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Redevelopment of the Bycatch Management Information System (BMIS)

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Abstract
The Bycatch Management (formerly 'Mitigation') Information System (BMIS) is being redeveloped as a global resource with funding provided by the ABNJ (Common Oceans) Tuna Project. It is proposed that the new look BMIS will present a broader range of material, particularly regarding the management of bycatch, e.g., bycatch species interaction rates and threats, population-level assessments, and national and international management schemes. Progress on bycatch data harmonisation, electronic reporting (e-reporting) and e-monitoring will be included. A new database platform will offer improvements in database stability, security and flexibility, and facilitate more efficient data entry, reference management and general administration. A new web interface will be required, given the proposed changes in the underlying database, as well as in scope and content. The redevelopment will enhance the role of the BMIS in building understanding of bycatch mitigation and management among those involved in tuna and billfish fisheries, thereby supporting the adoption and implementation of science-based management measures so that bycatch is managed comprehensively and sustainably.

1 Introduction

Launched in 2010, the Bycatch Management (formerly 'Mitigation') Information System (BMIS) is an online resource for fisheries managers, scientists, fishers, educators and the general public. As an initiative of the Western and Central Pacific Fisheries Commission (WCPFC) it is accessible via the commission website at:

http://www.wcpfc.int/bmis

The database holds information on the mitigation and management of bycatch of special interest, including seabirds, sharks and rays, marine turtles and marine mammals that are incidentally caught in oceanic fisheries targeting highly migratory species (HMS), including tuna and billfish[1]. Along with references (scientific and technical literature) on bycatch mitigation and management, the BMIS presents relevant decisions (e.g. regulations and conservation measures) of the five tuna Regional Fisheries Management Organisations (tRFMOs) and other management bodies. Descriptions of mitigation methods summarize the latest knowledge on bycatch reduction techniques. Importantly, there are internal links between species groups, references and decisions so that technical and management information are linked for each taxon. Links to other websites and useful documents are provided by category: Marine Turtles, Seabirds, Sharks, Gear, General, Identification and Handling Guides, Other Bycatch Databases, Research, RFMOs and Videos. BMIS content is continually updated.

Historically, development of the BMIS has been driven by a desire to build an understanding of bycatch mitigation and management among those involved in tuna and billfish fisheries, thereby assisting in the adoption of conservation and management measures embodying the principles prescribed in the WCPFC Convention text (Part II, Article 5), i.e. to:

- (e) ..."*minimize...catch of non-target species, both fish and non-fish species*"...[and]..."*promote the development and use of selective, environmentally safe and cost-effective fishing gear and techniques*" and
- (f) "*protect biodiversity in the marine environment*".

[1] This includes longline, purse seine, pole and line, and troll fishing. The BMIS does not deal with traps, trawl, dredge, gillnet or surrounding net fishing gear, nor recreational fisheries. While it focuses on oceanic fisheries, information in the BMIS is sometimes applicable to nearshore fisheries, e.g., circle hooks are useful in both.

While the focus of the BMIS to date has been the tuna fisheries of the Western and Central Pacific Ocean (WCPO), much of the information in the database is applicable to similar oceanic fisheries globally. With this in mind, funding has been secured to fully realise the potential of the BMIS as an educational resource reaching across ocean basins and supporting all tuna Regional Fisheries Management Organisations (tRFMOs).

2 BMIS History in Brief

Papers presented to WCPFC Scientific Committee meetings in 2007, 2010, 2011, 2012 and 2013 (Williams 2007; Fitzsimmons 2010, 2011, and 2012; and Fitzsimmons & Bunce 2013) provide an overview of the history of development of the BMIS, as well as more detail on database structure and content.

The WCPFC has supported the BMIS financially since its inception. Between 2007 and 2010, in-kind contributions of information were received from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Australia and the Pacific Islands Fisheries Science Centre (PIFSC) Honolulu. The International Sustainable Seafood Foundation (ISSF) funded the overall running and update of the BMIS in 2013. It also funded content update in 2014.

The BMIS is a 'living document' which requires active management and ongoing resources to keep content current and to retain its relevance. Information needs to be collected, analysed and integrated on a regular basis. Staff are needed to respond to user enquiries and contributions, and make technical changes to the database and user interface. WCPFC and ISSF have financed this support, as described above.

The BMIS received in-principle support from the Kobe Process Joint (tuna) RFMO Technical Working Group on Bycatch (TWG-BYC) at their 2011 meeting. The TWG-BYC work plan included the objective of progressing information sharing among RFMOs through the BMIS (Anon. 2011). Funding to further develop the BMIS was provided to WCPFC and SPC by the Global Environment Facility (GEF)-funded, FAO-implemented Areas Beyond National Jurisdiction (ABNJ) Tuna Project in 2015.

It is proposed that ABNJ funds will be used to maintain the BMIS and to develop it in the following ways:

- Adopt a new database platform to improve database stability, security, data integrity and reliability, particularly when using external entry of data
- Improve the efficiency of data collection and entry/upload
- Adapt the web-user interface in accordance with the change in scope and content
- Reorganise the database table hierarchy to add new content modules dealing with bycatch management
- Broaden the scope of content to include literature on bycatch management (see Box 1 - New content modules, below)
- Reorganize web pages to better showcase content on priority issues, such as safe handling and release guidelines and species identification guides
- Include bycatch interest news stories as ‘Bycatch Bytes’

These additions to the BMIS are described in more detail in Sections 3 and 4 below.

3 New Database and Web Platforms

An overhaul of the BMIS MS Access 7 database platform is due. More is required of the database than was originally conceived when it was designed seven years ago. Migration to a new database platform will enable implementation of proposed changes in BMIS scope and content, as well as more efficient database management. It should also allow greater flexibility for future modifications. Similarly, while

significant improvements were made to the BMIS web interface when WCPFC redesigned the commission website recently, the BMIS website will be revised to reflect the changes in scope and content described above.

The BMIS will continue to be hosted and supported on the WCPFC server. The implications of the proposed redevelopment of the BMIS and migration of the new version to the WCPFC server will be assessed. A specifications document will be provided by the end of September 2015 for review by the WCPFC website contractor, Eighty Options. This will enable any major constraints faced in redesigning and migrating the BMIS 'Version 2' to the WCPFC website to be identified.

In deciding which platform(s) to adopt, functional requirements as well as priority areas for update are being identified and documented. Consideration is being given to, *inter alia*:

- Compatibility with WCPFC's Drupal/PHP/MySQL framework
- Database stability, security, data integrity and reliability
- Database fields, linkages between database tables and reorganisation of the database table hierarchy to add new content modules dealing with bycatch management
- Unique web location for both presentation of BMIS information and remote data entry by the BMIS manager
- Efficient data entry via user-friendly forms
- Real-time (immediate) data update
- Output options, e.g., facility to export files, print tables
- Website template contiguous with the WCPFC's format and colour scheme but differentiated to showcase the resources in the BMIS
- Presentation of illustrations, graphs, maps
- Format of tabular information (e.g. Conservation and Management Measures)
- Search capabilities and connectivity between different sections of the website
- Linkages with reference management software
- Website features (e.g. data export, traffic monitoring, social media links)

The BMIS Update and Development Coordinator will provide scopes of work for the database designer and web designer and prepare the specifications for database and web design work. All work will be done in consultation with the ABNJ Technical Coordinator-Sharks and Bycatch and the WCPFC ICT Manager.

4 Content

4.1 Bycatch Mitigation and Management Overview

The BMIS is now known as the Bycatch Management Information System, with 'management' being taken to encompass mitigation. As it stands, the BMIS holds scientific and technical references and summary information describing mitigation techniques and their performance and refinement in experimental situations. The database is also a repository of t-RFMO bycatch conservation and management measures. Links to other websites and useful documents are provided by category, as described above. It is proposed that BMIS searchable content be expanded to include a broader range of information which provides context and rationale for the development of bycatch conservation and management measures, including 'modules' listed in Box 1 below.

Box 1 - New content modules

- ÷ bycatch interaction rates
- ÷ bycatch threats/mitigated threats
- ÷ population-level assessments
- ÷ implementation levels for mitigation techniques
- ÷ national and international management schemes (e.g. CITES, CMS)
- ÷ static maps of bycatch distributions, threats, etc
- ÷ bycatch data harmonization across tRFMOs
- ÷ E -monitoring.

These modules are inter-related parts of a complex web. The policy and legal framework set by international and national management instruments informs the bycatch conservation and management policies of tRFMOs. RFMO bycatch conservation and management measures require or encourage the implementation and reporting of mitigation techniques. The availability of data on bycatch interaction rates, implementation of mitigation methods and evaluation of their effectiveness (and the extent to which they reduce overall threats to bycatch populations) is dependent upon the availability of monitoring data. With a few exceptions (e.g. the USA's monitoring of marine mammal interactions with fisheries), the availability of bycatch data is very limited. Work is underway to begin to harmonise bycatch data across the tRFMOs. E-reporting and E-monitoring are new technologies which should support. and reduce the burden of, observer work and improve the availability of data for scientific analysis. Centralising this information in the BMIS will enhance its role as an educational tool for those involved in managing tuna fisheries, as well as for a broader audience.

4.2 Interaction Rates, Threats and Mitigation Success

With some notable exceptions, data on bycatch interactions with fishing fleets, the implementation of bycatch mitigation technologies and the effectiveness of these in reducing quantities of bycatch is generally scarce (or not publicly available) worldwide. However, literature which examines broad-scale patterns in these areas is available and will be included in the BMIS.

For example, Favaro and Côté (2015) use meta-analysis to consider whether bycatch reduction devices in longline fisheries reduce capture of sharks and rays. Godin et al. (2012) use meta-analysis to weigh the effect of circle hooks on shark catchability and at-vessel mortality rates in longlines fisheries and Caneco et al. (2014) use integrated analysis of combined datasets representing different fisheries to assess interaction rates of various gear configurations. Some of this type of literature is already available in the BMIS if it has been gauged to provide useful information about a mitigation technique, as in the references above. Studies such as Oliver et al. (2015), on elasmobranch bycatch in commercial longline, trawl, purse- seine and gillnet fisheries and Bugoni et al. (2008) on seabird bycatch rates in the south-western Atlantic Ocean do not discuss mitigation specifically but will henceforth be included as they provide useful information for management planning. However, the BMIS will distinguish these studies which relate to bycatch rates specifically from studies which describe the status of bycatch populations, as in the following section.

4.3 Population-level Assessment

Cortés et al. (2015) describes three broad categories of risk assessment methodologies which operate at the population level:

- Productivity-susceptibility analysis (PSA) - a semi-quantitative approach useful as an exploratory or triage tool that can be used to prioritize research, group species with similar vulnerability or risk, and provide qualitative management advice.
- Demographic methods - typically used in the conservation arena to provide quantitative population metrics that are used to quantify extinction risk and identify vulnerable life stages.

- Stock assessments - quantitative estimates of population status and the associated risk of exceeding biological reference points, such as maximum sustainable yield.

Studies using any of the methods described above will be collected in the BMIS. Users will be able to search by type of assessment, species group or species, e.g. blue shark *Prionace glauca*, and locate information about the type of model used, area modelled and years modelled.

4.4 National and International Management Instruments

International agreements such as CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) and the Convention on Migratory Species (CMS) are important components of the bycatch management framework within which nations and regional management authorities such as tRFMOs operate. For example, Clarke et al. (2014) outline issues for tRFMOs arising from the CITES Appendix II listings of five sharks, and all species of manta rays, implemented in September 2014. Also significant are the FAO International Plans of Action (IPOA) for sharks and seabirds that, though voluntary, recommend National Plans of Action (NPOAs) for these species groups. With regard to sharks, for example, Nations/States are encouraged to adopt and implement an NPOA if their vessels conduct directed fisheries for sharks or if their vessels regularly catch sharks in non-directed fisheries. Developing an NPOA drives collaboration and feedback among stakeholders (and provides for regular review of the plan), contributing to improved conservation and management outcomes.

The BMIS will provide an overview of the most significant international instruments in bycatch management planning and provide some national examples. Literature collated will also include studies that review fisheries management performance in light of international and national management instruments as outlined above. For example, references which assess whether bycatch management has been efficient or effective (Kirby & Ward 2014), propose new standards, or identify priority gaps (Gilman 2011, Gilman et al. 2012) will be included in the BMIS.

4.5 Static Maps

Static maps of bycatch distributions (species ranges, overlaps with fisheries, nursery areas – special habitat areas, hotspots, etc.) can be found in reports, journal publications and other literature. They are also available online via websites such as "The State of the World's Sea Turtles" (SWOT) global sea turtle data http://seaturtlestatus.org/learn/maps/all . Literature and sites will be reviewed and boundaries defined with regards to what is feasible to include in the BMIS and how it will be presented.

4.6 Bycatch Harmonisation

Harmonisation of bycatch data across tRFMOs is progressed through initiatives arising from the Joint tRFMO Technical Working Group on Bycatch. A study has been initiated to assist with "identify the minimum data standards and data fields that should be collected across all RFMOs with a view to allowing interoperability" (Anon. 2015a). Data harmonisation would allow for more comprehensive reporting on the status of bycatch species, assist with the identification of factors that cause or increase bycatch, and evaluate the performance of mitigation methods (Anon. 2015a). At the same time, improvements in quality of the data collection should help stock assessments and other functions of tRFMOs (Anon. 2015a). It is anticipated that reports, interim data tables, and agreed outcomes will be forthcoming. The BMIS would be a useful, central location to follow progress on bycatch data harmonization across tRFMOs, providing access to working groups reports etc, as described. It would also be a place to present summary bycatch data, should this become available.

4.7 E -monitoring

E-monitoring technologies are being trialled onboard vessels in some fisheries for their potential benefits in improving management, reporting, and cost efficiencies (e.g. Ruiz et al. 2015). They have the potential to ensure data collections are timely, accurate, adaptable to emerging needs, and capable of providing data at a scale that will support management and scientific needs (Anon. 2015b). Furthermore E-monitoring has the potential to expand the data collected by freeing at-sea observers to

concentrate on data fields or tasks that cannot be collected via E-Monitoring. A new module will be added to the BMIS that provides a repository of information on studies, trials and reports that document the advantages and disadvantages of E-monitoring for bycatch species. This will include studies that describe best practices and technical specifications, as well as issues that require further work.

4.8 Safe Handling and Release and Species Identification

Greater prominence will be given to safe handling and release guidelines. Recent studies on post-release mortality show that safe handling techniques can have a significant effect on bycatch survival rates. For example, Poisson et al. (2014) found that while methods that prevent sharks being brought onboard should be a priority for future investigations, good handling practices should also be promoted as they could reduce mortality by at least 19%. Some national government bodies require fishing vessel owners and operators to complete training in protected species safe handling and release techniques and to follow specific guidelines, e.g., the USA's NOAA sea turtle compliance guide http://www.fpir.noaa.gov/SFD/pdfs/Compliance_Guide_Sea_Turtle_(rev.%202013-08).pdf

Similarly, species identification manuals will be given greater prominence. Better identification skills among crew and observers furthers the use of appropriate handling procedures and promotes better quality data collection.

4.9 Other Content

Improvements will be made to the web-user interface to make it more engaging and user friendly and to make it easy for users to share pages via social media. Bycatch interest news stories, 'Bycatch Bytes', will feature on the Home page. These might include, for example, stories about developments in bycatch technologies, new management measures adopted, or notable research projects underway.

5 Reference Management

Reference management lies at the core of BMIS administration. Zotero, which is open source (free), online reference management software (www.zotero.org), has recently been adopted to capture, collate and store new (from 2014 onwards) reference material, improving the efficiency of reference management and building a BMIS 'library'. Zotero operates as an extension for the Firefox web-browser. For many websites, a Zotero icon will be visible in the URL line. Clicking this automatically adds bibliographic data and related files (such as PDFs, images, audio and video files). Citations, footnotes and bibliographies are easily generated.

Literature captured in the Zotero library in 2014 and 2015 will be visible online in the BMIS after the redevelopment is complete. The new database platform will enable data to be exported from Zotero and uploaded into the BMIS.

Through its 'Groups' facility, Zotero provides the option to share the 'BMIS' library online. There are different group membership rights, with regards to viewing and editing or adding references. At present, copyright issues prevent the whole BMIS library (i.e., complete with file attachments) being shared freely online - it is only possible to publically share citations. Many journal articles are 'pay-to-view', and there is no facility in Zotero to designate a file as 'free to share'. However, it is possible to use the library in its entirety among small, specific groups, e.g., among tRFMO administrators or contributing scientists. This could be beneficial for improving collaboration as well as library content (e.g. adding references in languages other than English). The journal publishing scene will continue to evolve, with more and more journal articles being published as 'open access', and using Zotero should provide the flexibility to adapt with it.

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