







Fishing Global and Regional Processes Team
Fisheries Division

Food and Agriculture Organization of the United Nations

Quantifying IUU Fishing-Issues and Methods

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Presentation Overview





- 1. Benefits and challenges of quantifying IUU fishing
- 2. The importance of defining what to quantify
- 3. Estimation methods what and why?
- 4. Indicator methods what and why?

Topic 1 - Benefits and Challenges of Quantifying IUU Fishing

- IUU fishing undermines effective fisheries management and therefore we need to combat it → but why do we need to quantify it?
 - To build political will (including acquiring resources) for countermeasures
 - To understand the scale and potential impacts of the problem (biological, economic and social)
 - To determine whether specific MCS elements are sufficient for deterrence
 - To be able to show whether deterrence is working



Issue:

→ Not enough information, resources or time

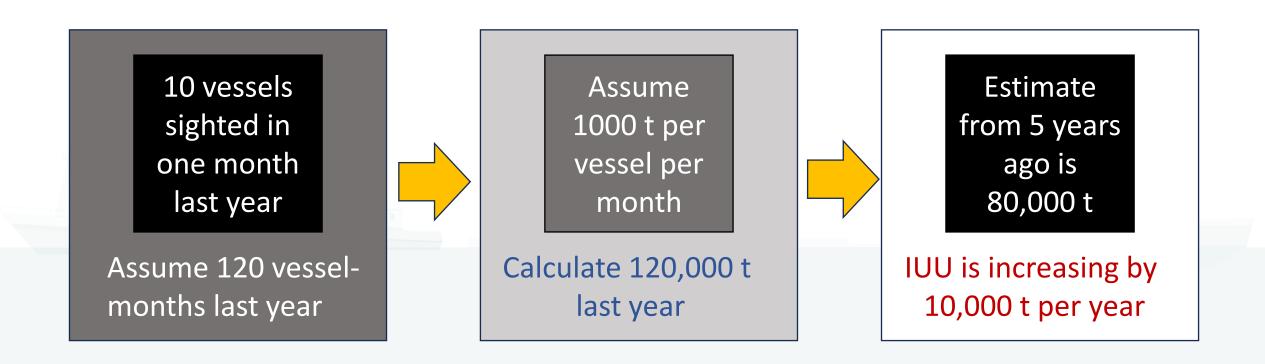
Therefore:

- Have to guess
- Can't document or can't convince
- Influenced by biased information

And then:

The estimate is not believable





How credible is this estimate?



Issue:

→ Many elements in the estimate are variable

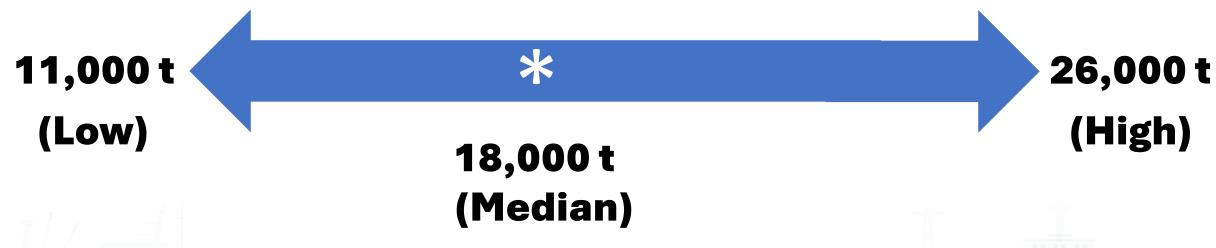
Therefore:

- Carefully document the range of values
- Carry those ranges through the entire estimate
- Explain the situation to managers

And then:

→ It is difficult to understand what the result means





Next year another estimate is made:

Has IUU fishing decreased?



Issue:

→ The reason for analyzing IUU fishing is to better understand how to fight it

Therefore:

- Use the best available information
- Produce a credible estimate
- Attract attention to the problem

And then:

→ Managers want to know what to do next



Reported catch by species A, B, C



Expert survey of the amount of IUU fishing for species

A, B, C (high, medium or low)



Amount of IUU catch of species A, B, C

What are the most urgent management steps?



Summary of IUU Fishing Quantification Challenges

- Amount of available data varies widely (sometimes there is none!)
- Quality of available data varies widely ("garbage in, garbage out")
- Easy methods can over-simplify, complex methods can be costly and hard to explain (there is no universally preferred method)
- Assumptions and uncertainties are often ignored, and if not, work
 - against a clear conclusion
- Difficult to compare between studies
- Difficult to know what to do next



Image: Vecteezy.com (Andres Ramos)

Volume 1 – Principles and Approaches





SN 1020-5292

FAO
TECHNICAL GUIDELINES FOR
RESPONSIBLE FISHERIES

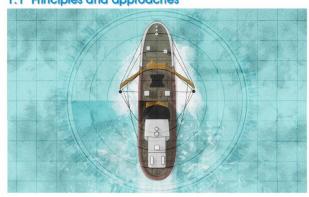
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Suppl. 1 Vol. 1

IMPLEMENTATION

OF THE INTERNATIONAL PLAN OF ACTION
TO PREVENT, DETER AND ELIMINATE ILLEGAL,
UNREPORTED AND UNREGULATED FISHING

- 1. Methodologies and indicators for the estimation of the magnitude and impact of illegal, unreported and unregulated fishing
- 1.1 Principles and approaches



- Explains how to define the scope of the estimate
- Highlights <u>characteristics</u> of a robust estimate
- Classifies IUU fishing <u>risk</u>
 types and suggests ranking
 them

Topic 2: Defining What to Quantify



- 1. Define the scope of interest (area, fishery, species)
- 2. Identify and assess types of risks (IUU fishing activities)
- 3. Compile and assess available data
- 4. Select an assessment approach



Step 1: Define the Scope of Interest

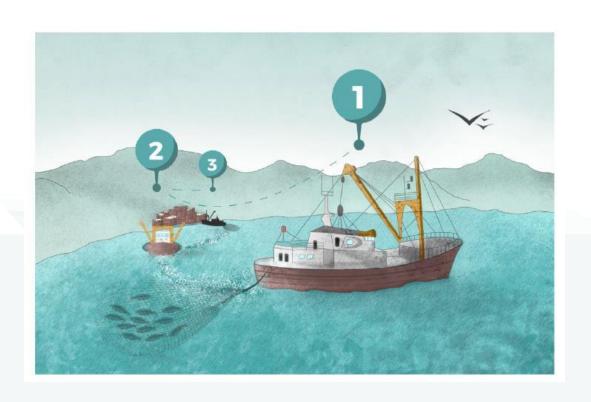




- By fisheries/sectors
- By species
- By area/region
- By timeframe
- By what is considered IUU fishing (e.g. include unregulated?)

Step 2: Identify and Assess Types of Risks



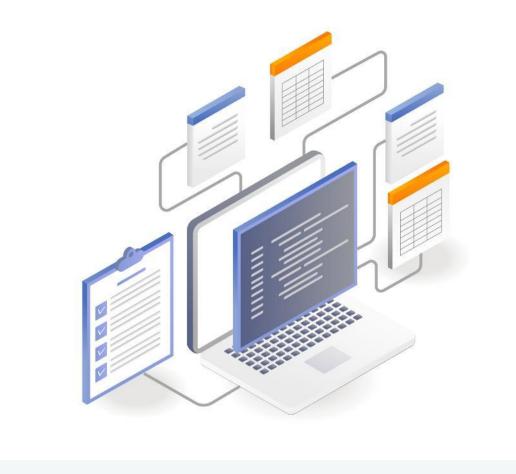


- Unlicensed fishing
- Reporting issues
- Non-compliance with licensing conditions
- Illegal transshipment
- Improper landing
- Other?

Step 3: Compile and Assess Available Data



- VMS
- logbook
- observer
- landings
- satellites
- stock assessments
- trade records
- expert opinion surveys



Graphic: vecteezy.com



Consider quantity, quality, relevance and accessibility of data for each risk

Volume 2 – Practical Guide



- Flowchart of steps for "project managing" an IUU fishing estimate
- Table of potential data types and their strengths and weaknesses
- Emphasis on stakeholder involvement



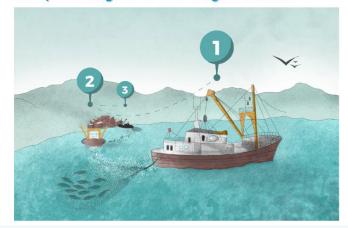
TECHNICAL GUIDELINES FOR RESPONSIBLE FISHERIES

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Suppl. 1 Vol. 2

IMPLEMENTATION OF THE INTERNATIONAL PLAN OF ACTION TO PREVENT, DETER AND ELIMINATE ILLEGAL, UNREPORTED AND UNREGULATED FISHING

- 1. Methodologies and indicators for the estimation of the magnitude and impact of illegal, unreported and unregulated fishing
- 1.2 A practical guide to delivering an estimate



Topic 2 - Defining What to Quantify



- 1. Define the scope of interest (area, fishery, species)
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Topic 3 - Estimation Methods: What and Why?





Estimates

Aim for the best possible measure of the amount of IUU fishing (quantity or value)

Indicators



Aim to measure several different signals of whether things are getting better or worse

Graphic: vecteezy.com

Volume 3 – Catalog of Examples





SN 1000-5292

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TECHNICAL GUIDELINES FOR
RESPONSIBLE FISHERIES

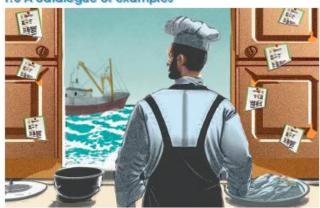
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Suppl. 1 Vol. 3

IMPLEMENTATION

OF THE INTERNATIONAL PLAN OF ACTION
TO PREVENT, DETER AND ELIMINATE ILLEGAL,
UNREPORTED AND UNREGULATED FISHING

- Methodologies and indicators for the estimation of the magnitude and impact of illegal, unreported and unregulated fishing
- 1.3 A catalogue of examples



- Detailed guidance on how to actually do an estimate
- Each situation will be unique, so providing detailed advice in every case is impossible
- Examples from all types of fisheries around the world in the form of 26 "recipe cards"

Example "Recipe Card"

Clarke, S.C., McAllister, M.K., M d, E.J., Kirkwood, G.P., Michielsens, C.G., Agnew, D.J., Pikitch, E.K., Nakang vii, M.S. 2006. Global estimates of shark atches using trade records from commercial markets. Ecology Letters, 9(10): 1115-1126. Converted records of shark products from a centralized commercial market to whole xtrapolated to the total quantity in trade and compared to reported catche us reported catch. Yellow approach group Data group 2 constituents How they sourced it Other ways to source it Quantity of Compiled market repeated observational market (auction) records surveys (e.g. photos, counts) product traded showing trade name. published records of wholesale per unit time product sizes and markets (if product is a standard weight/size) quantities Used genetic testing rely on market names to be species-Species INGREDIENTS specific, or use expert judgement to identity of to match trade name product to species make an allowance for mixing if doing market observational surveys, use visual identification gather and apply expert judgement Conversion Used morphometrics • use measurements from factors from from literature and photographs product to whole sampling whole fish gather and apply expert judgement fish trade compendiums e.g. FishStatJ or —. Conversion National customs statistics from major COMTRADE sampled market markets gather and apply expert judgement to entire market estimate from sales quantity or value

	Steps	Example	Cautions
Н	Lestimate the total product	Each auction handles 400 kg of shark fins.	 Account for variability in quantities traded.
	quantity traded	Auctions are held on	May need to fill in missing data.
	per unit time	Mondays. 400 kg x 52	 Some trade data are only available
		= 20.8 tonnes of shark fins per year	monthly or yearly.
	2. Break the	If 20.8 tonnes of shark	Account for uncertainty in species
	total quantity into	fin per year, and half	proportions.
	species-specific	is blue shark, = 10.4	 If species identification is unavailable
ш	quantities	tonnes of blue shark fins	estimates may need to stay at a higher taxonomic level.
ACIPE FORE	3. Convert the	If dried fins are 2%	Conversion factors may vary by
ž	product to whole	of wet weight, 10.4	species.
	fish	tonnes of blue shark	 Products may not all be the same
		fins represents 520	size.
		tonnes of blue shark	It is necessary to account for uncertainty in the conversion.
	4. Extrapolate	If one of three equally	• The products in unsampled markets
	the quantity of	sized markets were	may differ.
	whole fish to the	sampled, a total of	Ideally the size of each market is
	total volume of trade	3 x 520 tonnes = 1560 tonnes of blue shark	known from trade statistics, but domestic supplies may also be
	trade	were traded (live equivalent)	present.
	_		
	2. Compare	1560 tonnes of	This comparison will be most
	estimate to catch	blue shark is X% of reported catch	meaningful if the sampled market is a centralized outlet for a majority of the catch.
			There may be a time lag between catch and trade.
	Best suited to:		Difficult to apply when:
APPLICABILITY		valuable internationally	products are not distinguished (or
1	traded products;	, Williams	mixed) in trade/market statistics;
1		node that can represent	 there are many or diverse markets;
3	a large portion of		conversion factors are imprecise or
Ż		fishery data are lacking reliable than trade	unavailable; and • personnel are unfamiliar with
Ţ	data.	TENSIONE CHARLET CLOSE	statistical methods for incorporating

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Lestimate the total product	Each auction handles 400 kg of shark fins.	 Account for variability in quantities traded.
quantity traded	Auctions are held on	May need to fill in missing data.
per unit time	Mondays, 400 kg x 52	Some trade data are only available
pur urine urine	= 20.8 tonnes of shark	monthly or yearly.
	fins per year	manually at yearly.
2. Break the	If 20.8 tonnes of shark	Account for uncertainty in species
total quantity into	fin per year, and half	proportions.
species-specific	is blue shark, = 10.4	 If species identification is unavailable
quantities	tonnes of blue shark	estimates may need to stay at a
•	fins	higher taxonomic level.
3. Convert the	If dried fins are 2%	Conversion factors may vary by
product to whole	of wet weight, 10.4	species.
fish	tonnes of blue shark	 Products may not all be the same
	fins represents 520	size.
	tonnes of blue shark	It is necessary to account for uncertainty in the conversion.
4. Extrapolate the quantity of whole fish to the total volume of trade	If one of three equally sized markets were sampled, a total of 3 x 520 tonnes = 1560 tonnes of blue shark were traded (live equivalent)	The products in unsampled markets may differ. Ideally the size of each market is known from trade statistics, but domestic supplies may also be present.
5.		
 Compare estimate to catch 	1560 tonnes of blue shark is X% of	 This comparison will be most meaningful if the sampled market is
escritate to catch	reported catch	a centralized outlet for a majority of the catch.
		There may be a time lag between catch and trade.
		catch and trade.
Bact cuited to:		
Best suited to:	valuable internationally	Difficult to apply when:
 conspicuous and 	valuable internationally	Difficult to apply when: • products are not distinguished (or
 conspicuous and traded products; 	. WIII	Difficult to apply when: • products are not distinguished (or mixed) in trade/market statistics;
 conspicuous and traded products; a central market 	node that can represent	Difficult to apply when: • products are not distinguished (or mixed) in trade/market statistics; • there are many or diverse markets;
 conspicuous and traded products; a central market a large portion of 	node that can represent the trade; and	Difficult to apply when: • products are not distinguished (or mixed) in trade/market statistics;
 conspicuous and traded products; a central market a large portion of situations where 	node that can represent	Difficult to apply when: • products are not distinguished (or mixed) in trade/market statistics; • there are many or diverse markets; • conversion factors are imprecise or
 conspicuous and traded products; a central market a large portion of situations where 	node that can represent the trade; and fishery data are lacking	Difficult to apply when: • products are not distinguished (or mixed) in trade/market statistics; • there are many or diverse markets; • conversion factors are imprecise or unavailable; and



Example Scipe Card"

CIPE

Clarke, S.C., McAllister, M.K., Milner-Gulland, E.J., Kirkwood, G.P., Michielsens, C.G., Agnew, D.J., Pikitch, E.K., Nakano, H. & Shivii, M.S. 2006. Global estimates of shark catches using trade records from commercial markets. Ecology Letters, 9(10): 1115-1126.

Converted records of shark products from a centralized commercial market to whole shark equivalents, then extrapolated to the total quantity in trade and compared to reported catches.

Approach group

Estimate total catch minus reported catch

Yellow approach group

INGREDIENTS

Commercial sources

Data group 2

omniled market	
ompiled market	
ANTIQUECUL LITTLE PACE.	 repeated observational market
	surveys (e.g. photos, counts)
howing trade name,	 published records of wholesale
roduct sizes and	markets (if product is a standard
uantities	weight/size)
Jsed genetic testing	 rely on market names to be species-
o match trade name	specific, or use expert judgement to
o species	make an allowance for mixing
	 if doing market observational surveys,
	use visual identification
	 gather and apply expert judgement
Jsed morphometrics	 use measurements from
rom literature and	photographs
ampling whole fish	 gather and apply expert judgement
	 trade compendiums e.g. FishStatJ or
	COMTRADE
narkets	 gather and apply expert judgement
	 estimate from sales quantity or value figures
	sed genetic testing of match trade name of species

Steps	EX	Cautions
		ALLE TOOL
. Estimate the	Each auction handles	 Account for variability in quantities
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2		
Break the	If 20.8 tonnes of shark	 Account for uncertainty in species
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pecies-specific	is blue shark, = 10.4	 If species identification is unavailable,
quantities	tonnes of blue shark	estimates may need to stay at a
	fins	higher taxonomic level.
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		uncertainty in the conversion.
4. Extrapolate	If one of three equally	The products in uncompled morbots
he quantity of	If one of three equally sized markets were	 The products in unsampled markets may differ.
whole fish to the	sampled, a total of	Ideally the size of each market is
otal volume of	3 x 520 tonnes = 1560	known from trade statistics, but
rade	tonnes of blue shark	domestic supplies may also be
a desired	were traded (live	present.
	equivalent)	production

Best suited to:

5. Compare

 conspicuous and valuable internationally products are not distinguished (or traded products:

estimate to catch blue shark is X% of

1560 tonnes of

reported catch

- a central market node that can represent there are many or diverse markets: a large portion of the trade; and
- · situations where fishery data are lacking or likely to be less reliable than trade data.
- Difficult to apply when:

catch and trade.

the catch.

mixed) in trade/market statistics:

There may be a time lag between

This comparison will be most

meaningful if the sampled market is

a centralized outlet for a majority of

- conversion factors are imprecise or unavailable; and
- personnel are unfamiliar with statistical methods for incorporating uncertainty.

Example "Recipe Card"

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Converted records of shark products from a centralized commercial market to whole shark equivalents, then extrapolated to the total quantity in trade and compared to reported catches.

Approach group

Estimate total catch minus reported catch

Yellow approach group

Data group

INGREDIENTS

Commercial sources

Data group 2

Key constituents	How they sourced it	Other ways to source it
_		
Quantity of	Compiled market	 repeated observational market
product traded	(auction) records	surveys (e.g. photos, counts)
per unit time	showing trade name,	 published records of wholesale
	product sizes and	markets (if product is a standard
	quantities	weight/size)
2. Species	Used genetic testing	· rely on market names to be species-
identity of	to match trade name	specific, or use expert judgement to
product	to species	make an allowance for mixing
		 if doing market observational surveys,
		use visual identification
		 gather and apply expert judgement
3. Conversion	Unad marshamatrian	
factors from	Used morphometrics from literature and	use measurements from
product to whole	sampling whole fish	 photographs gather and apply expert judgement
fish	sampling whole rish	gatrier and apply expert judgement
IISII		
1 -		
4. Conversion	National customs	 trade compendiums e.g. FishStatJ or
factors from	statistics from major	COMTRADE
sampled market	markets	 gather and apply expert judgement
to entire market		 estimate from sales quantity or value
		figures

8	Steps	Example	Cautions
	/ Estimate the	Each auction handles	 Account for variability in quantities
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	2. Break the	If 20.8 tonnes of shark	 Account for uncertainty in species
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	species-specific	is blue shark, = 10.4	 If species identification is unavailable
	quantities	tonnes of blue shark	estimates may need to stay at a
		fins	higher taxonomic level.
	3. Convert the	If dried fins are 2%	Conversion factors may vary by
	product to whole	of wet weight, 10.4	species.
	fish	tonnes of blue shark	Products may not all be the sam
	Hall	fins represents 520	size.
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		torines of blue shark	uncertainty in the conversio
	1		/0/
	4. Extrapolate	If one of three equally	The products in unsamp ets.
	the quantity of	sized markets were	may differ.
	whole fish to the	sampled, a total of	Ideally the size of each s
	total volume of	3 x 520 tonnes = 1560	
	trade	tonnes of blue shark	domestic supplies be
		were traded (live equivalent)	present.
	×	equivalenti	
(ted to	1560 tonnes of	• This compa
	* tch	blue shark is X% of	meaningf ampled market is
	~ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	ported catch	a central et for a majority of
	~()		the
		\	Ther time lag between
۱			catch
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		valuable internationally	 products are not distinguished (or
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			and the land and the dark to the second the second to the

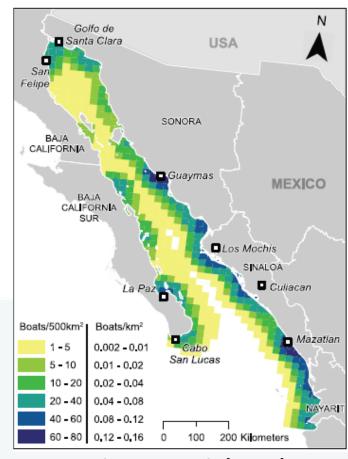
data.

statistical methods for incorporating

Example 1 – Small-scale Fishery in Gulf of California



- 1. Correlated the number of vessels (from aerial photos) and population data
- 2. Assigned known vessels to a grid cell based on population
- 3. Used VMS on some vessels to check whether the number of vessels per grid cell was correct
- 4. Used landings data from some areas to predict catch per vessel, then extrapolated to fill missing catch



Johnson et al. (2017)

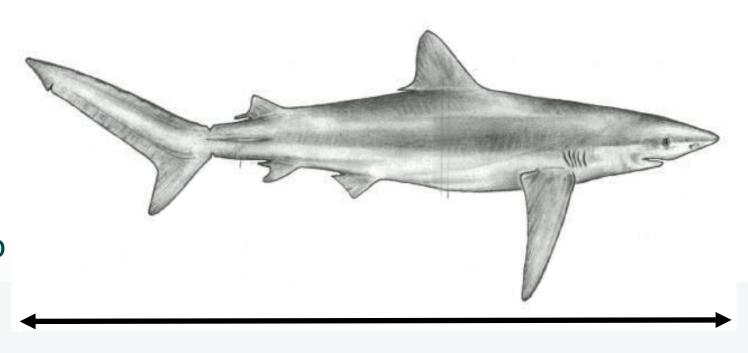


This study was focused on effort rather than catch, but the same method could be used to predict unreported/unregulated catch

Example 2 – Sharks for the Fin Trade



- 1. List products and quantities in one major market
- 2. Use genetics to identify species from product names
- 3. Convert product size/weight to whole size/weight by species
- 4. Extrapolate from one major market to global amounts



Clarke et al. (2006)



Found that shark biomass in the fin trade is 3-4x higher than reported shark catch worldwide

Topic 4 - Indicator Methods: What and Why?



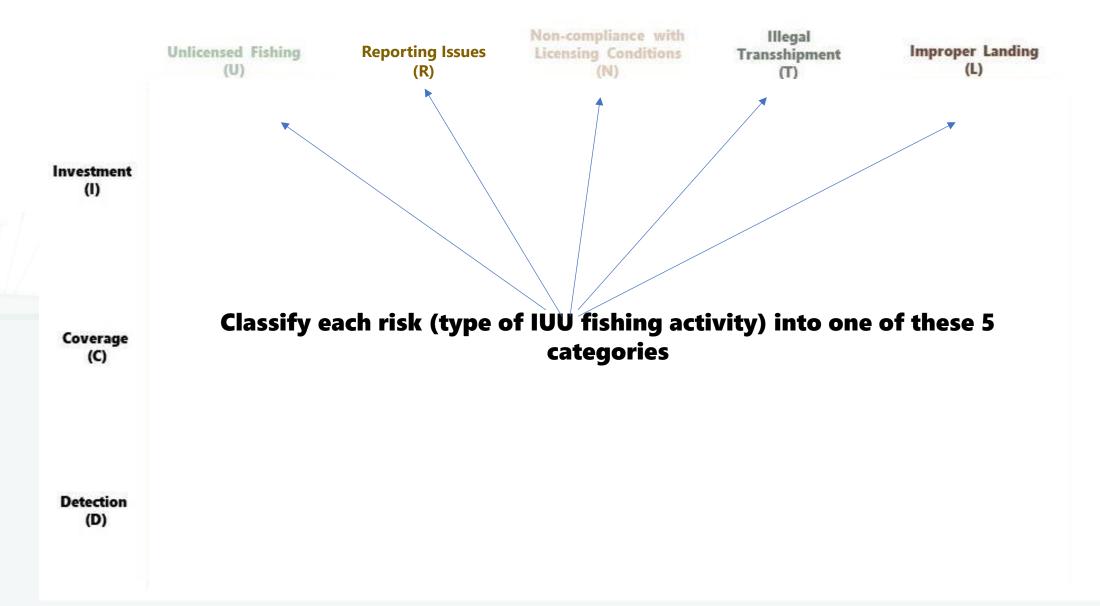
- If estimates are too complicated (due to data quality or quantity, lack of resources or expertise), indicators can be used to understand risks and whether they are getting better or worse
- This can be more helpful in developing a strategy to combat IUU fishing

Indicators

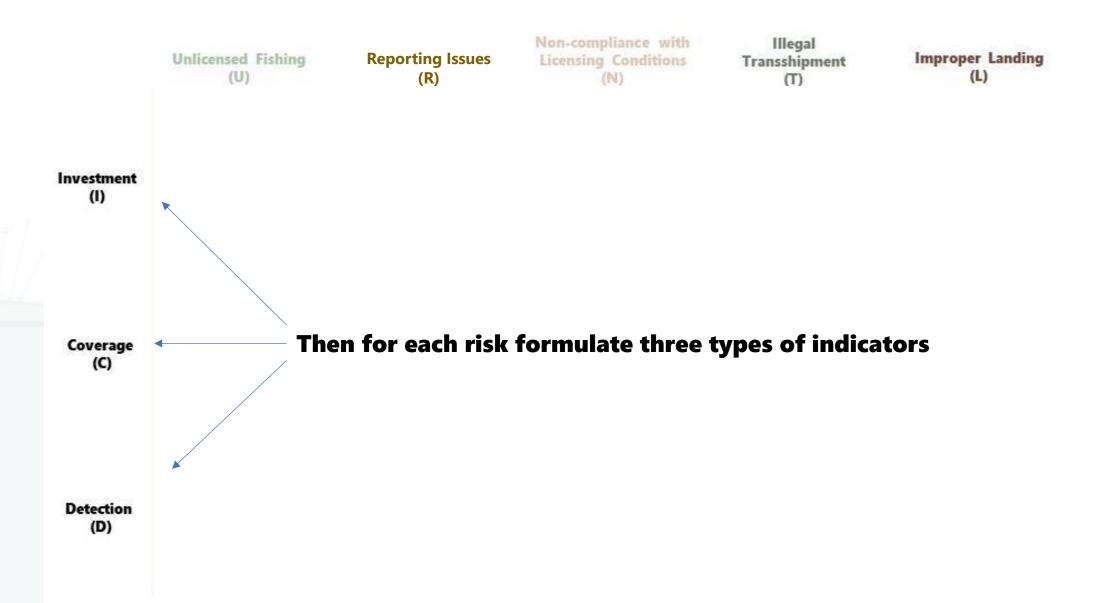


Aim to measure several different signals of whether things are getting better or worse











Unlicensed Fishing (U) Reporting Issues (R)

Non-compliance with Licensing Conditions (N) Illegal Transshipment (T)

Improper Landing (L)

Investment (I)

> Coverage (C)

Detection (D) How much potential IUU fishing did you find?



Unlicensed Fishing (U) Reporting Issues (R)

Non-compliance with Licensing Conditions (N) Illegal Transshipment (T)

Improper Landing (L)

Investment (I)

> Coverage (C)

How hard did you look?

Detection (D)



Unlicensed Fishing (U) Reporting Issues (R)

Non-compliance with Licensing Conditions (N) Illegal Transshipment (T)

Improper Landing (L)

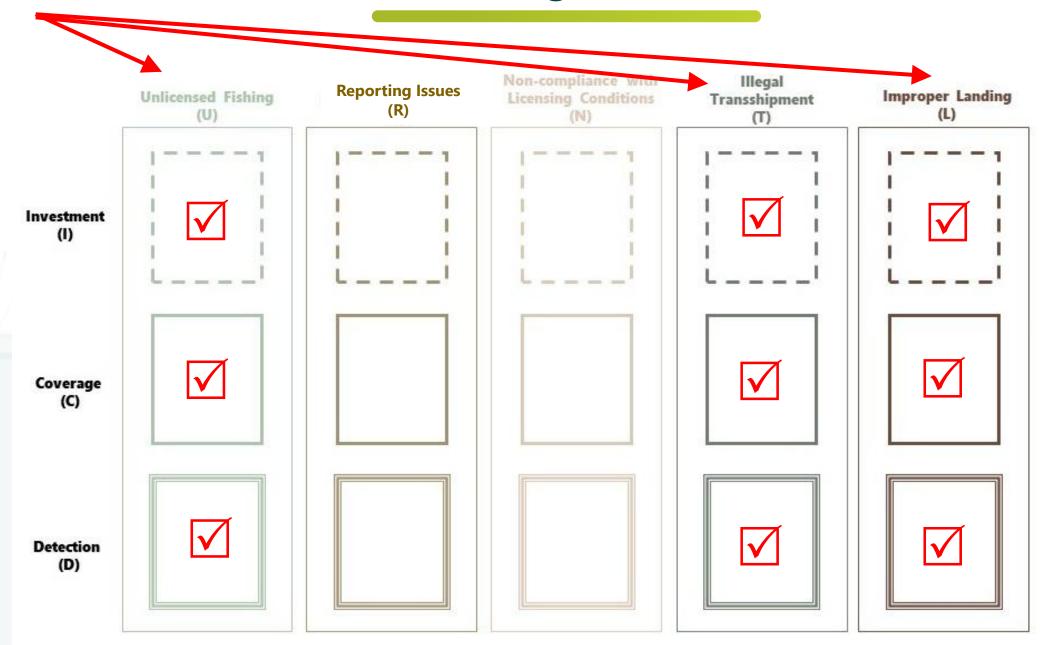
Investment (I)

How much did you invest in your system?

Coverage (C)

Detection (D)





Indicator Structure



Positive direction of change:

Detections shrink

Detections Potential Detections

Detection Indicators (ratios)

Coverage expands

Coverage **Entire Fishery**

Coverage indicators (ratios)

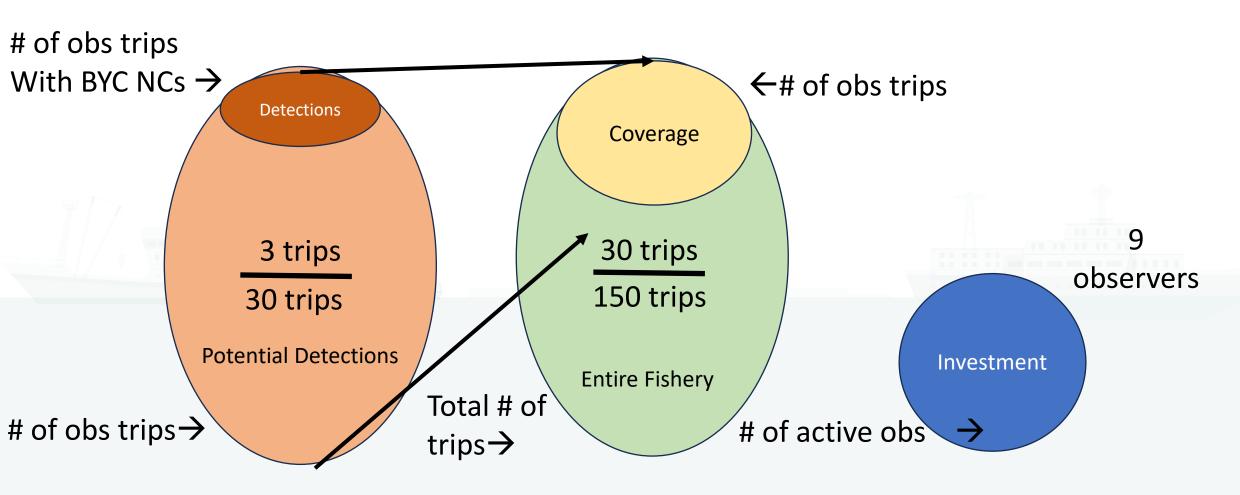
Investments increase

Investment

Investment indicators (quantities)

Indicator Example #1 - Bycatch





Detection Indicator = 0.1

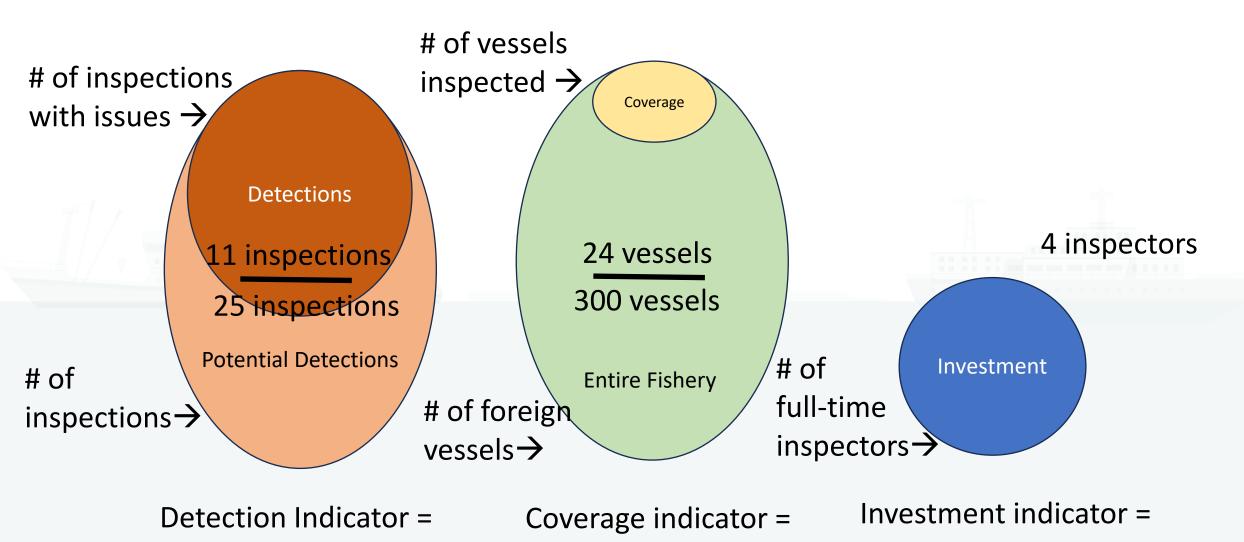
Coverage indicator = 0.2

Investment indicator = 9 observers

Indicator Example #2 – PSMA Inspections



4 inspectors



80.0

0.44

Volume 4 – Indicators of Performance







Suppl. 1 Vol. 1

IMPLEMENTATION

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- 1. Methodologies and indicators for the estimation of the magnitude and impact of illegal, unreported and unregulated fishing
- 1.1 Principles and approaches



Volume 1

Principles and Approaches





Suppl. 1 Vol. 2

IMPLEMENTATION OF THE INTERNATIONAL PLAN OF ACTION TO PREVENT, DETER AND ELIMINATE ILLEGAL, UNREPORTED AND UNREGULATED FISHING

Food and Agriculture

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- 1. Methodologies and indicators for the estimation of the magnitude and impact of illegal, unreported and unregulated fishing
- 1.2 A practical guide to delivering an estimate



Practical Guide



Suppl. 1 Vol. 3

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- 1.3 A catalogue of examples



Volume 3 **Catalogue of Examples**



Suppl. 1 Vol. 4

IMPLEMENTATION

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- 1. Methodologies and indicators for the estimation of the magnitude and impact of illegal, unreported and unregulated fishing
- 1.4 Developing and using indicators of performance



Volume 4 **Indicators of Performance**

https://www.fao.org/iuu-fishing/tools-and-initiatives/quantifying-iuu-fishing/en/