Summary of Seahorse Population and Distribution

Koh Rong Samloem
Preah Sihanouk, Cambodia

Report of Seahorse Demographics and Habitats

Marine Conservation Cambodia
2nd Quarter Report 2014 – Apr/May/June

marine conservation CAMBODIA

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

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Abstract

In June 2011, MCC began an initial set of surveys to assess and monitor the changing conditions of the seahorse population and habitat in the study site, 'The Corral', located off the East coast of Koh Rong Samloem.

These surveys recommenced in August 2012 and continue in present time. This report covers the second quarter (Arpil, May and June) of 2014. In this quarter, a total of 38 specimens were sighted over 75 survey dives. 26 of these were adult *Hippocampus spinosissimus*, of which 7 were non-pregnant males, 3 were pregnant males, and 16 were females. The remaining 11 specimens were juveniles and as such, species and sex were not recorded. Site information regarding habitat, holdfast selection, depth, and temperature was also collected on each survey and compiled with all previously recorded data.

All observed specimens were found on pencil urchins, which is in conjunction with previous records of preferential selection for pencil urchins as holdfasts.

Data from this quarter continued to support previous hypotheses which stated that; *H. spinosissimus* seem to be more suited to the disturbed habitat than other seahorse species previously observed in the study area - and the seahorse population on The Corral appears to have adapted to the use of mobile holdfasts.

The current paper is the third consecutive quarterly review of our local seahorse population that has shown femals to be the most abundant demographic cohort. Although this abundance is not significant ($p=0.05$, $t=0.57$ to juveniles, and $t=0.37$ to culminative males), analyses of larger datasets shows significance. It is likely that females are the sex competing for access to males.

The consant expansion of our database is enabling us to notice patterns in the characteristics of our sehorse population inhabiting the Corral. Continued research and analysis will only contribute to a better understanding of the popultion.

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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.

Special Thanks

H. E. Dr. Nao Thuok	Director General of the Fisheries Administration
Mr Ing Try	Deputy Director of the Fisheries Administration
Mr Ouk Vibol	Director of Fisheries Conservation Division
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Save our Seahorses	Kealen Doyle

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INTRODUCTION

There are number of anthropogenic activities that continuously threaten marine habitats and biodiversity including overexploitation, habitat destruction, introduction of invasive species and climate change (Jackson *et al*. 2001). One method with which to mitigate at least the first two of these factors is the establishment of marine protected areas (MPAs). MPAs are regions with restricted anthropogenic activity, and act as harbours for marine species to breed and recruit (Gell and Roberts 2002; Leslie 2005). In 1970, there were a global total of 118 MPAs, currently there are more than 5,045 (Kelleher and Kenchington 1992; Spalding *et al*. 2008). One of the first steps to MPA establishment is the assessment of a habitat or region in order to identify areas of important ecological value in terms of species to be protected. Furthermore, adding a species or genus of concern to the Convention on International Trade in Endangered Species (CITES) Appendix can help achieve sustainable fisheries and fishing quotas (Foster and Vincent 2004). Amongst the first marine fish added to a CITES Appendix, were all known species of seahorse (*Hippocampus spp.*).

Members of the Syngnathidae family, 48 identified species of seahorses are a genus of ecological, economic, medicinal and cultural importance (Vincent *et al.* 2011). Generally for most species, seahorses occupy shallow coastal waters (<30m depth) distributed between 50° north and 50° south (Foster and Vincent 2004), however some species, such as the Zebra Seahorse, *Hippocampus zebra*, are found as deep as 70 meters (http://www.saveourseahorses.org /seahorses.php). Different *Hippocampus* species tolerate a plethora of different environmental parameters, from cool, deep, open water highly saline habitats to warmer, shallow, dense seagrass freshwater estuaries and intermediary mangroves, macroalgae and corals (Tipton and Bell 1988). As they prey on bottom-dwelling organisms, seahorses help maintain trophic balance within their occupied habitats (Bologna 2007). As such, they are a lineage of important conservative value. Characteristic of many life-history specialists, seahorses exhibit strategies which may make them particularly susceptible to overexploitation and habitat destruction (Foster and Vincent 2004).

Occupying small home ranges, poor mobility, low dispersal rates, parental care and monogamous breeding habits, seahorses have relatively low levels of fecundity and thus low population recruitment rates (Foster and Vincent 2004). Such a life-history strategy coupled with high susceptibility to unsustainable fishing techniques, a persistently high trade demand, and increasing commercial value with decreasing abundance (Courchamp *et al*. 2006), seahorse populations are internationally threatened. Their sedentary nature of attaching themselves to holdfasts using a prehensile tail makes them susceptible to habitat destruction as well as population overexploitation. Wild populations are harvested using a variety of techniques, including (but not limited to) unselective trawl fishing in American and south-east Asian waters, breath-hold diving in Brazil and the Philippines and dip-netting in India (Meeuwig *et al*. 2006; Rosa *et al*. 2006; Vincent 1996). Up to 95% of seahorses in circulation for trade are by-catch from shrimp trawlers (McPherson and Vincent 2004), and Indian, Thai and Vietnamese fisheries have particularly high levels of annual seahorse by-catch (Vincent *et al*. 2011). As such, the Gulf of Thailand is an area of particular concern when evaluating seahorse population management and assessment.

Much of the information regarding seahorse harvest quantities and wild populations comes from relatively old trade surveys and interviews (Vincent 1996; Vincent *et al*. 2011). This assessment method is limited as it compiles out-dated figures which are often highly conservative in their estimates of seahorse catch (O'Donnell 2010). Moreover, fishery authorities can provide false harvest figures as a means to persistently exploit the growing economic demand for seahorses, particularly for use in Traditional Chinese Medicine (Doyle, n.d.). Indeed, targeted efforts by individuals and organisations such as Kealan Doyle (Save our Seahorses) and The Seahorse Trust, have shown that in China alone over 150 million seahorses are consumed for use in Traditional Chinese Medicine yearly (Doyle, n.d.). This staggering figure is more than seven times the official number of specimens declared by the Chinese authorities (awionline.org). The fact that official numbers of harvested specimens produced by local and governmental fisheries are such an underestimate calls for a drastic re-evaluation of the ways in which seahorse harvest quantities and wild populations are determined.

One such method is to directly assess the population quality in a region by conducting population and habitat surveys. Many previous surveys of wild seahorse abundance and density have only been one-off snapshots (Rosa *et al*. 2007). Although useful for an immediate assessment of the area, such assessments provide no temporal coverage (Barrows *et al*. 2009), which is required to assess the effect of any conservative measures such as fishing quotas or MPAs on fish populations over time (Gell and Roberts 2002). The current study has been assessing seahorse populations and habitat in the same geographical area for 23 months to date.

Primarily, seahorses are an appropriate study species for conservation and management due to their status as a 'flagship' species (Shokri *et al*. 2008). Such species are considered charismatic and are capable of attracting public attention and sympathy, which can in turn potentially attract funding for protection (Caro and O'Doherty 1999). Also, Syngnathid density has previously been shown to be indicative of non-syngnathid species diversity in Australian estuarine seagrass beds (Shokri *et al*. 2008). As such, Syngnathids could potentially be used as indicators for areas to be protected by MPAs or fishing quotas, as these areas would encompass a diverse array of species and densities.

METHODS AND MATERIALS

Study area

Koh Rong Samloem is an island 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.

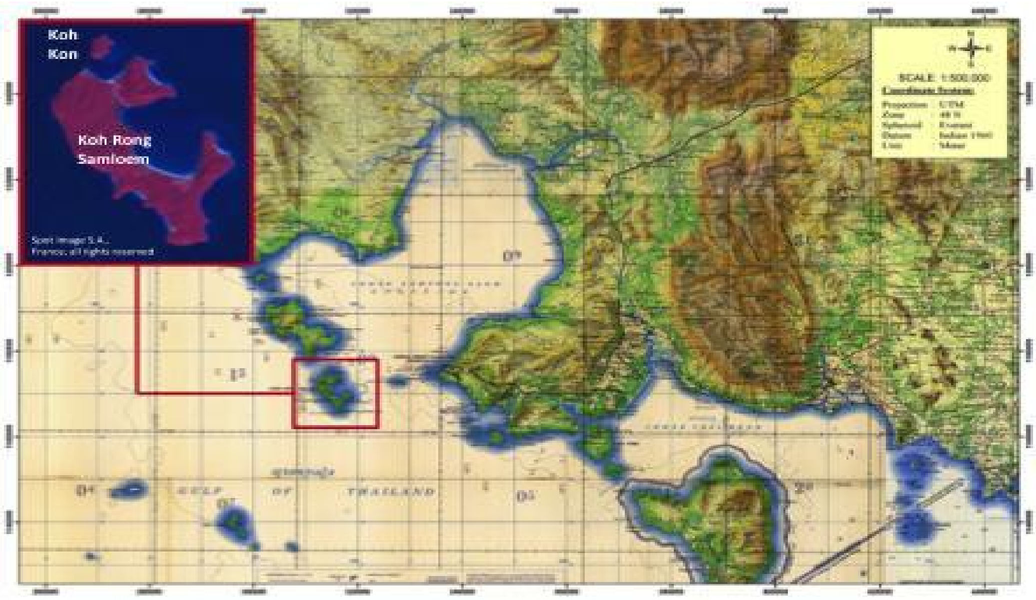


Figure 1. Map of Southern Cambodia and islands with magnification of Koh Rong Samloem

The Corral is a rectangular area, located to the east of Koh Koun (figure 1 above, figure 2 below). The co-ordinates of the north, south, east and west corners are as follows (I) North: 10°38'41.84N, 103°18'55.72E, (II) South: 10°37'51.27N, 103°19'20.31E, (III) East: 10°37'29.20N, 103°18'40.42E, (IV) West: 10°38'22.14N 103°18'14.62E.

The area is dominated by sloping sand flats, with depths ranging between 5-20m. The area supports populations of bivalves, soft corals, hydrozoans and large numbers of pencil urchins (*Prionacidaris spp)*.

The habitat was observed to be in excellent condition in 2007, at which time there were a diverse number of seahorse species recorded on The Corral (6 species photo-identified; *Hippocampus spinosissimus*, *Hippocampus trimaculatus*, *Hippocampus kuda*, *Hippocampus comes*, *Hippocampus kelloggi and Hippocampus histrix*; *Hippocampus barbouri* is suspected but has not been photographed, P. Ferber pers. comm.).

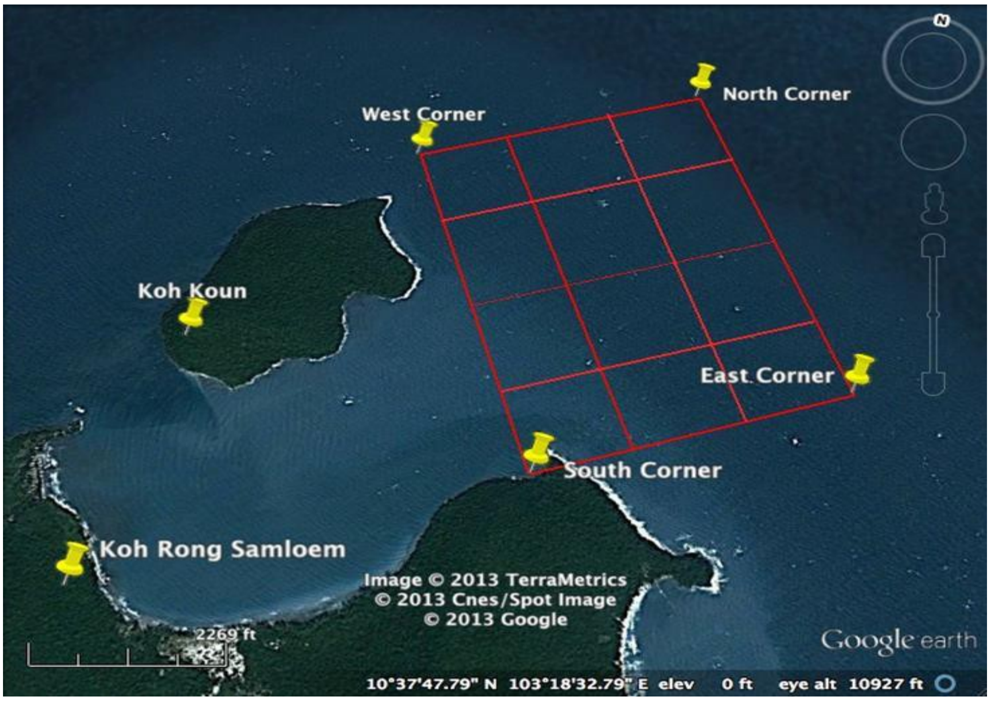


Figure 2. Map of the study area detailing the structure of the grid pattern used for surveying.

Recent damage from illegal trawling activity has greatly damaged the habitat, reducing the biodiversity and productivity of the ecosystem. Field observations from 2007 compared to results of surveys over the past three years show that seahorse species diversity has decreased to almost exclusively favour *H. spinosissimus.* Of the 251 specie-identified specimens recorded since August 2012, only 12 have not been *H. spinosissimus* (4 *H. trimaculatus*, 4 *H. kuda,* 2 *H. comes* and 2 *H. kelloggi*).

Legal protection of the habitat had 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. Protective measures are often ignored or circumvented; and thus frequent monitoring and increased patrols are necessary to prevent trawling activity in the area.

Unfortunately, MCC patrols have ceased, and anecdotal evidence suggests that trawling activity in the region has increased dramatically since 2011, with regular sightings of fishing boats trawling through the protected area. Regularly conducted population assessments provide frequent data, which is necessary for temporal comparisons to measure the recovery or decline of the seahorse population.

Population assessment

Site selection

The population assessment was achieved using underwater visual transects, which were conducted in the Corral study area. The starting point of each 500 metre^2 transect survey was dependent upon a grid system whereby the entire seahorse area is divided evenly into 12 sections. Each day, two GPS co-ordinates within the Corral were randomly selected and surveyed. This often becomes pseudo-random, as consideration is given to the experience of the survey team available, both in terms of survey experience and diving ability.
Directions are randomised for the survey by choosing from eight options (N, NE, E, SE, S, SW, W, NW) for each individual survey point, and ensuring these are evenly distributed throughout the month.

Survey methodology

Each survey team consists of five trained divers, four of whom survey and the fifth reels out and reels in one of the lines. Each survey begins with three of the divers establishing the transect area. This is achieved by planting two poles into the seabed five metres apart, from where two parallel 50 metre lines are reeled out, spaced 5 metres apart, in a previously determined direction. On each transect line, two divers swim on either side of the line surveying the area 2.5 metres adjacent. The total area surveyed for each transect is 500m^2.

Measurments

Seahorse species, trunk, head and snout length, associated habitat and demographic class (pregnant male, male, juvenile, female) were recorded for each seahorse specimen found. Measurments were taken to the nearest mm using straight lines (as per Harasti *et al.* 2012). Trunk length measured from the top of the coronet to the beginning of the tail. Head length measured from the eye to the back of the coronet, and snout size was measured from base of the snout under the eye to the snout tip.

Sex determination

Juveniles were defined as any seahorse with a trunk length under 2cm, and were not sexually distinguished due to difficulties in differentiating small individuals without fully developed morphological characteristics. Males were determined via the presence of a brood pouch or a smooth transition from body to tail. Females were identified using their characteristically sharp abdomen transition to the tail.

Counts of pencil urchins, soft corals, anemones, sea grass, hydrozoans, sea pens and man-made structures were also recorded during the surveys.

Data was recorded in Microsoft excel and Microsoft excel was used for data analyses. Datasets were tested for homogeneity of variance using standard error of the mean, and Student's t-test were undertaken to test for significance.

RESULTS

Population and Demographic Composition

Over the course of the second quarter (April, May and June 2014), there were 38 seahorse sightings over 75 dives (Figure 3). Females were the most commonly seen cohort with 16 sightings. Juveniles were the second most abundant with 12 sightings. Non-pregnant males were seen 7 times, and pregnant males seen only 3 times over the three month period.

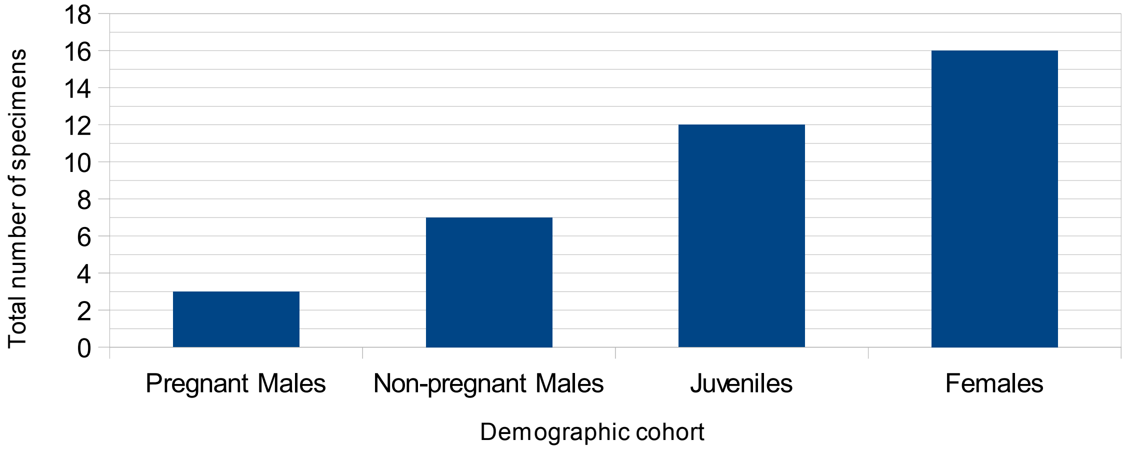


Figure 3. Graph representing the entire observation set in demographic cohorts (n=38, dives= 75).

For any single dive during the 2014 second quarter, on average, 0.22 females were seen, 0.17 juveniles were seen, 0.1 non-pregnant males were seen and 0.04 pregnant males were seen (figure 4). Per dive, there were significantly more non-pregnant males than pregnant males (p=0.05, t=0.04), and significantly more females than pregnant males (p=0.05, t=0.01). However, females were not significantly more abundant than juveniles or non-pregnant males (p=0.05, t=0.57, t=0.12 respectively), and juveniles were not significantly more abundant than either male cohort (p=0.05, t=0.4, t=0.09).

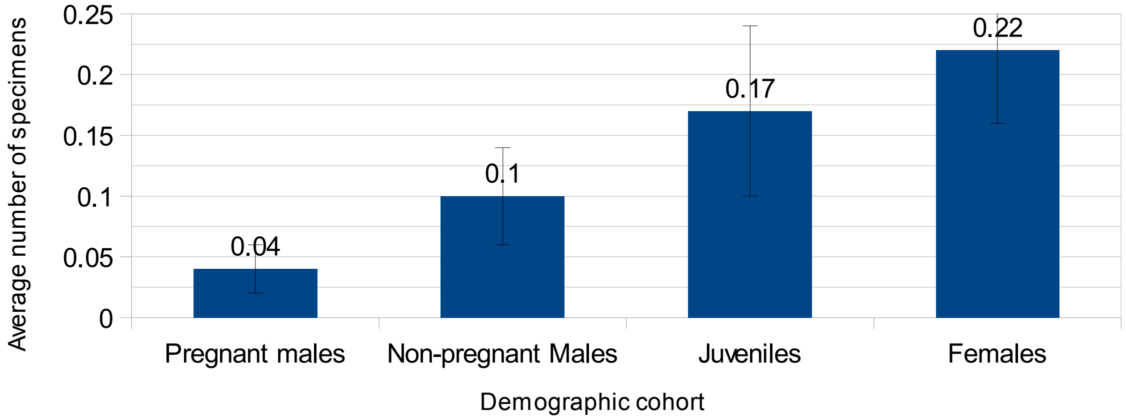


Figure 4. Graph representing each demographic cohort (n=38, dives= 75).

As shown in figure 5 below, females were the most abundant cohort throughout the quarter, comprising 42% of the oservation set. Juveniles composed 32% of the quarterly population, Males composed 18% and pregnant males 8%.

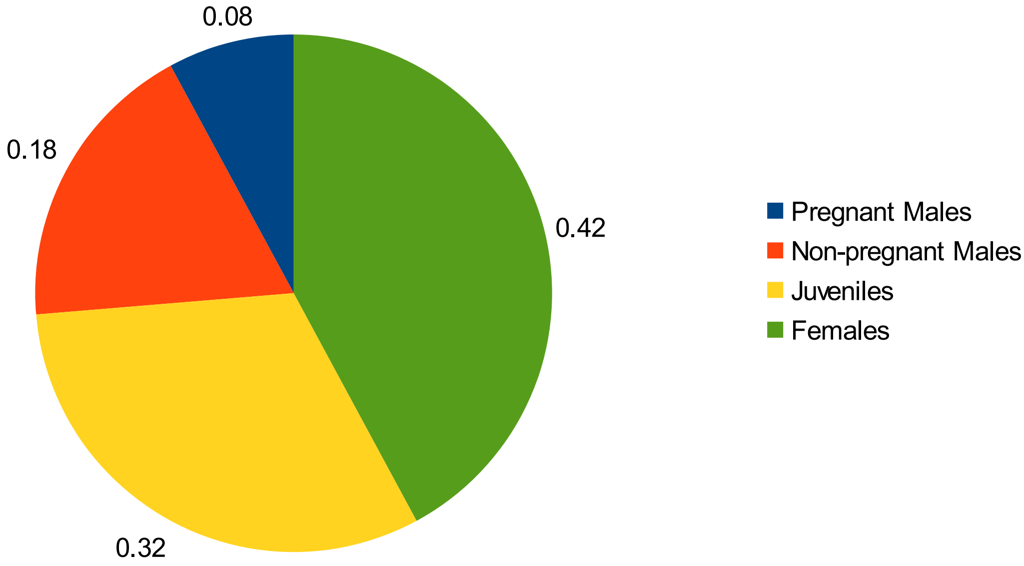


Figure 5. Demographic composition of the second quarterly 2014 observation set (n=38, dives= 75).

Holdfast and Habitat Selection

Seahorses were exclusicely found to be using pencil urchins as their holdfast in the 2014 2nd quarter (figure 6 below), with all 38 specimens found using them.

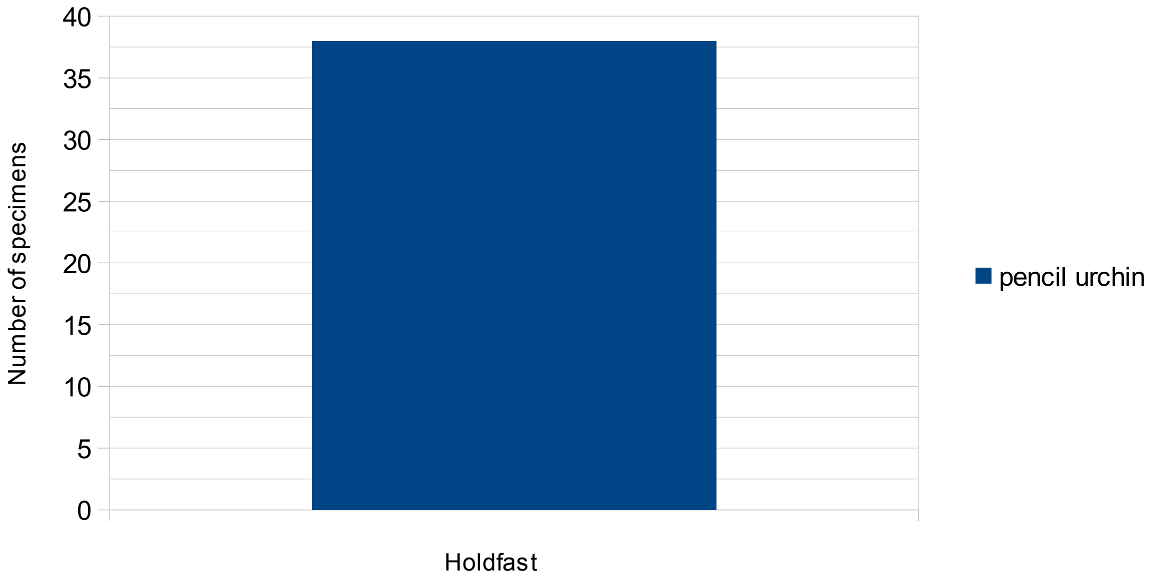
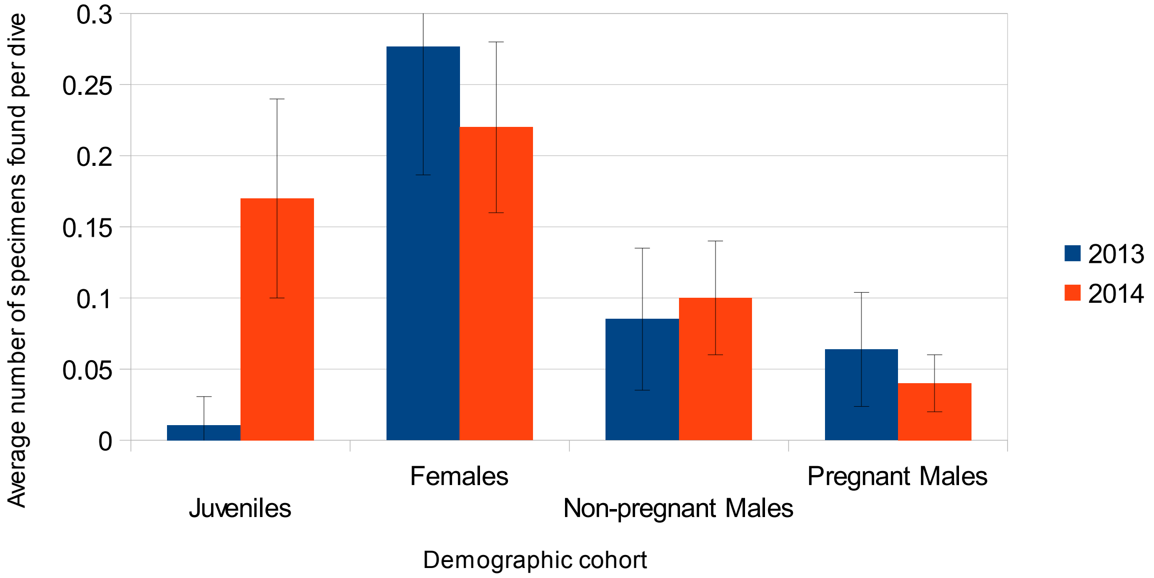


Figure 6. Average number of specimens found on various holdfasts per dive (n=38, dives= 75).

Temporal population oscillations

As shown in figure 7 below, there was no significant difference between the relative abundances of pregnant males, non-pregnant males and females between the two years. There are significantly more juveniles in the 2014 second quarter than the 2013.



0.01	0.27	0.41	0.27
Values of the t-tests conducted between the 2013 and 2014 datasets, testing for significance in the difference between the two years.			

Figure 7. Graph representing the average number of specimen sightings in 2013 and 2014, divided into demographic cohort, also showing the t value for the tests for homogeniety between the datasets.

The graph below presents the demographic composition of our seahorse population for both the second quarter of 2013 (one year ago), and the second quarter of 2014.

Females were the most abundant cohort in both years, however composed 21% more in the 2014 population. Proportions of non-pregnant males were very similar for both years, (20% in 2013 and 18% in 2014). The relative proportion of males in 2013 (15%) was almost double that of 2014 (8%).

There was a far greater proportion of juveniles in the population in 2014 as opposed to 2013 (32% compare to 2%).

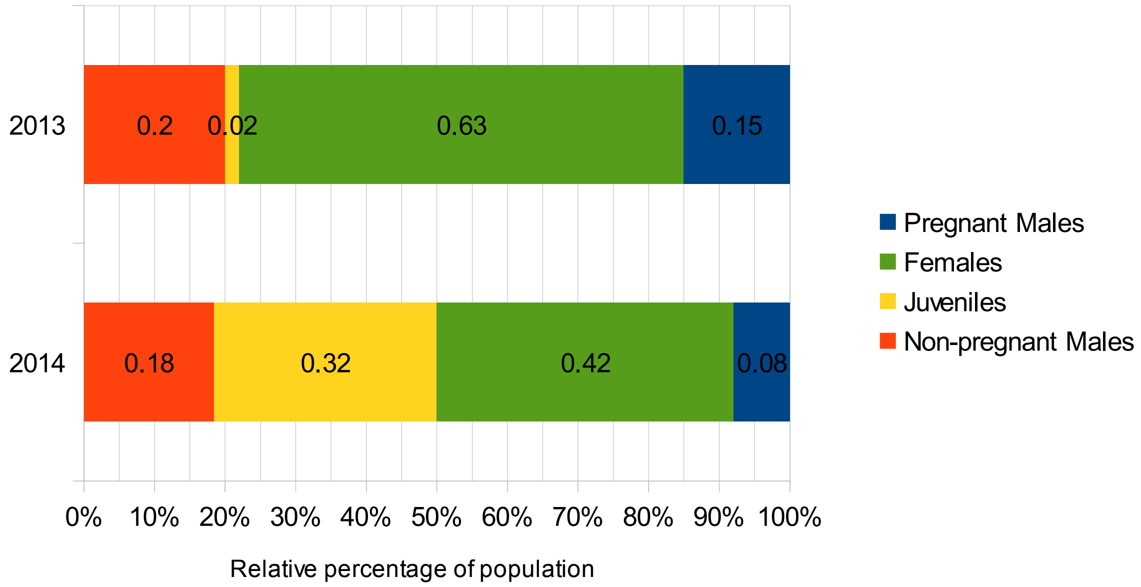


Figure 8: Graph to show and compare the demographic composition of the Corral seahorse population in the second quarrter of 2013 and 2014 (2013 n=41, dives=93. 2014 n=38, dives=75).

DISCUSSION

Seahorses (*Hippocampus spp*.) are a particularly charismatic, mystical and unique genus. Similar to the tiger and giant panda for terrestrial conversation, seahorses are useful as a flagship species for the conservation of marine environments (Shokri *et al*. 2008). Over the past two decades, marked efforts by a number of organisations and grass-roots operations have focused on persistent, continuous surveys of seahorse populations (www.theseahorsetrust.org). Long-term monitoring of a specific population via unrelenting surveying provides valuable insight into temporal oscillations within that population's abundance, demographic composition and to monitor the effectiveness of any conservative schemes that may be in place (Barrows *et al*. 2009). Marine Conservation Cambodia (MCC) has been monitoring seahorse populations in a single study area, 'The Corral' over the past twenty three months. The current study is the 2014 second quarterly assessment of the population, compiling data collected during April, May and June 2014.

Almost exclusively, the current *Hippocampus* composition within The Corral is dominated by a single species, *Hippocampus spinosissimus*. Despite high species diversity at the Corral in 2007, extensive trawling activity destroyed the habitat and populations in the area. Various other species are beginning to return to the area, with recent positive identifications of *H. comes, H. kuda, H. trimiculatus*, and *H. kelloggi.* These sightings have mostly been seen outside of surveys and in very low abundance (Emma Robertson, pers. obs.). As such, the current study focuses on *H. spinosissimus*. Accurate knowledge of a particular species' life-history is important for the planning and implementation of schemes to support population regeneration and long-term persistence in a region (Foster and Vincent 2004).

Previous literature cites *H. spinosissimus* as a species inhabiting coral and soft bottom (sand) habitats, normally in depths of less than 30 meters (Foster and Vincent 2004). As the Corral is predominantly sloping sand flats with an average depth of 20 metres between 10-11° latitude, it is a predicted habitat for *H. spinosissimus*. Various life-history stages and strategies may render *H. spinosissimus* less of a specialist than other *Hippocampus* species; they have a yearly breeding season with several pregnancies, a relatively short gestation period of 12-14 days, a planktonic juvenile stage, and have been observed to utilize a relatively diverse selection of holdfasts (Truong and Nga 1995; Nguyen and Do 1996; P. Ferber pers. obs.; Cai *et al*. 1984; S. Morgan unpubl. Data). All of these traits make *H. spinosissimus* more suited than other species to damaged and fragmented habitats, such as The Corral. Population recruitment rates are higher relative to other seahorses, with greater dispersal, rendering them better adapted to re-occupy damaged habitat.

Population and demographic composition

Due to a yearly breeding cycle and short gestation period, it is unlikely that *H. spinosissimus*' reproductive strategy would have any significant effect on the natural temporal demographic composition of the population. The current report compared data from April, May and June 2013 and April, May and June in 2014, allowing us to compare the relative population composition and abundance.

Figures 7 and 8 above show that the sexually active proportion of the population (mature males and females) did not significantly fluctuate between 2013 and 2014. Their numbers stayed quite close to one another, however there were far more juvenile specimens identified in 2014 than in 2013. This could possibly be explained by the yearly breeding cycle of *H. spinosissimus;* if in one year juveniles occupy 2% of the population and the same time in the consecutive year 32%, an asynchronous breeding strategy might be predicted. Opportunistic breeding (which is the hypothesized strategy used by the population, see 'habitat and habitat selection' below) could result in some periods of time being more successful than others with regards to juvenile survival and also mating success. It must be expected that opportunistic breeding will result in some chance fluctuations in mating success. Continued surveying and comparison between years will give a better picture.

In situ breeding trials using a single captive pair of *H. spinosissimus* by MCC showed the male pregnant every 10 days, yielding 3 broods in a single month (P. Ferber, pers. Comm.). This shows how rapidly the male is capable of recovering from pregnancy and giving birth, and that atleast in captivity over a month, requires no interval between broods. The females ability to produce and hydrate her eggs within the short 10 day gestation period also shows the high level of fecundity expressed by this species. However, captive conditions very rarely reflect natural conditions. It is likely that such an intense month of breeding is unnatural, as males would need to replenish energy reserves to ensure a viable brood, and since seahorses in the current population have not been observed in pairs, it is likely that there will be a search interval between pregnancies, giving the male time to recover. The observed female egg production and hydration and male receptivity in captivity helps us understand why *H. spinosissimus* is, as a species, capable of persisting in an area as badly damaged as the Corral.

Habitat and habitat selection

It must be remembered, that the study site in the current paper is a damaged and fragmented habitat. The Corral is almost exclusively non-vegetated sand flat, with bottom composition changing only in shell cover. Sponges, sea pens, hydrozoans and soft coral are observed in low densities, rendering The Corral an open water habitat, with sparse distribution of benthic invertebrates and flora. Little is known about the particulars of *H. spinosissimus* habitat preference and holdfast selection, however other *Hippocampus* species, *H. capensis* and *H. hippocampus*, have been found to select open habitats and different species select a plethora of different holdfasts (Bell *et al*. 2003; Foster and Vincent 2004; J. Curtis and A. Vincent, unpubl. data). All *Hippocampus* species possess a prehensile tail, used to grasp holdfasts (Foster and Vincent 2004); however specimens of certain species have been observed far from any object, settled in depressions within the substratum (A. Vincent, pers. obs.). Different holdfasts might be selected for a variety of reasons, from predation avoidance due to camouflaging, maximizing feeding potential via water flow to simple object availability (Bell and Westoby 1986; Bell *et al*. 2003; Choo and Liew 2003). However, the vast majority of holdfasts selected in previous literature are sedentary; seahorses in the current study have been found to significantly select mobile pencil urchins as their holdfast (figure 5).

As a genus, *Hippocampus* has generally been observed to be territorial and relatively sedentary. This has resulted in monogamous pair-bonding within a single breeding cycle in the majority of studied populations, with the male only accepting eggs from a single female in a breeding cycle (Foster and Vincent 2004). Monogamy serves to increase reproductive success of fishes found in relatively low densities, that have low mobility and that depend on camouflage as a defence against predation (Barlow 1988; Vincent and Sadler 1995). However, a monogamous breeding strategy is associated with one sex being territorial (and therefore sedentary), establishing a breeding ground and home range in which to mate and spawn. However, the seahorse population in the current study is often found on mobile holdfasts. Interestingly, there is no relative shortage of sedentary holdfasts available on The Corral; indeed seahorse individuals are found on sponge, sea pens, shells and other holdfasts (figure 5). Indeed, the current report is analysing 38 seahorse sightings over 3 months, all of which specimens were found on pencil urchins (figure 6 above).

Given the suspected relatively low density of the current study population, adaptation to a moving holdfast might be selected for by countering the effect of a low chance of interaction with another individual (if attached to a sedentary holdfast). In a sparsely populated area, therefore, if both sexes select a mobile holdfast, reproductive potential is maximized by increasing the chance of encountering a mate. One method of determining holdfast switching rate (thus inferences on territoriality and mating strategies) would be to use a tagging scheme to pair seahorse individuals with their associated holdfast. This would show how often seahorses in our study population release their holdfast, and risk the strong currents to find a new one. Although beyond the scope of this current quarterly assessment paper, future yearly assessments will examine holdfast selection relative to demographic cohort. This will increase our understanding of mating strategies and territoriality of The Corral seahorse population.

In a genus as diverse as *Hippocampus*, it is likely that populations are capable of adapting to their local habitat, provided environmental factors such as salinity, temperature fluctuations, depth and habitat-associated pathogens remain within the tolerance levels of that particular species. Indeed, such local adaptation has been shown in UK *H. hippocampus* and *H. guttalulatus* species in response to sheltered vs. non-sheltered populations to fluctuating weather conditions (Garrrick-Maidment 2013). In these studies, populations of seahorses living in non-sheltered areas of Studland Bay have adapted a migration behaviour to avoid stormy, shallow water. The population inhabiting Poole harbour, directly next to Studland bay, have no need to migrate during the winter as they are sheltered from the storms by their habitat (the harbour).

As such, a population of a species such as *H. spinosissimus* with a relatively general life-history strategy could be expected to adapt to and persist in a disturbed habitat such as The Corral. We are unable to compare the relative health of the population in the current study with other populations due to insufficient robust data regarding the particular densities of *H. spinosissimus* in other habitats. However, previous literature indicates that seahorses in general have patchy distribution and low densities (Foster and Vincent 2004); given the fragmented habitat and continued fishing pressure on The Corral, it is likely the population in the current study is sparse and relatively scarce. Furthermore, our current inability to assess the density of our study population due to individual recognition (thus re-count) limits our behavioural assessment potential; the potential implementation of individual tagging schemes will make population density assessment possible, giving insight into the mechanisms behind mobile holdfast selection.

CONCLUSION

The current paper continues the on-going research conducted by MCC at Koh Rong Samleom, Cambodia; aiming to monitor, assess and analyse the seahorse population of our single study site. In particular, the study aims to assess changes in the seahorse population over time and the way the population responds to changes in habitat conditions. With each quarter of data collected and analysed, it is hoped that the expanding dataset can explain the changes within the seahorse population in terms of abundance, species diversity, demography, and contribute to hypotheses on breeding and mating patterns.

In this second quarterly report for 2014 (April, May and June), thirty eight seahorses were observed in seventy five survey dives. Data from this quarter continued to support previous hypotheses and observations. *H. spinosissimus* significantly select the Pencil Urchin as their preferred holdfast. Mechanisms behind this behaviour remain uncertain, however this could possibly be an adaptation to a sparse population. Traditionally, seahorses have been observed to be territorial and select sedentary holdfasts; perhaps the population on The Corral can not afford to be territorial due to the highly fragmented, poor quality of the habitat, instead selecting mobile holdfasts which increase the chances of inter-individual interaction, thus increasing the chance of finding a mate.

The current study shows that the life-history traits of *H. spinosissimus*, such as short gestation period, yearly breeding cycle with numerous pregnancies and a diverse holdfast selection, renders it the best suited species to adapt to a fragmented habitat, such as The Corral. This explains the relative absence of other seahorse species which had once been observed in the area, however no longer are.

The fact that there was no significant difference in the abundances of all sexually active demographic cohorts initially indicates that the breeding ratio is constant. The significantly larger number of juveniles in 2014 than 2013 could be due to an asynchronous breeding cycle, in which there are no yearly patterns. However, future comparison between quarters will provide more detailed understanding.

The datasets collected over a single quarter are often quite small. Indeed, this report is based on thirty eight sightings over three months, making it difficult to draw definitive conclusions. This is why it is imperative to have continuous surveying of any single population. It will be the analysis of an entire year of data, and then comparison between years, that will provide solid, reliable data, allowing for temporal analyses revealing any breeding patterns, local behavioural adaptations and any yearly oscillations in population demographics. This project, Marine Conservation Cambodia, is part of a developing global co-operation between a number of different seahorse research projects. Other surveying projects are being carried out in the United Kingdom, Malta and Malaysia. By using a standardised database and persistent surveying, our knowledge of this splendidly unique creature's ecology, status and conservation methods can continue to increase. This is now more important than ever, due to increasing economic demand, particularly from the traditional chinese medicine trade. With knowledge, we can attempt to protect seahorses and their diverse associated habitats world-wide, and by extension, contribute towards global marine conservation efforts.

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