APPENDICES

Appendix A. Capacity Building and Community Engagement

During 2011 and 2012, NOAA worked with the Government of Timor-Leste, Ministry of Agriculture and Fisheries (MAF), USAID Timor-Leste Mission, and local partners and stakeholders to identify and prioritize some key coastal management tools that could help people and communities adapt to the marine ecosystem impacts of climate change and better sustain fisheries and food security in Timor-Leste. During various meetings, MAF and their partners outlined a critical need for enhanced local, institutional, and organizational capacity to continue long-term observations to bring Timor-Leste's resource managers scientifically-credible observations for informed decision making. NOAA-CREP scientists leveraged the partnership opportunities provided by the Coral Triangle Support Partnership (CTSP) to build and maintain the relationships needed to achieve this objective. Through the generous support of the CTSP, implemented primarily by Conservation International (CI) in Timor-Leste, and working in partnership with local organization Rai Consultadoria, the NOAA-CREP team brought together scientists, managers, and community members to develop a framework for an ecosystem approach to fisheries management (EAFM) and prepare for the impacts of climate and ocean change on coral reef ecosystems. The following is a summary of NOAA-CREP's community engagement and capacity building efforts, which, where applicable, include links to blogs posted by NOAA-CREP about the activities.

Mission Planning – February 2012

In preparation for the first NOAA-CREP led field mission in Timor-Leste planned for later in 2012, NOAA-CREP traveled to Timor-Leste and met with local in-country partners at MAF to provide an overview of the proposed work and identify: 1) how NOAA-CREP could best provide for the needs of Timor-Leste via the NOAA-USAID partnership, 2) what training and local participation was needed, and 3) where NOAA-CREP should establish monitoring sites. NOAA-CREP then traveled overland, visited, and gathered reconnaissance on the 10 proposed monitoring sites identified by MAF officials as important areas for investigations of marine resources and oceanographic conditions.

Mission Preparations and Operations – October 2012

In early October 2012, four members of NOAA-CREP arrived in Dili to commence the first field mission in Timor-Leste. They met with partners from MAF and USAID to outline the schedule for instrument deployment at the 10 monitoring sites. Before the mission officially commenced, MAF staff along with a representative from the Rai Consultadoria joined the NOAA-CREP team to learn firsthand about NOAA-CREP's instrumentation and planned activities, including an introduction to installing autonomous reef monitoring structures (ARMS), calcification accretion units (CAUs), subsurface temperature recorders (STRs) and collecting water samples at Dili Rock (Figure 46).

Figure 46. Preparing for and executing the 2012 field mission in Timor-Leste: prior to the mission, staff from MAF and NOAA-CREP assemble ARMS (*left*); NOAA-CREP dive team and local partners during the mission (middle); and a local partner with an assembled ARMS unit ready to be deployed (*right)*.

This collaboration was intended to be the first of many targeted capacity building efforts between NOAA-CREP and MAF. The majority of the near two-week expedition took place aboard a chartered 12-m (40-ft) catamaran and successfully concluded with instrumentation deployed and surveys conducted at 10 locations along the north and south coasts of Timor-Leste (see Figure 23 in Chapter 4 for a map of the survey locations).

Blog Posts:
Team embarks on field mission in Timor-Leste, posted October 18, 2012:
https://pifscblog.wordpress.com/2012/10/18/cred-mission-timor-leste/

The final count: Timor-Leste expedition completed, posted November 20, 2012:
https://pifscblog.wordpress.com/2012/11/20/final-count-timor-leste/

EAFM LEAD Workshop – March 2013

NOAA-CREP, with support from USAID's Regional Development Mission for Asia and the CTSP, led a two-day training workshop on an Ecosystem Approach to Fisheries Management for Leaders, Executives, and Decision makers (EAFM-LEAD) to help build Timor-Leste's capacity for effective fisheries management using a more holistic ecosystem approach. Leaders from several Timorese government agencies attended the workshop in Dili, including the Secretary of State and the National Director of Fisheries and other MAF staff, the National Directorate of Forestry, the naval component of the Defense Forces of Timor-Leste, and Professors from the National University of Timor-Leste (Figure 47). The workshop concluded with participants feeling optimistic yet realistic about the long-term process required for the transition toward an EAFM.

Figure 47. Representatives from NOAA-CREP and from government agencies, academia, and the naval force of Timor-Leste who participated in a 2-day EAFM LEAD workshop in Dili.

Blog Post:

NOAA helps Timor-Leste leaders build capacity in an Ecosystem Approach to Fisheries Management, posted April 5, 2013: https://pifscblog.wordpress.com/2013/04/05/timor-leste-leaders-eafm/

Mission Planning – May 2013

In preparation for NOAA-CREP's second field mission in Timor-Leste, NOAA-CREP and CI, with support from the CTSP, traveled overland to meet with MAF District Fisheries Officers to familiarize them with the upcoming field mission, confirm logistical support for scientific operations, and discuss engaging with community members during the planned research activities.

Mission Operations and Community Outreach – June 2013

In early June 2013, six members of NOAA-CREP arrived in Dili to initiate NOAA-CREP's second field mission in Timor-Leste (Figure 48). The primary objective of the mission was gathering data on fish species. The team also collected water samples and information about seafloor characteristics, including photographs and depth soundings. During the nearly month-long mission, two local charter vessels were used for conducting underwater surveys at 150 sites along the northern coastline of Timor-Leste, including the Capital of Dili, the Districts of Oecusse, Bobonaro, Liquica, Manatuto, Baucau, and Lautem, as well as Atauro and Jaco Islands.

Figure 48. Staff from NOAA-CREP met with representatives from MAF, CTSP, USAID, and the Secretary of State for Fisheries prior to the start of the team's surveys in Timor-Leste.

To raise awareness during the mission, a banner was attached to the catamaran used for the surveys that read, "Levantamentu dadu kona-ba biomasa ikan iha Timor-Leste nia tasi-feto," (The survey data on fish biomass in Timor-Leste's northern coast) and included the insignia of all cooperating agencies: NOAA, USAID, CI, CTSP, and the Democratic Republic of Timor-Leste (Figure 49).

Figure 49. The catamaran used for the live-aboard portion of the mission, shown here with the banner that was displayed to raise awareness about the NOAA-CREP mission to study reef fish along Timor-Leste's northern coastline.

CI and NOAA-CREP also produced several short videos (2-4 minutes each) that covered various aspects of the mission:

1. Liquica Day 1, engaging the community in Liquica: https://www.youtube.com/watch?v=QYnI62om7_c
2. Liquica Day 2, introduction to water collection methods and instrumentation: https://www.youtube.com/watch?v=vJDh4-7Kxag
3. Liquica Day 3, NOAA-CREP performs data entry following reef fish surveys in the field: https://www.youtube.com/watch?v=7JSNHyLEDek
4. Liquica Day 4, introduction to subsurface temperature recorders: https://www.youtube.com/watch?v=JTo6C8xHlOY
5. Overview of NOAA-CREP dive safety drills and protocols: https://www.youtube.com/watch?v=3hNr3SuQZGs

While the surveys were underway, representatives from NOAA-CREP and CI traveled overland visiting each district prior to the team's arrival by sea to inform the communities about the surveys being conducted in their neighborhoods and to explain how the information will help to manage their reef fisheries. A series of information, education, and communication workshops were hosted to discuss the importance of well-managed marine ecosystems while raising awareness about NOAA-CREP's activities in Timor-Leste. Participants included national, district and suku (local government unit) government personnel, women's groups, fisherfolk, local business owners, and USAID personnel (Figure 50).

Figure 50. Local fishermen attending an IEC (information-education-communication) workshop in the district of Manatuto, Timor-Leste. The banner translates as "Look after the ocean, and the ocean will look after you." (© CI/photo by Claire Farrugia)

A number of informational flyers and posters were created for these workshops, with versions translated into Tetun. These printed materials explained the purpose of the field missions and the ongoing scientific monitoring being conducted at locations in Timor-Leste, including:

1. "Understanding Fish Populations in Timor-Leste" (flyer)
2. "Understanding Ocean Acidification in Timor-Leste" (2-page flyer)
3. "Monitoring Coral Reefs in Timor-Lester" (poster including Tetun translation)
4. "ARMS: From Science to Outreach—A Universal Method to Collect Knowledge of the Unknown" (poster including Tetun translation)
5. "DIVERSITY!" (poster including Tetun translation)

These printed materials are included at the end of this Appendix.

Blog Posts:

Scientists assess reef fish and benthic communities, monitor effects of ocean acidification off Timor-Leste, posted June 3, 2013 by NOAA-CREP:
https://pifscblog.wordpress.com/2013/06/03/fish-acidification-timor-leste/

Update from Timor-Leste: team completes 50 surveys of reef fish and benthic communities in first week, posted June 19, 2013 by NOAA-CREP:
https://pifscblog.wordpress.com/2013/06/19/update-timor-leste-first-week/

Update from Timor-Leste: scientists complete live-aboard mission to survey reef fishes and benthos, assess ocean acidification, posted July 8, 2013 by NOAA-CREP:
https://pifscblog.wordpress.com/2013/07/08/timor-leste-live-aboard/

Timor-Leste Fish Survey Will Help Create Sustainable Fisheries, posted August 7, 2013 by Rui Pinto:
http://blog.conservation.org/2013/08/timor-leste-fish-survey-will-help-create-sustainable-fisheries/

The final count: summary of mission to assess reef fish assemblages, build capacity in Timor-Leste, posted August 13, 2013 by NOAA-CREP:
https://pifscblog.wordpress.com/2013/08/13/final-count-timor-leste-2/

In Timorese Communities, Importance of Fishing May Be Underestimated, posted August 15, 2013 by Rui Pinto:
http://blog.conservation.org/2013/08/in-timorese-communities-importance-of-fishing-may-be-underestimated/

From the Field in Timor-Leste: Giving Communities a Voice in Conservation, posted August 21, 2013, by USAID/Timor-Leste:
https://blog.usaid.gov/2013/08/from-the-field-in-timor-leste-giving-communities-a-voice-in-conservation/

Coral Triangle Day – June 2013

To commemorate "Coral Triangle Day" in Timor-Leste, the NOAA-CREP scientists participating in the field mission led capacity-building activities for local partners from MAF and CTSP. The team provided an overview of the survey method used in assessing fish populations and demonstrated the method onshore before heading into the field for the day (Figure 51). The team then traveled by boat to Dili Rock to demonstrate the survey methods and water sampling to the participants, and show them the underwater suite of monitoring instruments deployed in 2012.

Figure 51. NOAA-CREP staff reviews the stationary-point-count method with MAF and CTSP staff on the beach at Dili Harbor.

At a second location, Black Rock at Caimeo Beach, the NOAA-CREP team provided an in-depth description of the water sampling protocol, and the partners practiced using Niskin bottles to collect and process water samples (Figure 52). A videographer from the local television news captured these activities. The news station featured these Coral Triangle Day events on the local news the following night, highlighting the collaboration between NOAA-CREP and MAF supported by USAID and the CTSP.

Figure 52. Local partners undergoing training in water sampling techniques.

Blog Post:

NOAA scientists, local partners mark Coral Triangle Day in Timor-Leste with capacity-building activities, posted June 18, 2013 by NOAA-CREP:
https://pifscblog.wordpress.com/2013/06/18/coral-triangle-day-timor-leste/

Spatial Data Management Development & Mission Planning – June 2014

NOAA-CREP traveled to Timor-Leste to discuss spatial data management needs as part of NOAA-CREP's activities in Timor-Leste. Meetings with representatives from MAF were held for: 1) sharing progress on the data collected by NOAA-CREP during the 2012 and 2013 missions in Timor-Leste and on the two basemaps being developed from satellite imagery, and 2) gathering requirements for organizing and managing the data to be provided by NOAA-CREP to MAF at the end of the project.

Figure 53. NOAA-CREP staff met with MAF staff and other local partners to discuss spatial data management needs.

Preparations for the third NOAA-CREP mission planned for later in 2014 were also initiated. Meetings were held with numerous in-country partners from various organizations, including service vendors, NGOs, USAID, MAF, and the U.S. Embassy to arrange logistics for the mission (Figure 53).

While in country, NOAA-CREP staff attended a celebration for "World Oceans Day" in Dili with representatives from CI and the U.S. Embassy, and gave a presentation to the Secretary of State for Fisheries and other regional partners on the NOAA-USAID projects in Timor-Leste.

Mission Operations – September/October 2014

For the third and final field mission, NOAA-CREP scientists worked closely with numerous local partners (private, NGO, government, and the community) to facilitate retrieval of the monitoring instruments deployed in 2012 (Figure 54). Through this collaboration, the training and instrumentation provided enabled the participating partners to build skills for the potential continuation of the coral reef monitoring efforts at the established climate monitoring sites in Timor-Leste beyond the NOAA-USAID partnership.

Figure 54. Scientific dive team members en route to recover monitoring instruments during the 2014 mission.

Building on the relationships established through the information, education, and communication workshops conducted in 2013 in each of the districts, the team received a tremendous amount of support and interest from local residents, fishers, and even school children in sorting and identifying the tiny unique organisms collected from the ARMS units that were retrieved after sitting for two years on the seafloor. Several “Hands-on ARMS” outreach events were organized as part of the effort (Figure 55).

Figure 55. Photos from "Hands-on ARMS" community outreach events in Timor-Leste: girls help look for and sort invertebrates from a processed ARMS (*top left*), boys watch a NOAA-CREP personnel filter matter from ARMS (*top right*), children from Beacou help process an ARMS (*middle left*), crabs and other invertebrates found on ARMS are stored for further study (*middle right*), two brothers from Atauro examine sorted invertebrates before they are photographed (*bottom left*), villagers from Beacou help NOAA-CREP personnel process ARMS (*bottom right*).

Blog Posts:

Scientists return to Timor-Leste for reef monitoring mission, posted September 30, 2014 by NOAA-CREP: https://pifscblog.wordpress.com/2014/09/30/timor-leste-atauro/

Update from Timor-Leste: children help researchers to process invertebrates from a study site off Beacou, posted October 3, 2014 by NOAA-CREP: https://pifscblog.wordpress.com/2014/10/03/beacou-arms-children/

USAID funds NOAA mission for scientists to return to Timor-Leste to monitor coral reefs, posted October 13, 2014 by USAID Timor-Leste: https://www.facebook.com/USAIDTimorLeste/posts/766030143443046

GIS Workshop & U.S. Embassy Outreach Event – October 2015

NOAA-CREP conducted a three-day workshop in which MAF's Agriculture and Land-Use Geographic Information System team was introduced to NOAA coral reef data management and linking this with the science to support fisheries management in Timor-Leste. Workshop participants explored making use of the data collected by NOAA-CREP in Timor-Leste through a series of instructional and "hands-on" GIS exercises (Figure 56).

Figure 56. Photos from the GIS workshop in 2015: NOAA-CREP workshop instructor supporting a workshop participant with a question (*top left*), a workshop participant entering field data using best data management practices (*top right*), two workshop participants working together conducting a GIS analysis using NOAA-CREP GIS data for Timor-Leste (*bottom left*), NOAA-CREP instructor demonstrating data collection in the field using a hand-held GPS unit (*bottom right*).

NOAA-CREP participated in a U.S. Embassy Outreach event, "Amérika iha Timor-Leste: Parseria ba Prosperidade (America in Timor-Leste: Partnership for Prosperity)," at Timor Plaza. This event was a day-long exhibition showcasing the relationship between the U.S. and Timor-Leste, and the NOAA booth was one of the most popular stops for many parents and children (Figure 57).

Figure 57. Photos from the U.S. Embassy Outreach event: NOAA and USAID staff with the U.S. Ambassador for Timor-Leste (*left*), and Schoolchildren learn about NOAA through coloring activities (*right*).

Blog Posts:

NOAA Leads GIS Workshop in Timor-Leste, posted November 10, 2015 by NOAA-CREP: https://pifscblog.wordpress.com/2015/11/10/workshop-timor-leste/

America in Timor-Leste: Partnership for Prosperity, posted October 18, 2015 by U.S. Embassy Timor-Leste: https://www.facebook.com/USAIDTimorLeste/photos/?tab=album&album_id=948050691907656

Final Deliverables – June 2017

In-country meetings are planned for June 2017 in which the data and information products (including this report) will be delivered. The purpose of these meetings is explaining and demonstrating how the information can best be used in both the short-term and the long-term for more effective management of coastal and fisheries resources in the face of climate and ocean changes.

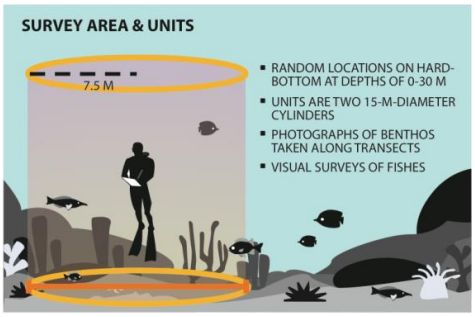
OUTREACH FLYERS AND POSTERS

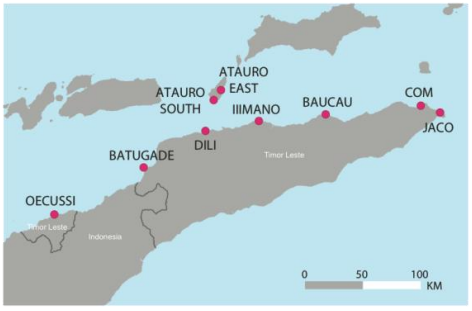
"Understanding Fish Populations in Timor-Leste" flyer:

UNDERSTANDING FISH POPULATIONS IN TIMOR-LESTE

THE DIVE TEAM

The Coral Reef Ecosystem Division (CRED) of the U.S. National Oceanic and Atmospheric Administration's (NOAA) Pacific Islands Fisheries Science Center will be conducting reef fish and benthic surveys along the entire North Coast of Timor-Leste in conjunction with the Coral Triangle Support Partnership (CTSP), the National University of Timor Leste, and the Ministry of Agriculture and Fisheries (MAF). Based in Hawaii, CRED conducts ecosystem assessments and long-term monitoring, benthic habitat mapping, and applied research on coral reef ecosystems in the US Pacific. With support from the USAID Timor Leste and in collaboration with the above partners, NOAA's current work in Timor-Leste focuses on providing technical assistance and building capacity to sustainably manage and conserve fisheries, biodiversity, and coral reefs.





REEF SURVEYS OF THE NORTH COAST

Six NOAA scientists using SCUBA will conduct surveys to assess coral reef fish populations and benthic habitats along the north coast of Timor-Leste. The survey methods used will provide information about the relative abundance, size, and diversity of the coral reef fishes, including surveys near Atauro Island, Jaco Island, Oecusse, Batugade, Liquisa, Dili, Maubara, Baucau, Manatuto, Tutuala and Com. In total, the team aims to conduct up to 150 surveys at different sites on the north coast of Timor-Leste between 03 June and 28 June 2013.

WHY DO REEF SURVEYS?

The data collected on fish abundance and size (used to estimate biomass) and composition of benthic habitats will provide important information to local fisheries and coastal resource managers, and local communities, that can be used as a basis for determining the status of the nearshore fishery resources of Timor-Leste. The data will also be useful for planning and evaluating potential fisheries and resource management and conservation strategies. The estimates of reef fish abundance will serve as the baseline for comparison with future surveys.

USAID FROM THE AMERICAN PEOPLE
NOAA
CONSERVATION INTERNATIONAL

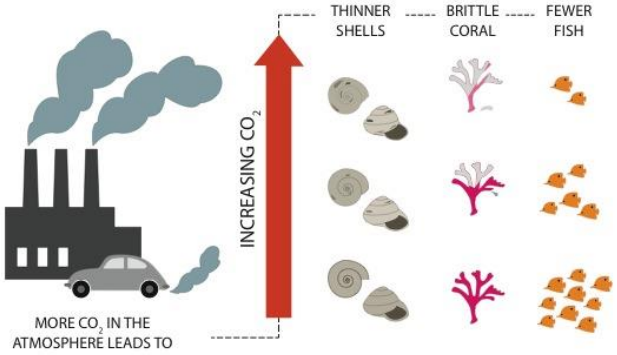
"Understanding Ocean Acidification in Timor-Leste" flyer:

UNDERSTANDING
OCEAN ACIDIFICATION
IN TIMOR-LESTE

WHAT IS OCEAN ACIDIFICATION?

The release of carbon dioxide (CO_2) into our atmosphere has been increasing steadily since humans began burning fossil fuels (gas, coal, and oil) more than 200 years ago. When the ocean absorbs CO_2, a series of chemical reactions take place, and they make the water more acidic. This process, called ocean acidification, has widespread and varied effects on marine organisms. As ocean acidity increases, it becomes more difficult for shellfish to build their shells and for corals to grow or build their skeletons. A number of potential effects on fish populations are being investigated. NOAA scientists are using the following instruments and sample types to learn how ocean acidification affects the biodiversity and ecosystems of coral reefs in Timor-Leste.

NOAA scientists have collected samples and deployed instruments on several locations around Timor-Leste.

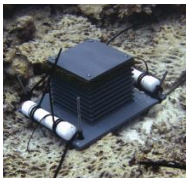


Calcif cation Accretion Units (CAUs) are simple devices that are deployed in reef environments to measure production of calcium carbonate by corals, calcifying algae, and other shelled organisms. CAUs are left in the f eld for two to three years. After that time, they are retrieved and the weight of the growth on the plates is measured. There are currently 50 CAUs deployed around Timor-Leste.

Subsurface Temperature Recorders (STR) are deployed on coral reefs in shallow water (<30 m) to measure water temperature. Temperature information provides insight into several water properties that af ect coral reefs.

Water Samples are collected by divers to help scientists understand the ef ects of ocean acidif cation on the reefs of Timor-Leste.

Autonomous Reef Monitoring Structures (ARMS) are collecting devices that imitate the natural structure of coral reefs to attract colonizing marine invertebrates. These small invertebrates, which form the base of the coral reef food web, can be af ected by acidif cation. There are currently 30 ARMS deployed around Timor-Leste.



Coral Cores of large corals have been collected in Timor-Leste. After coring, the holes in corals are plugged and new coral growth covers them. The cores have growth rings, like those of a tree, that are used to measure historical growth rates of corals. A 40-cm-long core allows scientists to measure growth rates over the past 10—30 years.

Resource managers can use the information gathered from these instruments and samples to make better decisions to protect the coral reefs that the people of Timor-Leste depend on for their food and livelihoods.

Scientists from NOAA Fisheries collaborate with the Timor-Leste Ministry of Agriculture and Fisheries, and Conservation International to study ocean acidif cation on the coral reefs of Timor-Leste. This project is funded by USAID Timor-Leste and NOAA.

USAID FROM THE AMERICAN PEOPLE

CONSERVATION INTERNATIONAL

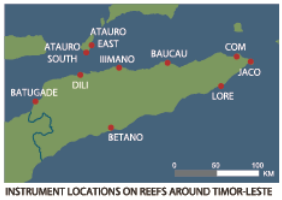
"Monitoring Coral Reefs in Timor-Leste" posters:

MONITORING CORAL REEFS IN TIMOR-LESTE

Some new arrivals have appeared on the reef around Timor-Leste. They may seem unusual or out of place on the reef. Some may even look like discarded trash. They are scientific instruments used to study reef health and monitor ecosystem changes due to ocean warming and acidification. These instruments are part of an investigation for the Ministry of Agriculture and Fisheries (MAF) and the Coral Triangle Initiative.

PLEASE DON'T DISTURB–
CORAL REEF MONITORING IN PROGRESS

If you're fishing or diving in this area and see any of these instruments, then please don't touch or disturb them, even if they seem out of place. If you have questions about these instruments, then please contact U.S. Agency for International Development (USAID), MAF, or the Coral Reef Ecosystem Division.



INSTRUMENT LOCATIONS ON REEFS AROUND TIMOR-LESTE

WHAT YOU MIGHT SEE

- **CALCIFICATION ACCRETION UNITS (CAUs)** are plastic plates (10 cm x 10 cm) used to determine growth rates of calcifying algae and corals. CAUs are staked into hard, non-living substrate in groups of five to characterize the existing reef environment.
- **CORAL CORING** of large corals (such as *Porites lobata*) have been collected at select sites. The cores have growth rings, like those of a tree, that are used to measure historical growth rates of the coral. A 40-cm-long core allows us to measure growth rates over the past 10 to 30 years. This technique has been shown to have no lasting effect on corals and tells us, amongst other things, how coral growth rates are changing over time.
- **SUBSURFACE TEMPERATURE RECORDERS (STRs)** are deployed at depths of 0.5–30.0 m and are attached to a reef structure or positioned on the seafloor with weights. STRs measure water temperature at 60-min intervals and provide insight into the water properties that affect corals.
- **AUTONOMOUS REEF MONITORING STRUCTURES (ARMS)** are collection devices designed to mimic the structure of coral reefs to monitor biodiversity. Once an ARMS is recovered, all organisms within the ARMS are counted, photographed, and preserved for genetic processing. This work provides information about biodiversity and reef health.

This project is funded by USAID Timor-Leste in collaboration with the U.S. National Oceanic and Atmospheric Administration's (NOAA) Coral Reef Ecosystem Division.

FOR MORE INFORMATION CONTACT:
USAID Timor-Leste, Democratic Republic of Timor-Leste Ministry of Agriculture and Fisheries, or NOAA Fisheries Coral Reef Ecosystem Division
pifsc.noaa.gov/cred/oceanography

USAID FROM THE AMERICAN PEOPLE

BAINAKA FOUN IHA TIMOR-LESTE NIA AHU-RUIN

Ita iha bainaka iha Timor-Leste nia Ahu-ruin. Dala ruma ema bele deskonfia ka hanoin sá ida mak buat ne'e halo besik ahu-ruin ne'e? Sasán ne'e mak instrument sientifiku atu estuda no moritoriza Saudi ahu-ruin no mós mudansa ba ekosistema no impaktu husi alterasaun klimátika. Ministériu Agrikultura no Peska, USAID no NOAA servisu hamutuk hodi instala sasan ne'e.

KETA BO'OK–
MORITORIZASAUN AHU-RUIN SEI LA'O HELA

Keta ita boot luku karik iha área ne'e keta bo'ot sasan ne'e. Ketak iha lia-husu ruma favór ida kontaktu Ministériu Agrikultura no Peska no Divisaun Ahu-ruin no Ekosistema husi NOAA.

IFATIN HO AHU-RUIN NE'EBÉ ITA BELE HETAN SASAN PESKIZA NIAN

BUAT NE'EBÉ ITA BO'OT BELE HARE'E

- **UNIDADE HALIBUT AHU (CAU)** mak sasán ki'ik halo lori plastic PVC atu ajuda sura tempu ne'ebé ahu ruin presiza atu moris no buras ita fatin ida. CAU sira sei tau iha tasi okos iha parte to'os, baibain ita tau klibur CAU 5-5 ne'ebé besik malu atu ajuda sura didi'ak taxu kreximentu ahu-ruin
- **FOTI AHU-RUIN** nia laran (ahu-ruin to'os) mós akontese nudar parte peskiza. Nune'e mós ita boot bele hare'e kanek balun iha Ahu-ruin. Kanek ne'e la todan no ahu-ruin sei la mate. Amostra ahu-ruin laran permite sientista hatene ahu-ruin nia tinan no velosidade kreximentu kolónia ahu-ruin ne'e. Bainbain amostra ne'e varia entre 20 cm no 40 cm. Amostra ho 40 cm permite ita atu hetan informasaun kona-ba lala'ok bura ahu-ruin ne'e durante tinan 10 to 30 nia laran. Téknika ne'e la oho ka mate ahu-ruin no permite foti dadu oioin kona-ba temperatura tasi tinan hirak liu ba no kona-ba kondisaun tasi horiuluk.
- **SUBSURFACE TEMPERATURE RECORDERS (STRs)** instala ho kle'an entre 0.5m to 40 metru no sei kesi iha ahu-ruin ka iha tasi okos ho ankora no foti dadu kona-ba tasi ben nia temperatura kada 30 minutu no propriedade seluk tasi ben nian.
- **AUTONOMOUS REEF MONITORING STRUCTURES (ARMS)** mak fatin ne'ebé halibur balada no kutun tasi. ARMS koko atu halo kópia ba estrutura ahu-ruin natural. Liu tiha balada tama ba ARMS, sientista sira sei hakat mai fali no foti fotografia no amostra atu hala'o procesamentu dadu. Ida ne'e fó oportunidade úniku atu hetan informasaun kona-ba Saudi ahu-ruin liu no ninia biodiversidade.

This project is funded by USAID Timor-Leste in collaboration with the U.S. National Oceanic and Atmospheric Administration's (NOAA) Coral Reef Ecosystem Division.

ATU HETAN INFORMASAUN TAN, FAVÓR KONTAKTU:
USAID Timor-Leste, Democratic Republic of Timor-Leste Ministry of Agriculture and Fisheries, or NOAA Fisheries Coral Reef Ecosystem Division
pifsc.noaa.gov/cred/oceanography

USAID FROM THE AMERICAN PEOPLE

"ARMS: From Science to Outreach" posters:

ARMS

From Science to Outreach—A Universal Method to Collect Knowledge of the Unknown

Autonomous Reef Monitoring Structures

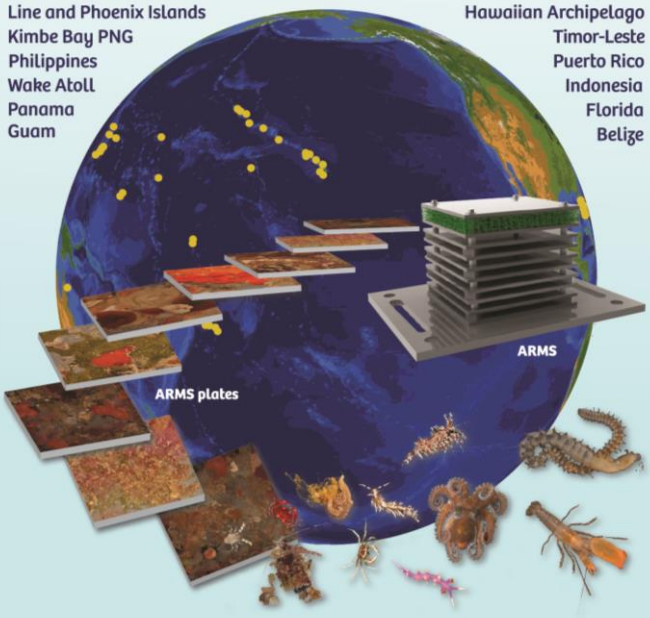
Roughly mimicking the complexity of coral reefs, ARMS attract and collect colonizing invertebrates and are used to assess and monitor the diversity of understudied, cryptic coral reef organisms in a systematic and comparable manner on a global scale.

What Purposes do ARMS Serve?

- Fill taxonomic gaps for understudied species biodiversity
- Provide a standard method for molecular analysis of invertebrate biodiversity through 454 mass parallel sequencing
- Standardize measurements of cryptic organism diversity globally
- Enhance ecosystem-based management
- Increase ability to monitor/predict ecological impacts of global climate change, particularly ocean warming and acidification
- Provide interactive learning through "Hands-On-ARMS" outreach

By 2013 >850 ARMS were deployed throughout the World's Oceans.

The Commonwealth of the Northern Mariana Islands
Lizard/Heron Islands and Ningaloo Reef, Australia
Reunion, Europa, and Glorieuses Islands
Line and Phoenix Islands
Kimbe Bay PNG
Philippines
Wake Atoll
Panama
Guam
Cayman Islands
American Samoa
Moorea, French Polynesia
Hawaiian Archipelago
Timor-Leste
Puerto Rico
Indonesia
Florida
Belize



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ARMS

Husi Sientista ba ema hotu--Material simples atu foti dadu barak kona-ba buat foun no uniku iha mundu

Hadak mamuk atu halibur no tau matan ba Ahu-ruin

ARMS hanesan hadak ida ne'ebe mamuk no fo fatin ba balada oioin atu mai tu'ur no hari'i sira nua uma. Ami tau hadak mamuk hirak iha mundu tomak hodi dada balada ki'ik sira ne'ebe bainbain subar iha ahu-ruin laran ba fatin ida ne'ebe fasil ba ita atu estuda no kompara diferensa entre fat-fatin.

Tansá mak ita uza ARMS?

- Komprende di'ak liu tan kona-ba balada ki'ik ne'ebe moris iha ahu-ruin laran
- Fo metodu ho standar atu sura no sukat biodiversidade balada ki'ik iha ahu-ruin laran
- Fo matadalan ba Governu husi nasaun oioin atu la'o tuir no kompara ninia rezultadu
- Hametin sistema jestaun tatomak (sistema jestaun kompletu)
- Hasa'e kapasidade atu halo monitorizasaun no siik impaktu husi alterasaun klimatiku liu-liu ninia impaktu ba tasi
- Fo buat ida ne'ebe komunidade bele kaer no hare'e ho matan atu komprende di'ak liu tan kona-ba biodiversidade tasi laran

Iha 2013, ita sei iha ARMS 850 iha mundu tomak

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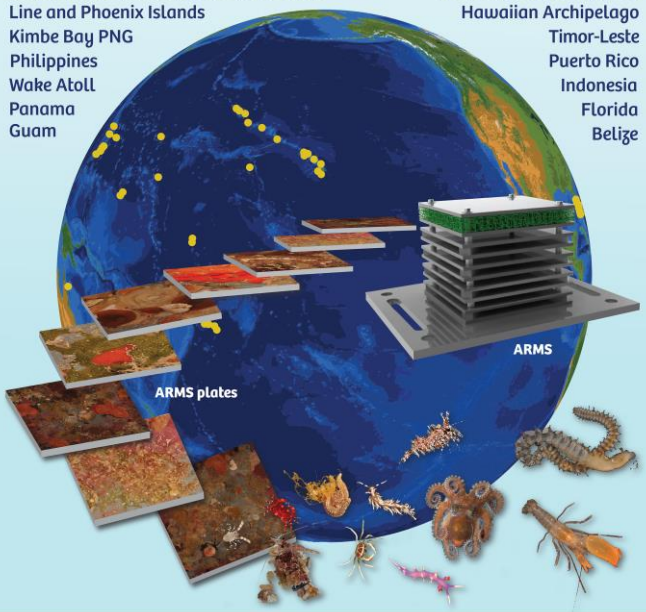

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ARMS "DIVERSITY!" posters: