VARYING IMPACT OF HUMAN FEEDING ON PINK WHIPRAYS, *HIMANTURA FAI*, AT TWO SITES ON MO'OREA

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Abstract. This study was conducted on Mo'orea, French Polynesia to investigate and record the impacts of ecotourism on two populations of *Himantura fai*, pink whiprays or pink whiptail stingrays. Two sites were chosen each with varying human impact on the rays. Photographs and recordings were made and analyzed. Thirty-seven individual rays were identified, 29 from one site, 8 from the other. Five kinds of scarring were described and compared between the two sites: wavy, thin scrape, thick black, scrape cluster, and cospecific bite. Two scar types, wavy and thick black were not found at site 2. The densest ray population, site 1, had more injuries and impact from and habituation to humans. The higher frequency of injury suggests a lower quality of life and indeed a negative impact from ecotourism as it follows the trend seen in the Southern Stingray populations. A mock mark and recapture study using the Licoln-Peterson method gave population estimates of 30 and 8, indicating that the 29 and 8 rays identified are the entire populations. No rays were seen at both sites, which indicates site fidelity.

Key words: Himantura fai; pink whiptail; pink whipray; stingray;, ecotourism

INTRODUCTION

There is increasing public interest in natural history and the first hand experience of living organisms and ecosystems. As a result an entire industry of ecotourism has developed. This rapidly growing industry is controversial. It can be extremely lucrative for the country or the village it occurs in, yet it also can alter natural behaviors that have existed for millions of years. This is particularly visible in the case of feeding wildlife.

Feeding wildlife poses many risks both to the species and to the people feeding (Orams 2002). Feeding also causes changes in social structure, interspecies interactions, and increases population densities (Millazo 2006). Marine ecosystems are particularly susceptible especially in the case of Dasyatids, the family containing rays, skates, sharks, and other cartilaginous fishes.

Feeding of Dasyatids is worldwide but is particularly concentrated and intensely studied and monitored along the coast of Latin and South America. The target species there is *Dasaytis americana,* commonly known as the Southern stingray. The vast numbers of feeding tours and operations there have led to populations of rays altering their natural behaviors and becoming dependent on humans as well as habituated to them (Semenuik 2008). The results of other studies on the southern stingray have further solidified this result. This kind of tourism is exponentially increasing internationally and the altered behavior is soon to follow.

One species *Himantura fai*, the pink whiptail stingray or pink whipray, which is found in Mo'orea, French Polynesia is a species that has not been studied in detail, yet it is being targeted by ecotourism.

The feeding of this species is leading to forced interactions with black tip reef sharks, *Carcharhinus melanopterus*, a predator of the pink whipray. Furthermore, the species, normally a solitary forager, congregates in dense populations as a response to the constant food source. Through lessons learned in the past and in the majority of papers on group living and tourism involving rays and every species affected by ecotourism, we can safely say that these populations are on their way to human dependence and decreased health. Through studying them we can match the detrimental signs documented on other species and show that there is reason to stop this kind of tourism, or at least adjust the methodology.

In general the populations being fed are more injured, bare higher parasite loads, and lose natural cycles and seasonality of mating behaviors (Semeniuk 2008). By gathering data on this species we can attempt to prevent the negatives of tourism and modify our human behavior in order to help keep this organism in its evolutionary role in the coral reef ecosystem. For the two populations studied I would like to know 1) what explains the differences between scars/injuries found on *Himantura fai*? And 2) how large are the populations at each site and are any individuals found at both sites? I believe that the individuals in the lagoon, Site 1, will have a higher frequency of injuries as well as a higher population. The higher incidence of injuries will be caused by the denser population and the also deeper water allows for more boats. There will be no overlapping rays between sites and the two will be distinct populations.

METHODS

Figure 1: Map with study sites labeled from Google Earth

Two sites were used, one, a lagoon near the motu Tiahura at 17°29'15.94"S and 149°54'0.36"W and the other in Pao Pao/Cook's bay outside of the restaurant Te Honu Iti at 17°30'17.96"S and 149°49'8.31"W. For this I used an underwater camera, standard camera, and an underwater video camera as well as a second person both to help record data and as a safety measure.

Study organism

Himantura fai (Jordan and Seale, 1906), commonly called the pink whiptail stingray or the pink whipray, was the focus of this study. It belongs to the Family Dasyatidae, Order Rajiformes, and Class Elsamobranchii. This species tends to be found in sandy areas just outside reefs. They are solitary bottom feeders with large home ranges. The species is found primarily in the Indo-Pacific They can be a variety of colors from brown, tan, pinkish, to dark grey. The largest recorded weight is 18.5 kg. For defense they have venomous barbs. They begin life with two but will lose them if they are used. Their diet consists mostly of small, sand-dwelling creatures especially stumatopods (Mould).

Figure 2: *Himantura fia*

Observations

First, depth of each of site was measured by using a transect tape and taking three measurements at different, random areas in the site, and then averaging the depths together. Each observation took place at the site for one hour on different days and at different times, which were dependent on transportation. Each site was observed five times, for a total of ten observations. During each hour, I alternated photography and recording every fifteen minutes; however if no rays were present during the first photography time period I did not take video because of the lack of rays. After each observation I uploaded the pictures and the film. Using the different types of scaring and injuries, individuals were identified and scar types were categorized and then put into a data table. I also recorded the numbers of boats and the presence or absence sharks at the sites every fifteen minutes. This information as well as the average depth were placed into a table.

Using the scars and injuries individuals were identified, numbered, and organized into folders labeled either L# or THI#. The scars were sketched and referenced as I filtered through photographs and separated the individuals.

Mark recapture

To estimate the populations of rays at the two locations the Lincoln-Peterson method (Besbeas) was used.

The equation for this is $N = \frac{MC}{R}$, where N=population size, M=total numbers of animals captured and marked on first visit, C=total numbers of individuals captured on second visit, and R=number of individuals marked during visit one and recaptured during visit two. Only two observations were used to estimate populations. Unlike traditional mark recapture methods I neither marked nor recaptured individuals. I used the individuals identified using their scar and injuries. With these identifications I went through the film and photos again and sample two observation hours. I looked at total numbers of rays for each visit. Furthermore, I compared the tapes for each site and looked for rays from Site 1 showing up at Site 2, which led to a general idea of site fidelity.

RESULTS

Observations

From analyzing the data from the 10 observations a total of 37 individual rays were identified, 29 from Site 1 and 8 from Site 2. The scars were split into 5 categories, wavy (figure 3), thin scrape (figure 4), scrape cluster, co-specific bite, and thick black (figure 5). The scars were then counted for each individual ray and summed for each respective site. The site counts were put into graphical form, (figure 6). Average number of scars per ray, most scars per ray, average depth of site, and presence of boats and sharks were all recorded (Table 1).

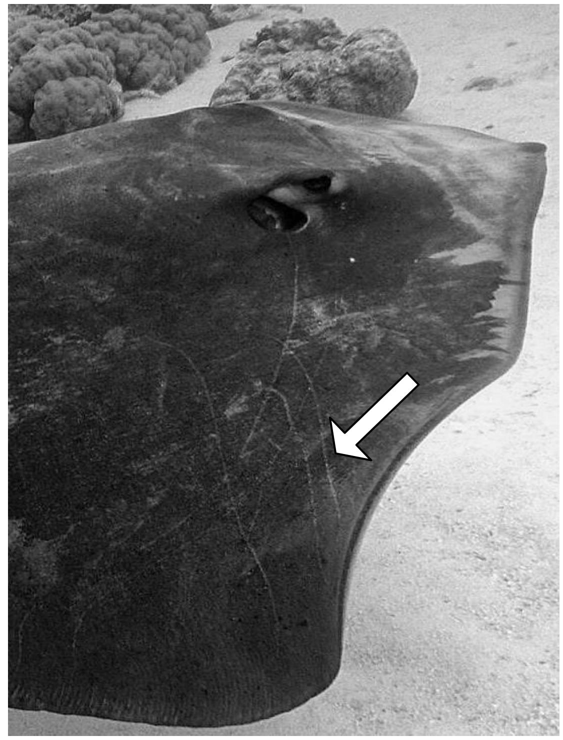

Figure 4: Example of Thin Scrape Scar Type

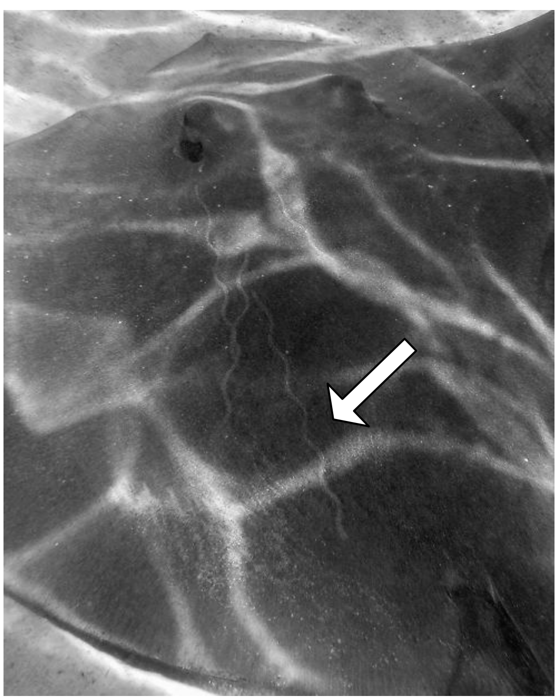

Figure 3: Example of Wavy Scar Type

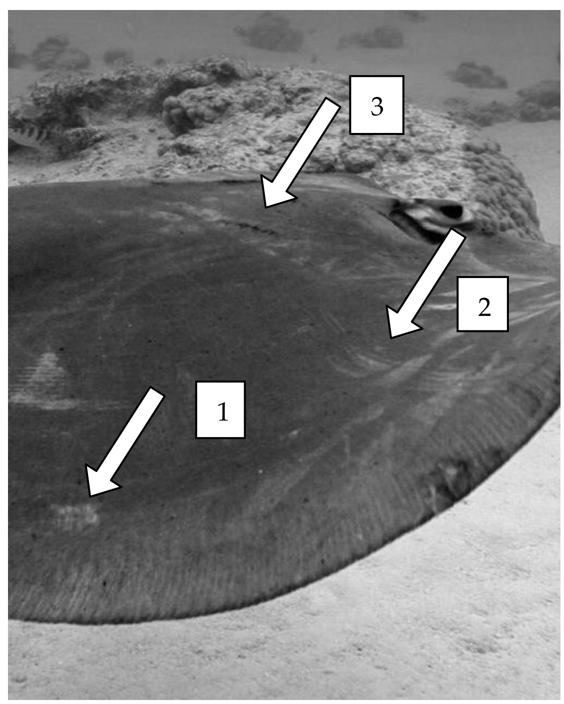

Figure 5: Example of Cospecific Bite (1), Scrape Cluster (2), and Thick Black Scar (3)

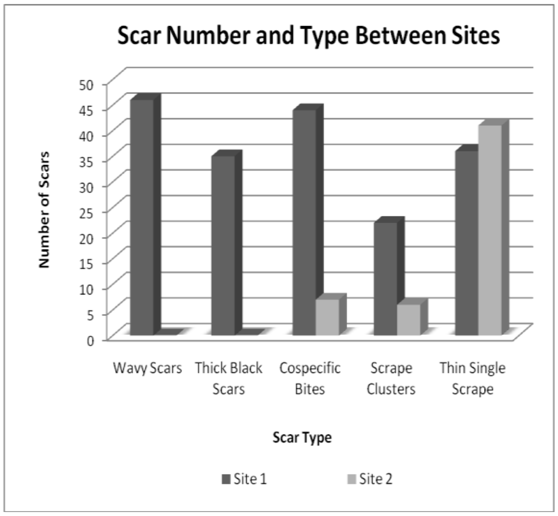

Figure 6: Comparison of Scar Types at two locations

	Lagoon	Te Honu Iti
Number of Individuals Identified	29	9
Average Number of Scars Per Ray	6.31	6
Highest Number of Scars on One Ray	22	15
Sharks	Present	Absent
Average Depth	3.556 m	.69 m
Average Number of Boats Present	3	0

Table 1: Data from Observations

Mark and recapture

The Licoln-Peterson method was used twice, once for each site. For site 1 the first observation used was October 13th, 2008 and the second November 10th, 2008. The first observation yielded 13 marked rays. The second observation yielded 10 rays, 6 of which were recaptures. Using the equation the population estimate for site 1 is 30 individuals.

The same procedure was done for site 2. The first observation used was October 19th, 2008 and the second November 10th, 2008. The first yielded 8 rays and the second 2, with the same two having been identified before. This gives a population estimate of 8 rays, again using the Lincoln-Peterson equation.

DISCUSSION

The results obtained support the main hypotheses. At site 1, which is larger, there is more human impact, and boat traffic, the rays have more scars and a larger population. The Site 2 rays also have injuries and when looking at averages the two do not seem so different; however, there was one ray at Site 2 who was heavily injured this skewed the results, this ray is known as THI1. The rays at Site 1 were fairly equal in their injury numbers.

Five scar types were identified, but only three were found at both sites. Wavy and thick black scars were absent at Te Honu Iti. Although not thoroughly tested I believe the wavy scars are caused by anchor chains or boat props of some kind. The absence of boats and wavy scar type at Te Honu Iti adds to this theory. This also may suggest that the thick black scars may be caused by a number of factors not present at Site 2 such as, increased boats, sharks, or human presence.

Site 1 was noticeably impacted by humans. The rays at the site would swim up and onto you and all responded to boat sounds and shadows. I kayaked to Site 1 and even that attracted a swarm of rays each time I anchored. The waters were chummed for both black tip reef sharks and rays. The two would compete for the food. Chumming predominately uses extra fish parts and these do not fit a ray diet. A ray ate a fish head while I was watching, but it had to slam itself against the fish head and the ocean floor in order to even eat it. That is not standard feeding behavior.

There is constant boat traffic and a constant stream of people at Site 1. Co-specific bites, as defined in Semeniuk 2008, are caused by rays biting other rays when either mating or in territorial attacks. These rays are being forced to live too close to one another. The high frequency of co-specific bites at Site 1 is telling us that rays living in such close quarters with one another are being negatively impacted. The rays are definitely becoming habituated and my data reflects their body conditions are lowering because of it as they are beginning to follow southern stingray trends.

Site 2 also showed human impact on the rays, but far less than 1. Te Honu Iti hand feeds the rays from outside the water and under lights so the guests are able to see them while they eat their dinners. Although there were injuries, there are far less than at Site 1. Two categories of scars dropped out completely while two others are significantly less. Co-specific bites only accounted for 7 scars at site 2, while site 1 they accounted for 44. Thin scrapes were higher at Site 2, but again this is because one ray had 20 thin scrapes. The one heavily injured ray at Te Honu Iti skewed averages and counts within my study.

Te Honu Iti only feeds the rays once a night during dinner, except on Wednesdays when they are closed. I visited the site twice during the day and once on Wednesday at 7 pm and saw no rays. Even swimming and surveying the general area I saw nothing. To add to that I was only able to successfully photograph and videotape the rays from outside the water; these rays were so skittish that when I moved they dashed away from sight and did not return for some time. This leads me to believe that these rays still have some natural instinct left.

As for the population estimates I identified 29 rays at Site 1 and 8 at Site 2. The Licoln-Peterson method gave me estimations of 30 and 8 respectively. This reflects that I indeed captured most if not all of the rays at each site. Also, it helps conclude that there is indeed no cross over between the two populations as no ray was seen at both sites.

This study had errors, the major one being a lack of consistency. Due to technology breaking down or simple availability conflicts I had to use different cameras. Each camera is unique and may have been clearer or less accurate depending. Furthermore, abiotic factors such as visibility or a heavy tourist day were not things I could control, but they did affect my study.

For future study a basic natural behavior study on *Himantura fai* would be exceptionally useful and beneficial to ecology in general.

No one has ever studied this species of whipray and as our climate changes and coral reefs and ocean chemistry change it will be helpful to have as much information as possible on our current biodiversity. Also, continued study on the impacts of ecotourism would allow us to stop a potential problem in its tracks. It would be more useful if vertebrate permits could be obtained and one could look at parasite loads and general medical health as added parts of the study. I did find that using scars and injuries was an effective method for identification. This is very low impact to the species and with continued use may be a positive, non-invasive alternative to conventional tagging.

Ecotourism is something we have some control over and can prevent. Continued study and monitoring is both necessary and feasible and entirely worth the effort to potentially preserve a piece of biodiversity for future generations.

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