Development and Delivery of a School-Based Fishery-Monitoring Program for a Remote Village in Papua New Guinea

Ken Longenecker

Honolulu, Hawaii
September 2011

COVER

Ken Longenecker discusses marine-resource-monitoring techniques with students and teachers at Kamiali Primary School's 2010 observation of World Environment Day. Photo: Holly Bolick.

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EXECUTIVE SUMMARY

The rationale for and process of designing a school-based fishery-monitoring program for a Papua New Guinea subsistence community maintaining traditional tenure over its marine resources is discussed. A curriculum, which it is hoped will be modified for use in similar communities worldwide, is presented. This curriculum includes translations in Tok Pisin (the *lingua franca* of Papua New Guinea) and Kala (the vernacular language of Kamiali, for which the program is designed, and five neighboring villages).

Past anthropological research suggests there is a positive link between use of the vernacular language and a conservation ethic at Kamiali. Because a writing system for Kala was recently developed, the curriculum is one of the first published documents in what was considered an endangered language. The Kala translation should help promote a conservation ethic, whereas the curriculum content will provide village residents with actionable information necessary for sound marine-resource management.

"… any scientist who couldn't explain to an eight-year-old what he was doing was a charlatan."

Kurt Vonnegut, <u>Cat's Cradle</u>

INTRODUCTION

This publication is atypical for a technical report. The ultimate goal of the project this report describes is to develop a community-based marine-resource-monitoring program in Kamiali, a Papua New Guinea subsistence village that maintains traditional tenure over its land and water. The perceived need for this program is based on my interactions with Kamiali residents, and the following is a narrative of the events that led to the end product, rather than a formal scientific manuscript. It is my intention and sincere hope that the program and product presented herein will be adapted for and used in other communities that depend on marine resources for their main source of dietary protein.

My rationale for developing a community-based monitoring program results from two remarkable experiences while working in Kamiali. The first will require some background information.

In 2008, I began leading the marine portion of the Kamiali Initiative, a project to develop a self-sustaining cycle of environmental conservation, economic development, and scientific research at Kamiali. The focus of this initiative is the 32,000 hectares of terrestrial habitat and 15,000 hectares of adjacent marine habitat established by the village in 1996 as the Kamiali Wildlife Management Area (Figure 1).

Figure 1. Partial views of Kamiali Wildlife Management Area as seen from land (top) and sea (bottom). Upper photo: Allen Allison.

Kamiali is remote. It is about 65 kilometers south of the port town of Lae, and there are no roads to (or in) the village. Its approximately 600 residents obtain most of life's needs from the surrounding environment.

Gardening and subsistence fishing form the basis of the Kamiali economy and are a focus of village life; however, residents need money for basic supplies and services (*e.g.*, medicine, education, and clothing). These needs, combined with a lack of of revenue, make exploitation of natural resources (*e.g.*, logging, mining) a tempting short-term source of income. However, these activities often have disastrous long-term environmental and social impacts. In the interest of conserving their natural resources, and thus their traditional lifestyle, in 2006 Kamiali leaders signed a Memorandum of Understanding with Bishop Museum outlining the development of a world-class remote scientific research station. Visiting researchers will pay fees for research permits, field assistance, lodging, and meals. The Kamiali Initiative thus establishes a link between economic benefit and environmental conservation, and provides a strong incentive for villagers to protect their land and water in perpetuity (Figure 2).

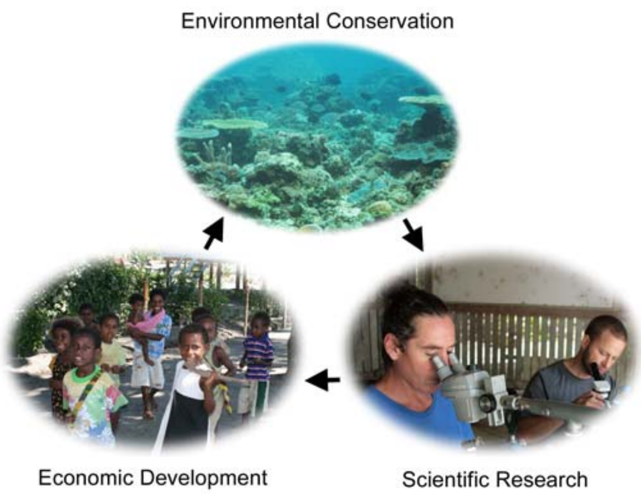


Figure 2. Conceptual model of the Kamiali Initiative. A well-managed environment attracts biological research, providing a means of economic development to pay for school and medicine, thus providing incentive for continued environmental conservation. Photos: Holly Bolick.

For the Kamiali Initiative to succeed, village residents must conserve their natural environment such that it continues to attract biological field researchers. Exploitation of coral reef fishes may represent the biggest challenge to the initiative; the overwhelming majority of dietary protein for this coastal village is fish, and coral reefs are preferred fishing sites. Thus, the village must balance the conflicting needs of marine conservation to attract research revenue against marine exploitation for their dietary requirements.

To help Kamiali residents evaluate whether reef-fish exploitation is properly balanced with their conservation, my collaborators and I began surveying fish populations in Kamiali Wildlife Management Area. These surveys provide basic information such as the average size of exploited species. This information can be used to evaluate whether village fishing practices allow each species the chance to reproduce and whether these practices are sustainable.

The information we've generated to date[1,2,3] is based on a series of seven short (3 – 21 days), but intensive, field trips to Kamiali. At least once during each trip, my collaborators and I attend a Sunday meeting (Figure 3). These meetings are the venue where the entire community has discussions about and makes decisions on village issues. They are an excellent opportunity to introduce ourselves, explain our intentions, and gain formal permission to conduct our work.

The first motivation for this project came when I attended my first meeting after a three-day fact-finding visit to Kamiali. During that visit, I spent portions of two days snorkeling in the Kamiali Wildlife Management Area. At the meeting, the village chairperson asked me how Kamiali's waters were doing. I was astonished that approximately 600 people who spend significant portions of their lives on the water would ask me, who had spent perhaps a dozen hours in the same environment, about the condition of the habitat on which they depend for sustenance. I have been asked the same question almost every trip since then.

Figure 3. Sunday meetings. Research plans are discussed with the village (top). Nearly the entire community attends these meetings (bottom).
Photos: Holly Bolick

I think this deference to outside opinion is partly due to village residents being fascinated (and perhaps intimidated) by the education and technology of a scientist from a developed country. Certainly my collaborators and I arrive with advanced degrees, technical dive equipment, computers, and specialized laboratory equipment all of which can be overwhelming to an adult with, on average, a sixth-grade education and who obtains most of life's necessities from the nearby forest and ocean. However I am convinced that Kamiali residents know far more about their marine environment than I (or my colleagues) ever will.

This deference to outside opinion also seems to be encouraged by visitors to Kamiali. I have often heard researchers, conservationists, or their support staff lecture village residents about what they should or should not do to their environment. This "we know better than you" mentality is unlikely to promote self-confidence amongst villagers with respect to managing their natural environment. In fact, my collaborators and I believe this common outsider attitude discourages residents from speaking honestly about their knowledge and use of marine resources.

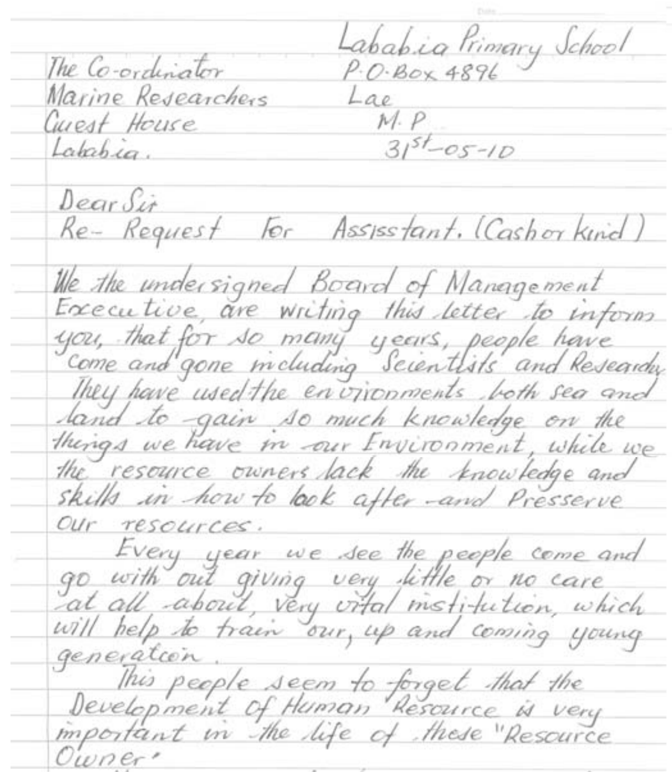
The second motivation for this project is a striking example of the above in a statement made by a person loosely associated with one of my own research trips. I had just finished explaining to the village, at a Sunday meeting, how the information I was hoping to gather could be used to evaluate the status of Kamiali's exploited fish stocks. The individual then spoke up and told the village that they *needed* us to do the work because noone would believe the villagers if *they* said their fish stocks were declining.

Figure 4. Laser videogrammetry. To estimate fish lengths we have laser pointers mounted in parallel on a video camera used to film fish (top). The lasers superimpose a measuring scale on the side of fish and length can be estimated from frame captures (bottom). Upper photo: Holly Bolick

I was speechless. Fundamentally, all we were doing was measuring fish. Granted, we were using expensive equipment and techniques (Figure 4), but honestly, *anyone* can measure a fish. Why shouldn't the villagers be believed if they made statements about the state of their natural resources?

There really are no reasons as long as the statements are supported by information gathered and documented in a standardized fashion. This is my motivation for developing a community-based marine-resource-monitoring program geared toward primary school students.

Why focus on school students? There are three reasons. First, I was invited by Kamiali Primary School's headmaster to speak at the school's 2010 observation of World Environment Day. There I described the work my collaborators and I were doing at Kamiali. During my discussion with the students, it became apparent that they already understood the implications of average fish sizes changing through time. Here was a group that could do the sort of work I was doing (remember, *anyone* can measure a fish) and that understood why the work should be done. Second, during nearly every visit to Kamiali, school representatives asked me to support their chronically underfunded institution (Figure 5). As a field biologist with a limited research budget, my capacity to donate money or supplies is extremely limited. The community-based-monitoring curriculum presented here is my attempt to support village education. Third, and perhaps most importantly, the school provides a permanent, centralized location as the project base. It is a routine part of life for project participants (students), so no extra effort is required to attend instructional meetings or deliver data. The school provides a logical location for storage and distribution of project supplies. It is also the logical site for data-archiving, on which the utility of the program heavily depends.


Lababia Primary School
P.O.Box 4896
Lae
M.P
31st-05-10

The Co-ordinator
Marine Researchers
Guest House
Lababia.

Dear Sir
Re- Request For Assisstant. (Cash or kind)

We the undersigned Board of Management Executive, are writing this letter to inform you, that for so many years, people have come and gone including Scientists and Researchers They have used the environments both sea and land to gain so much knowledge on the things we have in our Environment, while we the resource owners lack the knowledge and skills in how to look after and Presserve our resources.

Every year we see the people come and go with out giving very little or no care at all about, very vital institution, which will help to train our, up and coming young generatcon.

This people seem to forget that the Development of Human Resource is very important in the life of these "Resource Owner"

Figure 5. Part of a letter from Kamiali Primary School's Executive Board. Requests for school support were received on nearly every research trip to Kamiali.

The school curriculum presented here is a simplified version of the fishery-monitoring work my collaborators and I have been doing at Kamiali. Once a few community-level decisions have been made (*e.g.*, what species will be monitored? when and how long will monitoring take place each year?), students will simply need to measure and record the size of fish caught by their families. When their data is compiled, the community will have annual records of average fish sizes. This information can be compared among years to determine whether average size is changing, and compared to estimates of size-at-maturity and size-at-optimum-yield to evaluate whether fishing practices are sustainable.

Although the curriculum was prepared for Kamiali Primary School as a result of marine conservation efforts at Kamiali Wildlife Management Area, it should be equally useful in other coastal areas of Papua New Guinea or wherever people maintain traditional tenure over their marine resources.

The curriculum was originally written in English, my native language, and the principal language of education in Papua New Guinea[4]. However, Tok Pisin (the official name of

Papua New Guinea's vehicular language, or *lingua franca*) is the more comfortable language for most Papua New Guineans. Even in educational situations, where a lecture may be conducted in English, group discussion will often be in Tok Pisin. In more-casual problem-solving or counselling situations, Tok Pisin is invariably the preferred language[4]. To make the curriculum subject matter less intimidating, a Tok Pisin translation is included.

Finally, I have followed the excellent example of Edvard Hviding's Reef and Rainforest: An Environmental Encyclopedia of Marovo Lagoon, Solomon Islands[5], and included a vernacular translation. This translation targets a much smaller audience, because the language (Kala) is spoken by only the approximately two-thousand individuals living in six villages along the Huon Coast. The Kala translation is an attempt to link marine conservation to traditional values in the minds of Kamiali's residents.

Remarkably, the vernacular translation could not have been included before now; until recently, there was no formal writing system for the Kala language. In 2006, about half of all school-aged children were not fluent in Kala, and a growing number had only a rudimentary knowledge of the language, prompting concern by community adults and educators that the language would be lost. The Kala Language Committee, with members from all six Kala-speaking villages, recognized the need for a single, written form of the language, and for curriculum materials informed by Kala culture, history, and attachment to place.

In 2010, anthropologists John Wagner and Christine Schreyer, and their undergraduate assistant Chara DeVolder (University of British Columbia Okanagan) worked with the Kala Language Committee to develop the writing system. Preliminary work by Dr. Wagner suggests there is a positive link between use of the vernacular language and a conservation ethic at Kamiali. The Kala version of the curriculum presented here could be a powerful contribution to marine conservation along the Huon Coast.

METHODS

I prepared an English-language version of the curriculum based on techniques currently used to describe exploited fish populations at Kamiali Wildlife Management Area[2,3]. In recognition of the target audience (primary school students) and location-based constraints (*e.g.*, extremely limited school funding, no electric service) several modifications were necessary: 1) no high-technology equipment could be employed, 2) the necessary supplies could not be expensive, and 3) the project was designed around fish caught by the family. The latter is a regular event, meaning the project requires little extra effort by students whose time is already occupied, to a great degree, by assisting their family in fulfilling subsistence needs.

The English-language draft was edited by members of Kamiali Primary School board for grade-level appropriateness, and by Kamiali members of the Kala Language Committee to ensure words and concepts could be translated into Kala. The edited draft was then translated into Tok Pisin and Kala under the direction of Kamiali resident, Gabu Ruben.

The above Kamiali-based editors also chose five exploited fish species they believed would be most appropriate for community-based monitoring. For each of these, I prepared a fact sheet with the information needed for calculations described in the curriculum. These fact sheets include the scientific name, Kala name, a color image, an estimate of size-at-maturity (*i.e.*, "adult length" in the curriculum) and and estimate of size-at-maximum-yield (*i.e.*, "best length" in the curriculum).

Size-at-maturity estimates were obtained, when possible, from peer-reviewed or technical reports. Of the five species chosen for Kamiali Primary School, published estimates were avaiable for the lined surgeonfish, *Acanthurus lineatus*[6]; the yellowfin tuna, *Thunnus albacares*[7]; and the skipjack tuna, *Katsuwonus pelamis*[8]. For the remaining species, size-at-maturity was estimated by applying empirically derived equations[9]. First, maximum observed length was converted to an estimate of asymptotic length (L_∞). For the Timor snapper *Lutjanus timorensis*, maximum length was obtained from a published regional estimate[10], whereas the estimate for yellowspotted trevally, *Carangoides fulvoguttatus*, was obtained from FishBase[11]. The resulting asymptotic length estimates were then converted to size-at-maturity estimates.

All size-at-maximum-yield estimates were obtained from empirically derived equations[9]. For *A. lineatus*, *T. albacares*, and *K. pelamis*, estimates are based on published size-at-maturity values. For *L. timorensis* and *C. fulvoguttatus*, estimates are based on the above asymptotic-length estimates.

Finally, translations were reviewed by North American researchers familiar with Kamiali. Allen Allison and John Wagner reviewed the Tok Pisin, in which they are both fluent. Linguist Christine Schreyer reviewed the Kala version.

RESULTS AND DISCUSSION

The community-based marine-resource-monitoring program developed for Kamiali Primary School is presented in Appendix A. Kamiali member of the Kala Language Committee wrote the translations by hand after a single planning meeting. This hand-written document was then mailed Bishop Museum for transcription into an electronic format. Unfortunately, some errors and inconsistencies may be present in the transcription. The translated portions would benefit from an additional editing meeting. Regardless, the document is important because it is one of the first written examples of in Kala. Information sheets for the species chosen for study at Kamiali are presented in Appendix B.

This curriculum was written with the intention that it can be adapted for other communities with traditional tenure over their marine resources. Perhaps the biggest curriculum-modifying challenge will be obtaining estimates of size-at-maturity and size-at-maximum-yield. These can be calculated by applying empirically derived equations[9] to maximum length estimates. If no published region-specific length estimates are available, values from FishBase[11] can be used.

Some modest supplies will be needed to conduct the monitoring exercise. Many of these would be considered in developed countries to be standard school supplies; however, given Kamiali's remote location and subsistence economy, many of the items are difficult to obtain Following is an annotated list of the supplies I delivered to Kamiali Primary School:

1) Printed copies of the curriculum. There are no printers at Kamiali, so these had to be produced and transported to the school. I printed these on heavy-bond paper (32 lb) to increase the lifespan of the documents; the heavy paper should withstand the high-humidity environment.
2) Printed copies of species-information sheets. These were also produced on heavy paper.
3) Printed copies of data sheets (an example is included in Appendix A). Pre-printed data sheets are not absolutely necessary, however they will help ensure that data is recorded in a standardized and useable fashion. Whether printed or not, the paper used for data recording should be the most durable that can be obtained. These sheets will be the basis of long-term monitoring, and archiving them will be crucial for demonstrating any changes in fish size over time.
4) Pencils. I also provided pencil sharpeners and erasers.
5) Measuring tapes. I distributed cloth tailor's tapes. These are inexpensive; are long enough to measure most fishes caught at Kamiali; are compact, for easy transportation to and from home; will not break (unlike plastic or wood measuring sticks); will not rust in a salty, humid environment (unlike metal tape measures or measuring sticks); and can be used for other classes (*e.g.*, home economics).
6) Calculators. These should help reduce computational errors and need only be basic-function units (addition, subtraction, multiplication, division). Given Kamiali's lack of electrical service and the expense (and lack of a nearby source) of batteries, solar-powered units were a must. These can also be used for other classes (*e.g.*, mathematics and science).
7) Graph paper. I also provided rulers to help draw graph axes.
8) Manila folders. These will help organize data sheets and results by species and year when archived.
9) File box. Also useful for archiving, a portable, plastic file box will help protect data sheets from humidity and vermin (and will, itself, withstand a salty, humid environment).

Of the above supplies, the only atypical items (from a purchasing perspective) are the tailor's tapes and solar-powered calculators. I purchased both of these in bulk. Tailor's tapes cost $0.39 (US) and the calculators were $1.62 each. Thus, other than what may reasonably be considered standard school supplies, the cost for performing this community-monitoring project is $2.01 per student. This cost can be lowered significantly if students share calculators.

The curriculum and fact sheets presented in the appendices, and the supplies listed above were delivered to Kamiali Primary School in June 2011. At that time, I reviewed fish measurement, data recording, and data analysis with the school teachers. They reassured me that data-gathering methods and the required mathematical analyses (calculating averages and percentages, and constructing bar graphs) were appropriate for the grade levels (7 and 8) that would conduct the study; however, the teachers were concerned that they would err when covering the fine-scale procedure of data analysis. Given teacher concerns, this program would most likely benefit from another site visit after students have gathered data on fish lengths. Then, using real-world data, we could work through calculations and presentation of results. This would ultimately give the school confidence that the analyses are being done correctly.

Regardless of whether a second meeting with school teachers occurs, this subsistence community will have a detailed record of fish catch through time. This will provide the community with actionable information on the state of their fishery resources. Finally, this information will have been collected in a standardized fashion. If community representatives engage others in conversations about the state of Kamiali's marine resources, they will have credible documentation and will be believed.

ACKNOWLEDGMENTS

This project was supported by a private foundation wishing to remain anonymous. Ross Langston reviewed the technical content of English-language version of the curriculum. Gabu Ruben, Tusi Nandang, and Kisi Issacc reviewed the words and concepts used in the english-language version of the curriculum and translated it into Tok Pisin and Kala. The Kala-language version of the curriculum would not have been possible without the work of Christine Schreyer, John Wagner, and Chara DeVolder. With and on behalf of them, I thank all the Kala speakers who worked with them since 2006 to create an orthography of the Kala language: members of the Kala Language Committee, *tok ples* teachers, research assistants and language experts in the villages of Kui, Buso, Lababia (a.k.a. Kamiali), Lokanu, Logui, and Kela. Christine Schreyer and John Wagner were supported by the University of British Coumbia Hampton Research Fund and the Firebird Foundation for Anthropological Research. Chara DeVolder was supported by the I.K. Barber Undergraduate Research Awards Program of the University of Columbia - Okanagan. Holly Bolick and Ross Langston provided many of the photographs used in the curriculum. Images of fishes in appendix B were obtained from FishBase[11]. Holly Bolick reviewed the final draft of this report.

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APPENDIX A

Curriculum

Monitoring Village Fish Resources

Lukauting Ples Pis Na Risos Bilong En

Koto Kana I Ŋe Ambola Ma Gele Golotome

English-language content prepared by Ken Longenecker
Tok Pisin and Kala translations by Gabu Ruben and assistants

ENGLISH

Fish caught in your village's waters is an important part of your diet. Because getting enough fish is a big part of staying healthy, your village leaders want to make sure there is enough fish to catch today and that there will be enough fish for future generations.

One way to determine whether village fishing practices balance current and future needs is to monitor fish populations. This is a job that can be done by the community. By doing a fish study every year, the information from this work will help your village decide whether a good balance has been achieved.

This exercise explains how to do a study of your village fish populations. Some community decisions will have to be made for the project to work. These decisions are described below. The rest of the work will depend on you, the student. We hope your school will repeat the study every year so that your village can feel confident that its waters will continue to provide enough food.

TOK PISIN

Pis yu kisim insait long ples solwara bilong yu em gutpela abus long bodi bilong yu. Bikos yumi kisim plenty pis bodi bilong yumi em orait, nogat sik. Ol ples leaders laikim olsem yumi imas igat inap pis long kisim o pulim long nau ma imas igat inap long behain tu.

Wanpela rot long lukluk long ples pis, rot bilong tudei ma behain taim t. Rot bilong lukautim ol pis, dispela wok em wok tru bilong olgeta community insait long ples, la bai yumi imas save long ol pis olgeta yia. Dispela stori na wok bai halivim ples bilong yu save olsem igat gutpela bilong en bai kamap.

Dispela trenin i soim wanem rot yumi luksave long ol pis bilong yumi. Tintin bilong kominiti bai kamap long strongim dispela projet long wok. Dispela tintin bai istap daun bilo. Olgeta wok istap long yumi na skul sumatin, mipela tintin skul bilong yu iken wokim dispela stadi olgeta yia, bai comminiti iken igat bikpela hamamas, solwara bai givim inap kaikai.

KALA

I katayu ma kataga ge kana ta da anda gu wede ma gu kana masalo ŋagĩ. Sudene da katĩ i golikĩ su kana masalo da tatapi gimba tã. Lauaŋo ambola ŋa siŋgu taga i dingi gu katĩ ndi wele dene ma kana tengi gu buliya ŋa ĩ.

Andalawa gu takano i ŋe kana mbola ŋa, ndi no dene ma su buliyã. Adalawa gu ŋo i, kuluku tad a kala golotome kana kuluku gẽ su ambolã gĩ, ma kala golotome tagu i la ndi yala golotome. Bitadene ma ŋa kuluku wele iki ŋa moasing ndi kala lau ambala ŋa, kai kaguye ŋanda wele ŋomopi.

Andalawa gu tadõ gu koto kana I ŋa, ma gĩ, koto kuluku ŋa. Ma kakano ŋakau ge su lubula gĩ. Kuluku golotome da kala magĩ sala guluwa lumi ŋa. Yama kau dudene gu bemi lumi wele sinu kuluku dene ndi yala samop, gu dene ma bala golotome wele mugu anda, ma bemi ta wele iki bodi gabo.

Community:

Do not make extra effort to catch fish or to catch fish of a certain kind. Just fish like normal.

Some important decisions will have to be made the first time the project is done. Because the information will be most valuable if the work is done the exact same way every year, these decisions should be carefully made. It may be best if these decisions are made as a community (at Sunday meeting).

1) Choose five species of fish. These should be species that many people eat, that are caught during the season this project will be done, and that are easy to tell apart from other species.
Record the names of the species chosen.

2) Choose a time of year to do the project and how long the project will last. To be most useful, the project should be done every year at the same time and for the same length. Doing the project at the same time helps to be sure that any differences seen from one year to the next are not caused by changes in season.

Kominiti:

Noken painim narapela rot long kisim pis, rot nau yu save kisim pis behainim olsem tasol.

Sampela stronpela toktok bai yumi wokim taim projet i pinis. Sapos disisen bai istap gut taim wok em pinis long olgeta yia. Dispela disisen bai imas kamap gut. I gutpela sapos dispela disisen bai kamap (long Sundei miting).

1) Kamapim faivpela pis. Dispela pis olgeta man i meri kaikai na save igat taim bilong em long kisim na dispela wok mas pinis. Isi long yumi luksave long arapela.
Raitim nem bilong pis yu laikim.

2) Kamapim wanem yia na deit we projet bai stat na pinis bilong en. Dispela projet mas kamap olgeta yia wankain taim. Taim projet wok, seim taim em halvim yumi long save wanem nogut na gutpela long wanpela yia, igo lon narapela yia na em ino inap kamapim senis lon olgeta taim bilong projet.

Guluwa:

Gindi ta gu talĩ andalawa gdikĩ ngu taga i ŋa, andalawa masa dene kataga mo da tabuliya dudememe.

Bi ŋayakala wele taŋgu ndi no masaŋgu kuluku mbae. Koto kana walo ne ŋapeme ndi yala samop. Kana bi samop masa taŋgu, tangu ŋapeme ma kana walota wele, tangu (ndi Sonda).

1) Tayali i indi litama, ma i lau golotime legi ma ŋa no gu iga ŋa gẽ, ma kuluku ta mbae, iyali gu lau ŋakala sigu.
Kato i ŋasẽ masa kama tengĩ.

2) Taki no yala u kuluku ŋa ma ŋanoŋgu mbae ŋa. Kuluku dene wele ŋe yala samop ndi no tutume. No ngu kuluku inu kuluku, ndi no dini aiki moasi mdi kala ma tagu ŋanda ma ŋayama ndi yala nuwa, ŋe su yala nuwa wele tawi no kuluku ŋa tã.

If the project lasts less than one month, choose a start time based on the moon cycle. This helps to be sure that differences seen from one year to the next are not caused by when people prefer to fish. For example, if the work is done during the quarter moon one year, and during the full or new moon the following year, you may see a change in fish size that is not caused by too much fishing. Instead, because poison rope fishing is more common during very low tides (at full and new moon) and poison rope catches lots of small fish from shallow water (rather than larger fish caught by hook and line in deeper water) you may see smaller fish one year, but this could be caused by a change in the way people fished instead of the fish getting smaller. The longer the project lasts every year, the more time people will have to fish. That means the community will be able to gather more information and have a better idea of how the fish are doing.

Record the start time and length of the project (for example, all of June; or one week following the full moon closest to May 15; or from full to new moon on the first full moon after June 15).

Sapos projet istap wanpela, wanpela mun tasol, kamapim stat taim bilong en behainim raun bilong mun. Dispela halvim yu lukim gutpela bilong projet kamap long wanpela yia igo long arapela yia na dispela bai halvim yu taim yu tintin long kisim pis. Luksave, sapos wok i pinis long tripela mun o wanpela mun long olgeta yia, bai yu lukim igat senis long sais biling pis, taim yu kisim pis bikos poisen rop long klim pis emi no gutpela long klim pis long olrai wara taim, long wanpela mun, poisen rop save krim planti liklik pis long rif na bikpela pis yumi kisom long string na hook long dip solwara yu bai lukim liklik pis long wanpela yia tasol dispela bai lukim liklik pis long wanpela yia tasol, dispela bai igat senis taim ol man i krim pis na pis igo liklik. Longpela taim long painim pis, so kominiti bai kisim planti save na idea long wei bilong kisim pis na pis i istap olsem wanem.

Raitim stat taim na lonpela bilong project (olsem insait long mun June olgeta, wanwan week long ful mun, klostu long May 15, o long ful na nupela mun long dei bilong mun long June 15).

Ma kuluku wele ŋe galawe, galawe nuwa me, taki ŋano ndi galawe samop. Dene wele kagu kuluku ŋa anda gẽ su yala nuwã gi, ma wele iki kau ndi kai ngu kaga i wauŋ. Wele kakano ngu kuluku mbae ndi galawe, ndi yala samop, wele kagu i tatu, oibabo ndi no masa gu kayu i, gu wasebaŋa da andalawa gu tali i tatu dudu ma andalawa ta da anda tã, ndi no manolabe ŋa, gẽ su galawe nuwa gi, waseba gindi ngu ili i tatu dudu ŋe su kuli ŋa, ma i babo da katayu ŋa aiŋ, awe gẽ tawalã. Kai wele kakano i tatu ŋe su yala nuwa me, ma wele kakano i tatu ndi yala tumeme me. Ma wele kakano ngu yeli i dudu wele i mbae. Sudene gi da kala golotome kana kau ŋe ma ngu koto i ŋadalawa ma i somo dudune.

Taga no ngu ŋamataŋa ma ŋa bali ngu kuluku ŋa (Sudene da ŋe su galawe litamaŋo nuwa, wake luwa ma galawe mandalã ŋano wake luwa).

Teachers:

The rest of this project should be done every year at the same time, for the same length, and in the same way.

1) Give every student enough materials to record information. This should include paper, pencil, and measuring tape.

2) Be sure every student will record information in the same way. A suggested design is presented later. Every paper should represent only one species of fish for only one year.

3) Explain the correct way to measure fish (explained later).

4) Collect information sheets each year and keep them organized (by year and species) in a safe location. Future decisions about village waters will depend on this information being available.

Tisa:

Olgeta dispela projet bai imas kamap olgeta yia long seim taim, na lonpela taim bilong em tu wankain.

1) Givim olgeta sumatin inap, pensil, pepa long raitim wok bilong ol, dispela bai igat pepa, pensil na makim tape.

2) Olgeta sumatin mas raitim toktoksave wankain tasol, tintin bilong piksa bai givim bihain. Olgeta pepa imas givim wanpela kain pis long wanpela yia.

3) Toktok klia long rot bilong makim pis (behain tok klia).

4) Kisim olgeta wok pepa ling wanwan yia na putim gut long yia, wanem kain pis, putim istap gut long safe ap. Behain taim long ples, long solwara bai igat stori istap pinis.

Kiduwaga:

Kuluku dene wele ŋe su yala samop ndi no tumeme, ma iŋa balĩ indi ata me ŋa andalawa tumeme.

1) Iki gele samop ndi guluwa lumi ŋa ngu sosoto saĩ kuluku su ŋa, sai kapia, kilipi ma gele ngu ŋi doiŋa.

2) Guluwa lumi ŋa soto bi samop iyatame, ma kau ngu oto ŋakatu ŋa wele ma lome ya. Kapia samob iki i tumeme ndi yala nuwa.

3) Ingu bi ŋe idaneme ngu iki do i ŋa (malome tangu bi ŋe idane).

4) Iga kapia samop, kikili yala me ma iki itã ŋapeme buliyã ŋa yala, i naŋa masa iki itã ŋapeme. Su buliyã wele ambola, ma ta wele ŋabi ŋe.

Students:

1) You have one piece of paper for each species of fish you will study. You also have a pencil and measuring tape.

2) Prepare an information sheet for each species of fish you will study by writing its name at the top of the sheet. Also write the year you are doing the project.

3) Only list information for the species of fish your village chose to study.

4) If you or someone in your home catches one of the species of fish being studied, measure it (following the instructions below) and write its length on the sheet for that species. When trying to understand how your seas are doing, small fish are just as important as large fish so be sure to measure all fish that you are studying. Make sure that you record each fish's length only once.

5) Take your information to school and combine it with information gathered by other students.

Sumatin:

1) Yu imas igat wanpela pepa long wanpela pis bai yu stadi. Yu bai igat pensil na makim teip.

2) Redim stori pepa long wanwan pis yu bai stadi, raitim nem istap antap long pepa. Tu raitim wanem yia yu wokim dispela dispela projet.

3) Kamapim tasol stori long wanpela pis we ol lain long ples makim long stadi.

4) Sapos yu o sapela lain long ples kisim wanpela pis yu stadi pinis, makim longpela bilong pis (behainim toksave istap daun bilo) na raitim longpela bilong pis long pepa. Taim yu luksave, solwara bilong yu i olsem wanem, liklik ol pis em gutpela long bikpela pis so yu imas makim ol pis (longpele bilong en) we yu stadi pinis. Yu mas save olsem wanpela pis yu makim longpela bilong en wanpela taim tasol.

5) Kisim wok pepa bilong yu igo long skul na bungim wantaim arapela sumatin.

Guluwa lumi ŋa:

1) Kai kama kapia gu i nuwa ŋa ŋgu kaga kau pi ŋa. Kai wele kama kilipi ma gele ngu iki dõ iŋa.

2) Kamasã bi ŋe kapia u i nuwã, ma kai wele kaga kau ngu oto i ŋa ŋasẽ ŋe pi kapia. Kato yala samop masa kakunu kuluku dene.

3) Iki i nuwa ŋasẽ, masa lau ambalã ŋa sese ŋasẽ ngu iga kau pi ŋa.

4) Ngu kai ma kama lau ambalã ŋa ngu bemiga i ngu mega kau pi ŋa, bemiki i ŋa balĩ (imbuliya bi ne gẽ lubula) ma oto ŋa balĩ su kapia. No masa ka gu ye gu ta wele duduna, i tatu da anda gẽ i babo ŋa dakaga ŋa balĩ, ĩ kama lekene (ŋa balĩ) ndi no masa kaga kau piye. Kagu ye ngu inuwa ŋabalĩ ndi no masa kaga lekene pigi ndi no tumeme.

5) Iga kuluku ma kapia miya to lumi ma iki pilata ĩ guluwa tatu lumi ŋa.

Measuring Fish

1) Lay measuring tape on a flat surface.

2) Lay fish on top of measuring tape.

3) Straighten the fish if necessary.

4) Make sure fish's mouth is closed (if it is not closed, push on jaw bones until mouth is closed). Many fish have mouths that can extend forward, if the mouth is at the most-forward part of the head and the mouth is extended, the fish's length appears longer than normal.

5) Put the front of the head on the zero mark on the measuring tape.

6) Keeping the mouth closed and the head at the beginning of the measuring tape, make sure the fish is arranged so the middle of its tail is over the measuring tape. In some cases, the middle of the tail will be the longest part; in other cases, it will be the shortest part. See the drawings.

Makim Pis

1) Putim makim teip istap antap long stret pela hap.

2) Putim pis igo istap antap long makim teip.

3) Stretim pis gut.

4) Yu imas luksave olsem maus bilong pis em pas (taim em i no pas, yu mas pusim inap emi pas). Planti pis maus em save surik igo longpela, so taim yu luksave olsem emi go longpela behainim tasol longpela bilong en na makim.

5) Putim het (o holim pas front bilong pis) long zero mak antap long makim teip.

6) Putim maus bilong pis istap pas oltaim, stret wantaim makim teip. Yu imas luksave olsem pis istap stret, namel long teil em longpela yu mas makim sotpela hap bilong teil (lukluk long piksa) long sampela taim yu bai luksave olsem namel long teil em longpela hap na tu sampela taim tu bai sotpela hap bilong teil (lukluk long piksa).

Ŋi i ŋadõ

1) Iki dõ i ŋa balĩ ŋe solome.

2) Iki i pi ŋa ŋe dõ.

3) Iki iŋeŋapeme.

4) Kai kaguye ngu i ŋa walo imuku bo (noli ŋo masa imuku bo tã, kai katĩ ŋayaga ŋgu imuku bo). I golikĩ sai walo wele imiya balĩ, kagu ye ngu i miya gu balĩ kambuliya me ma ũki dõ.

5) Ŋi i ŋagodõ to ma iki walu lekene ŋa pi ŋagodo, pi baba ma ŋi dõ.

6) Uki i ŋagodõ ŋe imukumbo ŋapã, ĩ gele lekene ŋa. Kai ta kagu ye ŋgu I ŋe ŋapame, i ŋayumi ge ŋawalã ma kaki dõ ŋe ŋa nambi ŋa, (kakano ŋe ŋakatu) ndi no yakala wele kakano ngu ŋawalã gẽ ŋayumi wele ŋe ŋanambi (kakano ŋe ŋakatu).

7) Record the length of the fish in centimeters. The fish’s tail will usually not be exactly on a centimeter mark. Simply record how many centimeters it covers, and do not worry about smaller parts of a centimeter.

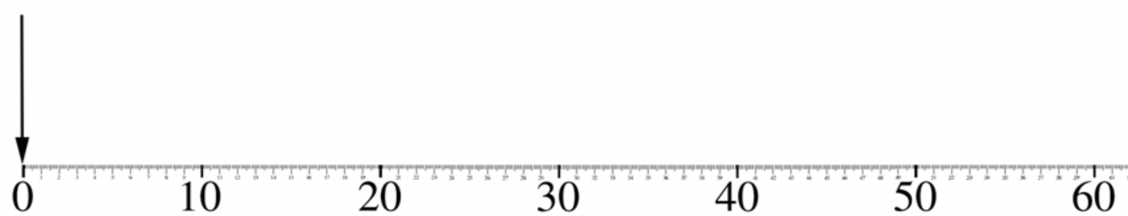
7) Raitim longpela bilong pis long sentimita mak. Tel bilong pis bai ino inap kamap long sentimita mak. Raitim tasol hamas sentimita em i karamapim na noken wari long ol liklik hap bilong wanpela sentimita.

7) Oto iŋa balĩ ŋa lekene masa itapi iŋa madĩ. Iŋa yumi wele gindi tã ŋgu itapi iŋa madi ta. Oto iŋa madĩ ŋe iŋa godõ ŋamopi ŋayumi ŋatuwã me. Teŋgi u iŋa yumi ŋaisã ŋa tã.

Lay the measuring tape so that it is flat. You will place the fish so that the front of its head lines up with the zero mark (the arrow below shows where to place the front of the fish head). Be sure the fish’s mouth is closed.

Putim tep mesa istap stret. Yu bai putim pis bai poret bilong het bai stret wantaim zero mak (errow bilong tambobo bai seim wanem hap bilong putim poret bilong pis. Tingim maus biolong pis i mas pas.

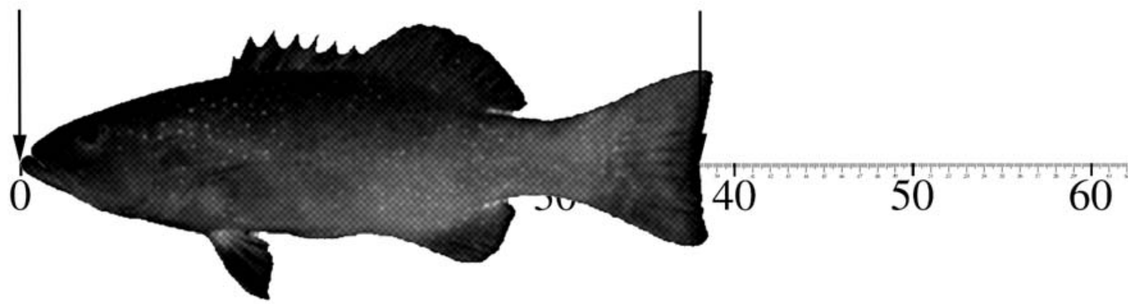
Uki walu lekene ŋa ta ŋe solome kaki i suŋa ŋe solome ngu wele i ŋala bolã ŋe solome ĩŋalekene ŋa madĩ. Teŋgi ŋgu iŋa walo wele imukũ bo.



Determine the distance from the front of the fish's head (with mouth closed) to the middle of the edge of the tail (the right arrow shows the correct point to measure. Record the length of the fish to the nearest centimeter. For the fish below, the correct measurement is 38 centimeters.

Painim aut longpela bilong het bilong pis igo inap long namel bilong arere bilong tel (erro i soim stret mak bilong mesarim). Raitim longpela bilong pis igo long sentimita i klostu olgeta long pis tambolo longpela bilong em stret em 38 sentimita.

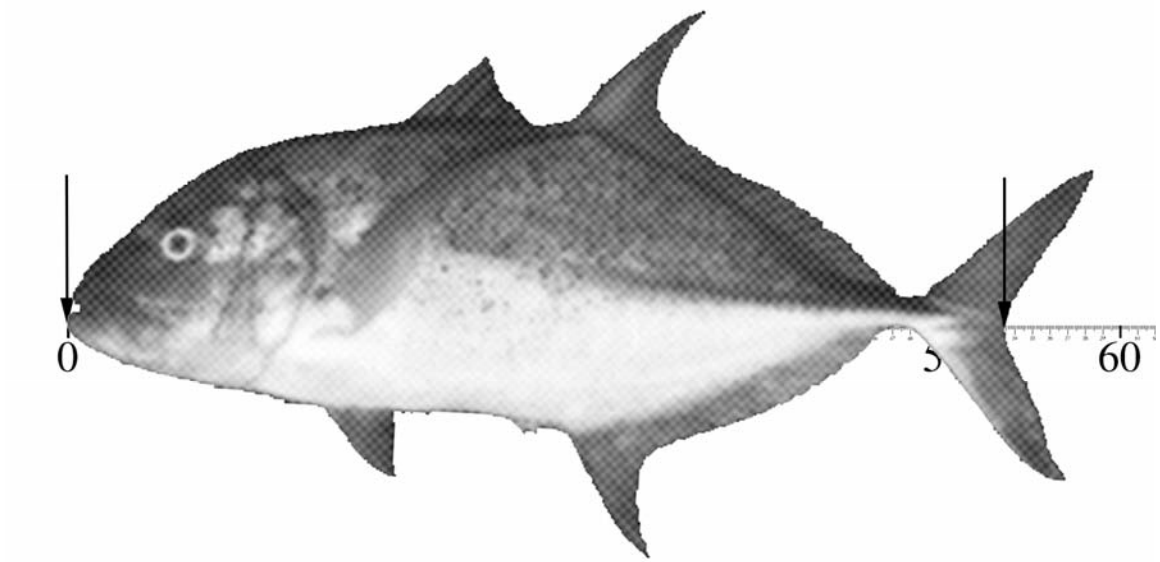
Oto iŋa balĩ mia ŋa obo lekene dene ŋa badi. I dene gẽ lubula ŋa da aŋa balĩ solome da gindi, tambu tlawa, ŋa lita ma aŋo tlawa.



Some fish have forked tails. Again, you should measure the length at the middle of the edge of the tail (the right arrow shows this point). For the fish below, the correct measurement is 53 centimeters.

Sampela pis i gat tel olsem fok. Gen yu mas makim longpela bilong em long namel long arere bilong tel (erro I soim stret dispela mak). Long pis tambolo longpela bilong em stret em 53 sentimita.

I yakla da ŋayumi sasaŋa. Gu dene ŋa wele kato iŋa balĩ ŋe walã me ŋesu iŋa yumi ŋaisã ŋa (e balĩ dini da madĩ ta salome). Gu i lubula ŋa da aŋa balĩ solome da tambu lita ma aŋo tlawa.



Record fish lengths on the form as shown below. Use one form for each species of fish. Be sure to write the name of the fish and the year on each form.

Fish Name ___ikula___ Year ___2011___

Fish Length in centimeters (list in columns)

45	61
62	53
25	32
31	25
23	24
47	49
64	50
33	39
23	40
31	
22	
43	
34	
19	
20	
48	
23	
46	
52	
18	
52	
25	

Calculations

Combine all information for a single species (the example calculations below will be based on the information from a single sheet, shown above).

1) Average length. For each kind of fish add the lengths of all fish measured and divide the total by the number of fish measured.

For instance the sheet above has measurements for 31 fish. If all of these measurements are added, the result is 1159. 1159 ÷ 31 = 37.4 centimeters.

2) Percentage of "best" length and adult length. For most fish species around the world, and especially on coral reefs, very little is known about what size they begin breeding or what size is best to take to catch as much a possible but help to be sure fish will be available for future generations. Some scientists have suggested estimates which are listed on the species information sheets.

1) Mak stret. Long wan kain pis, bungim longpela bilong algeta pis ol i makim pinis na brukim long total long namba bilong ol pis ol makim pinis.

Yumi tok, long pepa antap igat mak o namba bilong 31 pis. Sapos yumi bungim olgeta dispela namba, ansa bilong em i olsem 1159. 1159 ÷ 31 = 37.4 sentimita.

2) Namba i klostu long gutpela mak na bikpela mak. Long olgeta kain pis istap long world na long koral rip. Ino planti man save long sais ol I stat long karim or wanem sais emi gutpela long kisim tasol helpim long save olsem ol pis bai inap long nau na taim bihain. Samplela scientis ol i tingim namba we ol i raitim pinis long stori pepa bilong ol kain kain pis.

1) Ŋa badi solome. I golo totome dene wele tali iŋa balĩ sa ma tagu masa yeimbu yaŋ gwe piye ma taliko mbulia ŋa lekene masa yeimbu ye gẽ.

Kataŋgu, kabia baba ŋa da yoto iŋa toŋ gindi tambu tlawa ma ŋo nua 31. Maŋgu katali iŋa toŋ golo totome sa wele kata-tapi gindi 1159. 1159 ÷ 31 = 37.4 iŋa madĩ ŋa. (balĩ)

2) Lekene masa kobo anda ŋa ma gabo ŋa badi. Gẽ i golototome ŋa ne gẽsu pu gabo dene magĩ kulĩ. Lau golikĩ siyala iŋa gabo inagĩ iŋa no ŋgu siga ata o iŋa taga ŋa: Magĩ imasa gindi ŋgu katĩ ma omo subuliã. Lau tukau; saĩ teŋgi lekene masa sosoto ye su kopia iŋagi ne gẽ. (golototome)

What percentage of adult length and "best" length is the average fish size? Divide the average length (from above) by the estimate of adult size, and multiply the result by 100. Divide the average length (from above) by the estimate of "best" size, and multiply the result by 100.

For instance, assume adult size is 25 centimeters and "best" size is 40 centimeters. Percentage of adult size equals (37.4 ÷ 25) × 100 or 149.6%, so the fish being caught are about 50% larger than adult size. Percentage of "best" size is (37.4 ÷ 40) × 100 or 93.5%, so the fish being caught are close to "best" size.

Wanem namba bilong bikpela na gutpela mak emi olsem namel sais pis? Brukim namel namba long antap long "estimet" bilong bikpela sais na bungim wantaim ansa bilong 100. Brukim namel mak long antap long "estimet" bilong gutpela sais na bungim wantaim ansa long 100.

Tingim, sapos bikpela sais emi 25 sentimitas nagutpela sais emi 40 sentimitas. Namel namba bilong bigpela sais i olsem (37.4 ÷ 25) × 100 o 149.6%, olsem na pis ol i kisim i olsem 50% bikpela moa long bikpela sais. Namel mak bilong gutpela sais em (37.4 ÷ 40) × 100 o 93.5% olsem na pis ol i bin kisim em klostu tru long gutpela sais.

Gele anda gu iŋa da, iŋa olõ i masa babo ma I masa mo walã da ita anda solome. Taliko su walã meŋa, iŋa gabo ma talisa ĩ ŋo (tambuli taume 100). Taliko su walã me ŋgu tataki madĩ anda ma talisa pitumeme ŋgu itapi ŋo tambu taume (100).

Teŋgi, ŋgu i gabo nua ŋa gabo gindi. I gabo nua ŋa walã gindi (tambu tlawa ma ŋa gẽ wese taliko ŋa tambu lua ma tita) pilata i gindi tambu taume o gabo agẽ gẽ i babo yakla. I masa mo walã me da iŋa dõ anda dene (tambu tlawa ma lita ma ŋo lua, ma ŋa gẽ wese. Taliko da tambu ŋa) taki pilata gĩ tambu taume o lita ma ŋo ŋa ma lita gẽ wese gu dene ŋa da i masa ŋeiga da i gabo agẽ tã imo walãme

3) Size structure. Average length only tells part of the picture, by looking at the number of each size of fish, you can decide whether a change in average fish size is cause for concern. For each kind of fish, create a list of sizes (for instance 10, 11, 12, 13… or 5-9, 10-14, 15-19… or 0-9, 10-19, 20-29…). Then look at the lengths you recorded and make a mark each time that size is seen. Last, bring your results to school. They will be combined with other students' results to make a graph with fish size on the bottom and number on the side.

3) Sais straksa. Namel mak tasol bai tokim yumi long hap bilong dispela piksa, long luk luk long wan wan namba bilong wan wan sais pis. Yu ken tok sapos igat senis insait long namel pis sais sapos igat hevi. Long olgeta kain pis, raitim (o kamapim) list bilong os saises (tingim 10, 11, 12, 13… o 5-9, 10-14, 15-19… o 0-9, 10-19, 20-29…). Nau luk luk long namba yu bin na putim mak long olgeta taim, taim yu lukim dispela sais. Nau bringim ripot ido long skul. Ol bai bungim olgeta ripot ol arapela skul pikinini long kamapim wanpela piksa seim saises bilong ol pis long tambolo na namba long sait.

3) Badi (madĩ) ŋa andalawa. Madĩ (badi) walãme ŋa da iki kau kala ŋgu taga kau pi bi ŋasulu, ma ŋakatu ma takano i masa mo walãme ŋa gabo ŋa. Kala gindi ŋgu taŋgu bi pi iŋa ŋgu i gabo, o i kokole o walãme gu i golo totome ŋa tato iŋa lekene sa (teŋgi 10, 11, 12, 13…; 5-9, 10-14, 15-19…; 0-9, 10-19, 20-29…). Wele dene ŋgu takanu iŋa lekene ma ŋa madi maso gẽ ŋapã. Bae ma iga gele masa su kopia gi mia tu lumi ma talisa i golua tatu lumi ŋa ma sesi kano ŋakatu masa kialĩ iŋa gaboŋa ma walaŋa. Matakano lekene masa gẽ ŋaisã ŋa.

Using the information for the example above, we can divide fish into five centimeter groups, and count the number in each group (see the example below).

Lukluk long toktok istap antap, yumi ken brukim pis igo long faivpela sentimita grups na kaunim namba insait long wanwan grup (lukim piksa tambolo).

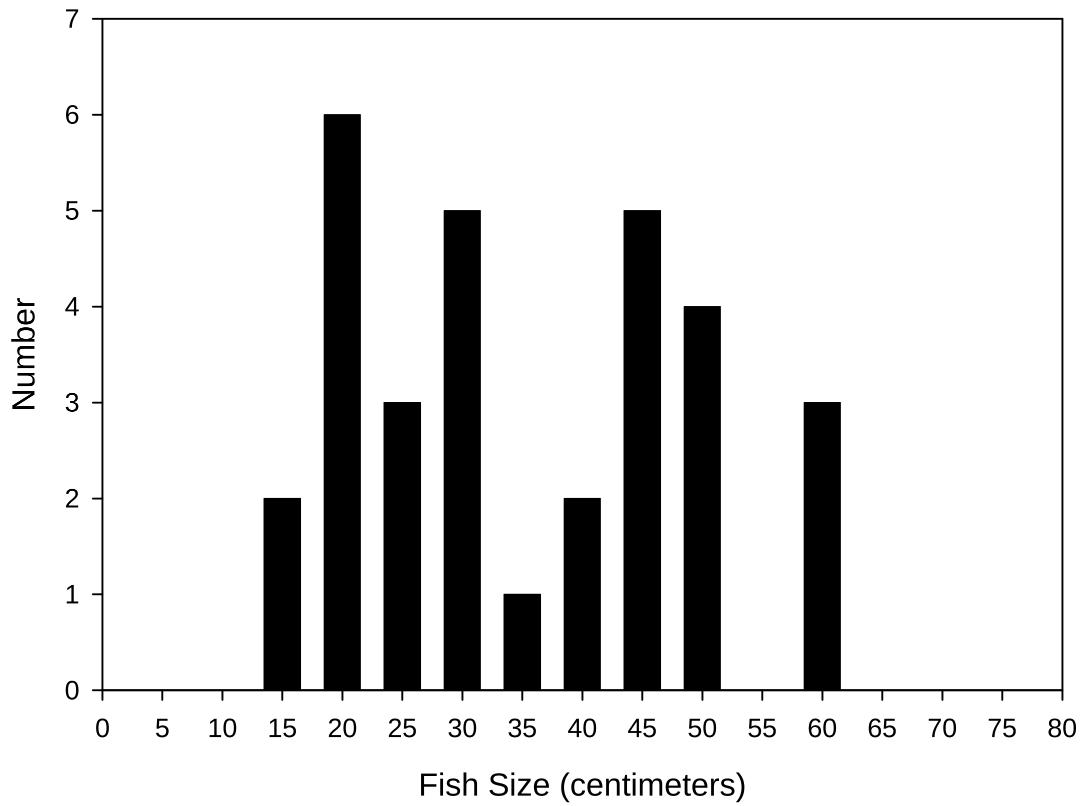
Ikano bi dene gẽ baba ma katali i kloko tuŋa toŋ ita da gindi lita tu ŋa toŋ (takano ŋakatu dene gẽ lubula ŋa).

Fish Size/Sais Bilong Pis (Iŋa Dõ)		Number/Namba/Tasisa
0-4	(mba)	
5-9	(lita)	
10-14	(taume)	
15-19	(taume aŋo lita)	//
20-24	(tambu lua)	//////
25-29	(tambu aŋo lita)	///
30-34	(tambu tlawa)	/////
35-39	(tambu tlawa aŋo lita)	/
40-44	(tambu ŋa)	//
45-49	(tambu ŋa aŋo lita)	/////
50-54	(tambu lita)	////
55-59	(tambu lita aŋo lita)	
60-64	(tambu lita ma ŋa taume)	///
65-79	(tambu lita ma ŋa taume aŋo lita)	
70-74	(tambu lita, taume, taume)	
75-79	(tambu lita, taume, taume aŋo lita)	

Then, we can create a graph showing how many of each fish size was caught in village waters. The following example is based on only the above tally, but everybody's numbers should be added to make a graph for the whole village.

Nau yumi ken mekim wanpela grap long soim amas bilong wan wan sais bilong pis ol ibin kisim long solwara bilong ples. Ol piksa hia I soim (sut) tasol long wok istap long antap, tasol namba bilong olgeta imas bungim wantaim long wokim grap bilong ples olgeta.

Wele kata masa ŋakatu kuluku ŋa wuã ŋgu iyalĩ iŋa dõ ŋe i masa kataga gẽ kawa ta ambolã ŋa. Ŋakatu dene da kiyalĩ kluku dene gẽ baba, teŋgi, katasi kala samop dene tamo ma tali ŋasẽ sa ŋgu tamasã ŋakatu kuluku ŋa ŋe kana ambolã.


7
6
5
4
3
2
1
0
Number
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Fish Size (centimeters)

Meaning

What do your results mean? The information from this project will be most useful if the study is done every year. You can look for patterns over a long time (5 years or more) to determine whether village fishing practices have struck a good balance between the needs of today and the future.

Average size – Is average size getting bigger, smaller, or staying the same? If average size is getting bigger or staying the same, chances are good that fishing practices today will also leave fish for the future. Shrinking average sizes suggest that current fishing practice may be putting future generations at risk of not getting enough fish.

Mining (As)

Wanem mining (as) bilong ansa (resalt) bilong dispela projet bai i kamap gutpela moa sapos stadi i kamap long olgeta yia. Yu ken painim sampela rot long longpela taim ikam inap (faivpela yia o moa) long painim aut sapos pasin pilong painim pis long ples ikamap long gutpela mak namel long nids bilong nau na bihain taim.

Namel sais pis – Sapos namel sais pis istap bikpela, liklik o istap wankain? Sapos namel sais bikpela o stap wankain, igat gutpela olsem pis pretis long nau bai lusim pis istap long behain taim. Putim namel sais olsem, now yet pis wok bai putim behain pikinini bai ino inap igat inap pis.

Bi Ŋala Bolã

Biŋa ŋala bolã dunao? Ŋgu kluku dene wele mia anda agẽ or ŋgu taga kau geleta wele gamopi ndi yala samop. Kai gindi ŋgu kautapi andalawa nua imia gamo itapi yala ind (lita ma miapi). Gu tatapi ŋgu andala ŋgu taga iŋa ŋe ambolã gwandasi momorome ŋgẽsu kana tapo lina ndi wele dene ma sumbuliã.

Ngu i tatu – Babo ma i masa gindi ngu katagaŋa omo iya tame? Ma ngu i ŋa babo omo iya tã wele andalawa ngu kataga i wele tanu waũ ta, ma i wele golikĩ ngu kaŋa tengi guluwa la su buliyã. Ma ngu katanu kuluku i ŋa ŋapã wele takano ngu wele i mbae, ma kana guluwa su buliya wele sitapi ŋapuŋa.

Percentage of "best" and adult length – It is best if percentage of adult length is more than 100 (average size is more than 100% of adult size, indicating fish have had the chance to produce young for the next generation). It is best if percentage of "best" size is close to 100, because this is thought to be the size that will allow the most weight to be caught without damaging future fishing. In other words average size should be more than adult size, and as close as possible to "best" size. The results from the sample calculations shown above suggest that the fish have had the chance to reproduce, but that if the village catches slightly larger fish, there would be more to eat while still helping to make sure fish will be available in the future.

Sapos namba i gutpela long longpela pis - So em gutpela sapos namba bilong pikpela longpela pis bai plenti oslem hundret (namel sais bai wankain olsem hundret namba (100%) bilong bikpela pis. Tintin tasol olsem pis igat rot long kamapim liklik yanpela pis long behain taim pikinini). Na sapos gutpela namba bilong gais istap klostu olsem hundret, bikos dispela em tintin we yumi kaikim long imas igat inap pis long kisim na yumi noken bagarapim pis bilong behain taim. Long arapela toktok, namel sais imas plenti long long ol bikpela pis, na em bai istap gutpela long sais. Na wok painim out namba soim antap olsem pis bai igat sans long kamapim nupela, tasol, sapos ples i kisim sampela bikpela pis, bai igat planti pis long kaikai na bai igat pis istap long behain taim.

Ŋgu i golikĩ ma I ŋa balĩ anda – Anda ngu i babo ma goliki wele omo duda, tambu luwa ma aŋo taume ma tambu luwa ma aŋo taume nuwã wauŋ (i ta wele golikĩ. Su dene gi da andalawa ngu i la siki ŋawau wauŋ u guluwa la su buliya). Su dene da kala golotome tangu, taga i gindi ngu katĩ ŋa ma talowẽ i ŋakala somo u guluwa buliyã ŋa ĩ. Gu dene ŋa da i walaya somo ŋapeme ila somo ma siki guluwa ŋawauŋ wauŋ. Kala lau ambalã taga i dingi ngu katĩ ŋa ndi no dene ma tengĩ su buliŋa ĩ.

Size structure – Looking at size structure can help understand whether a short-term decrease in average size is cause for concern.

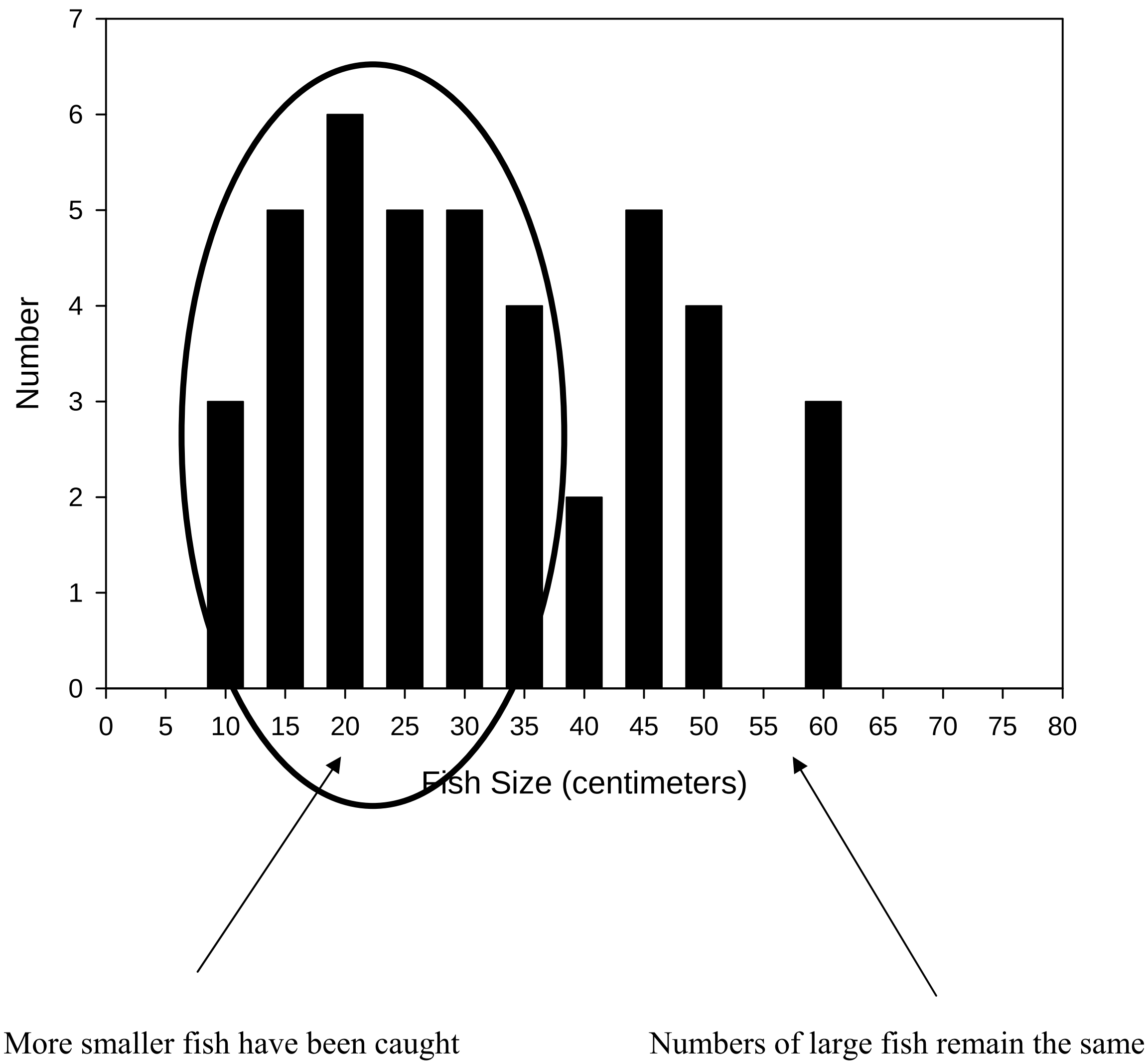
A smaller average size can be seen if fish populations produce lots of young (there are more small fish in the population). In this case, a graph of size structure would have many more smaller fish than had been recorded in earlier years (see area circled below, and compare it to the graph shown above). It would **also** have approximately the same number and sizes of larger fish seen in previous years. If this pattern is seen, chances are there is not much need for concern.

Sais straksa – Lukluk long ol piksa na sais bilong pis bai halivim yu long save long sotpela taim ol gutpela sais pis bai pinis na bai igat hevi.

Iken lukluk long ol liklik yanpela pis bai (kamapim plenti). Long dispela bai yu lukluk long piksa soim ya olsem ol nekot bilong yia igo pinis long en (lukluk long sekol istap istap tamboro) na lukluk long antap grap tu. Em bai igat wankain bikpela pis long arapela yia igo pinis. Sapos dispela grap bai igat senis i soim olsem igat hevi.

Badi (madĩ) ŋa andalawa – Ikano ŋakatu ma i babo, wele iki kau ndi kai ngu i lai somo ŋa.

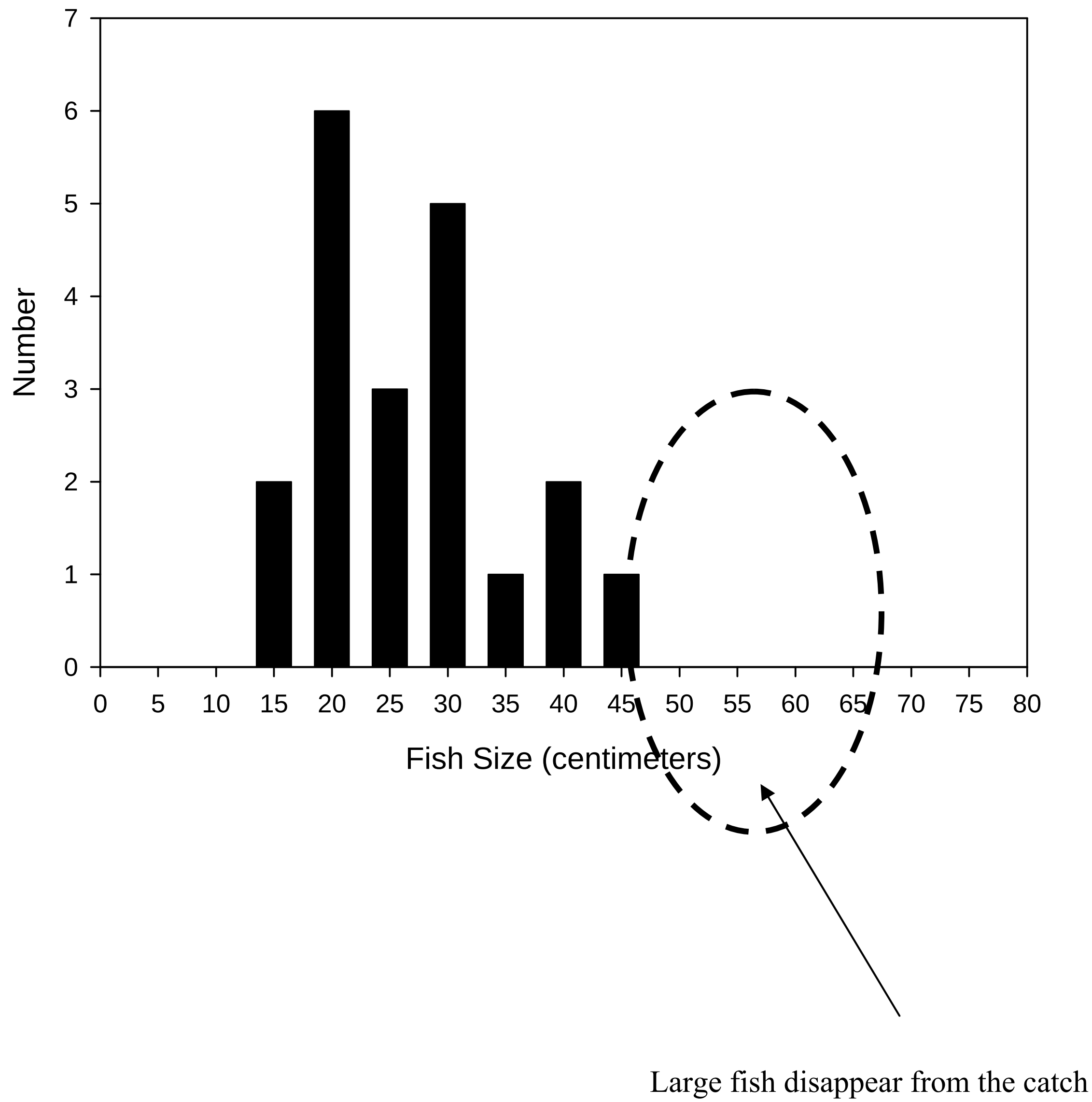
I wele somo tã ma wele mbae seme, ma ŋapuŋa ŋamosi (su dere da takano i tatu ngu ŋanguluwa somo golikĩ). Kakano ŋakatu yala buliyã ŋa (ma ukano ŋakatu gẽ lubula ŋa) ma ukano baba ŋaĩ. Wele kagu i golotome yala buliya. Sudene gi da ŋakatu kiyali dudene ngu ŋapuŋa.


Number
Fish Size (centimeters)
0
1
2
3
4
5
6
7
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
More smaller fish have been caught
Numbers of large fish remain the same

A smaller average size can also be seen if all of the big fish have been caught. In this case, there would not be much change in the numbers of smaller fish but there would not be as many larger fish (look at the area in the broken circle below and compare it to the original graph above). This pattern may be cause for concern because it may mean that fish are being caught before they have had the chance to grow and make young for the future.

Yumi bai lukim liklik namel sais tu sapos ol ibin kisim olgeta bikpela pis. Long dispela rot bai ino gat bikpela senis long namba bilong ol liklik pis. Tasol em bai ino gat planti bikpela pis (lukluk long hap insait long sekol i bruk long tambolo na skelim wantaim grap tru-tru antap). Dispela rot iken kamapim sampela hevi long wanim, ol bai i kisim ol pis pinis bipo ol i gat sans long kamap bikpela na kamapim ol pikinini long taim bihain.

Wele kata kano i tatu ŋgu yeiga i babo ye. Andala dene wele katagu dudene ŋgu itatu dene somo. Teŋgi i babo wele goŋ goliki tã. Takano ŋe ŋakatu dõdõwã dini kimblako ŋge lubula ma taga kau bi kluku ŋakatu dini ŋge baba. Andala dene wele iyali ŋapu ŋa yakla ŋgu yeiga i da I mbai. Ndi no dini da i laĩ no ŋgu u babosi ma siki gulua sumbu liã ŋgu ŋgi kalasa.



Number
0
1
2
3
4
5
6
7
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Fish Size (centimeters)
Large fish disappear from the catch

APPENDIX B

Fact Sheets

Acanthurus lineatus **iwiliya**

Adult length: 18 cm "Best" length: 19 cm

Carangoides fulvoguttatus **imaŋalẽ**

Adult length: 63 cm "Best" length: 80 cm

Lutjanus timorensis **iko**

Adult length: 29 cm "Best" length: 33 cm

Thunnus albacares **indẽ**

Adult length: 108 cm "Best" length: 122 cm

Katsuwonus pelamis **ipiya**

Adult length: 48 cm "Best" length: 52 cm