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Extending capacity of fish identification skills for improved fisheries assessments

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1 Acknowledgments

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Finally, we thank Kobi Colman and Kevin Liebersbach (Sarox web designs) for their useful feedback about the website platform and advice on ensuring longevity and continued expansion into the future.

2 Executive summary

Accurate identification of fish is a fundamental part of fisheries monitoring programs. Fisheries assessments regularly rely on fish catch data which is recorded by port based and/or on-board fisheries collection/monitoring staff. The quality of these assessments can be greatly impacted by data that is flawed as a result of incorrectly identified fish species. fishIDER (fish Identification Database and Education Resource), was developed in a previous SRA project (FIS/2016/048) to improve fish species identification in Indonesia and provide a training platform for users. The first stage focused on pelagic fishes (tunas, billfishes, sharks). This SRA project included an initial release to selected fisheries-related scientists to obtain feedback and make necessary changes before the official launch. Following this, fishIDER was officially launched at the Our Ocean Conference in Bali in October 2018. This event gained fishIDER a good level of media coverage and included an article in The Conversation. The launch coincided with the release of the stage 1 of fishIDER, the pelagic fish groups developed in the previous SRA project.

This SRA focused on developing content for the key inshore food fish groups, i.e. snappers, fusiliers, emperors, trevallies and groupers. Content for a total of 173 species were developed for fishIDER during this SRA, bringing the total species to 261 when combined with the pelagic species from the previous SRA. The translation process has continued, which included a second training workshop in Hobart for the Indonesian project team member. The services of a translation company were also sought to deliver more Bahasa Indonesian translations. A total of 85 species pages were translated during this SRA project.

A technical analysis of the design and functionality of the fishIDER WordPress site was sourced from an external website developer (Sarox). This analysis revealed a number of limitations with the current website which could cause significant issues moving forward as it expands. As a result, this developer was contracted to rebuild fishIDER on a more stable and custom designed Laravel framework. This will allow any expansion of fishIDER and improved speed, as well as allow for development of offline apps from fishIDER in the future.

3 Background

The fisheries monitoring programs conducted for the earlier Indonesian tuna project FIS/2002/074 and recently concluded project FIS/2009/059, revealed the difficulties that are often experienced by field staff in identifying fish species in 'less than fresh' condition. Fish identification training workshops, conducted by Indian Ocean Tuna Commission (IOTC) in collaboration with Indonesia's Directorate General of Capture Fisheries (DGCF) and marine research institutes, confirmed an overall poor level of fish identification skills among fisheries staff charged with the responsibility of daily fisheries data collection (IOTC-OFCF 2014; Stobberup and Geehan 2015). A further impediment to this problem is the fact that Indonesia lies in the Coral Triangle which has the highest biodiversity of fishes in the world, many of which are poorly known which further confounds identification difficulties. There is universal agreement among the relevant tuna Regional Fisheries Management Organizations (IOTC, Western and Central Pacific Fisheries Commission, and Commission for the Conservation of Southern Bluefin Tuna) and the NGOs (including The Nature Conservancy, Masyarakat Dan Perikanan Indonesia, World Wildlife Fund, and Sustainable Fisheries Partnership) who have current fisheries port-based monitoring programs in Indonesia, that improving the species identification skills of enumerators, in particular, is a high priority. This is particularly true, given the implementation by Indonesia's Ministry of Marine Affairs and Fisheries on 2017 of a nationwide One Data Program of enumeration for all marine fisheries. Improving species identification skills and hence the quality of data collection is seen as essential to the success of the One Data Program and to current Harvest Strategy developments for improved management of Indonesia's fisheries.

The difficulty in identifying two high priority species, yellowfin tuna (*Thunnus albacares*) and bigeye tuna (*T. obesus*) was a prime example of the need for improved species identification. Identifying these species at small size (< 60cm FL) with confidence is difficult, especially when the fish are in non-fresh condition. The current uncertainties around the true scale of catch of juveniles of these species by the fisheries of Indonesia and Philippines, and the level of uncertainties in current regional stock assessments, have been exacerbated by recognition that many (but not all) enumerators struggle to discern these two species at small sizes. This situation was highlighted during the sampling of these two species at several sites across Indonesia, for the population structure study of project FIS/2009/059. Our interactions with local enumerators and fisheries staff revealed an overall low level of skills among those staff for accurately identifying these fish at small size if fish condition was less than fresh. This spawned the idea for an on-line fish identification resource which was developed during a previous SRA, FIS/2016/048, called fishIDER[1], which enumerators and other data collection staff can access in the field if they possess a smartphone or tablet with internet access, and also access at time of data entry in their offices.

For the many fish[2] species commonly caught and landed by Indonesia's fishing fleets, there are excellent identification resources available in the form of books - e.g. White *et al*. (2006); White *et al*. (2013), and fish ID sheets and booklets - e.g. those available through IOTC and Secretariat of the Pacific Community (SPC) (Moore and Colas 2016). However, as good as these resources are, in general, the photos and images used to illustrate the species show the species in best (i.e. fresh) condition, with all 'live' colours and other external markings clearly visible. A significant problem for enumerators in their data collection situations, in fish markets or at landings wharf-side, is that the species they

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[1] *fish Identification Database and Education Resource – fishIDER.org*

[2] *"Fish" in this context includes the fish, sharks, rays, crustaceans and molluscs commonly seen in Indonesian fish markets and catch landing places.*

need to identify and record are often in ‘less-than-fresh’ to sometimes very poor condition and are missing those key identifying colours and markings. Hard copy books also become out of date very quickly with changing taxonomy and improvements to previous identifications.

In addition to *fishIDER.org* being a tool for species identification, its other main focus is as a training tool, with modules developed to test and improve the identification skills of the users. The website’s training modules will be of benefit to all fisheries agencies in enumerator and observer training courses.

The primary aim of this SRA project was to expand fishIDER’s taxonomic coverage of key food fish species from Indonesia and revise the tool based on user feedback during both a soft launch and subsequent official launch.

4 Objectives

Primary objective:

To expand the species coverage of the fishIDER website to include an additional ~200 species of important food fish and non-fish groups.

The specific objectives of the project were to:

1. Populate the website with the key groups of reef fish known to be important food fish in Indonesia, in particular the snappers (Lutjanidae, Caesionidae), emperors (Lethrinidae), and groupers (Serranidae);
2. Populate the website with key non-fish groups, in particular lobsters, prawns, squid, hard-shelled molluscs, turtles, etc;
3. Provide further training to an Indonesian partner scientist to enable contributions from Indonesia in the populating of content, assistance with translations into Bahasa Indonesia, and management of the website;
4. Improve the websites functionality including responding to users' feedback following its launch in mid-2018.

5 Methodology

This SRA was largely a desktop-based project to expand the fishIDER website established during a previous ACIAR SRA (FIS/2016/048). Images and data for key species had been collected in previous ACIAR projects in Indonesia and additional images are available from the Australian Fish Collection at CSIRO in Hobart.

The majority of the project activity was populating the website with content, and developing accurate species keys and interactive training modules.

A second round of training was provided at CSIRO Hobart for Mr Enjah Rahmat, scientist of Indonesia's Research Institute for Marine Fisheries. The 2 weeks of training focused on the translation of the English components to Bahasa Indonesia directly into the backend of the WordPress site.

A 'soft' launch (initial release) of the website was done in September 2018 via email to around 64 persons; fisheries scientists, both within and outside of Australia, and select potential users in Indonesia (i.e. fisheries enumerators).

The official launch of fishIDER was delayed from the previous project's timeline to align with the Our Ocean Conference in Bali in October 2018. We needed to be responsive to user feedback and modify aspects of the website following the 'soft' launch, the official launch and field testing.

6 Achievements against activities and outputs/milestones

Objective 1: Populate the website with the key groups of reef fish known to be important food fish in Indonesia, in particular the snappers (Lutjanidae, Caesionidae), emperors (Lethrinidae), and groupers (Serranidae)

no.	activity	outputs/ milestones	completion date	comments
1.1	New species pages will be established for at least 200 species of bony fishes	173 new species pages generated	June 2019	See Discussion in section 7
1.2	For each family, an illustrated species key will be developed to allow users to accurately identify fish to the species level	Keys generated for the key families, Lutjanidae, Caesionidae and Lethrinidae	June 2019	Key for Serranidae still in development – see Discussion section 7
1.3	Translate all English text into Bahasa Indonesian to ensure all sections of the website are bilingual	2nd round of training for E. Rahmat; 85 of the total 261 species pages translated to date	June 2019	Translations were found to take far longer than anticipated requiring us to pay for translation services which was cost limiting in terms of how many species pages we could get translated

PC = partner country, A = Australia

Objective 2: Populate the website with key non-fish groups, in particular lobsters, prawns, squid, hard-shelled molluscs, turtles, etc

no.	activity	outputs/ milestones	completion date	comments
2.1	New group, family and species pages will be established for at least 40 key non-fish species, e.g. crustaceans (prawns, crabs, crayfish), molluscs (squid, octopus, bivalves, trochus), reptiles (turtles), marine mammals and sea birds	Nil	Not commenced	Objective not commenced due to other commitments not foreseen including the launch, WordPress upgrades and website redevelopment (see Discussion section 7)

PC = partner country, A = Australia

Objective 3: Improve the websites functionality including responding to users' feedback following its launch in mid-2018

no.	activity	outputs/ milestones	completion date	comments
3.1	Obtain feedback about the website's functionality prior to the official launch (soft launch)	Website revised based on feedback from selected contacts	September 2018	nil
3.2	Officially launch fishIDER at the Our Ocean Conference in Bali	fishIDER booth manned by project staff (C. Proctor, H. O'Neill, E. Rahmat)	October 2018	Malcolm Turnbull visited the booth and gave permission to use his Twitter handle to advertise

3.3	Field testing of fishIDER following launch in Bali	fishIDER revises where necessary	October 2018	C. Proctor showcased fishIDER to enumerators and other data collection staff at five fishing ports: Lampulo (Aceh), Bungus (West Sumatera), Palabuhanratu (West Java), Bitung (north Sulawesi) and Ambon (Maluku).
3.4	Revise the web design to ensure its longevity and allow expansion in the future and development of apps	Technical analysis fishIDER on the WordPress platform; Redevelopment of fishIDER onto a more stable platform	May 2019; redevelopment June-August 2019	Main outcome of scope was “There are many critical flaws with the current system which could make it difficult to maintain and will make it difficult to expand in the future.” This led to us needing to contract a web designer to redevelop the fishIDER platform

PC = partner country, A = Australia

7 Key results and discussion

The initial stages of this SRA were devoted largely to the official launch of fishIDER, together we a 'soft' launch before the main launch to a selected group of people. We had originally planned for the launch to be held in Jakarta, possibly in line with another ACIAR event, but an opportunity arose to launch at the Our Ocean Conference (OOC) in Bali in October 2018. The OOC events are focused on politicians and policy makers making it an ideal audience to launch fishIDER. This required more preparation than was originally planned in the SRA, including development of a banner, two posters and a flyer (Appendix 2), business cards, and caps.

The initial release, or soft launch, of fishIDER was conducted on 12th September 2018. A link to the planned stage 1 release of fishIDER was sent to 64 relevant people, including 21 Indonesian colleagues. Comments were received from a number of these people and necessary changes were made in fishIDER prior to the official launch at end of October.

Three of our team, Enjah Rahmat, Helen O'Neill and Craig Proctor, attended the OOC conference and manned an exhibition booth for fishIDER. The launch of fishIDER was announced by Allaster Cox (Deputy Head of Mission, Indonesia) during the event. The Hon. Malcolm Turnbull spent some time at the booth and was impressed with fishIDER tool and allowed us to use his Twitter handle to promote fishIDER. The booth was visited by a large number of people who showed great interest in the tool.

This project added 173 new fishes to fishIDER, bringing the total of species on the website to 261, which represent the key reef fish groups observed in the markets, i.e. snappers (Lutjanidae), fusiliers (Caesionidae), trevallies (Carangidae) and emperors (Lethrinidae). Combined with the pelagic species previously entered into fishIDER in the first SRA (FIS/2016/048), fishIDER now contains important species identification information for the key food fishes in Indonesia. Keys were developed for each of these groups to allow for identification in the field.

The translation component of the project needed to adapt throughout this SRA. Enjah Rahmat attended a second workshop in Hobart (12-23rd November 2018), with the aim of progressing the translations. The translation of the text directly into the WordPress site was quite challenging and much slower than we anticipated. As a result, we diverted some of the funds in the project to contracting a translation company (ICanLocalize) to undertake more translations than we could have otherwise achieved. A total of 85 (of the total 261 species pages) are now translated and more funds will need to be sourced to continue progressing this into the future.

The additional time spent preparing for the launch of fishIDER and the delays with the translation component led to a decreased delivery of content for fishIDER than originally planned. Objective 2 regarding including non-fish groups on fishIDER was not undertaken due to these time limitations and will be delayed for a later date when more funds are available.

During the course of this SRA, the web content analyst, Helen O'Neill, raised concerns about the long-term functionality of the Word Press site due to the number of add-ins and quantity of images and data being incorporated. As a result, we sought the services of a website developer, Sarox, to provide a technical analysis on the long-term strategy of fishIDER. This analysis detected a number of flaws in the current system which would make it difficult to maintain and continue to expand fishIDER into the future. One of the biggest concerns with continuing with the Word Press site is that it will become quite slow as content is added. This would be a real issue in the field where time taken for pages to render would not be ideal. This analysis suggested a re-build of the fishIDER website with a Laravel framework which would give more flexibility around the design and functionality of the website. It will also allow for a simpler process in developing off-line apps for fishIDER which is currently not possible. We subsequently contracted Sarox to undertake this rebuild of fishIDER which is currently underway and due to be completed in August

2019. This rebuild does not affect the use of fishIDER in the interim and the system will look largely the same to what is currently available.

8 Impacts

8.1 Scientific impacts – now and in 5 years

- The primary scientific impact from *fishIDER.org* will be improved fisheries assessments, as a direct result of the improved accuracy and reliability of fisheries data, resulting from improved fish identification skills of data collection personnel;
- The improved accuracy of fish identifications through use of the *fishIDER* tool will lead to significantly improved fisheries catch assessments by Indonesia, including for internal purposes and for reporting to the RFMOs and FAO, resulting in improved stock assessments by Indonesia and the RFMOs;
- *fishIDER* has the potential to improve the scientific knowledge of not only fisheries staff but also of fisheries scientists or of anyone conducting research involving tropical fish species.

8.2 Capacity impacts – now and in 5 years

- The primary capacity impacts from this project will be the improved fish identification skills of persons (enumerators, observers, local fisheries staff) involved in fisheries data collection and the resultant improved fisheries assessments and fisheries management through more accurate and reliable catch/landings data. These impacts will come directly from the availability and use of *fishIDER.org* as a fisheries identification training resource;
- The training delivered in this project (and the previous SRA) to an Indonesian scientist in the 'back-end' management of the website provided Indonesia with improved capacity in taxonomic skills (including development of taxonomic keys).

8.3 Community impacts – now and in 5 years

The fishIDER tool has as ultimate goal of improving sustainable management of fisheries, improving capacity for fish identifications, leading to improved quality of fisheries data, leading to improved fisheries assessments and thus more effective fisheries management. The community impacts that will come from more sustainable fisheries include employment and livelihood security, food security, and the benefits to the environment through protection against overfishing.

8.3.1 Economic impacts

fishIDER provides an important resource for not only species identification but also as a training tool to educate users on how to identify fish. The fishIDER platform allows for expansion both geographically and taxonomically very easily. This will facilitate taxonomic training in the future and will be a far more economical approach to such training than operating individual, project-based taxonomic training workshops.

8.3.2 Social impacts

The ultimate goal of more effective fisheries management through more accurate fisheries data entering the pipeline will potentially benefit communities in Indonesia through improved sustainability of fish resources. It will also provide the knowledge for a wide audience of users to develop taxonomic identification skills.

8.3.3 Environmental impacts

Improved fish identification will improve data quality in Indonesian fisheries which in turn, over the longer term, will result in improved fisheries management. This will likely have positive influences on preservation of some species through improved management.

8.4 Communication and dissemination activities

- A logo produced for fishIDER for the website and all promotional material (Appendix 1);
- H. O'Neill presented an oral presentation at the Australian Society of Fish Biology conference in Melbourne in October 2018, in the symposium "Challenges in fisheries management and assessment". The abstract submission was: O'Neill, H., Proctor, C., and White, W. *fishIDER – A bilingual, web-based fish identification tool for marketfish in Indonesia*;
- W. White invited to talk about fishIDER to the CSIRO business unit National Collections and Marine Infrastructure in August 2018 and to the CSIRO Executive Team including the CEO Larry Marshall in September 2018;
- During the course of the project, information about the aims and development of *fishIDER.org* was provided in person and in emails to many fisheries scientists, to fisheries agency staff in Indonesia, and to the RFMOs and to the various NGOs. The overall response from those receiving this information was extremely positive and yielded several offers of contributions of materials (primarily fish images) for the website's further development;
- Two posters (Appendix 2), a flyer (Appendix 2), a banner, a business card and printed hats were produced and printed for the launch at the Our Ocean Conference in October 2018;
- A 'soft' launch via email to 64 persons in September 2018; to fisheries scientists both within and outside of Australia, and select enumerators and other fisheries data collection personnel in Indonesia;
- Our Ocean Conference launch in Bali October 2018 – a booth was organised to showcase fishIDER and was manned by C. Proctor, H. O'Neill and E. Rahmat (see Appendix 3). The head of the Australian delegation, Hon. Malcolm Turnbull, spent 15 min at the booth viewing fishIDER and gave permission to use his Twitter handle to promote the tool;
- In November 2018, C. Proctor gave demonstrations and presentations on fishIDER to fisheries enumerators at five fishing ports: Lampulo (Aceh), Bungus (West Sumatera), Palabuhanratu (West Java), Bitung (north Sulawesi) and Ambon (Maluku);
- Article about fishIDER published in the Conversation - https://theconversation.com/fishider-a-new-tool-to-improve-fisheries-management-in-indonesia-105578
- H. O'Neill and W. White had a meeting with SPC contacts about synergies between fishIDER and PacFish which they have produced. Future collaboration would see a sharing of a lot of imagery for both projects;
- W. White invited by Sarah Martin at FAO to attend the Indian Ocean Tuna Commission's Working Party Meeting on Ecosystems and Bycatch at Réunion in September 2019 to promote fishIDER as a tool to assist with bycatch related issues;
- Received positive industry feedback from a sustainable seafood company in the Philippines, Meliomar Inc. (mother company Blueyou, Switzerland) about fishIDER –

‘*Hi, just a little word to express how GREAT is this tool! I'm working in a sustainable seafood company and this website helps us to correctly identify fishes we process - in a world where more than 20% of fishes are mislabelled, this is a really really important tool for us. Thanks a lot!*!” which highlights the regional need for a tool such as fishIDER.

9 Conclusions and recommendations

9.1 Conclusions

Our main conclusion is that despite not meeting some of the targets set out at the start of this SRA, i.e. species pages and not all translations, we have had a very strong and highly visible launch and finished with a stronger product than at the start of the year based on the website rebuild (currently in progress). The training of the Indonesian project member in Hobart was continued and he was also involved in the launch at the OOC event in Bali. We are very satisfied with the what has been achieved in this SRA and we feel very satisfied that the rebuild of the website is well underway which will ensure long-term maintenance and growth of fishIDER into the future.

9.2 Recommendations

Our key recommendation to emerge from this SRA project would be to continue funding support for fishIDER throughout the South-east Asian region. In particular, funding to incorporate Artificial Intelligence software through Machine Learning technology would greatly improve the functionality of fishIDER.

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10.2 List of publications produced by project

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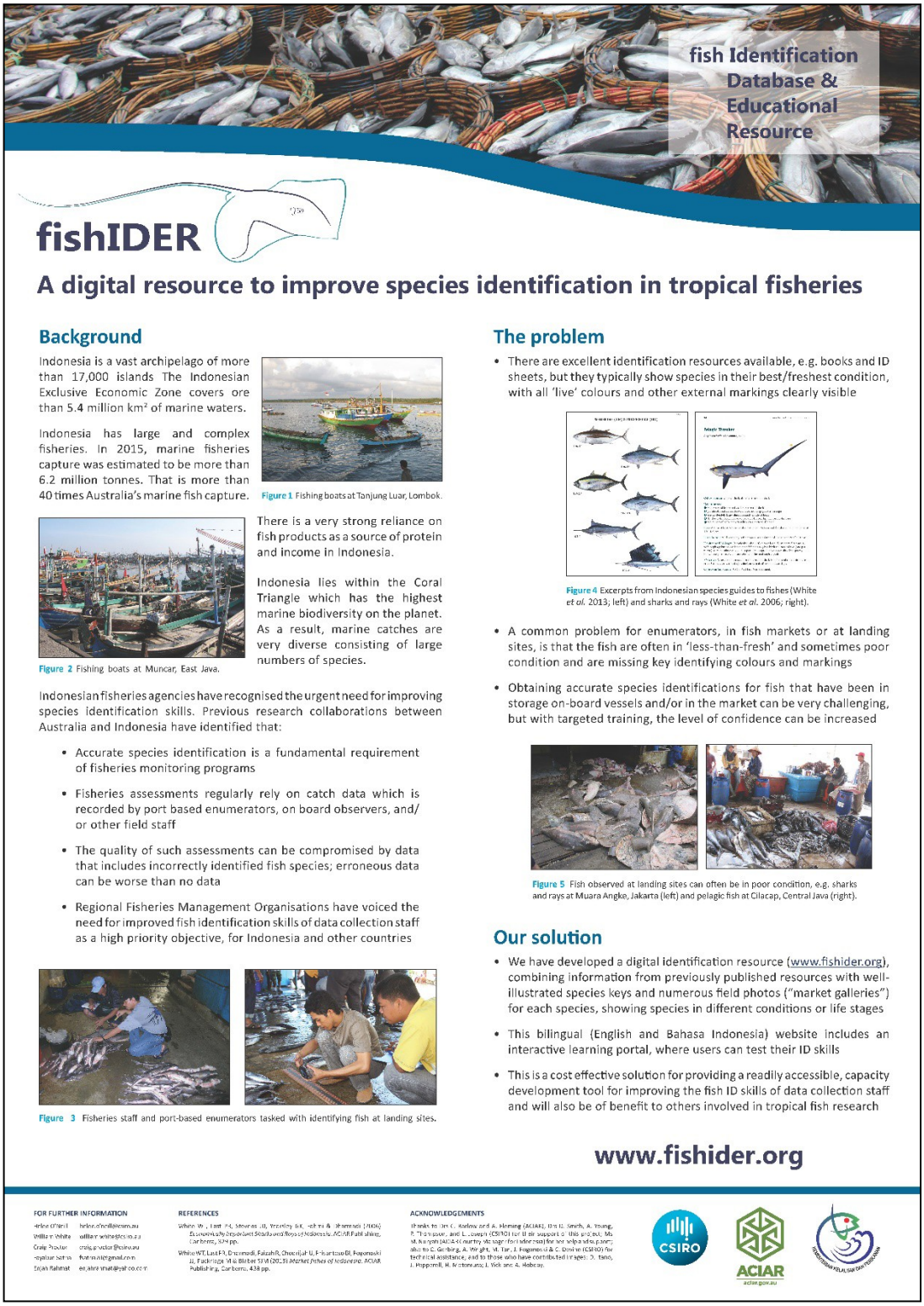
11 Appendixes

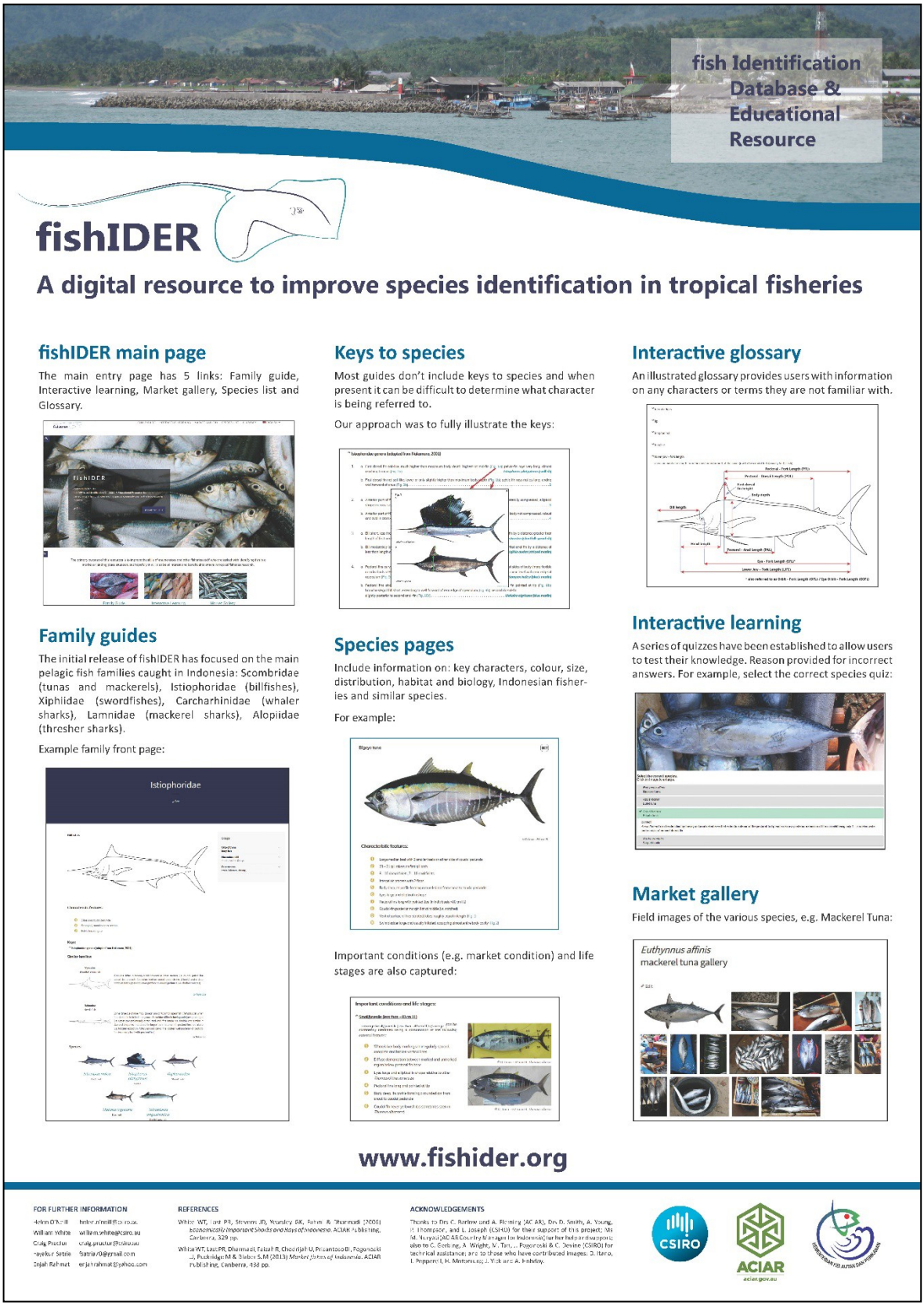
11.1 Appendix 1: fishIDER logo developed by Helen O'Neill

11.2 Appendix 2: Outreach material produced for fishIDER's official launch at the Our Ocean Conference

11.2.1 Poster 1 developed by William White



11.2.2 Poster 2 developed by William White



11.2.3 Flyer front page, developed by William White

fishIDER

A digital, bilingual, fish identification and training tool

Background

- Accurate species identification is a fundamental requirement of fisheries monitoring programs
- Fisheries assessments regularly rely on catch data which is recorded by port based enumerators, onboard observers, and/or other field staff and their quality can be compromised by data that includes incorrectly identified fish species
- Regional Fisheries Management Organisations have voiced the need for improved fish identification skills of data collection staff as a high priority objective, for Indonesia and other countries

The problem

- There are excellent identification resources available, but they show species in their best/freshest condition
- A common problem for enumerators, is that the fish are often in 'less-than-fresh' condition and are missing key identifying colours and markings
- Accurate species identifications for fish in poor condition is very challenging, but with targeted training, the level of confidence can be increased

The solution

- We have developed a digital identification resource (www.fishider.org), combining information from previously published resources with well-illustrated species keys and numerous field photos ("market galleries") for each species, showing species in different conditions or life stages
- This bilingual (English and Bahasa Indonesia) website includes an interactive learning portal, where users can test and improve their ID skills
- This is a cost effective solution for providing a readily accessible, capacity development tool for improving the fish ID skills of data collection staff and will also be of benefit to others involved in tropical fish research

www.fishider.org

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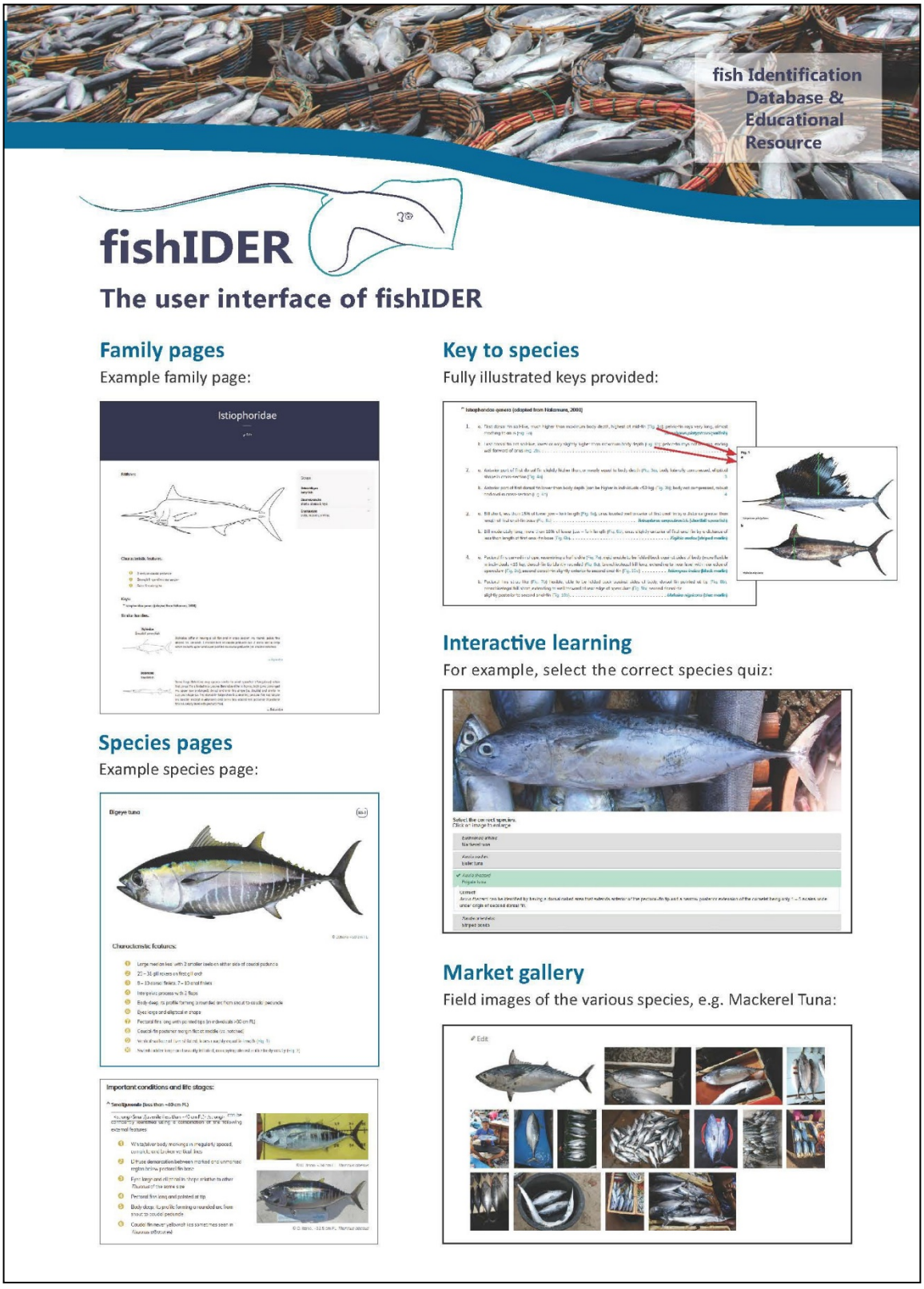
11.2.4 Flyer back page, developed by William White



11.3 Appendix 3: Images from fishIDER's official launch at the Our Ocean Conference

11.3.1 Helen O'Neill and Enjah Rahmat demonstrating the fishIDER website to Hon. Malcolm Turnbull

11.3.2 fishIDER team at the OOC launch in Bali in front of the exhibition booth