



Food and Agriculture Organization
of the United Nations



PSMA, Fisheries Operations and Compliance Team (NFIFP)
Fisheries Division
Food and Agriculture Organization of the United Nations

Quantifying IUU Fishing: The FAO Technical Guidelines Series

Shelley Catherine Clarke
NFIFP

Overview of this Presentation



- **Poll 1 – Perception of Trends in IUU Fishing**
- **Overview of FAO's work on IUU Fishing**
- **IUU Fishing Estimation Methods**
- **Poll 2 – The Importance of Quantification**
- **IUU Fishing Indicator Methods**
- **Poll 3 – Reflections on Methodological Differences**
- **Q&A**

Polling



Round 1 – Perceptions of IUU fishing

Round 2 – Objectives of IUU fishing quantification

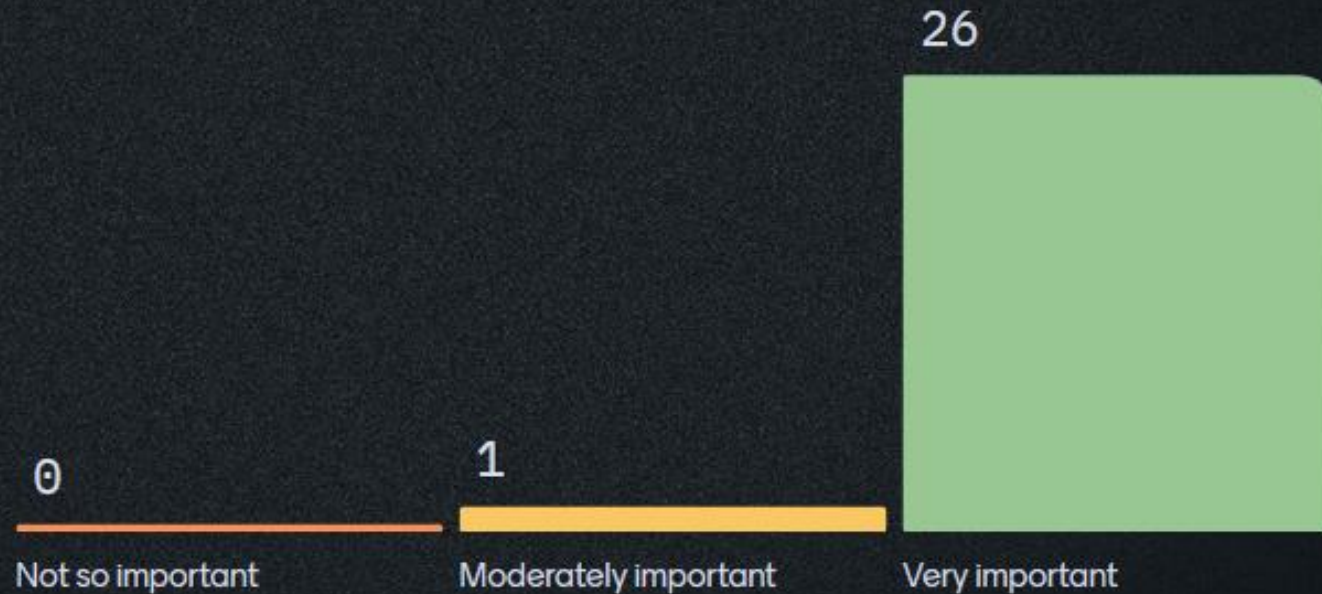
Round 3 – Who will quantify IUU fishing and how



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Mentimeter

In the context of fisheries management, how important do you think it is to address IUU fishing?



4 27 / 37

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Do you think the level of public concern about IUU fishing now, as compared to 10 years ago, is:



Mentimeter

28 / 37



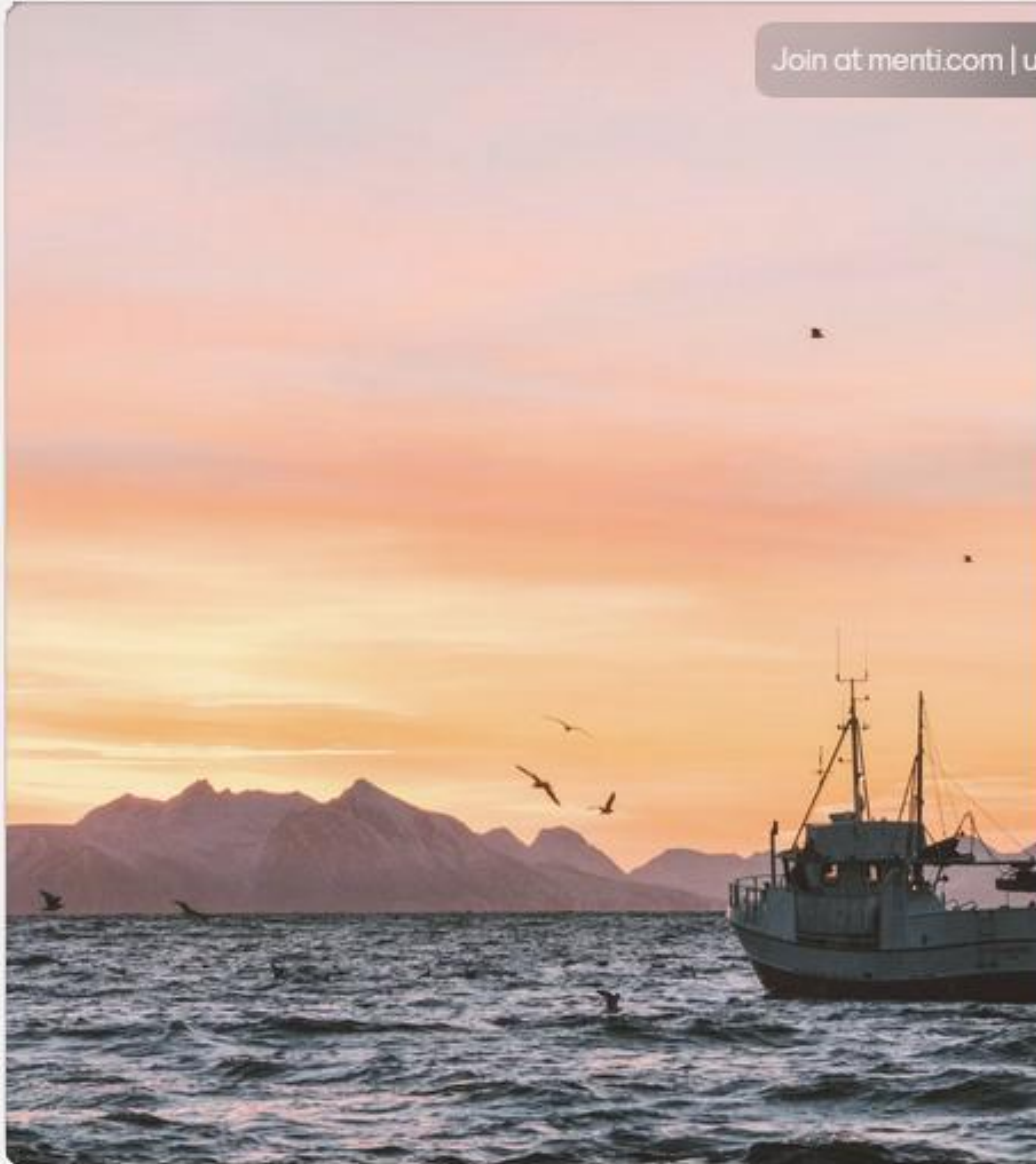
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Mentimeter

Compared to 10 years ago, is the actual, current level of IUU fishing:



30 / 37



Why is Quantifying IUU Fishing Difficult?

- 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 intransparent (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 about the amount of IUU fishing found

Why is Quantifying IUU Important?

- 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

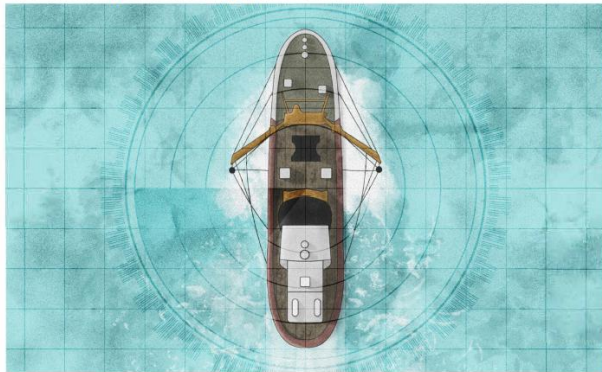
Estimation Tools



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

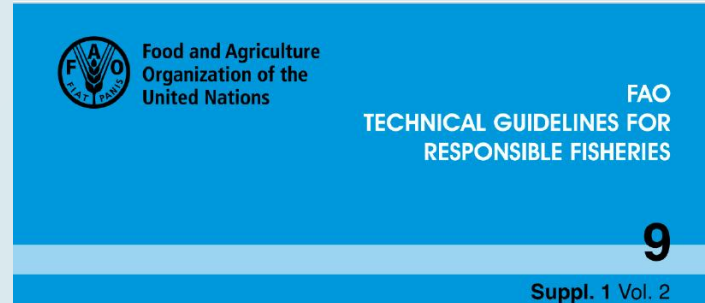
1. Methodologies and indicators for the estimation of the magnitude and impact of illegal, unreported and unregulated fishing

1.1 Principles and approaches



Volume 1

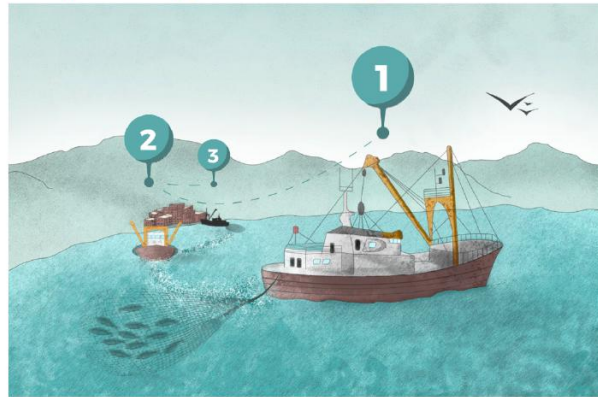
Principles and Approaches



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

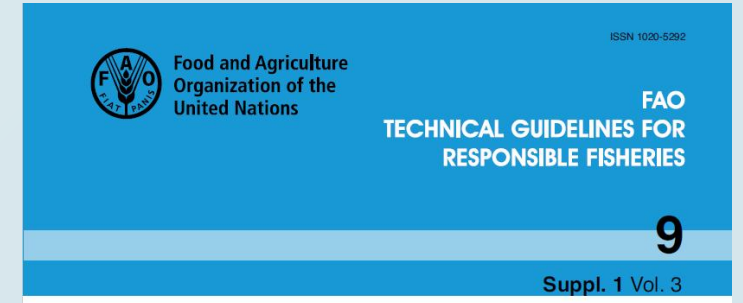
1. Methodologies and indicators for the estimation of the magnitude and impact of illegal, unreported and unregulated fishing

1.2 A practical guide to delivering an estimate



Volume 2

Practical Guide



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

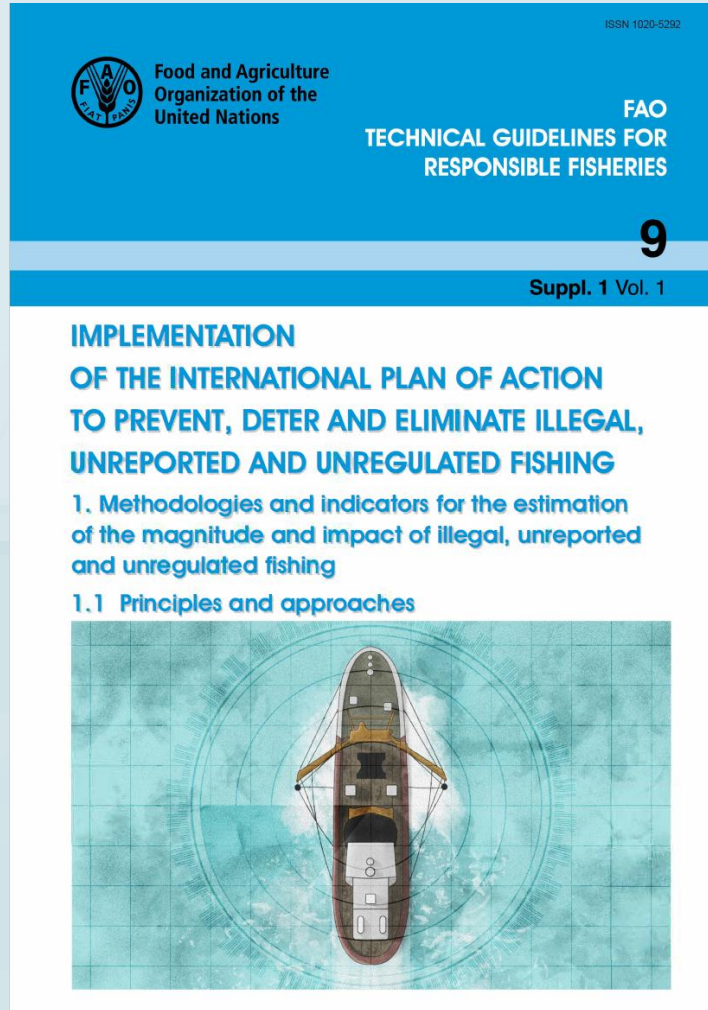
1.3 A catalogue of examples



Volume 3

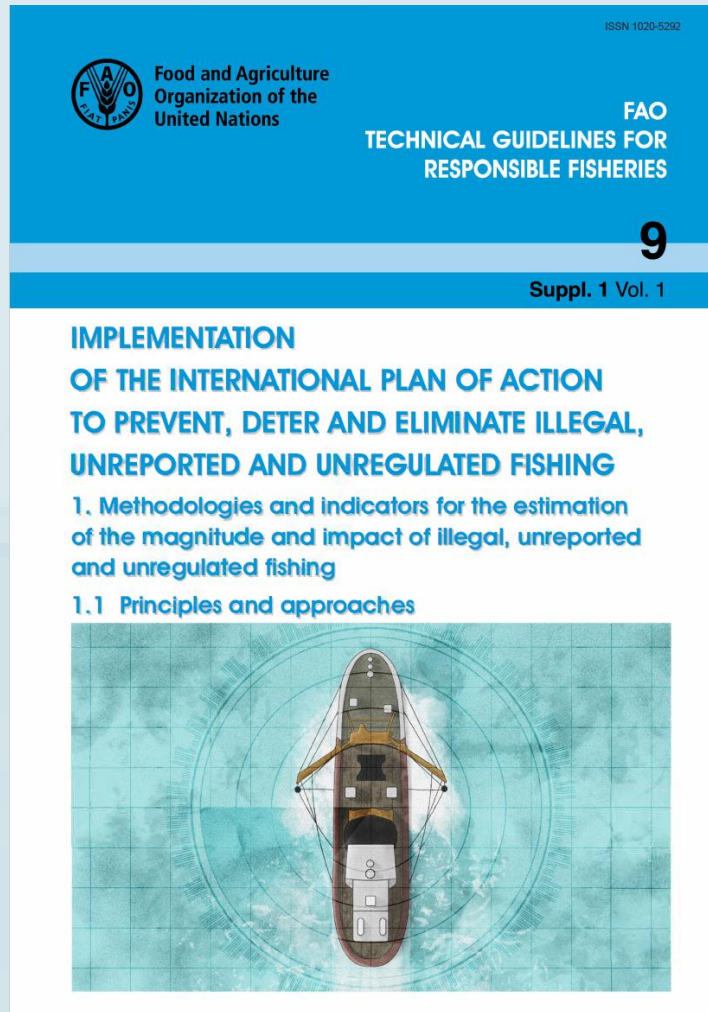
Catalogue of Examples

Volume 1 – Principles and Approaches



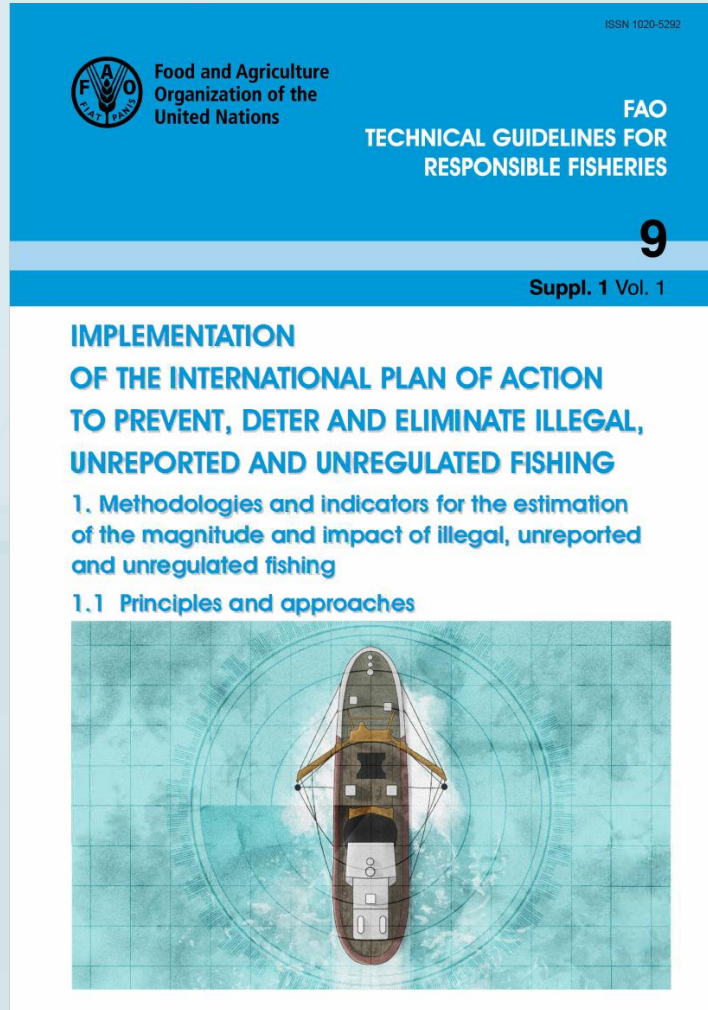
- Provides some analysis of the definition of IUU
- Explains how to define the scope of the estimate
 - By fisheries/sectors
 - By species
 - By area/region
 - By timeframe
 - By activities (e.g. illegal and unreported, but not unregulated)

Volume 1 – Principles and Approaches



- Highlights characteristics of a robust estimate:
 - Reproducible methods
 - Data-driven
 - Triangulation
 - Clear assumptions
 - Accounts for uncertainty
- Encourages stakeholder involvement and peer review

Volume 1 – Principles and Approaches

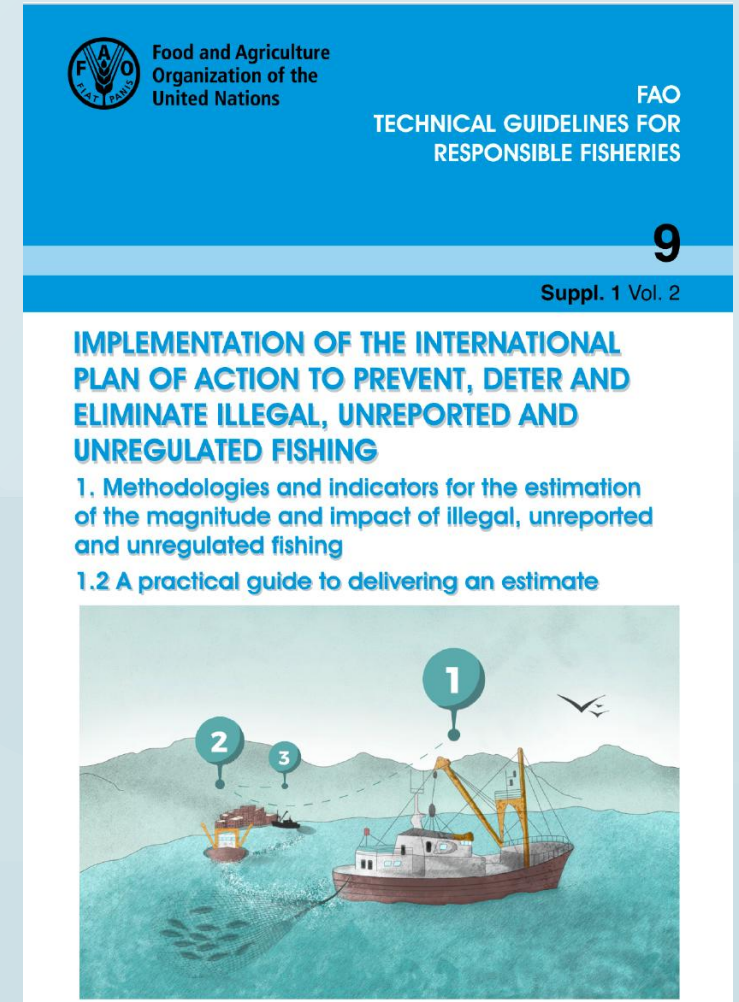


- Table of IUU fishing risk activities
 - Encroachment
 - False documentation
 - Area/species/gear/transport
 - Legal non-reporting
 - Improper reporting
- Risk identification & assessment
 - Identify distinct risks
 - Assess their relative importance

Volume 2 – Practical Guide

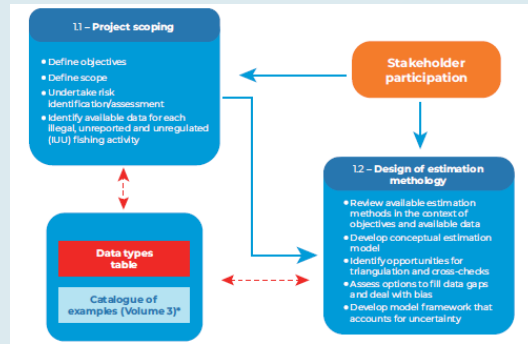
- Flowchart of steps for “project managing” an IUU fishing estimate

- Planning
- Execution
- Presentation

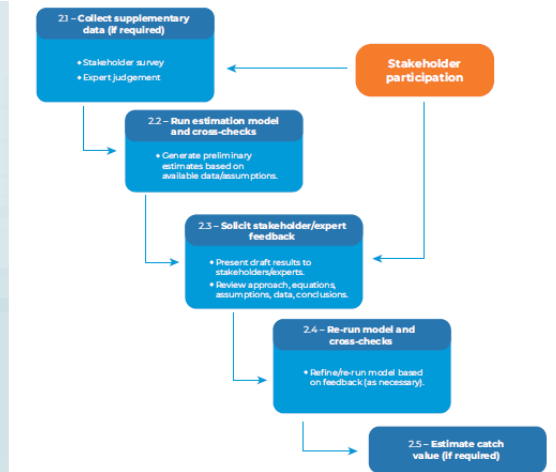


Volume 2 – Practical Guide

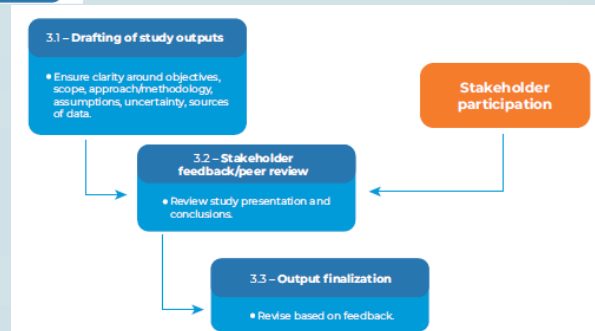
Planning




Execution



Presentation




Food and Agriculture Organization of the United Nations

FAO
TECHNICAL GUIDELINES FOR RESPONSIBLE FISHERIES

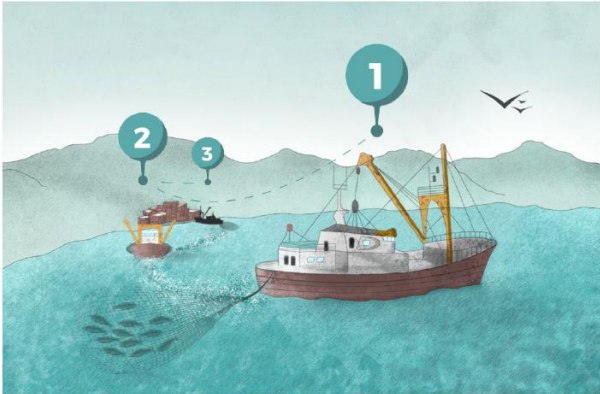
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Suppl. 1 Vol. 2

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

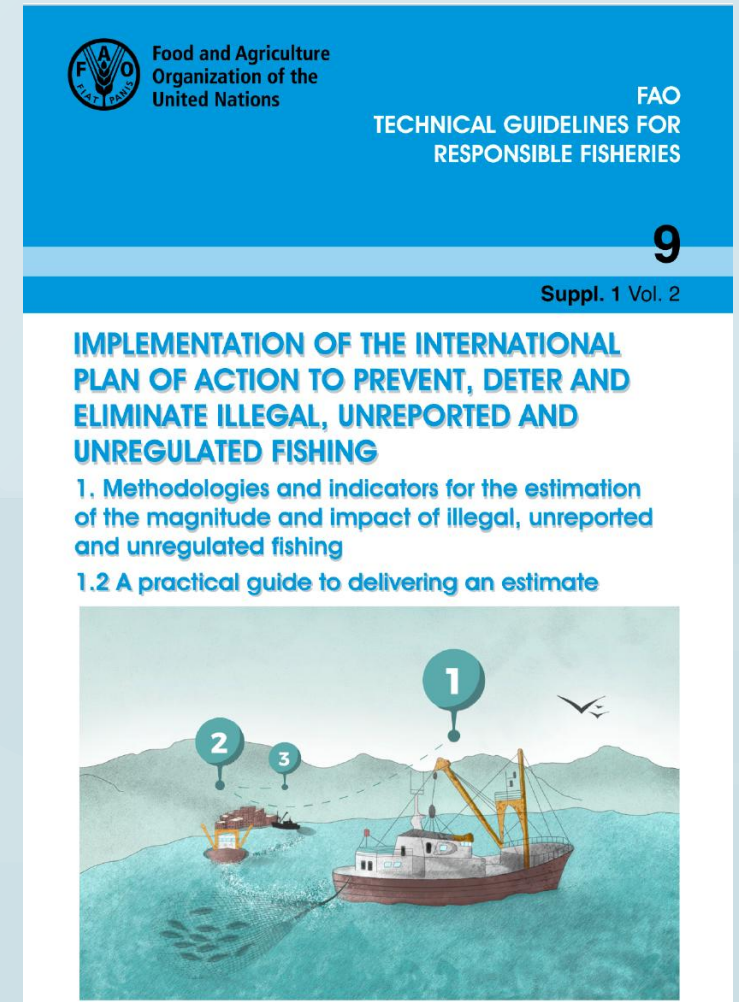
1.2 A practical guide to delivering an estimate



Volume 2 – Practical Guide

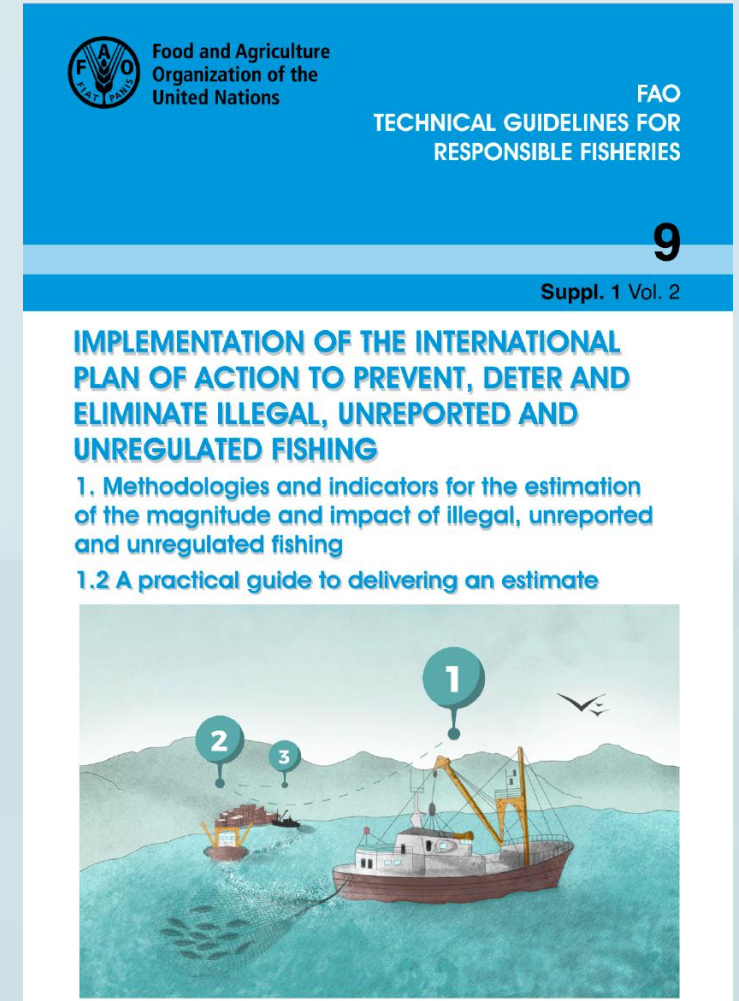
- Table of potential data types and their strengths and weaknesses

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

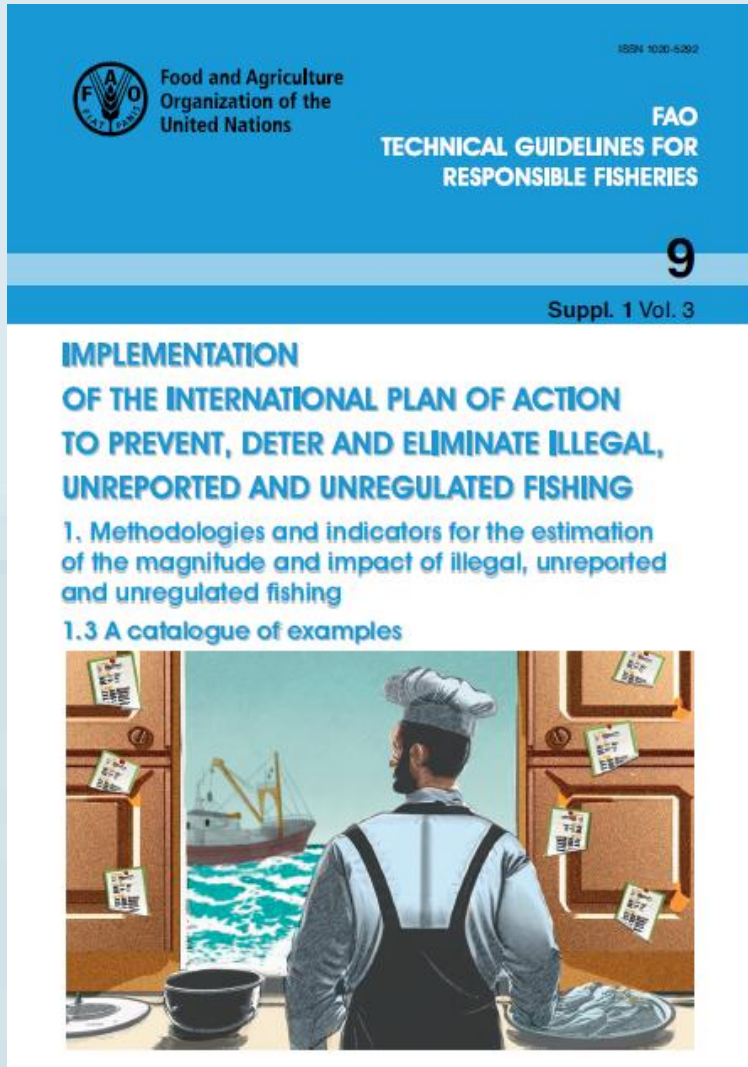


Volume 2 – Practical Guide

- Use a combination of methods (triangulation)
- Account for uncertainty
- Methods characterized as either:
 - Bottom up
 - Top down

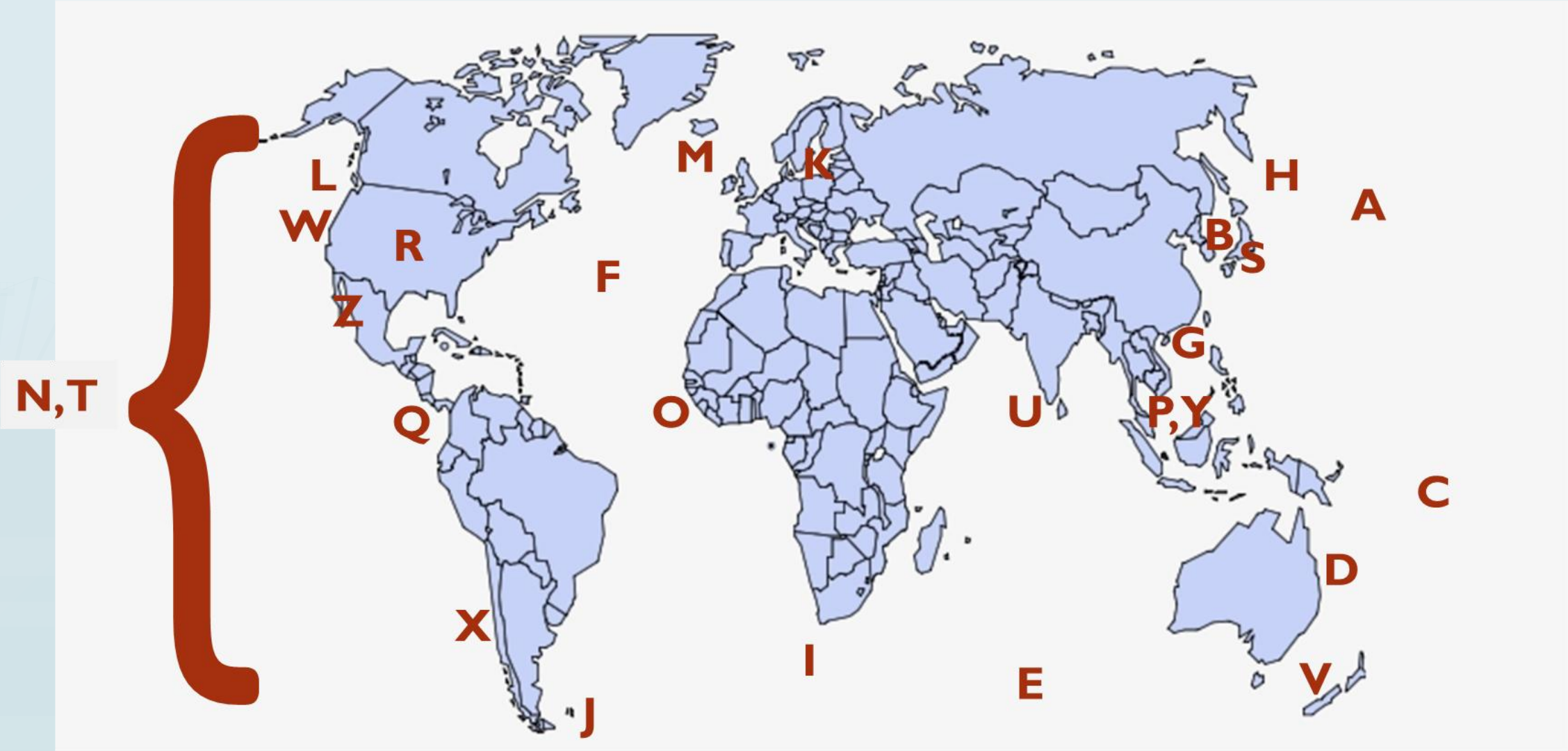


Volume 3 – Catalog of Examples



- Detailed guidance on how to actually do an estimate
- Each situation will be unique, so providing detailed advice in every case is impossible
- Points to the most relevant existing examples in the form of “recipe cards” and keys to find the best “recipe”

Geographic Representation



Sector Representation

Industrial



A, B, C, E, F, H, J, K, L, O, V

Including purse seine, pelagic and bottom longline, pelagic and bottom trawls, squid jiggers, drift nets, bright light nets

Small-scale



D, Q, W, Z

Including coastal longlines, hand lines, diving, mixed gear

Combination



G, I, M, N, P, R, S, T, U, X, Y

Including diving, trawls, purse seine, longline, drift nets, handlines, bomb fishing, poison fishing

Example "Recipe Card"

Reference

Summary

Indexing

HEADER

Study
 Clarke, S.C., McAllister, M.K., ... d, E.J., Kirkwood, G.P., Michielsens, C.G., ... gnew, D.J., Pikitch, E.K., Nakano ... vji, M.S. 2006. Global estimates of shark catches using trade records from commercial markets. *Ecology Letters*, 9(10): 1115-1126.

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

Approach
 Estimated from ... reported catch. **Yellow approach group**

Ingredients

Key constituents	How they sourced it	Other ways to source it
1. Quantity of product traded per unit time	Compiled market (auction) records showing trade name, product sizes and quantities	<ul style="list-style-type: none"> repeated observational market surveys (e.g. photos, counts) published records of wholesale markets (if product is a standard weight/size)
2. Species identity of product	Used genetic testing to match trade name to species	<ul style="list-style-type: none"> rely on market names to be species-specific, or use expert judgement to make an allowance for mixing if doing market observational surveys, use visual identification gather and apply expert judgement
3. Conversion factors from product to whole fish	Used morphometrics from literature and sampling whole fish	<ul style="list-style-type: none"> use measurements from photographs gather and apply expert judgement
4. Conversion factors from sampled market to entire market	National customs statistics from major markets	<ul style="list-style-type: none"> trade compendiums e.g. FishStatJ or COMTRADE gather and apply expert judgement estimate from sales quantity or value figures

APPLICABILITY

RECIPE

Steps	Example	Cautions
1. Estimate the total product quantity traded per unit time	Each auction handles 400 kg of shark fins. Auctions are held on Mondays. 400 kg x 52 = 20.8 tonnes of shark fins per year	<ul style="list-style-type: none"> Account for variability in quantities traded. May need to fill in missing data. Some trade data are only available monthly or yearly.
2. Break the total quantity into species-specific quantities	If 20.8 tonnes of shark fin per year, and half is blue shark, = 10.4 tonnes of blue shark fins	<ul style="list-style-type: none"> Account for uncertainty in species proportions. If species identification is unavailable, estimates may need to stay at a higher taxonomic level.
3. Convert the product to whole fish	If dried fins are 2% of wet weight, 10.4 tonnes of blue shark fins represents 520 tonnes of blue shark	<ul style="list-style-type: none"> Conversion factors may vary by species. Products may not all be the same size. 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 = 1 560 tonnes of blue shark were traded (live equivalent)	<ul style="list-style-type: none"> 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	1 560 tonnes of blue shark is X% of reported catch	<ul style="list-style-type: none"> This comparison will be most 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.

APPLICABILITY

Best suited to: <ul style="list-style-type: none"> conspicuous and valuable internationally traded products; a central market node that can represent 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: <ul style="list-style-type: none"> products are not distinguished (or mixed) in trade/market statistics; there are many or diverse markets; conversion factors are imprecise or unavailable; and personnel are unfamiliar with statistical methods for incorporating uncertainty.
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Example "Recipe Card"

Constituents

Study

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

Simple summary

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

Total catch minus reported catch

Yellow approach group

Data

Commercial sources

Data group 2

Key constituents	How they sourced it	Other ways to source it
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2. Species identity of product	Used genetic testing to match trade name to species	<ul style="list-style-type: none"> rely on market names to be species-specific, or use expert judgement to make an allowance for mixing if doing market observational surveys, use visual identification gather and apply expert judgement
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3. Conversion factors from product to whole fish	Used morphometrics (measurements) of whole fish	<ul style="list-style-type: none"> use measurements from photographs gather and apply expert judgement
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4. Conversion factors from sample to estimate	Trade statistics from major markets	<ul style="list-style-type: none"> trade compendiums e.g. FishStatJ or COMTRADE gather and apply expert judgement estimate from sales quantity or value figures
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Sources

INGREDIENTS

Alternatives

RECIPE

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Example "Recipe Card"

Steps

Examples

Cautions

HEADER

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Estimate total catch minus reported catch. **Yellow approach group**

Data group
Commercial sources. **Data group 2**

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RECIPE

Example "Recipe Card"

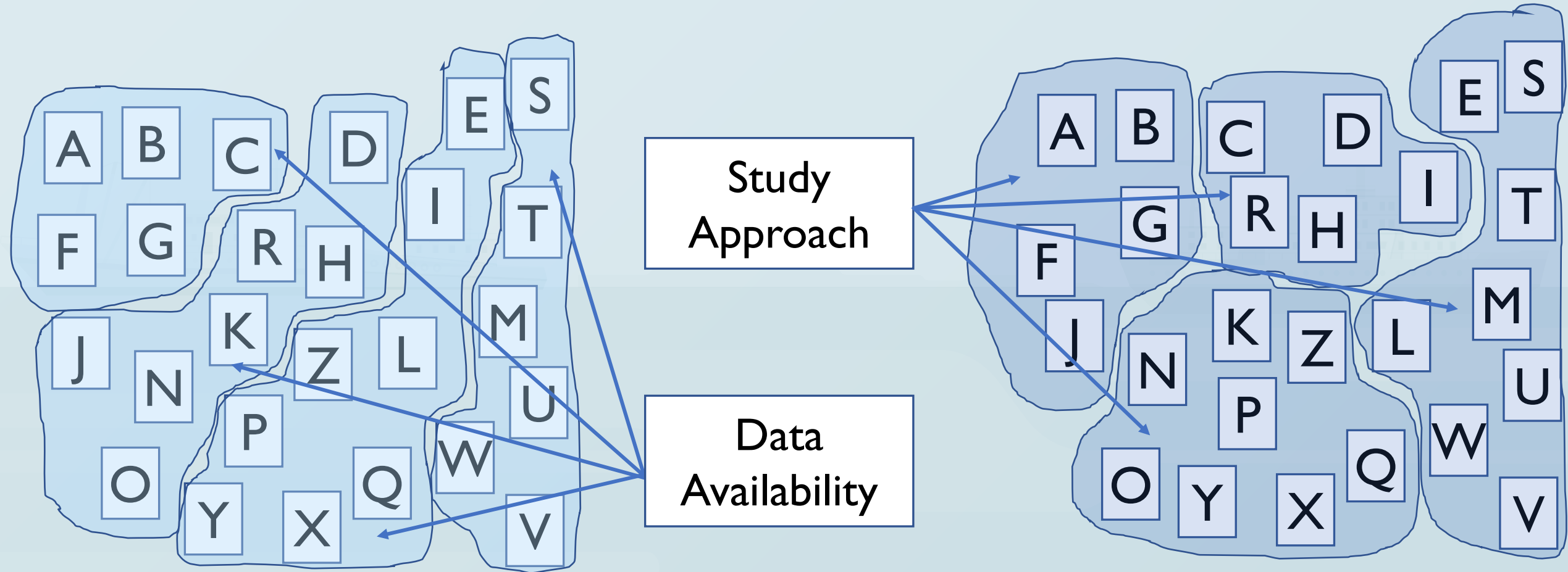
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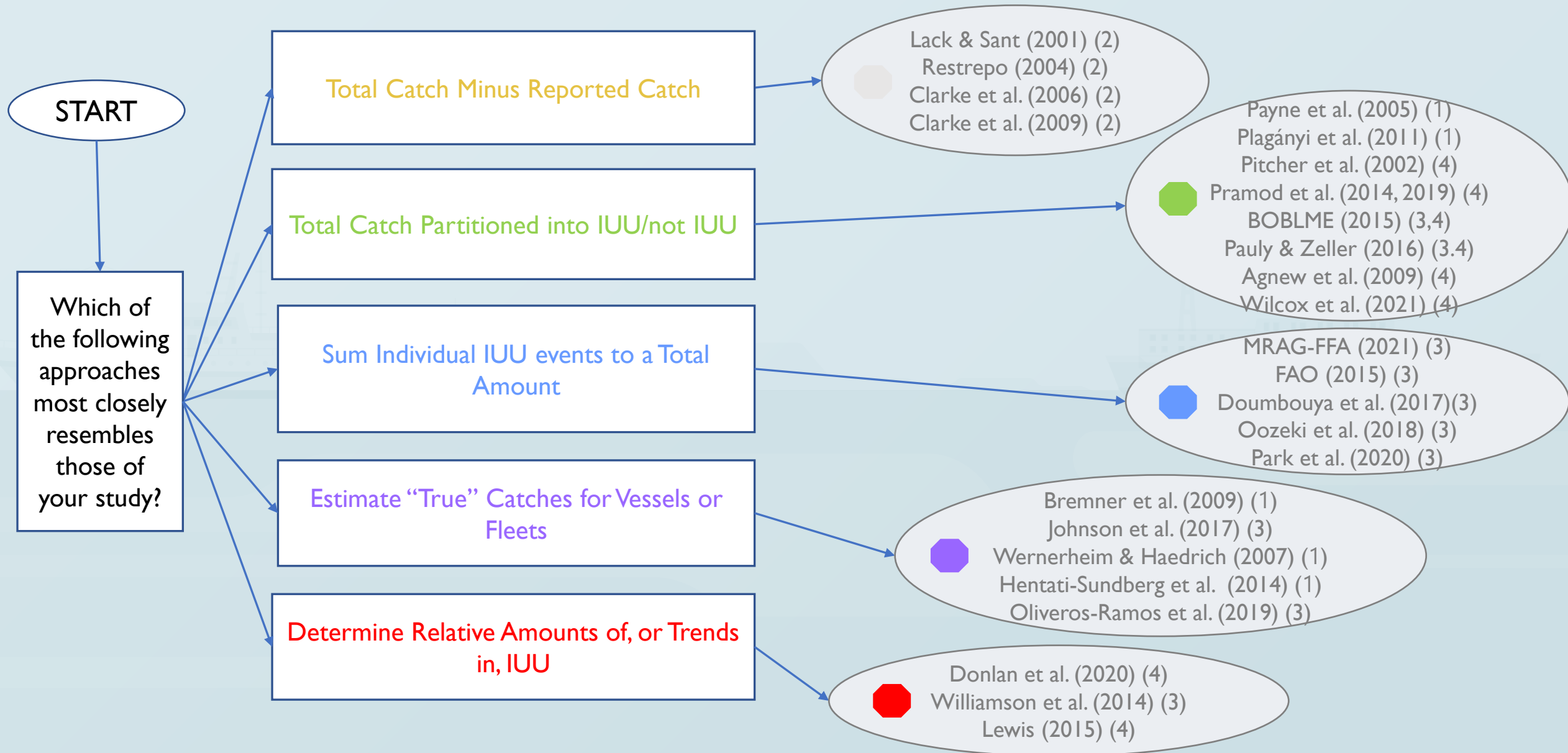
Best suited to

Difficult to apply to

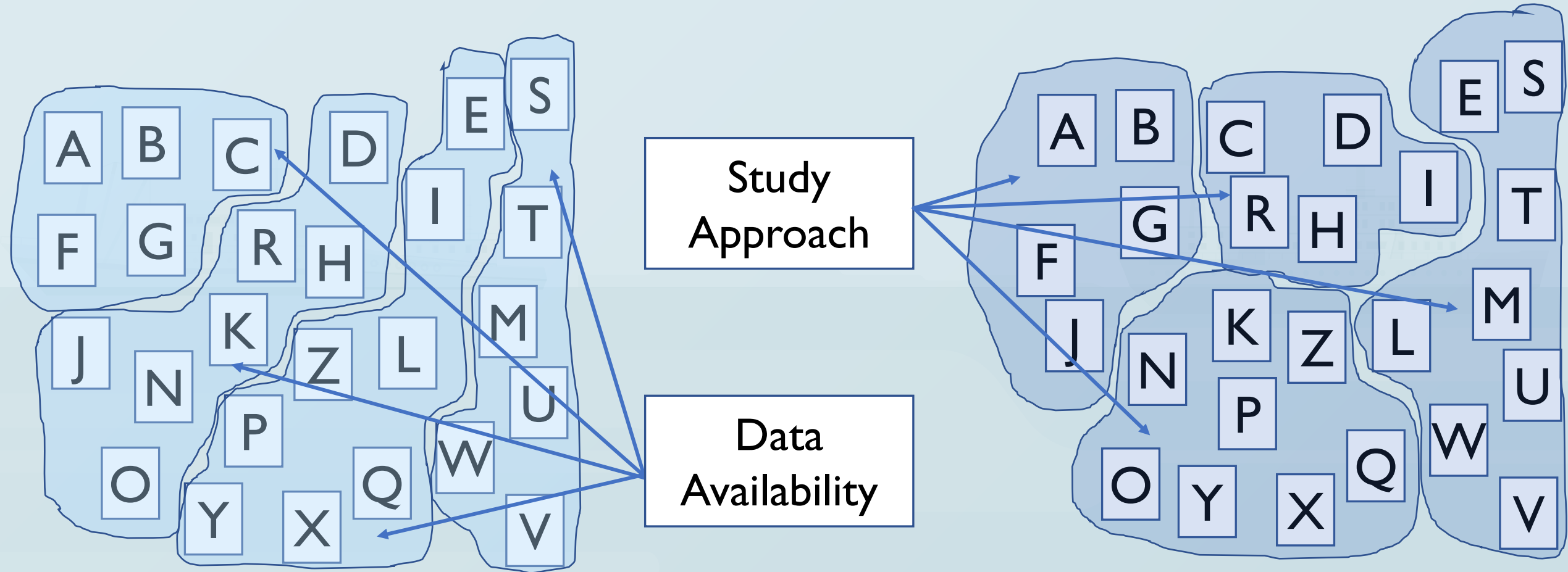
Two Types of Classification



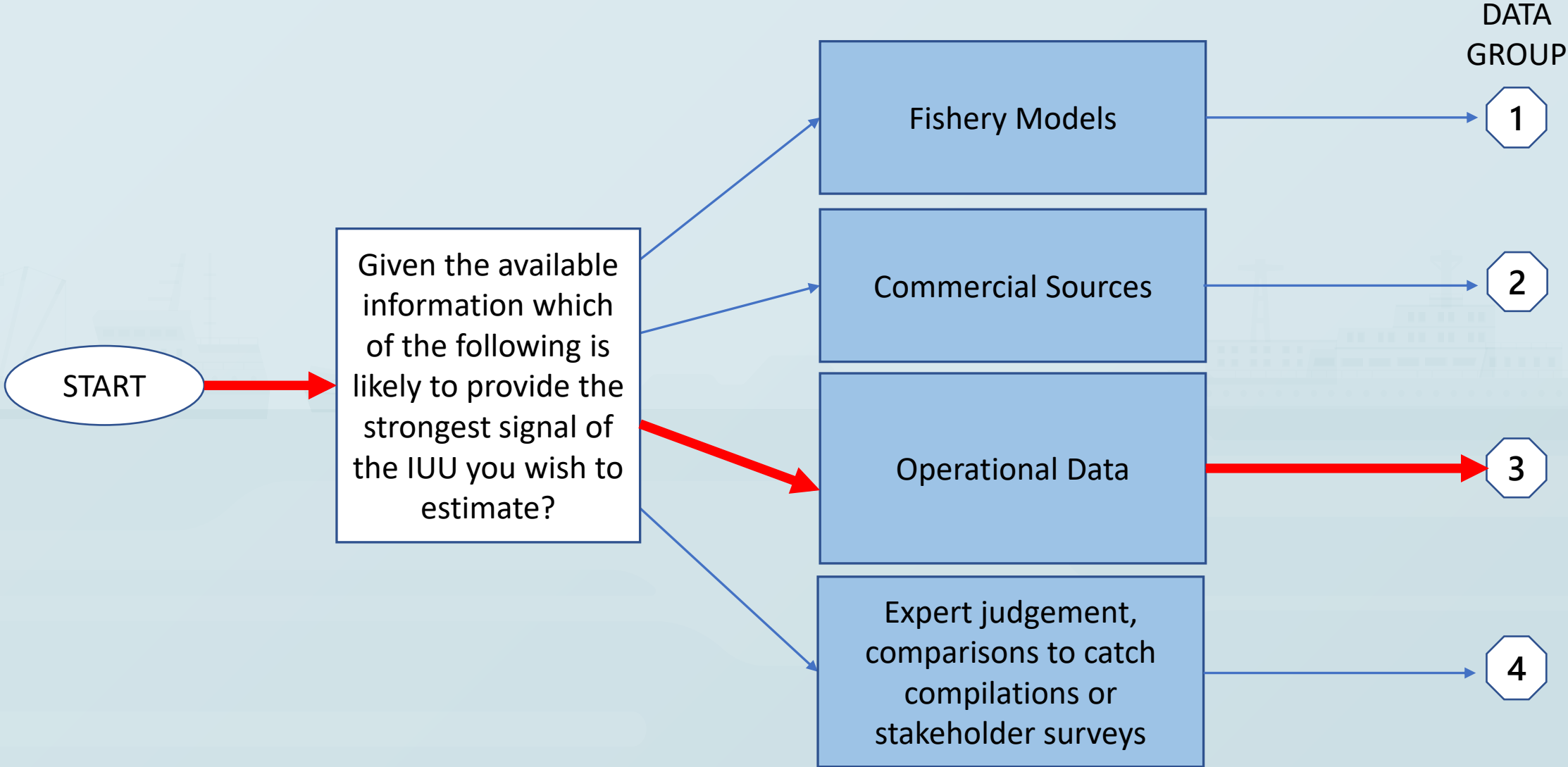
Classification by Study Approach



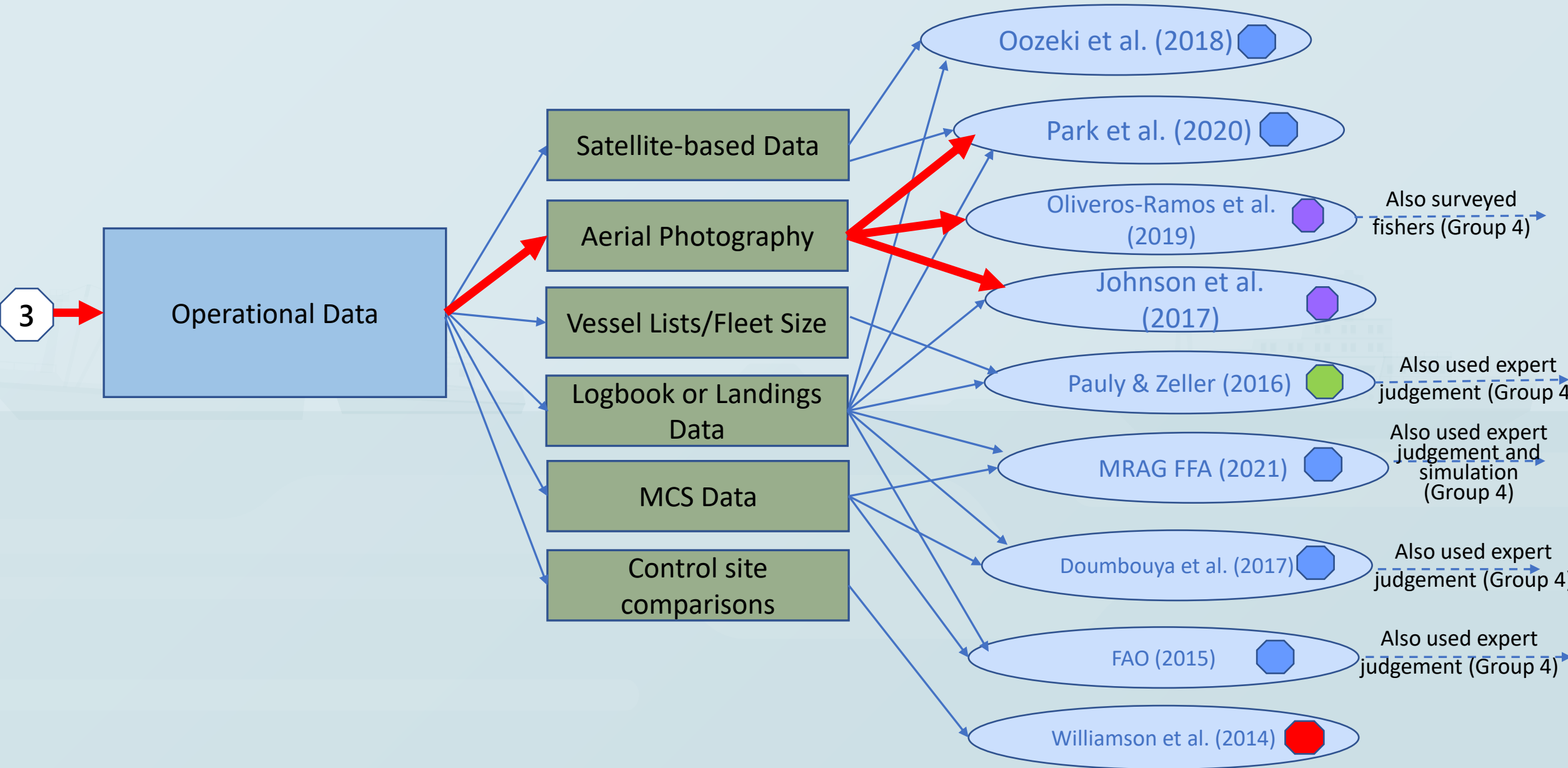
Two Types of Classification



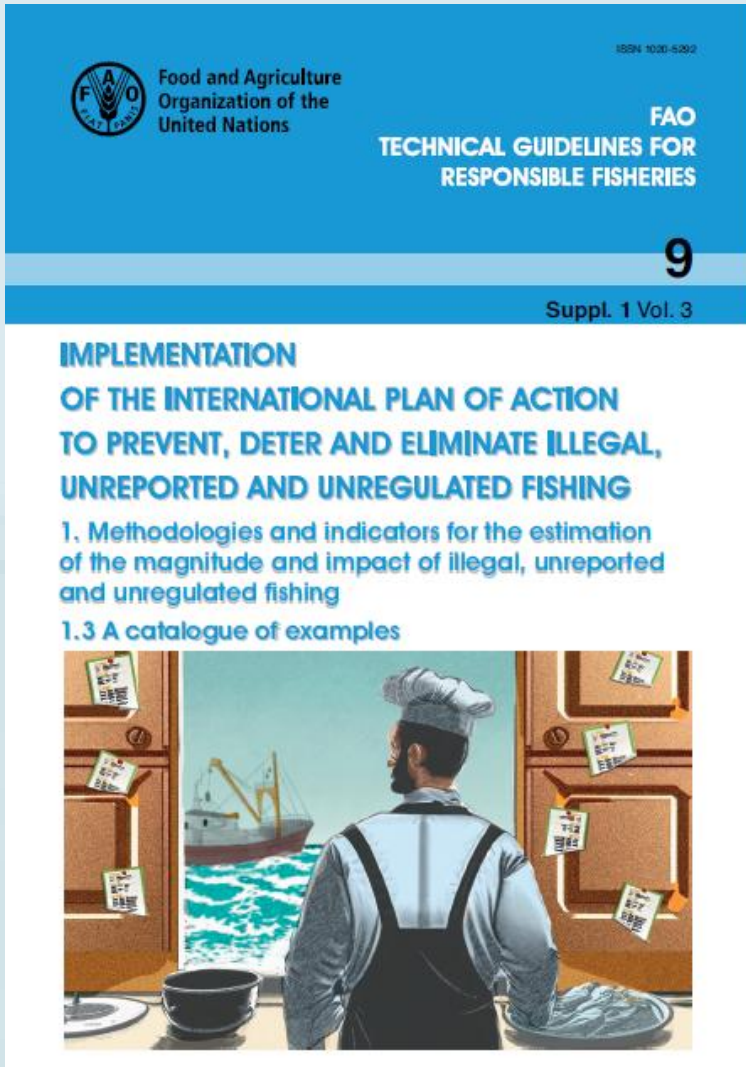
Classification by Data Availability



Classification by Data Availability



Volume 3 – Catalog of Examples

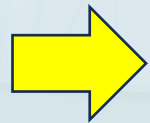


- 20 of 26 methodology authors reviewed their ‘recipe cards’—comments incorporated
- Even when simplified, it’s quite complex
- More of a reference for analysts than national authorities

Polling



Round 1 – Perceptions of IUU fishing



Round 2 – Objectives of IUU fishing quantification

Round 3 – Who will quantify IUU fishing and how



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Mentimeter

How would you rank the importance of the following reasons for quantifying IUU:

1. Understand the true quantity of removals
(for stock assessment)



2. Understand economic impacts



3. Understand how to strengthen monitoring,
control and surveillance (MCS)



4. Motivate political will



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In combatting IUU fishing, how important is it to know the amounts taken before and after your management action?



Mentimeter



27 / 37





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Mentimeter

When quantifying IUU fishing, would you estimate illegal (I), unreported (U), and/or unregulated (U) fishing?

1. Illegal, Unreported and Unregulated (separately)
2. Illegal, Unreported and Unregulated (as one number)
3. Illegal and Unreported only (as one number)
4. Illegal and Unreported only (separately)
5. Illegal only

26 / 37



A different approach

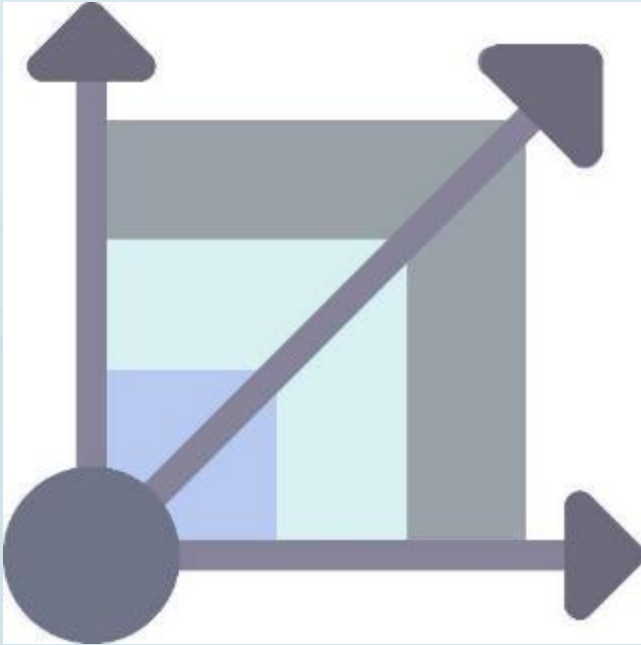
- Given that lack of data (quantity, type or high uncertainty), resources or expertise will often hamper IUU fishing estimates:
 - Is there a quicker and simpler way to try to assess whether IUU fishing is getting better or worse?
 - Can such an assessment help us better understand how to fix the problem?



Indicators

Two approaches to quantification

Estimates



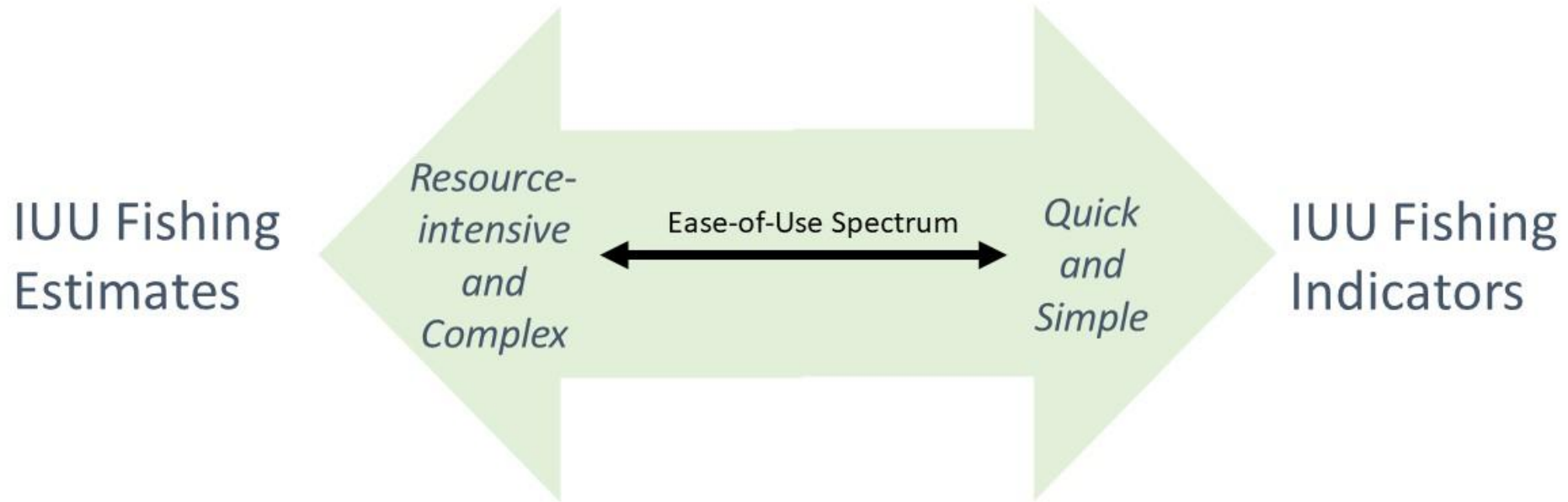
Aim for the best possible measure of the amount of IUU fishing (quantity or value)

Indicators



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

Estimates versus Indicators



- Aim to measure IUU fishing directly
- Framed as catch quantity or value
- Often single-figure
- Can be resource-intensive
- May require specialist expertise
- Methods may be difficult to explain

- Provide insights to, but do not measure IUU fishing directly
- Easy to calculate and update
- Multiple measures can be used as a suite
- More practical to compare across fisheries
- Drawn from, and provide feedback to, MCS systems
- Individual indicators may have multiple interpretations; suites of indicators may show contradictory trends

Review of Crime and Drug Indicators

- Similarities to IUU fishing indicators include:
 - Wish to know the true rates of occurrence but only detected occurrences can be tracked
 - Detection rate is not constant but rather a function of surveillance effort and the efficiency of the monitoring and enforcement systems
- Review included:
 - Crime statistics and how to compare across systems (e.g. Africa); National police performance metrics and indicators (Canada, Ireland, USA); and Anti-drug strategy performance measures (Caribbean, UK)

Review of Crime and Drug Indicators (cont.)

Findings



- These systems often use citizen surveys to estimate the “true” crime and crime reporting rates (this obviously will not work in a fisheries setting)



- Criminal justice system indicators often use ratios (detections per unit of surveillance effort)

Rates, Trends and Ratios

Example:

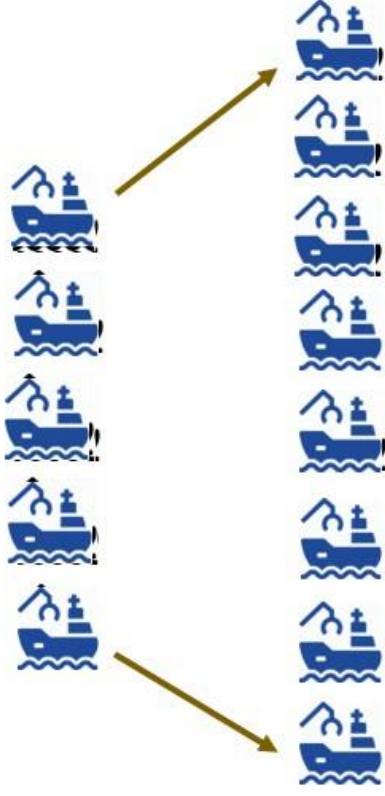
Unobserved trans-shipments



2022=5



2023=8



$2023/2022 = 8/5 = +60\%$



2022=5/11=45%



2023=8/20=40%

RATE

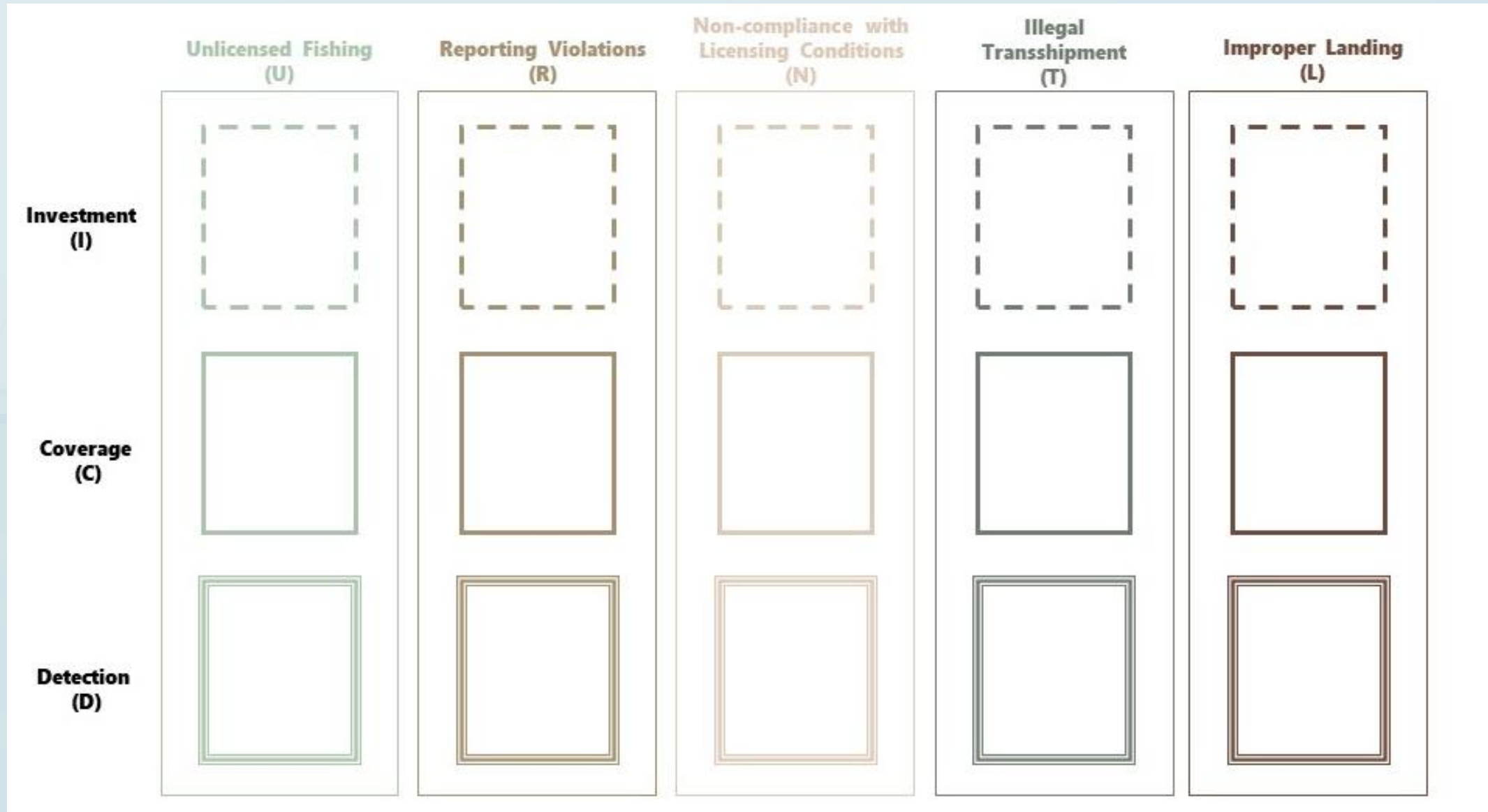
TREND

RATIO

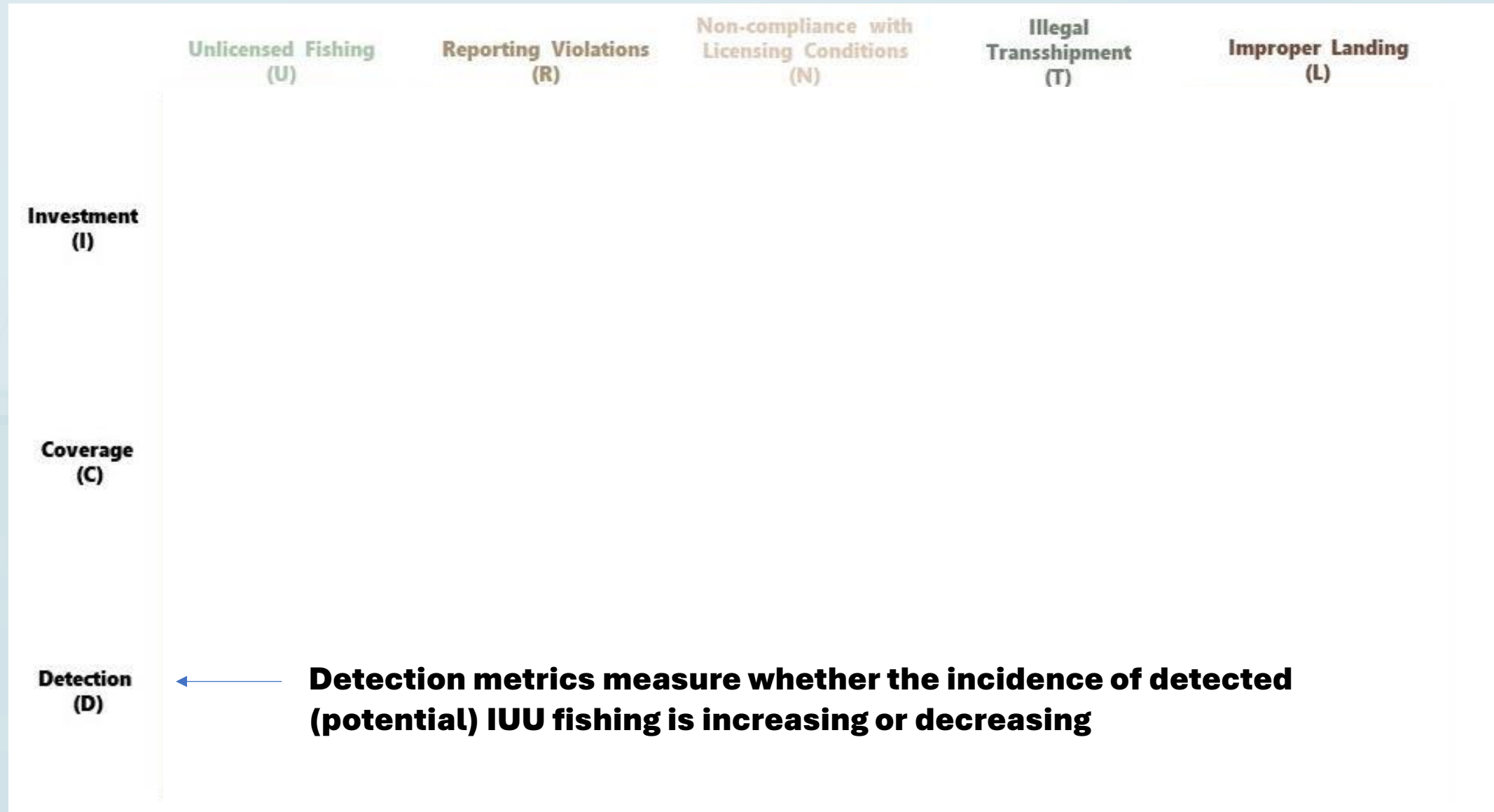
Review of Crime and Drug Indicators (cont.)

- These systems often use citizen surveys to estimate the “true” crime and crime reporting rates (this obviously will not work in a fisheries setting)
- Criminal justice system indicators often use ratios (detections per unit of surveillance effort)
- These systems frequently have indicators to measure investment, i.e. steps taken to improve the likelihood of detection
- Some systems establish a hierarchy of importance so that not all indicators need to be calculated each time

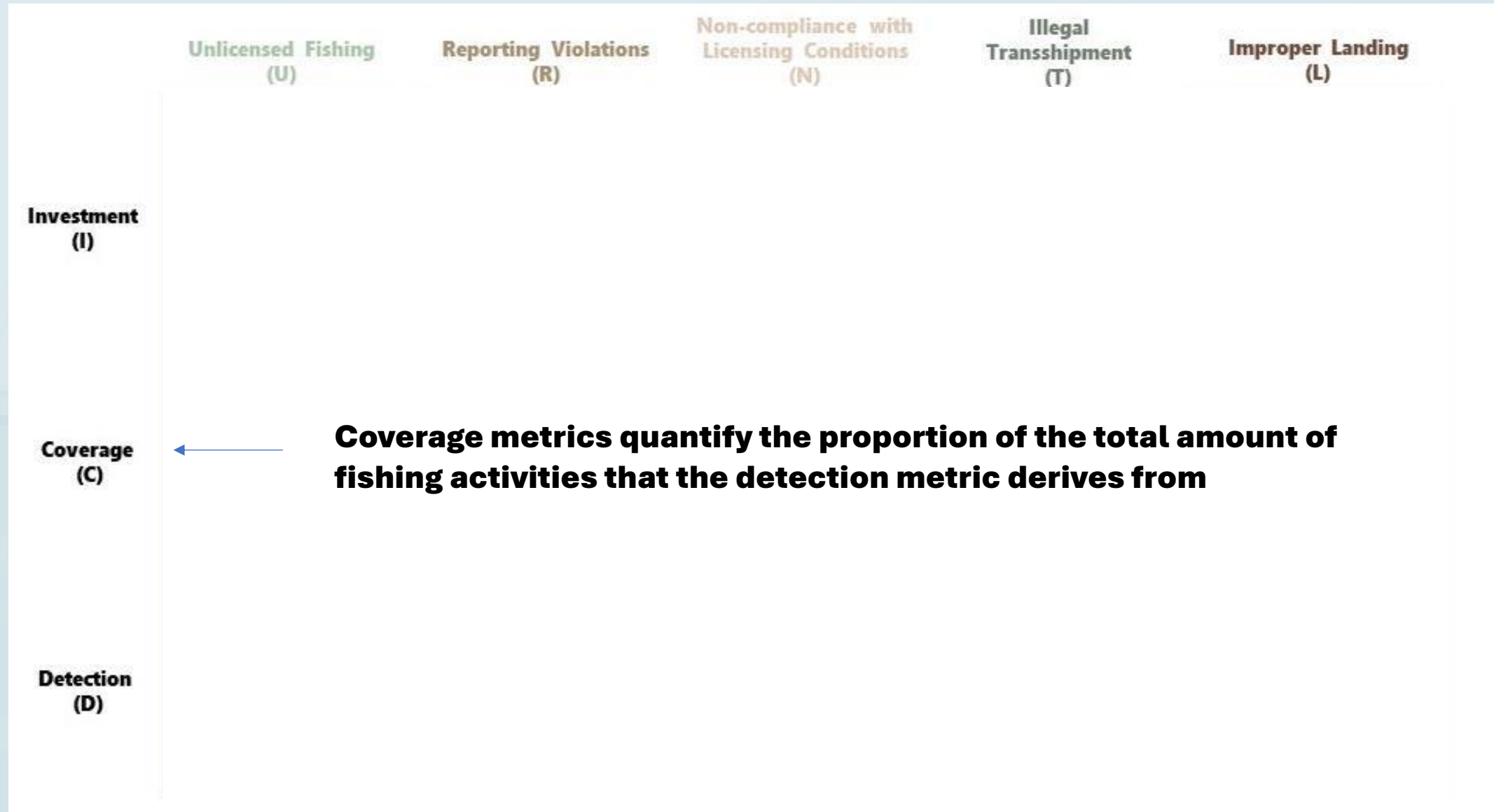
Universal IUU Fishing Indicator Framework



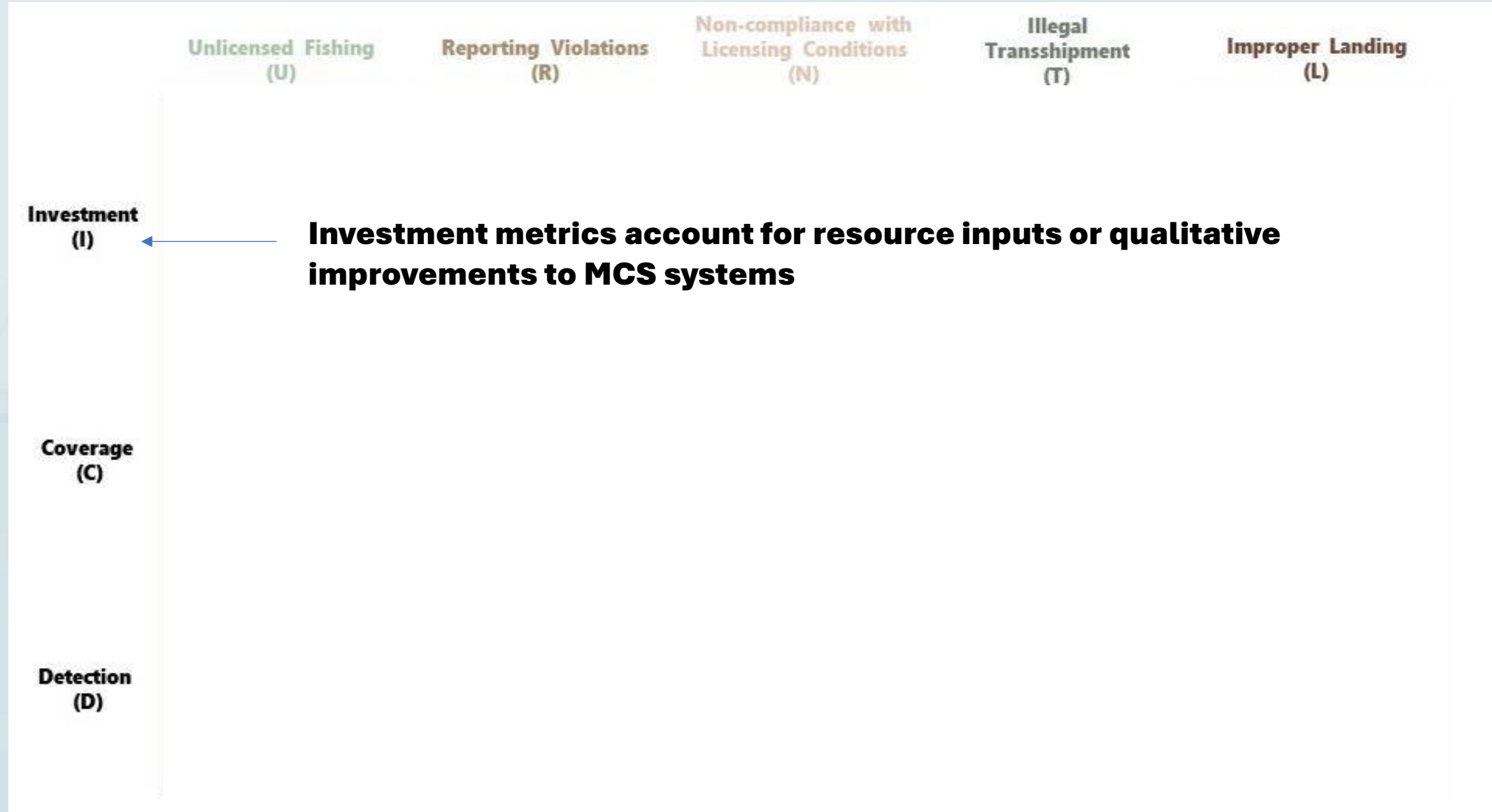
Universal IUU Fishing Indicator Framework



Universal IUU Fishing Indicator Framework



Universal IUU Fishing Indicator Framework



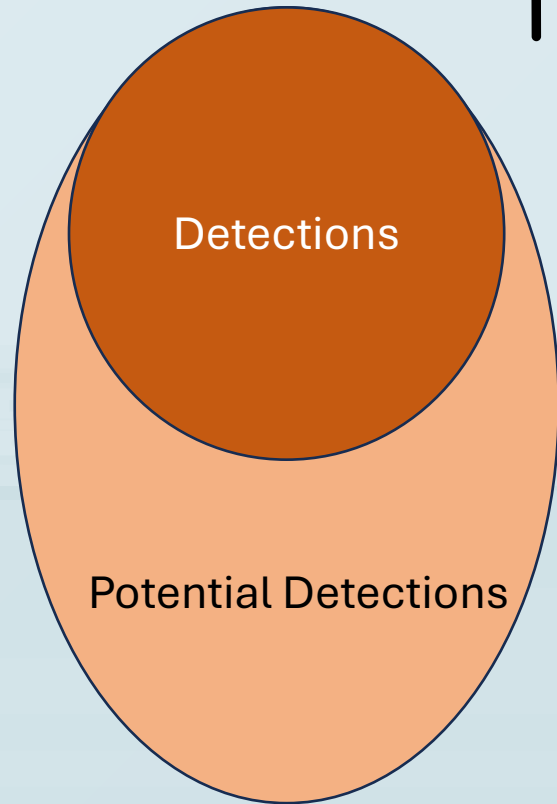
Universal IUU Fishing Indicator Framework



Indicator Structure

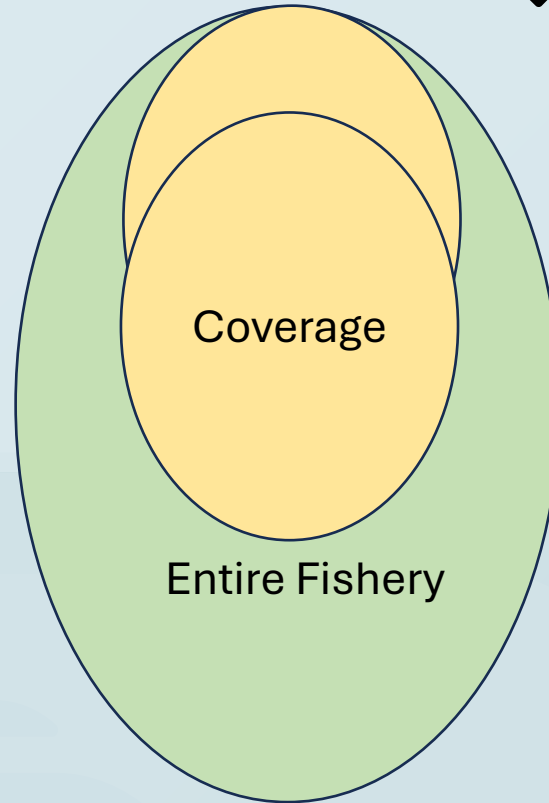

Positive
direction of
change:

Detections
shrink




Detection Indicators
(ratios)

Coverage
expands



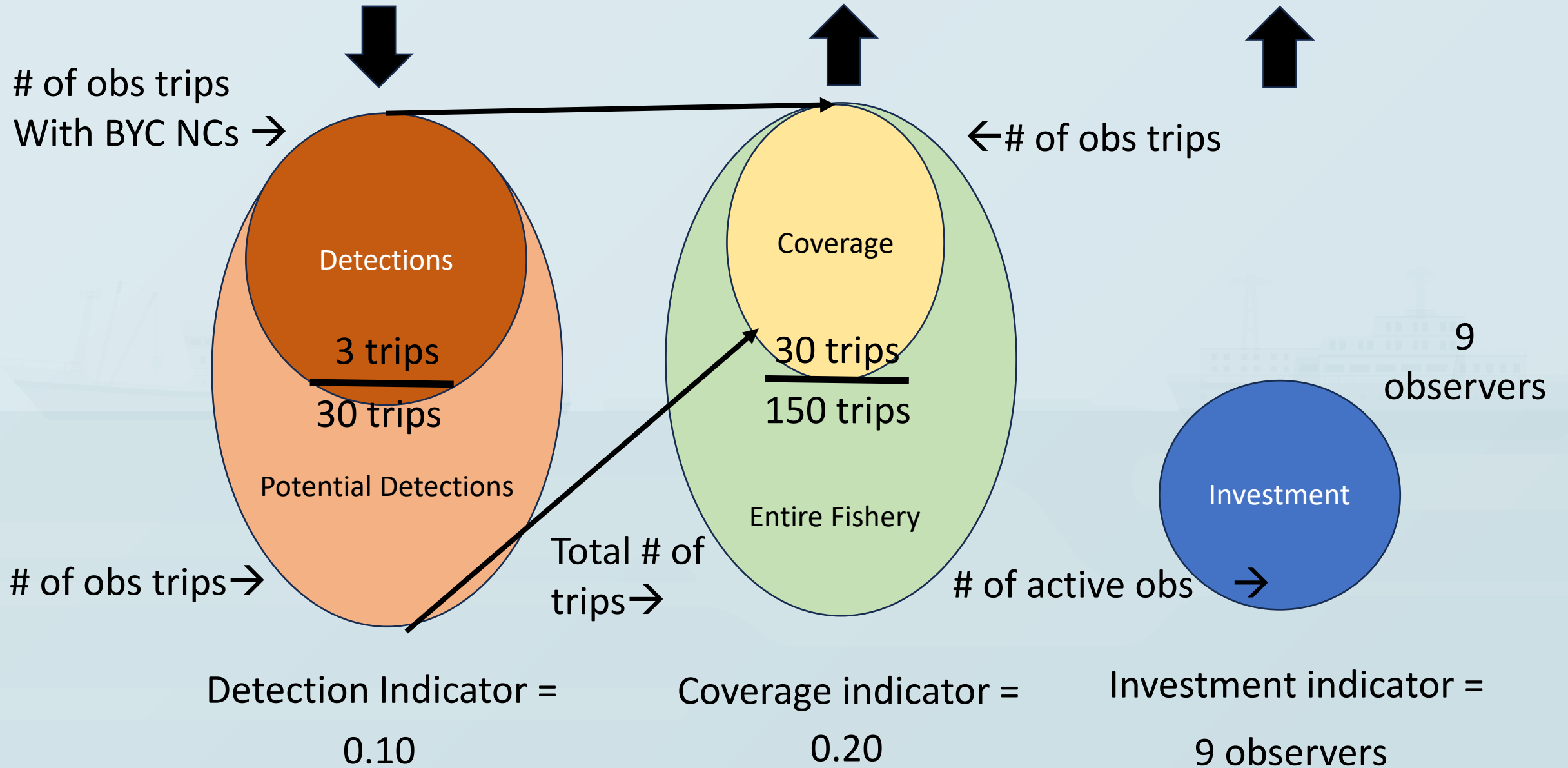
Coverage indicators
(ratios)

Investments
increase

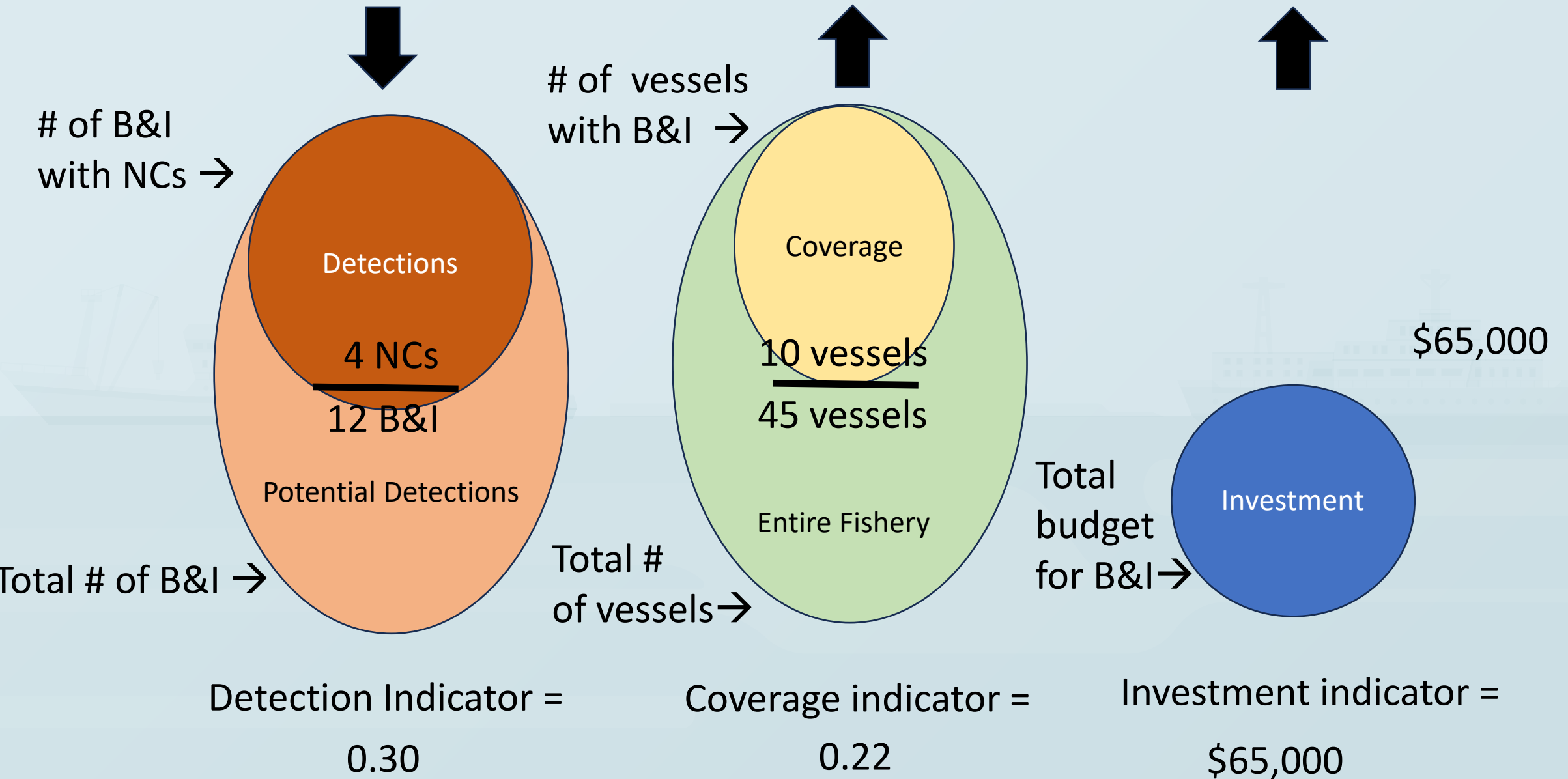


Investment indicators
(quantities)

Indicator Example #1 - Bycatch

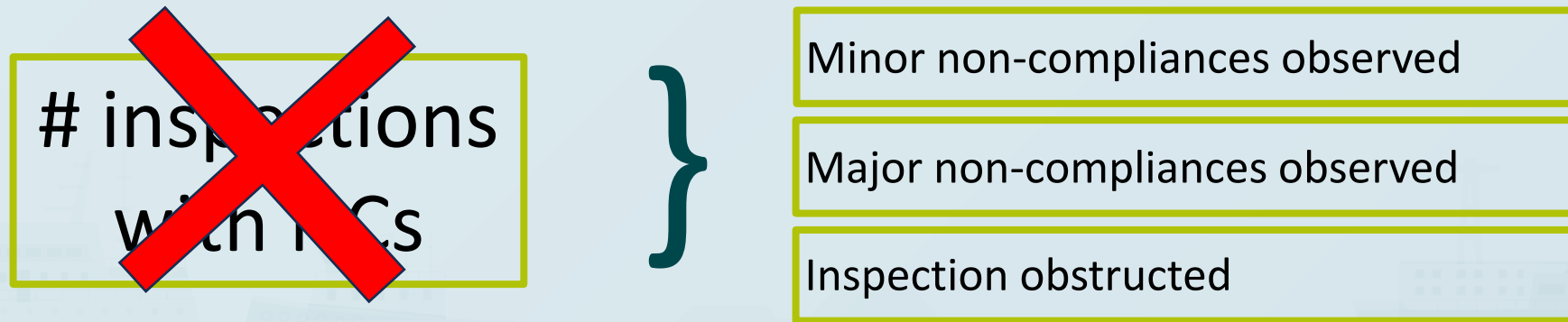


Indicator Example #2 – Boarding and Inspection



Specification of Indicators

- Use hierarchies to track at a more granular level:



- If concerned about data quality issues, increase precision:



Worked Examples in the Guidance Document

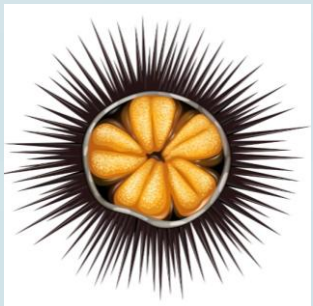
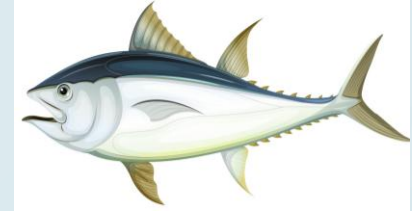


1. Distant Water High Seas Squid Fishery

2. Tuna Fishing by Foreign Vessel in Coastal State Fishing Grounds

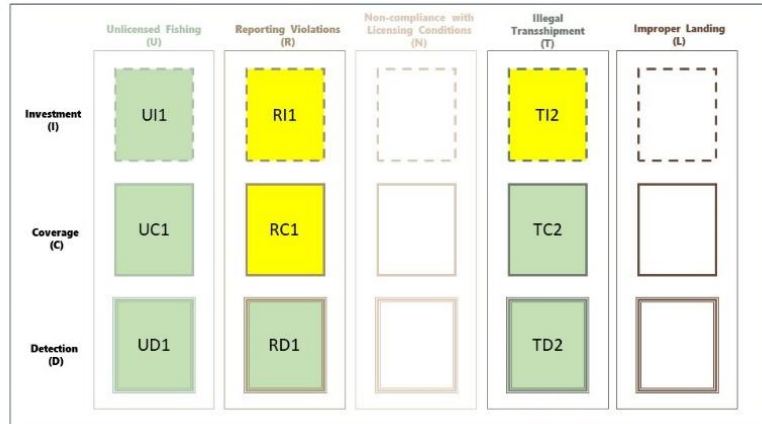
3. Domestic Commercial Trawl Fishery for Mackerel

4. Domestic Invertebrate Dive Fishery



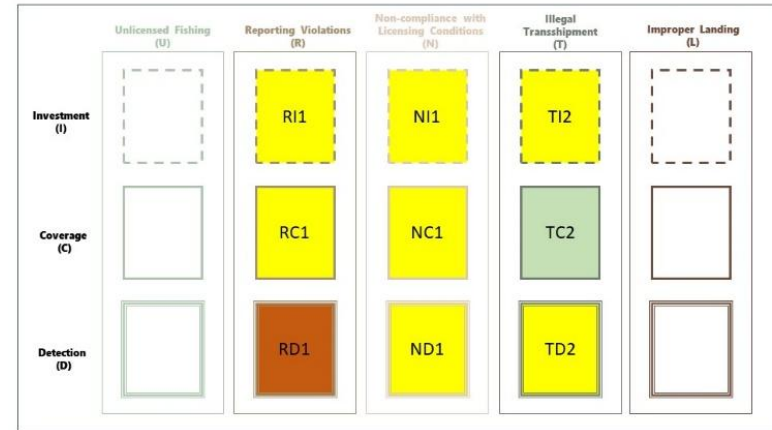
Summary of Worked Examples using Hypothetical Data

Case Study 1



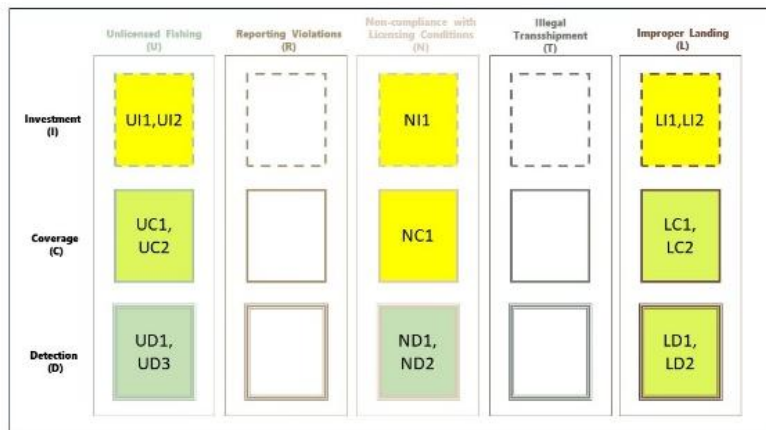
OVERALL: All three detection indicators show only low incidences of IUU fishing, however, further investment is needed to improve coverage for the reporting indicator and improve the quality of coverage for the transshipment indicator.

Case Study 2



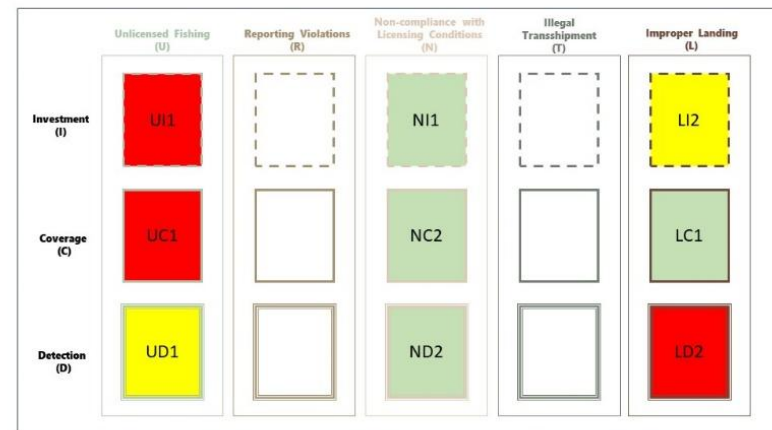
OVERALL: Under-reporting of target species was detected but better understanding of this risk requires improved observer coverage which would also assist with monitoring non-compliances related to bycatch. Transshipment coverage is high but requires quality improvements to distinguish between real and suspected IUU fishing risks.

Case Study 3



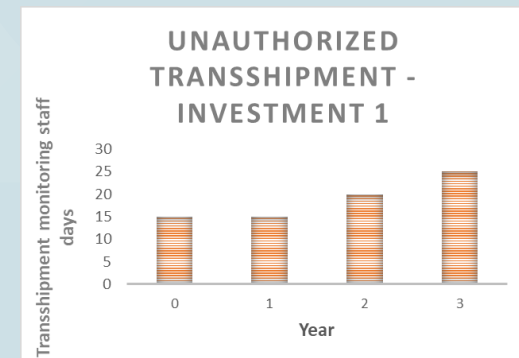
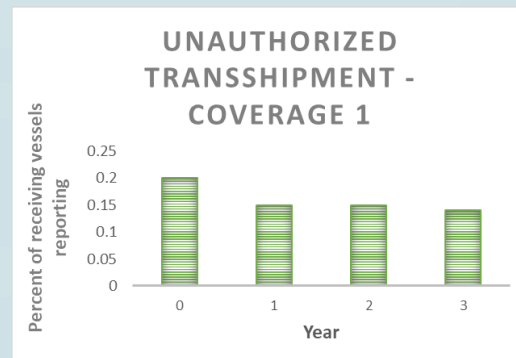
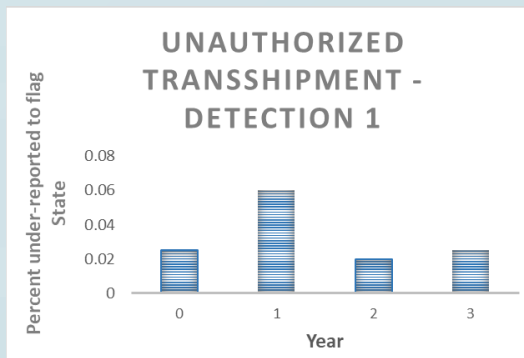
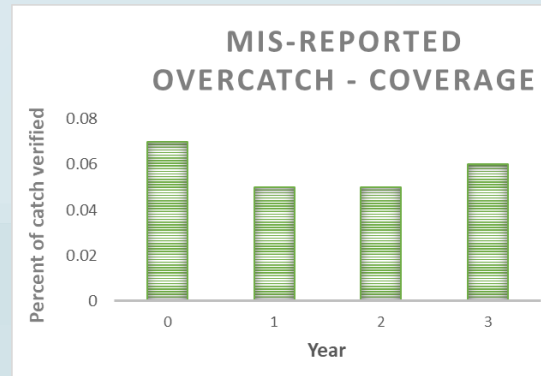
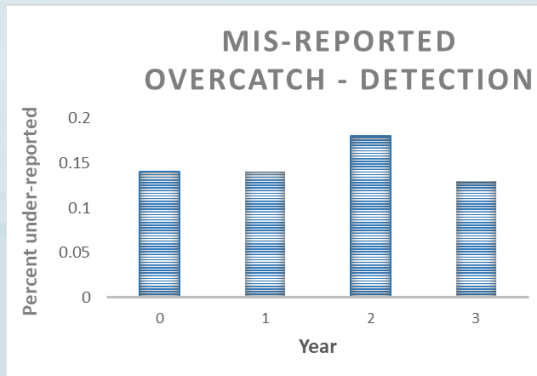
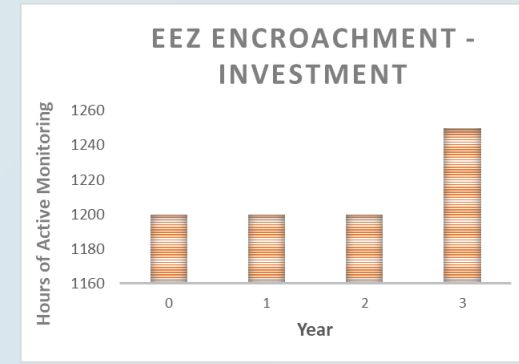
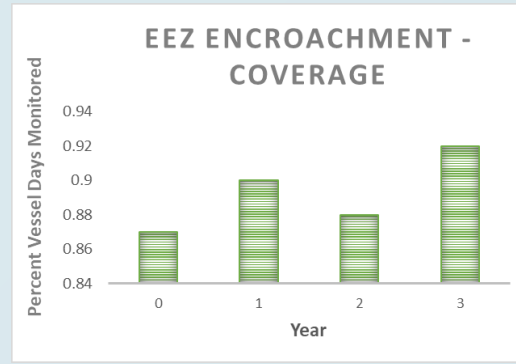
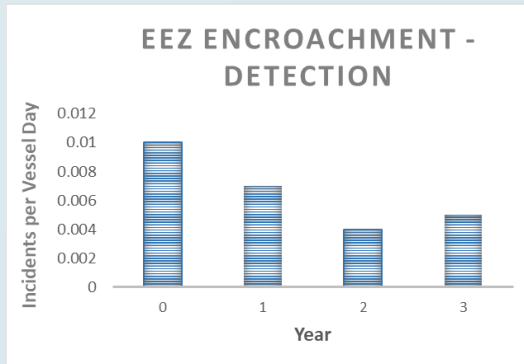
OVERALL: Detection indicators do not indicate a substantial risk of IUU fishing from unlicensed fishing (U) or discarding (N), but there is a moderate level of concern from one of the two indicators interpreted under improper landing (L). For this case study coverage is reasonably good, but unknowns remain, therefore more investment is needed.

Case Study 4



OVERALL: Over-catch of one high-value species was detected through landings monitoring (L), and despite low coverage a potential threat from unlicensed fishing (U) was also indicated. Both of these indicators require further investment, whereas the indicator for violation of protected area and season regulations (N) shows no issues.

Hypothetical Results in a Dashboard Format



Exercise: If after three years of quarterly monitoring you observed the following combinations of trends in detection, coverage and investment indicators, how would you interpret the IUU fishing situation in your fishery?

Indicator Interpretation

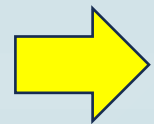
	Detection	Coverage	Investment	Possible Interpretation
1.	↓	↑	↑	
2.	↑	↓	↓	
3.	→	↓	↑	
4.	↑	→	→	
5.	↑	↑	↑	
6.	↓	↑	→	

Polling



Round 1 – Perceptions of IUU fishing

Round 2 – Objectives of IUU fishing quantification

 **Round 3 – Who will quantify IUU fishing and how**

References and further reading



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



Volume 1
Principles and Approaches



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



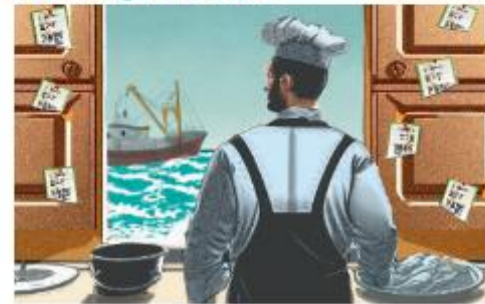
Volume 2
Practical Guide



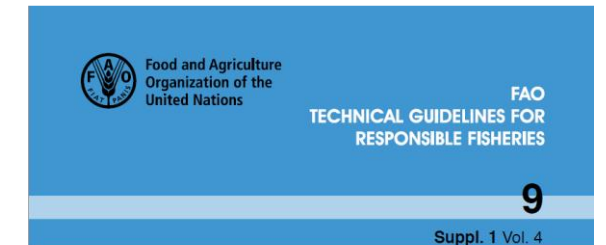
IMPLEMENTATION OF THE INTERNATIONAL PLAN OF ACTION TO PREVENT, DETER AND ELIMINATE ILLEGAL, UNREPORTED AND UNREGULATED FISHING

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

1.3 A catalogue of examples



Volume 3
Catalogue of Examples



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

1.4 Developing and using indicators of performance



Volume 4
Indicators of Performance





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Mentimeter

Which of the following groups do you think should have a primary role in quantifying IUU fishing?

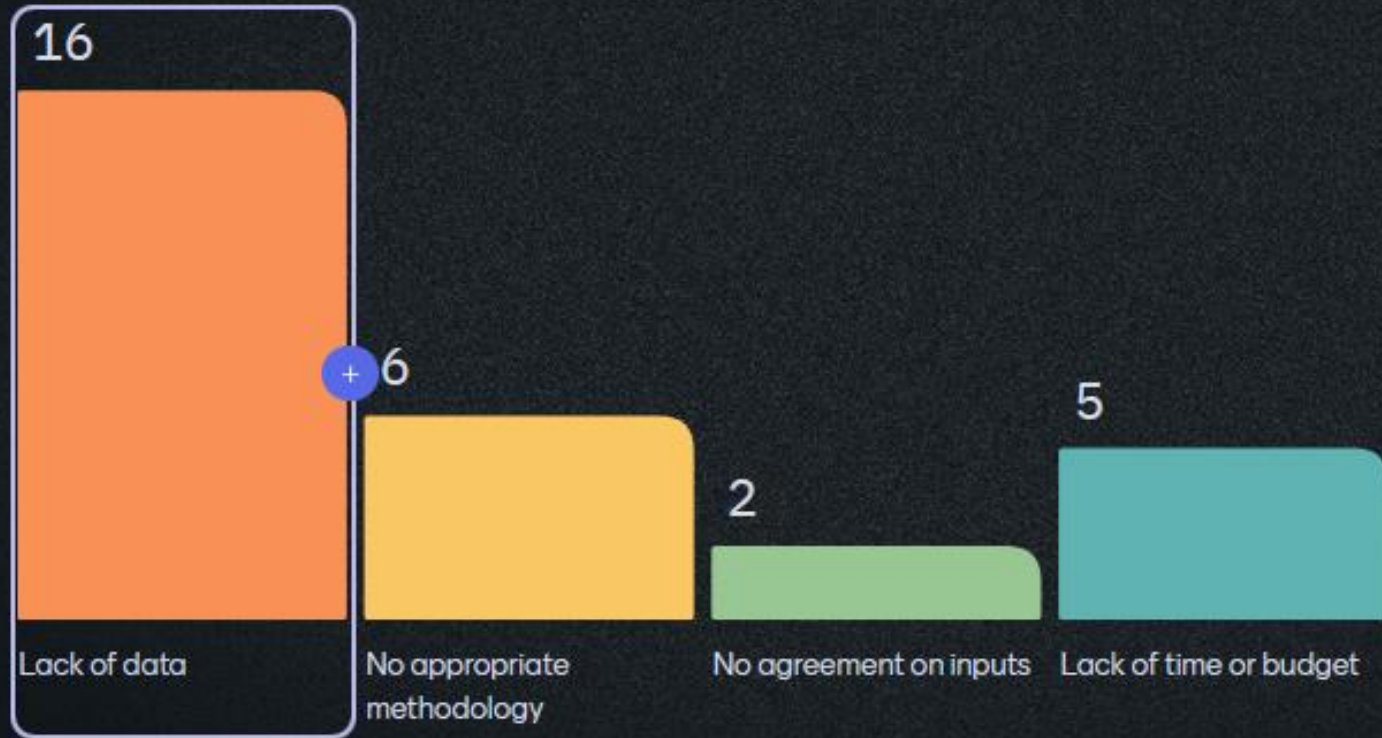


29 / 37



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Which of the following would limit, or have limited, your ability to make an estimate of IUU fishing:



● Would you choose estimates or indicators? Why?

Indicators, because easy to understand and no need much data.

Indicators because evidence is better than forecasting

Estimates. To give me the overview state.

Indicators as it is sufficient enough to pull the trigger of the management and political

Estimates . can see current trends and future trends.

Indicators because its observable, measurable facts or data points that point to a specific conditions

Estimate, because we will have an overview more wider

Estimate because the nature of iuu happen in the dark

The selection of appropriate indicators would facilitate the evaluation of the magnitude of IUU fishing.

Estimate I think that many fishermen don't know how many benefit do they lose due to IUU fishing. In order to motivate fishermen for combatting IUU, we need to inform them it.

Indicators:

I selected this indicator because it is intended to measure the level of success in controlling and combating illegal, Unreported and Unregulated (IUU) fishing

Use "estimates" when want to present figures and use "indicators" when want to interpret patterns or trends.

Indicators, for more accurate number. And it is very helpful in developing targeted responses based on the gaps and challenges identified in the indicators. Indicators would show the solution often.

Indicators, because of it's easier!

Estimates, because in my opinion that calculate from data collected .

IUU fishing vessel - reflect the effectiveness of MCS activities

Indicators. Because provide better data/results more than estimates

Indicators, to ensure accuracy

I would choose estimate because indicators is hard to measurement and weight.

Indicators, to ensure accuracy

Estimate, because the data is more great

Indicators is easy to use

Estimates, because we will have an overview more widely

"I would choose indicators because they are more practical and reliable when data availability is limited. However, estimates are essential when we need to quantify the impacts of IUU fishing.