Monitoring of FADs Deployed and Encountered in the WCPO

FAD-IWG,
28-30th September, 2016

MRAG asia pacific

Overview

- Why uniquely mark FADs?
- What type of marking options exist?
- What are others doing?
- Cost-benefit modelling
- Proposed way forward

What type of FADs are used in WCPO?

Anchored FADs (aFADs)

- Most common type is drum/ bamboo, with chain, palm leaves or mesh
- **6% of assoc. sets**

Drifting FADs (dFADs)

- Variable materials – most common are bamboo cane, floats, net mesh
- Usually satellite buoys attached, some sonar buoys
- **59% of assoc. sets** (26% on other vessel's FAD)

Natural FADs (nFADs)

- Logs, debris
- **16% of assoc. sets** (~40% with buoy attached)

Figures from Abascal et al, 2014

Why uniquely mark/monitor FADs?

- **Legal responsibilities**
  - Marking fishing gear/FADs required/encouraged in FAO CCRF, UN FSA, FAO Tech. Guidelines for Responsible Fisheries

- **Scientific benefits**
  - Clear picture of number and type of FADs, plus capacity to track 'life history' of individual FAD, essential to understanding impacts of FADs – e.g.
    - Influence of duration at sea/design/materials on target/non-target catch
    - Influence of FADs on stock dynamics, catch rates
    - Examining how increased use of sonar buoys affects CPUEs

  - Abascal et al (2014) highlighted inability to uniquely identify FADs a key impediment to effective scientific analysis

Why uniquely mark/monitor FADs?

- **Management and compliance benefits**
  - # FADs deployed in WCPO essentially uncapped and unknown, BUT key component of overall PS fishing capacity/efficiency – difficult to manage effectively
  - Stronger marking/monitoring allows for:
    - Stronger capacity to manage overall numbers/impacts of FADs
    - Stronger capacity to enforce existing FAD measures (e.g. set limits/FAD closures)
    - Industry accountability for abandoned/washed up FADs
    - Tracking dFADs through closed waters
- **Economic benefits**
  - Better positions WCPFC CCMs to meet stock management objectives (BET/YFT) – should lead to economic benefits through higher stock sizes, improved catching efficiency, etc


What type of marking options exist?

Marking Options

- Can broadly be divided into 2 types:
  - Physical – unique ID permanently attached to the FAD itself
  - Electronic – uses unique ID of sat buoy

- Options examined:
  - Physical marking
    - Industry applied (e.g. epoxy paint)
    - Pre-printed tag
    - Acoustic tags
  - Electronic marking (satellite buoy ID)
  - Combined physical + electronic

Physical marking - industry applied

- Would involve industry applying a permanent physical marking to FAD prior to deployment
- ID # could be sat buoy ID, or standalone ID – doesn't really matter, key thing is its unique
- Ideally should be standard format/materials (e.g. size/colour of lettering/background)
  - field test to define best configuration (durability, visibility for captains/observers)
- To be most effective, FADs should be registered prior to deployment – provides upfront record of number and type of FADs, allows for verification of details at time of deployment

Industry applied – benefits/costs

- Benefits
  - Marking stays with FAD itself allowing life history to be tracked (resilient to changes of buoy)
  - Requiring FADs to be registered upfront (with info verified at deployment) will provide credible account of number and type of FADs in WCPO for first time

- Costs
  - Main costs are in institutional staffing/IT costs, industry compliance costs (registration, materials)
  - ~$600,000 annually (assumes 50,000 FADs = ~$12/FAD)
  - Other costs (e.g. updating logsheet/observer workbooks etc) assumed to be marginal

Industry applied – practical issues

- For manual marking system to be effective, number of supporting measures required:
  - All FADs registered prior to deployment (or for nFADs encountered and set upon, within a specified time – e.g. 48hrs);
  - No deployment of FADs other than in presence of an authorised observer
  - No setting on FADs without authorised marking

- Trade-off between increasing visibility of marking for captains/observers Vs making other companies' FADs easier to see

Pre-printed tags

- Industry apply for, or purchase, pre-printed tags with unique ID
- Must be permanently applied to FAD prior to deployment
- Could either be large enough for observer/captains to see, or could be small and require industry to apply same (larger) marking to FAD
- Registration/verification system same as industry-applied marking option

Pre-printed tags

- Benefits
  - If large enough, removes need for industry marking
  - No scope for same ‘unique’ ID to be applied
  - Costs of implementing system could be recovered through purchase of tags (additional costs applied to recover costs of FAD research/monitoring etc)

- Costs
  - Similar to industry applied option
  - Main additional cost would be tags
  - ~$560k annually (more with more expensive tags)

Acoustic tags

- Two different electronic ‘tag’ types assessed:
  - RFID
  - Acoustic

- RFID – effective scanning distance v. small in seawater (although technology improving)

- Acoustic more promising:
  - can be detected at distances up to 1km,
  - can be embedded with unique ID,
  - Long battery life (3-5yrs)

80 kHz Acoustic Tag

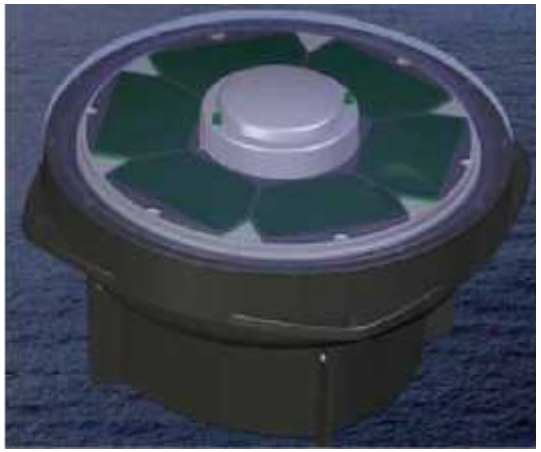
Acoustic tags

- Benefits
  - Removes need for industry applied marking
  - Assist with identification – avoids problems with fouling covering marking, markings degrading
  - Assists with FAD ID in pre-dawn sets
  - Assist in monitoring compliance with FAD prohibition/FAD sets
  - Can detect submerged FADs
  - No possibility of same ‘unique’ IDs being applied

- Costs
  - Main additional costs are hardware/set up
  - Tags ~ $190 each; data logger/hydrophone set ~ $4,000
  - Total cost ~ $10m; $202/FAD

Satellite buoy based ID

- Based on using unique ID associated with each satellite buoy
- PNA trials confirm sending buoy info to more than one receiver feasible (at no additional comms cost)
- Most poll twice/day
- If unique ID of sat buoy used, all FADs in WCPO would need to fit sat buoys in order to get complete picture of FAD usage



Satellite buoy based ID

- Benefits
  - Key benefit is access to near-real time sat buoy position info:
    - Scientific analysis (e.g. impact of FAD distribution/density on stock dynamics, etc)
    - Compliance/industry accountability (may have some utility in helping enforce FAD measures; tracking unrecovered FADs)
    - Management (tracking of FAD sets; drift of FADs through closed zones)
  - Biomass info from sonar buoys
  - Oceanographic info – sea surface temperature, speed, etc

- Costs
  - Institutional costs dependent on whether WCPFC can 'piggyback' off existing systems (e.g. PNA)
  - Industry costs – buoy/airtime costs assumed to be marginal; extra costs if buoys required on all FADs
  - ~$400k annually; ~$8.30/FAD

Satellite buoy based ID

- Potentially efficient, BUT subject to practical challenges:
  - **Buoy swapping**
    - anecdotal evidence suggest buoy swapping relatively common (25% sets made on another company's buoys); sometimes remote from main vessel
    - High potential for 'life history' of FAD to be lost (therefore need permanent marking on FAD itself)
  - **Data access complications** (if multiple systems used with different rules of access)
  - **Reporting of buoy numbers** – between 2009 and 2014, buoy number reported only 52% of associated sets by observers (albeit may be improved with increased emphasis)
  - **CRITICAL NEED FOR DATA SECUITY**

Combined physical+satellite buoy

- ‘Best of both worlds’ system – ensures life history of FAD is maintained, while providing valuable sat buoy info
- Costs likely to be only marginally higher than physical system alone because hardware/airtime already paid for
- ~$644k annually; $12.89/FAD

Cost comparison

	Painting	Tag	Acoustic	Electronic	Combined Painting/electronic
Average annual cost	$603,713	$558,713	$10,098,463	$413,903	$644,403
Total per FAD (50,000)	**$12.07**	**$11.17**	**$201.97**	**$8.28**	**$12.89**

- Main messages:
  - Sat buoy based system cheapest, but subject to major flaws
  - Physical marking systems slightly more expensive, but needed to maintain ‘life history’ of FAD itself
  - Costs of having a combined physical+electronic system are only marginally more than physical alone, BUT additional science/management/compliance benefits are substantial


What are others doing?
MRAG
asia pacific

IATTC (Resolution C-16-01)

- All FADs to be marked by 1 Jan 2017
- Alphanumeric codes to be provided by IATTC, or can use sat buoy ID
- If sat buoy attached, ID painted in 5cm letters on buoy
- If no buoy attached, painted on uppermost part of FAD
- No sat buoy info at this stage, but Secretariat working with vessel owners to get info (with few months time delay)
- Key issue highlighted during interviews was possibility of FAD life history being lost if buoy swapped

IOTC (Resolution 15/08)

- FADs to be marked from January 2016 – marking scheme to be considered at Regular meeting in 2016
- Should be easy to read, easy to apply, will not dissociate
- Vessels must submit provisional purchase of instrumented buoys by 1 Jan 2016;
- By end 2016 provide # of buoys activated, deactivated, active in each quarter
- Radio buoys to be phased out by 1 Jan 2017
- Advice from Secretariat suggests scheme yet to be adopted in practice

PNA

- PNA recently commenced trial that requires all FADs deployed by vessels on OVR to be registered through FIMS
- ‘Port to port’ monitoring
- Potentially covers majority of FAD-related activity (exc. ID/PH domestic fleets)

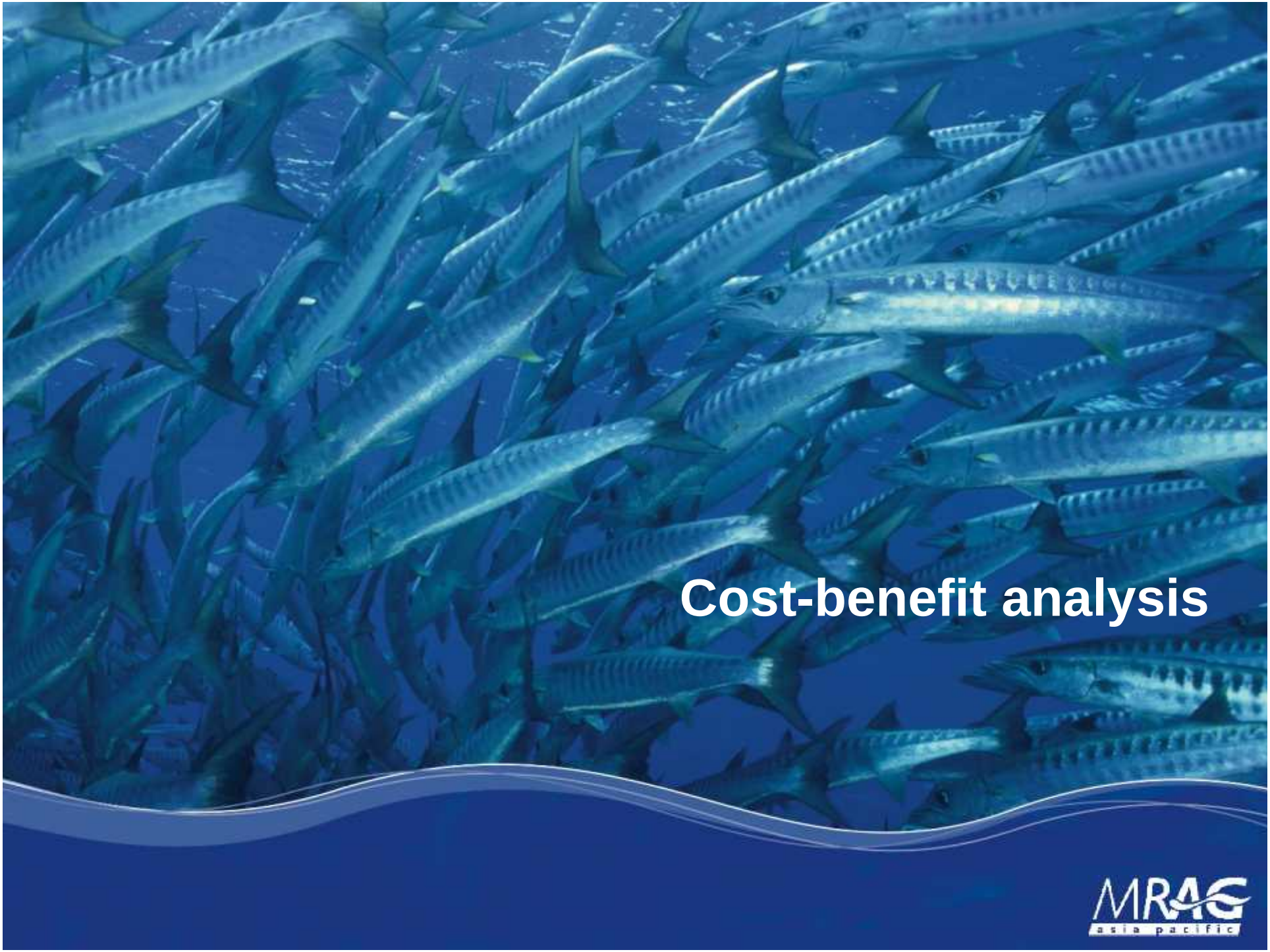
%	2010	2011	2012	2013	2014
FAD Sets - PNA	95.1%	95.6%	92.7%	92.0%	92.5%
FAD Catch - PNA	93.3%	93.5%	92.2%	89.5%	90.6%

- But, as basis for universal FAD marking scheme faces challenges:
  - No marking on FAD itself (life history may be lost)
  - Unknown levels of compliance

PNG (Gazettal, Sept 2015)

- Comprehensive scheme – requires both physical mark and sat buoy info
  - All FADs to be registered – unique # to be allocated by NFA
  - FADs to be marked with name and rego of deploying vessel
  - 30cm high, contrasting colour to back plate
  - Raft section of FAD must remain above waterline and be visible from 1km
  - Sat buoys linked to registered FAD – vessel operator shall provide direct feed of ALL data
  - FADs cannot be deployed from non-licensed vessel (100% obs. coverage)
  - If nFAD is encountered and set upon, must attach sat buoy
  - Cost recovered

- Early days of new arrangements – will be settling in period


Cost-benefit analysis
MRAG
asia pacific

Cost-benefit – overall approach

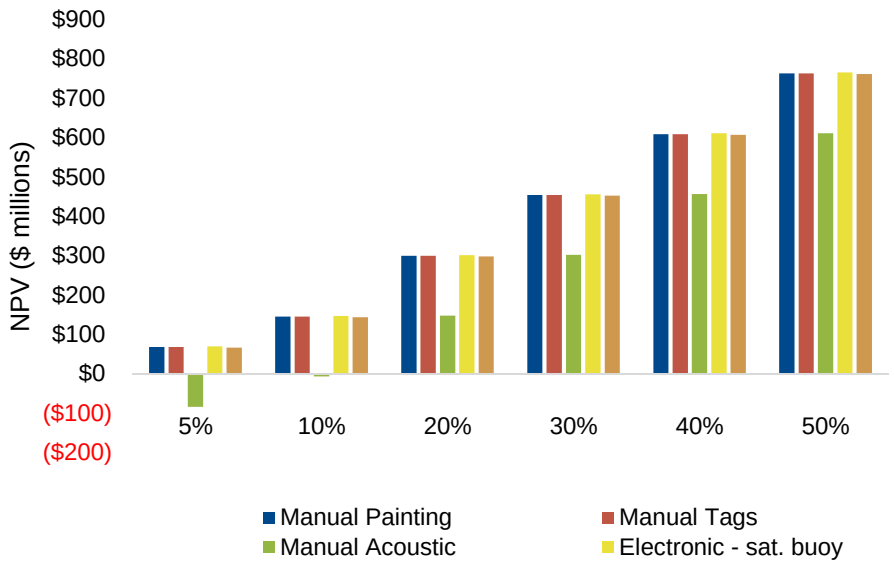
- Quantifying direct economic benefits of FAD marking difficult
- Putting aside 'ecosystem type' benefits, one major benefit is better positioning CCMs to effectively manage target stocks (e.g. BET/YFT)
  - more chance of meeting stock management objectives (MSY)
  - should lead to economic benefits (larger stock sizes, more efficient fishing, fewer restrictions, etc)
- One way of quantifying benefits is to look at hypotheticals around likelihood of meeting stock management objectives
  - What would be the economic benefit gained if FAD marking/monitoring meant we were 10% more likely to meet stock management objectives?
  - e.g. if marking scheme cost X, how much more likely would we need to be to meeting stock management objectives to offset cost?
- Cost-benefit judgement to be made is whether likely improvement exceeds 'tipping point' – i.e. benefits outweigh costs
- Not meant to be definitive – 'educated hypothetical'

Cost-benefit modelling - inputs

- Costs based on cost estimates for each marking scheme
- Benefits based difference between economic rent from fishery under status quo scenario and improved scenario with FAD marking
- Only considered benefits to the PS sector, BET/YFT (conservative because benefits also flow to LL, SKJ)
- Prices calculated from BKK import data; rents calculated from previous studies
- Two scenarios for each stock modelled – MSY and 'poor' (1/2 MSY for BET; ¾ MSY for YFT) (23 years)
- Benefits calculated by adjusting likelihood that stock will meet either scenario

Cost benefit analysis - results

Marking system		5%	10%	20%	30%	40%	50%
Manual	Painting	$68.54m	$145.76m	$300.21m	$454.66m	$609.10m	$763.55m
	Tags	$68.13m	$145.36m	$299.80m	$454.25m	$608.70m	$763.15m
	Acoustic	-$84.00m	-$6.78m	$147.67m	$302.12m	$456.57m	$611.02m
Electronic (Sat. buoy)		$70.29m	$147.51m	$301.96m	$456.40m	$610.85m	$765.30m
Combined (Paint-Elect.)		$66.62m	$143.84m	$298.29m	$452.74m	$607.18m	$761.63m



Cost-benefit analysis – ‘tipping point’

Marking system	Manual			Electronic (Sat. buoy)	Combined (Paint/sat. buoy)
	Paint	Tags	Acoustic		
‘Tipping point’	0.56%	0.59%	10.44%	0.45%	0.69%

- Main message: only a very small (<1%) improvement in the likelihood of meeting MSY objectives is required to offset the cost of implementing marking system
  - Because of high value of BET/YFT resource – even small improvements in management performance result in substantial improvements in economic return

Main messages and proposed way forward

Main messages

- **Is there a need for a marking system for FADs? Yes**
  - Scientific, management, compliance benefits - little dispute amongst stakeholders interviewed
  - Question really is which system/combination of systems provides best value for money
- **Physical marking slightly more expensive** than sat buoy based systems, BUT **important in tracking life history of FAD**
  - Requires range of supplementary regulations to be effective
- **Electronic (sat buoy) marking** less able to track life history of FAD, BUT **delivers v important information at little marginal cost**
  - Critical to ensure data security
- **Combination of systems likely to be most cost-effective**
- Other types of marking (e.g. acoustic tagging) offer potential benefits
- **All are likely to result in net economic benefits**, even with only minor improvements in management performance

Proposed way forward

- Need to better understand number and effects of FADs, means starting point required – can be refined and improved over time

- **Step 1: Introduce a manual marking scheme**
  - Require FADs to be registered and marked
  - Registration can be either be centralised (through WCPFC) or hybrid based on national/sub-regional systems
  - Upon registration unique ID allocated – details can be verified by observer at time of deployment
  - Marking should be applied in a way that's permanent, easily identifiable to captain/observer (ideally should be field-tested to identify best specifications)
  - Range of supplementary measures required to ensure integrity
    - Prohibit FAD deployment except with observer present
    - Prohibit setting of FADs without authorised ID
    - Require sat buoys on all dFADs
    - Require vessels to report all changes of sat buoys on logsheets

Proposed way forward

- **Step 2: Secure access to sat buoy information**
  - V valuable information – can be accessed at modest marginal cost
  - Explore with PNA allowing data from trials to be made available to SPC for analysis
  - Covers up to 95% of FAD activity (exc. ID/PH domestic)
  - Consider whether arrangements are required to access info from FADs not covered by PNA system

- **Step 3: Further investigate and trial alternative marking systems**
  - Potentially offer advantages over manual marking alone (e.g. pre-dawn sets, compliance with FAD closures, FAD set limits etc)
  - Most promising seems to be acoustic tags
  - Funds should be sought for field trials to determine practicality

Proposed way forward

- Approach generally consistent with existing recommendation from IWG (scheme should apply to FAD and sat buoys)

- Steps 1 and 2 can be implemented concurrently; step 3 soon after

- None of these systems likely to be implemented without ‘hiccups’
  - where possible, practical trials should be run prior to implementation
  - System should be subject to ongoing review/refinement where necessary

Thank you!

Thanks to all those interviewed, WCPFC Secretariat, IWG Chair for overseeing work