Summary of Seahorse Population and Distribution

Koh Rong Samloem
Preah Sihanouk, Cambodia

Report on seahorse demographics and habitats

Marine Conservation Cambodia
2nd Quarter Report 2013 – Apr/May/Jun

Photo 1 –*H. Spinosissimus* on the Corral, MCC 2013

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Abstract

This is the second quarter report of 2013 for the seahorse population and habitat surveys undertaken, starting with an initial survey done in June 2011 and continuing in August 2012 through to June 2013. This report covers April, May and June of 2013.

The aim of the ongoing study has been to assess and monitor the changing conditions of the study site, called the Corral, off the East coast of Koh Rong Samloem, particularly in regards to the local seahorse population found there.

During the second quarter of 2013 there were a total of 41 seahorses observed over a total of 94 surveys. Of the 41 seahorses recorded at our survey site 39 were identified as *H. spinosissimus*, 1 as *H. trimaculatus* and 1 as *H.kellogi*. Population demographics, depths, and holdfast selection were also recorded and compiled with all previous data.

Due to the ongoing and continuous nature of these surveys there is a better understanding of the local seahorse populations, their behavior, depth range, migratory patterns, yearly movements and distribution within the study site.

It is hoped that through continuous research, a database of the conditions of this study area can be compiled in order to help protect and conserve this fragile and important ecosystem.

By establishing relationships between species composition and diversity, depth, preferred holdfasts and holdfast densities, habitat cover, sexual demographics and reproductive activity, a more effective conservation strategy can be designed and implemented.

All of this will lead to a better understanding for the long term protection of this fragile species and sensitive habitat.

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Acknowledgements

Marine Conservation Cambodia (MCC) has been working on conservation and community livelihoods in collaboration with the Royal Government of Cambodia Fisheries Administration (RGC FiA), local authorities and local communities since 2008.

The Marine Monitoring and Marine Research programs around Koh Rong and Koh Rong Samloem are now well underway and are currently undertaking marine surveys around Koh Rong Samloem, this is to monitor the Seahorse populations and the coral reefs, so it is possible to assist the FiA in the creation of Marine Fisheries Management Areas (MFMAs), Cambodia's equivalent to Marine Protected Areas (MPAs).

Close collaboration with the FiA and international institutions such as the FAO Regional Fisheries Livelihoods Programme (RFLP), The Seahorse Trust (UK), Save Our Seahorses (Ireland) has proven that MCC is now a respected and credited leader in conservation and community work in Cambodia.

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Table of contents

Introduction

Cambodia has a unique marine environment with an unusual array of species and a diverse range of habitats. As part of a long term study of the seahorses in southern Cambodia, a site was chosen within a specific area off the small island of Koh Rong Samloem Island, 18km south west of the port of Sihanoukville. The chosen site is known locally as the Corral and the surveys were conducted throughout June and July of 2011, again in November and December of 2011, and in August 2012 to June 2013. This report introduces data recorded in the second quarter of 2013 (April, May and June) and looks to integrate all data into a cohesive report.

Population assessments provide a useful tool for measuring the current condition and viability of the population allowing abundance and organism structure to be determined within the aforementioned study area. Each survey undertaken provides a static picture of the condition, abundance of organisms and bottom composition for the selected area. This is done to determine patterns that will be beneficial in understanding the behaviour, migration, and distribution of the seahorses.

The assessment will therefore allow the seahorse population of the Corral site to be tracked and the effects of disturbance, such as destruction from trawling boats, to be monitored over long periods of time. Other trends, such as shifts in the dynamics of the species composition and age structure can also be observed over time. By comparing the dataset from the previous year with new survey data we hope to gain insight into the changing population and distribution demographics, as well as species composition and age structures within our study site.

As more surveys are performed an accurate trend of what is really happening at the study site will begin to emerge. It is vital to have a clear understanding of the conditions and number of organisms throughout the study area, so that management protocols can be implemented and conservation and monitoring strategies designed.

Furthermore, it is important to recognize habitat degradation, and consequently population decline early on, so that effective measures can be put into place to mitigate and alleviate the pressures responsible.

Study Area

Koh Rong Samloem Island is located 28 km south west of the port of Sihanoukville on Cambodia's southern coast. The island's coastline is predominately shallow, mainly composed of sand flats, seagrass beds and coral reef habitats. Previous studies have identified 5 geographically separated coastal areas of seahorse habitat, designating one particular area, the Corral site, as a location for targeted seahorse research. This is due to its large breeding populations and close proximity to Marine Conservation Cambodia (MCC) facilities.

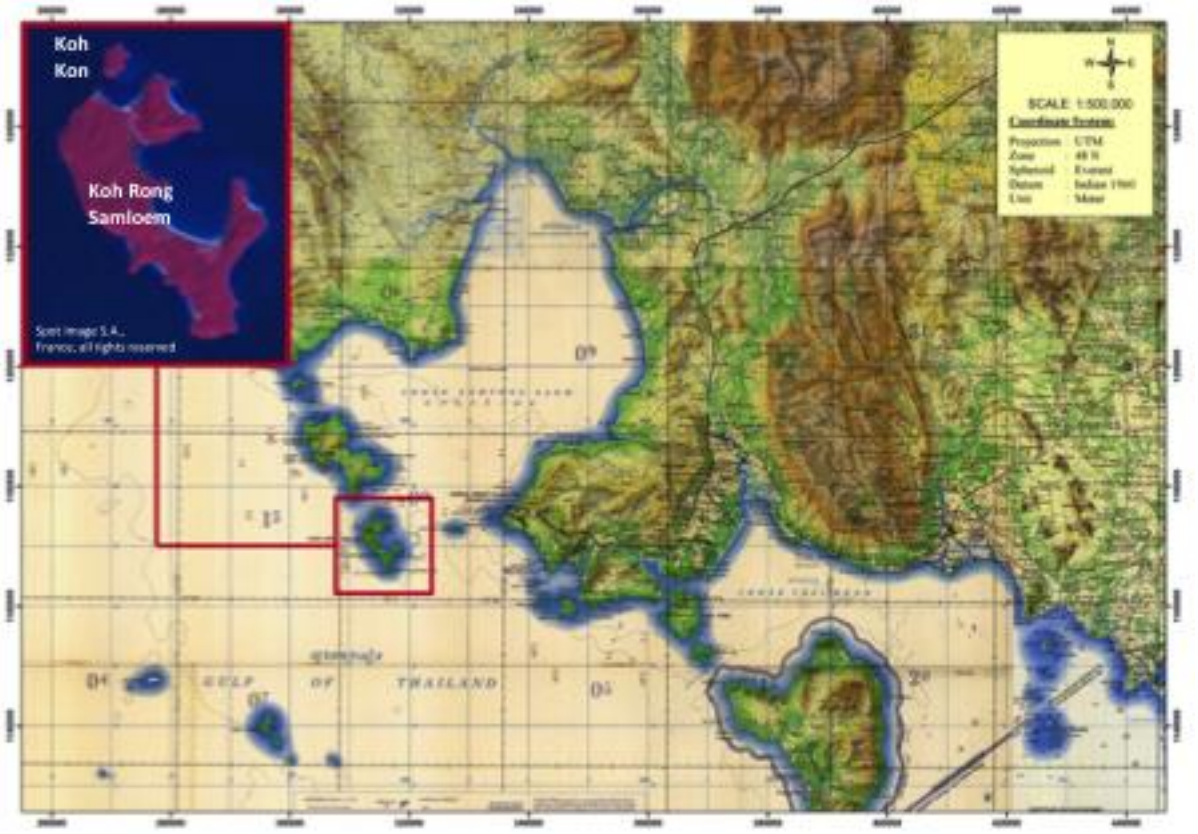


Figure 1: Map of Southern Cambodia and islands with magnification of Koh Rong Samloem

The Corral site is located to the east of Koh Koun, a small island situated to the north of Koh Rong Samloem. The area is dominated by sand flats, which slope gradually from the east coast of Koh Koun, with depths ranging between 5-20m. The area supports populations of bivalves, soft corals, hydrozoans and large numbers of pencil urchins (*Prionacidaris spp*), which provide valuable holdfasts for seahorses.

The habitat was observed to be in excellent condition in 2007, at this time species

diversity of the area was observed to be unusually high, with 6 species of seahorse identified from photographic evidence taken at the Corral site. These species are *Hippocampus spinosissimus, Hippocampus trimaculatus, Hippocampus kuda, Hippocampus comes, Hippocampus kelloggi, Hippocampus histrix*, (*Hippocampus barbouri* and *Hippocampus comes* are suspected by has not been photographed). Previous data demonstrates that *H. spinosissimus* heavily dominates the population.

However, recent damage from illegal trawling activity has greatly impacted the habitat, reducing the biodiversity and productivity of the local ecosystem. Field observations from 2007 suggest that since this period of time seahorse species diversity has decreased to strongly favor *H. spinosissimus.*

Legal protection of the habitat has been established in the form of a 300m No Take Zone (NTZ) extending from Koh Koun Island as well as a community conservation area. The 300m NTZ only covers a small percentage of the study site; however the community conservation area covers far more of the area. Unfortunately protection measures are often ignored or circumvented; and thus, frequent monitoring and increased patrols are necessary to prevent trawling activity in the area. Regularly conducted population assessments provide the consistent data necessary to measure the recovery or decline of this area, and to make comparisons to previously observed ecosystem productivity. This data will also show the impacts, both positive and negative, of the conservation measures currently in place.

Methodology

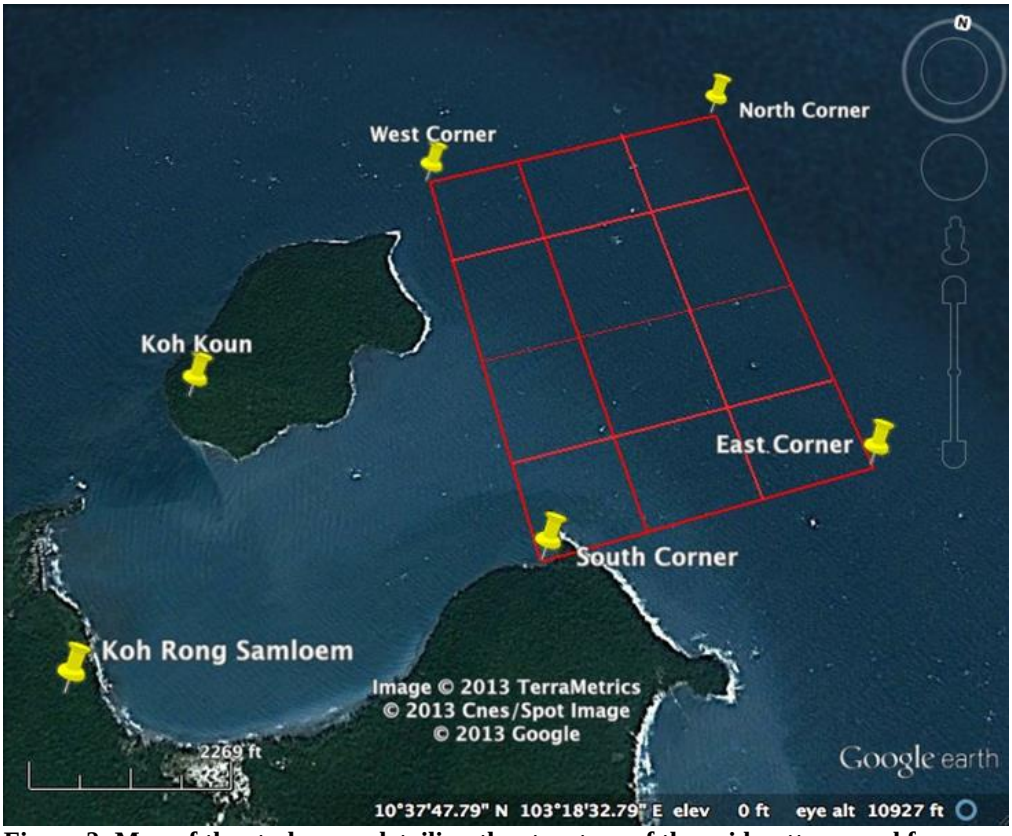


Figure 2: Map of the study area detailing the structure of the grid pattern used for surveying.

The population assessment was conducted through underwater visual transects conducted in the Corral study area. The starting point of each 500m^2 transect is dependent upon a grid system whereby the entire seahorse area is divided evenly into 12 sections. Two GPS co-ordinates are chosen from one grid each day and surveyed. This means that each day they are randomly selected from a different grid, ensuring that each grid is selected at least once in the month before we start repeating grids. In order to have 30 sites surveyed per month inevitably some grids end up repeating more than others due to the fact there are only 12 grids. Directions are also randomised for the survey by choosing from eight options (i.e. N, NE, E, SE, S, SW, W, NW) for each survey point and making sure these are evenly distributed in any one grid. Choosing random directions from random grids ensures the same direction is not favored in any particular grid.

Each survey involves laying two parallel 50m lines, spaced 5m apart, in a previously determined direction. On each transect line, two divers swim on either side of the line

surveying the area 2.5m adjacent. The total area surveyed for each transect is 500m^2.

Seahorse species, demographic class, trunk, head and snout length, and associated habitat were recorded for each seahorse specimen within the transect area. Juveniles were defined as any seahorse with a trunk length under 2cm, and were not distinguished by sex due to difficulties in differentiating small individuals without fully developed sexual and species characteristics. Counts of pencil urchins, soft corals, anemones, sea grass, hydrozoans, sea pens and manmade structures were also recorded.

Results

During the second quarter of 2013 there were a total of 41 seahorses found over 94 surveys. Of the 41 seahorses recorded 39 were identified as *H. spinosissimus*, 1 was *H. trimaculatus* and 1 was identified as *H. kellogi*. The population demographic breaks down to 8 males, 6 pregnant males, 26 females, and 1 juvenile, with percentages of 20%, 15%, 63%, and 2% respectively (Figure 3).

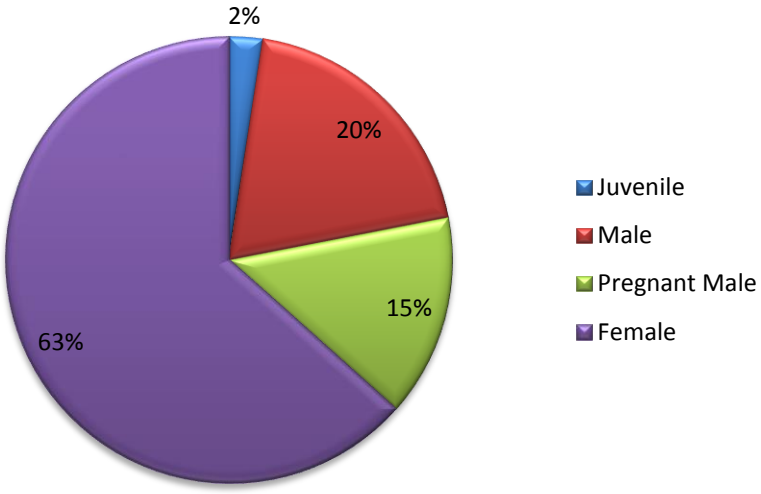


Figure 3: Sexual demographics of seahorses observed Apr/May/Jun 2013.

Holdfast selection favored pencil urchins with 26 seahorses found there. Of the remaining 15, 2 were found on sea pens, 5 were found on shell and the other 8 were observed attached to other miscellaneous substrate (sand, clam, rock) or were free-swimming (Figure 4).

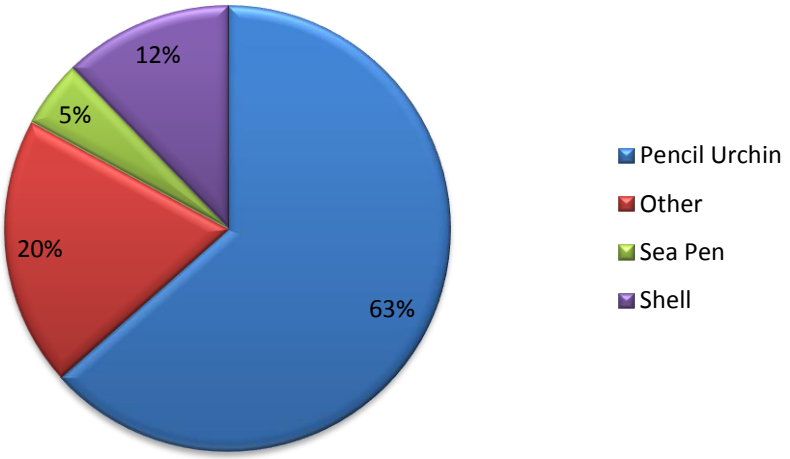


Figure 4: Holdfast selection for observed seahorses Apr/May/Jun 2013.

The relationship between seahorses and pencil urchins, pencil urchins and shell cover, and shell cover and seahorses, were tested using a paired t-test. All relationships were found to be statistically significant.

Figure 5: P-value for relationships of seahorses, pencil urchins, and shell cover for Apr/May/Jun 2013 using a paired T-test. * denotes significance.

Relationship	P-value
Seahorses vs Pencil Urchins	0.00*
Pencil Urchins vs Shell Cover	0.00*
Shell Cover vs Seahorses	0.00*

The average depth of all seahorses observed in the second quarter of 2013 was 10.35m. Juveniles averaged 12.70, males 11.89, females 10.08, and pregnant males 9.58 (Figure 6). The averages per month of this second quarter are also shown (Figure 7).

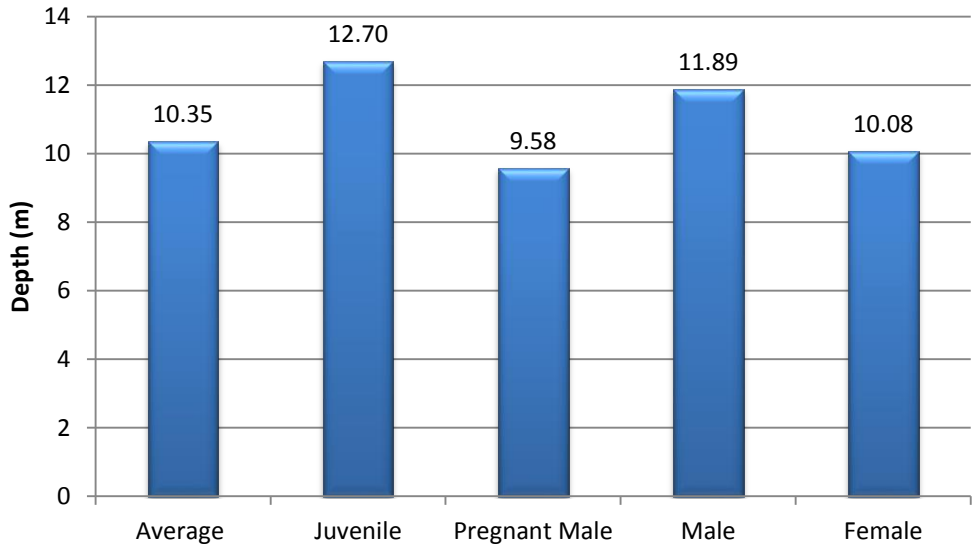


Figure 6: Average depth of all seahorses recorded in Apr/May/Jun 2013.

Average depth of recorded seahorses in relation to sexual demographics shows that during the April, May, June quarter female seahorses were found at an average depth of 11m, 9m and 10.5m respectively. In comparison, male seahorses were found at 9m, 10m and 14.5m, whereas pregnant males were recorded at an average of 8.5m in May and 11.5m in June with none recorded in April. Lastly, juveniles were only documented in May at an average depth of 12.5m (Figure 7).

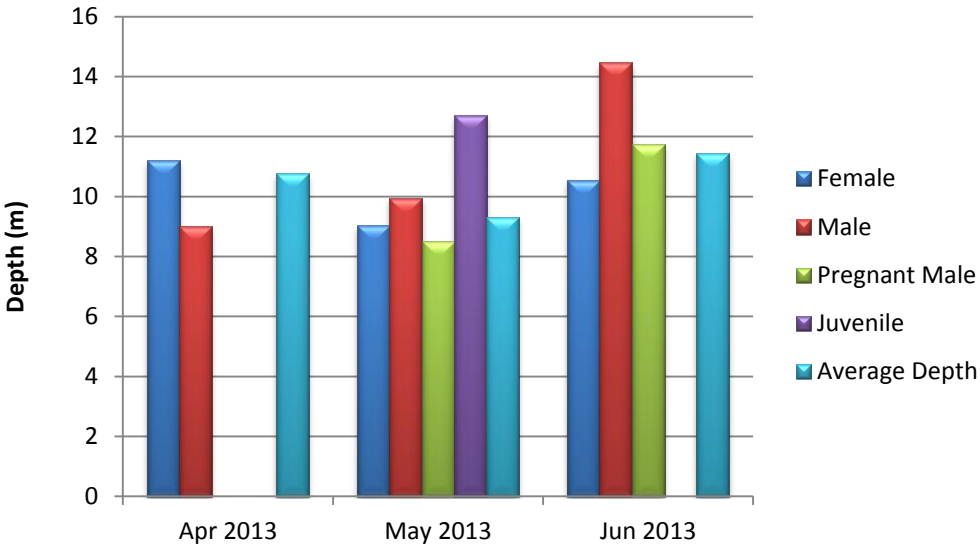
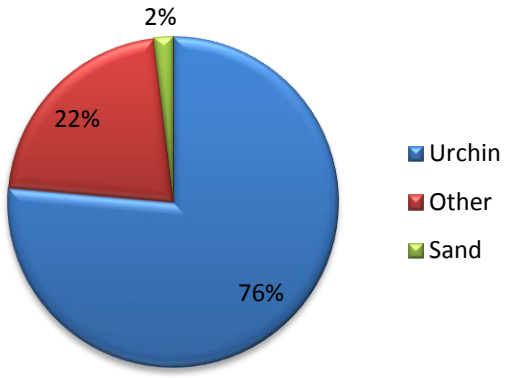


Figure 7: Average depth of seahorses recorded by month.

In 2012, 85% of seahorses were recorded on pencil urchins, 13% were on other holdfasts, and only 2% were found on sand. In comparison, seahorse holdfast selection for April - June of 2013 shows that holdfasts were found to be composed primarily of pencil urchins with 76%. 22% were recorded on other holdfasts, and 2% of seahorses were found on sand (Figure 8).



Figures 8: Holdfast selection for seahorses Aug 2012 – Jun 2013.

During the first quarter of 2013, the average number of seahorses seen per dive was 0.53 with 48 seahorses recorded over 90 surveys. Whereas in the second quarter, 41 seahorses were observed over 94 surveys, resulting in an average of 0.44 seahorses per dive. During April, May and June, the average number of seahorses observed per dive was 0.19, 0.63 and 0.50 respectively (Figure 9).

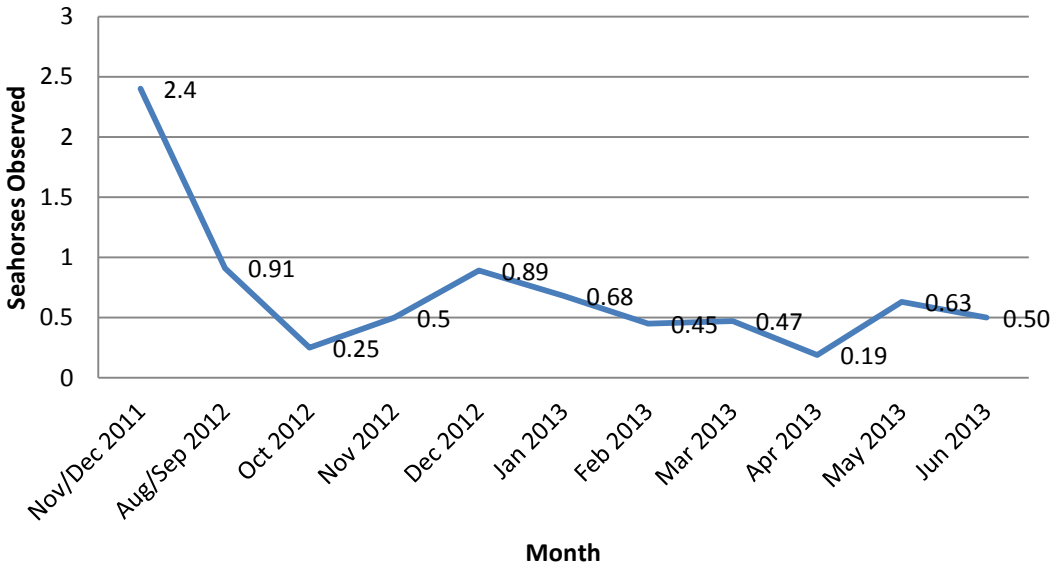


Figure 9: Average number of seahorses observed per survey for Nov-Dec 2011, and Aug 2012 to Jun 2013.

Of the 41 seahorses observed this quarter, there were 8 non-pregnant males, 6 pregnant males, 26 females and 1 juvenile (Figure 10).

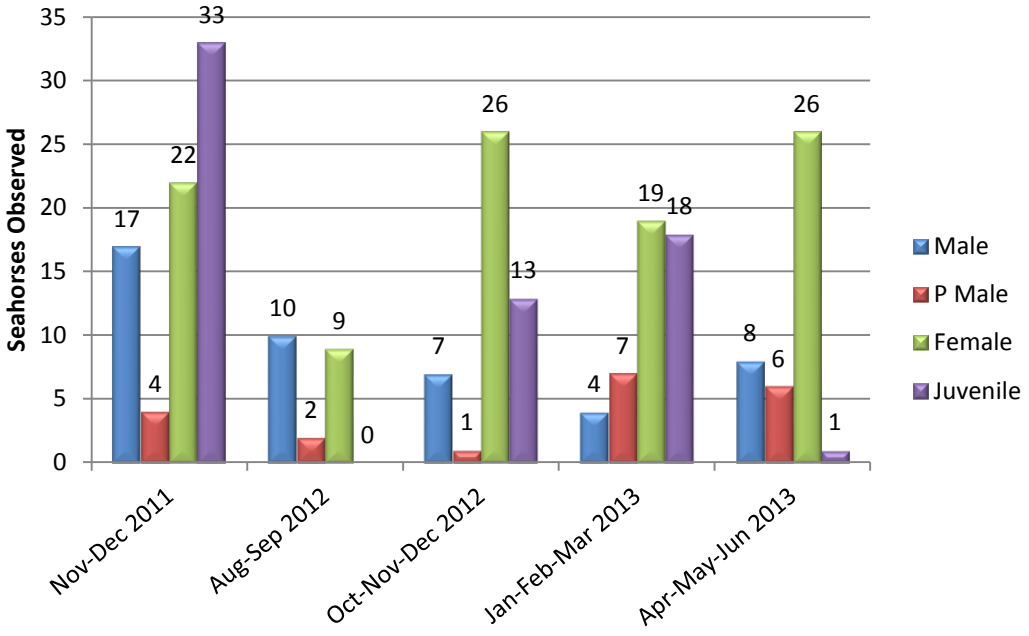


Figure 10: Number of seahorses observed according to sexual demographic.

Over the study period, the percentage of females observed far outweighs that of any other demographic. Females make up 51% of the seahorses observed from Aug 2012 to June 2013.

20% of observed seahorses were juveniles, 18% were male, and 10% were pregnant males (Figure 11).

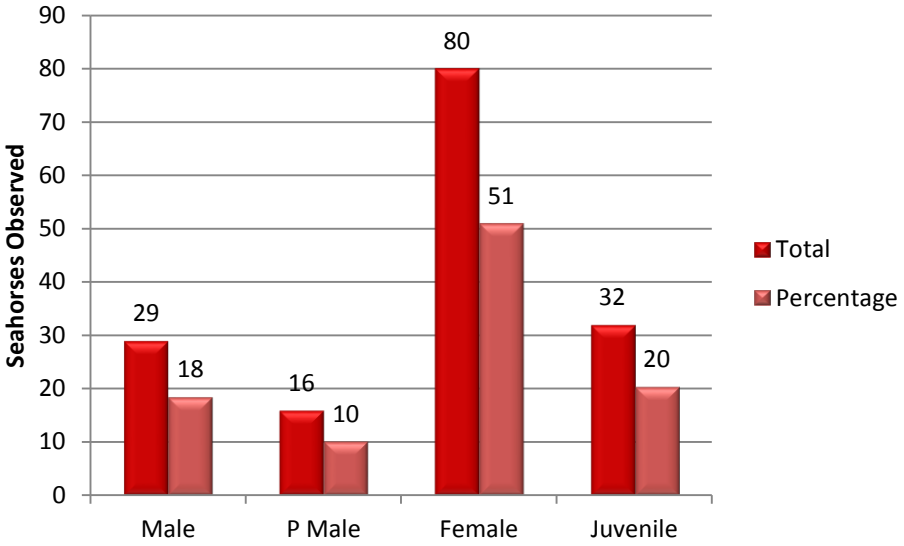


Figure 11: Total observed seahorses by sexual demographic from Aug 2012 to June 2013.

The average depth of all seahorses recorded during the study period was determined to be 10.67m. On average, females and non-pregnant males were found to be on par with the overall average (10.43m and 10.47m respectively) while juveniles had a higher recorded average depth of 12.06m. Pregnant males were found at a lower than average depth of 9.66m (Figure 12).

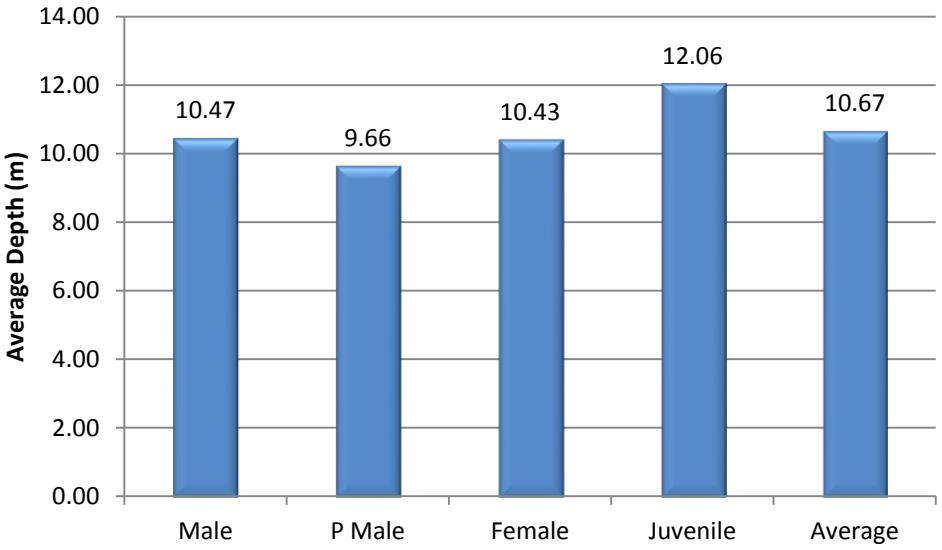


Figure 12: Average depths of sexual demographics from Aug 2012 – June 2013.

Throughout the overall study period, the depth at which each individual seahorse was observed was recorded. The highest number of seahorses was found on a depth of 7m. In general the number of seahorses observed is relatively high between 7m and 12m. From 13m down the number of seahorses observed is lower (Figure 13).

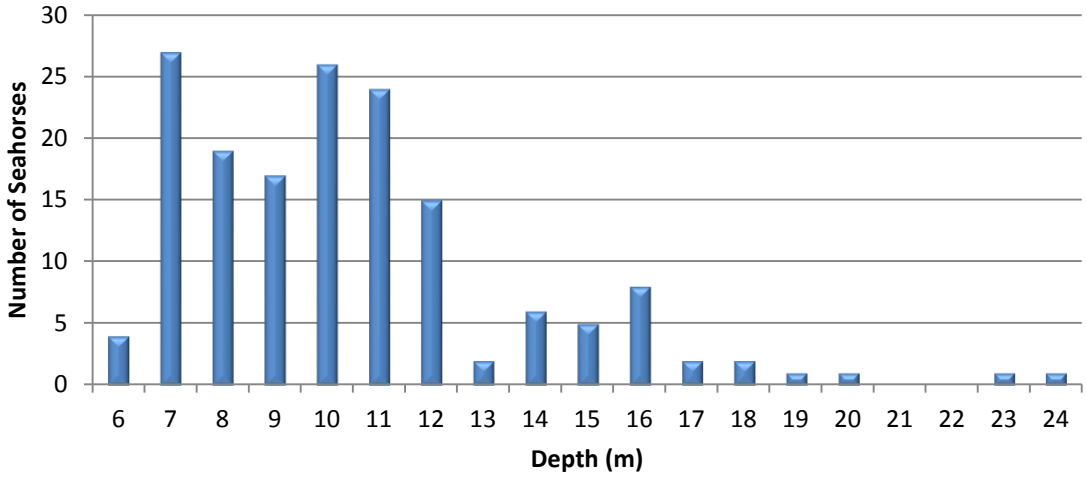


Figure 13: Number of recorded seahorses per depth from Aug 2012 through June 2013.

A breakdown of the recorded depths of seahorses into sexual demographics shows that while all sex categories were recorded at shallower depths, once the depth reached 15m, male seahorses were rarely found (Figure 14).

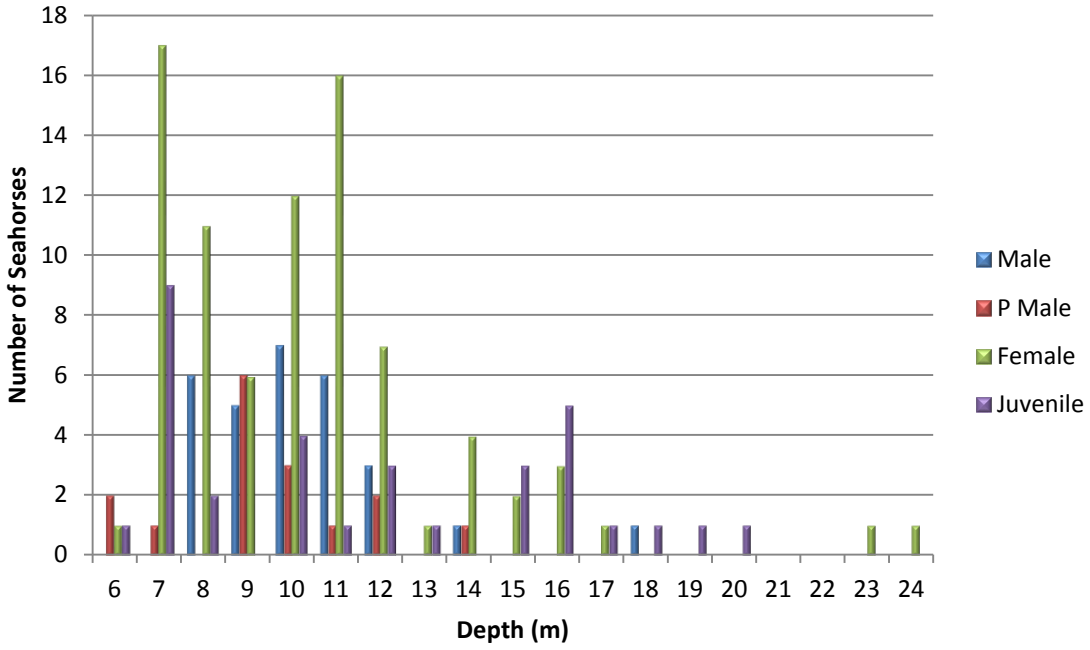


Figure 14: Sexual demographics of all seahorses by depth Aug 2012-June 2013.

During the period between August 2012 and June 2013 most of the surveys were conducted at a depth between 7m and 12m. Surveys at a depth of 13m and deeper were conducted less frequently (Figure 15).

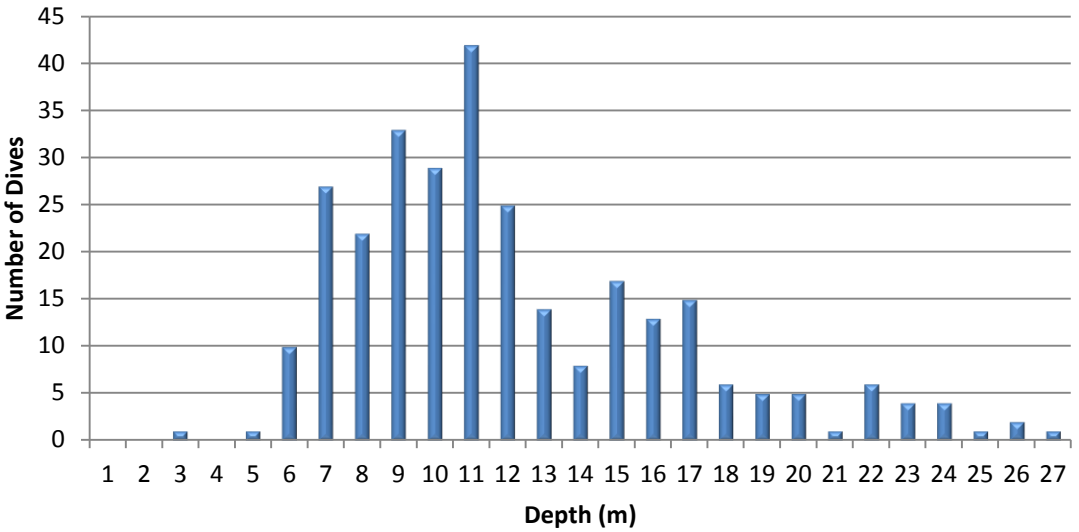


Figure 15: Total number of dives per depth Aug 2012-Jun 2013.

Between the depths of 6- 20m the average number of seahorses observed per dive ranged from 0.15 to 0.85, with an outlier of 0.5 at 24m. On average, the highest number of seahorses recorded per dive at a specific depth was 0.85 seahorses recorded at 7m (Figure 16).

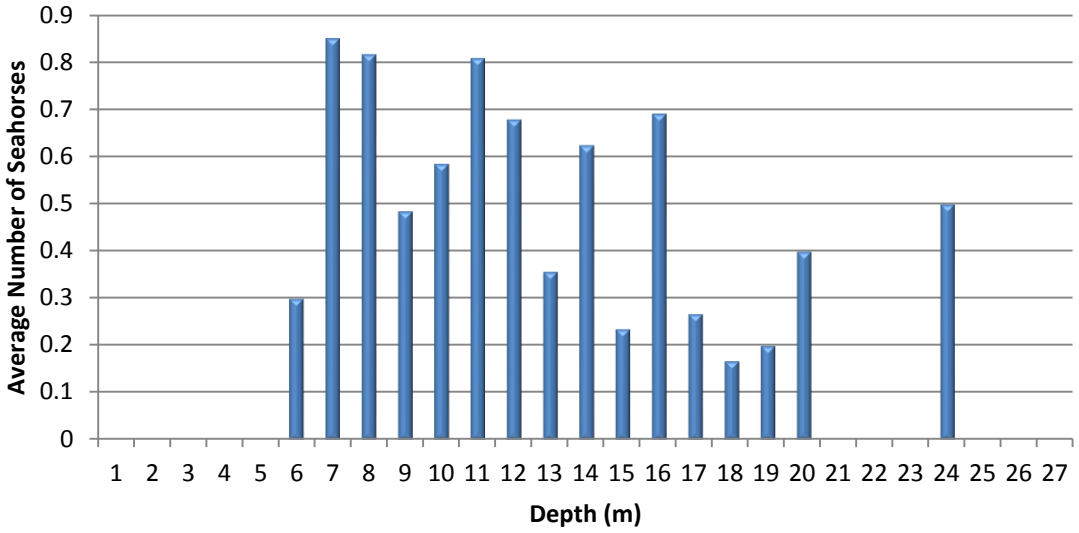


Figure 16: Average number of seahorses observed per depth per dive Aug 2012 through June 2013.

Between the depths of 6-27m the average number of pencil urchins per dive ranged from 5 to 135 with an outlier of 10 at a depth of 3m. In general, more pencil urchins where recorded

between the depths of 15-24m (with a range of 30-135 pencil urchins) compared to the depths of 6-14m (with a range of 5 to 45 pencil urchins) (Figure 17).

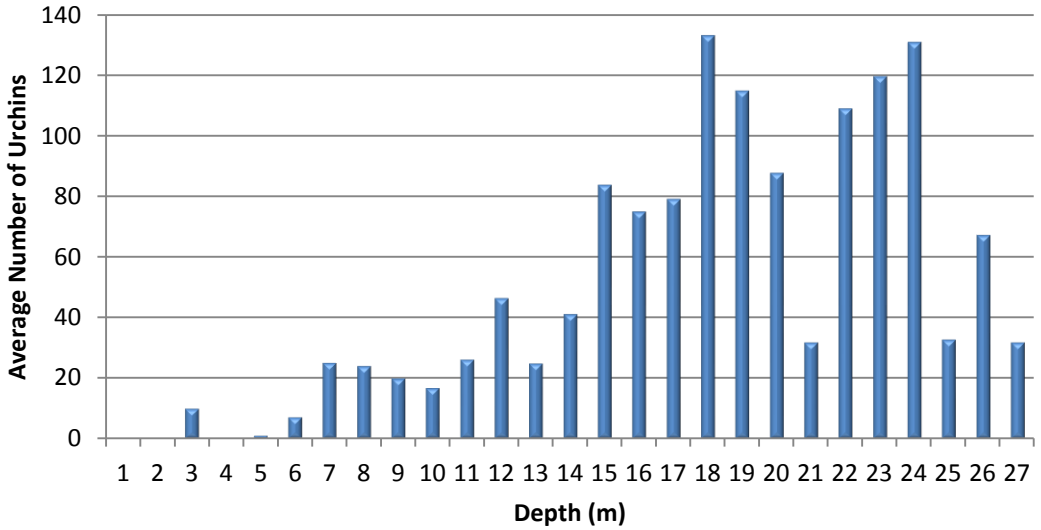


Figure 17: Average number of pencil urchins observed per depth per dive Aug 2012 through Jun 2013.

Bottom temperature recorded over the study period ranged between 27°C and 33°C. The highest recorded number of seahorses was 27 at 30°C followed closely by 25 seahorses at 29°C (Figure 18).

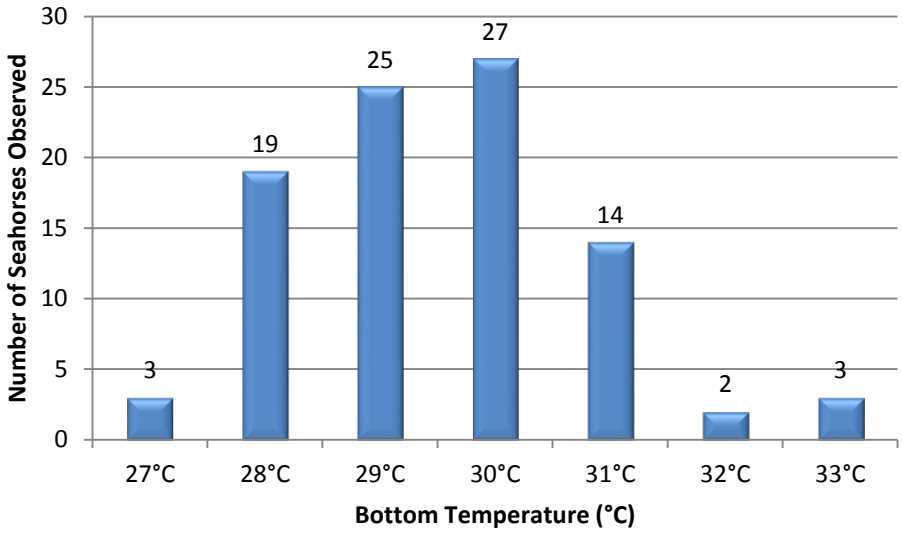


Figure 18: Average bottom temperature of observed seahorses Aug 2012 - Jun 2013.

Discussion

As a result of this long term study, patterns are now starting to emerge as to the seahorse species, their habitat preference, preferred depth, and sex ratios on the site.
In this discussion we look at all of these aspects and try to understand the implications of all of these factors on the Corral.

Holdfast and habitat preference

The relationship between pencil urchin population density, the percentage cover of broken shell on the seabed and seahorses recorded, were again all found to be significant. It is believed that the lack of solid complete objects available for the seahorses to use as holdfasts is a result of the negative effect that illegal trawling and bottom gill netting is having on the seahorse populations.

Based on studies and observations of other species, in a typical healthy and undamaged seahorse habitat, they would be attached to solid non-motile holdfasts such as seafans, coral, sea pens, sponges. However, on the Corral, due to the destructive nature of the trawling, solid holdfasts are in limited supply, so the seahorses have adapted to using other organisms such as pencil urchins. In the 2012 surveys when organisms such as pencil urchins were not available, seahorses were often found to be either drifting on the seabed or had moved out of the area. There are now signs that this might be changing.

In the first quarter of 2013 there was an increase in the number of seahorses recorded on traditional stable holdfasts as opposed to those recorded on motile holdfasts such as pencil urchins. It is possible that this increase in the observation of non-motile holdfasts is an indication that the habitat is recovering to its former state with stable holdfasts becoming more prevalent. The data from the second quarter of 2013 has continued to support this claim with the number of seahorses found on stable holdfasts again displaying an increase. While this continuing pattern is a positive sign of potential habitat restoration due to decreased trawling, further studies are still required to provide a definitive answer. Due to the fact that pencil urchins are mobile, questions are also raised regarding territoriality and migration patterns, which may disrupt their natural reproductive behavior.

Another interesting point of notice is that there are routinely extremely strong currents present at our study site. On several occasions it has been observed that the currents will

actually take the pencil urchins with them, bouncing them along the seafloor like tumbleweed. This again raises interesting questions on holdfast selection and territoriality. How can the local population be expected to maintain a territory if the currents are far too strong to swim against and their primary holdfast is also no match? Further study on current strength and direction will hopefully provide clarification on the how the local population has adapted to these conditions.

Pre trawling it was recorded that there were 6 species of seahorses in large numbers; however, only the *Hippocampus spinosissimus* is present in any significant numbers during 2012 and the first half of 2013, leading to the conclusion that they are best adapted to this fragmented habitat. However, in December 2012 the first sighting of a species other than *H. spinosissimus* was recorded since November 2011, with 1 *H. kuda* positively identified in our study site. In February of 2013 there was also the first sighting of *H. kellogi* made since November 2011. In the second quarter of 2013, another *H. kellogi* and 1 *H. trimaculatus* were recorded while on survey, while suspected *H. barbouri* and *H. comes* were sighted on non-survey dives. While it is too early to make any assumptions, it is hoped that these sightings of seahorses previously thought to have moved from the area, combined with an increase in the number of seahorses attached to stable non-motile holdfasts may indicate the beginning of the habitats recovery to its former condition.

In the long term, as the original habitat continues to recover, it is hoped that other seahorse species will return to the area in greater numbers.

Seahorse population

To date, apart from the obvious decline in seahorse population numbers post-trawling, no clear pattern has emerged that indicates an overall increase or decrease in seahorse numbers. The sporadic nature of the data collected so far could possibly indicate that the breeding habits of this seahorse population are seasonal. However, the validity and probability of this claim will be determined after the next quarter of data is collected resulting in a complete year of study.

Sexual demographics of seahorses recorded also supports the idea that breeding patterns may be seasonal, with that of seahorses recorded being similar to numbers observed in the last quarter of 2012. Ratios of females to males have stayed similar since the trawling event in

early 2012; however, there has been variation in the numbers of pregnant males and juveniles, which also possibly alludes to seasonal breeding patterns.

In terms of the role that depth plays in seahorse distribution, seahorses were most often recorded at shallower depths (between 6-12m), however, data shows that more survey dives were conducted at these depths. Although depths of 18-25m are surveyed and there is a high percentage of shell cover, which provides suitable non-stable holdfasts, seahorses are rarely recorded. This is not thought to be attributable to specific species as *H. spinosissimus* are known to be found at depths of up to 70m. While at shallower depths, less opportunity for attachment to stable and non-stable holdfasts are available, yet higher numbers of seahorses are recorded. This data leads to the conclusion that conditions common at deeper depths on The Corral are not favourable for the seahorse population found here.

Lastly, temperature recorded on survey dives has been found to be within a very small range over the study period so far. While data indicates no significant patterns at this stage, continued monitoring of temperature in the future may reveal something more substantial.

Conclusion

This is the early stages of a long term study and as such any statements made should be considered to be in early hypotheses. As the study progresses, continued data will allow further analysis which can provide more detailed and definite conclusions to those contained within this report.

By analysing the data collected both before and after the trawling event, it is clear that there is a direct correlation between the condition of the seabed and the number of seahorse species and individuals observed. The majority of pre-trawled data is strictly observational and based around species distribution, diversity, and population densities with little direct data on urchin densities and shell cover before illegal trawling resulted in large-scale damage. However, the impact that trawling has had on density and distribution of seahorses is unquestionable, and it is reasonable to assume that the removal of holdfasts and the drastic altering of the habitat has been a driving force in seahorse declines.

Further study is needed to determine if the slow population recovery and diversity is a result of low numbers and conditions impacting upon mating behavior and slow growth to sexual maturity, or if it is due to seahorses being commonly caught as by-catch in trawling nets and gillnets. All these factors can be possible reasons for the different rates of recovery by different species.

By comparing the type of stable or non-stable holdfasts on the study site it shows clearly that *H. spinosissimus* is best suited to adapt to this broken and fragmented habitat and even this hardy species is reducing in numbers.

In an effort to protect and enhance the current seahorse population and diversity of species it is recommended that increased protection is established in the form of a Marine Fishing Management Area (MFMA). This MFMA could effectively stop the illegal fishing practices taking place and allow the habitat to reestablish and restore it to its former status.

Further studies on depth, temperature and mating patterns are necessary to fully understand what is occurring within this population and what is required in order to protect and conserve it. Only by continuing this study into the future will these questions reach a valid conclusion.