Monitoring Green Turtles (*Chelonia mydas)* Behavior and Abundance in Kāneʻohe Bay: Do Basking Coves Indicate Coral Substrate Selection?

By Violet Marshall

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01 Introduction

Why is this research
being done?

Coral and Algal Abundance

- Coral in Kaneohe Bay is a keystone species.

- There has been a decline in Coral health starting in the 1940's- 1970's (Banner, 1970).

- The coastal water has increased in pollutants such as phosphate and nitrogen due to the growth of urbanfication in town.

- Pollutant caused Green bubble algae to invade coral eventually killing it.

Green Turtles Role in Bay

Green Turtles inhibit basking coves, yet it is unknown if resting coves are associated with specific coral species.

- They are most abundant herbivore in the bay.

- Green Turtle (*Chelonia mydas)* high abundance is due to there usage of the coral reefs, such as for feeding pastures and resting coves (Balaz , 1980).

- There Diet consist of seagrass, green algae *Chlorophyta* , red algae (*Rhodophyta)* ,brown algae(*Turbinaria ornata)* and invasive algae(Parker 2011).

— Research Goals

The goal is to determine which species of coral is being **most commonly** used by turtles to determine which species of coral are are at **lower risk** of algae destruction.

— Motivation

The motive of my research is to determine if the relationship between **green turtles** and **preferred substrate,** can further help to restore the deteriorating coral in the bay.

Hypothesis

<u>Hypothesis 1:</u> *Chelonia mydas* recorded will have a higher average of resting due to that being a common behavior near feeding pastures.

<u>Hypothesis 2:</u> There will be a higher average of turtles abundance in coves that have majority percent coverage of *Porites compressa* due to that species covering 90% of the bay.

02 Methodology

Survey

Collect Field data

Analysis

Analysis Photograph Data

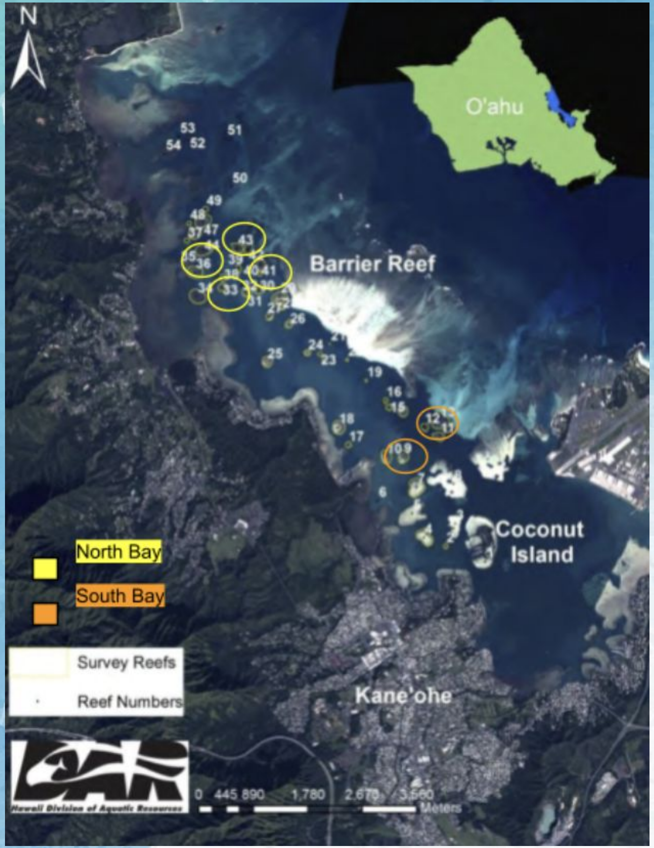
Test

Statistical Test used to Determine significance

Map of Surveys

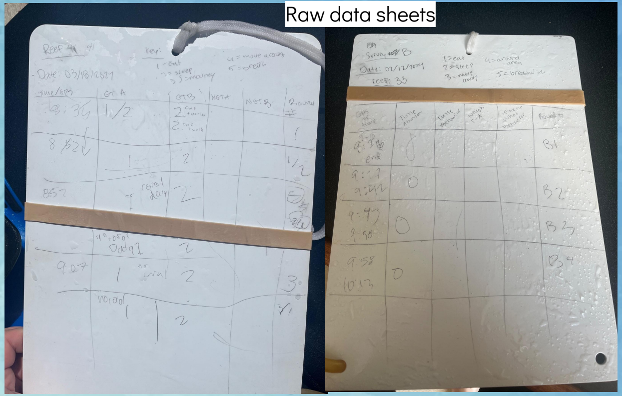
- 9 Reef Surveyed
- Surveys conducted weekly on monday morning from 9-10 am
- Surveys were 15 minutes long and done 4x per outing

Reefs Surveyed:
Reef 43 = NB/OFF
Reef 41= NB/OFF
Reef 36= NB/ON
Reef 33 = NB/ON
Reed 14= SB/OFF
Reef 12= SB/OFF
Reef 11= SB/OFF
Reef 10= SB/ON
Reef 9= SB/ON



How Data were Collected

- Survey the perimeter of reef
- Behavior will be recorded by the behavior key
- Abundance will also be recorded
- Abundance per reef used to determine which regions has more turtle activity



Ex: Behavior survey

Date:

Reef:

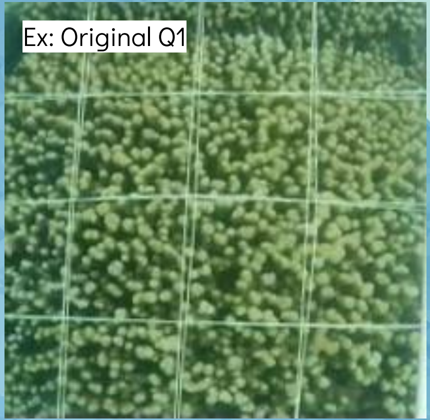
Behavior key:
1= Eating
2=Resting
3= Moving away from basking area
4= Moving Around the basking area
5= Breathing and moving up/down
6= Circling basking area
7= Staying in basking area, with large breathes
8= Charging

GPS/Time:	GT count:	GT Behavior:	N-GT count:	N-GT Behavior:	Round # :

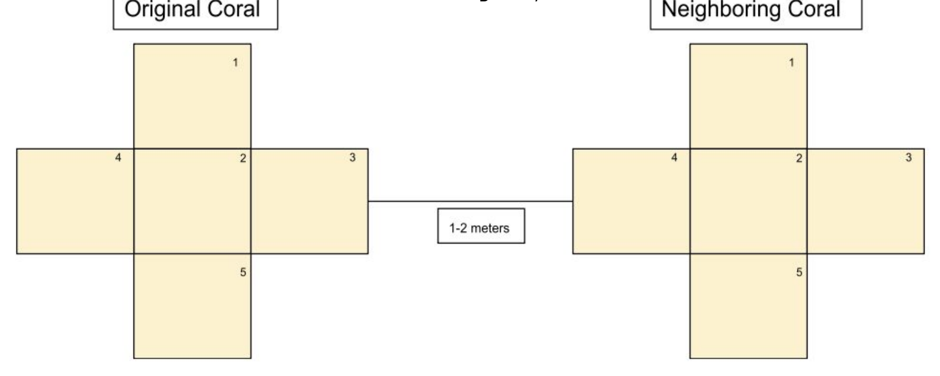
Substrate and Coral Coverage Photographs

- When applicable four-five substrate quadrats images from the cove with turtle present will be taken.

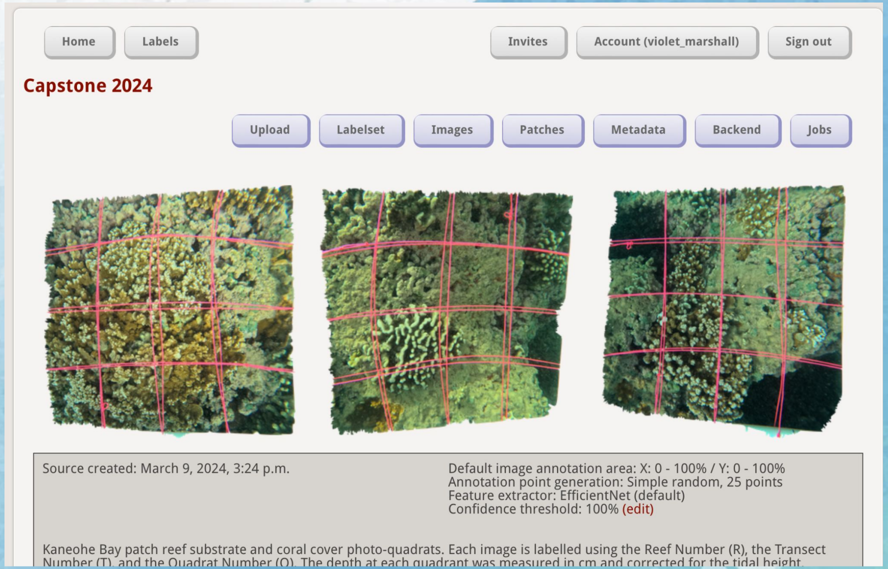
- Randomly going left or right ,We will then move 1-2 meters away from active turtle cove to then take adjacent images of substrate where turtles are absent.



Ex: Image Layout



CoralNet Software



- Created by UCSD
- Software will pin 25 points that can be identified within the photo

03 Results

Abundance Results

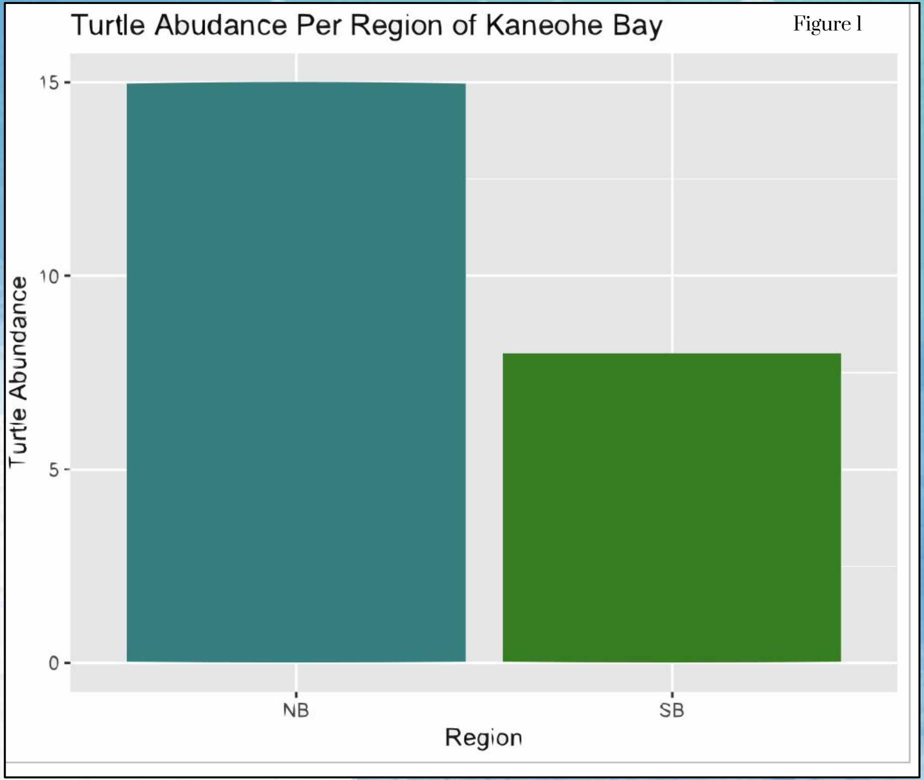


Figure 1: Raw Abundance Data of North Bay (65%) compared to South Bay(35%).

Abundance Results

Table 1

```
Multiple comparison test after Kruskal-Wallis
alpha: 0.05
Comparisons
               obs.dif critical.dif stat.signif
S_Off-S_On    3.766234     12.33428       FALSE
S_Off-N_Off  10.390909     11.14644       FALSE
S_Off-N_On    5.009091     13.75947       FALSE
S_On-N_Off   14.157143     12.57183        TRUE
S_On-N_On     1.242857     14.93756       FALSE
N_Off-N_On   15.400000     13.97280        TRUE
```

```
        Kruskal-Wallis rank sum test

data:  Turtle by Region
Kruskal-Wallis chi-squared = 4.7716, df = 1, p-value = 0.02893
```

```
        Kruskal-Wallis rank sum test

data:  Turtle by R_Off_On
Kruskal-Wallis chi-squared = 15.757, df = 3, p-value = 0.001272
```

Figure 2

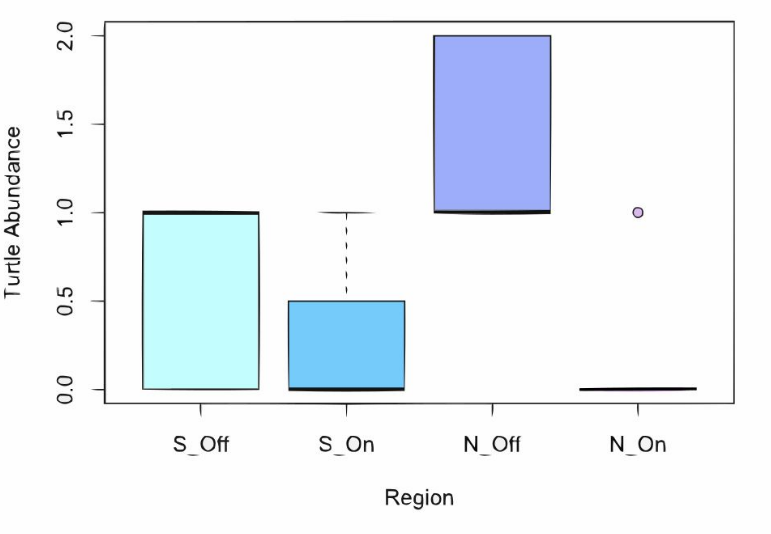


Table 1: Kruskal-Wallis results for comparing each region of the bays turtle abundance. Kruskal-Wallis test results for Southern Region compared to Northern Region . Kruskal-Wallis results for offshore and onshore abundance.

Figure 2: Boxplot of turtle abundance per Region of Kaneohe Bay.

Behavior Results

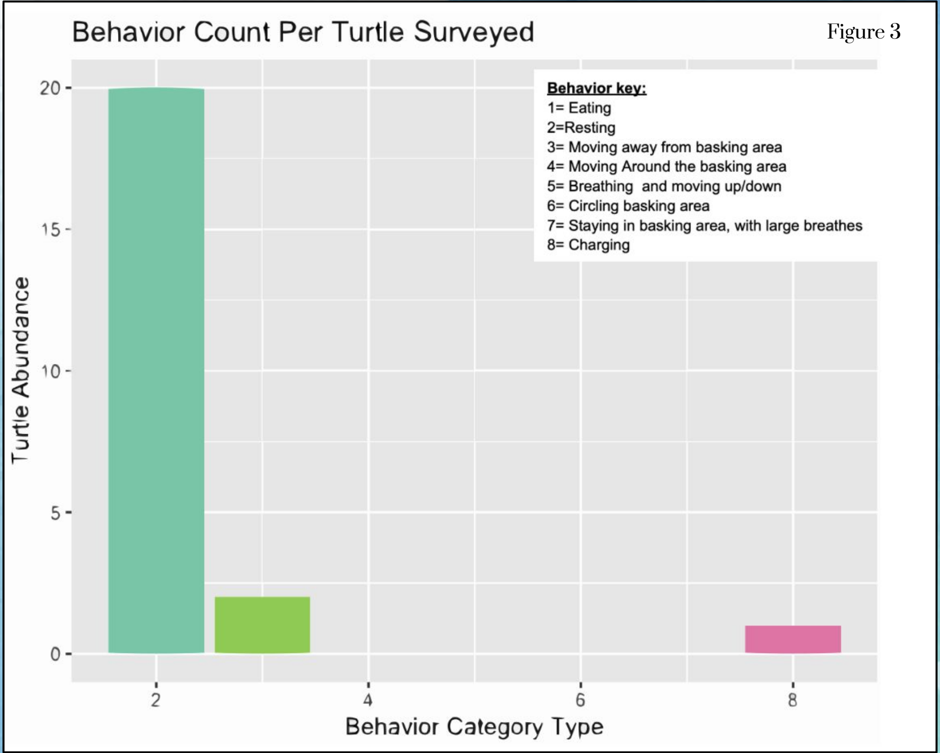


Figure 3: Turtle behavior monitored throughout all 9 reefs surveyed

Table 2

```
Chi-squared test for given probabilities

data:  x
X-squared = 29.826, df = 2, p-value = 3.337e-07
```

Table 2: Chi-squared test comparing significance of behavior type throughout all 9 reefs surveyed

Table 5

```
        Spearman's rank correlation rho

data:  data$NE and data$OR
S = 30.417, p-value = 0.8047
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.1309307
```

Table 5: Spearman Rank Correlation Test of OR vs NE substrate percent coverage at Reef 43

Table 6

```
        Spearman's rank correlation rho

data:  data$NE and data$OR
S = 2, p-value = 0.3333
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
0.8
```

Table 6: Spearman Rank Correlation Test of OR vs NE substrate percent coverage at Reef 41

P-Value = not significant

Spearman Rank Correlation Test

(Individual Test per Reef)

Table 7

```
        Spearman's rank correlation rho

data:  data$NE and data$OR
S = 15.528, p-value = 0.7177
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.2236068
```

Table 7: Spearman Rank Correlation Test of OR vs NE substrate percent coverage at Reef 41

```
        Spearman's rank correlation rho

data:  data$NE and data$OR
S = 24.029, p-value = 0.5452
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.3134678
```

Table 8: Spearman Rank Correlation Test of OR vs NE substrate percent coverage at Reef 12

```
        Spearman's rank correlation rho

data:  data$NE and data$OR
S = 0.5359, p-value = 0.3333
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.8660254
```

Table 9: Spearman Rank Correlation Test of OR vs NE substrate percent coverage at Reef 11

Northern Reefs

Figure 4: Reef 43 Substrate percent coverage of OR vs NE

-High Abundance of PorComp in both OR and NE

- Variety of substrate in NE

- only 24 images used

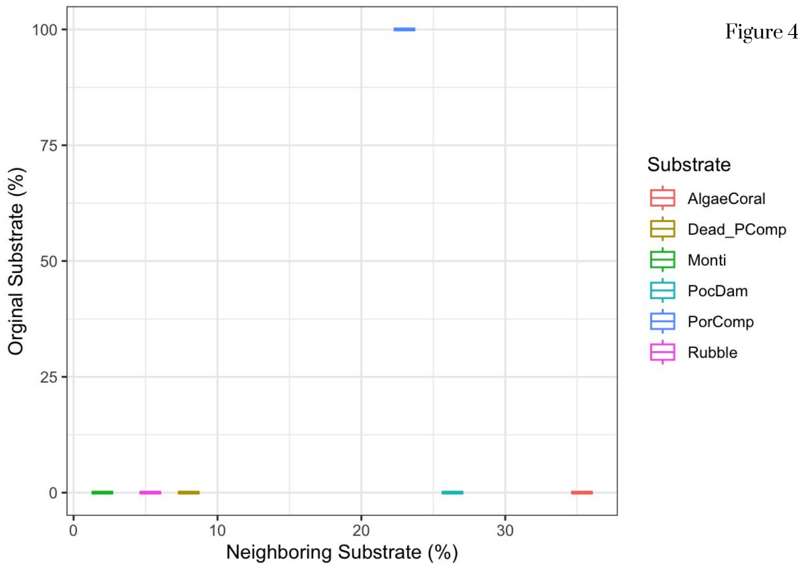


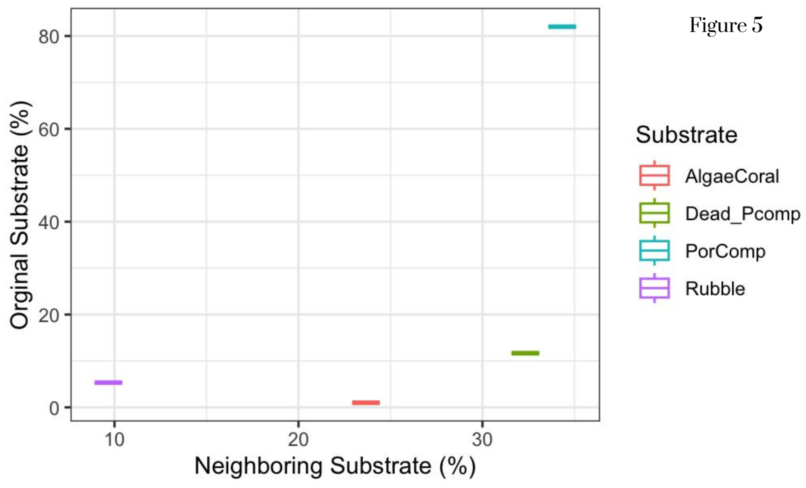
Figure 5: Reef 41 Substrate percent coverage of OR vs NE

-High Abundance of PorComp in both OR and NE

- Slightly increase Dead PorComp in OR

- Variety of substrate in NE

- only 24 images used



Southern Reefs

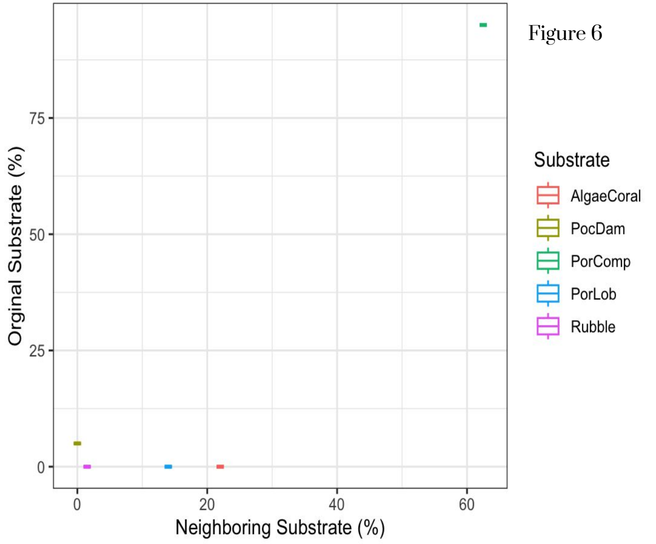


Figure 6

Figure 6: Reef 14 Substrate percent coverage of OR vs NE

-High Abundance of PorComp in both OR and NE

- Variety of substrate in NE

- only 16 images used

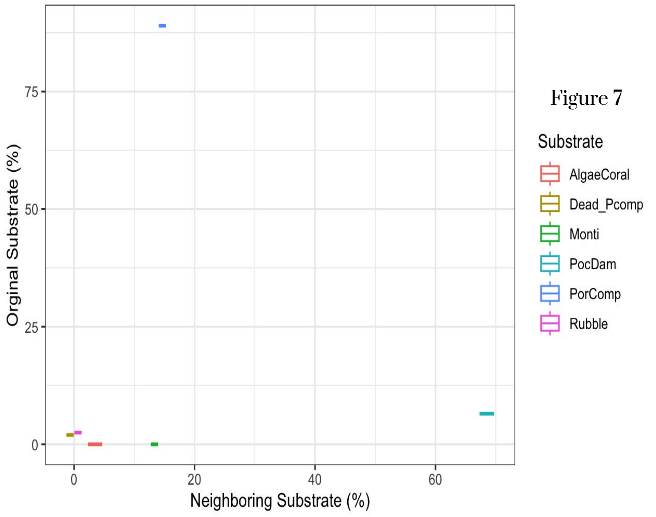


Figure 7

Figure 7: Reef 12 Substrate percent coverage of OR vs NE

-High Abundance of PorComp in both OR and NE

- Dead PorComp in both OR and NE

- Variety of substrate in NE

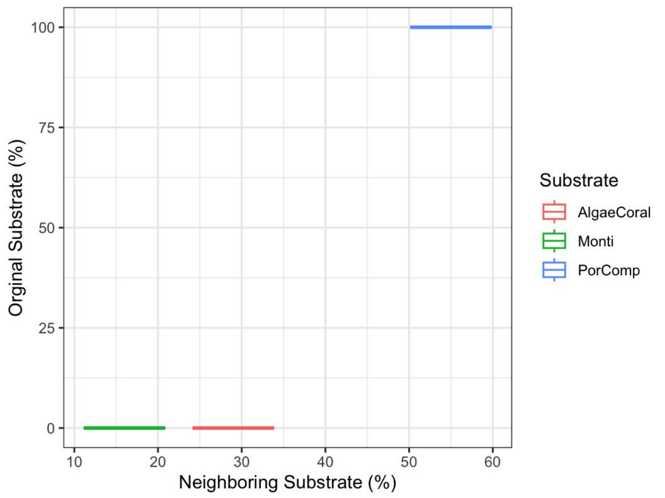
- only 16 images used

Figure 8: Reef 11 Substrate percent coverage of OR vs NE

-High Abundance of PorComp in both OR and NE

- Only 3 substrate identified during the survey

- only 8 images used



Coral Results

Table 3

```
        Welch Two Sample t-test

data:  SB_PC_capstone$PC_OR and SB_PC_capstone$PC_NE
t = 4.4374, df = 4.8507, p-value = 0.007282
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 25.74848 98.25152
sample estimates:
mean of x mean of y
     93.6      31.6
```

Table 4

```
        Welch Two Sample t-test

data:  NB_PC_capstone$PC_OR and NB_PC_capstone$PC_NE
t = 6.8472, df = 7.8079, p-value = 0.0001472
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 40.80912 82.52421
sample estimates:
mean of x mean of y
 91.00000  29.33333
```

Table 3: T-Test of South Bay Porites Compressa percent coverage of coves with turtle present (OR) compared to no turtle present (NE).

Table 4: T-Test of North Bay Porites Compressa percent coverage of coves with turtle present (OR) compared to no turtle present (NE).

Discussion

Abundance:

- Turtles are most dominant in North Offshore
- P-value of Kruskal Wallis test indicates significant differences between abundance in North and South
- P-value Kruskal Wallis test indicates significant difference between Abundances in On and Off shore

Behavior:

- Majority of Turtles monitored were resting (90%) and foraging (10%).
- P value of Chi Square test, confirmed that data was significant.

Substrate :

- The P-value of t test showed that South Bay and North Bay Original sites had significant more amount of Porites Compressa % coverage.

Spearman rank test showed that there was no association between the ranked substrates per individual reef

04 Conclusion

Conclusion

Summary:

- Porites Compressa high percent coverage in basking coves, but it has majority abundance throughout every reef.
- Substrate has no association to each other which concludes that restrictions based on reefs substrate would be extremely difficult.
- Focusing on increasing restrictions for the public's use of reefs in Northern Offshore region would be most beneficial to increase turtle grazing.
- Goal to see preferred substrate in basking cove was semi successful

Future Studies:

- Compare algae abundance in patch reefs with and without turtle coves.
- Eliminate as many limitations for future research , due to monitoring abundance and behavior of a wild animal.

Limitations

How many reefs surveyed during research.

The time of year/season.

Dependency of additional help while conducting surveys.


Thank you for watching!♡

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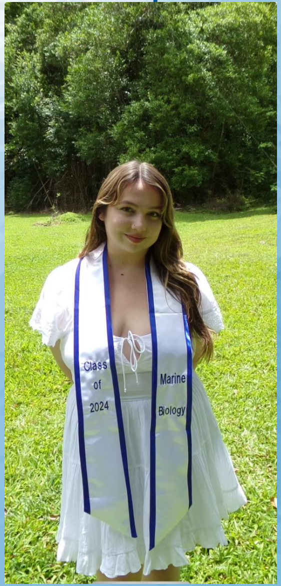

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Data Images