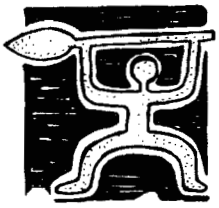

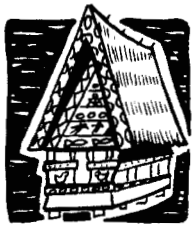

MICRONESIA-AMERICAN SAMOA STUDENT INTERNSHIP PROGRAM (MASSIP)

PROJECT REPORT FOR:

CORAL REEF RESEARCH ON ASCIDIANS

December 13, 1996

Prepared By:

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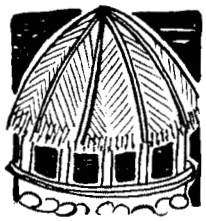

CORAL REEF RESEARCH FOUNDATION -
MASSIP INTERNSHIP PROGRAM
May 16, 1996 - August 1, 1996

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Abstract:

In the search for a cure for cancer, more and more researchers and scientists have been studying coral reef invertebrates for anti-tumor chemicals. During my two-month Micronesia-American Samoa Internship Program (MASSIP) internship at the Coral Reef Research Foundation (CRRF) in Palau, I studied a little known marine invertebrate family called ascidians. I learned the techniques and skills involved in collecting, photographing, cataloging and shipping marine invertebrates, specifically ascidians, for study at the National Cancer Institute in Washington DC.

I also learned much about the many marine ecosystems of my home country, some of which include marine lakes, seagrass beds and coral reefs. In addition, I made many friends and contacts that will help me in my career during college and after graduation. My internship at CRRF taught me not only about ascidians but also the methodology that marine scientists use when doing research in the field, and I am sure that will help me in my classes this fall at the University of Hawaii.

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Introduction

The Republic Of Palau is a nation in a state of transition. With its newly gained independence, Palau is trying to get out from underneath the wing of the United States which has been supporting Palau for far too long. One way that Palau is trying to build a strong economy is to start a booming tourism industry. Although tourism is definitely an industry that is lucrative, it also can be very destructive to the environment if it is not controlled by laws and enforcement. [1]

Palau should not only have to rely on tourism as the one major source of income to the islands. An ideal situation would be to have at least two major industries in Palau which would have very little impact on its environment. One industry that is just beginning to surface is the research industry.

In the search for a cure for cancer, more and more researchers are looking to the ocean in search of anti-tumor chemicals. Recently studies on marine invertebrates have indicated that some produce anti-tumor chemicals. These chemicals are being tested as possible treatments or cures for some kinds of cancer. [2]

Researching invertebrates can be a very big industry for a nation such as Palau which boasts some of the richest marine ecosystems in the world. There is incredible diversity in the marine life of Palau and because of this, Palau is one of the most sought after destinations for visiting scientists and researchers in the world.[3]

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[1] Wesley-Smith, Terence
[2] Scheuer, Paul
[3] Carlson, Bruce

The Coral Reef Research Foundation (C.R.R.F.) is a non-profit organization, based in Palau and funded by the National Cancer Institute (N.C.I.) and the government of Palau. C.R.R.F.'s mission is to search coral reefs around the world for organisms which may have anti-tumor properties. Samples are collected for study at the N.C.I. in Washington DC. If an anti-tumor chemical is found in a sample invertebrate from Palau and is manufactured as a cancer treatment or cure, Palau would get royalties. This income could match or exceed the amount produced by Palau's booming tourism industry.

My project at the C.R.R.F. was comprised of two major activities. First I was part of the team in charge of the collection of samples for the N.C.I. Second, I was expected to learn as much as possible about a particular marine invertebrate called an ascidian. I had never heard of an ascidian before the trip, but I got to know them pretty well during my internship. My project involved collecting ascidians from the coral reefs around Palau, photographing them, preserving them, cataloging them, and finally developing my film and creating a slide collection with a database to go along with my samples. I chose this project because ascidians around the world, not to mention Palau, are not studied as much as other marine invertebrates.

Ascidians are marine invertebrates that can take many forms. They are classified in the phylum, Chordata and the class, Ascidiacea. There are two categories of ascidians, solitary and colonial.[4] Both solitary and colonial ascidians are found in a variety of colors and patterns. Although they may look different, all ascidians share common characteristics such as skin like tunic and two openings through which water passes. (Figure 1)

[4] Coral Reef Ascidians of New Caledonia

Solitary ascidians, sometimes referred to as a "sea squirts" consist of one animal or zooid surrounded by a tunic that usually feels leathery. People call solitary ascidians sea squirts because of the way water shoots out of the atrial[5] siphon when the ascidian is taken out of the water. Solitary ascidians are usually larger than colonial ascidians. They range from about the size of a fingernail to the size of a grapefruit.

Colonial ascidians are small when compared with solitary ascidians. Colonial ascidians live in colonies of many individual zooids surrounded by one common tunic. An individual zooid or animal in a colonial ascidian has basically the same structure of a solitary ascidian but is smaller and shares it's skin with many other ascidians. These zooids can sometimes be microscopic but are usually about one to three millimeters in diameter. The single tunic or skin that surrounds the colony can vary in color and it took me a while to correctly distinguish between some colonial ascidians and a sponges that had the same color.

The individual zooids in colonial ascidians sometimes structured so that together they form patterns to accommodate for one shared atrial siphon. This allows them to save space on the already crowded reef surface.

The competition with other benthic[6] marine animals for space on the reef ecosystem is the reason for the ascidian's chemical production. There is limited amount of space coral reefs and because of the enormous diversity of marine reef life, competition for space is fierce and predation is very high. Some organisms compensate for this by

[5] One of the two siphons through which water passes on an ascidian, Invertebrate Zoology (pg. 385)
[6] Animals that live on the ocean bottom.

creating defenses. Hard corals have hard calcium shells to protect them. Other organisms such as sponges have siliceous spikes which, among other things, deters predators.

Ascidians have no hard covering and no spikes to protect them, so some produce toxic chemicals to keep predators from eating them. It is these chemicals which researchers are searching for and studying in hopes of finding a cure for cancer.

Ascidians are filter feeders and each individual zooid has two siphons. Water flows in one siphon (buccal) and out the other (atrial) and the ascidian filters out the plankton in the water. [7] Ascidians can filter large amounts of water and their body tissue can be a good indicator of polluted water because they retain heavy metals and toxins in their bodies.

Ascidians are fascinating as invertebrates because they are more closely related to humans than any other invertebrate. During the ascidians planktonic stage, the ascidian resembles a tadpole and has a notochord. This notochord is the reason that ascidians are classified as Chordates.

Ascidians are planktonic for a very short time. Approximately 24 hours after they are born, they attach themselves to a solid surface and undergo a metamorphosis in which they lose their notochord and become a more simple life form. This example of 'backwards' evolution is one of the reasons I am interested in ascidians.

[7] Invertebrate Zoology (pg. 385)

Because ascidians are a very 'understudied' group of invertebrates, no one knows exactly how many species there are and what their distribution is throughout the world. More new species are being discovered all the time, and I am hoping that some of my samples may turn out to be an undiscovered species of ascidian.

Data Collection

Most of my internship was spent either collecting or processing the data that I collected. The method in which I collected my specimens differed with each type of ascidian that I collected. After finding the ascidian, I would photograph it and remove it from the reef. Some ascidians could just be picked off the substrate[8] quite easily, but usually they had to be scraped off with a knife or other sharp object. Some colonial ascidians were very delicate and I had to be very careful not to destroy them during collection. (Figure 3)

Having removed the ascidian from the substrate, I would then place it in a clear plastic collection bag. I usually tried to keep the ascidian specimens separate from each other, but sometimes I would end up with a bunch of ascidians all in one bag. After the dive, I would record the ascidian information such as the depth it was collected, the collection site, the G.P.S.[9] location and the substrate on which it was collected. (Appendix 2)

When we got back to the lab, our sample bags would then be poured into tubs and the samples would be separated. Once the samples were separated, I would place my individual samples along with a collection number for identification into Whirl Bags[10] and fill the bags half full with a formalin solution. Formalin is liquid formaldahyde and it is the

[8] Substance to which the organism is attached or growing on.
[9] Global Positioning Satellite.
[10] Polyethelyle bags with built-in twist ties used for preservation of ascidian samples.

chemical C.R.R.F. uses to preserve ascidian samples. The formalin solution we were using was made up of 10% formalin and 90 % water.

After my samples were nicely preserved in formalin, I would place them on trays awaiting their respective slides to be developed. Before I knew it, I was collecting too many samples to keep track of. I solved this problem by creating a database. I have included a copy of my database as Appendix 1,2 and 3. My database includes information about each sample along with the location site, depth it was collected and the date it was collected. Each sample is numbered so it an be cross referenced with it's corresponding slide.

Before my internship was over I had collected over one hundred specimens and slides to go with them. The task then was to go through the slides to see which samples we could identify at the C.R.R.F. and which ones we would be sending to Paris for identification. Pat, Lori and Larry helped me a lot with the identification, but even with their help, we couldn't identify many of the samples. Pat also said that there was a good chance that there were some unidentified species in my samples.

Pre-Departure Training and Preparation

May 16-25, 1996

My internship officially started the first week of June, but the pre-departure preparations started two weeks before that. On May 16, I flew to Hilo to join the other MASSIP interns for the pre-departure training. The MASSIP staff consisting of Jenny Saman, Sharon Ziegler, Liz Kumabe, and Jim Mellon spoke to us about re-entering our culture and how things would seem different. We also had guest speakers which included previous MASSIP interns.

A few days later, we were off to Honolulu to meet with our contacts and to get our supplies that we would need in the field. It was through my research at the University of Hawaii at Manoa and my contacts at the Bishop Museum and the Waikiki Aquarium that I finally found out what an ascidian was. Professor Paul Scheuer[11] was very helpful in answering my questions about ascidians and even let me borrow his ascidian book which proved to be very helpful during my internship.

A part of our MASSIP training involved learning how to communicate on the PeaceSat satellites. We were scheduled to have weekly meetings over the satellite system and we needed to learn the basic protocol of satellite communication. This was one of the more interesting parts of the pre-departure training. Tom Okamura[12] was a great help and very enthusiastic in teaching us the proper lingo.

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[11] Scheuer, Paul. Professor, Department of Chemistry, University of Hawaii
[12] Okamura, Tom, Program Developer, Peacesat

I also met with Sherwood Maynard, the director or the Marine Option Program (also my faculty advisor), and we laid out a plan on what I was going to be doing at the C.R.R.F. Sherwood suggested that I collect samples of ascidians in Palau and with the slides that I would take, create a handbook of the ascidians of Palau. He was very helpful in getting me motivated and kept me on track before, during and after my internship.

Starting the Internship

June 1, 1996

During the first week of my internship, I spent most of my time getting to know the people at the C.R.R.F. Pat and Lori Colin manage C.R.R.F. and employ four people to help in the collection and cataloging of the specimens: Larry Sharon, the Chief Collector, his two assistants, Matt and Emelio who helped him on the collection, and Carla Salii, the curator of the C.R.R.F. invertebrate collection.

The staff at the C.R.R.F. turned out to be very friendly and I felt very comfortable working with them. The collection team which consisted of Larry, Matt, Emelio and me, went on collection trips about two to three times a week. The collection trips would range from three hours to a whole day. During my two month internship, we collected at twelve different locations. (Figure 2) The collection sites ranged from spectacular "drop-offs", with a hundred feet of visibility to mangrove swamps where the visibility ranged from one to two feet. (Appendix 2)

One of the skills that I acquired during the internship was learning how to take and develop underwater photos. This was important in collection because each sample species that is collected must be photographed for identification. Pat taught me to use a Nikonos underwater camera which included a flash and close-up lens with extension

tubes. I learned how to develop my own slides and soon I was put in charge of developing all of the film for the C.R.R.F. slides during remainder of my internship.

We used two types of 35 mm film for all of our specimen slides. Fuji Velvia and Sensia, I was told, were the best films to use in taking close-up underwater photos. We used a basic developing kit from Kodak to develop the slides. This process involved winding the film onto spindles that were then inserted into an enclosed tube. Chemicals could be poured into the tube but light could not enter. Each chemical had a specific time in which it should wash in the tube.

Pat, Lori and I decided that I would collect and photograph as many ascidian samples as I could, and, when I was through, they would send the samples and photos to France to be identified by the leading experts on ascidians, the Monniots.

Ascidians, as previously stated, are a very unstudied group of invertebrates. Only a handful of people in the world are qualified to identify them. Claude and Francoise Monniot are two of them. The couple lives in Paris and they do all of the ascidian taxonomy for the C.R.R.F.

Follow-up

The last few weeks on my internship were spent finishing up with the database and getting my slides in order. Pat and I had agreed for me to leave the samples at the C.R.R.F. and to take the slides back to the MASSIP staff because they wanted duplicates. This way, I could have the people at MASSIP make duplicates and send the originals back to C.R.R.F. so Pat could send the samples along with the slides to the Monniots for identification.

After all this was taken care of, I said my good-byes and, I was off. A few days after arriving in Hawaii, I met with Liz and Sherwood. We went over my data and slides and we agreed to have the slides reproduced and the originals sent back to C.R.R.F.

The follow-up procedures in Hawaii involved creating a presentation in which each of the MASSIP interns did a slide show on their projects. I also had to have duplicates made of all my slides.

Evaluation

The MASSIP Internship was a wonderful learning opportunity for me. I learned how invertebrates can be a resource that will possibly halt one of the world's greatest killers, cancer. In addition to the health benefits of underwater organisms, I learned to recognized the economic value of what I had only considered valuable to tourists. It was a real eye-opener in more ways than one. I also learned how to take and develop underwater photographs.

Further, I learned how to collect and catalog specimens for scientific study. This process taught me a great deal about the marine ecosystems of my home island. I think the most important thing that I achieved on the internship was the contacts that I made both in Palau and Hawaii. The entire experience has given me a better understanding about my home, my people, and our fragile and rich environment.

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Figure 1

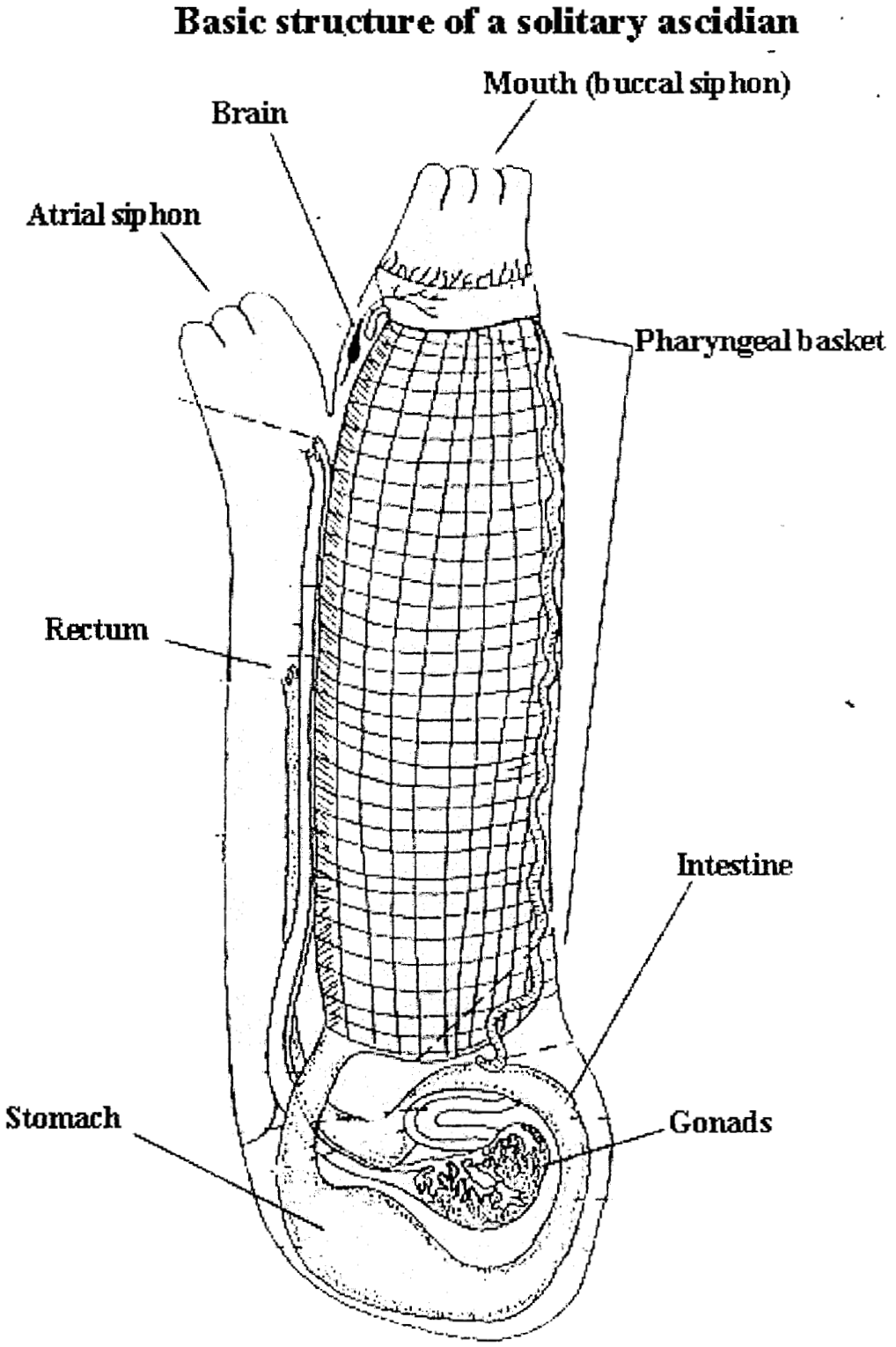

Basic structure of a solitary ascidian
Mouth (buccal siphon)
Brain
Atrial siphon
Pharyngeal basket
Rectum
Intestine
Stomach
Gonads

Figure 2

Collection Sites

1. Badibei
2. Ibobang
3. Nederrak
4. Flatworm Lake
5. Ngermutidech
6. Lighthouse Channel
7. Airai Seagrass Bed
8. Wonder Channel
9. Omodes
10. Ngerikul Pass
11. Big Jellyfish Lake
12. KB Channel

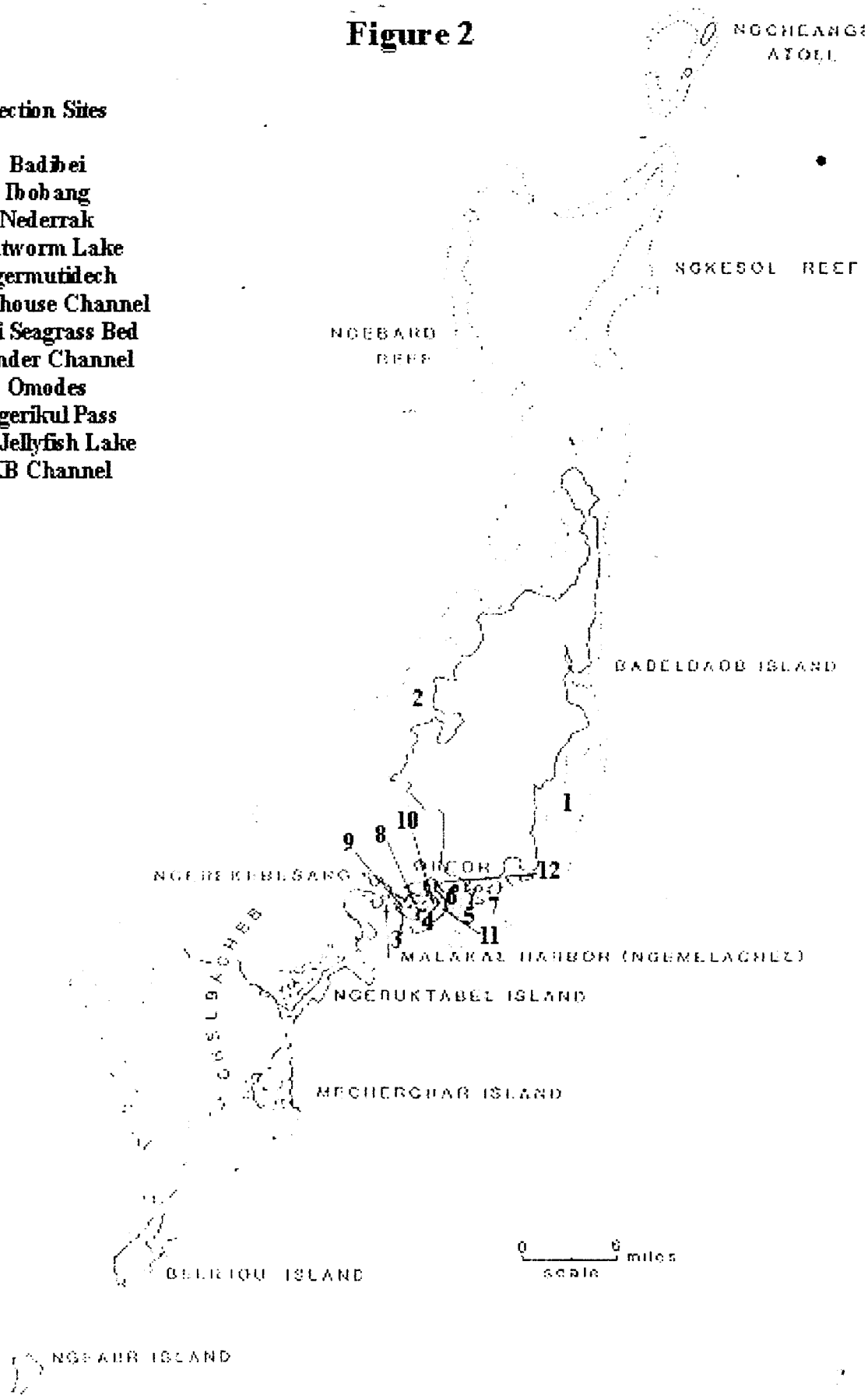


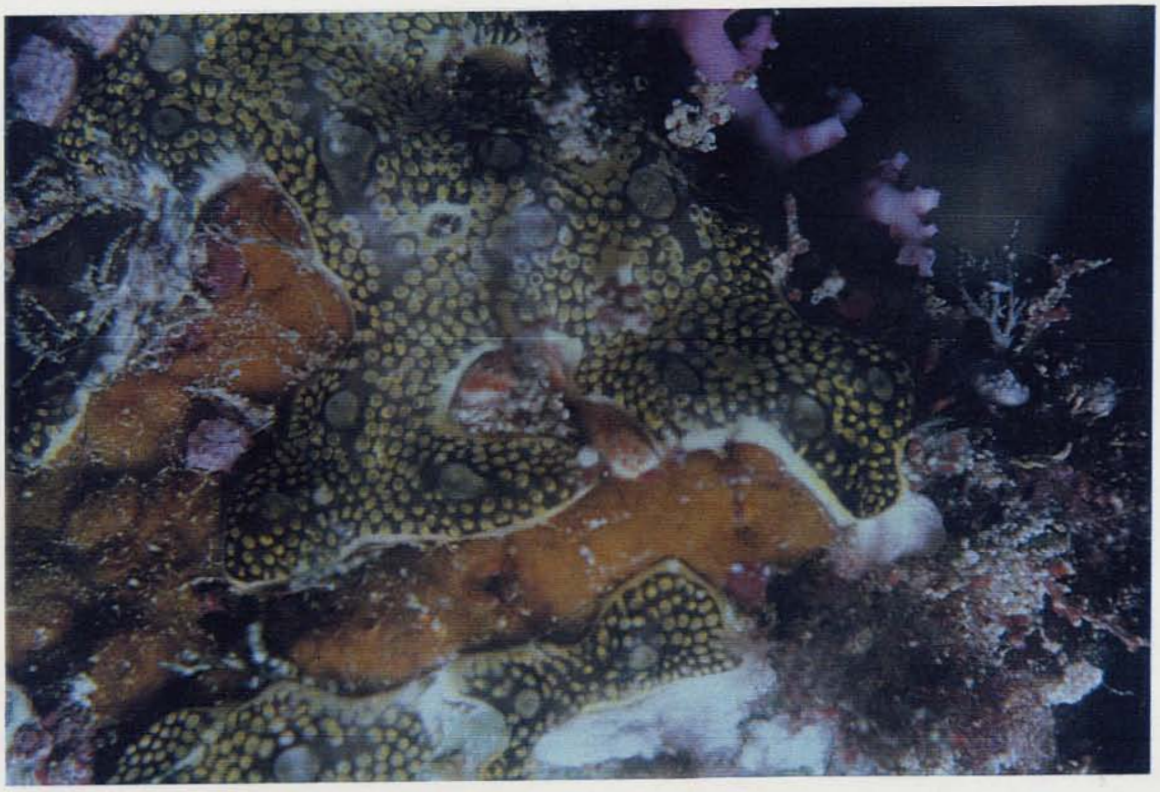
Figure 3

CHO: 95
This is a cluster of solitary ascidians collected at Ngerikul Pass. 7/22/96

CHO: 34
This group of solitary ascidians were collected at the Lighthouse Channel. Note the individual openings of the bucual and atrial siphon. 6/18/96

Figure 4

CHO: 92
This is an example of a colonial ascidian collected at KB Channel. 7/22/96



CHO: 38
Here is another example of a colonial ascidian. Note; each dot is an individual zooid. Collected at Lighthouse Channel. 6/18/96

Appendix 1

COLLECTION	DATE	LOCATION	DEPTH	HABITAT	DESCRIPTION
cho-1	6/8/92	Badelbei	18m	Sandy basin bottom	Gray encrusting
cho-2	6/8/92	Badelbei	18m	Sandy basin bottom	Light gray w/ dark gray depressions
cho-3	6/8/92	Badelbei	30m	Sandy basin bottom	Burgundy globs slightly translucent
cho-4	6/9/92	Ibobang	1m	Seagrass bed	Stalked, orange w/ translucent white pompoms
cho-5	6/9/92	Ibobang	1m	Rocky shelf	Slightly stalked, olive green
cho-6	6/9/92	Ibobang	10m	Rocky shelf	Bright yellow w/ white specks around siphon
cho-7	6/9/92	Ibobang	7m	Rocky shelf	Gray w/ black specks, encrusting
cho-8	6/10/92	Ibobang	15m	Ship wreck	Solitary, pink translucent (soft)
cho-9	6/10/92	Ibobang	12m	Rock ledge	Transparent w/translucent blue towards siphon
cho-10	6/10/92	Ibobang	15m	Rock ledge	Encrusting, translucent w/ dark green specks
cho-11	6/11/92	Ngederrak	1m	Rock ledge	Inflated balls, gray w/ green inside
cho-12	6/11/92	Ngederrak	1m	Algae mat	Gray encrusting
cho-13	6/11/92	Ngederrak	1m	Algae mat	Black encrusting, shiny
cho-14	6/11/92	Ngederrak	1m	Algae mat	Brown encrusting
cho-15	6/11/92	Ngederrak	1m	Algae mat	White encrusting, inflated
cho-16	6/12/92	Flatworm La	1m	Marine lake	Stalked translucent pale yellow, silty
cho-17	6/12/92	Ngermutidec	1m	Seagrass bed	Encrusting, thin, pink inflated
cho-18	6/12/92	Ngermutidec	1m	Seagrass bed	Burgundy encrusting around seagrass
cho-19	6/12/92	Ngermutidec	1m	Seagrass bed	Translucent white and green, encrusting
cho-20	6/13/92	Ngermutidec	1m	Seagrass bed	Thick encrusting dark olive green
cho-21	6/13/92	Ngermutidec	1m	Seagrass bed	Stalked, light gray, mottled
cho-22	6/13/92	Ngermutidec	1m	Seagrass bed	Inflated balls, gray with green inside
cho-23	6/13/92	Ngermutidec	1m	Seagrass bed	Thin encrusting white
cho-24	6/13/92	Ngermutidec	1m	Seagrass bed	Brown encrusting
cho-25	6/13/92	Ngermutidec	1m	Seagrass bed	Pink encrusting w/ white openings
cho-26	6/13/92	Ngermutidec	1m	Seagrass bed	Translucent w/ white zooids
cho-27	6/13/92	Ngermutidec	1m	Seagrass bed	Pale orange thin encrusting
cho-28	6/13/92	Ngermutidec	1m	Seagrass bed	Translucent pink soft, solitary
cho-29	6/17/92	Lighthouse C	10m	Coral	Green encrusting and rubbery (thin)
cho-30	6/17/92	Lighthouse C	10m	Soft Coral	Encrusting, inflated, brown (thin)
cho-31	6/17/92	Lighthouse C	10m		Stalked, mottled, gray and white
cho-32	6/17/92	Lighthouse C	10m		Thin encrusting purple (smooth)
cho-33	6/17/92	Lighthouse C	10m	Rock	Thin encrusting dark pink, inflated
cho-34	6/17/92	Lighthouse C	10m	Soft Coral	Colony of solitary, translucent yellowish with yellow border around siphon.
cho-35	6/17/92	Lighthouse C	10m	Rock	Thin encrusting red stiff.
cho-36	6/17/92	Lighthouse C	15m	Rock	
cho-37	6/17/92	Lighthouse C	15m	Rock	Very thick encrusting forming large globs (rubbery)
cho-38	6/17/92	Lighthouse C	15m	Rock	Thin encrusting gray with yellow dots (inflated)
cho-39	6/17/92	Lighthouse C	15m	Rock	Thin encrusting gray with black dots
cho-40	6/17/92	Lighthouse C	15m	Sandy Bottom	Spherical, stalked (sand covered)
cho-41	6/17/92	Lighthouse C	15m	Rock	Thin encrusting yellow stiff (white underneath)
cho-42	6/17/92	Lighthouse C	15m	Rock	
cho-43	6/17/92	Lighthouse C	15m	Rock	Thick encrusting black with large white dots
cho-44	6/17/92	Lighthouse C	15m	Rock	Spherical red gelatianous
cho-45	6/17/92	Lighthouse C	15m	Rock	Thick encrusting rubbery gray/white
cho-46	6/17/92	Lighthouse C	15m	Rock	Encrusting rubbery black and gray pattern
cho-47	6/17/92	Lighthouse C	15m	Soft Coral	yellow w/ dark green spots (stalked, firm)
cho-48	6/17/92	Lighthouse C	15m	Rock	Orange stalked gelatianous
cho-49	6/17/92	Lighthouse C	15m	Rock	Thin encrusting stiff black/white pattern w/ some red dots
cho-50	6/17/92	Lighthouse C	15m	Rock	Forms large lumps (large visable holes, rubbery)
cho-51	6/17/92	Lighthouse C	15m	Rock	
cho-52	6/18/92	Ngederrak	1m	Algae mat	
cho-53	6/18/92	Ngederrak	1m	Algae mat	
cho-54	6/18/92	Ngederrak	1m	Algae mat	Inflated translucent balls hanging from threads, delicate pale yellow stripes
cho-55	6/18/92	Ngederrak	1m	Algae mat	Solitary, soft pink white mottled around siphon, translucent
cho-56	6/19/92	Ngederrak	1m	Algae mat	Solitary, brown firm white dots around siphon.
cho-57	6/19/92	Ngederrak	1m	Algae mat	
cho-58	6/19/92	Airai Seagras	1m	Algae mat	
cho-59	6/19/92	Airai Seagras	1m	Algae mat	
cho-60	6/19/92	Airai Seagras	1m	Algae mat	
cho-61	6/19/92	Airai Seagras	1m	Algae mat	Thick encrusting Army Green Rubbery
cho-62	6/19/92	Airai Seagras	1m	Algae mat	Thin encrusting oblong patterns, Green/white dots (prochloron)
cho-63	6/19/92	Airai Seagras	1m	Algae mat	Black encrusting around seagrass Gelationous
cho-64	6/19/92	Airai Seagras	1m	Algae mat	Thick encrusting, Green w/ white ridges (prochloron)
cho-65	6/19/92	Airai Seagras	1m	Algae mat	Thin encrusting oblong patches beige, fuzzy
cho-66	6/19/92	Airai Seagras	1m	Algae mat	Thin encrusting oblong patches solid green (prochloron)

Appendix 1

cho-67	6/19/92	Airai Seagras	1m	Algae mat	Thin encrusting, irregular patches, pale green w/ white chimney
cho-68	6/19/92	Airai Seagras	1m	Algae mat	Thick encrusting around seagrass gray w/ white(rubbery)
cho-69	6/19/92	Ngederrak	1m	Algae mat	Solitary tunicate small hard (usually several) rust colored
cho-70	6/19/92	Ngederrak	1m	Algae mat	
cho-71	6/19/92	Ngederrak	1m	Algae mat	Solitary, light brown, soft white black around siphon
cho-72	7/9/92	Wonder Cha	15-20m	Rock/Coral	Encrusting, thin pale orange
cho-73	7/9/92	Wonder Cha	15-20m	Rock/Coral	Thin, encrusting white
cho-74	7/9/92	Wonder Cha	15-20m	Rock/Coral	Encrusting, rubbery, jet black
cho-75	7/9/92	Wonder Cha	15-20m	Rock/Coral	Encrusting, rubbery, sandy colored. dull yellow
cho-76	7/9/92	Wonder Cha	15-20m	Rock/Coral	Encrusting bumps about 1-2mm in diameter. light orange
cho-77	7/9/92	Wonder Cha	15-20m	Rock/Coral	Encursting, leathery, orange with light spots
cho-78	7/9/92	Wonder Cha	15-20m	Rock/Coral	Encrusting, leathery. Beige with darker beige mottling
cho-79	7/9/92	Wonder Cha	15-20m	Rock/Coral	Clear encrusting with white large zooids. White mottling around tunic
cho-80	7/9/92	Wonder Cha	15-20m	Rock/Coral	Same as 74
cho-81	7/9/92	Wonder Cha	15-20m	Rock/Coral	Leathery encrusting. Black with dark orange mottling.
cho-82	7/9/92	Wonder Cha	15-20m	Rock/Coral	Semi-thick encrusting. Dark bluish-green with whiteish mottling.
cho-83	7/9/92	Wonder Cha	15-20m	Rock/Coral	Small clumps of individual zooids. Colonial. Dirty orange with milky orange z
cho-84	7/9/92	Wonder Cha	15-20m	Rock/Coral	Thick encrusting, beige/pale. Same as 78
cho-85	7/9/92	Wonder Cha	15-20m	Rock/Coral	Same as 79
cho-86		Omodes	1m	Rock	Thick encrusting, Dark Brown with orange Mottling (slightly pink)
cho-87		Omodes	1m	Rock	Thick encrusting, Brownish maroon with pink mottling.
cho-88		Omodes	1m	Rock	Thick encrusting and dark purple.
cho-89	7/18/92	Big Jellyfish	1m	Branches & ascidian	Encrusting sometimes forming dribbles on mangrove roots. Grey to white
cho-90	7/18/92	Big Jellyfish	1m	Rock, Branches, oyst	Solitary, orange living in clusters.
cho-91	7/18/92	Big Jellyfish	1m	Solitary Ascidians	Thin white encrusting living on the orange ascidians.
cho-92	7/21/92	KB Channel	15m	Rock	Orange gelatinous, thick encrusting with darker orange depressions
cho-93	7/21/92	KB Channel	30m	Rock	Thin encrusting pink with red circles (pebbly) larger zooids
cho-94	7/21/92	Ngerikul Pas	15m	Rock	Solitary dark blue with yellow around siphons. Small and delicate.
cho-95	7/21/92	Ngerikul Pas	15m	Rock	
cho-96	7/21/92	Ngerikul Pas	15m	Rock	
cho-97	7/21/92	Ngerikul Pas	15m	Rock	
cho-98	7/21/92	Ngerikul Pas	15m	Rock	
cho-99	7/21/92	Ngerikul Pas	15m		
cho-100	7/21/92	Ngerikul Pas	15m		
cho-101					
cho-102					

Appendix 2

LOCATION	GPS	DESCRIPTION
Badibei	N 7'23.69 - E 134'35.3	Depressions in reef aprox. 5m/Sandy bottom channel.
Ibobang	N 7'30.58 - E 134'29.6	Narrow passage of a bay, muddy w/ some seagrass.
Nederrak		Algae mat outside of Malakal harbor/ 1m
Flatworm lake	N 7'19.12 - E 134'07-3	Marine lake SW side of KB channel/5m
Ngermutidech	N 7'18.74 - E 134'31.1	Seagrass bed outside of Flatworm lake
Lighthouse Channel		Channel that runs into Malakal on East opening
Airai Seagrass Bed		Other Side of Ngermutidech
Wonder Channel		
Omodes		The channel leading out of Nikko bay before uel island
Ngerikul Pass		
Big Jellyfish Lake		
KB Channel		Channel leading out of the KB bridge. East of Airai

Appendix 3

COLLECTIO	PHYLUM	CLASS	ORDER	FAMILY	GENUS	SPECIES
cho-1	Chordata	Ascidiacea		Didemnidae		
cho-2	Chordata	Ascidiacea				
cho-3	Chordata	Ascidiacea				
cho-4	Chordata	Ascidiacea			Distaplia	
cho-5	Chordata	Ascidiacea				
cho-6	Chordata	Ascidiacea			Phallusia	julinea
cho-7	Chordata	Ascidiacea			Polycarpa	
cho-8	Chordata	Ascidiacea			Herdmania	
cho-9	Chordata	Ascidiacea			Rhopalaea	
cho-10	Chordata	Ascidiacea				
cho-11	Chordata	Ascidiacea		Didemnidae	Didnemnum	molle
cho-12	Chordata	Ascidiacea				
cho-13	Chordata	Ascidiacea				
cho-14	Chordata	Ascidiacea			Lissoclinum	
cho-15	Chordata	Ascidiacea		Didemnidae	Didnemnum	
cho-16	Chordata	Ascidiacea				
cho-17	Chordata	Ascidiacea				
cho-18	Chordata	Ascidiacea				
cho-19	Chordata	Ascidiacea			Lissoclinum	patella
cho-20	Chordata	Ascidiacea				
cho-21	Chordata	Ascidiacea				
cho-22	Chordata	Ascidiacea			Didnemnum	molle
cho-23	Chordata	Ascidiacea				
cho-24	Chordata	Ascidiacea				
cho-25	Chordata	Ascidiacea				
cho-26	Chordata	Ascidiacea				
cho-27	Chordata	Ascidiacea		Didemnidae	Didemnum	
cho-28	Chordata	Ascidiacea				
cho-29	Chordata	Ascidiacea				
cho-30	Chordata	Ascidiacea		Didemnidae	Didemnum	
cho-31	Chordata	Ascidiacea				
cho-32	Chordata	Ascidiacea		Didemnidae		
cho-33	Chordata	Ascidiacea		Didemnidae	Didemnum	rubeum
cho-34	Chordata	Ascidiacea			Clavelina	sp?
cho-35	Chordata	Ascidiacea		Didemnidae		
cho-36	Chordata	Ascidiacea				
cho-37	Chordata	Ascidiacea			Eudistoma	?
cho-38	Chordata	Ascidiacea				
cho-39	Chordata	Ascidiacea				
cho-40	Chordata	Ascidiacea				
cho-41	Chordata	Ascidiacea		Didemnidae		
cho-42	Chordata	Ascidiacea				
cho-43	Chordata	Ascidiacea				
cho-44	Chordata	Ascidiacea			Eudistoma	?
cho-45	Chordata	Ascidiacea				
cho-46	Chordata	Ascidiacea				
cho-47	Chordata	Ascidiacea				
cho-48	Chordata	Ascidiacea				
cho-49	Chordata	Ascidiacea				
cho-50	Chordata	Ascidiacea				
cho-51	Chordata	Ascidiacea				
cho-52	Chordata	Ascidiacea				
cho-53	Chordata	Ascidiacea				

Appendix 3

cho-54	Chordata	Ascidiacea				
cho-55	Chordata	Ascidiacea				
cho-56	Chordata	Ascidiacea			Polycarpa	cryptocarpa
cho-57	Chordata	Ascidiacea				
cho-58	Chordata	Ascidiacea				
cho-59	Chordata	Ascidiacea				
cho-60	Chordata	Ascidiacea				
cho-61	Chordata	Ascidiacea				
cho-62	Chordata	Ascidiacea				
cho-63	Chordata	Ascidiacea				
cho-64	Chordata	Ascidiacea			Lissoclinum	patella
cho-65	Chordata	Ascidiacea				
cho-66	Chordata	Ascidiacea				
cho-67	Chordata	Ascidiacea				
cho-68	Chordata	Ascidiacea				
cho-69	Chordata	Ascidiacea				
cho-70	Chordata	Ascidiacea				
cho-71	Chordata	Ascidiacea				
cho-72	Chordata	Ascidiacea				
cho-73	Chordata	Ascidiacea				
cho-74	Chordata	Ascidiacea				
cho-75	Chordata	Ascidiacea				
cho-76	Chordata	Ascidiacea				
cho-77	Chordata	Ascidiacea				
cho-78	Chordata	Ascidiacea				
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cho-84	Chordata	Ascidiacea				
cho-85	Chordata	Ascidiacea				
cho-86	Chordata	Ascidiacea				
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cho-93	Chordata	Ascidiacea				
cho-94	Chordata	Ascidiacea				
cho-95	Chordata	Ascidiacea				
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cho-97	Chordata	Ascidiacea				
cho-98	Chordata	Ascidiacea				
cho-99	Chordata	Ascidiacea				
cho-100	Chordata	Ascidiacea				
cho-101	Chordata	Ascidiacea				
cho-102	Chordata	Ascidiacea				