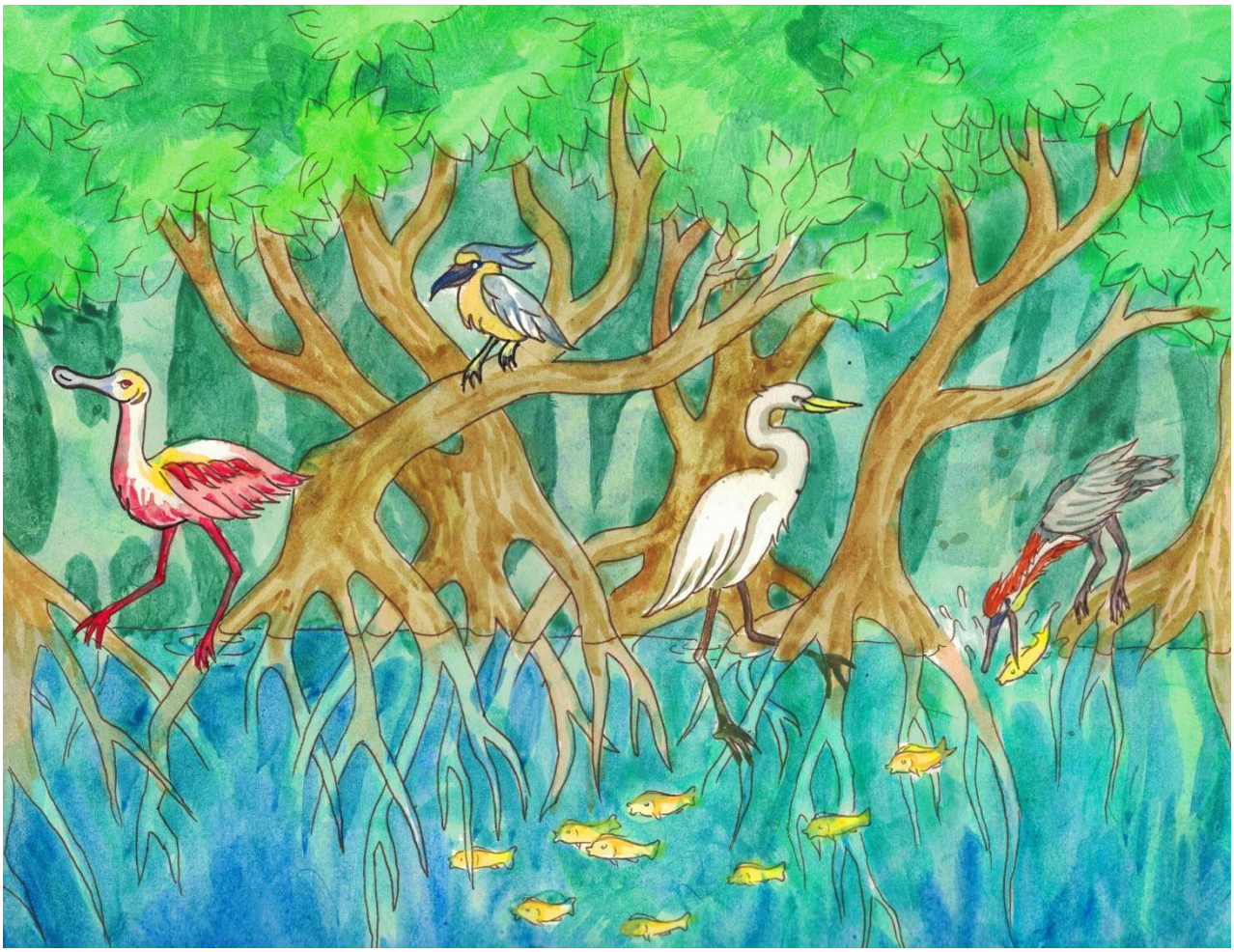
Känään K’ak’naab’ Ti Ma’yan Up’is

Tan uye’ik Aleeb’eh



Okok Ha’il K’ak’naab’

Hu’um ich Mopán ti’i Belize

Men ah Robby Thigpen yet’okoo’ ah Juan Ico etel ah Richard Peck

B’oona’an Men ah

Madison Heltzel

KÄNÄÄN K’AK’NAAB’ TI MA’YAN UP’IS.
B’ALO’ XAN INCHE’EX.

www.marinefrontiers.org

Okok Ha’il K’ak’naab’

Tala’an Menoo’ ah

Robert C. Thigpen, Juan Ico Etel ah Richard Peck

Tulakal a b’a’al ayan wayeh ti’i kap’eel t’an kamb’ala tz’iib’a’an men

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B’etaha’an upach a hu’um ad’a’a men ah: Madison Heltzel

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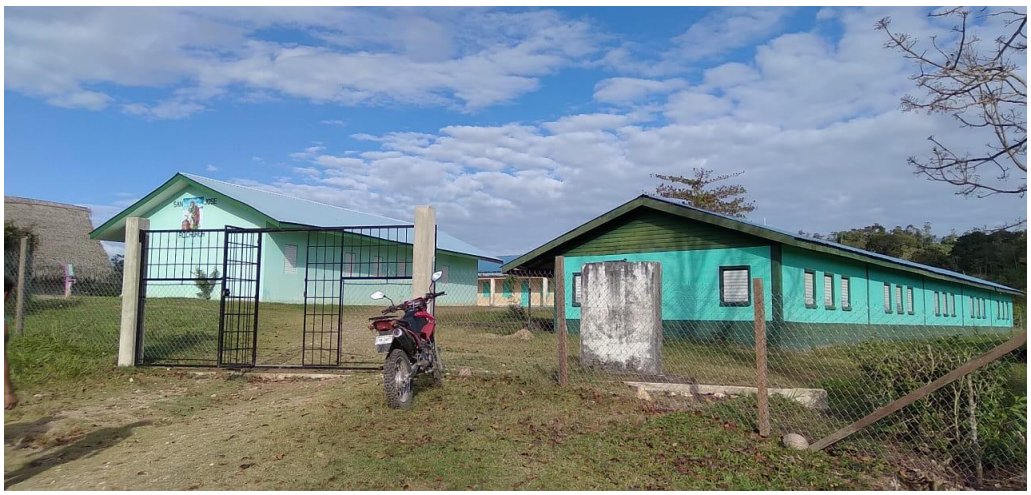
In k’ati’ in tz’aah a b’o’tik ti’ihoo’ in wah Mopan itz’inoo’ etel suku’unoo’ akuma’anoo’ San Jose etel kuuchil kamb’al San Jose RC School, Toledo, Belize. Le’ek a hu’um ad’a’, upektzil b’iki’ ti yan a kuxtala a tz’iib’a’ani ich Mopan, ma’ kuchi yanahi wah kuch mayanoo’ u tz’ok’sah eteloo’ uki’ilal. äää



Pach Hu’um: Ah chäk tzohe’en kuchaara ko’ Ho’ho’ (*Platalea ajaja*), Ah kayuuko ko’ Ho’ho’ (*Cochlearius cochlearius*), Noxchi’ Säk Ho’ho’ (*Ardea alba*), etel a pelon B’aalum Pach Ho’ho’ (*Tigrisoma mexicanum*) a hed’eeka awilik tanoo’ uhed’el, ximb’al etel tanoo’ umächkoo’ a käy kumaanoo’ ich Okok Ha’il K’ak’naab’.
B’oona’an Men ah Madison Heltzel

The Mangroves
By
Robert C. Thigpen,
Juan Ico Etel ah Richard Peck

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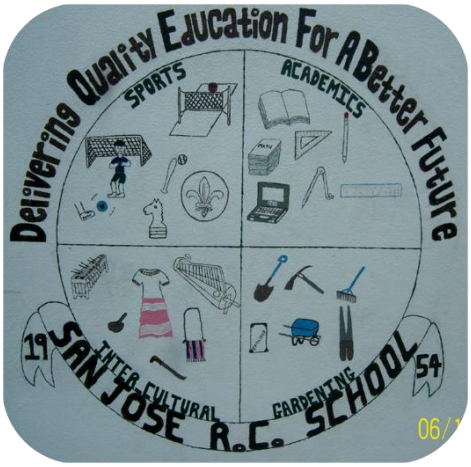
We want to thank our Mopán brothers and sisters in San José Village and the San José RC School in Toledo Belize. This Mopán edition of this biology curriculum would not be possible without their trust and friendship.



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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Ah Mansah T'an ich Mopan Maya
Juan Ico[10] etel Ah Richard Peck[9, 10]

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Muuch' ti mak le'ek u polintahoo a kamb'al ad'a'a
Celeste Cariamo Castillo[1], Katie Deas[1, 4], Claudia Eveline Ortiz Lopez[1], Grazzia Maria Matamoros Erazo[1] & Robert C. Thigpen[1]

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Ah utz kinah Tz'iib' ich Mopán
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Ukaheeb'al Ich Mopán

Hunp'eel tukul ha'ha'ih! Intuklah ilik inb'eteh a tukul ad'ah uchi', k'u'ub'etiki, chumen ti ma'yan atak'ini ma'ilik inb'etah. Le'ek a hu'um ad'a'ah b'el uka'a uheb'eh utukul a tz'ub'oo' le'ek b'ikih etel k'u' uk'ab'eetil a Okok Ha'il K'ak'naab'a ichiloo utzikb'al. le'ek ad'a'ah b'el uka'a uchilam kunteh ichiloo' utukul k'u' uk'ab'eetil Okok Ha'il K'ak'naab' ti'ihoo' ukuxleeb'al käy etel b'iki ti walakoo' usa'altiko'on tu wich a chich ik'.

Top manal k'ucha'an tin wich a hu'um ad'a'ah. Le'ek ad'a'h hump'eel hu'um a tz'a in k'aatik ti'ihoo in wah ka'ansahoo' etel tz'ub'oo' ka' utz'a'hoo' ti meyah ichiloo' uka'ansah. Ichil a k'in amanihi, ucho'on ti ka'ansah eteloo a hu'um yan ich Ingles, k'u ub'etiki' chich u ch'a'toh tikoo' tz'ub' a t'an ayan ichil.

Le'ek a hu'um ad'a'ah ab'etb'a'anih ich Mopán ma' had'ih b'el uk'a'a uyaanto'on ti'I ka' ti ki'ool teh ti t'an Mopán, b'el ilik uka'a uyaanto'on ka' ti na'teh ti ki uk'ab'eetil a Okok Ha'il K'ak'naab' ti'i ti xoyoob'al etel a kuuchil hal k'ak'naab' Belize.

Ti tan intukulik, manal ki' ku'chi ka' yanak hunhunp'eelak uhu'umil meyah ti'i a hunhunpaay uka'nalil kamb'al. Le'ek ad'a'ah hunp'eel anoxi tukul a tz'a uyantal ti'i ak'in awatak ti'i ka' kaak ti talel ti hunp'elik ti t'an, tanak ilik u oksab'aanäl at'an Ingles ti'i ka' yanak a kamb'ala ti kich'pan. Etel a hu'um ad'a'ah b'el uka'a uheb'eh hunp'eel kich'pan tukul ti'i ka' ti hätzäh ti tzikb'al etel ti b'iki ti yano'on ino'on a Mopán.

Ichil a k'in awatak toh, ti tz'ub' le'ekakoo' huntuul b'eloo' uka'a yaanteh ukänääb'äl etel usa'alb'äl ukuuchiloo' uyalak k'ak'naab' *Okok Ha'il K'ak'naab'*.

Uyad'a'il, inen huntuul a tan in ka'ansah 29 haab aleeb'eh, in k'ati in wilah ka uchuk a helt'an ti'i ka' ki'ak akamb'al ichil ti kaal Belize etel ti'ihoo' ah Mopán Maya kuma'anoo' Belize.

B'o'tik,

Midonio Cal
Educator / Administrator
San José RC School
Toledo, Belize

Mopán Introduction

It's a dream come through! I have thought of this initiative in the past but due to financial constraints it was not possible. This book will enhance the knowledge of students on the uses and benefits of mangroves in their own language. This will definitely present to them a better comprehension of what the mangroves means to the survival of fish populations and protection during hurricanes.

I am very appreciative of these documents. This will surely be the number one book that I will personally request for my teachers and student to use in their regular session. In the past, we have used the English books which in many cases children often have difficulty in understanding the terms used.

This exceptionally crafted mangrove book in our Mopán language will not only promote the appreciation of the Mopán language but will also promote the deeper meaning of the use of mangroves to our environment and coastal regions of Belize.

In retrospect, I strongly appreciate that a separate activity book be designed for all levels in the primary school. This will surely be a great initiative in the future to begin re-uniting our language, incorporating the English instruction for better learning opportunities. It will also open the avenue to sharing our language and culture through this great book.

In the future, our children will better advocate for the protection and preservation of our key marine habitat, *The Mangroves*.

Finally, as an educator for over twenty-nine years, I look forward for these ethnotranslations to continue for the betterment of education in Belize and especially to our Indigenous Maya Mopán people of southern Belize.

B'o'tik,

Midonio Cal
Educator / Administrator
San José RC School
Toledo, Belize

Ukaheeb'al
Xok ti'i hoo' ah Kaansah

K'ämoola'anakech men u hu'umil Känään K'ak'naab' Ti Ma'yan up'is a tz'iib'a'an ti'i kamb'al ichiloo' ulak' t'an. Manal uki'il ti wool ti ke'enech a waanto'on ichil u ka'ansab'äloo' a meen tzub' eteloo ch'ahom, ixchu' ti'i b'iki ka' uyahkuntoo etel ti'i ka' u känään te' u ayik'alik ti k'ak'naab' ti'i a k'in awataka. A ka'ansah ad'a'a tan ub'etab'aanäl ka'axtub'ahak chil a hunpeet ti yok'olkab'.

Le'ek a hu'um ad'a'a b'etaha'an ti'i a tz'ub'oo' a ke'en chil uwuk (7) tak b'olon (9) haab' kamb'al xok.

K'u ah b'eel atan ti b'etiki: U noxi'il a ti k'ati ka' uchuku le'ek ti k'ati' ka' k'ämb'aanäk ti ino'on uyumil, ino'on tz'ah ti känääntik a k'ak'naab'. Walak ti tz'ok'sik ti a kamb'ala yaab' uki'il le'ek ti tan ti kanasah ichiloo' ulaak'tak tzikb'al. Walak ti tz'ok'sik ti le'ekoo' a hunhunpaay tah tzikb'ala yan hunhunpaay k'u a tanoo' u käxtiki. Ti b'aalo tunu, tan ti tz'eek a kamb'al ti kich'pan ichil a tzikb'al a suk ti'ihoo' etel utzikb'aloo' ichil uhunp'ehnahil. Le'ek b'o'onoo' ti wah xoko ak le'ekoo' tun huntuul tanoo' u yilik k'u uki'il ahu'um ad'a'a aleeb'e etel ichil a k'in a wataktoh, mentäkäh k'ab'eet etel yan unah ka uchuko'on ti tzikb'al ti toh eteloo b'oon atanoo' utz'eek ti meyah a hu'um ad'a'a.

B'iki kah tz'aa ti meyah a hu'um ad'a'a: Le'ekoo a meen hu'um ad'a'a tz'aha'an ti le'ek ka' u ch'aa ub'enil ah ka'ansah/kamb'al hab'ix ti walak a ka'ansah ichil ukuuchil kamb'al. Tz'aha'an tech ti ka' a tz'aa ti meyah le'ek b'iki ti ki' chil a kuuchil tub'ah kuma'anech etel le'ek k'u a nu'kul a yanteche. K'äha'anak tech ti tz'a yan uhu'um a hunhuntuul ti tz'ub'u.

Ichil a hunhunp'eel ule' ahu'um yan a kamb'ala a koom upacha tz'iib'a'an ich Ingles etel ich Mopan. Wah k'atihi hed'eek a ka'ansik a hunp'eel ti tzikb'al waxan ka'anseh tu ka'p'eelil.

Ka' tatz'ka'hes a kamb'al tel uki'i awool etel hunp'eel k'ämool kich'pan, etel hunp'eelak tukul a hah tu pach k'u a tukul a b'el uka'a ti tzikb'alb'a'anäl. Payenb'eh ka b'eteh tulakal k'u a k'ab'eet ti'i ka'ansah etel tub'ah b'el aka'a ti tz'iib'. Tu wich tub'ah walak a tz'iib'i tz'iib'a'anak le'ekoo' a tumul t'an, upolil a ka'ansah, etel täk'aanak a noxi hu'um tub'ah b'oona'an ub'o'oy le'ek k'u a b'el aka' aka'anseh chen ki' ti yanoo' ad'a'a uchak tun ma' yantech u maakinahil ti tz'iib' ti a ye'ikal ub'o'oy hab'ix ti kuxa'an.

"Le'ek makoo' a yah uyäb'ih etel a kuma'anoo' tu tzeel k'ak'naaba' top manal yah ti'i ka' utukloo' wah mah huntulikoo' etel a k'aknaab'a." – Hermann Brochä

Ukuuchil u Okok Ha'il K'ak'naab'a top manal yaab' oo' tub'ah k'ink'iin a uha'il ak'ak'naab'a ka'ax tub'ahak ichil a uyok'olkab'a. A Säkal Hanal kab [White-throated Bee-eater] (Merops albicollis) ichil Okok Ha'il K'ak'naab' te'i Indian Ocean. Bo'oy hok'a'an men ix Agnes Mukami, Gazi Bay, Kenya EA.

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^{th}-9^{th} 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.

Ukaheeb'al Hu'um

Uch'a'ikal in na'at wayeh ichil u kuuchil hook' ich K'ak'naab' Kariib'e ya'ax kahi' tanil in hook' tu tzeeloo' a käyb'alil winik Belize. Le'ekoo' a winik ad'a'a u ch'a'ahenoo' hab'ixen uyet'okilenoo' te' Cayo ma' xan hab'ix huntuul a kamb'al tu pach k'ak'naab' tala'an Estaad'o. Kaheen ti k'aatchi' tu pach b'iki ti yan ukuxtal a k'ak'naab, tanil in ch'a'ikal in na'ata in käxtah hunp'eel tukul a ma'eela'an etel xan a tukul ab'e'eh inkäna' le'ekoo' uyah uchb'en tukul a käyb'alil winik (upataliloo' uchb'en Ma'maa). Ti ke'enen tu yaamoo' ka' heen in na'te b'iki ti yanoo' u hunp'enahil, k'u tak awalak u tz'eekoo' ti meyah ti'ihoo' u hook'o, etel b'iki' ti walakoo' ukamb'a. Le'ek akamb'al ad'a'a ma' kuchi inweeltah wah kuchi' ma ke'enen tu yaamoo' sansamal ti meyah taan k'ak'naab'.

Le'ek ah hook'oo' ad'a'a uyeeloo' ti tam ichiloo' uyool b'iki ti yan a k'ak'naab' le'ek tub'ah kuma'anoo' etel tub'ah tanoo' umeyah, hab'ix tah weel huntuulak amak a natz' tah tzeel waxan huntuulak mak ahed'eek a noh ooltik. Ti'i a k'in aleeb'e le'ekoo' a hook' ad'a'a tanoo' uyahkunb'ul men hunp'eel a ma'ki'ilal a tan utalel ti naach hab'ix ti top manal tupach uchäkähil ak'ini, yaab' ak'as ich k'ak'naab', hook' ti manal, pol letz' ich hah, b'aalo xan tan u yohb'ol ukuuchiloo' u yahmeen alak' a k'ak'naab' chen ti'i ka' in wad'äh tz'etz'eekak. Le'ekoo' a hook' ad'a'a hah tu yeeloo' ti ki' b'iki ti kumaanoo' a ab'alche' tel p'äk'aal ich much'nalili k'u ub'etik, le'ekoo' uyah uchb'en tulukoo' ma' tan u tzolik ti chilam tub'ah etel k'u tan u talesik a yahilal yok'oloo'. Le'ekoo' a hu'um ad'a'a b'etb'aanih ichil u k'ab'ah, u tukul etel u t'anoo' a hook'oo' wayeh b'aloo' xan etel u t'an etel utukulili kamb'al to pach b'iki ti yan a yok'olkab'a ti'i ka' yanak ti muk' ti tz'ikb'alte' ichil ti t'an a yahilal atan umanäl ti'i to'on. Ti b'aloo' xan, etel a noxi tumul tukul eteloo' ut'an ichiloo' utz'ib'al b'el uka'a uyaantoo' uyad'ab'äl b'iki ti yed'eekoo' u känääntik ah k'ak'naab' le'ek tub'ah walakoo' u käxtik uhanal ti'i hunp'enahil, etel xan a k'ak'naaba a noha'anoo' uyool etel ti chilam ti tohpol eteloo' mak atanoo' uhyik a hook'oo', ah tz'iib' toh kimb'eeb' sip'il, eteloo' ilik xan tulak atanoo' u tz'eek uyool ukänäänte' ukuxtal a malo' yok'olkab'.

Le'ek ti kaakech a na'te' utukuloo' ah uchb'en makah yaab' tub'ah hed'eek a k'ad'äl tumen xan chen ich t'an mansab'aanih a tukuloo' ab'e'e. Hunp'eel k'uxpolil awalak uyantala le'ek ti ma'yan ut'anil k'u atan a meyahtik upacha ichil ulaak' tzikb'al. Ti'i ka' ti manes a k'uxpolil ad'a' ti käxtahoo' a mansah t'an a yanoo' uyah uchb'en tukul etel awaloo' utzikb'al ichil ut'anoo' ti'I ka' u b'etoo' ah tumul t'an ti'i k'u atan uyad'ab'aanäl ichil ut'anoo'. Ub'etahoo' ah tumul t'an etel b'oon uyeeloo'. Yan ti tz'ok'sah ichil k'u a ti b'etah etel b'iki ka' ti b'etah, k'u ub'etiki tantoh ti kamb'al tanil ti b'el ichil a tukul ad'a'a. B'el ti ka'a ti wätz kunteh etel ti wa'kunteh ti ki' b'iki ti walak ti b'etik ichil u laak' a hu'um awatakoo' toh: Uhu'umil B'iki Ka Känäätel Ukuxtal a Yok'olkab', Uule a polaanoo' ichil ti kuuchil, etel uhu'umil Muuch' kap'eel tanil b'iki ti yan a k'olkab'a etel u pektzil p'äk'aal eteloo' b'a'alche'. Le'ekoo' a tumul t'an ayan chil u hu'umil Kokok ha'il K'aknaab yanoo' unukul tu yad'a'il a hu'um ad'a'a. le'ekoo' a tumul t'an ama' tz'iib'a'an ichil a Muuch' Ka'p'eel tan chil a hu'um ad'a'a b'el uka'a ti ilb'aanäl ichil ulaak' ahu'um awatal toh.

In k'ati' intz'aa a b'o'tik ti'i ah hook'oo' eteloo' u hunp'ehnahil ti'i ka' uk'äm ool tahenoo' etel ti'i ka' u oksahenoo' ichiloo' ukuxtal. Wah kuchi' ma' yan akamb'al in känah eteloo', mah kuchi hed'eek upaatal a meyah ad'a'a. In k'atilik intz'aa a b'o'tik ti'i hoo' ti wet'ok usihahoo' umeyah akumaanoo' tub'ahak ichil a yok'olkab'a, wah kuchi' ma' yanoo' ma'kuchi' chäk lahil uwichil a tukul ad'a'a.

Ich much'nalil ino'on ah Känään K'ak'naab' Ti Ma'yan Up'is etel aleeb'e b'aaloo' xan inche'ex!

Robby Thigpen
Upolil Meyah
Känään K'ak'naab' Ti Ma'yan Up'is

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

Okok Ha'il K'ak'naab'- MANGROVES

B'iki Ti kuma'ano'on ich hunketil etel ti Xoyoob'al 1 (Hun)

Upolil Kamb'al: Okok Ha'il K'ak'naab' – Uyotochoo' alak etel b'a'ache' hab'ix ti p'ätmaha'an
K'u ah b'eel atan ti b'etiki: Xok Ti'i Ka' a Na'teh
Tumul T'an: Okok Ha'il K'ak'naab', Ti kuuchil, kuuchil yalam ha', mukulha'il ch'iich', Hun much' ti ch'iich a tanoo' uhe'.

B'oon Upatalil a Tukul: Ichil utz'atz'il Okok Ha'il k'ak'naaba' te' yaaboo' a p'ak'aal ayanoo' ich ha' etel yok'ol ha'. Le'ekoo' u kan a Okok Ha'ol K'ak'naab'a a che ka'al yok'ol ha'a le'ek kuuchil ti'i hoo' a manälil ch'iich' ich ha'. Le'ekoo' u k'ä' a che' ad'a'a walak utz'eekoo' ukuuchil tub'ah hed'eekoo' ukuntal ich sis oolal etel tub'ah hed'eek u hed'eloo' to hob'oloo' ti tzak manäl k'in. A Okok Ha'il K'ak'naab'a le'ek ilik uyotochoo' ah manälil ch'iich' ich ha te walak uyankuntoo' etel uch'isoo' uyal. (Hun much' ti ch'iich a tanoo' uhe'). Wah kuchi ma'yanoo' a Okok Ha'il K'ak'naab'a, le'ekoo' a ch'iich' ad'a'a ma' kuchi yan a kuuchil tub'ah ukuntaloo'.

K'aatchi
1. B'iki'il a kuuchil tub'ah yanoo' Okok Ha'il K'ak'naab'a?
2. K'u akuuchil ti'ihoo' a manälil ch'iich' ich ha'a?
3. Tub'ah walakoo' utz'eek uk'u' etel uyankuntik uyaloo' a manäl ch'iich' ich ha'a?
4. K'u tah tuklik walak utzeentikoo' a ch'iich' ad'a'a?

Meyah
1. Tu pach ti hob'oke'ex a tzikb'alteh ak'aatchi'oo' eteloo' awet kamb'ala, b'oonteh ub'o'oy b'iki ti kuma'anoo ah manälil ch'iich' ich ha' tu yaamoo' Okok Ha'il K'ak'naab. Ye'eh b'iki ti k'ab'eet a kuuchil ad'a'a ti'ihoo' ukuxtal a ch'iich'. Ulaak' Meyah/ Täk'e'ex tub'ahil tulakal a b'oontahe'ex ich hunp'elik ti'i ka yee ichil u kuuchile'ex a kamb'al.
2. Wah natz' kuma'anech tub'ah yan a Okok Ha'il K'ak'naab'a, xen a sutinteh a kuuchil ab'e'e etel ka tz'iibteh upach tulakal k'u a wilah.

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-o-War Caye natz' tzeel Dangriga, Belize le'ek kuuchil tub'ah walakoo' u he' etel u ch'isah aloo' a ch'ich känääna'an ti ki' (rookery) te'i South Water Caye Marine Reserve ich Belize Barrier Reef Reserve System, le'ek UNESCO World Heritage Site. Le'ek a kuuchil ad'a'ah, waxan kuuchil tub'ah kuma'anoo' uyalak' a k'ak'naab'a, le'ek hump'eel kuuchil ti'ihoo' hab'ixwalal kän paay ti ch'iich': a Nox hook' Ko B'ox Ch'iich' (*Fregata magnificens*), Uk'ul b'oon pach paato ok ch'iich' (*Sula leucogaster)*, a ka'leet' taan ch'iich' (*Phalacrocorax auritus*), etel a luk' b'ooon pach rumuk koh ch'iich' (*Pelecanus occidentalis*). Le'ek a Man-o-War Caye le'ek hunp'eel a ka'nal lu'um xoya'an men k'ak'naab'a, k'u' ub'etik huub'ih humb'uuh hak men a chich ik', paan ch'ich' etel uheelel muk' k'in tan unak'sik ukanalil a k'ak'naab'a. b'o'oy men ix: 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

B'iki Ti kuma'ano'on ich hunketil etel ti Xoyoob'al (Ka')

Upolil Kamb'al: Okok Ha'il K'ak'naab' – aseyteh-Ik' uk'ab'a CO_2
K'u ah b'eel atan ti b'etiki: Xok Ti'i Ka' a Na'teh
Tumul T'an: Ik' uk'ab'a CO_2, Le'ek B'iki Tan uheel umuk' a k'in, Laal kunb'ul K'ak'naab', aseyteh, ulaak' tak b'alal tub'ah walak ti cha'ik muk' ti'i meyah, le'ek a ma' walakoo' uhob'ol

B'oon Upatalil a Tukul: Le'ekoo' u Okok Ha'il K'ak'naab'a walakoo' umächik a Chuwen Ik' (CO_2) etel walakoo' ub'etik a Ik ti'i Tiwik' (O_2). Hunp'eel ayahilal ayan aleeb'e le'ek Uheelel Umuk' K'ini, le'ek ad'a'a tan unaksik uyoox a hunpeet ti yok'olkab'a etel tan ilik ulaal kuntik a k'ak'naab'a. Hunp'eel noxi b'a'al atan ukahsik Uheelel Umuk' a K'ini le'ek ti top tan uyaab'tal a Chuwen Ik' (CO_2) ich ik' etel ich k'ak'naab'. Tan uyaab'tal a Chuwen Ik' tumen tan ti chuwikoo' aseeyteh, ulaak' tak b'a'al b'etaha'an tel aseeyteh etel xan a b'ox tunich awalak uchuwul (Coal). Tzahee'ex ti p'ätik unohoolb'ol aseeyteh ti'i meyah. Ka'ax kuchi ka' ti p'ätä' ti tz'eek ti meyah a aseeyte samala, yanak tolik ti manal to'on a Chuwen Ik' (CO_2) ich ik'ih. Ti ke'en a Chuwen Ik' (CO_2) ti ka'ana walak utaak'tik uyoox ak'ini. Le'ek ti ke'en a Chuwen Ik' (CO_2) ich K'ak'naab'a walak ulaal tal uha'il ti manal. Hunp'eel unoxi' k'ab'eetil a Okok Ha'il K'ak'naaba', hab'ix tulakaloo' ap'äk'aala, walakoo' umächik a Chuwen Ik' (CO_2) etel walak u b'etik a Ik ti'i Tiwik' (O_2). Le'ekoo' a Okok Ha'il K'ak'naab' walak utz'iiltik uk'asil a ik' (C) awalak ti hok'sik ka tun utz'ahoo' ti meyah ti'ihoo' umuk'. Le'ekoo' a Okok Ha'il K'ak'naab'a manal pataloo' u mächäh uk'asil ik' (C), mentäkäh tz'ah ti känääntikoo'.

K'aatchi'

1. B'iki ka wad'äh b'iki tu laal tal aK'ak'naab'a?
2. Le'ek ti manal a Chuwen Ik' CO_2 b'iki tu k'as kuntikoo' a Okok Ha'il K'ak'naab etel uxoyoob'aloo'?
3. B'ik' ti hed'eeke'ex ti känäätikoo' a Okok Ha'il K'ak'naab'a?

Meyah

Tz'ah ti meyah a Maakinah ti'i Tz'iib' (Internet) ti'i ka'a käxte ub'o'oy hab'ix ti kuxa'an (video) le'ekoo' a Okok Ha'il K'ak'naa'b a yanaha'anoo' uchi' natz' tatz'eel Ho (5) waxan Lahun (10) yaab' aleeb'e, ka' tun a wila' k'u' uhupaayil ti'i ak'in aleeb'e. Tz'ikb'alte'ex uhunpaayil a käxtahe'ex eteloo' a wet kamb'al. Yaaltehe'ex a tz'iib' ti'hoo' amak ayanoo' uwichil ichile'ex a kaal ka wad'e'ex k'u' a käxtahe'ex.

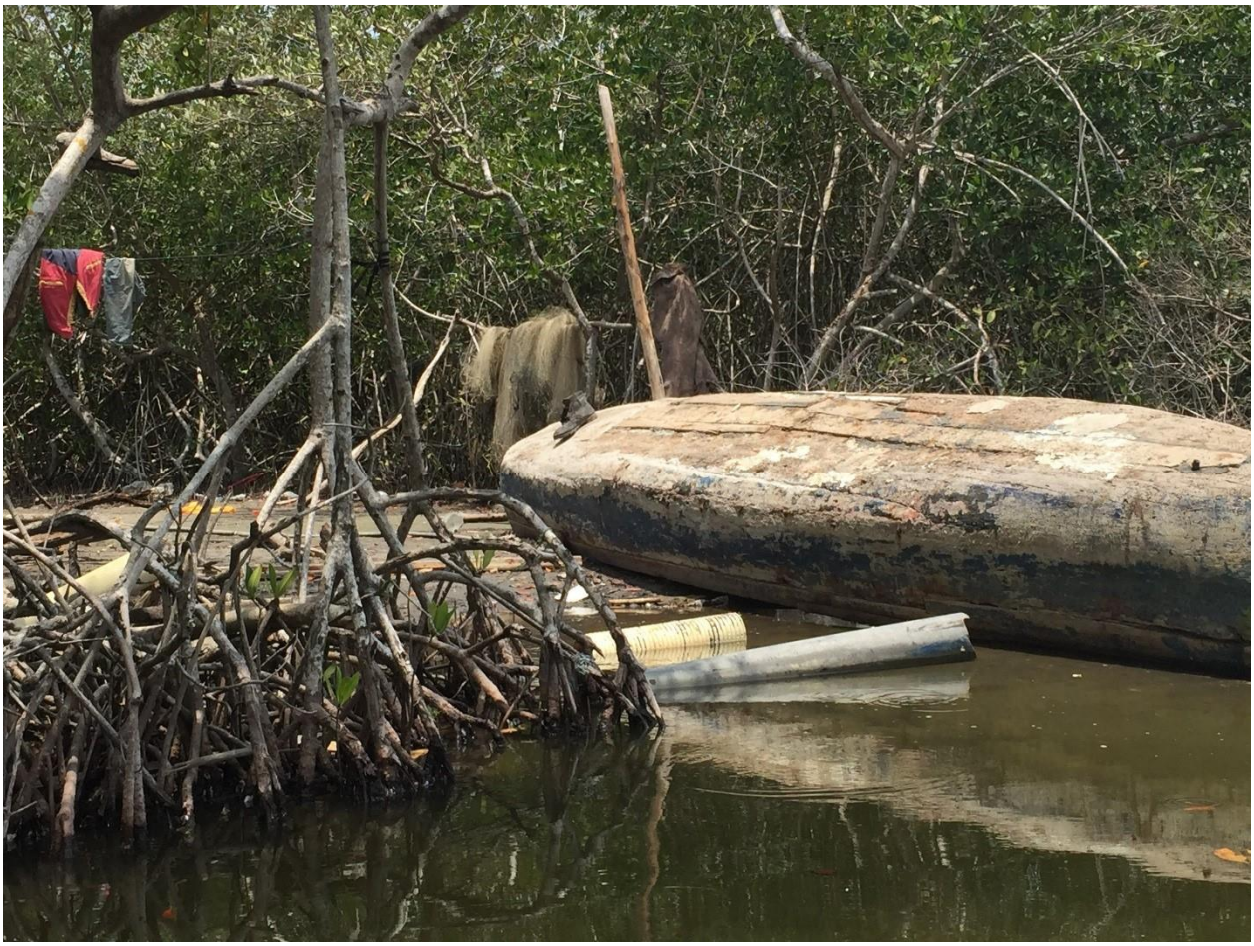
Connectivity and the Environment 2

Theme: Mangroves-Fossils Fuels- CO_2
Objective: Reading Comprehension
New Vocabulary: Carbon Dioxide (CO_2), Climate Change, Ocean Acidification, Fossil Fuel, Renewable Energy
Critical Thinking Skills: Mangroves also take in carbon dioxide (CO_2) and produce oxygen (O_2). 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_2 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_2 in the atmosphere. CO_2 in the atmosphere captures heat from sunlight. In the ocean CO_2 makes the water more acidic. One important role of mangroves, like all plants, is to take in CO_2 and produce O_2. 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_2 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.



Le'ekoo' ah nukche' Okok Ha'il K'ak'naab' ad'a'a ke'en tu tzeel a kah Cartagena de Indias, Colombia ma' had'ih walakoo' utz'eek uyotoch a hook'oo', walakoo' ilik utz'eek umuk'aanil a kuuch ad'a'a ti'ihoo' uyalak' a k'ak'naab'a awalak' umächikoo' a hook'o. Tu tzeel ab'e'e, le'ekoo' u Okok Ha'il K'ak'naab' walak uhok'sik uk'asil a b'utz atanoo' uhok'ol ichiloo' ukuuch maneeb'al (Caaro, trok, bus) ayanoo' ich nukuch kah. Ub'o'oy: 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

B'iki Ti kuma'ano'on ich hunketil etel ti Xoyoob'al 3 (Oxp'eel)

Upolil Kamb'al: Ukuuchiloo' - Okok Ha'il K'ak'naab'
K'u ah b'eel atan ti b'etiki: Xok Ti'i Ka' a Na'teh
Tumul T'an: ah Ma'yan B'akel B'a'alche', K'u'un B'a'al, Noyha', Huub'ul

B'oon Upatalil a Tukul: Ukanoo' a Okok Ha'il K'ak'naab' ake'enoo' ich ha'a manal yaab' b'iki ti yan. Walakoo' utz'eek ti yaab' tub'ah hed'eekoo' u mukik ub'ahil a meen käy eteloo' ah ma'yan b'akel b'a'alche' eteloo' noyha' ti'i tutu' etel ulaak'tak b'a'alche'oo'. A kuuch ad'a'a k'ab'eet ti'i ch'isah al, kuuchil ti'ihoo' a meen b'a'alche', etel wayeh walak uhanaloo' a yaab' paay ti käay awalak ukomb'ol ti'i men tak'in hab'ix ah Ta'anpuse'en pach Käy (*Lutjanus griseus*). Le'ek ahäypaay ti käy ak'ab'eet ti'I komb'olo ichil ti kaal Kariib'e walakoo umansik tz'etz'eekak ukuxtal ichil ukanoo' a Okok Ha'il K'ak'naab'a waxan ichil usu'ukil k'ak'naab'. Wah kuchi ma'yanoo' a Okok Ha'il K'ak'naab'a eteloo' usu'ukiloo' k'ak'naab'a, tulak tub'ah walak ahook'o ti'i men tak'ini ich Kariib'eh lah b'uka'ah ti huub'ul.

K'aatchi':
1. Tzikb'alteh k'u' ach'a'tohtah tupach "Uk'ab'eetil kanche' ich ha'.
2. Uka'a tahtulik ti le'ek atutu'u walak u t'äk'untikoo' ub'ahil tuwich noyha'?
3. Ichil a t'an inchech tab'ahil, ad'äh b'iki ti b'uka'ah ti huub'ul ukuuchiloo' ahook' ich K'ak'naab'Kariib'e wah kuchi' ma'yanoo' Okok Ha'il K'ak'naab'a?

Meyah: B'eteh hunp'eelak uch'a'ikal ana'at ichil akaal ti'i ka käteh b'oon uk'ab'etil to'on a chäk Ch'eh (*Lutjanus purpureus*) ti'i ti hanal waxan ulaak paay ti käy ayanoo' wayeh. Ka' wad'ä': b'oon ayan, b'oon utool, b'oon awalak ukexb'a'anäl, b'oon awalak ukonb'a'anäl, b'oon uki'il, b'iki'in ti hed'eek a hook', etel b'oon ak'atiina'an aleeb'e.

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.

Le'ekoo' a meen K'än ch'eh (*Lutjanus apodus*) tanoo' ukaxan hanal tu yaamoo' ukan a Chäk Okok Ha'il K'ak'naab' (*Rhizophora mangle*). A meen ch'ehoo' ad'a'a walakoo' uhantikoo' a chich pach b'a'alche' hab'ixoo' yux eteloo' a meen pemech ayanoo' tuwich ukan a Chäk Okok Ha'il K'ak'naab. Hed'eekoo' ilik hanb'el umukoo' ub'ahil yaam ukan ache'e ti'i ti ma' uhantab'äloo' umen a nukuch käy.
Hok'aan ub'o'oy wayeh Belize: ©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

B'iki Ti kuma'ano'on ich hunketil etel ti Xoyoob'al 4 (känp'eel)

Upolil Kamb'al: P'oo'ol-Okok Ha'il K'ak'naab'
K'u ah b'eel atan ti b'etiki: Xok Ti'i Ka' a Na'teh
Tumul T'an: P'oo'ol, Utz'iikil K'ak'naab'a.

B'oon upatalil a Tukul: A Okok Ha'il K'ak'naab'a yanoo' ilik uk'ab'eetil. Walakoo' u sa'altik a meen lu'um taan k'ak'naab'a etel the lu'um ti'i ti ma' ukuchb'ul men a chich-chich- ik' eteloo' ulaak' ik'ilha'. Ukanoo' a Okok Ha'il K'ak'naab'a, hab'ix ilik laakoo' ukan che'e: walakoo' uyaantik umächb'äl a lu'um tub'ahil ti'i ti ma' b'uukul. Ulaak' ama'ki'ilal awalak utalesik a ik'ilha'il le'ek walak unak'sik utz'iikil a k'ak'naab'a. Walak uyantal umuk' le'ek ti walak utulkab'äl a k'ak'naab' toha'anil lu'um etel le'ek ti yaab' umuk' a ik' yok'ol ha'. Le'ekoo' a Okok Ha'il K'ak'naab'a walakoo' uyantik usa'alb'äloo' a lu'um taan ha' etel ilik ti lu'um ti'i ti ma' uhuub'ul, p'o'b'ol, waxan ulaak'tak ma'ki'ilal awalak utalel men umuk' ak'ak'naab'a.

K'aatchi':
1. B'iki ta tuklik ti walak uyahkunb'ul a Okok ha'il K'ak'naab' a ke'enoo hal k'ak'naab'a?
2. Walak wah tuklik ti le'ekoo' ti wetlu'umala hed'eekoo' uyanat ti'i ti ma' uhuub'ul uhaal a k'ak'naab'a? B'iki?
3. Ila'an wah a chich ik'ilha'il hal k'ak'ab' amene? K'u ti t'aniloo' a hed'eek awad'ik tu pach k'u awilaha?

Meyah: B'eteh hunp'eelak a hu'um tud'a'an etel ub'o'oy hunhunpay Okok Ha'il K'aknaab'a ke'enoo' halk'ak'naab'a a yanoo' ka'ax tub'ahak ichil a yokolkab'a. K'äha'anak aye'ik Okok Ha'il K'ak'naab ayan tub'ah kuma'anech inche'e. Ka yeeh "ti maxtoh etel ti manih a ik'ilha'il". Ka käxtoo' a b'o'oy a hok'sab'aanoo' lahun (10) yaab' uchi ka' tun awad'äh k'u uhumpayil etel a leeb'e.

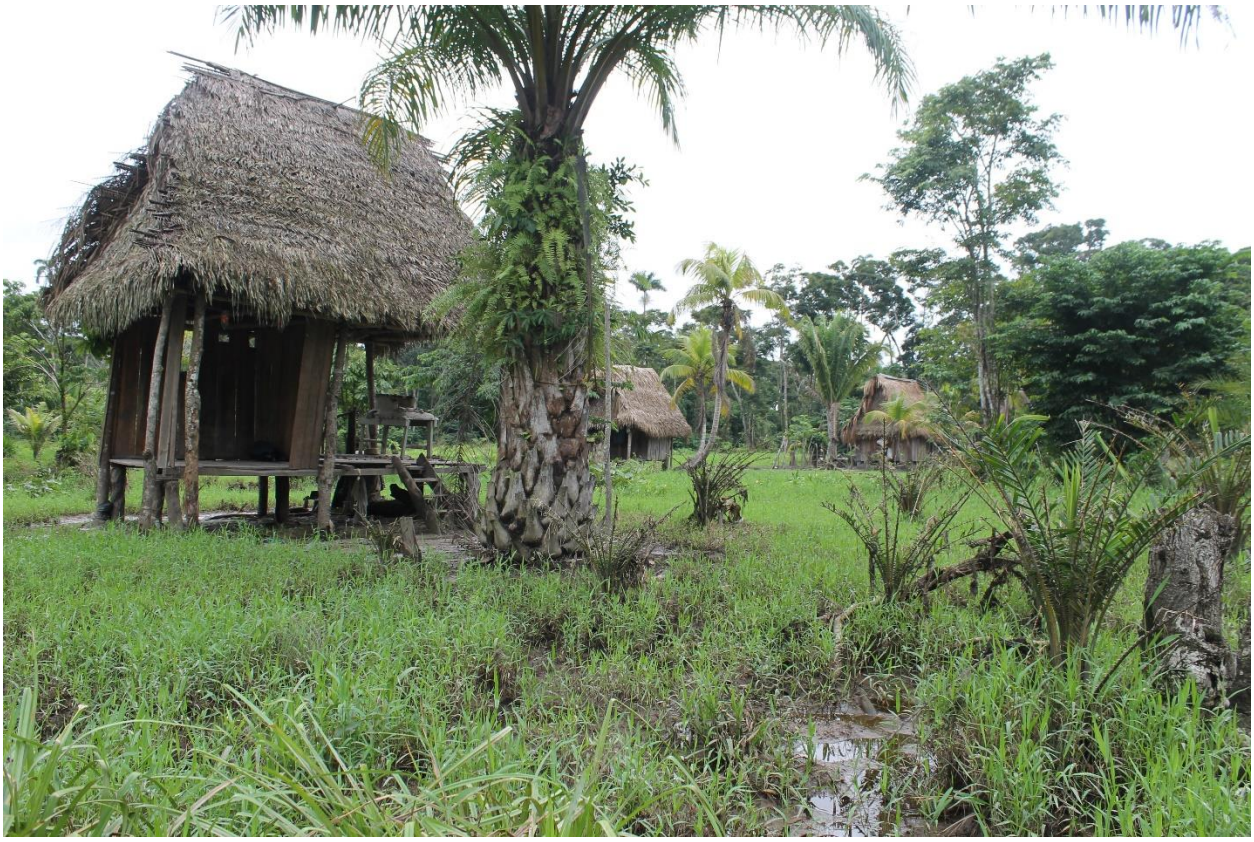
Connectivity and the Environment 4

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.



K’asoo tan utz’u sik okok ha’il k’ak’naab’, p’oo’ol, etel top yaab’ umuk’ a k’as atanoo’ utalel ich noh ha’ etel kaal a kuma’anoo’ hal k’ak’naab’a. le’ek ti tan uhob’sab’a’anäloo’ a okok ha’il k’ak’naab’ hal k’ak’naab’a ma’yan b’iki’ ka’ u sa’altoo’ b’ahil a kaal ayanoo’ natz’ hal k’ak’naab’ tu wichoo’ a chich ik’eel ha’il, p’oo’ol etel tud’el ha’il. Tub’ah: Laguna de Thompson-Barras de Cuero y Salado Wildlife Refuge, Honduras. B’o’oy men: © Ivany Argueta

Mangroves protect the coast from hurricanes and prevent erosion and buffer excess nutrients from coastal river systems and coastal communities. The loss of riparian mangroves exposes communities to the impacts of tropical storms, erosion, and flooding. Location: Laguna de Thompson-Barras de Cuero y Salado Wildlife Refuge, Honduras. Photo: © Ivany Argueta

B’iki Ti kuma’ano’on ich hunketil etel ti Xoyoob’al

Meyah Pachnah:
(Ti’ihoo’ akamb’al a kuma’anoo’ natz’ tu tzeel K’ak’naab’a)

Ub’etb’el ukuuch tub’ah a ch’isik a chäk Okok Ha’il K’ak’naab’

K’u ak’ab’eet ti’i ka paatak:

- Usemiiyahil Okok Ha’il K’ak’naab’a (Unek’). Hed’eek amolikoo’ ad’a’a manäl haab’ tuwich una’ Okok Ha’il K’ak’naab’. Molo’ oxkuul (3) waxan ho’kuul (5) ti’i a hunhuntuul ti tz’ub’u’.

- Ah kap’eh liitro plastik b’oteeyoh a ma’yan ub’a’al (oxkuul (3) waxan ho’kuul (5) ti’i a hunhuntuul ti tz’ub’u).

- U tzuk koko

- Noyha’ ayan ichil uyaam Okok Ha’il K’ak’naab’.
- Kub’eeteh/p’uul
- Tiheerah
- Ha’

B’iki ub’etb’el: Käxte hunpeelak a kuuch ayan ich b’o’oyil pach ukuuchil a kamb’al. Xot’oh chumuk etel tiheerah ah plastik b’oteeyoh. Inchil a kub’eeteh, xaab’teh a luk’u etel u tzuk a koko b’ix wala hunsut manal yok’ol ulaak’ (2:1). Tud’es hunxoot’ak a hunhunkuul ti b’oteeyo’ etel aluk’ a xaab’tah. P’äk’äh hunhunkuulak a semiiyah ichil ahunhunp’eel ti b’oteeyoh. Tz’iibteh tupach b’oteeyoh b’ik’in ti paak’ih etel mak tz’ub’il up’äk’ah. P’ätäh tun a b’oteeyoh ichil a b’o’oy a käxtah samihi. Ka ch’uloo’ a p’äk’aal sansamal etel hilha’ waxan etel a ch’ooch’ ha’ tanak a b’etik ti b’a’alo’ le’ektoh ti manäk a kän (4) waxan ho’ (5) uh ka’tun ach’aah ti p’äk’b’äl tub’ahak. Inche’ex wet’ok a wah ka’ansahili, k’aate’ex ka’ uchuke’ex a komon meyah eteloo’ upolil a kaal ti’i ka’ käxte’ex tub’ah etel b’ik’in ti ki’ ka’ p’äk’e’exoo’ a Okok Ha’il K’ak’naab’a. Le’ek tun b’ik’in etel tub’ah ad’ab’aanih, p’äk’e’ex a semiiyah atan uhok’ol uyoko ich noyha’ hab’ix ilik ka’a p’äk’ah ich b’oteeyoh, (Ho’lahun tika’käl) 35 cm uyaam ka p’äk’oo’.

(Ti’ihoo’ a kamb’al a naach ke’enoo’ chi’ k’ak’naab’)
Ub’etb’el ukuuch tub’ah a ch’isik a che’ a to’onoo’

K’u ak’ab’eet ti’i ka paatak:

- Usemiiyahil che’ ayan tub’ah kuma’anech (Oxkuul (3) waxan Ho’kuul (5) ti’i a hunhuntuul ti tz’ub’u)
- Ah kap’eh liitro plastik b’oteeyoh a ma’yan ub’a’al (oxkuul (3) waxan ho’kuul (5) ti’i a hunhuntuul ti tz’ub’u)
- ah b’ox lu’um
- xa’ab’aan lu’um etel atu’uh päk’aal (hed’eek ub’etb’a’anäl etel uyad’ah hanal)
- tiheerah
- Ha’

B’ikih ub’etb’el: Käxte hunpeelak a kuuch tub’ah ma’ walak u ti’ich’ a k’in ti manala. Xot’oh chumuk etel tiheerah ah plastik b’oteeyoh. Inchil a kub’eeteh, xaab’teh a b’ox lu’um etel a xab’a’an lu’um etel a tu’uh p’äk’aal hab’ix wala hunsut manal yok’ol ulaak’ (2:1). Tud’es hunxoot’ak a hunhunkuul ti b’oteeyo’ etel alu’um a xaab’tah. P’äk’äh hunhunkuulak a semiiyah ichil ahunhunp’eel ti b’oteeyoh. Tz’iibteh tupach b’oteeyoh b’ik’in ti paak’ih, k’u’ ti che’il, etel mak tz’ub’il up’äk’ah. P’ätäh tun a b’oteeyoh ichil a kuuchil a käxtah samihi. Ka ch’ulu’ a p’äk’aal sansamal etel hilha’. Le’ek ti ch’iikoo’ ameen che’ hab’ix walah 45 -50 cm, ki’ak tun up’äkb’äloo’ tub’ahak. Inche’ex wet’ok a wah ka’ansahili, k’aate’ex ka’ uchuke’ex a komon meyah eteloo’ upolil a kaal ti’i ka’ käxte’ex tub’ah etel b’ik’in ti ki’ ka’ p’äk’e’exoo’ a meen che’eoo’ ad’a’a.

A meen Okok Ha’il K’ak’naab’oo’ ki’oo’ u häp’b’äl te’i Gazi Bay, Kenya EA. B’o’oy men ix: 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.

B'oon upatalil a tukul

Wah ka' hob'okoo' ti b'eb'eel a Okok Ha'il K'ak'naab'a, b'el wah uka'a ti ki'tal waxan ma'ki' tal umuk' ak'in ichil a hunpeet ti yok'olkab'a? Uka'a?

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

Yaab' paay a käy ak'ab'eet ti'i konolo, hab'ix a ta'anpuse'en pach ch'e (Lutjanus griseus), noha'anoo' uyool etel akuxtal awalak utz'eekoo' a Okok Ha'il K'ak'naab'a. Ad'äh b'iki ti b'el uka'a ti cho'b'ol ukäxtikal ti tak'in wah ka' emek uyaab'iloo' a Okok Ha'il K'ak'naab'a.

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.

Wah kuchi' ma'yanoo' a Okok Ha'il K'ak'naab'a, ma' yan b'iki ka' sa'alb'äko'on tu wich a nukuch ik' etel u laak'tak a yahilal awalak utalesik, hab'ix up'o'b'aanäl lu'um tu hal k'ak'naab. Le'ek ka' ti chaa akanan awalak utz'eekoo' a Okok Ha'il K'ak'naab' b'iki tun tu cho'b'ol usa'alb'eeb'aloo' akuma'anoo' hal k'ak'naab'?

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?

Le’ek u hob’sab’äl tub’ah yanoo’ a Okok Ha’il K’ak’naab’a le’ek hump’eel yahilal tan ichil a hump’eet ti yok’olkab’ah. Yaab’ a yahilal ad’a’ah tan ucho’ ti manal ka’axtub’ahak etel tan ilik u cho’ikoo’ tub’ah walakoo’ u käxti u kich’pan hanal a hunhunp’eh nahil. Ah Okeeb’ k’inil Ho’ho’ [western reef heron (*Ardea gularis*, Bosc, 1792)] a hed’eek u ilb’a’anäl tan u kaxan hanal ich Okok Ha’il K’ak’naab’ a tan to umolik ub’ahil. A pulul letz’ ich ha’ tan ilik u cho’ikoo’ b’iki tu hanaloo’. Hed’eek a wilikoo’ a mechech letz’ yok’ol ha’ ichil a b’o’oy ke’en ti pol ich seeb’k’ä’. B’o’oy hok’a’an men ix: 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

Yaab' Unuukb'eeb (di kweschan dehn ku ga moa dan wan ansa)
Multiple Choice (yan tuyaam a k'aatchi ma' hunp'elik unuukb'eeb'e)

1. B'iki'il tu yaamoo' ad'a'a ab'el uka'a ti cho'b'ol ti manal wah ka' huub'uk a lu'um tu yaamoo' Okok Ha'il K'ak'naab'a?

a. ah manälil Ch'iich' ich Ha'
B. ah hanal b'a'ache' a tala'anoo' ich tamil ha'
C. ah hook'oo'
D. Nah ayanoo' ti natzah

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. K'u hed'eek uyemsikoo' uyaab'il a ta'anpuse'en pach ch'eh (*Lutjanos griseus)* ti manal?

a. Emsab'äl uyaab'iloo' a manälil ch'iich' ich ha'
b. a chich chich ik'
C. uhob'sab'äloo' Okok Ha'il K'ak'naab'
D. ukänäänb'äloo' Okok Ha'il K'ak'naab'

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. K'u awalak ub'etikoo' a Okok Ha'il K'ak'naab' ti'i a b'utz ake'en ich ik'ih?
a. walak uyaab' kuntik ah chuwen ik' (CO_2)
b. walak uhok'sik ub'oxil a chuwen ik' (C) ich ik'ih
C. walak uhok'sik a Ik' ti'i Tiwik' (O_2) ich ik'ih
D. walak uyaab' kuntik a Ik' ti'i Tiwik' (O_2)

3. What do mangroves do to the gases in the atmosphere?
a. Produce CO_2
b. Take C from the atmosphere
c. Take O_2 from the atmosphere
d. Produce O_2

Muuch' T'an etel unukulil

Ah B'utKoh Ch'iich'il Hal K'ak'naab' [Short-billed Dowitcher] (*Limnodromus griseus* Gmelin, 1789) n. ah ma' top nooch, chawak koh, manälil ch'iich' le'ek a walak u mansik a sisil tuwich uluk'il k'ak'naab' etel a ch'ooch' laguna.

Ah Cho' [Culprit] n. Huntuul mak uka'sah a k'uxpolil waxan ukäxtah usip'il, waxan mak atan utz'a'b'a'anäl usip'il etel a ma'ki'ilal a b'etb'a'anih.

B'ox Okok Ha'il K'ak'naab' [Black Mangrove] (*Avicennia germinans* Linnaeus, 1764) n. *A. germinans* le'ekoo' a meen che' tatz' ya'axoo' ule' manäl haab' atanoo' uch'iil tub'ah walak uk'ochol umuk' a k'ak'naab' tz'eek naach tu tzeeloo' a chäk Okok Ha'il K'ak'naab'. Hed'eek a na'tikoo' a che' ad'a'a eteloo' u kan a tichintiichoo' yok'ol lu'um hab'ixoo' che' ti tz'iib', le'ekoo' ad'a'a walakoo' utz'eek a ik' ti'ihoo' ukan. Le'ekoo' a b'ox okok ha'il k'ak'naab'a walakoo' uch'iil 12 m uka'nalil, kuluul a yok'olo etel hemeel uxa'ay. A hunhunxeel ule'e yan 5 -11 cm uchawakil etel 0.5-0.75 cm utaan. Yanoo' uyah meen (1 cm) säktop' manäl haab', much'uul tu ch'iiloo' etel pachil ab'e'e walak uyantal uyah pechek ich ayan hunkulik unek' ichil. Le'ek a k'ab'ah, b'ox okok ha'il k'ak'naab'a, yanahih men b'ox utz'u ache' ad'a'a.

Chich Ik' (Hurricane) n. A mison ik'ilha' awalak ukuxtal yok'ol a k'ink'iin k'ak'naab' etel 75 mph (miiyah amal hoorah) umuk'. Ichil a hunb'uuh ti'i yok'olkab' ti Norteh te'ih a ik'ih kukulpach tu sutuul, le'ek tun ichil a hunb'uuh ti'i yok'olkab' ti Sur ich seebk'ä' walak usutuul.

Chuwen Ik' CO_2 [Carbon Dioxide, CO_2] n. Ah tät ik' a walak u yantal le'ek ti walak u nutzik hunp'eel ti'i a b'utz ik etel kap'eelak ti'i ik' a ti'i ti wik'ih. Walak uyantal le'ek ti walak u chuwb'a'anäl ab'a'al ayan a b'utz ichil (hab'ix aseeyteh), le'ek ti' tz'äma'an ab'a'al, le'ek ti tan u uuyul ak'imen b'a'ala, etel ti tan uhok'ol u yik' a kuxa'an b'a'al. A Chuwen Ik' CO_2 walak uhok'sab'aanäl ich ik' menoo' päk'aal le'ek ti tanoo' u b'etik uhanal, le'ek ti tanoo' ub'etik ad'a'a tanoo' uyankuntik a Ik' ti'i ti wik' O_2. A CO_2 le'ek hunp'eel noxi b'a'al tan u chäkähkuntik a yok'olkab'a. Le'ek ilik tan u b'etik ti laal a k'ak'naab'a chumen ti walak u laaltal ti walak uxaab' tik ub'ahil etel ha'.

Hahab'en Uuya'an B'a'al [Fossil Fuel] n. Aseeyteh awalak ub'eetel le'ek tu uuyul akimen b'a'al a muka'an ti xan ich lu'um. A Hahab'en Uuya'an B'a'al le'ekoo' a b'ox tunich, aseeteh ayan ich tunich, Ik', aseeyteh pach tunich, etel a tät aseeyteh. Le'ek tanoo' uhelik ti manal umuk' a k'ini, tumen le'ek ti tanoo' uchuwb'a'anäl tan ub'etikoo' ti manal yaab' a Chuwen Ik' (CO_2) amal haab'.

Hub'uul [Collapse] v, n. hunp'eel noxi yoohol waxan kaachäl, waxan hunpul ti chob'aanih b'iki ti yan a hunmuch' ti ab'a'al, otoch, konol etel k'ex, hunmuuch'il, waxan ulaak' tak b'a'al.

Kuuchil' a he'il ch'iich' [Rookery] n. Le'ek akuuchil tub'ah walakoo' uhe' a ch'iich' etel ulaak'oo' b'a'alche' le'ek awalakoo' uhe' ich much'nalil chi k'ak'naab'a.

Kuuchil Yalam ha' [Underwater Habitat] n. Kuchil waxan uxoyob'al kuchil yalam ha' tub'ah kuma'an a hunpaylik, yaab' paay alak', hunp'elik waxan ayaab' paay ti much'nalil. Ichiloo' a kuchil ad'a'a yanoo' ilik ab'a'al a kimen etel kuxa'an tu xoyoob'al ich ha'.

K'u'un B'a'alche' [Mollusks (or Molluscs)] n. B'a'alche'oo' a ma'yanoo' ub'akel atala'anoo' ichil uyaamil a hunmuuch' ti b'a'alche' *Mollusca* (Latin *molluscus*, "K'u'un") k'u'un etel huntuutz ub'äk'el le'ek a b'uuka'an tu tuluub'al waxan b'uka'an tz'eekak upachoo' etel k'uta'an. Tulakal a K'u'un B'a'alche' yanoo' upol; lu'umal tub'ah yanoo' upäsäk'al etel tub'ah hed'eekoo' u ch'a'ik uyik', yantal uyal, ti'i hanal, etel ti'i tah; etel yanoo' uyah muk'a'an ok ti'i manäl. Yanoo' ilik u xich'el awalak utzol, chukul häp'a'an ub'äk'el etel utah; ad'ab'äl hab'ix a hob'on tud'a'an etel ha', hätza'an tuyaam a hob'onil ub'äk'el kuma'anoo' ich hunp'elik. Ichil uyaab'iloo', uk'uta'aniloo' upach chi'ich men b'ähmenahih. Chumen ti manal 100,000 paay a eeltzilil *Mollusca* uka'p'eel a b'a'alche'oo' a yaab' tu pach *Arthropoda*. Ichil u muuch'il K'u'un B'a'alche' yanoo' ilik a yanoo' uwich tu pol etel chichichoo' upach (tu'tu', t'ot'), yanoo' ilik a nukuchoo' upolo etel yaab'oo' uk'ä' (squid, octopus, nautilus), yanoo' ilik a walak uheeb'e etel u k'aaläl u pacha (pemechoo'). Na'tab'aanih ti le'ekoo' ab'a'ache' ad'a'a a ma'yanoo' ub'ak'el pataloo' etel wayeh ch'a'b'a'anih utukulil ti yanoo' utukul ab'a'alche'.

Laal kumb'ul K'ak'naab' [Ocean Acidification] n. u ema'anil umuk ha' ich k'ak'naab' le'ek atan uye'ik ti tan u laaltal uha'il hab'ix wal 30%, men yaab'ahih a chuwen ik' (CO_2) ich k'ak'naab'a.

Manälil ch'iich' ich ha' [Wading Birds] n. Uch'ich'iloo' ha', le'ek ayanoo' ichil uhunmuch'il *Charadriiformes,* chawakoo' uteel, ukal eteloo' u koh le'ek walak uyantikoo' ti manäl ich ha' waxan ti'i kaxan hanal ich tz'atz'il.

Ma'yanb'akel [Invertebrates] n. /adj. B'a'alche'oo' ama'yanoo' ub'akel uch'ib'al upach waxan ubak'el. A ma'yanb'akel b'a'alche' le'ekoo' ti hunmuuch' b'a'alche' a manal yaab'oo', yanoo' 97% uyaab'iloo' tuwich ulaakoo' a b'a'alche' tu yaamoo' ad'a'ah yanoo' *Porifera* (b'a'alche' hab'ixoo' ucha'an so'sot'), *Cnidaria* (b'a'alche' ayaab'oo uk'ä'), *Platyhelminthes* (pechek nok'ol), *Nematoda* (kuluul nok'ol), *Annelida* (cemp'eh hab'ix lukumil lu'um), *Mollusca* (t'ot'), *Arthropoda* (a saak', a toy, yux), *Echinodermata* (b'a'alche'iloo' k'ak'naab' a k'i'ixoo' upach).

Muk' ti'i meyah a ma' hob'ol uka'a [Renewable Energy] n. Muk' le'ek awalak utalel tub'ah ma'yank'in uhob'ol hab'ix etel k'in, ik', muk'ha', noh ha', k'ink'iinha' ich lu'um, ta'oo' b'a'alche', waxan ulaak' b'a'al. Eela'an ti le'ekoo umuk'u manal kich'pan ti'i meyah tuwich a muk'a walak utalel ti tan uchuwb'a'anäl a aseeyteh, etel ma'taach ilik uyan kuntik a k'ask tuwich tub'ah kuma'ano'on. Yanoo' tub'ah hed'eek ti ch'a'ik ti muk' a ma' walak uhob'ol hab'ix, muk' tala'an etel k'in, muk' tala'an etel ik', muk' tala'an etel ha', etel muk' tala'an etel k'ink'iin ha' ich lu'um.

Noyha' [Substrate] Etz'aan luk ich ha' awalak utz'eekoo' akuuchil tub'ah ukuntal, ch'iil waxan tub'ah ukäxtik uhanal a kuxa'an b'a'ala.

Okok Ha'il K'ak'naab' [Mangrove] n. Che' awalak uch'a'ik a taab'a le'ek a awalak uyantal ich chäkäh waxan tuyaam chäkäh etel k'ink'iin kuchil. Walak uch'iil tub'ah tikin uhatz' a ha' hal k'ak'naab', ichil ch'ooch' tz'atz'il, etel ich luk'il. Ichiloo' a kuuchil ad'a'a ch'ooch'oo' uha'il, sansamal tan uhatz' a k'ak'naab te'ih, ma'yan a ik' ich lu'um, etel manal u sak a k'in te'ih. Ti'i ka' kuxakoo' wayeh, le'ekoo' a Okok Ha'il K'ak'naab'a ukäxtahoo' b'iki ti tz'ahoo' ukuxtal, hab'ix u leloo' walak u pulik a taab'a, walakoo' ukaal ti hok'ol uyok unek' le'ek toh ti ch'uya'an tuwich una', eteloo' ukan a tich'ka'aloo' ich ik'ih. Yaab'oo' a yanoo' ukan a chäka'an yok'olha' ti'i ka' wa'kunteh a che' ichil a ku'un lu'um, ti'i ka' uhok'es ataab', etel ti'i ch'a' ik'. Ti'i uch'a'ikaloo' u yik' potooxoo' ukan. Le'ekoo' a Okok Ha'il K'ak'naab'a yaab b'iki ti walak uyaantik upach ti kuxtal. Walakoo' usa'altik uhal a k'ak'naab' tuwich Chich Ik' etel p'oo'ol, walak ilik utz'iil

k’as, walak ukich’pankuntik a ha’, etel walak utz’eek ukuchil tubah uyantaloo’ etel uch’iillo a men käy, ama’yan b’ak’el b’a’alche’, etel ulaak’ tak b’a’alche’.

Le’ek a t’an Okok Ha’il K’ak’naab’a walak ud’ab’a’anäl ti le’ek nukche’ waxan le’ek hunmuuch’ ti che’.

Pachkuxtal [Ecosystem] n. Uyaab’il b’iki ti yanoo’ ukuxtal akuxa’an ab’a’al, b’iki ti kuma’anoo’ tu yaam a kimen etel a kuxa’an b’a’al le’ek tub’ah kuma’anoo’, etel tulakal b’iki ti kuma’anoo’ etel ti noha’anoo’ uyool tub’ahiloo’ ichil hunp’eelak kuuchil.

P’oo’ol [Erosion]n Le’ek ti tan umiisb’anäl chunchunb’eelil uwich a Yok’olkab’a men ik’, b’ät, etel ha’, hab’ixoo’, b’ut’, yokha’, nukuch ha’, kuxlinha’, umuk’ha’, uhatz’ha’, etel tud’a’an ha’il. Ichil a p’oo’olo walak ilik u uup’ul a nukuch tunich waxan ulaak’ b’a’al a ma’taach uhok’ol ichil ukuuchil ka’ tun kuchb’ukoo’ tu laak kuuchil.

Uheelel Muk’ K’in [Climate Change] n. Uheelela’anil ak’ini ti manal etel ti xan tuwich a yok’olkab’a. Tan uyantal ad’a’a aleeb’e tu men tan uchuwb’a’anäl aseeyteh le’ek tun tan u chäkäh kuntik a yok’olkab’a tumen manal a Chuwen Ik’ CO_2 ti ka’ana. Wah ka’ nak’äkäh 2°C umuk’ uchäkähil ayok’olkab’a uchak u talesik a k’in a sab’entzil. Hab’ix a tan uyad’ik World Wildlife Fund (WWF), le’ek ti tan unak’äl umuk’ uchäkähil ak’in tan uyaabtal etel tan usab’entzil tal ayahil ichil a hunpeet ti yok’olkab’, tan tun u uuyesik a b’ätäh, tan unak’äl uha’il a k’ak’naab’a, etel manal uhunpayil a k’ini.

Utz’iikil K’ak’naab’a [Storm Surge] n. U ka’nalil ha’ le’ek awalak u tud’esik uhal a k’ak’naab’ awalak uyantal men achich ik’ yok’olha’ etel le’ek ti kab’al uyalil a ik’ yok’olha’ awalak uyantal men amison ik’

Glossary

Black Mangrove [B'ox Okok Ha'il K'ak'naab'] (*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, CO_2 [Chuwen Ik' CO_2] 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_2 is absorbed from the air by plants in photosynthesis, while oxygen is produced as a by-product. CO_2 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 [Uheelel Muk' K'in] 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_2. 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 [Hub'uul] v, n. A severe failure or breakdown, or complete destruction of a system, structure, business, institution, or something else.

Culprit [Ah Cho'] n. Someone who is responsible for a problem or for committing a fault, or that is accused of a crime.

Ecosystem (Pachkuxtal) n. A complex system of living organisms, their abiotic and biotic environment, and all their relationships and interactions in a particular unit of space.

Erosion (P'oo'ol) n. The gradual wearing down of material from the Earth´s surface caused by 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 [Hahab'en Uuya'an B'a'al] n. Fuel derived from hydrocarbon 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 tons of carbon dioxide (CO_2) per year.

Hurricane (Chich Ik') 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 [Ma'yanb'akel] n. /adj. A multicellular animal without a vertebral column or backbone. Invertebrates form the most numerous groups 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* (Tu'tu'), *Arthropoda* (insects, spiders, crabs), *Echinodermata* (starfish, sea cucumbers).

Mangrove [Okok Ha'il K'ak'naab'] 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 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. These contain breathing pores or lenticels. Mangroves provide diverse ecosystem services. Among others, they protect shorelines from hurricanes and erosion, serve as sediment traps, improve water quality, and serve as nursery areas for reef fish, invertebrates, and other species.

The term mangrove also applies to forests or vegetation of such plants.

Mollusks [K'u'un B'a'alche'] 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 100,000 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 [Laal kumb'ul K'ak'naab'] 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_2) in the ocean.

Renewable Energy [Muk' ti'i meyah a ma' hob'ol uka'a] 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 [Kuuchil' a he'il ch'iich'] n. The breeding ground of some birds and marine mammals that nest in colonies or congregate to breed.

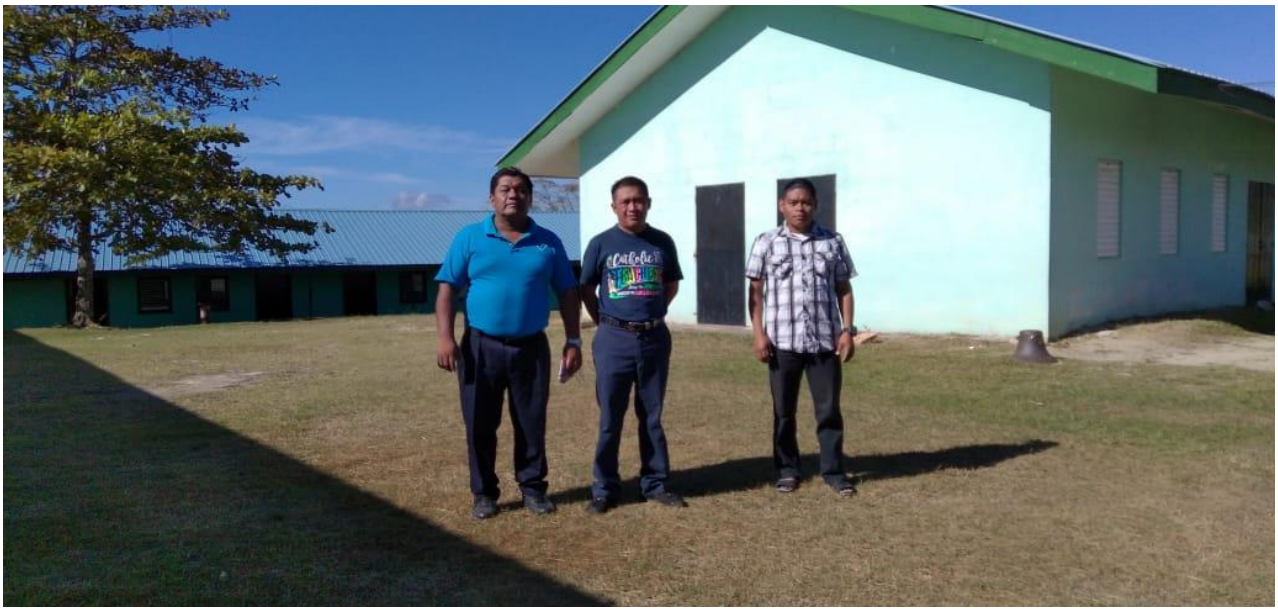
Short-billed Dowitcher [Ah B'utKoh Ch'iich'il Hal K'ak'naab'] (*Limnodromus griseus* Gmelin, 1789) n. A medium to large, long-billed, migratory shorebird that spends the winter on coastal mud flats and brackish lagoons.

Storm Surge [Utz'iikil K'ak'naab'a] 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 [Noyha'] n. A surface or underlying material that provides an organism with a place to live, grow, or obtain food.

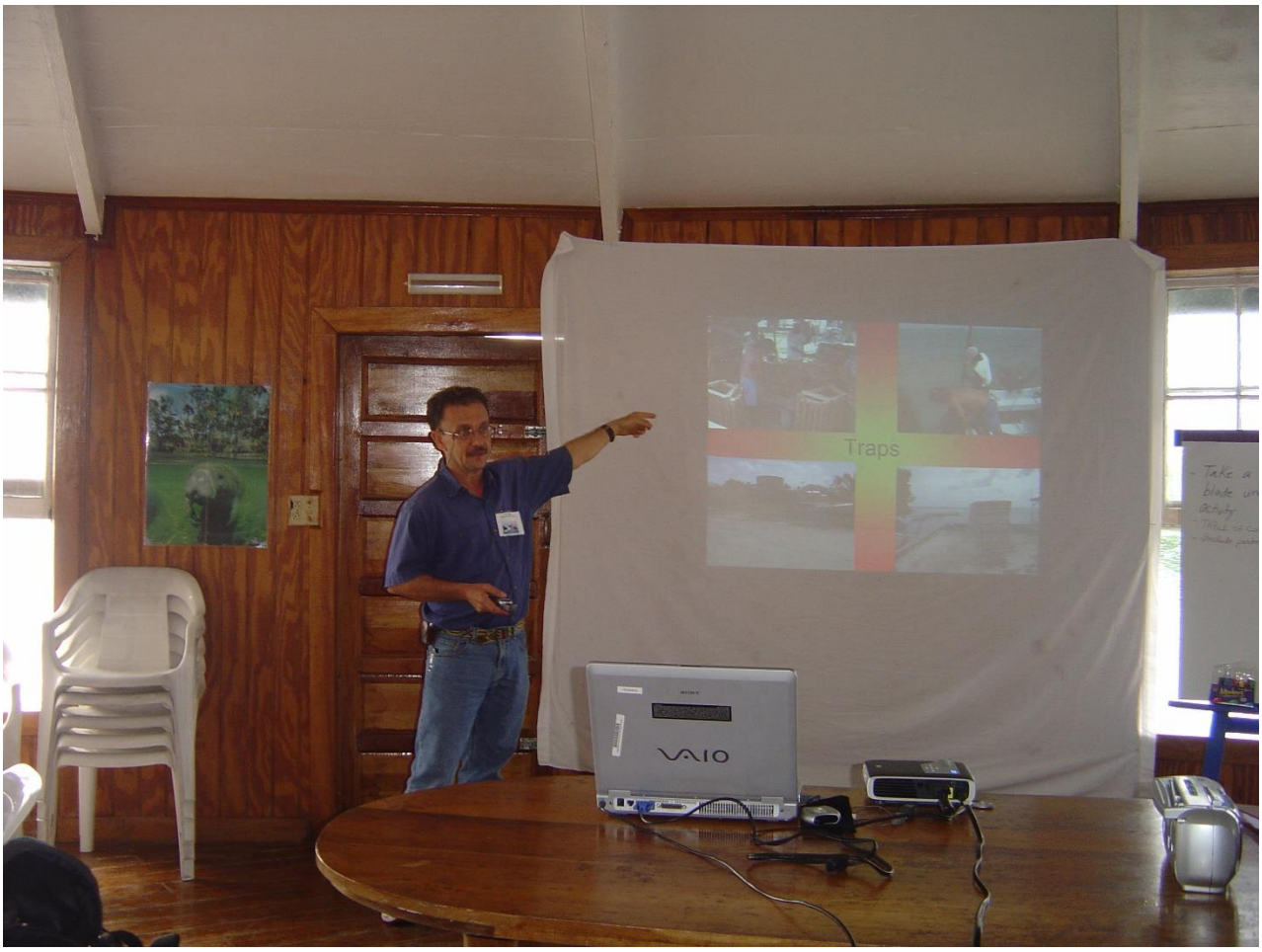
Underwater Habitat [Kuuchil Yalam ha'] n. The place or environment under the water surface where a species, species populations, or one or several communities live. These habitats include the abiotic and biotic components of the surrounding underwater environment.

Wading Birds [Manälil ch'iich' ich ha'] 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.



Ti wet tz'iib' tala'anoo' ichil a kah San Jose, Toledo, Belize hok'a'anoo' ub'o'oy tu taan San Jose RC School. Upolil ka'ansah, ah Midonio Cal, a ka'ansah ah Richard Peck, etel a tz'ub' a mana'an ti kamb'al wayeh ah Juan Diego Ico. B'o'oy: Men ah Micheal Ico.

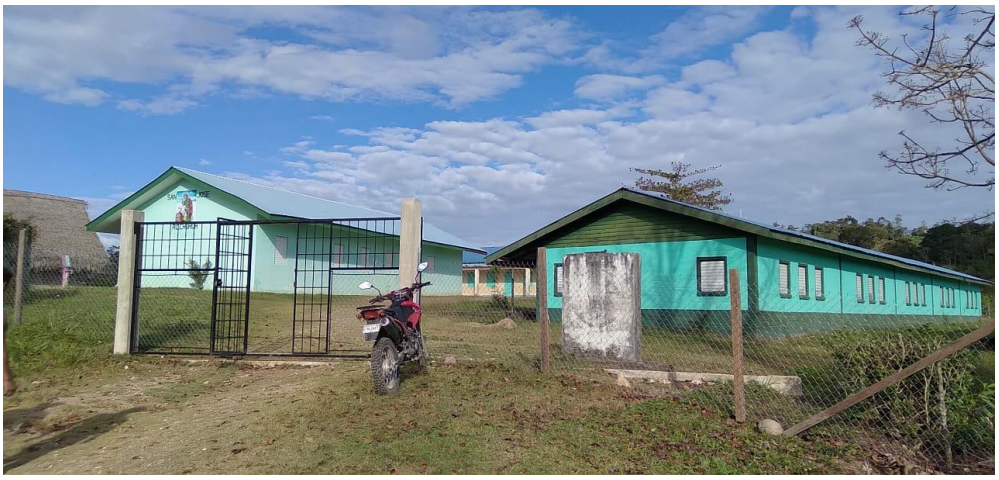
Our Mopán coauthors from San José Village, Toledo Belize in front to the San José RC School. Headmaster Midonio Cal, teacher Richard Peck & former student Juan Diego Ico. Photo: Micheal Ico

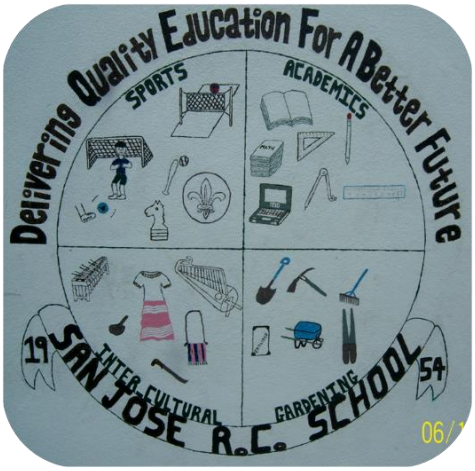


Uyah Noxi Polil Kaxan Robby Thigpen tan uye'ik wayeh k'u' ukäxtah tu pachoo' akäyba'il mak a kuma'anoo' okeeb' k'in Kariib'e ich kamb'al ti'ihoo' a kansah ichil Spanish Lookout Caye ichil Belize, Central America. B'o'oy hok'a'an menoo' ah Celeste Castillo and Alyssa Majil.

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

KÄNÄÄN K'AK'NAAB' TI MA'YAN UP'IS.
B'ALO' XAN INCHE'EX.





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