

## **Expert Workshop to estimate the magnitude of Illegal, Unreported and Unregulated fishing globally, FAO, 2-4 February 2015, Rome, Italy**

This meeting, involving 39 experts, was organized by the Fisheries and Aquaculture Policy and Economics Division (FIP) and the Fisheries and Aquaculture Resources Use and Conservation Division of the FAO Fisheries and aquaculture Department. It was attended by Serge, M. Garcia, Chair of the IUCN-CEM-FEG.

It was the first step planned by FAO in a process to develop an authoritative methodology to estimate IUU fishing globally, inter alia with the view to: (1) Further raise awareness on IUU; (2) Monitor progress in the fight against IUU; (3) Better understand IUU globally and its impact on food security and livelihoods; and (4) develop guidelines on estimating IUU to improve comparability between estimates made by different institutions.

The following is a short extract of the meeting process and outcome. A complete and final report, it is suggested to go to the FAO website or contact [francis.chopin@fao.org](mailto:francis.chopin@fao.org)

The participants discussed in particular:

1. The definitions of the terms “Illegal”, “Unreported” and “Unregulated”. In the absence of a definition of IUU, the workshop considered whether the three terms should be separately defined. It was widely agreed that this could be practically impossible and that the term “illegal” was the most important. Nonetheless, it was agreed that taking IUU as a single concept would be the most sensible approach.
2. The list of activities to be considered as “IUU” fishing. Such a list should be developed to inform all estimation efforts. A first list of such activities was elaborated (Annex 7):
3. Recent, ongoing and planned studies to estimate IUU in certain regions were presented and discussed, e.g.: (1) Redfish fishery in the sea of Irminger (NEAFC); (2) IUU fishing in the Bay of Bengal under the BOBLME programme; (3) IUU fishing tuna fisheries in the FFA area. A new company, FishSpektrum, presented its work using AIS data from the Marine Traffic database<sup>1</sup>, coupled with a fishing (carrier and service) vessel database with more than 700,000 references and various correction algorithms, to map fishing presence and pressure.
4. Methodological options and data issues. Some of the potential methodologies for estimating global IUU fishing and their strengths and weaknesses were discussed. Issues related to: (i) The process (a global study or multiple ones in different regions and different types of fisheries or types of IUU); (ii) The extent to which new studies are available or existing data can/should be used; (iii) The different approaches to different species and elements of IUU definitions; (iv) The Ways to combine different estimates and statistical properties (of variance, bias) and avoid double counting; and (v) The presentation of results, especially in terms of transparency and minimum requirements. The participants also discussed the challenges faced in combining outputs from multiple studies. They agreed that estimates of IUU catch should be by area rather than for fleets and that it was important to determine levels of IUU catch from different types of IUU activity, with some confidence limits. They recognized the value of market information (rather than data on trade between countries) may be a helpful source of data. They considered that the origin of the data used and transparency were essential to avoid double counting.

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<sup>1</sup> <http://www.marinetraffic.com>

The future FAO work on the issue should focus on a global study of IUU and the development of guidelines on estimating IUU fishing. A pragmatic and cost-effective approach to this endeavor could include: (i) Exploration of other ongoing studies; (ii) Encouraging other institutions, including RFMOs to undertake IUU studies; (iii) Assessing their strengths and weaknesses to inform the global study and the guidelines. It was stressed that guidelines providing best practice on conducting studies of IUU estimates and suggesting outputs of those studies in a common format might be helpful and widely acceptable.

The potential content of the future guidelines and the related FAO policy and process issues were discussed in break-out groups.

A potential structure for the technical guidelines was elaborated as well as the composition (profiles) of the group of contributors (e.g. coordinator, statistician, MCS compliance practitioner, trade expert, and a developing world expert). Regarding the way to elaborate a global estimate, two options were considered: (1) A 'design estimate' combining the outputs of individual studies; (2) A 'modelled estimate' using the outputs of studies that had used the guidelines. It was considered that making a full estimate every 10 years would be advisable, using selected and simple indicators to monitor trends in between. In terms of scope, it was agreed to include inland fisheries but not aquaculture (focusing on wild stocks) or subsistence and coastal fisheries.

In terms of FAO policy, it was recognized that FAO was fully mandated to monitor fisheries and their parameters worldwide and to provide statistics and support fight against IUU and that, as a consequence it should lead the process of estimating IUU at different scales (regional and global). It was also suggested that the Guidelines would fit in the series of FAO *technical* guidelines and should be preceded by a "study of studies" that would inform the guidelines, take stock of previous experiences and identify key partners and informants for the development of the guidelines. It was noted that any future guidelines should be a "living document" evolving as new data, new technologies, and methods are developed. FAO should then provide IUU fishing estimates on a recurrent basis in its State of Fisheries and Aquaculture (SOFIA) report. It could act to facilitate a community of practice on estimation of IUU fishing and seek ways to involve the FAO Coordinating Working Party on Statistics.

It was agreed that the guidelines should ideally be ready for COFI 2016 and could be presented at a side event at COFI along with the outputs of any other studies considered to be robust.

## Workshop prospectus

# Expert Workshop to Estimate the Magnitude of Illegal, Unreported and Unregulated Fishing Globally

February 2-4, 2015, Rome, Italy  
PROSPECTUS

### 1. Introduction

Illegal, unreported and unregulated (IUU) fishing remains one of the greatest threats to aquatic ecosystems, undermining national and regional efforts to manage fisheries sustainably and conserve aquatic biodiversity. Motivated by economic gain, IUU fishing takes advantage of corrupt administrations and exploits weak management regimes, especially those of developing countries lacking the capacity and resources for effective monitoring, control and surveillance (MCS). It is found in all types and dimensions of fisheries, occurs both on the high seas and in areas under national jurisdiction, concerns all aspects and stages of the capture and utilization of fish, and may sometimes be associated with organized crime.

Fisheries resources extracted by those engaged in IUU fishing, lead to reduced economic benefits being gained by bona fide fishers and contribute to the collapse of fisheries resources. IUU fishing also has implications in terms of the increased/high costs of MCS that then have to be deployed in attempts to ensure compliance. Moreover, products derived from IUU fishing illegally find their way into local and overseas markets, thus distorting prices, competition, and trade. Hence, IUU fishing threatens the livelihoods of bona fide fishers and other fishery-sector stakeholders, exacerbates poverty and food insecurity, and results in economic inefficiencies that might otherwise be avoided.

While the international community has made some progress towards understanding and combatting IUU fishing, the thirtieth session of COFI agreed that, despite some progress, IUU fishing continues to be a persistent and pressing problem which has a significant adverse impact on achieving sustainable fisheries and food security. Its dynamic, adaptable, highly mobile and clandestine nature prevents a straightforward estimation of its quantification, and impacts have been difficult to quantify due to its covert nature.

Notwithstanding, one of the most cited reports (and oft used by FAO) is the Agnew et al. paper titled “The Global Extent of Illegal Fishing”<sup>2</sup>. This paper estimated that the overall loss from studied fisheries was 11-19% of the reported catch, worth some \$5-11bn in 2003. Taking the total estimated value of illegal catch losses within the analyzed fisheries and areas and raising by the proportion of the total world catch, the lower and upper estimates of the total value of current IUU losses worldwide were between \$10bn and \$23bn annually, representing between 11.06 and 25.91 million tonnes of fish.

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<sup>2</sup> Agnew DJ, Pearce J, Pramod G, Peatman T, Watson R, et al. (2009) Estimating the Worldwide Extent of Illegal Fishing. PLoS ONE 4(2): e4570.

While there was some degree of consistency with other studies prepared around the same time (MRAG, 2005, the European Commission, 2007 and Pauly et al.2002), several concerns regarding the estimates include, amongst others: the raising methods; what forms of illegal, unreported and unregulated were accounted for in the study; and the wide range between the lower and upper estimates.

Recognizing that: (i) it is now over ten years since the original study, (ii) various global IUU related instruments have been developed under the auspices of FAO and the Committee on Fisheries, such as the FAO IPOA-IUU, the Port State Measures Agreement and augmented through IUU counter measures being implemented at national and regional levels, it is likely that the magnitude and characteristics of IUU have changed. Accordingly, a new estimate of IUU fishing involving FAO is timely. Such an estimate of IUU fishing would allow FAO and its Members to more effectively understand the current extent of the problem, but also to engender institutional, financial and technical support for efforts to combat IUU fishing.

Within this context, FAO will convene an expert workshop to develop the methodology to estimate IUU fishing globally and follow on actions associated with data collection and analysis (Phase I). The results will lead to the preparation of a report (Phase II) to include a global IUU estimate, which if ready in time could be presented to COFI in 2016.

## **I. WORKSHOP OBJECTIVES**

The workshop will bring together an international cross-section of experts involved in counter-IUU fisheries work to exchange information, review previous literature and methods to estimate IUU fishing, and develop an FAO methodology for a study to estimate IUU fishing.

## **II. WORKSHOP INPUTS**

- This prospectus
- Workshop agenda
- Background paper 1: FAO instruments related to IUU, definitions and terms related to IUU in the FAO lexicon, and potential definitions of I, U and U for the purposes of a future estimate
- Background paper 2: Methods for estimating the extent of IUU fishing
- Background paper 3: Issues to be considered in the formulation of an analytical framework for the estimation of IUU fishing

## **III. WORKSHOP PARTICIPANTS**

This workshop will comprise;

- FAO professionals with specialization in fisheries resource management, policy, economics, statistics, MCS operations, legal frameworks and IUU counter measures;
- International experts in one or more of the following IUU specializations: statistics, fisheries economics, value chain economics, MCS operations, IUU risk assessments and IUU threat reduction tools.

#### **IV. WORKSHOP OUTPUTS**

The output from the workshop will be a workshop report, which will include the background papers and other related material available from FAO and other contributors. The workshop report will inform further actions by FAO and tasks in estimating IUU fishing globally. The report will include:

- Lessons learned from previous estimates on IUU fishing
- Strengths / Weaknesses of previous estimates of IUU
- Agreed methodology to be adopted for estimating IUU fishing, including the use of case studies for IUU estimates in selected fisheries / regions
- The timeline and associated work plan to estimate IUU
- Terms of reference for FAO and external consultants involved in an estimate of IUU
- Identification of associated work that would form part of the proposed study and presented as standalone chapters in the FAO report on IUU
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#### **FURTHER INFORMATION**

## Annex 4: Workshop agenda

Expert Workshop to estimate the magnitude of Illegal, Unreported and Unregulated fishing globally
2-4 February 2015, Rome, Italy
Venue: Borgo di Tragliata, Rome, Italy
AGENDA

### Day 1, Monday 2 February

- 08h30 – 10h00**      **Registration of participants**
- 10h00 - 10h15*      *Tea/coffee break*
- 10h15 – 10h45**      **Opening and Welcome remarks by**  
Árni Mathiesen (ADG, FI)  
Joe Zelasney (Pew Charitable Trusts)
- 10h45 – 12h00**      **Introductions, objectives of workshop, future study, and workshop planning**  
**(Secretary, Frank Chopin)**  
*Intended output: Participants have collectively agreed the objective of the workshop, and the workshop agenda which makes best use of time and will result in the required workshop outputs.*
- 12h00 - 13h30*      *Lunch*
- 13h30 – 15h15**      **Topic 1: How to define and distinguish between I, U, and U fishing for the purposes of the future study**<sup>3</sup> (Chair, Blaise Kuemlangan. Panelists: Martin Tsamenyi, Mathew Camilleri)  
*Intended output of Topic 1 discussions: Participants have discussed in plenary and arrived at differentiated operational definitions of illegal, unreported and unregulated fishing to inform and guide the methodology in the future study.*
- 15h15 - 15h30*      *Tea/coffee break*
- 15h30 – 17h30**      **Topic 1 Cont.: How to define and distinguish between I, U, and U fishing for the purposes of the future study**
- 19h00 -*              *Drinks and dinner* (continuing informal discussions on I, U and U fishing)

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<sup>3</sup> See Background Paper 1

## Day 2, Tuesday 3 February

- 08h45 – 09h45**      **Topic 2: Other ongoing/planned studies to estimate IUU and their methodologies** (Chair, Alicia Mosteiro. Panelists: Roberto Mielgo (Fishspektrum / ODI project), John Pearce (FFA / BOBLME study), Stefan Asmundsson (NEAFC))  
*Intended output of Topic 2: Participants have been briefed on other ongoing work, and can assess the relevance of such work to the FAO study in terms of methodological approaches and potential incorporation of estimates of IUU fishing into the FAO study.*
- 09h45-10h00**      *Coffee*
- 10h00 – 12h00**      **Topic 3: Methodological options and data issues for estimating IUU fishing globally**<sup>4</sup> (Chair, Alejandro Anganuzzi. Panelists: David Agnew)  
*Intended output of Topic 3 discussions: Participants have considered methodological options for the future study, their robustness, their data requirements, and the potential applicability to different 'units of study' for scaling up to global level.*
- 12h00 – 13h30**      *Lunch*
- 13h30 – 15h30**      **Topic 3 Cont. Methodological options and data issues for estimating IUU fishing globally**
- 15h30-16h00**      *Tea/Coffee*
- 16h00 – 17h30**      **Topic 4: The content of Technical Guidelines to estimate IUU fishing, and the role of FAO in the development of such guidelines and a global estimate**  
**Group 1: Development of annotated methodology guidelines**  
**Group 2: FAO's role in future work to develop guidelines and a global estimate**  
*Intended output of Topic 4: Breakout sessions will consider and then report back in plenary on the issues they are tasked with considering, so as to reach agreement on an outline for technical guidelines, and FAO's future role.*
- 19h00 -**              *Drinks and dinner*

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<sup>4</sup> See Background Paper 2

## Day 3, Wednesday 4 February

- 08h30 – 10h30**      **Topic 4 *Cont.*: The content of Technical Guidelines to estimate IUU fishing, and the role of FAO in the development of such guidelines and a global estimate**
- 10h30 – 10h45**      ***Coffee***
- 10h45-12h45**      **Topic 5 Post Workshop Next Steps** (Chair, Frank Chopin, Frank Meare, Joe Zelasney)  
*Intended output of Topic 5: FAO has clear guidance from the workshop on its future tasks and work streams and some suggestions as to who might be involved, when tasks should be completed by, and potential costs.*
- 12h45 – 14h00**      ***Lunch***
- 14h00 – 15h00**      **Workshop closing and final remarks**  
Frank Chopin  
Árni Mathiesen FI-ADG

## Annex 5: Background Workshop Papers

Frank/Martin/Matthew/Blaise to insert finalized paper 1

Francis Chopin (FIRO) 19/2/2015 08:17

Comment [1]: Ok... being addressed

### Estimating the extent of IUU fishing

D J Agnew

Paper 2 for the FAO Workshop on Estimating Worldwide IUU fishing

#### Previous studies and available estimation methods

Previous global and regional estimates of IUU fishing have made use of multiple data sources and methodologies to estimate illegal and unreported fishing for specific countries, species and times. The individual methods available at this level of specification range from direct, statistically robust estimation methods which yield point estimates and confidence intervals, to anecdotal, patchy and biased methods which yield a poorly defined point estimate only.

The following sections describe some of the properties of methods of estimating IUU on a species- or situation basis as well as on a global basis. Table 1 presents a summary of the strengths and weaknesses of the methods.

#### *Scientific methods based on population dynamic models*

##### *Method:*

Stock assessments generally assume perfect knowledge of catches, and use either trends in fishery dependent indicators (such as catch per unit effort, mark-recapture studies) or fishery-independent indicators (such as survey density estimates) to generate plausible estimates of the current and past state of the stock. They can incorporate observation and process error in these indicators but rarely do so for catches. However, if there is external knowledge of unreported data this can be estimated by stock assessment models. This usually works best if at least there are some periods of assumed accurate recording of catches, such that the IUU estimated period is constrained. In these circumstances the model uses information from the “good” bits of the assessment – for instance knowledge about variability in natural mortality or fishing mortality – to help it estimate the catches in the uncertain period.

##### *Examples:*

There are a number of examples of the use of these techniques; Plaganyi et al (2011) used an assessment model in conjunction with an analysis of trade data to estimate the quantity of illegal poaching of abalone in South Africa, Payne et al (2005) used a production model to estimate IUU catch of toothfish over a 2 year period in the SW Atlantic, and ICES has used the technique to estimate unreported catches during the early 2000s. While the precise methodology used in each study does differ, the latest ICES assessment for cod in the North Sea gives a good description of the issues (ICES, 2014).

Facing a rapid decline in cod stock size in the North Sea, in the 2000s the European Commission implemented a number of measures which aimed to recover stocks, including area closures, restrictions in effort and reductions in total allowable catch (Mardle et al, 2008). The substantial reduction in TACs in

the early 2000s are judged likely to have led to significant under-reporting, whether illegal (landings) or not illegal (discarding). Scottish compliance authorities tracked illegal landings, and through a series of measures were able to reduce them to the extent that in 2006 they were thought to have been eliminated, real fishing mortality dropped rapidly and the stock has been recovering from about that time. The ICES working group in 2014 used a model called SAM. Instead of assuming catches to be known without error and simply subtracting those, SAM assumes that catches include observation noise. This has the consequence that estimated F-at-age paths display less inter-annual variability with SAM than with deterministic assessment models, because part of the observed fluctuations in catch-at-age are arising from observation noise in-stead of from changes in F. Application of the model assuming unknown catch observation noise for a very long period of time (1993 to the present) did not lead to satisfactory results, but constraining the “uncertain” time to 1993 – 2005 allowed ICES to estimate that during the period of most rapid management action, the early 2000s, real catches were up to 68% higher than the combined declared catches (including discards).

Plaganyi et al (2011) used a different approach. While ICES (2014) assumed no actual knowledge of the magnitude of unreported catch except that it probably happened, Plaganyi et al (2011) took an index of illegal activity, from compliance/inspection records (confiscations per unit policing effort), and used this to tune the estimated catch in each year, again within the framework of a population dynamics model. The results were cross-checked against estimates of illegal catches/exports generated through a review of trade data.

Some estimates of IUU fishing have used logical assumptions about continuity in catch – which is akin to the above-mentioned assumption of some inter-year or inter-cohort consistency in fishing mortality – to reconstruct catch series based on existing data and plausible argument/ancillary data. The most recent and comprehensive study appears to be Cisneros-Montemayor et al (2013) but for the Baltic Zeller et al (2011) conducted a similarly robust analysis.

#### *Pros and cons:*

Using stock assessments to estimate illegal or unreported catch have the advantage that they can be accurate when the illegal activity is known to have happened but unknown in magnitude. They benefit from being a statistical method framed within a model of the dynamics of fish populations, and so cannot estimate biologically unreasonable levels of illegal catch. However, they are computationally intensive, rely on there being a stock assessment approach that can be used, and cannot distinguish between illegal activities and legal activities.

#### ***MCS Inspection and intelligence data***

##### *Method:*

There are many ways that MCS data can be used to generate information on illegal activity but one of the biggest challenges is to understand whether the methods are able to objectively estimate IUU catches. This depends on whether they have been generated in a way that allows reasonable extrapolation to the entire population of fishers. Most MCS systems take a targeted approach to policing, meaning that the data they develop are not random, and will need to be stratified before they could be applied to the entire fleet. Nevertheless, they can provide very high quality data on the types of offences detected, from which a deliberate categorisation of I, U and U is possible, and the consequences of the action, in terms of under-reporting, using illegal gear, contravention of discarding rules, using gears in prohibited areas, etc. Note that the two most common inspection types, at-sea and dockside inspections, have the ability to detect different types of violation: dockside inspections are cheaper and can cover overall landing regulations,

but at-sea inspections, or observer systems, are required to detect issues such as illegal discarding, slippage, handling of protected species and gear use.

*Examples:*

Although some other referenced material was used, 41 individual interviews were used by Pramod et al (2014) in their study of IUU imports to the USA, of which 32 were confidential. These were of varying quality, but did allow for the determination of specific IUU problems, such as illegal discarding during Russian Pollock fishery aimed at retention only of roe for market. In that same study, the authors report reductions in violations from inspections in the Sea of Okhotsk from 3.4% in 2008 to 1.7% in 2010, but note discrepancies with other data sources. Understanding such estimates also requires that we understand the sampling approach taken by inspectors, coverage and statistical reliability. In some cases reports of inspection activities are made publicly available (eg the European Fisheries Control Agency), but in most cases it is difficult to acquire raw data on inspections, overall fleet disposition and the other elements that would allow a statistically robust estimate of IUU activity to be made.

Surveillance data may be acquired by non-surveillance authorities, but its translation into absolute estimates of catch requires a statistical approach. Between 1st January 2010 and 31st July 2012, EJF's community surveillance project in southern Sierra Leone received 252 reports of pirate fishing by industrial vessels in inshore areas (EJF, 2012). These data could form the basis of an estimate of total IUU activity and catch.

Anecdotal information from MCS and other government employees and from non-MCS professionals and the general press is of perhaps limited value in estimating IUU activity, because it is even more difficult to analyse and understand statistically. However, widely applied, statistically designed surveys of fishers themselves may yield more accurate data than one would expect. King et al (2009) report that their surveys of fishers suggest that in the US non-compliance is more prevalent than previously thought, accounting for 10-20% of the overall harvest. Recent court cases (such as the American Seafoods case (2013) where the company was found guilty of having flow scales erroneously calibrated such that catches were under-reported) may support these results.

*Pros and cons:*

MSC inspection data can provide accurate information, but the statistical basis of extrapolation to the entire fleet requires that details of inspection strategy and probability of detection of different violations needs to be known; and acquiring raw data from which these estimates can be made is often difficult. Fisher surveys may provide an alternative, but other anecdotal data arising from interviews with MCS professionals or the press on a one-off basis, with no cross-validation, should be treated with caution.

**Remote sensing**

*Method:*

This method includes all elements of remote sensing: at-sea sightings not followed by inspections, overflight sightings, satellite transponder information (active reporting) and remote sensing satellite imagery (passive reporting). Using scientific observers to identify illegal vessels fishing within a fleet has not proven particularly successful to this author's knowledge, mainly because unlike observers/inspectors on patrol vessels observers on fishing vessels have no way to confirm the identity of sighted vessels. Clearly there are very large differences between these different methods, but what they have in common is a potentially wide scale of application and ability to detect vessels that are fishing where they should not, balanced against an inability to determine the activity that is being undertaken – they are even more removed from being able to identify specific issues of illegal practice than shore based landing

inspections. Thus they need to be matched with ways of determining what vessels that are not meant to be in an area are actually doing. Determining if they are fishing is possible through some remote sensing methods, but determining likely catch quantities, composition and interaction with non-target species such as birds and bycatch, requires extrapolation from data acquired on legal vessels, either by fisher or observer reporting.

*Examples:*

MRAG (2005) used data from overflights to estimate the number of unlicensed vessels fishing in west Africa. CCAMLR uses anecdotal information on IUU vessels fishing in CCAMLR waters, matched with national patrol vessel sightings, to estimate the number of vessels still fishing illegally in the Antarctic. Estimates of likely catch are also required, which can be acquired from catch rates of legal (observed) vessels or estimates of trip length, hold volume, etc (CCAMLR, 2013). IOTC used the same approach to generate early estimates of IUU (unreported) catches in the Indian ocean by combining knowledge of active vessels whose catch was known not to be reported to the Commission with estimates of the likely catch of those vessels during the year. (while not strictly being a “remote sensing” methodology, having some close links to the port inspection data described above, the basic philosophy behind the approach was similar to IOTCs). Agnew & Kirkwood (2002) used patrol vessel sightings of illegal vessels and gear in the water, embedded within a model of vessel movements and catch quantities calibrated using legal vessels, to statistically estimate the amount of IUU fishing at South Georgia (South Atlantic). These methods suffer from the problem of null sightings, which in reality does not always translate to no IUU fishing. To the author’s knowledge this approach has also been used by FFA in the past to estimate IUU activity and catches in FFA waters.

In the mid-2000s a number of systems were developed to match synthetic aperture radar (SAR) satellite imagery with the known position of legal and illegal vessels, the former through their transponder reporting systems (VMS or AIS) and the latter by a process of elimination. The EU’s Joint Research Centre’s VDS (Vessel Detection System), which uses SAR, VMS, AIS and other information from inspection services, continues to be developed (see Greidanus et al<sup>5</sup>). Skytruth used an AIS/SAR approach to monitor the waters around Easter Island in 2013, detecting more than 40 possible vessels fishing without a licence<sup>6</sup>. These systems suffer from an inability of SAR to detect small vessels or those with a very low radar image (eg wood, glass fibre), and to be confused by some sea states and by icebergs and bergy bits with the same reflectance and size properties as vessels, the cost of SAR imagery, the necessity of pre-ordering image capture and download from the satellite, and the voluntary nature of AIS particularly for fishing vessels. On the other hand, SAR is widely available, and has the big advantage that it is not hindered by clouds, and is available at a number of different satellite resolutions. VDS also provides the possibility of generating excellent quality statistical information on IUU, and might be available in some areas.

The implementation of AIS has been used by a number of specialist organisations seeking to match the following information: freely available AIS data tracking large vessel movements (eg marinetraffic.com); algorithms able to detect fishing activities (as opposed to steaming, transshipping, etc) with reasonable accuracy; information on prohibited fishing areas (MPAs, other management areas); fishing vessel licence authorisations. Such programs include Global Fishing Watch (Google, Oceana, Skytruth) and Fish Spektrum. These are emerging technologies, and to my knowledge have not yet been used to estimate the extent of IUU fishing in particular areas, although they have demonstrated their ability to identify potential IUU activities by individual vessels.

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<sup>5</sup> Harm Greidanus, Marlene Alvarez, Jean-Noel Druon; Space-based surveillance tools for fisheries control. Available at <http://151.1.154.86/GfcmWebSite/VMS/2012/ppt/GFCM-VMS-Rome-April2012-Greidanus.pdf>

<sup>6</sup> See [http://skytruth.org/wordpress/wp-content/uploads/2013/07/SkyTruth.About\\_IUU\\_2013.FINAL\\_.pdf](http://skytruth.org/wordpress/wp-content/uploads/2013/07/SkyTruth.About_IUU_2013.FINAL_.pdf)

*Pros and cons:*

I describe a large number of different applications of remote sensing data, and many of them have different properties. However, by their nature the power of all these remote sensing techniques is their ability to cover large spatial and temporal scales with unbiased statistical accuracy. Their drawback is that it is often difficult to establish what IUU activity is being undertaken, if any, and ancillary data need to be used to translate presence/absence into catches (eg data from legal, observed vessels).

**Trade data analysis**

*Method:*

Trade statistics analysis examines the level of trade in a species, matching exports and imports against government records of catches (Willock, 2004). These core activities can be supported by observer/MSC data, and inspection/customs service information on seizures, etc. Because international trade statistics are often publicly available, particularly for high profile species, these methods can have some power, and TRAFFIC have developed a guide to sourcing and analysing fisheries trade data<sup>7</sup>. However, there is often a mismatch between the catch period and the export/import periods; not all fish may be exported; exports are by product, necessitating assumptions about conversion rates between whole fish weights and various product types. The advent of catch documentation systems for high profile species and, in the EU at least for all species imported into the EU, should provide more granularity to such data, and allow better statistical estimates of IUU fishing to be made. However, the objective of catch document schemes is to eliminate IUU fishing by insisting on declaration and accounting on import, and as such they may be unable to detect IUU fish that does not go to export, or is otherwise misdeclared, illegally discarded, etc.

*Examples:*

Global trade analyses were used to estimate the mismatch between declared (legal) and traded toothfish by Lack & Sant (2001) and abalone (Plaganyi et al, 2011). Shelley Clarke has applied trade analysis to Russian sockeye salmon (Clarke et al, 2009) and sharks (Clarke et al, 2006). The TRAFFIC approach has been successfully applied to squid and abalone in South Africa (Bergener, 2010). Where specific statistical document schemes exist, they are used to derive trade-based estimates of illegal/unreported catches, or to augment other estimates. For instance, in ICCAT the statistical document scheme was used to identify underreporting of catches in the mid-2000s (Restrepo, 2004) and it is still used by the ICCAT statistical committee in conjunction with other data (estimates of total catch based on capacity and fishing power of the fleet, for instance).

*Pros and cons:*

Trade data are increasingly easy to access electronically, making desktop studies easy, particularly with the electronic guide produced by TRAFFIC. However, there are limitations to the methodology: the method requires that there are recognised customs codes for the species in question, and for some this may be “miscellaneous”; misdeclared products are not captured; and assumptions must be made about conversion rates (unless whole fish are traded) and the time periods represented by capture and import data. Finally, catch document schemes can work well to capture the global trade in a particular commodity only where most or all of the product is imported by countries requiring use of the document.

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<sup>7</sup> [http://www.fisheries-trade-data.org/menu\\_guide.html?guide](http://www.fisheries-trade-data.org/menu_guide.html?guide)

### *Anecdotal reports*

Many citations for IUU fishing come from individual reports: press articles centred on individual arrests or IUU fishing cases; interviews with individual ministers, fishery management or compliance officers. These data are difficult to validate, and have none of the robust properties associated with the other types of data and analyses described above, but have the benefit of being searchable on the web and very common. Nevertheless they are sometimes useful to cross check other data.

### **Global estimates using meta-data**

#### *Methods*

There have been very few attempts to estimate the global extent of IUU fishing, but most studies have had to use a mix of the methods described above to generate a global estimate of IUU fishing, with the sources generally coming from other published studies. Pauly et al (2002) make reference to IUU catches worth \$25m globally, but the methodological basis for this estimate is not clear. Agnew et al (2009) is perhaps the most comprehensive, making an explicit consideration of 54 EEZs and 15 high seas regions and supporting the final paper with an extremely detailed review of grey literature on IUU fishing giving all supporting references. An earlier publication (MRAG 2005) had attempted to do this for Africa only.

#### *Examples*

In their global study, Agnew et al (2009) employed a mixture of methods depending upon the data availability for specific countries or commodities, covering all the above potential estimation methods. They combined the data, from published sources, to produce estimated historical trends using the “anchor points and influence table” approach of Pitcher et al (2002). Because the estimation methods were so varied, and delivered quite different levels of confidence and bias (both statistical and assumed), the authors used extreme upper and lower estimates to generate a uniform bound of confidence for each species group and country, integrating the whole into a global estimate by pro-rating monte-carlo derived median and upper/lower confidence intervals to the entire global catch from 54% of the global catch represented in the studied EEZs and RFMOs. Importantly, all source information was available in a 242 page report accompanying the main paper (Pramod et al, 2008) and detailing the data sources available for each country/ area studied, and explaining how estimates of IUU by country/species were arrived at based on the many hundreds of citations. However, both this paper and an earlier study of IUU fishing in Africa (MRAG 2005) had identified a significant negative correlation between IUU fishing and governance (eg the World Bank governance indices), which could be used to more intelligently pro-rate the results.

The most recent IUU publication (Pramod et al, 2014) also uses multiple different data sources and the combinative approach used by Agnew et al (2011), but unfortunately the exact application of the methods, and the detail of the assumptions and estimates of confidence levels surrounding the combination of data from information sources with widely varying likely accuracy, bias, temporal and spatial resolution, is hidden from the reader in this study.

Perhaps the most comprehensive recent study on a country scale (although not a global scale) is that of Cisneros-Montemayor (2013), in respect of Mexico. The authors identified situations where catch in official statistics is incomplete but the magnitude of missing catch unknown, and used well-informed estimate to replace these zero values. Reconstruction of catch series was by species rather than fishing sector, and where there were obvious gaps in catch series either these were linearly interpolated or other information was used to correct unreported catch. Information from fisher and other experts surveys was also used.

### *Pros and cons*

It is difficult to avoid using multiple data sources when compiling global estimates of IUU fishing, so much thought must go into how they are combined. Although Agnew et al (2009) is the most commonly cited report on global IUU estimation, the paper suffers precisely from being global. Good quality data are simply not available for every country in the world. Even acquiring data for the 54 EEZs necessitated recourse to low quality anecdotal or un-validatable data on a number of occasions, which was treated as uncertain in the analysis and attracted wide confidence (min-max) intervals. Acquiring source/raw data and understanding the reliability of any analysis, whether peer reviewed or not, is key.

Having to use multiple data sources for each country also leads to a mix of estimated quantities – reflecting the types of estimates shown in Table 1. For instance, for one country a good estimate of total illegal catch of demersal species may be available from remote surveys and interpolated catch rates derived from legal vessel observer records, and for one species total extractions may be available from a population dynamics model. The difference between these two estimates might represent unreported discarding/black fishing by the legal fleet, or it may represent errors in one methodology or another, and it is very difficult to separate these issues, or to accurately identify, for each fishery and species, the precise mix of illegal and non-illegal unreported catches. Similarly there may be overlaps between studies on specific EEZs, RFMOs which cover high seas and EEZ fishing, and studies of individual flag performance, and it is difficult to separate these estimates to avoid double counting unless detailed sources are known.

On the other hand, the strength of the method used in Agnew (2009) is that cross-checking was high from the multiple data sources used, and the overall conclusion about global IUU catches, and particularly the relationship between IUU and governance, is probably correct at a global scale even if use of the results on an individual country fishery scale may be difficult. Furthermore, to guard against misinterpretation, a description of the content, and interpretation, of the supporting references was presented in Pramod et al (2008).

**Table 1: Summary table of the ability of the methods above to generate good information on catch volumes by species, including interactions with non-fish species, and with attribution of specific IUU activity.**

Data type/source	Potential elements being estimated	strengths	weaknesses
Stock assessment data	<ul style="list-style-type: none"> <li>Estimates of total unreported catches of fish</li> </ul>	<ul style="list-style-type: none"> <li>Statistically robust estimates</li> <li>Good spatial and temporal coverage: coverage of the whole of the stock, over all years</li> <li>Potentially applicable to all species caught by the fleet if they are assessed</li> </ul>	<ul style="list-style-type: none"> <li>Unable to identify violation type, eg to separate illegal from legal unreported</li> <li>Should be used in conjunction with other information on relative levels of IUU activity to anchor the estimates</li> <li>Best to estimate significant periodic IUU, rather than long term constant IUU</li> <li>No information on collateral damage by IUU fishing to nontarget species and habitats</li> </ul>
MCS inspection data	<ul style="list-style-type: none"> <li>Accurate recording of individual violations (IUU or non-IUU) in practice on land and sea</li> </ul>	<ul style="list-style-type: none"> <li>High resolution data attributing IUU catches to actual fishing activity and violation type</li> <li>Large sample sizes from fishery surveys may be statistically unbiased</li> <li>Possibly information on damage to non-target species and habitats</li> </ul>	<ul style="list-style-type: none"> <li>Underlying statistical framework unlikely to be appropriate when arising from targeted MCS activities</li> <li>Catches from different activities may not be recordable by inspectors at sea</li> </ul>
Remote sensing	<ul style="list-style-type: none"> <li>Estimates of number of vessels fishing without licences or in areas that are prohibited</li> </ul>	<ul style="list-style-type: none"> <li>Possibility of repeat synoptic surveys, generating high quality statistical data</li> <li>Offers the possibility of matching various data sources – anecdotal and objective.</li> <li>Can detect and track individual vessels globally, not just in area of study</li> </ul>	<ul style="list-style-type: none"> <li>Computationally and electronically intensive/expensive</li> <li>Identification of actual fishing activity is lacking</li> <li>Cannot detect non-positional violations (eg gear, misreporting, discarding)</li> <li>Must be matched with other estimates of catch rate, species, etc from legal vessels</li> </ul>
Trade analysis	<ul style="list-style-type: none"> <li>Estimate of total IUU catch by species</li> </ul>	<ul style="list-style-type: none"> <li>Easy access to global data</li> <li>Accurate data if declared on catch/import documents by all countries importing</li> </ul>	<ul style="list-style-type: none"> <li>Misdeclared products not captured</li> <li>Specific violations (except import violations) cannot be detected</li> <li>Catch document schemes ineffective if large numbers of importing countries do not subscribe</li> <li>Relies on exporting - cannot detect IUU where fish are consumed locally</li> </ul>
Anecdotal reports	<ul style="list-style-type: none"> <li>Individual point estimates of IUU</li> </ul>	<ul style="list-style-type: none"> <li>Easily searched</li> </ul>	<ul style="list-style-type: none"> <li>Difficult to validate or understand in the context of any objective, comprehensive and statistical analysis.</li> </ul>
Global meta-data approaches	<ul style="list-style-type: none"> <li>Total extractions by country/global</li> </ul>	<ul style="list-style-type: none"> <li>Use of many different sources allows cross-checks</li> <li>Different data sources can be given different quality markings and assigned confidence</li> </ul>	<ul style="list-style-type: none"> <li>Difficult to consistently separate different types of IUU fishing</li> <li>Establishing quality and overlap of individual contributing studies is difficult</li> </ul>

## Lessons learned from previous studies

All previous global or country studies have had to confront the quantity that they are interested in estimating. For instance, it makes a big difference whether we are interested in the volume of catches not

declared, or the lost value to legitimate industries. The former can include catches taken by unlicensed vessels and by licensed vessels using illegal gear or, for instance, discarding whether illegal or not, that are not landed or otherwise accounted for within the statistics used by management authorities, either for their statistical purposes or for the purpose of setting quotas for legitimate vessels.

The important defining element of these catches (whether I or U) is that they are not accounted for. Agnew et al (2009) confined their analysis to illegal and unreported catches (IU), namely those taken within an EEZ which are both illegal and retained, and which are usually unreported, and all unreported catches taken in high seas waters subject to a Regional Fisheries Management Organisation's (RFMO) jurisdiction, but acknowledge that many of the supportive analytical methods (listed above) cannot distinguish between whether something is illegal or not (or what type of illegality) simply whether it is unreported.

The time period of estimates is of key importance, and one that is very difficult to control within global meta-analyses. IUU fishing patterns can change quite rapidly. In the North Sea, the peak IUU catch was in 2003 and by 2006 it was estimated to be zero. In the Antarctic the IUU catch of toothfish rose from less than 5000 t/year in the split-years 1994/95 and 1995/96, to more than 30,000 in 1996/97, and following increased surveillance and industry/NGO activity dropped to about 7000 t again in 1998/99 and 1999/2000 (Agnew, 2000; CCAMLR, 2008).

The Agnew et al (2009) and Pramod et al (2014) studies used “anchor points and influence factors” to rebuild trends. The theory behind this is that if one has only very few high quality estimates of IUU, from a few species and from a few years only, and very few of these estimates are coincident (in time, space, species etc) then it should be possible to assume some interpolative or extrapolated trend based on whether management systems are known to have changed. For instance, it would not be unreasonable to assume a reduction in IUU activity in the Baltic from the mid-2000s when the EC started its high scrutiny of the fleet behaviour in the region, the buyers started to require non-IUU catches, and the Community Fisheries Control Agency started its joint MCS activities in the area, but before this time it would be defensible to assume that an estimate of IUU activity in 1999 should equally well apply to 2005. In reality, the level of information and argumentation to translate these assumptions to quantitative corrections is rarely met, and even more rarely explained in publications of IUU fishing trends. However, where it is used in combination with statistical or other estimation methods, such as the stock assessment or catch interpolation methods that carry some underlying assumption about fishing mortality, the results can be quite plausible.

## Conclusions

In considering all of the above-mentioned studies, the following overall conclusions can be made

1. While there will be specific, very good quality studies available for some commodities/species/areas, where objective statistical estimates can be made, when confronted with attempting to derive an estimate for a country/RFMO/the world it will be inevitable that a wide variety of different data sources will need to be used. Any method to combine these sources needs to be able to characterise the uncertainty/bias in them.
2. Published and peer reviewed reports are useful, and should be accessed whenever possible. However, it is extremely rare that the detailed assumptions, and descriptions of data quality, can be accommodated in peer reviewed literature. Even published data should be scrutinised well and its validity and appropriateness assessed.
3. In many cases it will be difficult not to use anecdotal data, from fisher/MCS professional surveys and interviews, or from press reports. The most important thing about publication of any report on global IUU fishing by FAO should be complete transparency about all data sources and if they are

to be used, interviews with key MSC professionals should be supported with at least some corroborative/cross check data.

4. IUU fishing can change focus very rapidly, from one year to the next, in response to management actions, but multiple data sources of IUU estimates will be unlikely to be coincident in time. Any estimate of “current” IUU status should nominate a relatively short applicable time window (within the last 2-3 most recent years) and be very careful in its assumptions of the current level of IUU if this is based on studies that took place before that time window.

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## Issues to be considered in the formulation of an analytical framework for the estimation of IUU fishing:

### Background Paper 3 for the FAO Workshop on Estimating Worldwide IUU fishing

*Graeme Macfadyen (Poseidon) and Frank Chopin (FAO)*

The objective of the workshop is to exchange information, review previous literature and methods to estimate IUU fishing, and to develop a methodology for a future FAO study to estimate IUU fishing at the global level. The outputs from the workshop should provide guidance on the objectives, scope, and implementation methodologies (technical and logistical) for a future study to generate a global estimate of IUU fishing. This background paper therefore provides preliminary some thoughts on topics that will need to be discussed at the workshop in providing such outputs and achieving the workshop objective.<sup>8</sup>

#### **How broad should the scope of the future study be?**

The workshop could potentially need to discuss and agree on a number of questions which are grouped into themes below, which may be relevant to Topic 4, Sessions 1 and 2 of the workshop agenda).

#### ***Geographical scope***

Should the geographical scope of a global estimate include:

- *Inland fisheries as well marine fisheries.* It is assumed that both should be included given FAO's global mandate. Although inland fisheries catch is several orders of magnitude lower than marine catch, their immense importance as a source of food and livelihoods within poor rural communities makes them a candidate for study. Moreover, The sub-components of I, U and are likely to vary considerably in nature and extent between marine and freshwater fisheries e.g. unreported fishing may be of particular interest in inland freshwater fisheries;
- *territorial seas, EEZs, and high seas.* So as not to pre-judge the outputs of any future global study to estimate IUU fishing or to make assumptions about where the main IUU issues might occur, it is assumed that the future study will need to consider fisheries in all marine jurisdictional areas as defined in UNCLOS, but being cognizant of the fact that some species are highly migratory creating the potential for errors when generating estimates for trans-boundary fisheries.

#### ***Functional scope***

The workshop will need to consider the functional scope of future study in terms of:

- *different types of I, U, and U* (see background paper 1 for discussion on the potential distinctions between, I, U and U, and what might be included in a definition of each for the future study). And should it include all forms of removals / mortality (such as discards, slipping of catches) that are

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<sup>8</sup> The workshop will not be expected to consider *methods of reducing IUU fishing* (except in so far as the global estimate may be used for benchmarking and advocacy to generate future funds and institutional action to combat IUU). Given the limited time available, the workshop will focus exclusively on the future work to *estimate IUU fishing*.

regulated but may not be reported. The point being that such removals may increase the degree of uncertainty in management decision making. The future study will require clear guidance from the workshop on a working definition of I, U and U so as to preclude any uncertainty of what is included in each and whether the study will focus on catches and/or landings;

- *aquaculture and capture fisheries*. While some illegal activities may take place by aquaculture producers e.g. non-compliance with regulations related to fish health/husbandry, farm management, bio-security protocols, compliance with licence conditions, etc, IUU aquaculture production may be far less of a problem than IUU fishing in terms of volumes. Certainly the methodological issues associated with quantifying IUU aquaculture production (data sources, defining the I, U and U) would be very different to those for a future study focussing on capture fisheries. It is assumed that the focus of any future global estimate will be limited to capture fisheries only, but this assumption needs verification by the workshop. And in addition, some special issues, such as the capture of wild fish as inputs to fish farming operations (e.g. purse seining of Bluefin tuna for ranching, capture of wild grouper fingerlings for on-growing) could potentially fall within the future FAO study; and
- *commercial, subsistence and recreational fisheries*. Given the subsistence nature of many small-scale fisheries, it is assumed by the authors that subsistence fisheries would fall within the remit of a future FAO study, but the workshop will need to validate this assumption as well as consider the merits or not of including recreational fisheries as well.

### **Scale and granularity**

This issue could affect both the *methodology* to be used as well as the *presentation* of a future study's outputs. The workshop might consider:

- Given the stakeholders involved in I, U and U and the motivations that contribute to I, U or U, are there some important reasons for de-coupling the three sub-elements of I, U, and U?;
- Could the potential impact of the study and the use of its outputs be enhanced if the outputs are presented so as to provide individual estimates of, for example of i) I, U and U fishing, ii) of IUU fishing in marine fisheries and inland fisheries, iii) of IUU fishing in small-scale fisheries, semi-industrial and industrial fisheries, iv) of IUU by different metier i.e. fleet/gear types? And would being able to present combinations of a selection of these variables be desirable e.g. I fishing in inland fisheries, U fisheries in tuna purse seine fishing, etc?;
- What should be the ambition of the study in terms of ocean/species/country coverage?;
- Bearing in mind that a large proportion of the FAO reported catch from some regions is NEI, how should such species be interpreted within the I, U and U domain?;
- If a sampling approach is taken, what should be the accepted accuracy of estimates at various levels: stocks, species, inland/coastal/EEZ fisheries, countries, RFMOs, regions/LMEs, oceans, world? Balancing precision versus pragmatism needs to be a foremost consideration when developing a cost-restricted methodology; and
- How will the methodology address bycatch species which includes inter alia juvenile fish, seabirds, turtles, coral and marine mammals? While fish landings are typically estimated by weight, the same is not the case for seabirds and turtles. Moreover, if the approach will attempt to derive a monetary value of the I, U and U components, how can this be applied to non-commercial species, endangered or otherwise?

### *Agreement over what is to be measured*

Linked to the question about scale/granularity (above), a future study would need to understand what units it would use to quantify IUU. Most obviously will be the need to assess the *weight* of IUU catch based on an agreed definition of IUU for the purposes of the study (see background paper 1 for some proposals/possibilities).

However, perhaps less obvious is whether the study should also seek to derive the *ex-vessel value* of catches (for example by attributing a unit value to different types of species groups e.g. large pelagics, demersals, small pelagics, etc.), and how/whether such an approach would address non-commercial IUU catch (e.g. of juveniles, ETP species). The methodology for the future study could also consider *broader types of 'costs'* associated with IUU fishing. These broader types of costs might include:

- The cost to society of overfishing as a result of IUU activities in terms of lost future revenues to fishers, downstream actors in the processing/marketing chain, and Member States through reduced resource rents;
- The compliance costs related to combatting IUU fishing e.g. sea and aerial patrols and inspections, land-based inspection activities, VMS, and observer costs;
- Other institutional costs related to combatting IUU fishing e.g. administration costs, NGO activities, research costs, etc
- The reduced unit sales values to producers of IUU fish (where sales values are discounted because the fish is IUU);
- The lost revenues and/or value added (profits plus wages) to other operators of catches made by those engaged with IUU fishing not being available for catch by those that are acting legally, are reporting and are being regulated;
- The lost resource rents accrued to Member States, when rents are based on declared catch volumes or the sale of fishing licences; and
- The loss of critical elements of an ecosystem (loss of key species, loss of habitat, biodiversity).

The inclusion of an estimate of the value of IUU fish, and even more so the broader types of costs listed above, could increase the advocacy benefits of the study. However, while generating ex-vessel values from the weight of IUU fish should be less problematic, assessing the broader types of costs of IUU fishing would significantly increase the complexity of the future study (and therefore the study cost if a robust estimate is to be provided). The inclusion of broad economic costs of IUU fishing to society could potentially also serve to dilute a clear 'advocacy message' from the future study, by mixing estimations of the weight/value of IUU catch with downstream costs and other impacts.

Quantification of the weight of IUU catch may be considered sufficient if the intention of the study is to quantify the extent of IUU fishing, so as to mobilise action around the IPOA-IUU and related instruments and measure the extent of success in achieving their objectives. A global estimate of the weight of IUU fish could be considered sufficient on its own as a baseline for the future evaluation of success in meeting the IPOA-IUU's objective, which is 'to prevent, deter and eliminate IUU fishing'.

From a practical point of view too, only quantifying IUU catch weights (and potentially ex-vessel values) may be methodologically complex enough for the envisaged future study, given the potential timeframe and budget (see below), without committing the study to addressing the 'costs' of IUU fishing.

For all of the above reasons, the authors suggest that it may be advisable for the future study just to focus on the weight of IUU catch, and possibly the ex-vessel value of those catches with a commercial value,

but not the broader 'costs' of IUU fishing (which may in any case also be considered the broader costs of the general failures in fisheries management).

## **Methodology**

### ***Choice of method and accessibility of data***

The choice of methodology and data availability is intimately linked to the issue of the scope of the study discussed above. A decision to include inland fisheries for example could mean the use of different methods than for marine fisheries, if sources of data for assessing IUU fishing in marine fisheries, such as AIS/VMS data, may not be available for inland fisheries. Key issues will include the following:

- Background paper 2 presents a wide range of methodological approaches which could be used in the future estimation of global IUU fishing. Choosing between these approaches, or recommending options, may not be determined just by the methodological robustness of the estimate that might result from the different approaches, but also by issues of whether the data requirements for the different methodologies would require long or short timeframes for data provision, and what the costs might be of accessing data (both in terms of any potential need to purchase data, as well as the time inputs and staff costs associated with the work to access and process/analyse data e.g. can data be collected remotely, will country visits be necessary, etc.)
- Methodological choices/options may be in part determined by the workshop's perception about how willing data providers might be to provide the necessary data for the different methodological choices. The answer to this question may depend on commercial and data confidentiality issues, as well as the perceptions by data providers as to the motivations of FAO in supporting the study and the ultimate use and worth of the study's outputs.
- The prospectus seems clear that the future FAO study is not simply a repeat repeat/update the previous Agnew et al estimate of global IUU fishing. It is likely to be broader in scope (inland and marine) and is proposed to be used as a baseline against which future changes in IUU fishing might be monitored. Accordingly, the workshop will need to consider whether a new approach / new methodology is warranted, and whether it could provide tangible incremental benefits to previous approaches and be completed for a reasonable cost in a timely and pragmatic manner (see below).

### ***Scaling up***

- Bearing in mind a potential timeframe and budget for the future study, the workshop will need to consider strategies for scaling up estimations of IUU fishing in particular areas/fleets, to a global level. This will require consideration of *units of study* i.e. fleet types targeting specific species and potentially in different ocean areas, for example Pacific purse seine tuna fleets. Guidance will be needed for the future study over what these discrete units of study might be, so as to be able to scale up to generate a global estimate. The workshop will need to consider:
  - ❖ How to define specific units of study, and by implication how many are needed so that a select few can be examined in detail before scaling up;
  - ❖ If units of study are based on fleet types/species targeting, and the future study explores IUU fishing in a particular ocean area, can estimates of IUU fishing in that ocean area necessarily be applied to other ocean areas. For example if an estimate of IUU fishing in Pacific longline tuna fisheries is obtained, can that be applied to longline tuna fleets in the Western Indian Ocean;

- ❖ Should units of study focus just on those judged as being high risk in terms of IUU fishing, or should the study use a classification that encompasses all fishing globally. The former would require the study methodology to pre-judge IUU fishing hotspots rather than using the study to review all fisheries units for levels of IUU fishing. The latter could reduce the level of analysis possible on areas known to be high risk given a limited study budget. Could early decision making based on identifying and ranking fisheries, regions, fleets and gear types with the potential for significant impact (egregious violation of CMMs, loss of rents, biodiversity, livelihood impacts) arising from I, U and U, provide guidance on prioritizing fisheries, fleets and regions of most interest?; and
- ❖ What will the statistical issues be associated with scaling up from a necessarily (given timeframe/budget) limited selection of case studies, and how important could it be to try to minimise the range in the global estimate of IUU;
- Since the objective is to develop an FAO-led approach to estimating IUU globally, are other ongoing/planned studies compatible with a proposed FAO methodology and for scaling up? The answer might depend on i) whether other studies meet or exceed a set of minimum criteria outlined in the methodology for the FAO study, and ii) practical considerations of the advantages of doing so in terms of freeing up budget for other work to be completed by the FAO study. For example, if an ongoing FFA-supported study on IUU fishing in by tuna fleets is considered likely to generate results that are robust, can its outputs be used to i) preclude the need for the FAO study to undertake any work on tuna fisheries in the Western Central Pacific, and ii) apply any estimates of IUU fishing resulting from the study to tuna fisheries in other oceans. A technical oversight group engaged in FAO-led IUU studies might be one way of ensuring harmonization and compatibility.

### **Study timeframe and potential budget**

The prospectus for this workshop states that the future study is intended to provide outputs to feed into the 32<sup>nd</sup> session of COFI in 2016 (potentially in April 2016). Given that the future study may need to be preceded by a detailed project design phase (see more discussion below on what can be expected from the workshop), as well as a period of time to put in place financing and mobilize staff, completion of a future study in time to publish study outputs in a form suitable for COFI, could require a study period of around only 9 months. The workshop may need to consider and discuss whether such a timeframe is realistic, whether it may be desirable to allow more time for the study to produce a robust estimate, or whether the inland and marine fisheries might be developed in different phases.

The potential timeframe proposed by the workshop would also have a strong bearing on the methodology and approach to be used in the future study.

The methodology and approach, while partly determined by the timeframe for the study, will also be strongly influenced by the potential funds available for the study. In this regard, based on *known* sources of funding (from FAO and donors<sup>9</sup>) which may be in the order of around \$300-400,000, as well as other donors who *could* be interested in contributing to the future study, the study methodology, approach, and workplan for the future study could be modular to provide for activities which are known could be funded, and others which may not necessarily be? In addition the workshop may find it helpful to discuss potential sources of funding and to propose specific actionable items by different participants in seeking to ensure that sufficient funds are made available to cover the proposed methodology/approach, if known

<sup>9</sup> International and bilateral donor agencies, foundations funding fisheries issues, NGOs, RFMOs, etc

FAO/donor funds are not considered sufficient, and such funds can be obtained within a specific timeframe.

The above discussion suggests that the workshop will need to consider carefully the extent to which the methodology and approach could *determine*, but also *be determined by*, a potential budget bearing in mind that a study budget of around \$300-400,000 may be most likely i.e. will the methodology and approach designed fit with an indicative budget?

### **How far can the workshop go towards agreeing the operational arrangements of a future study**

The workshop prospectus implies that the outputs of the workshop should provide many of the components of a future study (e.g. agreed methodology, timeline, and workplan, ToRs). However, time is limited for discussions in Rome and it is likely that the workshop may only provide *options* for a future study and/or guidance on some key issues to be considered when formulating the phase two study. This in turn may limit the ability of the workshop to be specific about operational arrangements for the future study, and work carried out after the workshop by FAO will be required to develop a detailed project document.

Bearing these caveats in mind, the authors suggest that the workshop should nevertheless strive to provide as much agreed content of the future study as possible as a workshop output. This implies that the workshop could consider and provide some guidance for the future study on:

- Phase II study objectives, outcomes, outputs and activities, potentially in the form of a logical framework;
- Modalities for implementing the study and linkages between possible partners;
- Specific methodological choices (see background paper 2) and potential links to other projects;
- A budget breakdown which could be provided to potential donors and for monitoring expenditure during the study;
- A timeline for the proposed study with phasing, milestones and outputs at different stages over the agreed study period;
- Study governance and oversight mechanisms e.g. the formation of Steering Committee, its composition, and its frequency and modality for supervision; and
- The ToRs for those implementing the study.

## **Annex 6: Outputs of the breakout group on a possible structure for technical guidelines on estimating IUU fishing**

### **Preamble**

This section would describe the policy context and background to the development of the guidelines. It would also explain the key intention of the guidelines in providing:

- Advice on the format in which study results/outputs could support contributions to a global estimate;
- Ideas and best practice for those planning and implementing studies to estimate IUU fishing, and for those organizations/researchers which may benefit from such guidance; and
- A toolbox of different estimation methodologies.

### **Chapter on data output format for sharing**

This section would highlight that the ability to contribute/generate any global estimate of IUU fishing compiled from a range of different studies, would require and be facilitated by consistent outputs. It would therefore advise on consistency in certain parameters for those studies wishing to be considered for use in such a global estimate.

It would also highlight the need for studies to provide a full description of: all assumptions; the methodologies used; the data used and not used; potential biases; and a full list of references. In support of transparency and replicability, it would also suggest that methodology should be described in sufficient detail to enable any another group to use the same data and come up with the same estimate.

### **Chapter on design and intent of studies**

This section would guide readers on the need for their studies to clearly articulate the objectives of their study, the types of IUU to be estimated, and the scope of studies.

It would consider the need to ensure that key informants/participants are involved in the study so as to ensure that studies involve the appropriate data holders/sources of information and stakeholders.

It would highlight the potential need for, and benefits of, a risk-analysis (which could be completed as a workshop activity of relevant partners) as part of the design process, given the potential benefits of such an analysis in:

- i) developing a conceptual model of how the fishery operates and identifying likely IUU issues (e.g. problem fleets, species, areas, financial rewards of infringements, etc).
- ii) informing stratification and where to sample. (e.g. what activities are likely to be occurring - under-reporting , fishing with illegal gears etc.).
- iii) providing guidance on data sources and suitable methods.

### **Chapter(s) on methodology toolbox/options**

This section would represent the main body of the guidelines. Separate sub-sections could be provided for different methods, and for each there would be specific guidance on issues such as:

- data quantity and quality, sources, and standards of data to be used;
- a single ‘best practice study’ to provide an indicative methodology;
- a flow chart to explain how a particular method could be undertaken and the data sources that might be used;
- capturing the opportunity for using evolving technology and the impact on methodologies e.g. electronic monitoring, reporting and real time data [e.g. the FFA experience], where such possibilities exist ( may be more applicable to data rich fisheries rather than small-scale or data-poor fisheries);
- considerations of cost effectiveness;
- IUU indicators (what can be measured, how can indicators be interpreted)
- How to address issues of uncertainty e.g. i) if you have a point estimate, ii) the more uncertain the thing you are trying to estimate is, the more you need additional methods or ways to validate or triangulate the estimation.

### **Chapter on combining data/estimates**

This section would explain:

- how studies may combine different sources of information;
- combining different sources of data to get an estimate, combining different data sets;
- the use of co-variance; and
- how to upscale estimates to cover broader geographic scales, or from a subset of vessels/fishers to a fleet/population.

### **Chapter on concerns regarding double counting**

This section would characterize double counting issues, particularly related to the metric used to estimate the IUU activity (e.g. measuring illegal activity in a fishery and then applying to the catch of the fishery). It would note that using vessels in a fleet that have more than one type of violation could result in double counting. Other issues might include, for example, when three sets of lines are put out in one trip, but only one them is illegal, is the whole catch for the trip illegal?

### **Chapter on special considerations**

This would give some additional information on study design in some specific cases where generic advice may be insufficient. Specific issues might for example include:

- how to deal with numbers versus weights of special species (sea cucumber, turtles etc.);
- small scale fisheries, subsistence fisheries;
- inland fisheries;
- directed shark fisheries;
- recreational fisheries;
- live reef fish;
- data poor fisheries;

- how to determine inclusion/exclusion of unregulated fisheries (especially small-scale/inland fisheries)

### **Chapter on the presentation of results**

This section would describe best practice in displaying results in a meaningful and understandable format, and would also provide guidance on the importance of thinking about communications/PR issues associated with the results and how they might be released.

### **Useful Annexes**

The guidelines would be likely to include a number of relevant Annexes (e.g. references, although a list of useful reading/references could also be provided at the end of each chapter.

## **Annex 7: Outputs of the breakout group on IUU issues that frame the IUU estimation process and which could potentially be included in future estimates of IUU fishing**

Any estimate of IUU fishing, to be credible, must be based on the internationally accepted concept of IUU fishing under the IPOA-IUU. However, as we have seen, the IUU concept is not precise, resulting in possible grey areas. Another area of uncertainty relates to the fact that the IPOA-IUU does not offer a precise definition of IUU fishing as such, but merely provides examples of what may constitute the various elements of the concept.

Based on the discussion of the three constituent elements of the IUU fishing concept above, this section of the papers attempts to provide a synthesis of the possible elements that may be considered for inclusion in any such future estimate in order to provide a uniform and consistent basis for estimation. It should be noted that these proposed working elements for IUU fishing for estimating costs of IUU fishing are preliminary and merely intended to distinguish between the “I”, the “U” and “U”).

### **Illegal fishing**

- a) Fishing activities by all vessels (national and foreign) in areas under national jurisdiction in contravention of national law. The activities to be measured will largely be determined by what is stated in national legislation as a violation. Whether the contravention or violation can constitute a crime (attracts a criminal liability/sanctions) or attracts civil or administrative sanctions is irrelevant.
- b) Fishing activities in contravention of RFMO conservation and management measures to which a State is a member or which are contrary to the relevant provisions of the applicable international laws. The fishing activity will be undertaken by a vessel, but the “offender” will be the State as a result of its failure to implement its international obligations through domestic legislation. Under this sub-category, the contravention need not be “illegal” per se (contrary to an enforceable law) but is a contravention or violation that may go un-enforced or not penalised. The content of RFMO conservation and management measures will determine the scope of activities to be considered for the purpose of estimation. This sub-category will also include “unreported fishing” which is illegal (reporting is required by a law or regional/international conservation or management measure but there are no laws or the laws are not enforced or complied with).

### **Unreported Fishing**

This will include reporting that is not required by a law (not illegal under national law) or regional/international conservation and management measure but is recognised as essential that it be regulated (including needing to be converted into a legal requirement so that non-compliance becomes an illegal activity). Examples here may include non-reporting of catch or discards that is not contrary to law, relevant RFMO conservation and management measures or other rules of international law.

### **Unregulated Fishing**

This will cover other types of activities (other than reporting) that are not regulated. Examples may include specific (possibly unregulated) activity (other than unregulated reporting) that is not required by a law or regional/international conservation and management measure but is recognised fisheries management experts or competent international organizations as essential that it be regulated (including needing to be converted into a legal requirement so that non-compliance becomes an illegal activity).

For the purpose of any future FAO study to estimate levels of IUU fishing, IUU fishing activities will be considered to include the following:

- i. fishing without a valid licence, authorisation or permit by the relevant national authority, where required;
- ii. not fulfilling requirements to record and report activity and catch or catch-related data (including catches of target and non-target species, bycatch of unwanted species, discards, endangered, threatened and protected species (ETPs)), or submitting false reports, including catch certificates;

- iii. fishing in an area and/or season in contravention of management measures;
- iv. engaging in directed fishing for a stock or species which is subject to a moratorium or for which fishing is prohibited; or
- v. using prohibited or non-compliant fishing gear with applicable laws and conservation and management measures ;
- vi. falsifying or concealing the markings, identity (including electronic reporting) or registration of fishing vessels, vessels engaged in fishing related activities, or fishing gear, in contravention of applicable laws and conservation and management measures;
- vii. taking on board or landing fish in contravention of applicable laws and conservation and management measures (e.g. species for which there is no remaining quota, under-sized fish, fish not landed in designated landing centres, landing of shark fins;
- viii. transshipping and transporting in contravention of applicable laws or conservation and management measures;
- ix. Fishing and fishing related activities, including transshipping, in the area of a regional fisheries management organisation in contravention of the conservation and management measures of that organisation and flagged to a Contracting Party or Cooperating non-Contracting Party to that organisation,
- x. Fishing activities by vessels in areas under the jurisdiction of an RFMO where the flag State of the vessel is not a member or not cooperating with that organisation Fishing activities by vessels having no nationality (stateless vessel) or being registered at the same time in more than one registry and therefore being a stateless vessel, in accordance with international law.
- xi. Lack of reporting of fishing activities and catches in areas under national jurisdiction including EEZ, territorial seas, archipelagic waters, internal waters and inland waters(e.g. in recreational fisheries, coastal fisheries, where such reporting is not required under national laws and regulations.
- xii. Lack of reporting of fishing activities and catches in areas beyond national jurisdiction, whether covered or not by an RFMO, and where such reporting is not required under any law.