evolution. A proxy of species' exploitation rate	3

4.c	Maturity	-	Ocean Total	cm.	L <sub>50</sub> , a proxy of species adaptation to exploitation. Updated when possible from regional biological and tagging studies.  Note: should be estimated for the whole stock, not the gear.	3
<i>Ecological</i> 4.d	Species composition of the catch	Annual (mean)	Fishing zone Ocean Total	%/species	Catch composition in terms of target species and its evolution. De Finetti diagrams may be used to easily represent this information	1
4.e	Size frequency composition of the catch	Annual (mean, median)	Fishing zone Ocean Total	%/size class	Catch composition in terms of size classes of target species and its evolution. Link with average size.	1
4.f	Biodiversity indices	Annual, lustrum (mean)	Fishing zone Ocean Total	Index-specific	Different biodiversity indices could be developed: Alpha (Shannon, Simpson, Richness, She), Beta (species composition differences based on distance or time), Gamma (to compare oceans/regions). They reflect, somehow, the health of an ecosystem and its evolution. Particularly useful from a EBFM perspective	2
<i>Behavioral</i> 4.g	Residence times	-	Fishing zone Ocean Total	days	A proxy of FAD attraction power and use by species	2
<b>5. Capacity indicators</b> Data: ideally computed from official national administrations and RFMO fishing licenses Spatial scale: N/A						<b>P:1</b>
<b>Indicator</b>		<b>Time-scale</b>	<b>By (aggregation level)</b>	<b>Unit</b>	<b>Description-Utility</b>	<b>Priority level</b> (1 Major; 2)

						Moderate; 3 Minor)
5.a	Number of vessels	Annual (min, mean, max)	Fishing area Ocean Total	No. vessels	A proxy of fishing capacity and its evolution. If possible, vessels should be categorized in classes	1
5.b	Active capacity at sea	Annual (min, mean, max)	Fishing area Ocean Total	m <sup>3</sup>	A proxy of fishing capacity and its evolution	1
<b>6. Technology indicators</b> Data: estimated from companies', national administrations' or RFMOs' official records Spatial scale: N/A						<b>P:2</b>
<b>Indicator</b>		<b>Time-scale</b>	<b>By (aggregation level)</b>	<b>Unit</b>	<b>Description-Utility</b>	<b>Priority level</b> (1 Major; 2 Moderate; 3 Minor)
6.a	Equipment onboard	Annual	CPC Ocean Total	No. devices	Number of equipment onboard from a list of technological devices, as a proxy of fleet technological development and efficiency	1
6.b	Net size	Annual	CPC Ocean Total	(i x j) m	A proxy of catchability, efficiency and technological development of the fleets and its evolution	2
6.c	FAD depth	Annual	CPC Ocean Total	m	FADs dimensions, including both surface and subsurface parts, have been adapted to each oceans' environmental characteristics and species behavior. A proxy of potential catchability and efficiency of FADs and its evolution in each area	2
<b>7. Socio-economic indicators</b>						<b>P:3</b>

<b>Data:</b> Mainly estimated from official market prices and national administrations' or international organizations' statistics <b>Spatial scale:</b> N/A						
<b>Indicator</b>		<b>Time-scale</b>	<b>By (aggregation level)</b>	<b>Unit</b>	<b>Description-Utility</b>	<b>Priority level</b> (1 Major; 2 Moderate; 3 Minor)
7.a	Market price of species	Annual (min, mean, max)	Ocean Total	USD	A proxy of targeting and its evolution. Particularly important to understand fleet behavior and strategies	2
7.b	Price of fuel	Annual (min, mean, max)	Ocean Total	USD	A proxy of economic efficiency. Also related to fishing motivation and necessity under certain scenarios	3
7.c	Number of jobs	Annual	CPC Ocean Total	No. jobs	A proxy of fishery importance for the social and economic wellbeing and stability of an entity (CPC, region, etc.)	3
<b>8. Ecological impacts indicators</b> Data: Estimated from companies', national administrations' or RFMOs' official records, FAD logbooks and/or observers' data Spatial scale: N/A, except for 8.d which should ideally be estimated by fishing zone (i.e. statistical area).						<b>P:2</b>
<b>Indicator</b>		<b>Time-scale</b>	<b>By (aggregation level)</b>	<b>Unit</b>	<b>Description-Utility</b>	<b>Priority level</b> (1 Major; 2 Moderate; 3 Minor)
8.a	Non-entangling FADs	Annual	CPC Ocean Total	Percentage (%)	Percentage of FADs deployed that have a non-entangling structure	2
8.b	Biodegradable FADs	Annual	CPC Ocean	Percentage (%)	Percentage of FADs deployed that have a biodegradable structure	2



			Total			
8.c	Stranding events	Annual	CPC Ocean Total	No. of FADs	Number of FADs stranding on the coast. The stranding events/deployments ratios could also be estimated here	2
8.d	Bycatch ratios	Annual	CPC Fishing area Ocean Total	t per tons of tuna <i>or</i> number of individuals per tons of tuna	Bycatch ratio of different group of species (i.e. elasmobranchs, finfish, mammals, etc.)	1

ANNEX 1. A table describing indicator status (in place or not) and the data availability to estimate them across RFMOs. Note that this is just an exploratory analysis of current status by t-RFMO and that priorities are not defined yet. This table has no legal or compliance responsibilities and has merely been developed for description purposes.

Indicator	In place				Data available to develop the indices			
	IATTC	ICCAT	IOTC	WCPFC	IATTC	ICCAT	IOTC	WCPFC
1.a	X	X	X	X				X
1.b	X	X	Partly	Partly				x
1.c	X	X	X	Partly				X
1.d	X	X	X	Partly				X
1.e	X	X		Partly			X	X
1.f		X		Partly	X		X	X
1.g	X	X	X*	Partly		X	X	X
1.h		X	X*	X	X	X	X	X
1.i			X <sup>∞</sup>		X		X	
1.j		X	X <sup>∞</sup>		X		X	x
1.k		X	X <sup>∞</sup>		X	X	X	x
1.l	N/A	X	X		N/A	X		
2.a	X	X	X <sup>∞</sup>	Partly		X	X	Partly
2.b		X	X <sup>∞</sup>	Partly	X		X	Partly
2.c	X	X	X <sup>∞</sup>	Partly			X	Partly
2.d		X	X <sup>∞</sup>		X	X	X	
3.a		X		Partly <sup>Δ</sup>	Partly <sup>¥</sup>	*	X <sup>∞</sup>	Partly
3.b		X			Partly <sup>¥</sup>	*	X <sup>∞</sup>	
3.c				Partly			X <sup>∞</sup>	Partly
3.d		X	X <sup>∞</sup>	Partly	Partly <sup>¥</sup>	X		Partly
3.e					Partly <sup>¥</sup>		X <sup>∞</sup>	Partly
4.a	X	X	X	X		X		
4.b	X	X	X	X		X		
4.c								X
4.d	X	X	X	X		X		
4.e	X	X	X	X		X		
4.f					X	X		X

4.g					Partly <sup>£</sup>			X <sup>®</sup>
5.a	X	X	X	X		X		
5.b	X	X	X	X		X		
6.a			X <sup>∞</sup>		X			X
6.b			X <sup>∞</sup>	X	X			X
6.c			X <sup>°</sup>	Partly	X			Partly
7.a				X <sup>μ</sup>				
7.b				X <sup>μ</sup>				
7.c								
8.a		X	X <sup>∞</sup>	Partly	Partly <sup>€</sup>		X	Partly
8.b		X	X <sup>∞</sup>	Partly	Partly <sup>€</sup>		X	Partly
8.c			X <sup>∞</sup>	Partly	Partly <sup>¥</sup>		X	Partly
8.d			X <sup>∞</sup>	X	X		X	

**Notes:**

**IATTC:**

¥ Resolution C-17-02 and the WG-FADs shaped the buoy data requirements. However, not all the vessels are reporting, and the format of the data varies.

£ Some tagging data exists

€ New Floatsam observer and FAD logbook (9/2018) forms implemented in 2019 will include this information in detail.

**ICCAT:**

\*: In 2018 SCRS/COM approved new ST08 form, which will allow to report features of buoys deployed, density per geo strata, etc. NO DATA yet collected.

**IOTC:**

Minimum standards for the IOTC Regional Observer Scheme (ROS) are currently being discussed and finalized and these will cover a significant number of additional fields not available at present.

ROS: To be collected under the new ROS.

\* Effort is user defined.

∞ Partial for some fleets.

° Partial for some type of FADs.

**WCPFC:**

<sup>Δ</sup> Only for PNA waters and not all vessel reporting.

<sup>®</sup> In progress.

<sup>μ</sup> FFA collects the data.