

# Mareen Kansavayshan widowtn Boadaz prizent



## Di Mangro Dehn

Robert C. Thigpen wid Celeste Coraima Castillo,  
Yarisel Marleni Castillo ahn Zaida Nayelhi Majil

Madison Heltzel mek di picha dehn



WI DA MAREEN KANSAVAYSHAN WIDOWTN BOADAZ.  
YOO TU!





Di Mangro Dehn  
Bai  
Robert C. Thigpen

Dehnya bailingwal ejukayshanal mateeryal dehn poblis bai  
*Mareen Kansavayshan widowtn Boadaz [www.marinefrontiers.org](http://www.marinefrontiers.org)*

© 2018 Robert C. Thigpen, aal raits rizerv. Yu kyaahn mek dis buk eena eni way, di ful buk er paat a it. Yu kyaahn stoar it needa eena eni sistim, er sen it eena eni faam—ilekchronik, makyunikal, foatokapi, rikaadn, er eni ting laik dat—widowtn di permishan eena raitn fahn di poblis, eksep weh di kapirait laa a di USA gi permishan.

Fu aal permishan kontak: [info@marinefrontiers.org](mailto:info@marinefrontiers.org)

Kohva bai: Madison Heltzel

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Wi mek dis edishan a wi Mangro Eekosistim kansavayshan baiyoloji buk wid di help a aal mi fren da di Nashanal Kriol Kongsl a Bilee. Wi kuda-mi neva du dis werk widowtn fi dehn frenship ahn inkorijment.



Kohva: Yu kuh si dehnya bod dehn di res, di waak, ahn di hont fish weh liv eena di mangro dehn: Roseate Spoonbill (*Platalea ajaja*), Boat Mowt Gaalin (*Cochlearius cochlearius*), Lang Nek Gaalin (*Ardea alba*), Peel Nek Taiga Gaalin (*Tigrisoma mexicanum*). Madison Heltzel<sup>1</sup> mek di picha dehn.

The Mangroves  
By  
Robert C. Thigpen

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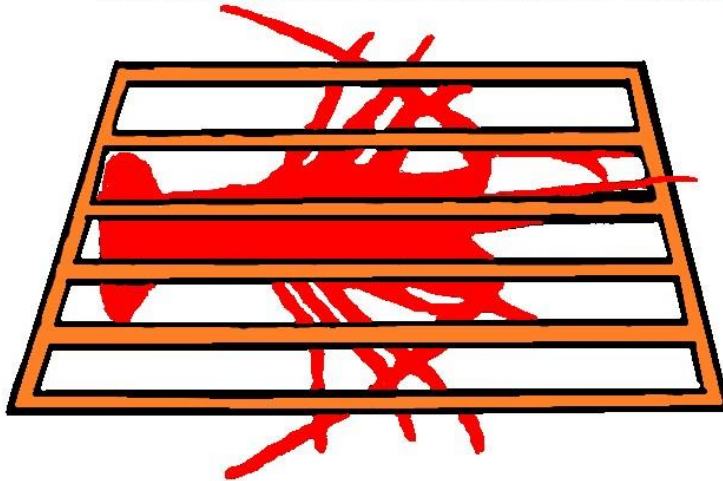
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This edition of our *Mangrove Ecosystems* conservation biology book was created for our good friends at the Northern Fishermens Cooperative Society LTD. This work would not be possible without their friendship and encouragement.

**NORTHERN FISHERMEN  
CO-OPERATIVE SOCIETY LTD.**



Cover: Roseate Spoonbill (*Platalea ajaja*), Boat-billed Heron (*Cochlearius cochlearius*), Great Egret (*Ardea alba*) Bare-throated Tiger Heron (*Tigrisoma mexicanum*) can be seen resting, walking and hunting fish that live in the mangroves. Illustration: Madison Heltzel

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## **Dedikayshan**

Dis buk dedikayt tu Misa Tony Vega ahn di membaz hoo mi faam di Naadan Fishaman Koa-aprativ Sosaiyiti Ltd (*Northern Fishermen Cooperative Society Ltd*). Dis da-mi di fos ofishal fishin groop, kaal koa-aprativ, eena di Kyaribeeyan. Dehnya man ahn uman mi mek op dehn main eena 1960 fu mek dis koa-ap, ahn soh dehn chaynj dehn laif fareva. Dehn kuda mi neva noa jos humoch chaynj datideh lee step uda mek, dat wan day di fishin koa-ap dehn eena Bileez uda bikom di bakboan a Bileez fishri. Dehnya koa-ap gi di fishaman ahn uman dehn rispek ahn di fishri da now paat a weh bring moni tu Bileez. Ah rait dis buk fi dehn granpikni pikni ahn fi Anaii, Riceni, Jahyan, Avimael, Jadel, Avimaely ahn Avy Castillo; Jayden Campos ahn Giannie Chee & Joida Nalini; Josue Hernandez, Jenny, Esau ahn Damari Salguero; Franesha Staine ahn Terry Reyes; Richard & Shanel Reid, ahn Nathaniel Rejon.

Noh mata wich koa-ap yu jain op wid, stay wid it schrang.

Dehnya da di fos membaz weh mek di Naadan Fishaman Koa-aprativ Sosaiyiti Ltd:

Adriano Marin, Alonzo Novelo, Audberto Pariente, Bernaldino Canto Enrique Carrillo, Bert Forman Luis Marin, Jr., Bonoficio Allen, Cecilio Heredia, Cleive Young, Crispin Rosado, Desidario Rosado, Domingo Vega, Eddie Young, Emelito Marin, Emilio Marin, Emilio Novelo, Erico Novelo, Ernesto L. Marin, Ernesto Reyes, Estevan Reyes, Faustino Canto, Felix Bradley, Fernando Magana, Filemon Pariente, Filiberto Bobadilla Valerio Novelo, Ismael Magana, Jesus Heredia, John Marin, Sr., Joseph Bevans, Leonardo Bobadillo, Magdalena Badillo, Manual Marin, Marciano Allen, Natalio Rosado Belius Guerrero, Nelson Young, Obdulio Conzalez, Orlando Carasco, Rafael Reyes, Ramon Reyes, Ray Auxihlou, Ray Barrow, Rodolfo Heredia, Rojelio Novelo, Santiago Marin, Teodoro Allen, Teodoro Marin, Tiburcio Badillo, Tom Young, Sr., Tony Vega, ahn Wilhelm Young.

Pahn tap wi need fi gi tanks tu di Naadan Fishaman Koa-aprativ Sosaiyiti Ltd fi mi mek mi goh da dehn bildin ahn goh chroo dehn hischri rekad, ahn fu dehn sopoat a weh Ah mi-di luk fa. Wi aalso waahn tank aal wi fren ahn kompni da Bileez Fishriz Dipaatment fi aal dehn help ahn advais pahn wi projek dehn, plos Misa Vincent Gillette da di Koastal Zoan Manijment Aatoriti ahn Instityoot.

Sayn way, wi waahn tank di Nashanal Kriol Kongsil fi dehn help ahn fi inkorij wi wid di Kriol a dis poblikayshan, speshali Miz Myrna Manzanares ahn Silvaana Udz. Pahn tap, wi waahn tank Miz Felicita Cantun a Yoa Krik Vilij ahn di Puks'ik'al Maya Groop ahn aal wi fren dehn da NICH.

Tugeda wi da *Mareen Kansavayshan Widowtn Boadaz* ahn now yu da paat tu!

*\*If we are missing any names in our list, please go to our website and let us know. We will do our best to verify and make the proper changes. Thanks!*



## **Dedication**

This book is dedicated to Mr. Tony Vega and the founding members of the Northern Fishermen's Cooperative Society LTD., the Caribbean's first fishing cooperative. These men and women made the decision in 1960 to form this cooperative and to change their lives forever. Little did they know the amount of change that this first step would catalyze and that one day the fishing cooperatives of Belize would be the backbone of the fishery. Fishermen became respected people in Belize and the fishery is now the lifeblood of the country. I write this book for their grandchildren's children and for Anaii, Riceni, Jahyan, Avimaeli, Jadel, Avimaely and Avy Castillo; Jayden Campos and Giannie Chee & Joida Nalini; Josue Hernandez, Jenny, Esau and Damari Salguero; Franasha Staine and Terry Reyes; Richard & Shanel Reid, and Nathaniel Rejon.

No matter which cooperative that you have joined, be loyal to it.

These are the Founding Members of the Northern Fishermen's Cooperative Society Ltd:

\*Adriano Marin, Alonzo Novelo, Audberto Pariente, Bernaldino Canto Enrique Carrillo, Bert Forman Luis Marin, Jr., Bonoficio Allen, Cecilio Heredia, Cleive Young, Crispin Rosado, Desidario Rosado, Domingo Vega, Eddie Young, Emelito Marin, Emilio Marin, Emilio Novelo, Erico Novelo, Ernesto L. Marin, Ernesto gmoiiiiReyes, Estevan Reyes, Faustino Canto, Felix Bradley, Fernando Magana, Filemon Pariente, Filiberto Bobadilla Valerio Novelo, Ismael Magana, Jesus Heredia, John Marin, Sr., Joseph Bevans, Leonardo Bobadillo, Magdalena Badillo, Manual Marin, Marciano Allen, Natalio Rosado Belius Guerrero, Nelson Young, Obdulio Conzalez, Orlando Carasco, Rafael Reyes, Ramon Reyes, Ray Auxihlou, Ray Barrow, Rodolfo Heredia, Rojelio Novelo, Santiago Marin, Teodoro Allen, Teodoro Marin, Tiburcio Badillo, Tom Young Sr., Tony Vega, and Wilhelm Young.

We also need to acknowledge the Northern Fishermen's Cooperative Society Ltd for granting me access to their facilities and historic records and for being supportive of my investigations. We also would like to thank all of our friends and colleagues at Belize Fisheries Department for all their cooperation and advice on our projects as well as Mr. Vincent Gillette at the Coastal Zone Management Authority and Institute.

Likewise we want to thank the National Kriol Council and SIL for their help and encouragement with the Kriol in this publication. Especially Ms. Myrna Manzanares and Silvaana Udz. Additionally, we want thank Ms. Felicita Cantun of Yo Creek Village and the Puk's'ik'al Maya Group and all of our friends at NICH.

Together we are *Marine Conservation without Borders* and now you are too!

*\*If we are missing any names in our list, please go to our website and let us know. We will do our best to verify and make the proper changes. Thanks!*

# **Inchrodokshan**

## **Fu di Teecha Dehn**

Welkom tu di infamayshan eena lata langwij fu *Mareen Kansavayshan widowtn Boadaz*. Wi oanli hapi hapi dat yu deh wid wi eena dis gloabal way fu teech wi pikni dehn ahn di yoot how fi lov ahn protek wi mareen chrezhaz fu di fyoocha.

Dis infamayshan bes fu Fos Faam tu Faam 3 (haiskool styoodent).

Objektiv: Di mayn ting wi waahn da fu teech how fu tek kyaa a wi mareen chrezhaz. Wee tink seh dat ejukayshan beta wen ih deh eena wi difrant langwij dehn. Difrant speekaz ga difrant needz. Dis mek wai wi di reech peepl eena di langwij weh dehn lov op ahn taak eena di hows. Dis mek sens sayka weh wi rekonaiz seh dat wi difrant reedaz da don wahn paat a how gud wi tek kyaa a wi mareen laif, soh ih mek sens wi taak dairek dairek tu dehn eena dehn oan langwij.

Di Intenshan: Di intenshan a dehnya buklet da fu mek di teecha ga wahn baysik gaid fu mek ih kantinyu ron ih klaas dehn gud gud-wan. Noh frayd fu chaynj op dis ahn dat fu bes soot fu yu oan klaas. Mek shoar evribadi ga fi dehn oan kapi.

Evri payj ga wahn shaat lesn wid di sayhn infamayshan rait eena Kriol ahn eena English. Yu ku chooz fu teech wan langwij er di ada er di 2 langwij dehn if dat soot fu yoo teechn stail ahn prefrens.

Aalwayz bigin evri lesn wid wahn nais greetn, enkorij dehn, ahn gi dehn wahn pees a inchrestin infamayshan weh kanek tu di klaas tapik fu di day. Geh yu mateeryal ahn boad redi hed a taim. Di boad fu shuda ga di nyoo werd dehn, di e-links, di Tapik/Mayn Aidyaa, ahn poasta imij if yu noh ga no intanet wehpaat yu deh fu shoa wahn veedyo.

“Pipl weh chravl wid di see noh eevn ku tink widowtn tink sohnting bowt di see.”

Hermann Broch



Mangro eekosistim deh aal oava di plays eena di trapikal mareen eekosistim aal rong di werl. Wahn Rongwe [Wait-chroat Bee-eeta] (*Merops albicollis*) eena di mangro pahn di Indyan Oashan.

# Introduction

## A Word to the Teachers

Welcome to Marine Conservation without Borders multi-linguistic educational resource. We are delighted to have you on board with us in this global effort to teach our children and youth how to love and protect our marine resources for the future.

This material is recommended for 7<sup>th</sup>-9<sup>th</sup> grade students.

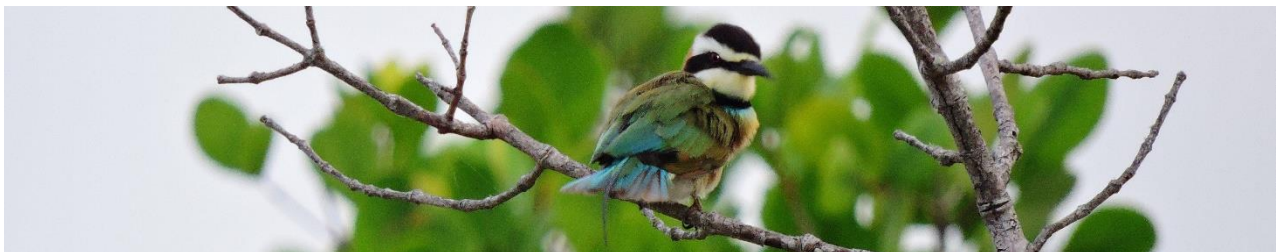
**Objective:** Our primary goal is to teach marine stewardship. We believe that education will benefit by multilingual delivery. We believe various speakers have various needs. Accordingly, we appeal to people within their familiar and formative home language experiences. Our various readers are already stakeholders in the present and future quality of our marine resources, so it is both important and appropriate to communicate directly with all users.

**How to use this Material:** These booklets are meant to be a foundation to guide the teacher/student classroom pace and settings. Feel free to adapt them to accommodate your location and resources. Make sure that each student has his or her own copy.

Each page presents a short lesson containing the same information written in both English and Kriol. You may choose to teach one language or the other, or both if it seems suitable to you.

Always begin each lesson with a positive, encouraging greeting, and an interesting fact related to the theme or topic of discussion. Prepare the materials and the board ahead of time. The board should include the new vocab, the e-links, the Topic/Theme, and poster images in case you have no internet available to display a video.

“Those who love and live by the sea can hardly form a single thought on which the sea would not be a part.” — **Hermann Broch**



Mangrove Ecosystems are ubiquitous in tropical marine ecosystems across the globe.  
A Rongwe [White-throated Bee-eater] (*Merops albicollis*) in mangroves on the Indian Ocean.

Photo by Agnes Mukami, Gazi Bay, Kenya EA.

## **Bifoa wi Staat**

Lata mi bakgrong eena mi fos risaach eena di ayrya a Kyaribeeyan fishriz mi kohn fahn di werk az saidman wid di artisanal fishriz a Bileez. Di fishaz mi chreet mi moa laik wahn faamli fahn Kaayo dan dehn mi chreet di mareen saiylentis dehn fahn Stayts. Sayka how Ah mi kweschon tingz di yooz soashal saiylens risaach wayz, Ah mi geh wahn speshal vyoo soh mek mi laan bowt di ayrya, plos Ah mi laan fahn dehnya fishaz hischri nalij weh mi paas dong fahn dehn ansestaz (dehn nalij heritij). Dehnya tingz Ah gaan chroo wid dehn mi aalso mek mi noa fu chroo fu chroo bowt dehn faamli, di way dehn goh bowt di fish eena dehn ayrya, ahn eevn di lookal ejukayshan sistim dehn Ah kuda mi neva laan bowt if Ah mi neva deh tee-dina-tee eena dehn werk evriday da see.

Dehnya fishaz noa gud gud-wan di eekosistim dehn weh dehn liv ahn werk eena, sayhn way wahn person noa gud gud-wan wahn kloas fren weh dehn chros. Tudeh day, dehnya fishriz weh kloas tu di haat a dehnya fishaz di geh presha fahn tingz owtsaid laik kaimit chaynj, polooshan, way tu moch yoos widowtn tek kyaa, plastik weh ga wan-taim yoos, plos di nersri ahn habitat dehn di brok op. Dis da jos wahn fyoo tingz. Da chroo dat di fishaz noa dehnya eekosistim gud gud, bot dehn nalij heritij noh di tek noatis bowt dehnya nyoo negativ owtsaid presha, plos weh kaaz dehn, ahn di saiylens bowt dehn. Dehya buk dehn mek fu bring tugada lookal fishaz nalij ahn dehn lookal langwij wid di langwij ahn aidyaa dehn a saiylens, soh dehn ku beta taak bowt dehnya ting weh kansaan dehn, ahn taak eena di langwij dehn yooz. Wen dehn taak dehn kansaan ahn aidyaa eena dehn oan langwij, dehn ku shyaa dehn wayz fu protek di food sikyooriti a dehn faamli ahn dehnya mareen eekosistim weh dehn pen pan. Dehn ku du dis eena wahn klyaa way, widowtn di bafu ahn kyaahn gama, wid pipl hoo da fishri manija, laa maykaz, ahn kansavayshan pipl.

Wen yu set yu main fi chranslayt di aidyaa dehn fahn saiylens intu wat da-mi langwij pipl doz taak oanli bot noh rait, yu ku bok op tu lata prablem. Wan problem da dis: sohn a di wod dehn noh ga no sayhn way fi seh eena di langwij yu di chranslayt intu. Fi geh oava dis problem, wi kaal op chranslaytaz weh ga di kolcha nalij ahn di langwij nalij wid di langwij wi waahn chranslayt intu, ahn soh mek op nyoo wod er way fi seh it eena Kriol (English kaal dis “neologisms” ahn eena Kriol wi ku kaal dis “nyoo sayin”). Dehn don du dis, di yoos di yoozhal wayz weh deh fi how wahn nyoo sayin faam. Wi feel schrang bowt wi dizain ahn metod, bot wi kantinyu di laan az wi goh lang. Wi wahn kantinyu fi fiks op ahn mek wi wayz a how wi mek dehnya saiylens wod dehn ahn sayin eena Kriol bikom moa standad, az wi werk pahn wi neks buk dehn. Dehnya da wahn kansavayshan saiylens poblikayshan, Maikro-Plastik Dehn eena wi Envairement, ahn wahn bailingwal dikshineri wid saiylens werds ahn diskripshan a floara ahn faana. Moas a di nyoo wod dehn yu wahn fain eena disya mangro ikologi buk ga dehn meenin eena di glasari. Di wan dehn weh noh deh eena di glasari a dis edishan wahn deh eena di bailingwal dikshineri ahn eena wahn fyoocha edishan a dis buk.

Ah uda laik fi tank di fishaz ahn dehn faamli fu aksep mi ahn mek mi paat a dehn laif. Widowtn di ejukayshan Ah mi geh fahn dehnya kamyooniti, dis projek noh mi wahn hapn. Ah aalso waahn tank wi intanashanal teem a valantyaaz; if da neva fi dehn di mek dehnya aidyaaaz kohn chroo, dis buk noh mi wahn hapn needa.

Robby Thigpen

Mayn Dairekta

Mareen Kansavayshan Widowtn Boadaz

## **Preface**

My first research in the area of Caribbean fisheries was largely informed by working as a side-man with the artisanal fishers of Belize. The fishers treated me more like a relative from Cayo than they did a marine scientist from the states. Approaching my questions in marine biology using social scientific research methods provided a unique perspective through which I was able to learn about and from these fishers' ancestral knowledge (intellectual heritage). These experiences also gave me insight into things about their families, the local fishing mechanisms, and even the local education systems that I could not have learned without being immersed in their daily work at sea.

These fishers know the ecosystems in which they live and work intimately, indeed in the same way one is familiar with a close and trusted friend. Today the fisheries to which these fishers are so tightly related are being affected by external influences such as climate change, point source pollution, overexploitation, single use plastics as well as destruction of nursery and juvenile habitats to name just a few. While these fishers know these ecosystems well, their intellectual heritage does not fully account for these new negative external pressures, their causes, and the science describing them. These books are designed to blend local fishers' knowledge and their local languages with the language and concepts of science so they are better equipped to discuss these issues in the languages they use. In turn, the new concepts and words in the context of their home languages will help them communicate their strategies for protecting their families' food security and the marine ecosystems on which they depend in a clear and concise manner with fishery managers, policy makers, and conservationists.

When you set out to translate scientific constructs into what have been traditionally oral languages you run into many problems. One problem is that some of the terms have no equivalent words in the language(s) with which you are working. To overcome this problem, we've enrolled translators with cultural and linguistic relationship (experience?) with the languages to create new words (neologisms) for these languages. They have done so using standard neologism methodologies. We are confident in our design and methodology, yet we are also learning as we go. We will continue to refine and standardize our approaches and procedures as we develop our next books: a conservation science publication, *Micro-Plastics in Our Environment*, and a bilingual dictionary of scientific terms and descriptions of flora and fauna. Most new words you find in the current *Mangrove Ecology* book are defined in the glossary. Those that are not in the glossary in this edition will be included in the bilingual dictionary and revised into a future edition of this book.

I would like to thank the fishers and their families for accepting me and allowing me into their lives. Without the education I received from these communities, this project would not have been possible. I also want to thank our international team of volunteers, were it not for them making these ideas a reality it would not be possible either.

Robby Thigpen  
Executive Director  
Marine Conservation without Borders

# DI MANGRO DEHN - MANGROVES

## How Evriting eena di Werl Kanek Tugeda 1

Mayn Aidyaa: Mangro – Nachral Habitat

Objektiv: Andastan Weh Yu Reed

Di Nyoo Werd Dehn: Mangro, Eekosistim, Anda-waata Habitat, Shoa Bod, ahn Nestin

### How fu Tink Klyaa wid Gud Sens

Eena di mangro swamp dehn, yu ga wahn eekosistim weh di plaant ahn animal werk tugeda. Yu ga plaant anda di waata ahn pahn tapa di waata tu. Di paat a di mangro dehn weh deh tapa di waata da wahn impoatant plays fi di bod dehn weh liv bai di see. Dehnya branch dehn da wahn sayf plays weh dehn ku sleep ahn res afta wahn lang day di hont. Di mangro dehn da plays weh di bod dehn ku ga dehn baybi ahn tek kayr a dehn yong wan dehn. If yu noh ga di mangro dehn, yu noh ga wahn plays fi di bod dehn fi liv (ahn nestn).

### Kweschanz

1. Weh kaina eekosistim mangro bilanz tu?
2. Wat da di mayn plays di shoa bod dehn liv?
3. Da wehpaat di shoa bod dehn nes ahn ga baybi?
4. Weh yoo tink dehnya bod feed pan?

### Tingz Fu Du

Wen yu don taak bowt di kweschanz dehn wid di klaas, jraa wahn picha a di nachral habitat. Dis da di mangro weh di shoa bod dehn. Shoa how dehnya bod need dis kaina plays fu liv. **Ekschra:** Chaynj di picha intu wahn kolaaj ahn put it op eena di klaasroom.

## Connectivity and the Environment 1

Theme: Mangroves-Natural Habitat

Objective: Reading Comprehension

New Vocabulary: Mangrove, Ecosystem, Underwater Habitat, Wading Birds, Rookery

### Critical Thinking Skills

Mangrove swamps are complex ecosystems with plant structures both underwater and above the water surface. The above water part of mangroves is a principal habitat for wading birds. These branches provide safe places to sleep and rest after a long day of hunting. The mangroves are also places for wading birds to have babies and rear their young (rookeries). Without the mangroves, these birds will have no place to live.

### Questions

1. What type of ecosystem do mangroves belong to?
2. What is the principal habitat for the wading birds?
3. Where do the wading birds nest and have their babies?
4. What do you think these birds feed on?

### Activities

1. After discussing the questionnaire with the class, draw a picture of the natural habitat-mangrove- of the wading birds. Show how these birds depend on this particular environment to survive. **Extra:** Change the picture into a collage for display in the classroom.
2. If you live near a mangrove, visit the area and write a detailed description of what you see.



Man-a-Waar Kee kloas Dangriga, Bileez, da wahn plays weh berd mek dehn nes ahn rayz dehn baybi (rookery). Govament protek dis sait, weh deh eena di Sowt Waata Kee Mareen Rizerv eena di Bileez Barya Reef Sistim, wahn UNESCO Werl Heritij Sait. Disya kee, er koril ailan, da hoam fi at lees foa speeshiz a berd: di magnifisent man-a-waar (frigate) berd (*Fregata magnificens*), di brong boobi (*Sula leucogaster*), di dobl-kres komorant (*Phalacrocorax auritus*), ahn di brong pilikin (*Pelecanus occidentalis*). Man-a-Waar Kee da wan a di taalis ailan eena di ayrya bot moa dan 50 percent a da ailan don wash-weh joo tu harikayn, jrejin ahn klaimit chaynj weh rayz op di see levl. Picha: Lisa Mulcahy

Man-o-War Caye near Dangriga, Belize is a highly protected bird nesting and rearing (rookery) site in the South Water Caye Marine Reserve in the Belize Barrier Reef Reserve System, a UNESCO World Heritage Site. This caye, or coral island, is home to at least four species of birds: the magnificent frigate bird (*Fregata magnificens*), the brown booby (*Sula leucogaster*), the double-crested cormorant (*Phalacrocorax auritus*), and the brown pelican (*Pelecanus occidentalis*). Man-o-War Caye is one of the tallest islands in the area, but the island has eroded more than 50 percent due to hurricanes, dredging, and climate change induced sea level rise. Photo: Lisa Mulcahy

## How Evriting eena di Werl Kanek Tugeda 2

Mayn Aidyaa: Mangro-Faasl Fyoowil-CO<sub>2</sub>

Objektiv: Andastan Weh Yu Reed

Di Nyoo Werd Dehn: Kyaaban Daiyaksaid (CO<sub>2</sub>), Klaimat Chaynj, Hai-asid Oashan, Faasl Fyoowil, Enerji weh noh ron owt (Renewable Energy)

### How fu Tink Klyaa wid Gud Sens

Di mangro dehn tek een kyaaban daiyaksaid (CO<sub>2</sub>) ahn mek aksijin (O). Wan a di impoatant kweschan dehnya dayz ga fi du wid di chaynj eena di klaimat. Di chaynj eena di klaimat di rayz tempricha rong di werl ahn ih di put asid eena di see. Di ting weh wi ku blaym fi dat di moas da moa kyaaban daiyaksaid (CO<sub>2</sub>) eena di ayaa ahn oashan. Moa di geh projoos wen wi bon faasl fyoowil, laik tingz weh mek owta ail ahn koal. Wi hafu noh pen soh moch pahn faasl fyoowil, ahn wi hafu staat pen pahn plays fi geh enerji weh noh ron owt aal di taim. Eevn if wi stap di yooz faasl fyoowil tumaaro, wi stil wahn ga lata ekschra kyaaban daiyaksaid (CO<sub>2</sub>) eena di ayaa. CO<sub>2</sub> eena di ayaa grab heet fahn di lait a di son. Eena di oashan CO<sub>2</sub> mek di waata ga moa asid. Wahn impoatant jab a di mangro dehn, jos laik aal plaant, da fi tek een (CO<sub>2</sub>) ahn mek O<sub>2</sub>. Di mangro dehn tek di kyaaban (C) owta di ayaa wi breed ahn yooz it fu enerji. Di mangro dehn gud gud wen ih kohn tu di grab C, soh wi hafu protek di mangro dehn.

### Kweschanz

1. How yoo uda diskraib di way asid damij di oashan?
2. Da how tumoch CO<sub>2</sub> afek di mangro ahn di plays ih groa?
3. Da how wi kuda help protek di mangro dehn?

Tingz Fu Du: Yooz di intanet fu fain wahn veedyo a di nachral mangro weh mi deh rong yu bowt 5-10 yaaz abak ahn kompyaa wid tudeh. Talk bowt di difrans wid yu klaasmayt dehn. Chrai sen wahn leta/eemayl tu yu loakal aatoriti wid infamayshan weh yu fain owt.

## Connectivity and the Environment 2

Theme: Mangroves-Fossils Fuels- CO<sub>2</sub>

Objective: Reading Comprehension

New Vocabulary: Carbon Dioxide (CO<sub>2</sub>), Climate Change, Ocean Acidification, Fossil Fuel, Renewable Energy

### Critical Thinking Skills

Mangroves also take in carbon dioxide (CO<sub>2</sub>) and produce oxygen (O<sub>2</sub>). A pressing issue of modern times is climate change, which is increasing temperatures globally and is also causing ocean acidification. One of the principal causes of climate change is an increase of CO<sub>2</sub> in the atmosphere and oceans. The increase is produced by the burning of fossil fuels, such as oil-based products and coal. We need to reduce our dependence on fossil fuels and begin our transition to renewable energy sources. Even if we were to stop using fossil fuels tomorrow, we would still have a lot of extra CO<sub>2</sub> in the atmosphere. CO<sub>2</sub> in the atmosphere captures heat from sunlight. In the ocean CO<sub>2</sub> makes the water more acidic. One important role of mangroves, like all plants, is to take in CO<sub>2</sub> and produce O<sub>2</sub>. Mangroves take the carbon (C) out of the air we breathe and use it for energy. Mangroves are very efficient at capturing C, so we need to protect mangroves.



### Questions

1. How would you describe acidification in the oceans?
2. How does excess of CO<sub>2</sub> affect the mangroves and their environment?
3. How could we help protect the mangroves?

Activities. Use the internet to find a video of the natural mangrove surroundings near you from 5-10 years ago and compare it to today. Discuss the differences with your classmates. Try to send a letter/email to your local authorities pointing out your findings.



Dehnya mangro bush nyaa Cartagena de Indias, Kolombya provaid hows fu di loakal fishaman ahn provaid wahn helti eekosistim fu di see animal dehn weh dehnya fishman need fi kech. Pahn tap, di mangro dehn kleen di kyaaban daiyaksaid fahn di smook weh let goh fahn lata kaa, chrok ahn bos eena di siti. Picha: Robby Thigpen

These mangrove forests near Cartagena de Indias, Colombia not only provide homes for local artisanal fishermen, but also provide a healthy ecosystem for the sea creatures these fishermen need catch. In addition, mangroves also clean the carbon from the exhaust many cars, trucks, and buses in the city.

Photo: Robby Thigpen

## How Evriting eena di Werl Kanek Tugeda 3

Mayn Aidyaa: Mangro - Eekosistim

Objektiv: Andastan Weh Yu Reed

Di Nyoo Werd Dehn: Animal wid no bakboan, animal laik skwid, Anda-paat, Brok op

### How fu Tink Klyaa wid Gud Sens

Wi noh ga notn weh da laik di sistim a plaant root weh deh anda di waata. Wi kaal dis mangro root ayrya di mahngl. Di mahngl kova di lee fish dehni fi haid dehni ahn protek dehni, lang wid di animal dehni weh noh ga no bakboan. Di anda-paat ahn mahngl gi di ting dehni laik hutis, ahn klam ahn skwid wahn plays fi huk dehni self aan. Dis sistim da aalso wahn plays weh di lee fish ku eet ahn groa op. Dehnya mangro da wahn feedn ayrya fi di impoatant kaina fish. Di fishaman dehni mek moni wen dehni kech fish laik Gray Snapa (*Lutjanus griseus*.) Aal di fish weh dehni kech eena di Kyaribeeyan di spen at lees paat a dehni laif eena di mangro mahngl er eena di see-graas weh dehni eena di see. If wi noh ga mangro ner see-graas, den aal di fishriz eena di Kyaribeeyan wahn goh bam brigidim buf.

### Kweschanz

1. Taak bowt weh yoo andastan wahn “root sistim anda waata” fu bee.
2. Da wai yoo tink seh skwid-laik animal huk aan tu di mahngl?
3. Eena fi yoo oan werd dehni, eksplayn wai di fishriz a di Kyaribeeyan uda brok op widowtn di mangro.

Tingz Fu Du: Du wahn risaach bowt yu siti fu fain owt humoch peepl pen pahni di red snapa (*Lutjanus purpureus*) er eni ada speshal kaina loakal fish. Inklood dehni tapik: Weh yu ku fain dehni, di yoozhal prais, impoat, expoat, kwaliti, rischrikshanz, ahn diman.

## Connectivity and the Environment 3

Theme: Mangroves- Ecosystems

Objective: Reading Comprehension

New Vocabulary: Invertebrates, Mollusks, Substrate, Collapse

### Critical Thinking Skills

The underwater root system of mangroves is a unique ecosystem. Mangroves add lots of cover for small fish and invertebrates and substrate for mollusks and other organisms. This system is also an important nursery area, a juvenile habitat, and a feeding area for many commercially important fish species such as the gray snapper (*Lutjanus griseus*). Every commercially important species in the Caribbean spends at least one phase of its life in the mangrove roots and/or in the seagrass meadows. Without the mangrove and seagrass meadows, all fisheries of the Caribbean will collapse.

### Questions

1. Discuss what you understand as a “below water root system”.
2. Why do you think mollusks attach themselves to the substrate?
3. In your own words explain why the fisheries of the Caribbean would collapse without the mangroves.

Activity: Conduct a research on your city to find out how much dependence there is on the consumption of red snapper (*Lutjanus purpureus*) or any other special species of fish locally. Include these topics: Availability, average cost, import, export, quality, restrictions, and demand.



Dehnya baybi Skoolmaasta snapa (*Lutjanus apodus*) swim mongs dehnya Red Mangro (*Rhizophora mangle*) root di luk fu food. Juvenile *L. apodus* eet smaal shel see animal laik kraab ahn amfipod weh liv pahn di mahngl dehn. Pahn tap, dehn ku swim faas fass eena di mahngl soh noh mek big fish eet dehn. Loakayshan: Bileez. Picha: ©Antonio Busiello

These juvenile Schoolmaster snappers (*Lutjanus apodus*) swim among these Red Mangrove (*Rhizophora mangle*) roots looking for food. Juvenile *L. apodus* eat small crustaceans like crabs and amphipods that live on the roots. They can also swim quickly into the root system to avoid being eaten by larger fish. Location: Belize. Photo: ©Antonio Busiello

## How Evriting eena di Werl Kanek Tugeda 4

Mayn Aidyaa: Mangro-Ihroazhan

Objektiv: Andastan Weh Yu Reed

Di Nyoo Werd Dehn: roazhan, Staam Waata Rosh Op

How fu Tink Klyaa wid Gud Sens

Di mangro dehn ga wahn nada fongshan tu. Dehn protek di ailan ahn di lan fahn ihroazhan fahn harikayn ahn ada kaina staam. Di mangro mahngl da jos laik di root sistim a ada plaant. Dehn help hoal di grong tugeda. Wahn neks prablem wid staam da wen di see waata rosh op pahn di lan. Dis hapn wen di see rayz op ahn geh push pahn di lan bai di taid ahn wen di ayaa presha loa. Di mangro dehn protek ailan ahn lan fahn dis kaina staam rosh fahn di seewaata ahn kip di lan fahn wash weh ahn fahn ada prablem weh kohn wen staam mek waata rosh op pahn di lan.

Kweschanz

1. Da weh yoo tink ihroazhan du tu di mangro nyaa di seeshoa?
2. Yoo tink seh pipi ku help stap ihroazhan a di mangro dehn? How?
3. Yoo eva deh eena wahn staam bai di seeshoa? Weh werd dehn yu kuda yooz fu diskraib it?

Tingz Fu Du: Mek wahn picha buk wid difrant mangro fahn di seeshoa dehn fahn rong di werl, ahn noh figet fu inklyood fu yoo ayrya tu. Shoa di “bifoa” ahn “afta” staam pichaz. Seh how dehn luk saym er difrant wid pichaz fahn laik 10 er moa yaaz abak.

## Connectivity and the Environment 4

Theme: Mangroves-Erosion

Objective: Reading Comprehension

New Vocabulary: Erosion, Storm Surge

Critical Thinking Skills

The mangroves also have another function. They protect the islands and mainland from erosion caused by hurricanes and other storms. The roots of mangroves are just like other root systems: they help hold the soil together and fight erosion. Another issue with storms is tidal storm surge. This occurs when the sea is pushed onto the land by tides and low atmospheric pressure. Mangroves help to protect islands and mainland from this rush of seawater, erosion, and other problems associated with storm surges.

Questions:

1. How do you think erosion affects the mangroves near the sea shores?
2. Do you think people can help the mangroves from suffering erosion? How?
3. Have you ever been in a storm at the seashore? What words could you use to describe it?

Activity. Make an album with pictures of different mangroves in shore lines around the world and be sure to include yours. Show the “before and after the storm” scene. Compare also with pictures from some 10 or more years ago.



Barbara Barrera Vilarmau ahn Johnny Hurtado Aguilar di manij di Refugio de Vida Silvestre Laguna Urpiano pahn di Kyaribeeyan koas a Costa Rica. Di waata don eet op soh moch a di beech dat di see tertl dehn kyaahn lay dehn eg eena dis ayrya weh govament protek. Joorin di see tertl seezn, kansavayshan pipl pachroal di ayrya da nait fi protek di see tertl eg fahn pipl weh kech it wen ih gens di laa. Dehnya brayv pipl tek di eg weh dehn fain ahn put dehn eena wahn plays weh sayf ahn dehn wach oava di eg dehn til dehn hach. Wen di lan geh eet op (ihroazhan) sayka weh di mangro dehn disapyaa, ahn wen di see raiz sayka di chaynj eena di klaimat, den dat wahn bee wahn bad prablem fi see tertl ahn fi pipl aal rong di werl. Robby Thigpen mek di picha.

Barbara Barrera Vilarmau and Johnny Hurtado Aguilar are the overseers of Refugio de Vida Silvestre Laguna Urpiano on the Caribbean coast of Costa Rica. The coastline has crept in so far that sea turtles cannot lay their eggs in this protected area. During sea turtle nesting season conservationists perform nightly sea turtle patrols to protect the eggs from poachers. These heroic people relocate any eggs they find into areas safe from poachers and watch over turtle eggs until they hatch. Erosion from the removal of mangroves and erosion from climate change induced sea-level rise, are serious threats to sea turtles and communities across the globe. Picture by Robby Thigpen.

# How Evriting eena di Werl Kanek Tugeda

## Ting fu Du Owtsaid:

(Fi skool weh deh kloas tu di sea koas)

## **Mek wahn red mangro nersri**

### Klaat:

- Mangro seed. Yu ku geh dis aal yaa rong fahn di mada mangro chree. Kalek 3 tu 5 seed fi eech styoodent.
- 2-leeta soada plastik batl (3 tu 5 fi eech styoodent)
- Kuknat hoks paat er faiba
- Dert fahn di mangro bush anda-paat.
- Bokit
- Sizaz
- Waata



How fi Mek It: Pik wahn ayrya eena yu skool wid nof shade. Kot di tap a di plastik batl dehn wid sizaz. Eena wahn bokit, miks di modi dert with di kuknat hoks faiba eena amongk 2:1. Ful haaf a eech plastik batl wid di mikscha. Plays wan seed per batl, wid di red-brongnish paat eena di dert. Maak di batl dehn wid dayt a wen ih mi plaant, di kaina plaant, ahn styoodent nayhn. Put di batl dehn eena di plays yu mi don set op fu dis. Waata di seed dehn evriday wid fresh er brekish waata fi 4 tu 5 monts bifo tek owt ahn plaant owtsaid. Tugeda wid yu teeche, aks loakal pipl weh ga powa eena dehnya ayrya fi seh weh da di bes plays ahn taim fi plaant di mangro dehn. Pahn datideh day ahn taim, put di seed dehn eena di grong di sayhn way yu mi put it eena di plastic batl dehn, ahn lef bowt 35 cm between eech wan.

(Fi skool weh deh weh fahn di see koas)

## **Mek wahn nersri wid naytiv chree**

### Weh Yu Need:

- Naytiv chree seedling dehn fahn yu ayrya (3 tu 5 fi eech styoodent)
- Emti 2 leeta soada plastic batl (3 tu 5 fi eech styoodent)
- Gyaadn dert
- Kompoas (yu ku mek dis fahn food weh lef oava)
- Sizaz.
- Waata

How fi Mek It: Pik wahn ayrya eena yu skool weh geh sonlait fu oanli lee bit a owaz evriday. Kot di tap haaf a di plastik batl dehn wid sizaz. Eena wahn bokit, miks di gyaadn dert wit di compost ina a wid di kompoas eena di amongk a 2:1. Ful haaf a eech plastik batl wid di mikscha. Plays wan seedlin eena eech batl. Maak di batl dehn wid dayt wen ih mi plaant, di kaina plaant, ahn styoodent naym. Put di batl dehn eena di plays yu mi don set op fu dis. Waata di seedlin dehn evriday wid fresh waata. Seedlin wahn redi fi tek owt ahn plaant owtsaid wentaim dehn groa tu di saiz rong 45-50 cm. Tugeda wid yu teeche, aks loakal pipl weh ga powa eena dehnya ayrya fi seh weh da di bes plays ahn taim dehn fi plaant di chree dehn.



Lee mangros eena Gazi Bay, Kenya EA. Pichr bai Agnes Mukami  
Small mangroves ready for transplanting in Gazi Bay, Kenya EA. Photo: Agnes Mukami

# Connectivity and the Environment

## Outdoor Activity:

*(For schools located close to the sea coast)*

### **Building a red mangrove nursery**

#### Materials:

- Mangrove propagules (seeds). These can be collected all year round from the parent mangrove tree. Collect 3 to 5 per student.
- Empty 2-liter soda plastic bottles (3 to 5 per student).
- Coconut coir or fiber.
- Muddy soil substrate from the mangrove forest.
- Bucket.
- Scissors.
- Water.



Procedure: Choose an area in your school with enough shade. Cut the top half of the plastic bottles with scissors. In a bucket, mix the muddy soil with the coconut coir in a ratio of 2:1. Fill half of each plastic bottle with the mixture. Place the red-brownish part of one propagule in the soil of each bottle. Label the bottles with date of sowing and student name. Place the bottles in the shaded area previously identified. Water the propagules daily with fresh or brackish water for a period of 4 to 5 months before outplanting. Together with your teacher, ask collaboration with local authorities to identify the best places and times to plant the mangroves. On the day and place indicated, place the propagules in the substrate the same way you did in the plastic bottles, leaving a distance of approximately 35 cm apart from each other.



(For schools located away from the sea coast)

### **Building a nursery of native trees**

#### Materials:

- Native tree seedlings from your area (3 to 5 per student).
- Empty 2-liter soda plastic bottles (3 to 5 per student).
- Garden soil.
- Compost (can be made from organic leftovers at home).
- Scissors.
- Water.

Procedure: Choose an area in your school which receives sunlight for only a few hours each day. Cut the top half of the plastic bottles with scissors. In a bucket, mix the garden soil with the compost in a ratio of 2:1. Fill half of each plastic bottle with the mixture. Place one seedling in each bottle. Label the bottles with date of sowing, plant species, and student name. Place the bottles in the school area previously identified. Water the seedlings daily with fresh water. Seedling will be ready for out-planting when they grow to a size of approximately 45-50 cm. Together with your teacher, ask collaboration from local authorities to identify the most best places and times to plant the trees.

### **How fu Tink Klyaa wid Gud Sens**

If di mangro dehn staat fi goh weh, yu tink dat wuda bee wahn gud ting or wahn bad ting fi klaimat aal oava di werl? Wai?

If mangroves became extinct, would the global climate be affected positively or negatively? Why?

Lata di fish laik di gray snapa mek (*Lutjanus griseus*), moni fi di fishman dehn weh di pen pahn di sistim weh di mangro dehn kriyayt. If di mangro dehn disapyaa, how yu tink dat wahn afek di hoal konchri?

Many commercially important species, like the gray snapper (*Lutjanus griseus*), depend on the ecosystems created by the mangroves. Explain how the economy would suffer if the mangroves were reduced.

Gi chree egzampl a how mangro di help plaant ahn animal weh liv anda di see.

Give three examples of the mangroves as providers for the marine life.

Widowtn di mangro dehn, wi noh ga protekshan fahn harikayn, ihroazhan, ahn nada prablem wen kohn fahn dehnya ting. If wi looz di protekshan a di mangro dehn, how dat wahn afek di sayfti a di pipl weh liv bai di see?

Without mangroves we lack protection from hurricanes, erosion and other problems caused by them. How is the sea shore population's safety affected when we lose the mangroves protection?



Da wahn prablem dat mangro eekosistim di brok op aal oava di werl. Di damij tu di langsaid eekosistim dehn schrech owt faar. Pahn tap, dis bad bad fi di faamli dehn hoofa food sikyooriti pen pahn helti eekosistim. Dehn geh lik bad. Yu ku si wahn Nyange Nyangej [westan reef gaalin (*Ardea Qularis*, Bosc, 1972)] di waak eena di mangro bush weh di geh bak gud. Ih di luk fi food. Plos plastik da wahn bad bad ting fi di food chayn. Ih brok it op. Yu ku si maikroplastik di float eena di picha da tap rait. Picha: Agnes Mukami, Gaza Bay, Kenya.

Destruction of mangrove ecosystems is a worldwide problem. The extended damage to the adjacent ecosystems are equally destructive everywhere and the families whose food security is dependent on healthy ecosystems are always negatively impacted. A Nyange Nyange [western reef heron (*Ardea gularis*, Bosc, 1792)] can be seen walking in the recovering mangrove forest looking for food. Plastics are also a global catastrophe negatively affecting the food web. Floating microplastics can be seen floating in the top right of the image.

Photo: Agnes Mukami, Gaza Bay, Kenya

**Chooz di karek ansa tu di kweschan** (di kweschan dehn ku ga moa dan wan ansa)

**Multiple Choice** (some questions have more than one answer)

1. If wi noh ga mangro, weh yu tink ih wahn afek moa?

- a. shoa bod
- b. fish weh liv deep eena di see laik shaak er wayl
- c. di fishaman dehn
- d. pipl hoam weh kloas tu di see?

1. Which of the following would be most affected by erosion in the mangroves?

- a. Wading birds
- b. Deep sea predators
- c. Local fishermen
- d. Nearby homes

2. Wat ku kaaz wi fi noh ga soh moch *Lutjanus griseus*?

- a. noh soh moch bod weh liv bai di see.
- b. wahn harikayn
- c. noh soh moch mangro
- d. protekshan a di mangro dehn

2. What could cause a drastic decrease in the population of *Lutjanos griseus*?

- a. Lowering the population of the wading birds
- b. A hurricane
- c. The destruction of the mangroves
- d. The conservation of the mangroves

3. Da weh di mangro dehn du wid di gyas dehn weh deh eena di ayaa?

- a. dehn projoos kyaaban daiyaksaid.
- b. Dehn tek kyaaban (C) owta di ayaa.
- c. Dehn tek O<sub>2</sub> owta di ayaa
- d. Dehn projoos O<sub>2</sub>.

3. What do mangroves do to the gases in the atmosphere?

- a. Produce CO<sub>2</sub>
- b. Take C from the atmosphere
- c. Take O<sub>2</sub> from the atmosphere
- d. Produce O<sub>2</sub>

# Glajari

## **Anda-paat** (Substrate) n.

Wahn tap er anda-paat mateeryal weh gi wahn aaganizm plays fu liv, groa, er fain food.

## **Andawaata Habitat** (Underwater Habitat) n.

Di plays er environment anda di waata tap weh wahn speeshiz, er speeshiz papulayshan, er wahn er moa kamyooniti liv. Dehnya habitat inklood paat a di andawaata weh ga livin tingz ahn tingz weh noh ga laif.

## **Animal wid No Bakboan** (Invertebrates) n/adj.

Wahn animal wid lata sel bot wid no spain er bakboan. Dehnya no-bakboan animal da di kain weh deh di moas, laik dehn da 97% a aala di animal speeshiz, plos no-bakboan animal ga lata groopin, laik *Porifera* (sponj), *Cnidaria* (koaral, jelifish, animoani), *Platyhelminthes* (flatwom), *Nematoda* (rongworm), *Annelida* (wom weh paat op, laik ertwom), *Mollusca* (snayl, skwid, aktapus), *Arthropoda* (insek, spaida, kraab), *Echinodermata* (staafish, see kyukomba).

## **Bam brigidim buf, brok op, brok dong** (Collapse) v.

Wahn big brok op, laik bam brigidim buf, er brok dong, a wahn sistim, schrokcha, bizniz, instityooshan, er sohnting els.

## **Blak Mangro** (Black Mangrove) (*Avicennia germinans* Linnaeus, 1764) n.

*A. germinans* da wahn smaal evagreen chree weh groa eena ayrya a di see weh taid deh ahn weh deh lee bit op fahn weh di red mangro dehn deh. Yu ku noa dehnya chree eezi-wan sayka di lata root paat weh luk laik pensil (dehn kaal dis *pneumatophores*), ahn weh stik owt fahn di grong, ahn gi aksijin tu di mahngl. Blak mangro ku groa op tu 12 m wid tik, rong tap ahn branch weh spread owt. Di leef pahn neks paat 5-11 cm lang ahn 0.5-0.75 cm waid. Smaal (1 cm) wait flowaz deh aal yaa, ahn groa eena bonch, wid wahn flat froot weh ga wan seed. Di nayhn, blak mangro, da sayka di daak kala a di haatwud.

## **Ekosistim** (Ecosystem) n.

Di hoal mek-op a di livin aaganizm dehn, weh inklood di laif er absens a laif eena dehn livin spays, plos aal di way dehn kanek wid eech ada eena wahn set yoonit a spays.

## **Enerji weh noh Don Owt** (Renewable Energy) n.

Enerji weh kohn fahn plays weh di enerji noh wahn don owt, laik di son, win, taid, riva, hat spring, baiyomaas, ahn soh aan. Wi aalso kaal dis kleen enerji sayka ih noh doti di envarinment laik enerji weh kohn fahn wen faasl fyoowil bon. Sohn kaina dehnya enerjo weh noh don owt da soala enerji, win enerji, hajjro-ilekchrik powa, ahn heet enerji fahn eensaid di Ert.

## **Faasl Fyoowil** (Fossil Fuel) n.

Fyoowil weh kohn fahn mateeryal weh ga hajjrokyaaban. Di hajjrokyaaban ihself mek nachral-wan fahn di Ert. Faasl fyoowil inklood koal, gyasoleen, nachral gyas, taar san, ahn hevi krood ail. Dehnya da weh wi seh da di bigis reezn fi klaimat chaynj sayka wen dehn di bon, dehn mek sevril bilyan tonz a kyaaban daiyaksaid (CO<sub>2</sub>) eech yaa.

## **Hai-asid Oashan** (Ocean Acidification) n.

Wen di pH a di oashan waata goh dong soh dat di asid eena di waata goh op bowt 30 percent. Dis da sayka di kyaaban daiyaksai (CO<sub>2</sub>) eena di oashan mi gaan op.

**Harikayn, Horikayn** (Hurricane) n.

Kaina staam weh dehn kaal chrapikal saikloan weh staat oava waam waata eena di chrapiks er sobchrapiks ahn weh ga win weh reech op tu 74 mph. Eena di naat hemisfayr di win dehn ton rong ahn rong bakway-klakwaiz, wail eena di sowt hemisfayr, di win dehn ton rong ahn rong klakwaiz.

**Ihroazhan; grong/lan wash weh** (Erosion) n.

Wen di tap a di Ert wash weh lee bit bai lee bit sayka di win, glayshal moavment, waata, meenin rayn, waata rong-aaf, riva, schreem, korant, wayv, ahn flod. Ihroazhan inklood wen di rak dehn er nada mateeryal staat wyaa weh eena wahn plays ahn dehn geh moav tu wahn nada plays.

**Klaimat Chaynj** (Climate Change) n.

Wahn chaynj fahn taim tu taim eena di ert klaimat sistim oava wahn lang taim. Di laas kohn-laytli chaynj kohn fahn di ting dehn pipl du, laik di bon faasl fyoowil weh den kaaz di Ert fu waam op sayka moa CO<sub>2</sub> weh deh eena di ayaa. Wen di gloabal avrij tempricha goh op jos bai 2°C, wi ku ga masiv klaimat chaynj. Di Werl Wail-laif Fon (WWF) seh dat tempricha weh di raiz da weh mek di weda hapninz rong di werl soh bad bad ahn schrang schrang, ting laik glaysha dehn di melt op, see level dehn di raiz op, ahn nyoo weda patan dehn di faam.

**Kulprit** (Culprit) n.

Sohnbadi weh mek wahn prablem hapn er hoo du sohnting, er hoo akyooz a wahn kram.

**Kyaaban Daiyaksaid** (Carbon Dioxide) n.

Wahn gyas weh tika dan ayaa ahn weh faam wen wan kyaaban atom ahn too aksijin atom geh tuge da. Ih geh mek wen di mateeryal dehn wid kyaabn bon op. Dis inklood faasl fyoowil weh ferment, aaganik mateeryal weh brok dong, ahn ih hapn eena aaganizm eena di ayaa when dehn breed [tek een ayaa ahn push owt ayaa—noh ga pikni!]. Di ayaa tek een CO<sub>2</sub> chroo di plaant dehn; wi kaal dis foatosintisis. Wen dis hapn aksijin geh mek tu. CO<sub>2</sub> da wan a di mayn kaaz a di greenhows ihfek. Pahn tap, ih mek di oashan dehn ga moa asid, sayka kyaaban asid faam wen di CO<sub>2</sub> brok dong eena di oashan waata.

**Mangro** (Mangrove) n.

Wahn chrapikal er sobchrapikal chree er shrob weh ku talarayt saalt ahn weh groa eena di paat a di koas weh taid kohn een ahn owt, langsaid crik, saalti swamp, er modi grong. Yu ku noa dehnya plays sayka dehn ga saalti waata ahn taid evriday. Plos dehn ga grong wid san weh no ga ayaa (kaal *anaerobic soil*), ahn schrang sonlait. Soh mek dehn ku liv anda dehnya kaina kandishan, di mangro dehn develop sohn chaynj, laik leef weh push owt saalt, wahn ting (kaal *vivipary*). Dis meen dat seed staat groa wen ih stil deh pahn di mada chree, ahn di tap-a-waata mahngl sistim, weh evribadi noa dehn fa. Lata speeshiz ga root weh yu ku si tap a di waata ahn dis gi dehn sopoot eena di saaf sediment. Plos ih help dehn noh tek een saalt. Ahn di root help dehn tek een aksijin fahn di ayaa chroo speshal root schrokcha weh mek dehn breed ayaa (kaal *pneumatophores*) sayka dehn ga hoal (kaal *lenticels*) weh mek dehn breed ayaa.

Mangro protek di shoar, kech ahn hoal di sediment, mek waata kwaliti beta, ahn provid di eekosistim dehn. Dis werd mangro aalso yooz fu meen bush ayraa ful a mangro.

**Moloks (Mollusks) n.**

Lata difrant kaina no-bakboan animal weh bilanz tu di saizabl animal groop nayhn *Mollusca* ((fahn di Latin werd *molluscus*, "saaf"). Yu ku noa dehn sayka dehn ga saaf badi weh no brok op eena paatz, ahn moas a dehn ga wahn shel weh kova dehn, mek fahn kalsum kyaabanet. Aal moloks ga wahn hed; wahn eensaid wid haat ahn aagan fi breed ayaa, aagan fi mek pikni, fi daijis food, ahn fi geh rid a dehn ways; plos dehn foot gah nof mosl fu mek dehn moav bowt. Pahn tap, dehn ga wahn nervos sistim, wahn chroo chroo badi kaviti weh ful a flooyid (kaal *coelom*), ahn wahn mantl, er waal pahn di tap a di bak weh kova aal weh deh eensaid. Da di mantl weh mek di kalsyum shel eena moas speeshiz. Moloks ga moa dan 100,000 speeshiz weh don diskraib. Moloks da di sekan animal groop weh ga so moch difrant kain eena ih groop. Di fos animal groop wid di moas difrant kain eena ih groop kaal *Arthropoda* [animal laik aants, beez, spaida, ahn soh]. Moloks inklood weh wi kaal *gastropods* (snayl, slog, konk), *cephalopods* (skwid, aktapus, wahn kozn tu skwid (kaal *nautilus*), *bivalves* (klam, aista, skyalop, mosl), ahn soh nada groop haadli enibadi andastan bowt gud. Wi tink dat *cephalopods* da di smaatis no-bakboan animal ahn dehn da wahn ekzempl a how wi kohn fi noa bowt ahn fi andastan animal oava di yaaz.

**Plays Weh Bod Liv; nes (Rookery) n.**

Di plays weh sohn bod ahn mareen mamal liv; dehn geh tugeda deh ahn ga dehn pikni deh.

**Shaat Mowt Dowicha (Short-billed Dowitcher) (*Limnodromus griseus* Gmelin, 1789) n.**

Wahn bigish tu saizabl lang-mowt shoabod weh maigrayt fu spen winta pahn di modi flat paat a di koas ahn eena brekish lagoon.

**Shoa Bod (Wading Birds) n.**

Waata bod, speshali dehn wan weh bilanz tu di Big Groop kaal *Charadriiformes*, wichin wi noa seh dehnya ga lang leg, nek, ahn mowt weh help dehn waak chroo shalo waata er eena mod fi fain food.

**Staam Waata Rosh Op (Storm Surge) n.**

Wahn raiz a see level weh mek di koas flod. Dis hapn sayka di schrang serfis win ahn loa presha eena di ayaa, laik di kaina weda weh wi tink bowt wen wi tink a harikayn.

## Glossary

**Black Mangrove (Blak Mangro) (*Avicennia germinans* Linnaeus, 1764) n.**

*A. germinans* is a small evergreen tree growing in tidal areas slightly upland from red mangrove colonies. Trees are easily identified by the numerous pencil-like root structures called pneumatophores protruding from the soil around them, which provide oxygen to the root system. Black mangroves may reach up to 12 m in height with dense, rounded crowns and spreading branches. Opposite leaves are 5-11 cm long and 0.5-0.75 cm wide. Small (1 cm) white flowers appear year-round, growing in clusters and are followed by a flattened fruit containing one seed. The name, black mangrove, comes from the dark color of the heartwood.

**Carbon Dioxide (Kyaaban Daiyaksaid) (CO<sub>2</sub>) n.**

A gas that is denser than air and is formed by the combination of one carbon atom and two oxygen atoms. It is produced in combustion of materials containing carbon including fossil fuels, in fermentation, decay of organic materials, and in respiration of aerobic organisms. CO<sub>2</sub> is absorbed from the air by plants in photosynthesis, while oxygen is produced as a by-product. CO<sub>2</sub> is one of the main causes of the greenhouse effect. It also causes ocean acidification as it forms carbonic acid when it dissolves in water.

**Climate Change** (Klaimat Chaynj) n.

A periodic change in the Earth's climate system over a long period of time. The most recent change is caused by human activities such as burning fossil fuels that lead to global warming due to increasing levels of atmospheric CO<sub>2</sub>. An increase of 2°C in global average temperatures may lead to catastrophic climate change. According to World Wildlife Fund (WWF), increasing temperatures are causing the frequency and intensity of severe weather events around the world, resulting in melting glaciers, rising sea levels, and new weather patterns.

**Collapse** (Brok op, brok dong, bam brigidim buf) v, n.

A severe failure or breakdown, or complete destruction of a system, structure, business, institution, or something else.

**Culprit** (Kulprit) n.

Someone who is responsible for a problem or for doing something, or that is accused of a crime.

**Ecosystem** (Eekosistim) n.

The complex of living organisms, their abiotic and biotic environment, and all their relationships and interactions as a system in a particular unit of space.

**Erosion** (Ihroazhan; grong/lan wash weh) n.

The gradual wearing down of material from the Earth's surface caused by the wind, glacial processes, and water, e.g., rainfall, runoff, rivers, streams, currents, waves, and floods. Erosion includes the weathering of rock or other material in one location and their transport to another point.

**Fossil Fuel** (Combustible Fósil; Faasl Fyoowil) n.

Fuel derived from hydrocarbon-containing materials of biological origin formed in the Earth by natural processes. Fossil fuels include coal, petroleum, natural gas, tar sands, and heavy crude oil. They are considered the biggest driver of climate change as their burning produces several billion tonnes of carbon dioxide (CO<sub>2</sub>) per year.

**Hurricane** (Harikayn, Horikayn) n.

Type of storm called a tropical cyclone that originates over warm tropical or subtropical waters and which has winds that reach a speed of 74 mph. In the northern hemisphere winds rotate counterclockwise, while in the southern hemisphere the rotation is clockwise.

**Invertebrates** (Invertebrados) n. /adj.

A multicellular animal without a vertebral column or backbone. Invertebrates form the most numerous group of animals, as they contain approximately 97 percent of all animal species and include many phyla, including *Porifera* (sponges), *Cnidaria* (coral, jellyfish, anemones), *Platyhelminthes* (flatworms), *Nematoda* (roundworms), *Annelida* (segmented worms such as earthworms), *Mollusca* (snails, squid, octopus), *Arthropoda* (insects, spiders, crabs), *Echinodermata* (starfish, sea cucumbers).

**Mangrove** (Mangro) n.

A tropical or subtropical salt-tolerant tree or shrub that grows in the coastal intertidal zone along estuaries, in salt marshes, and on muddy grounds. These areas are characterized by having saline water, daily tides, anaerobic soil, and intense sunlight. To be able to survive under these conditions, mangroves have developed several adaptations, such as leaves that excrete salt, vivipary which means that seed

germination begins while still being attached to the parent tree, and their characteristic aerial root systems. Many species have roots that are exposed over the water to provide structural support in the soft sediment, exclude salt, and absorb oxygen from the air through specialized respiratory root structures called pneumatophores which contain breathing pores or lenticels.

Mangroves protect shorelines, trap sediments, improve water quality, and they provide ecosystems. The term mangrove also applies to forests or vegetation of such plants

**Mollusks** (Moloks) Mollusks (or Molluscs) n.

Invertebrates belonging to the large and diverse phylum *Mollusca* (from the Latin *molluscus*, “soft”) characterized by having a soft unsegmented body which in most species is completely or partly covered by a calcium carbonate shell. All mollusks have a head; a visceral mass containing the heart and organs of respiration, reproduction, digestion, and excretion; and a muscular foot used for locomotion. They also have a nervous system, a true coelom, i.e. a body cavity filled with fluids, and a mantle or dorsal body wall covering the visceral mass. In most species, the calcareous shell is secreted by the mantle. With more than 100,00 described species *Mollusca* is the second most diverse animal phylum after *Arthropoda*. Mollusks include gastropods (snails, slugs, conch), cephalopods (squid, octopus, nautilus), bivalves (clams, oysters, scallops, mussels), and a few obscure groups. Cephalopods are considered to be the most intelligent invertebrates and an example of how the process of acquiring knowledge and understanding has evolved in animals.

**Ocean Acidification** (Hai-asid Oashan) n.

A decrease of the pH of ocean water that represents an increase in water acidity of approximately 30 percent, resulting from an increased concentration of carbon dioxide (CO<sub>2</sub>) in the ocean.

**Renewable Energy** (Enerji weh noh Don Owt) n.

Energy that is obtained from renewable sources, including the sun, wind, tides, rivers, hot springs, biomass, among others. It is also known as clean energy because unlike energy derived from burning of fossil fuels, it does not produce environmental pollution. Some types of renewable energy include solar energy, wind energy, hydroelectric power, and geothermal energy.

**Rookery** (Plays Weh Bod Liv; nes) n.

The breeding ground of some birds and marine mammals that nest in colonies or congregate to breed.

**Short-billed Dowitcher** (Shaat Mowt Dowicha) (*Limnodromus griseus* Gmelin, 1789) n.

A medium to large, long-billed, migratory shorebird that spends the winter on coastal mud flats and brackish lagoons.

**Storm Surge** (Staam Waata Rosh Op) n.

An elevation of sea level that produces a coastal flood and is caused by the strong surface winds and low atmospheric pressures associated with tropical cyclones.

**Substrate** (Anda-paat) n.

A surface or underlying material that provides an organism with a place to live, grow, or obtain food.



**Underwater Habitat** (Andawaata Habitat) n.

The place or environment under the water surface where a species, species populations, or one or several communities live. These habitats include the abiotic and biotic components of the surrounding underwater environment.

**Wading Birds** (Shoa Bod) n.

Aquatic birds, especially those belonging to the Order *Charadriiformes*, which are characterized by having long legs, necks, and bills which help with, wading or walking through water or mud in search for food.



Mayn Investigayta Robby Thigpen di prizent ih risaach pahn di aatisinal fishriz a di westan Kyaribeeyan da wahn werkshap fu teechez pahn Spanish Lukowt Kee eena Bileez, Senchral Amerika. Picha bai Celeste Castillo ahn Alyssa Majil.

Principal Investigator Robby Thigpen presenting his research on the artisanal fisheries of the western Caribbean at a teachers' workshop on Spanish Lookout Caye in Belize, Central America. Photo by Celeste Castillo and Alyssa Majil.





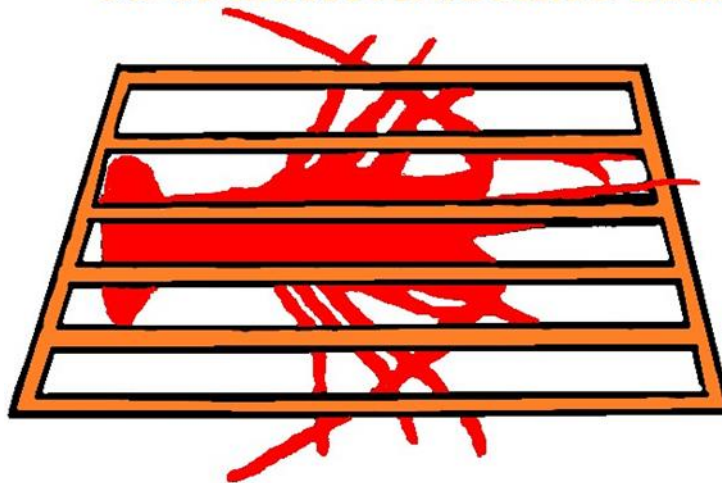


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