Study of Biodiversity and Abundance of Corals in Krabi, Thailand

Credit

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Abstract

The purpose of this research was to explore the coral areas around Koh Podah and to test new software applications for identifying the areas and environments of corals. This experiment compared the results of two programs, Cpce and Wolfram MatheMatica , to determine which one better suits data collection when applied in a qualitative research framework. The methodology involved on-site surveys, access to actual data sources, participatory observation, and group discussions. This research analyzed data using statistical results. The study identified the benefits of using both software types and the various ways of classifying corals.

Keywords : coral , coral reef , coral bleaching , Cpce , Wolfram MatheMatica , GLOBE , Ko Poda , Ocean

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1. Introduction

The problem of coral reefs in 2024 is considered a significant ecological issue in the Andaman Sea and the Gulf of Thailand. This is due to the risk of coral extinction. According to the "Coral Status by Province from 2018 to 2021" report by the Department of Marine and Coastal Resources, the number of corals in Thailand has been decreasing every year, with changes in many coral areas. The degradation of corals can theoretically be attributed to four main causes: 1. Excessive pollution due to garbage in the area, 2. Uncontrolled tourism leading to coral damage, such as diving, stepping on corals, and anchoring, 3. Sedimentation from dredging and navigation, 4. Bleaching due to excessive temperatures. Although corals are maintained and have guidelines for proper care, factors like temperature and sea level, beyond human control, also contribute to coral loss.

The risk of coral extinction has prompted researchers to examine the surrounding areas of coral study sites. Currently, corals are conserved by park officials on certain islands, but these areas also welcome tourists to generate income. This research aims to explore the current status of corals around Koh Podah in Krabi. The study will utilize software for calculating underwater coral data, including Cpce for point-by-point data entry and Wolfram Mathematica for coding individual data points and generating AI-based results. This exploration will not only reveal the condition of corals around Koh Podah but also employ Wolfram Mathematica as a new, more efficient alternative to Cpce for calculating the surrounding environmental conditions of the corals.

This article will concentrate on the diversity found in the coral reefs in Thailand's Krabi Province. The patterns of change in the reefs of Krabi. We will apply our existing skills and knowledge (which have not been combined or synthesized) to understand patterns of diversity and stop the degradation of coral reefs in the seas of Krabi Province, Thailand.

- **Objective and Hypothesis**

Monitor Biodiversity and abundance of corals in Krabi, Thailand

We can monitor the abundance of coral reefs by observing the surrounding environment and using tools such as cameras, or software to inspect the environment around the coral reefs. In addition to the corals themselves indicating the current environmental condition, the surrounding environment also provides insights into how the sea is affecting marine life at present.

Compare Efficiency between both of software that we use for coral analysis

We will utilize two types of software for this purpose.

1. **Cpce, or Coral Point Count with Excel extensions.** This tool is used for determining coral cover using transect photographs. A specified number of spatially random points are distributed on a transect image, and the features underlying these points are identified by the user. The use of Cpce is manual, requiring researchers to input data themselves.

2. **Wolfram MatheMatica** is a software system with built-in libraries for several areas of technical computing. This program can be adapted for use with coral studies by inputting data in each section, which the program then uses to select data at each point based on similarity to the images that have been input. It then makes decisions based on these data points

After using two software programs, we can find efficiency between both of the software programs that we use for coral analysis. So we can utilize the results to determine whether the manual data entry method of CPCE, or the

automated data entry of Wolfram Mathematica, provides more effective and reliable information. This decision will be based on which method yields the most accurate and useful data for our study of the coral environment.

2. Materials and Methods

- **Study sites**

The study area was Koh Poda (N 7.974617, E 98.809475) Mueng Krabi District, Krabi Province, Southern Thailand (https://maps.app.goo.gl/sGhPbYJws7VJFd116)

- **Data collection**
  - **Picture and Video of Corals in Koh Podah By using These camera for diving (All images were taken on 01/03/24)**
    - Olympus tg tough
    - Olympus omd em5
    - Canonpower short G1x mark2
    - Sony rx1004
    - DJI Osmo Action
  - **Water quality**
    - By using GLOBE Hydrosphere Protocol. So we have 2 sample of water

1. **Nopharat Thara Beach** sample water 500ml bottle Sample of water data obtained from the (N 8.044059, E 98.796690) Mueng Krabi District, Krabi Province, Southern Thailand

2. **Koh Podah** water sample water 1500 ml bottle
   Sample of water data obtained from the Koh Podah (N 7.974617, E 98.809475) Mueng Krabi District, Krabi Province, Southern Thailand

- After collect sample water following globe data collection method
  Measure each value 3 times (*clean the equipment after dipping in the water 2 times)
  First time : wash by filtered water and wipe with tissue
  Second time : wash by filtered water again and stabilize the value of the equipment
  - The difference between all value is not more than 0.05 or else you need to repeat all process again

- **Data Preparation**

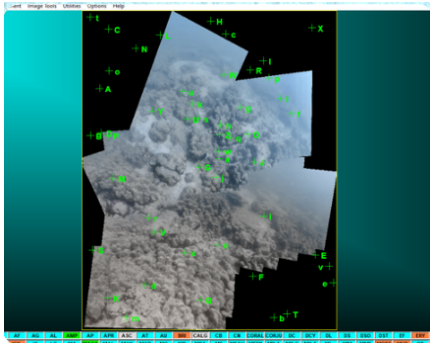
Because both the Cpce program and the Wolfram Mathematica program require image recognition in each segment to identify coordinates, here are all the steps we will undertake after obtaining the photographs/videos

- Select and crop useable picture and video of corals using "Clip Champ"
- Convert corals video to panorama using "Image Composite Editor"
- Color correcting and sharpening using "Photos in Mac"

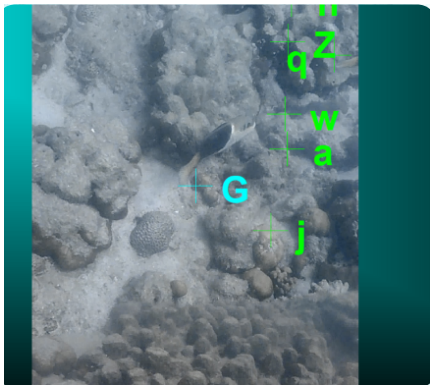
So we can cut out the water color in photo and this facilitates the classification of corals

- **Data Analysis**
  - **Manual analysis with CPCe Application**
    1. Import all picture from preparation step

2. Auto generate 50 randoms point overlay each picture



3. identify object type each point in every picture

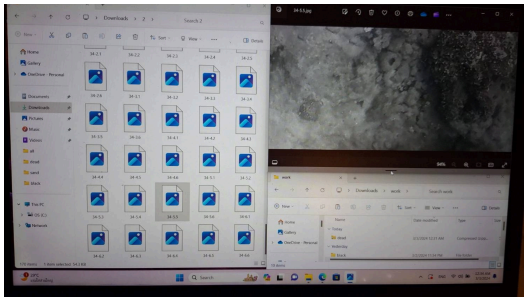


4. Export Excel file from the program.

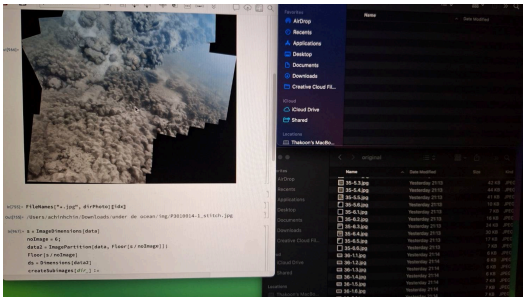
	A	B	C	D	E	F	G	H
1		Sheet 1	Sheet 2	Sheet 3	AVERAGE			
2	Shannon-Weaver Index	1.01	1.13	1.27	1.160644542	CORAL (C)	61.77474403	53.13807531
3	CORAL (C)	0.30	0.34	0.29	0.3034222081	GORGONIANS (G)	0	0
4	GORGONIANS (G)	0.00	0.00	0.00	0	SPONGES (S)	0	0
5	SPONGES (S)	0.00	0.00	0.00	0	ZOANTHIDS (Z)	0	0
6	ZOANTHIDS (Z)	0.00	0.00	0.00	0	MACROALGAE (MA	0	0
7	MACROALGAE (MA)	0.00	0.00	0.00	0	OTHER LIVE (OL)	1.365187713	0.4184100418
8	OTHER LIVE (OL)	0.06	0.02	0.06	0.05108326177	DEAD CORAL WITH	22.8668942	4.60251046
9	DEAD CORAL WITH ALGAE (DCA)	0.34	0.14	0.34	0.2942513907	CORALLINE ALGAE	0	0
10	CORALLINE ALGAE (CA)	0.00	0.00	0.00	0	DISEASED CORALS	0	0
11	DISEASED CORALS (DC)	0.00	0.00	0.00	0	SAND, PAVEMENT,	12.96928328	28.45188285
12	SAND, PAVEMENT, RUBBLE (SPR)	0.26	0.36	0.32	0.3114955846	UNKNOWNS (U)	1.023890785	13.38912134
13	UNKNOWNS (U)	0.05	0.27	0.26	0.2003920969			
14	TAPE, WAND, SHADOW (TWS)							
15								
16		Sheet 1	Sheet 2	Sheet 3	AVERAGE			
17	Simpson Index of Diversity (1-D)	0.55	0.62	0.66	0.6180631741			
18	CORAL (C)	0.38	0.28	0.02	0.1865516567			

- **Machine learning analysis with <u>Wolfram Mathematica</u>**

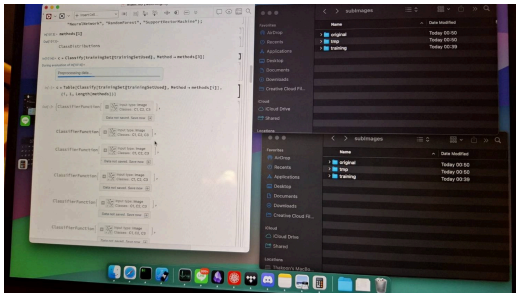
1. Select some picture from total



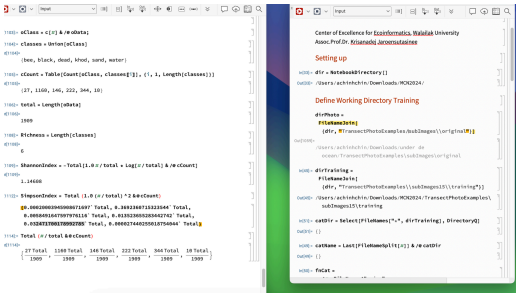
2. Divide a picture to many small pictures, then identify types of object by hand



3. Take them to train AI to classify and compare the accuracy between many models



4. Use machine learning model to classify and count objects



- Accuracy test

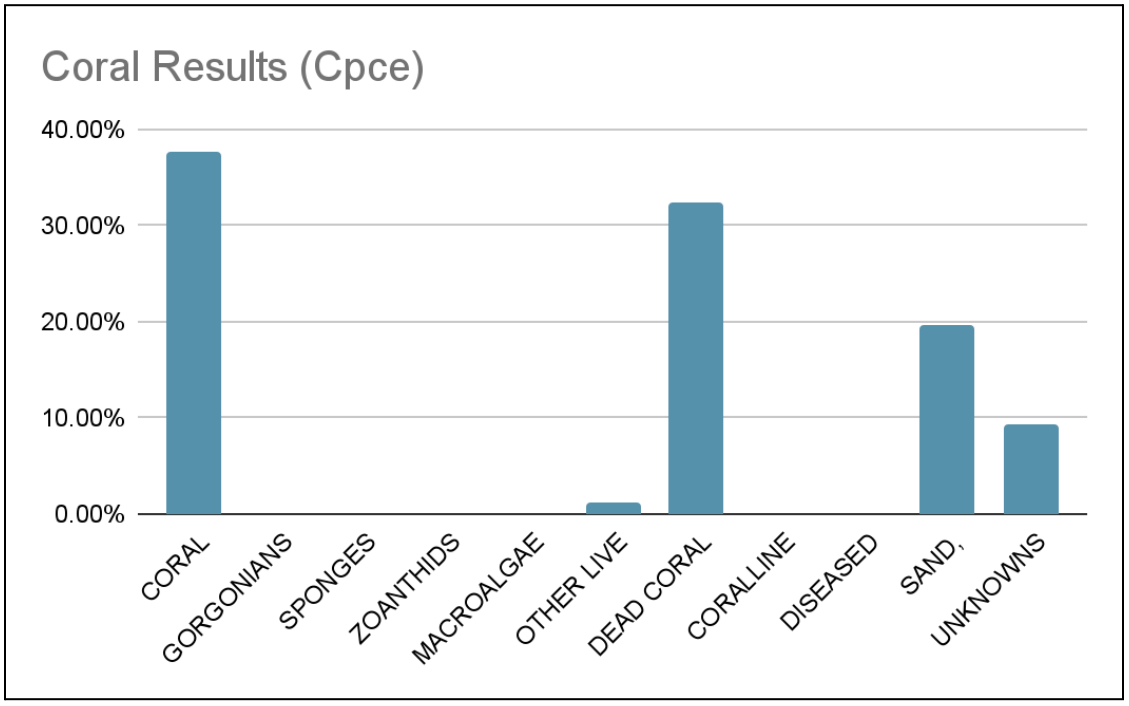
The Cpce program has an error margin of about 10% compared to the actual location, which is still considered a small amount. This is due to a lack of understanding of corals and the program's use of a wide variety of classifications, such as coral species, sand, soil, rocks, tape, etc. Most of the images obtained show broken, dead, or bleached corals, making it difficult to distinguish between living and dead corals. Meanwhile,

Wolfram Mathematica uses fewer classification categories, dividing them into coral species and dead corals. The results obtained from running data in Wolfram Mathematica are similar to those of CPce

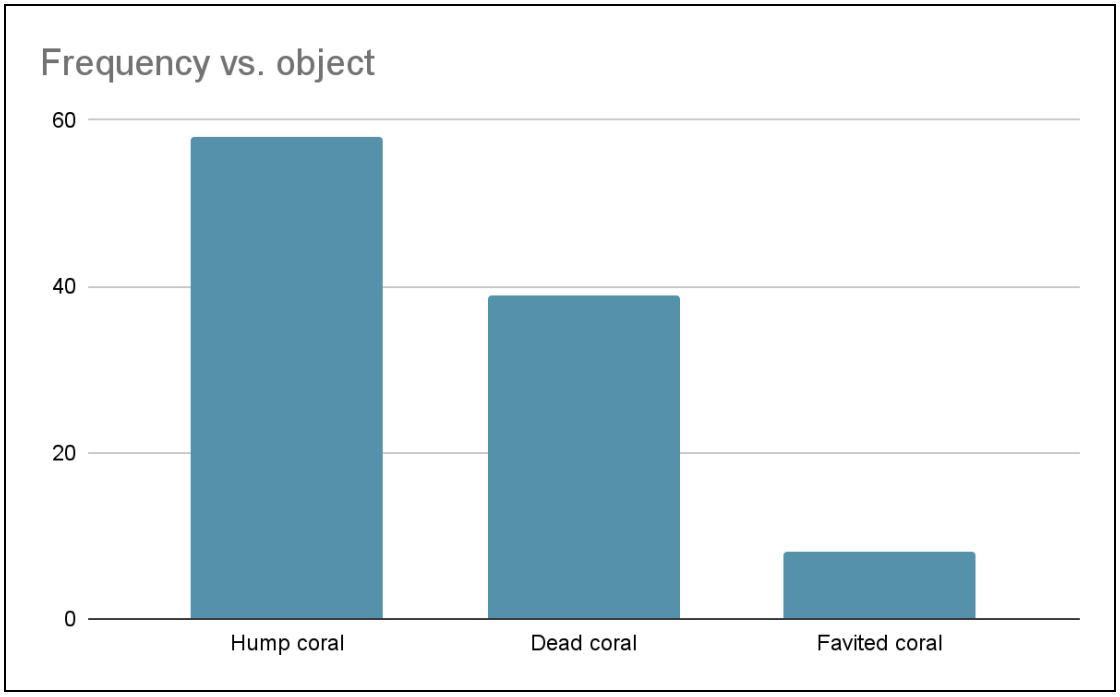
3. Results and Discussion

1. Results

- **Coral results**
  - **Cpce (Manual Analysis)**
    - Shannon-Weaver Index : 1.161
    - Simpson Index of Diversity(1-D) : 0.618



  - **Wolfram Mathematica (Machine learning analysis)**
    - Shannon-Weaver Index : 1.146
    - Simpson Index of Diversity(1-D) : 0.618



- **Water results**

  All water samples will be measured in two ways:

  1. pH
  2. Salinity

  Corals can survive in a pH range of 8.2 to 8.4, and the salinity should not be less than 30 or more than 35. The results of the water measurements, conducted using Analytical Instruments. results are as follows.

  - **Nopparat Thara Beach**

Water Quality	**Test 1**	**Test 2**	**Test 3**
pH	8.44	8.44	8.44
Salinity	17.8	17.7	17.6

- **Koh Podah**

Water Quality	Test 1	Test 2	Test 3
pH	8.54	8.56	8.56
Salinity	17.7	17.7	17.8

2. Discussion

The experimental results of the water are consistent with the condition of the corals. It was observed that in the area we surveyed, there was a significant loss of coral, almost 60% of the total coral population found. This aligns with the water quality, as the measured salinity was less than 30 ppt, which is below the level required for coral sustenance.

Additionally, the use of both Cpce and Wolfram Math programs yielded similar results. The most common type of coral found was massive coral, followed by dead coral, and then staghorn coral in that order

3. Recommendations

- **Recommendations for the Research Location (Koh Podah)**
    1. Increase the punishment for destroying coral reefs.
    2. Limit tourists traveling areas.
    3. Place artificial coral reefs to restore natural reefs.
    4. Installation of mooring buoys To prevent boats from being anchored on coral reefs.
- **Recommendations for other research**
    1. The Cpce program is more challenging to use than Wolfram Mathematica; therefore, during its operation, care should be taken and the methodology should be thoroughly studied.
    2. For coral reef surveys, considerations for protection and future preservation of the reefs should be included. This is due to the observation that in the area we studied, there is a higher quantity of bleached coral compared to living coral.
    3. It is advisable to find multiple locations for study to assess the effectiveness of the program.

4. Conclusion

The water quality analysis around Koh Podah indicates that the pH levels are adequate for coral survival. However, the salinity is lower than what corals require, explaining why most corals found in this area are dead. Corals cannot thrive in water with salinity levels below a certain threshold.

Additionally, most of the corals encountered are in tourist areas, suggesting other factors contributing to their degradation or death. These include inadequate management by park authorities, sedimentation from coastal erosion and transport ships, and the introduction of pollutants harmful to corals, such as trash disposal in the sea and the use of non-reef safe sunscreen.

I would like to claim IVSS badges

1. I AM A STEM PROFESSIONAL

Collaborate with a STEM professional who can contribute to the research methods. This could involve working with a marine biologist or an environmental scientist specializing in coral reefs. Their expertise can enhance the precision of your research and provide sophisticated analyses and interpretations of your results.

2. I AM A DATA SCIENTIST

Dive deep into data analysis of coral reefs, including data collected by students and other available sources. This can involve examining the limitations of these data, making inferences about past, present, or future conditions of coral reefs, and using data to answer questions or solve problems related to coral reef conservation. This might include data from other schools or databases.

3. I MAKE AN IMPACT

Focus on how your research addresses local issues, such as the conservation of coral reefs around Podda Island, and draws connections to global impacts. Describe or demonstrate how the research contributes positively to the community. This could be through making recommendations or taking action based on your findings, perhaps in terms of coral reef protection or environmental awareness.

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