Year 5 report on the Seahorse Tagging Project at South Beach, Studland Bay in Dorset run by The Seahorse Trust.

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The British Seahorse Survey (BSS) has, since its beginning in 1994 plotted the distribution of the two native species of Seahorse throughout the British Isles (and Ireland) and these sightings are recorded on the internationally recognised National Seahorse Database (NSD), which has over 800 records contained within it.
In 2007 Spiny Seahorses were reported at South Beach in Studland Bay, Dorset which led onto the setting up and running, under license of the Studland Bay Seahorse Tagging Project (SBSTP). This project has now been running for 5 years and has made some interesting discoveries, observations and conclusions.

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Introduction

Seahorses are a cryptic species, secretive, shy, a fish that is superbly evolved to live in a variety of habitats; they have an upright posture and the ability to camouflage, to blend into the background, with a prehensile tail that can only be forcibly unlocked in the most extremes of weather.

They have the ability to grow and reabsorb spiny appendages on their body, depending on the habitat they live in; however their most unusual claim to fame is that the male is the only male animal in the world to have a true, full pregnancy.

In 1994 Neil Garrick-Maidment set up the British Seahorse Survey which is run by The Seahorse Trust; it is the longest running continuous survey of its kind in the world.
The survey was set up to understand more about these incredible creatures and the world they live in and it now contains over 800 sightings; recorded from as far north as the Shetland Isles, out into the North Sea and all around the British coast (and around Ireland and Wales) with a main concentration of sightings along the south coast.

There are two species of Seahorse in the British Isles, The Spiny Seahorse (*Hippocampus guttulatus*) and The Short Snouted Seahorse (*Hippocampus hippocampus*); both widely distributed and both specialising in differing habitats due to subtle differences in the shape of the snout and body and their dietary needs, although they can also be occasionally found in the same habitat together (**Garrick-Maidment 2004**).

Short Snouted Seahorse
Hippocampus hippocampus
Map 1 & Photo 1

Spiny Seahorse
Hippocampus guttulatus
Map 2 & Photo 2

These two enigmatic, cryptic species are very difficult to study in the field (**Lucy Woodall, Maria McGlynn pers comms**) and with the exception of a few animals that have very distinctive general markings it makes them difficult to identify as individuals.

South Beach, Studland Bay, Dorset

In 2007, Julie Hatcher (**Marine Warden for Dorset Wildlife Trust**) discovered a pregnant Seahorse at South Beach in Studland Bay, Dorset and during preliminary searches in late 2008 we discovered approximately 40 individual seahorses (58 sightings) on the site which led to an opportunity for The Seahorse Trust and others to understand more, and to be able to study Seahorses in a relatively benign environment. It gave us a unique chance to look for and study Seahorses in an area which has proven to be internationally important for breeding Seahorses, particularly the Spiny Seahorse (*Hippocampus guttulatus*) but there have also been Short Snouted Seahorses (*Hippocampus hippocampus*) spotted on the site.

South Beach is in the southern corner of Studland Bay, in East Dorset and is relatively sheltered from all but easterly storms and is known as a safe haven for boats during stormy weather. Because of its sheltered nature it is also very popular with leisure boats, that come from nearby Poole Harbour for day trips, numbers of up to 350 have been recorded in a single day. (**The Seahorse Trust, 2008**)

The bay is a shallow area, with depths of up to 3.5 to 4 metres at its edges. During extreme spring tides, large areas near the beach can become exposed but seldom is the main seagrass meadow uncovered and so it provides a secure haven for many species resident in the seagrass, particularly seahorses, especially the more dominant Spiny Seahorses that come into the bay during warmer weather to breed.

The sheltered aspect of the bay means it is perfect for a seagrass meadow to have formed and it has one species of seagrass, *Zostera marina* dominant on it.
In recent years the invasive species Jap weed, also known as Wireweed - *Sargassum muticum* (http://www.marlin.ac.uk/speciesinformation.php?speciesID=4296) has got a hold onto rocks that have been dislodged from beneath the sandy bottom of the bay and onto the mooring blocks, there are also a variety of loose, free drifting brown and red algae living in amongst the seagrass.

Studland Bay, Dorset
Photo 3

South Beach at Studland Bay, Dorset
Photo 4 courtesy Google Earth

Legal protection

On the 6th of April 2008, the results and data of the British Seahorse Survey and extensive lobbying by The Seahorse Trust led to both native seahorse species receiving full protection under the Wildlife and Countryside Act (schedule 5, section 9, 1981); this

not only included the seahorses but also the habitat they live in as well, which was an amazing testament to the thousands of divers, fishermen and members of the public who have given up their time to look for these elusive fish and submit these sightings to the survey, to be added to the National Seahorse Database.

The WCA schedule 5, section 9 states, it is illegal to:

Section 9	
Part 1	intentional killing, injuring, taking
Part 2	possession or control (live or dead animal, part or derivative)
Part 4 (a)	damage to, destruction of, obstruction of access to any structure or place used by a scheduled animal for shelter or protection
Part 4 (b)	disturbance of animal occupying such a structure or place
Part 5 (a)	selling, offering for sale, possessing or transporting for the purpose of sale (live or dead animal, part or derivative)
Part 5 (b)	advertising for buying or selling such things

This we feel is just one step along the road to protecting, through management and conservation programmes and giving us a greater understanding about Seahorses in our waters and abroad; but we need to know more and so the chance to study individual seahorses at South Beach, Studland Bay in Dorset was a perfect opportunity for an intensive seahorse survey.

Licenses

In early 2009 The Seahorse Trust was issued with licenses in accordance with the Wildlife and Countryside Act (1981) by the Marine Management Organisation (MMO) to start studying and tagging seahorses at the Studland site.
As part of the initial licensing agreement conditions it was stated that the trust, in its first season, had to initially tag and recover three seahorses to check on the effect of the tags on the Seahorses and to see if there were any detrimental effects. This was done and all the Seahorses were recovered on numerous occasions, these repeated sightings meant we were granted our ongoing license to carry on with the research project.
(**Seahorse Tagging Project at Studland Bay in Dorset The Seahorse Trust. 2010 Neil Garrick-Maidment Published Online**.)

Licence Number: L/2012/00096/1

Tagging seahorses

In preparing for the project we looked into a variety of ways to identify individual seahorses in the field and we explored many methods such as using elastomer dyes which are injected under the skin, fin clipping, head profiling and tagging seahorses with a small numbered floy tag.

Our conclusions as to our final decision are listed below:-

- Injecting Elastomers were considered and we discussed this with many other projects throughout the world [**incl. Maria McGlenn, Spanish Tagging Project, Paul Camilleri, Malta**] and we decided this was not the method for us as we felt by having to remove the Seahorses from the sea to the surface and then injecting under the skin into the body was not acceptable and appeared quite cruel. Seahorses do not have a muscle mass to be able to inject into and it would be very possible to accidently do this into vital organs. We also learned that the dyes fade quickly and recovery rate for Seahorses was unacceptably low and it was not known what happened to the dyed animals that were not repeatedly seen.
- Fin clipping was also considered but again this was dismissed. We have been involved with fin clipping for DNA analysis with PhD graduate Lucy Woodall for several years and there are very limited detrimental effects. Underwater for identification purposes an elaborate system of fin clipping would need to be developed and we felt that it would become too intrusive on the Seahorses and we did not know the long term effects on the Seahorses. It is also known that fins grow back very quickly and so long term observation would not be possible without repeatedly clipping the fins.
- Floy Tags were decided on after extensive research in captivity including one female Spiny Seahorse that had a floy tag on, in captivity, in a deliberately complicated tank environment for 4 years. If there was to be a problem then the design of the tank and the longevity of this experiment would have shown up the problem.

Floy Tag Identification

After a great deal of discussion and investigation we decided that the floy tags were the best way forward initially for the project. The Floy Tags (http://www.floytag.com/) are basically a small plastic numbered tag which is held around the neck of the seahorse by an elasticated nylon cord. It is a very small tag 5mm x 3mm made out of plastic and it fits neatly under the neck of the seahorse on the cord. During extensive tests on a large number of individuals in captivity, we devised quite a number of environments, some deliberately complicated so that if these tags could get caught they would do in these set ups. During the 5 years of the study there has not been one situation where the Seahorses were entrapped because of the tags. Other institutions [**The Sealife Centres, Blue Reef aquariums, Blue Planet aquarium, NMA, and a few individual aquariums to name a few**] also use this method as a means of identification on their Seahorses and again there are no detrimental effects.

We used Floy tags for just under four years of the project and even when we had not seen a Seahorse for a couple of weeks it did not cause any problems to them at all. The only problem that might occur is the growth of algae on the tag but with a scrap of the thumb nail this was soon cleared.

Photo 5 Floy Tag

The Floy tag is located around the neck of the seahorse. In this picture it has been pulled to the side, so it can be seen but normally it is tucked under the neck and cannot readily be seen.

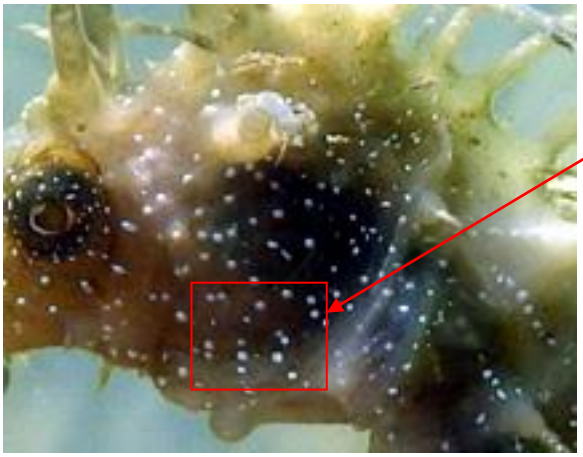
Head Profiling

As the project has developed during the first four years and by studying photographs of known individuals, identified through their floy tag numbers, we now know it is possible to identify individual seahorses through their unique facial spots (clusters) on either side of the head. This is a non-intrusive but very useful tool in identification, so we now use this method of identification. Although Floy tagging seahorses causes no stress to the animal during and after tagging, if any handling can be reduced even further, then this has to good for the seahorse.

It is not necessary to touch the seahorses for head profiling as pictures can be taken (without flash or lighting as per the law) from a distance and so are less intrusive.

Seahorse E456 seen from both sides of the head, by using the individual spots on each side of the head it is possible to identify individual seahorses.
Photo 6

Mucous spots form a unique pattern (clusters) like a finger print which can be used to identify individual seahorses. Counting and noting the location, pattern and number of certain spot clusters allows individuals to be identified, completely alleviating the need for tagging.



Spot clusters are unique to individual seahorses and as such can be used for identification.
Photo 7

The secondary advantage of using head profiling is that occasionally Floy tags fall off and so to be able to identify a previously seen animal is vital so that we do not double count the animals in the project.

Head profiling is now being fully used and initial results are very promising, volunteer Colin Wells has taken on the development of this project.

Photographing seahorses

The use of photographs in identifying seahorses for head profiling identification as above is vitally important to our work, however animal welfare is paramount to the research and of greater importance, especially as seahorses are a protected species (**achieved by The Seahorse Trust in 2008**) and so we look for methods that further reduce stress and problems for the seahorses.

In our research we have observed the effects that taking photographs with and without flash can cause and we have made several recommendations to the Marine Management Organisation (MMO) to make sure that seahorse welfare is the first and the most important thing; one of which is the ban on the use of flash photography in the wild, which we are pleased to say MMO agreed with and was put into place in 2010.

The structure of the seahorse eye is that it is designed to see in very low light levels and depending on the species it has either a green or blue hue to it; green tends to be in areas with plants and weeds such as seagrass meadows and blue is more aligned with coral reefs and rocky structures. This hue is thought to be a natural form of sunglass to protect the delicate eye structure in the natural habitat; it also gives greater definition in an area with certain dominant colours, allowing the seahorses to be able to focus better, more sharply and giving greater contrast when searching for food items in low light levels.

Seahorses are very well evolved to cope with natural light levels, from the almost black, lightless areas of their wintering grounds to the more brightly lit summer regions. They cope with extremes very well, even the pulsing effect of strong sunlight in seagrass meadows. However this is a natural adaption and they move from one light source to another very slowly, allowing them to adapt to each light level type and strength in their own time. Artificial lighting, such as flash or strobe is beyond their natural tolerance and causes many problems and the intensity of flash photography and strobe lights is such that it causes immense amounts of stress often with devastating consequences.

In seagrass meadows the Spiny Seahorses tend to be found at the bottom of seagrass stems where the fronds form a canopy above them, filtering the intensity of the sunlight in shallow waters.

By having eyes that see in very low light levels, the intensity of flash photography is very blinding to them and if a number of pictures are taken in quick succession then this brings on intense stress to the animals, often leading to death in the short term.

When seahorses get stressed they become ill very quickly; despite popular myth, seahorses don't just keel over and die, it's more indepth than that. Seahorses carry a wide range of diseases that lie dormant in their bodies such as TB and Vibrio, causing them no harm on a day to day basis. However, the moment they get stressed one of these diseases will get a hold of the seahorse, and death follows within a few weeks or slightly longer.

Death is caused by the disease brought on by stress and so unless identified, individual animals are followed daily for months (as we do in our work) it cannot be said that flash does not have a negative effect on them. It is not flash itself that kills the seahorse but the disease that is triggered by the negative effect of flash, which causes stress within the animal.

Every responsible researcher and public aquarium in the world bans the use of flash and keeps stress to an absolute minimum, because it is known that the result is death in most cases. Because of this and other incidents, we recommended to Marine Management Organisation (MMO) that the use of flash should be banned in the wild. It agreed, so it is now illegal to photograph seahorses in the wild with a flash, strobe or any artificial light. In fact, if you deliberately go to find seahorses in the wild in the UK, you require a licence (**see section on Licenses on page 4**).

Cirri (appendages) Profiling

Cirri are the appendages made of fleshy protuberances that are found mainly around the head and neck of seahorses, (all over the body in Seadragons) these are grown to help camouflage them in certain habitat types. They are not bony but are fleshy and made of skin and have little uniformity to them but are ideal for camouflage as they make the seahorse look like the weed they hide in. It is not reliable to use the appendages (cirri) located around the head and neck of Spiny Seahorses *Hippocampus guttulatus* (or any seahorse for that matter) for identification purposes (except in the very short term) as they do change over the life of an animal and they can be grown and slowly reabsorbed depending on the habitat the seahorse spends time in, this has been observed to happen over months in some cases.

This ability to grow and reabsorb cirri allows the seahorse to adapt to the environment it lives in for relatively long periods of time, and is solely dependent on individual seahorses and their needs. In some regions (in parts of Europe to the east of the UK) where both *Hippocampus hippocampus* and *Hippocampus guttulatus* live, it can be difficult at a quick glance to distinguish between the species as some *H.hippocampus* grow cirri and some *H.guttulatus* have very few, so using the cirri has been dismissed as an inaccurate way of identification.

Seahorse adults tend to have fewer and less dense appendages than juveniles because the juveniles are more reliant on the camouflage effect of cirri than adults. Being a non-settled juvenile, where they can move across a variety of weed covered habitats, can make them very obvious to potential predators, so the addition of cirri help to camouflage them. The fry and juveniles spend more time moving from site to site, even migrating like the adults but do not have set breeding territories, so to have denser and more appendages when settled as adults can be a disadvantage. Any advantage to have a large number of cirri when the seahorse is constantly moving, such as when juvenile, outweighs any potential negative affects The exceptions to this are seahorse species that tend to live in a wide variety of habitats such as Short Snouted Seahorses (*Hippocampus hippocampus*) in the UK, that mostly do not have cirri because of the wide ranging types of habitat they live in and so to have bushy, abundant cirri would be a disadvantage to fry, juveniles and adults alike as they would be more easily seen, especially in areas of open seabed.

A juvenile Spiny Seahorse camouflaged using its cirri to great effect.
Photo 8

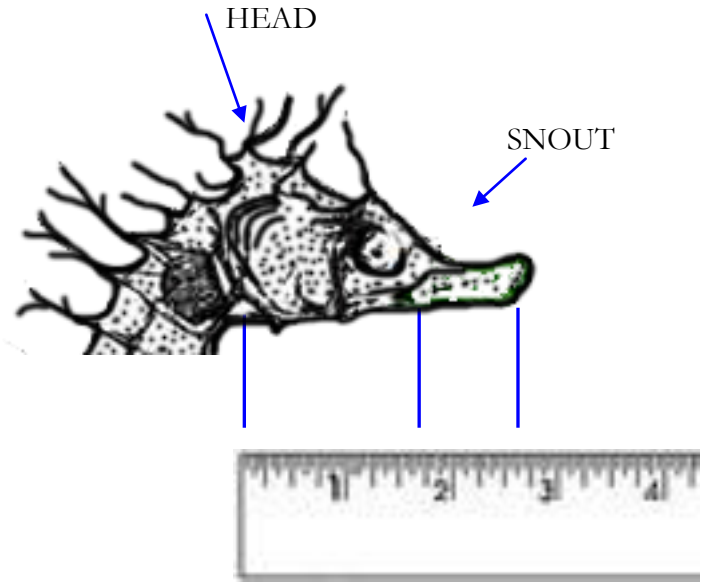
Morphometric measurements

Understanding seahorses in their natural habitat includes the collection of a wide variety of different bits of information, such as location (using gps and triangulation), weather, sea temperature, habitat, sex, size, depth, species and behaviour amongst other things.

This collective information is vital to understanding individual seahorses and long term trends but it is important to not spend time collecting unnecessary data for the sake of it. Many projects around the world collect head / snout ratio lengths, especially when there are more than one species in the area. On our study site, it is predominantly Spiny Seahorses *Hippocampus guttulatus* and so the usefulness of these measurements is less important to our work, so we do not collect it. However we do understand the need on other projects and if circumstances change at Studland or in the BSS then we will start to collect these measurements.

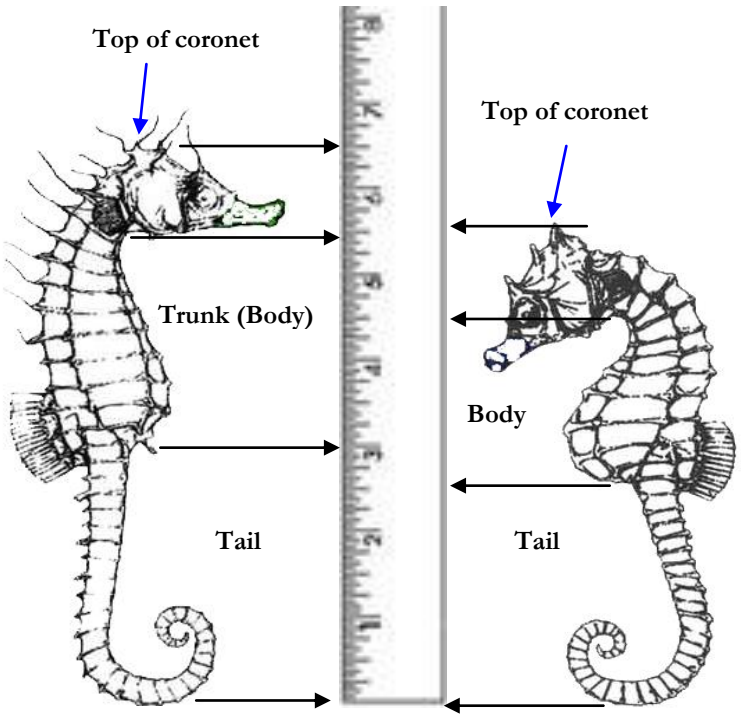
On the Studland site there has only ever been 2 Short Snouted Seahorses (*Hippocampus hippocampus*) seen in the 5 year period of the study, these were located on the very edge of the seagrass meadow where the habitat changes into rocks, sand and pebbles, rather than the seagrass meadow found throughout the rest of the area. With this very small number of Short Snouted Seahorses, it was decided to not collect head/snout information, which in turn meant less interference with the seahorses, as they would have to be held for longer if we did take these measurements. The welfare of the animals is paramount to us at all times and so any measures we can take to reduce contact are vitally important.

Head / snout ratio measurements
Diagram 1



A crucial measurement to help understand growth and the age of seahorses is to measure body length. When the measurements are taken, they are from the top of the coronet to the end of the tail. In some cases it is not possible to measure to the end of the tail as this would mean pulling the seahorses out in a straight line. In these cases the use of photographs are vital as an accurate guess of the length of the tail can be worked out from clear photographs.
Wherever possible measurements are taken by using a ruler positioned next to the seahorse and notes are taken of the relevant measurements

Measuring the seahorse helps to estimate the age of the animal and in the long term allows for a greater understanding of breeding and growth rates.



Measuring overall body/tail length of the seahorse
Diagram 2

Spiny Seahorse
Hippocampus guttulatus

Short Snouted Seahorse
Hippocampus hippocampus

Using a ruler or an item of a known size placed beside the seahorse, allows for measuring it without having to touch. In this example taken at South Beach, Studland Bay, an accurate measure could be taken and at the same time head profile pictures could be extracted from the pictures taken. This reduced overall identification time to less than a couple of minutes.

Measuring a seahorse through photographs
Photo 9

How the survey was conducted

The use of volunteers has been invaluable to this survey project and it could not have been achieved without them; the volunteers are crucial to act as eyes for the surveyors when we are doing our research under license from the Marine Management Organisation (MMO). The extra sets of eyes that volunteer divers provide, allow us to cover vast areas of seagrass on each dive. When the volunteers are diving and they see seahorses, they then point them out to the licensed dive leader so they can start work gathering data for the ongoing research project.

The licensed researchers dive on each dive accompanied by the volunteers; each dive group can be as small as 2 and as large as 10 including at least 2 licensed dive leaders, groups are never larger than 8 volunteers (1 licensed diver to every 4 volunteer divers).

To date (6th January 2014) at South Beach we achieved the equivalent of 592 dive days and have been underwater for 1,013 hours over a 5 and a half year period, an unprecedented amount of time for a project such as this in the UK. The extensive dive time means we have a greater understanding of the seahorses in their natural environment.

The area covered on each dive is dependent on what areas have been covered on each previous dive and is co-ordinated by the project officer, who oversees the whole project. Over each month the full study area is covered and certain areas are dived on each dive. These particular areas can be sites where seahorses have been found, possible seahorse areas, sites where extensive damage is occurring to the seagrass and sites where new, illegal moorings have been put in without permission, and the general seagrass bed and surrounding area as well.

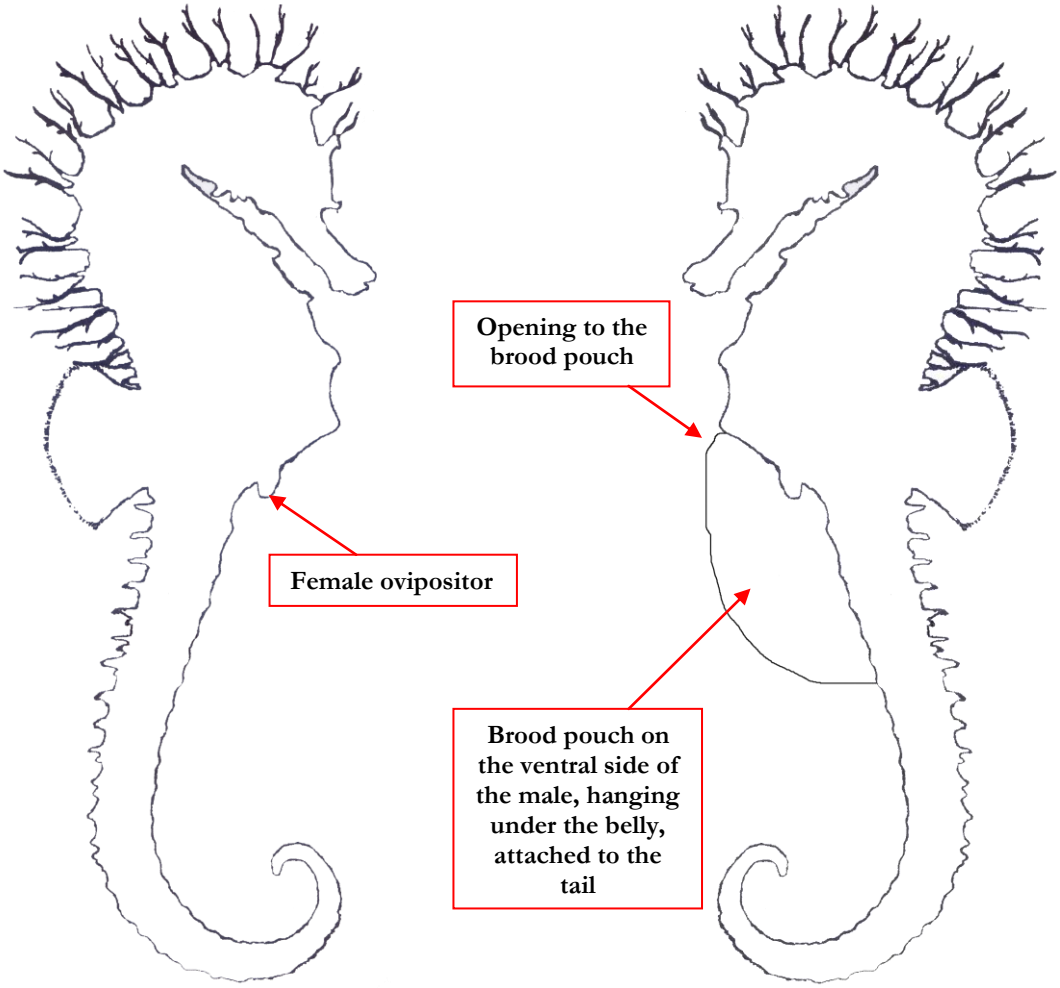
When surveying, the Project Officer has decided prior to the dive which areas need to be covered so that all areas are covered and any logged seahorses are checked for on every dive. By checking for these logged seahorses it is then possible to build up precise knowledge about individual seahorses and their behaviour, their partners and the size of the area (territory) they can be found in. After every dive, a debriefing session takes place and additional information can be noted and placed on the NSD.

The type of data gathered during these dives includes, the exact GPS location of individual seahorses, a surface triangulation of the location, habitat condition, seahorse condition and many other things, including morphometric details as noted above. Data is noted on the dive leaders dive slate, during the dive which also has a dive timer and compass on it. All this data and accompanying photographs are transferred onto the NSD when back in the trusts office, so the results can be compared with previous dives and seahorse markings can be compared with the NSD photo database. Seahorse locations are plotted onto Google Earth maps to build a picture of the pattern of seahorse movements.
Having dived the site for so many years the core team of researchers are now highly skilled at finding seahorses and even when a dive is short or if there is a limited team available then, if any seahorses were present then they would be found.

The divers are under a strict dive Seahorse /diver Code of Conduct (below), which has been devised by The Seahorse Trust when working with seahorses and has been adopted around the world on similar projects.

Identification of the sexes

Identification of the sex of an individual seahorse is crucial to understanding the population dynamics, sex ratios and to knowing as and when the male seahorses breed.
It is relatively easy to tell the difference, visually, between the two sexes as the male has a brood pouch attached to the lower part of the belly, which is linked along the ventral side of the tail and the female does not.



Female / male seahorse
Diagram 3

Life cycle of seahorses

Spiny Seahorses are seasonally, pair faithful; once they have migrated back into shallow waters from their deeper, winter refuge. The migration is timed so that the seahorses arrive as the sea temperature warms up to 9 degrees or more (**Neil Garrick-Maidment. Temperature report, 2013**), they then form pairs and hold territories. These territories are seasonal are held solely for breeding and not to protect food items, as they will tolerate juveniles and non-breeding individuals within the territory as long as they do not pose a breeding threat to one or other or the resident pair (**Neil Garrick-Maidment 2011 to 2013. pers obvs.**.)

Amongst the discoveries from the BSS is that in the UK, territories are held solely for seasons and pair bonding is not for life as previously thought but just for the breeding season.
Pair bonding is formed by elaborate courtship displays (**Amanda Vincent, Neil Garrick-Maidment et al**.) that are reinforced daily by the pair. It appears that first light is a stimulus to start these displays (**John Newman 2008, Neil Garrick-Maidment**) and the female will go into the male's territory (female territories overlap the males), the male will then initiate a 'dance' with the female. It appears the arrival of the female stimulates the male to start the dance however the female arrives after the male has pumped his pouch releasing pheromones into the water column to attract her attention, so it appears he is the instigator of the start of the courtship ritual and as has been said in early work by Professor Amanda Vincent, the male still remains the dominant sex even though he is the one who has taken on the female role of producing and giving birth to the fry.

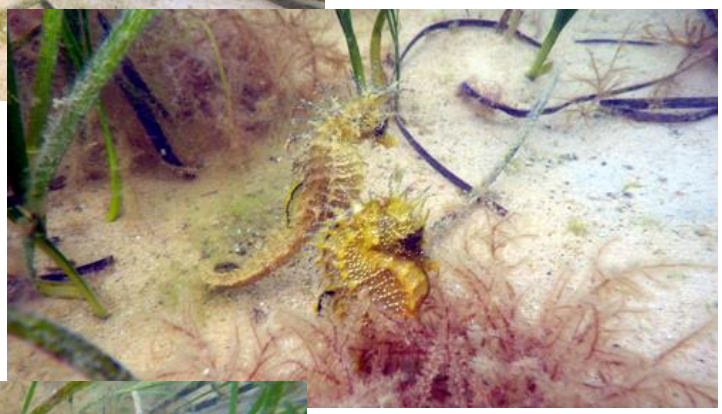
The courtship display is an intense affair with the male encircling the female in a shimmering, imitative move, corralling her against an upright object. If she is receptive the female will lighten to match the males light colouration (but both have a black face) which has changed as emotions become heightened and she will also match his body posture. They both swim in a stiffened movement with the head tucked against the chest and the dorsal fin is held out erect like a fan, which highlights the colours on the dorsal fin, especially the yellow and black lines that edge the fin. They often have a black line running down the dorsal and around the outer edge of the body which serves to highlight the outline of the seahorse.

Pumping of the tail is used in several ways such as to release pheromones but also to release the fry from inside of the male's brood pouch. The male will straighten the tail and bend it forwards at the point where the tail meets the body trunk in a straight lever like action. As he levers the tail upwards towards the front of the body, this compresses the brood pouch forcing the entrance to the pouch to open, which is situated at the top of the pouch. The opening of the brood pouch is very obvious and quite large and can be seen from some distance away. The fry inside of the pouch are already free from their placental ties and the male has equalised body fluids with seawater in the previous 24 to 48 hours by breaking the seal to the top of the pouch.

Male seahorses are the only species in the animal kingdom to have a true male pregnancy. The female deposits eggs into his brood pouch, via an ovipositor; the equivalent to a female penis and the eggs are then embedded into the lining of the male's brood pouch; after being fertilised internally by the male.
He then undergoes a gestation period which varies with species but is approximately 26 to 28 days in Spiny Seahorses *Hippocampus guttulatus,* during which the eggs and then the

fry receive all their nutritional needs via the equivalent of a placenta, which lines the pouch.

Courtship
Photo 10
Male and female come together with their dorsal fins raised showing the distinct black and yellow lines on the edge



Courtship
Photo 11

Male and female with their faces darkened to match each other, head tucked against their chests

Courtship
Photo 12
The male trying to encourage the female into a dance

Courtship
Photo 13
The female is responding by Changing colour (lighter)

Courtship
Photo 14
The female moves into the Male and he will encircle her and they then 'dance' around the seagrass stem.

Giving birth can be a long and protracted process with contractions lasting up to 12 hours, after which the fry, up to 500 to a 1,000 or more of them are released in seconds with a pumping action by folding up the tail in a straight line to the belly.

Seahorse fry spend the first few weeks drifting in amongst the plankton and when conditions are ideal they then settle out onto the seabed into suitable habitat. It is crucial that they settle out as quickly as conditions allow because swimming in the plankton is fraught with problems and they are subject to high levels of predation.

It is assumed that out of every 1,000 fry that are born in the wild (**Amanda Vincent pers comm**.) only 2 will survive to maturity which means that each male has the capability of producing 5 to 10 surviving offspring per breeding season, which is a very high survival rate for such a species.

Once a seahorse reaches the sub adult or adult stage then it is relatively safe from predators as its cryptic nature takes over and they can use camouflage and stillness to protect themselves. Very few creatures predate on adult seahorses, however, surprisingly Seagulls do (**National Seahorse Database records run by The Seahorse Trust**) as well as fish like Bass, Flat fish and Lumpsuckers, which is even more remarkable considering how well seahorses can hide and how difficult it is to see them

The high productivity of seahorses means that recruitment to other areas, via long shore drift, the Gulf Stream and other currents would explain why Seahorses can be found around most of the British Isles, albeit in very low numbers due to suitability of habitat, high predation rates and adult territorial needs.

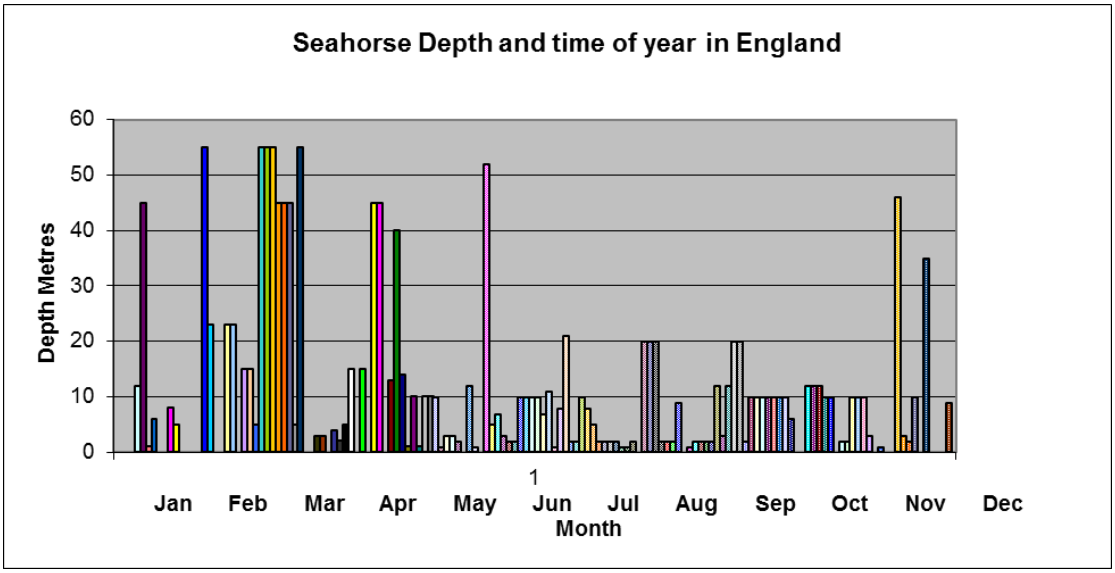
Adult seahorse numbers are relatively low in any area due to the need for suitable habitat, territories for breeding pairs and an abundance of correct food types. Even when an area has seahorses in it, they are never overly abundant, which makes South Beach in Studland Bay a unique site and internationally very important.

Although they have a wide distribution, reliance on certain habitat types means they are subject to strict environmental conditions and so numbers are considered to be quite low. Pressures on these habitats is such that suitable habitat is being destroyed or lost through a variety of reasons and so the long term future of seahorses around the British Isles is in serious doubt, which is one of the reasons why the two species were added to the Wildlife and Countryside Act in 2008.

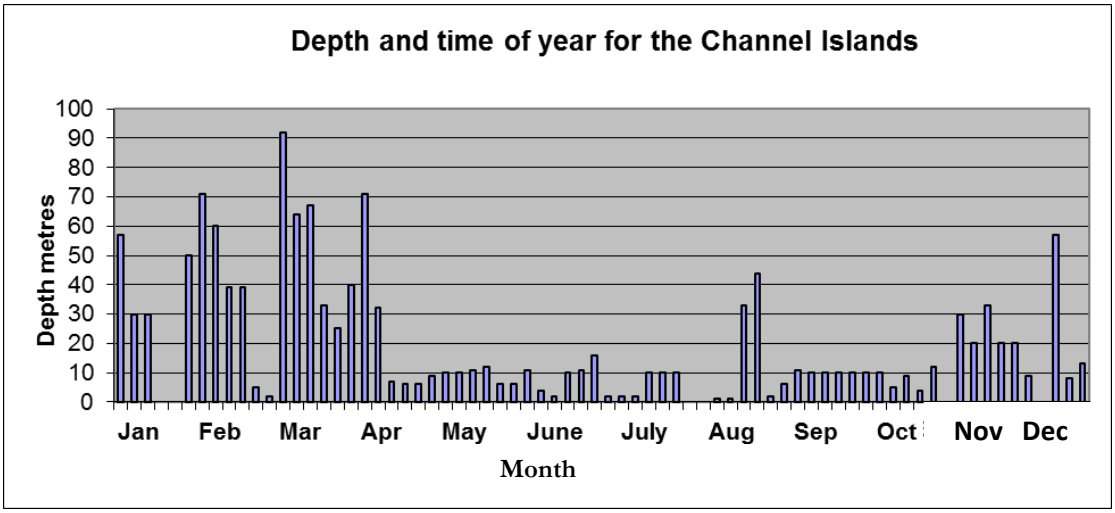
Seahorse migration

Through the work of the British Seahorse Survey (BSS) and Studland Bay Seahorse Tagging Project (SBSTP) we have discovered and confirmed so much about seahorse migration and although there is still a great deal more to learn; as our study continues we will come to understand more, the intricate, complexities of this species in greater depth.

As a very basic guideline seahorses migrate into deeper waters in early autumn and come into shallow water in early spring but it is much more complex than that, with day length, temperature, storms and suitable, undamaged habitat influencing and directly affecting the migration.



Graph 1: Seahorse depths throughout the year for England showing migratory patterns (data source, the National Seahorse Database NSD)



Graph 1: Seahorse depths throughout the year for the Channel Islands showing migratory patterns (data source, the National Seahorse Database NSD)

The above graphs show the pattern of seahorse migration in the British Isles and the Channel Islands illustrated as over a year from the records on the NSD. These graphs show all confirmed sightings contained in the survey and show the distinct migration pattern with the seasons, the graphs represent over 800 sightings, represented as a year.

Like so many species, seahorses need to conserve resources at every opportunity, especially in light of their poor digestive system, which lacks a true stomach and only has a digestive tract running from mouth to anus. This poor nutritional system means that they have to constantly eat and have optimum conditions to survive.

To try and survive stormy seas in the winter, uses much needed resources, so migration, where it is necessary, is the answer. However the finite use of resources means that if a seahorse does not need to migrate it will not, areas like enclosed harbours or sheltered bays, such as the harbour next to Studland Bay in Poole, has an all year around permanent population of seahorses (**National Seahorse Database 2013. Seahorses in Poole Harbour 2012 both ref: The Seahorse Trust.**). The seahorses are sheltered from all but the most violent of storms within the harbour confines so it is a natural place for them to overwinter.

There is probably limited recruitment of fry and one or two adults coming out of the narrow entrance of Poole Harbour and into Studland Bay (which lies to the west of Poole Harbour) and more likely much further afield, due to east/west long shore drift. However recruitment back into the harbour is from the east with a limited amount of localised circular movement of tides and currents moving animals from west to east, although numbers being circulated back into the harbour will be very limited.

There has been a suggestion that the seahorses of South Beach in Studland Bay, overwinter in Poole Harbour which is highly unlikely to impossible due to the availability of suitable overwintering grounds in much easier to reach areas just off the seagrass meadows of South Beach in a deep water channel area known as the Swash in Poole Bay, where the seahorses would not have to move against the east/west long shore drift or the strong current coming out of Poole Harbour. When researchers dive on South Beach there is always a very strong current coming from the east which is pushing the seahorses away from Poole Harbour, along the beach and out past Old Harry rocks and on to Swanage and beyond On an incoming tide there would be a small backward influence of the current that could push a small handful of fry back towards Poole Harbour mouth and indeed, the original population could have entered the harbour in this manner but it is more likely that the recruitment of seahorses into the harbour bringing with it new genetic material comes from the east, with a small number of adults moving into the harbour from other areas.

As has been stated, seahorses take the line of least resistance due to the finite nature of their resources, so to struggle back against a strong current would not make sense and The Swash is more easily available and it is just over the outer (east) edge of the seagrass meadow and it affords them secure protection throughout the length of the winter and through the most violent of storms.

This subject is covered in more depth in the article; Temperature and day length related seasonal movement of seahorses at South Beach in Studland Bay in Dorset. Neil Garrick-Maidment FBNA 2013, published abridged in the British Naturalist Associations Journal and in full on The Seahorse Trust website.

Temperature and weather effect on migration of seahorses at South Beach, Studland Bay

As has been said seahorses will migrate only if needs be and South Beach is a good example of why they need to migrate. It is an east facing bay and is protected from the predominant south westerly winds and storms that are the driving force of southern and western England, however easterly storms cause so much devastation in this small bay.
During the autumn and winter very strong easterly winds pound the shallow waters of South Beach and create devastation for any creature that tries to overwinter there. The seahorses have learnt to move (through various stimuli) into deeper waters in the autumn (usually about October) to be able to survive these storms.

It is mistakenly thought by some that the seagrass fronds found on the beach in the autumn and winter are whole seagrass plants, when in fact they are the leaves which are shed in the winter so that the root system (Rhizomes) are not dislodged and destroyed by the storms, much like leaves from a tree.

Seagrass leaves washed onto South Beach at Studland Bay during the autumn and winter storms
Photos 15 and 16

Seagrass plants, such as in **Photo 17** on the left which have been dislodged by anchor damage clearly have their root system still attached and do not set root again as they are moved around by the tides and currents; these are often washed up on the beach in the summer. Dislodging the rhizome causes holes in the seagrass meadow which can lead to the fragmentation of the whole seagrass meadow.

Throughout the study period of the SBSTP and the BSS we have recorded the movement of the seahorses into and out of South Beach at Studland and throughout the British Isles. There is a direct correlation with sea temperature when the first sightings of the spring season occur in shallow water, but it is strongly thought that temperature is not the only parameter in effect here and that seasonal lunar cycle's, and increasing day length bringing with it increased amounts of food and longer growth in the seagrass leaves are equally important.

It has been recorded since 2008 at Studland Bay that it is unusual to see seahorses before the temperature has risen to 9 degrees and they tend to leave the bay regardless of temperature when the autumn storms break and it becomes too dangerous for them to be in shallow water. Occasionally we see washed up seahorses when the first storms hit in the autumn or at the start of the season when the weather has warmed the sea and then an unseasonal storm hits, which catches the seahorses out in the shallows.

At the beginning of the season as the seasonal temperature increases and correspondingly with it the day length gets longer, the seahorses migrate back across the seagrass meadow into shallow waters from the deeper Swash Channel which sits to the east of Studland Bay. The migration is a slow process and the lengthening day is probably the stimulus for this process to start; which coincides with the seahorses coming into the shallow water by the time the water temperature has reached 9 degrees or above.
As has been said the eyes of seahorses are very susceptible to light levels so it is assumed that any barely perceptible change in day length can be detected even in the low light levels of deeper water. Seasonal lunar cycles are also very important to seahorse breeding and migration and initial work by the trust and students like Lauren Timson confirm this; this is a need for more research in this field.

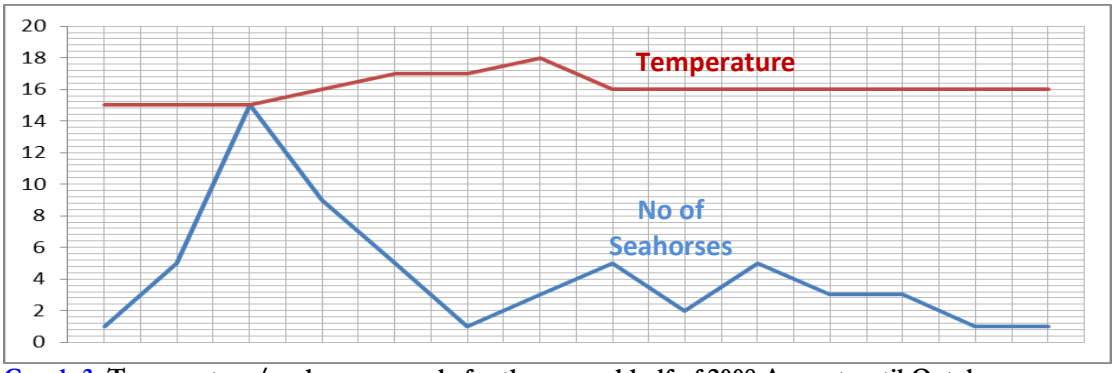
Seahorses usually appear by late April to early May depending on the sea temperature and go into deeper water by mid-October at the latest. Although the number of survey dives drop in the winter due to the weather, there has never been a confirmed recorded live sighting of a seahorse in South Beach, Studland Bay between mid to late October through to late April to early May the following year, although there has been a couple of dead animals washed up onto Middle Beach at Studland.

Seahorse at the base of a seagrass frond, where it is protected from strong light and predators
Photos 18

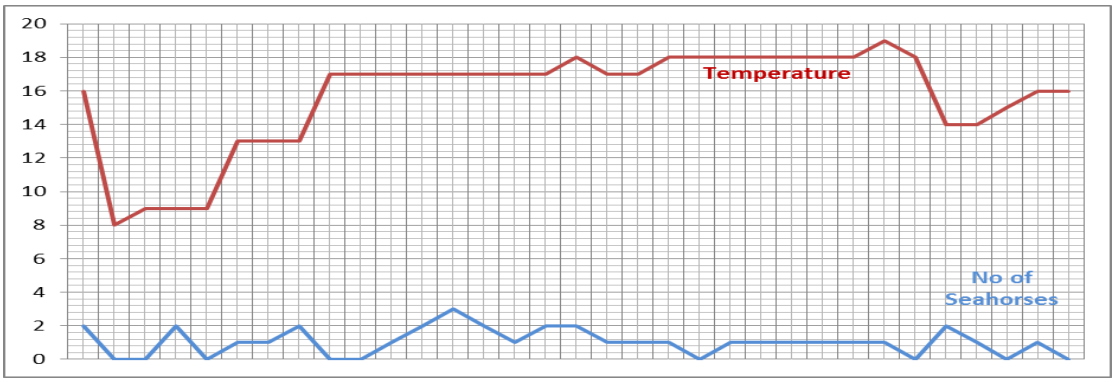
When seahorses arrive into Studland Bay, as has been recorded it is never before the temperature reaches 9 degrees. The arrival of the seahorses is timed so that as they move across the seagrass meadow the length of the seagrass frond is sufficient and still growing to give them adequate

cover; camouflaging them from potential predators. When they have reached their breeding grounds, the seagrass is almost full length and they can set up territories at the base of seagrass fronds, affording them protection from strong light levels and predators. Recent research by the survey has shown that the males set up a small territory (only several square metres), not a large one as was previously suggested; territories from which they will only move from if disturbed. The female's territory overlaps the males and can be substantially greater in size. The males and females will tolerate non breeding animals into their territories which illustrates that territories are set up solely for breeding and not held for feeding or other purposes.

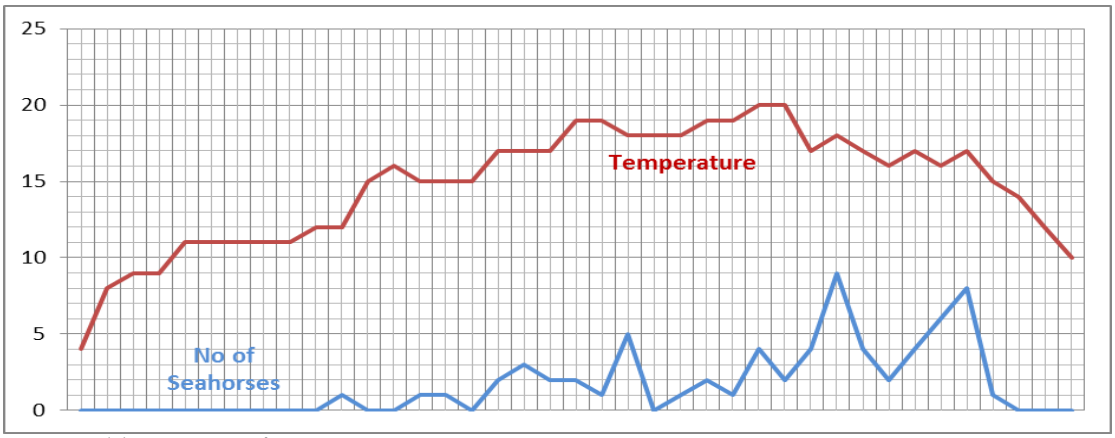
The graphs below show the years 2008 through to 2013, charting the temperature and seahorses sightings in Studland Bay. The earliest sighting was in late April and the latest sighting was in October. It is worth noting the sightings for 2008 were only for the second half of the season when the sea temperature was already at 15 degrees.



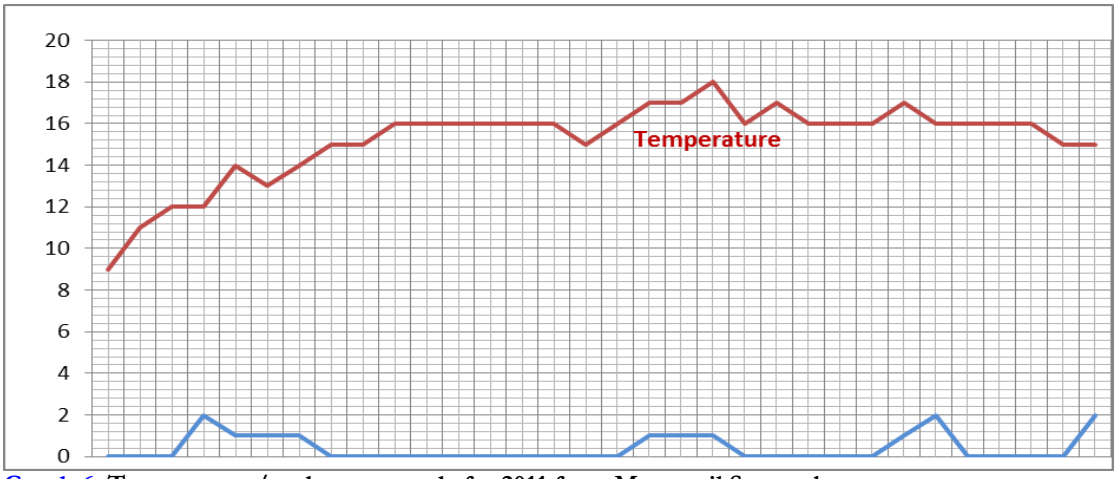
Graph 3: **Temperature/seahorse records for the second half of 2008 August until October**



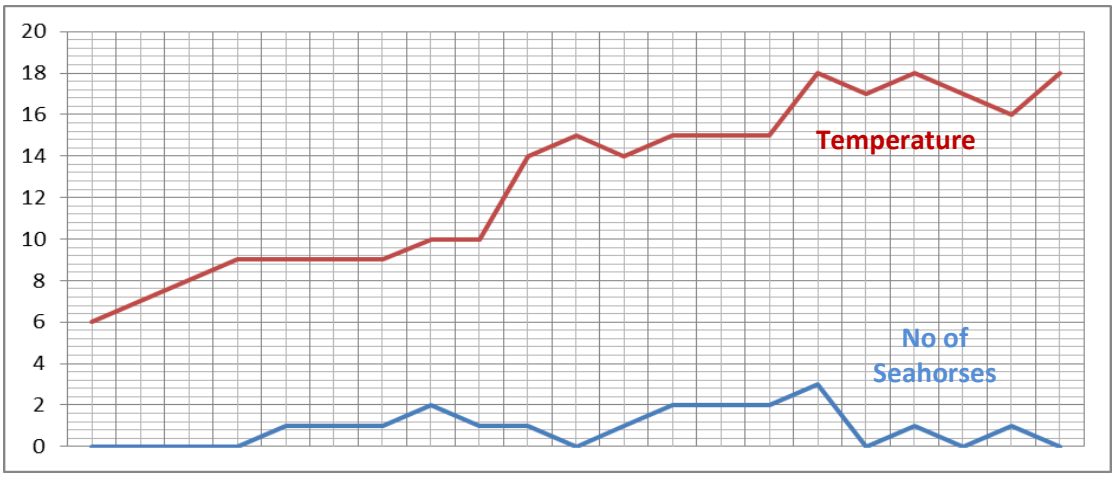
Graph 4: **Temperature/seahorse records for 2009 from the end of March until October**



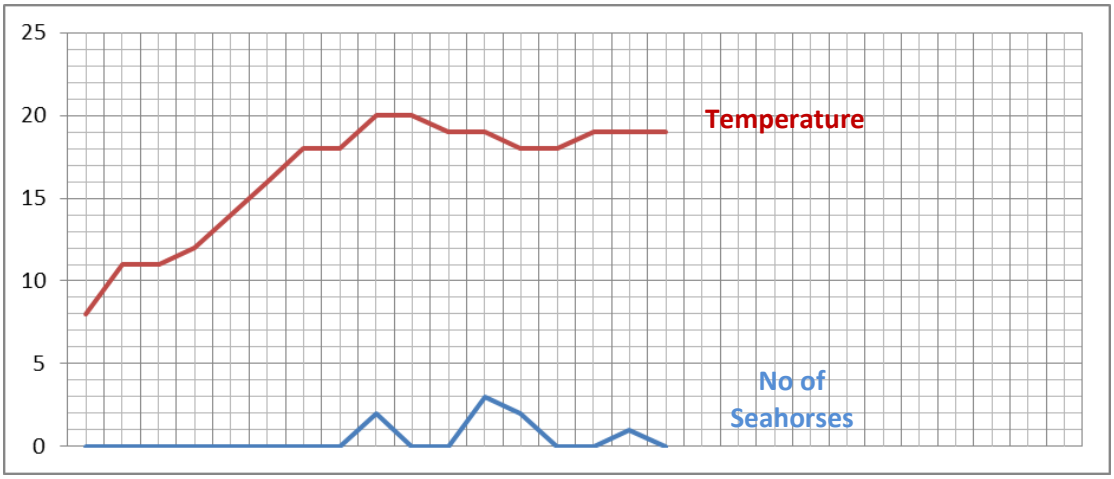
Graph 5: **Temperature/seahorse records for 2010 from May to September**



Graph 6: Temperature/seahorse records for 2011 from May until September

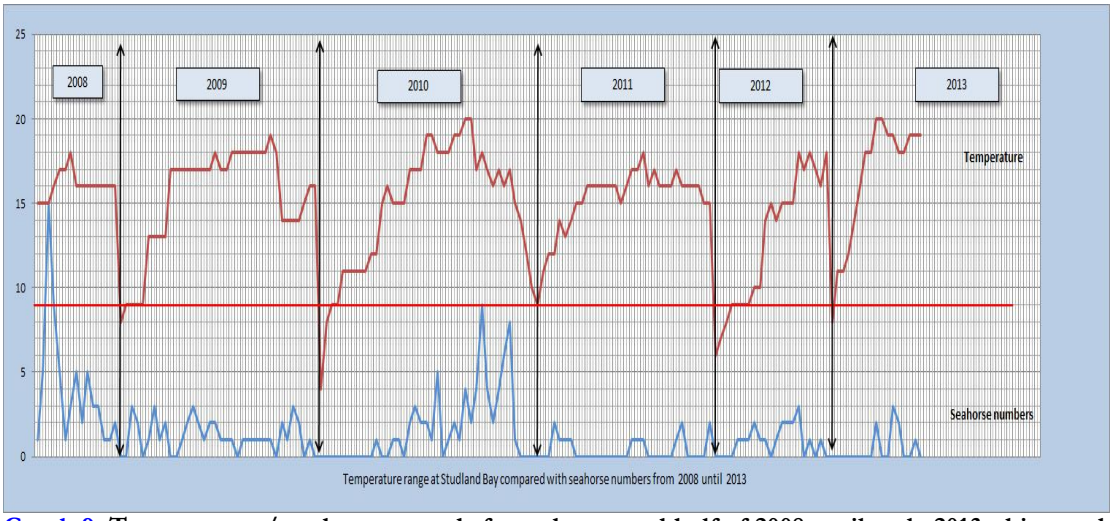


Graph 7: Temperature/seahorse records for 2012 from April until August

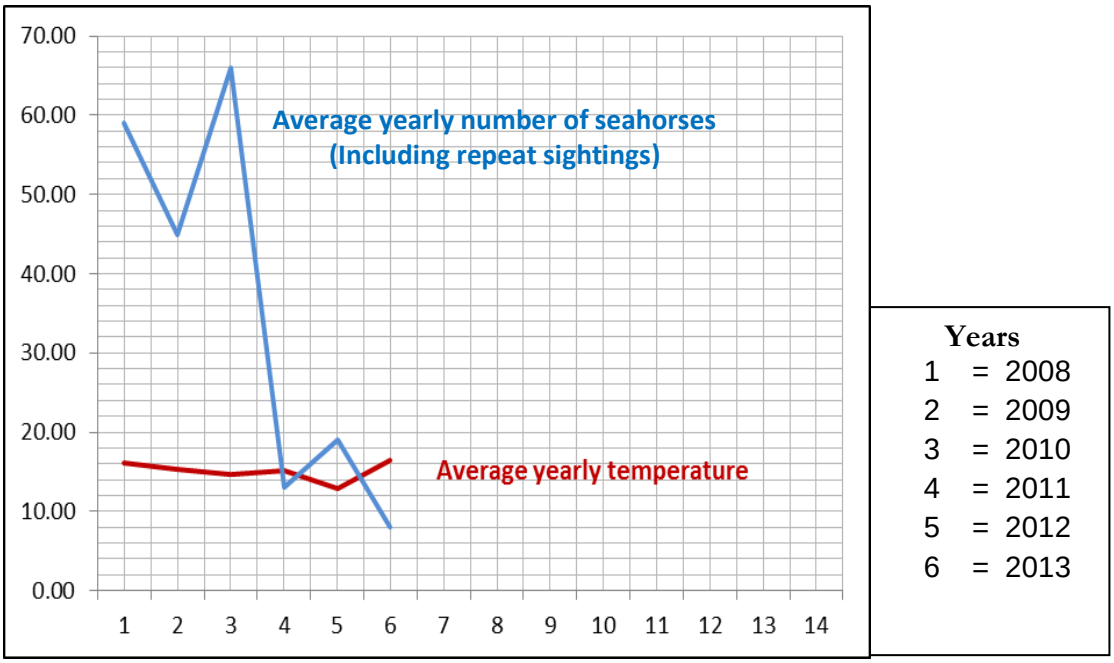


Graph 8: Temperature/seahorse records for 2013 from July until August

Temperature was recorded for other times of the year and many dives were undertaken but seahorses were not present, the graphs above only show when seahorses were present at South Beach and the correlating temperature at the time, not when they were absent.



Graph 9: Temperature / seahorse records from the second half of 2008 until early 2013, this graph only shows when seahorses were present and not the autumn, winter and early spring when they were not.



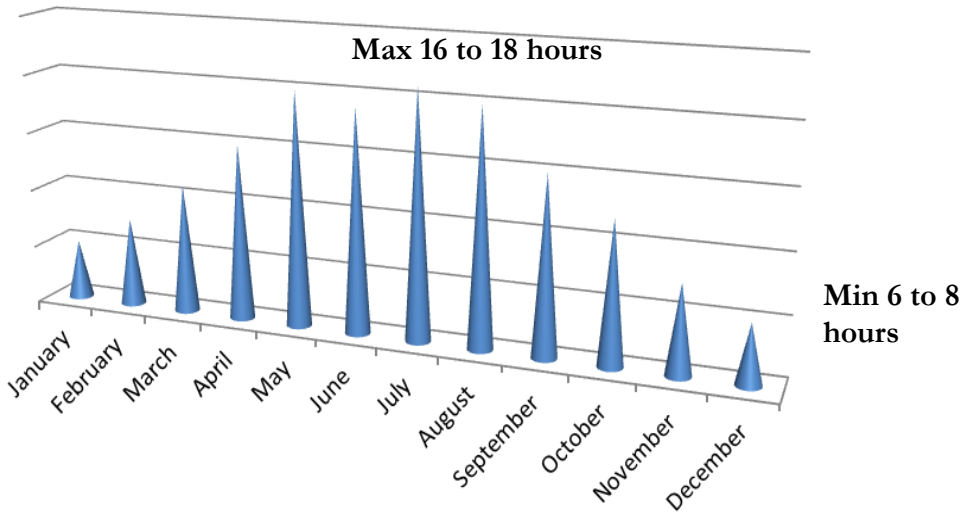
Graph 10: Average yearly temperature compared with number of seahorse sightings

It is worth noting in graph 10, that although yearly temperature does not vary much, seahorse numbers have dropped dramatically; this coincides with the fragmentation of the seagrass meadow as reported by Drs Jackson and Collins in their report (**see references**). This graph shows a direct correlation with the fragmentation of the seagrass and the loss of seahorses, giving a clear indication that the reduced number of seahorses is directly correlated with habitat and therefore food chain breakdown. This adds weight to the urgent need for conservation and management measures on the site before both the seagrass and seahorses are lost for good.

The graph below shows the average day length throughout the year which peaks at its highest from May to August, the very time seahorses have moved into shallow waters and also at the maximum sea temperature and plankton production.

Day Length, sea temperature and plankton production are the three main reasons for seahorses to move into the sunlit productive shallow waters to breed.

Lunar cycle is important for seahorse breeding, as the timing of the cycle brings together the maximum tides for distribution of fry and plankton production for feeding the fry.



Graph 11: Average day length for a year in the UK

Since the start of the survey at South Beach and by using tagging and photo ID we have identified several repeat sightings to the study site, a couple of these have been from previous years and one individual was identified after a 4 year absence from the site. We have confirmed that seahorses use the site each and every year to breed in although numbers are dropping very rapidly. We have also proven that seahorses will return to the site after a period of absence, one to four years (possibly more, as the Spiny Seahorse is known to live for up to 12 years); our ongoing research will show how frequently seahorses will return to the site but as the habitat degrades it will be become more unlikely for animals to return. In fact, should the habitat degrade to a point of no return then it is likely seahorses will be lost from South Beach for some time until measures are put into place to restore the site to former condition.

Gulf Stream

The Gulf Stream is a relatively warm 'river' of water that starts in the Gulf of Mexico and heads north east across the Atlantic; it then moves predominantly up the west coast of the British Isles and Ireland and up into and then west back across the north of the Atlantic, where the waters of the Atlantic meet the cold, nutrient rich Artic and then down the east coast of Canada and America. As it moves down from the Artic, it takes with it rich cooler waters down to the Gulf of Mexico, providing all the nutrients and elements to make the Gulf of Mexico one of the most important marine areas in the Atlantic.

Map 3: The blue lines show the direction and influence of the Gulf Stream. As the current moves into the North Sea, over the top of Scotland and through the English Channel it weakens and cools. There is a weaker push west to east (left to right on the map) through the English Channel because as the currents move down from the North Sea on the east side of the UK they are stronger down than those coming up through the English Channel. Illustration courtesy of DEFRA

It must not be underestimated the influence this warming current of water has on the British Isles and Ireland. Without it, we would have short hot summers and long, cold snowy winters, the same as in northern North America and Canada, with which we share the same line of latitude. The Gulf Stream gives us our maritime climate but it also gives us more than that, in the form of the varied number of species native to our shores and the vast variety of life, terrestrial and maritime that we have.

As the Gulf Stream hits our westerly shores it warms the shallow seas and brings with it necessary nutrients to provide for a myriad of creatures and to feed a wide variety of animals in the food chain; starting with the building blocks of life, plankton.

Plankton cycle

The plankton, zoo (animal) and phyto (plant) kick-starts a food chain that is dependent on temperature (from the Gulf Stream) and day length (due to changing seasons) but sustains a myriad of creatures from other plankton to shrimp, jellyfish, seahorses and up to Basking Sharks. Along the way, the food it feeds is food for other creatures, so for example the huge Leatherback Turtle found in British waters feed on Barrel Jellyfish which in turn feed on plankton.

The plankton cycle, booms and busts with rising and falling temperatures and longer and shorter day lengths and the cycle of plankton directly affects the life cycle of others species that are reliant on it.
During the cooler, shorter days of winter there is little plankton around but as the day length gets longer, this warms (aided by the Gulf Stream) the seas of the British Isles, this warming starts the growth in phyto (Plant) plankton creating large algal blooms that can be seen from space.

The abundance of phyto plankton allows the herbivorous, plant eating plankton to have sufficient food to grow and propagate into ever increasing numbers which are only kept in check by the coinciding increase of Zoo plankton; carnivores that feed on the herbivorous plankton. It is a fine balance that is easily disrupted.

As each type of plankton increase, it is kept from dominating the seas by the next group down or up. When the phyto plankton is depleted, there is little food for the herbivores to feed on and with that and the reduction in their numbers from carnivorous plankton, their numbers are reduced. Without the herbivores to be eaten the zoo-plankton, numbers drop, this goes on until the phyto plankton numbers build up again and the whole cycle restarts. The plankton cycle during the warmers months tend to peak each month around the full moon; (the Lunar Cycle) this peak at full moon coincides with the highest and lowest tides, which help to distribute the plankton much more widely.

Other species take advantage of this peak in plankton numbers by timing their reproduction to maximum numbers of plankton in combination with the best tidal movements to distribute their young. Seahorses are a perfect example of this and the adults and fry (young) are perfectly aligned to reproduce, grow and distribute according to lunar, plankton, seasonal, yearly and day length cycles.

The processes occurring in shallow water whilst the seahorses are migrating inshore include the increase in plankton, which in turn feeds the smaller crustacea such as Mysis Shrimp, so that by the time the seahorses arrive in the shallow water there is a good supply of food for them to increase body weight, improving their condition for breeding and once they start to reproduce then there is sufficient food for the fry.

Yearly temperature variation effect on algal growth

As the day length increases and temperature rises, photosynthesis takes place in the seagrass, increasing growth in the fronds (leaves); as the plants receive more sun light this will increase the growth rate causing a spurt of growth in early season. This slows down as mid-season approaches and stops just after mid-season when the plants seed.

Photo 19: Early season growth of seagrass

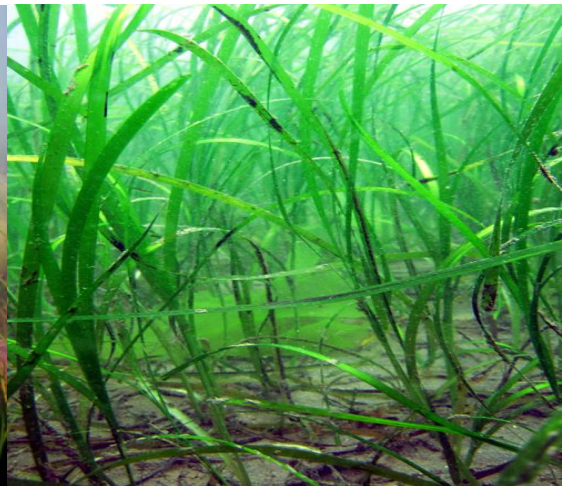


Photo 20: Mid-season growth of Seagrass

The migration inshore of the seahorses is intended to coincide with this growth spurt; by the time the seahorses arrive there is sufficient length on the seagrass fronds to create an overhang which the seahorses prefer to hide under. By hiding under the fronds they shelter from predators and benefit from the reduced light levels. Their cryptic nature and body and eye design allows them to be camouflaged in this dimly lit, dense habitat; Spiny seahorses prefer not to be out in the open.

Photo 21: Spiny Seahorses are found at the bottom of seagrass fronds, protected from predators and from the harmful effects of bright light. Seagrass acts like am umbrella, diffusing sunlight.

Damage to the seagrass meadow

When starting the research work at South Beach it was never The Seahorse Trusts intention to be involved in a long and protracted fight to save the site from undue pressures and damage, however it soon became evident that mankind's activities in the bay were having a negative effect on the natural order of things, especially the seagrass meadow, which is the kingpin of the bay.

South Beach at Studland is a site of multiple uses and intense pressure, predominantly man made; the combination of use and lack of formal conservation and management measures means that there is ongoing, unsustainable damage to the seagrass meadow and in turn the species that occupy it. This ultimately could be disastrous, not only to the seabed but also to the cliffs and beach edging the site; ongoing continuous damage to the site will lead to costly environmental damage that will affect natural processes and mankind. There have already been a number of landslips from the cliffs and banks behind the beach, which has led to the installation of gabions to hold back the bank in front of the beach huts and in the winter of 2012/2013 the bank slipped onto several of the beach huts, rendering some of them unusable and closing the coastal footpath down to the beach.

The bay is used by a wide variety of different users, such as swimmers, canoeists, snorkelers, wind surfers, jet skiers, divers, walkers, wildlife watchers and the boating community.
Although it is a multi-use site it is the boating community who have been most vocal in trying to stop any protective measures being put into place in the bay, organisation such as the Boaters Outrage Reaction Group (BORG) and the Royal Yachting Association (RYA) have spent a great deal of time fighting conservation measures. The BORG are actively trying to dispute that any damage occurs to the site (**M.Simons, BORG 2012/2013/2014**), despite scientific evidence from Dr Ken Collins from Southampton Universities, National Oceanography Centre, Dr Emma Jackson, formally of Plymouth University and others showing there is.

One of the main usages of the site is as an anchoring area for visiting pleasure craft looking to anchor up for the day and yachts that are seeking shelter from storms and high winds; it is traditionally a natural shelter anchorage.

One of the main reasons why this has become an issue in recent years is due to the sheer quantity of vessels using the site now, anywhere up to 2 or 3 hundred per day in high season (May to September), with the most ever recorded of 350. The vast majority of these boats drop anchor into the sensitive seagrass and when removing their anchors, they tend to drag the anchor through the grass before lifting it, which in effect is like ploughing a field. This loss of ground covering seagrass causes erosion, which is just the start of a process which ultimately could end with the loss of the seagrass meadow and the coastline itself.

A recent study by Drs Emma Jackson and Ken Collins has shown that the seagrass bed is fragmenting at an alarming rate and should a severe storm hit the site there is a strong possibility of complete loss of the integrity of the meadow as a whole.

Their paper is **Dr. E Jackson and Dr. KJ Collins**. A guide to assessing and managing anthropogenic impact on marine angiosperm habitat (NECR111) by found on the Natural England website.
http://publications.naturalengland.org.uk/publication/3665058

One of the many proposals put forward by The Seahorse Trust from the beginning to help alleviate the damage the anchors and moorings are causing, is the installation of Environmentally Friendly Moorings (EFM's). These are, in there basic form, a mooring block on the seabed with an elasticated riser to a surface buoy. When the tide drops the riser does not drag on the seabed as in traditional chain risers, thus alleviating the destruction of the seagrass. The Seahorse Trust is in negotiation with several large companies to fund the installation of these buoys and it is hoped the first ones will be installed in 2014.

If 50 EFM's were installed and the use of anchors banned, it would mean that the boat users can still use the area and the environment can recover. It appears the main reason behind the objection to the installation of these types of moorings is down to finance, as clearly stated to the trust by e-mail in the autumn of 2013 (**undisclosed sender 2013**); this is one of the reasons why we are seeking sponsorship of the EFM's.

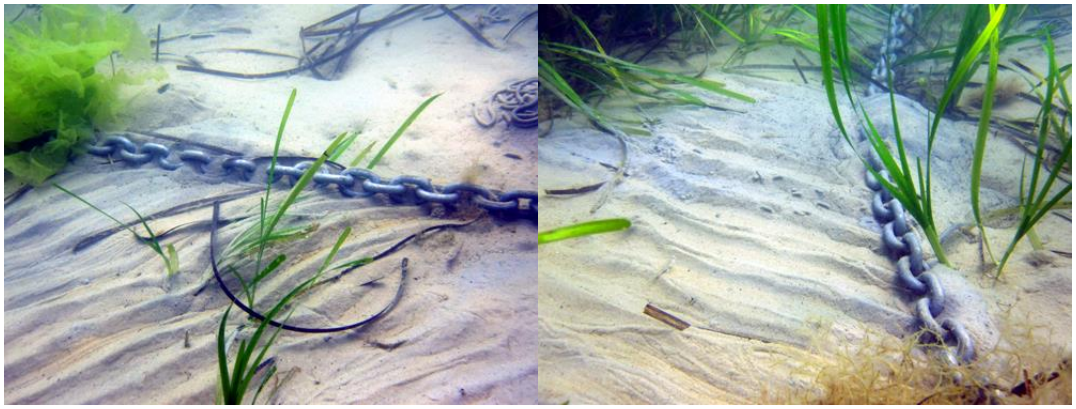
Things are very slowly changing in the bay with ongoing media coverage and education based on the seahorse survey conducted by The Seahorse Trust and seagrass studies by Southampton Universities, National Oceanography Centre; there is now a public wish to install protective measures to secure the future of the seagrass meadow.

In 2009 the Studland Seagrass and Seahorse Study Group set out to determine whether the high level of boating activity at South Beach that was impacting on the underwater habitat of the bay was supported by the public. Beach wardens were present every day during July and August to carry out a questionnaire survey, to monitor boat numbers and to talk to people about the seahorses and other wildlife. Their findings showed that over 60% of people questioned were in favour of protecting the site from damage while less than 1% felt there was no need for any protection. (www.ssssg.org.uk), this is a very encouraging sign and we hope it will influence the authorities into putting in the proposed protective measures.

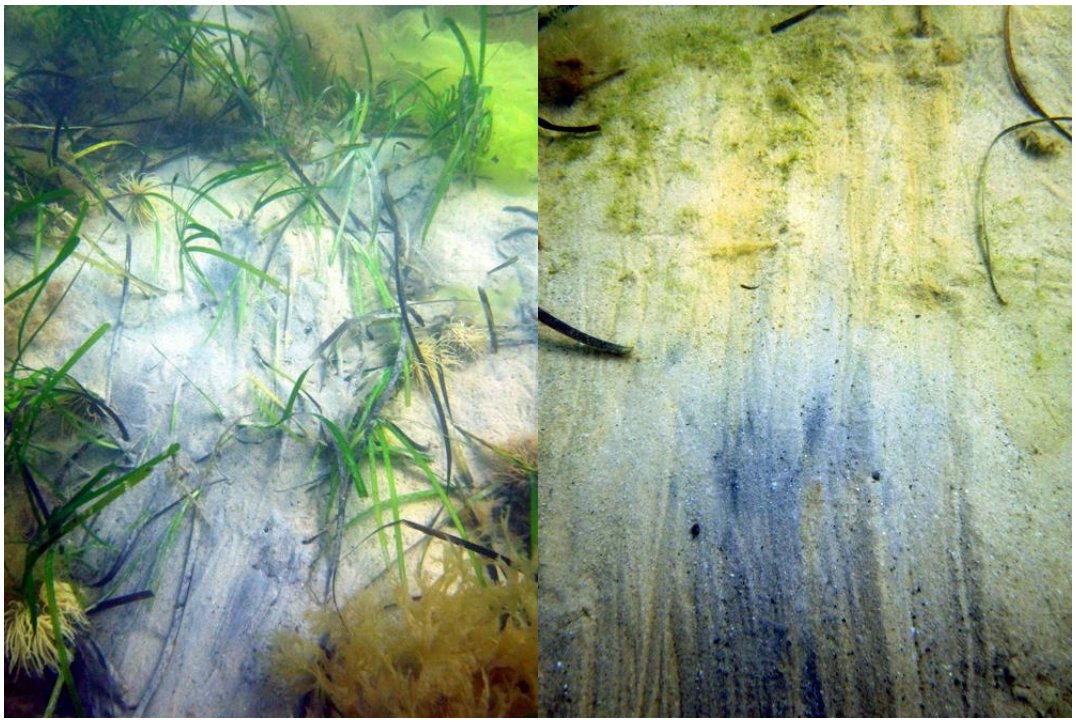
It should always be remembered that the seahorses and through them the seagrass is legally protected and as stated in the Wildlife and Countryside Act 1981, it is illegal to create damage to, make destruction of, or obstruct access to any structure or place used by a scheduled animal for shelter or protection, both seahorse species are scheduled animals. There are also a number of other legally protected species on the site, such as English Oysters and Undulate Rays both of which are also covered under the WCA Act and both include the habitat they occupy; so in essence there is absolutely no reason why South Beach should not become a protected site with conservation management measures imposed onto it.

Seagrass meadows are vital, not just on a local level but nationally as well, for many reasons because they help to alleviate coastal erosion, they are a CO2 sink, which helps in the battle against global warming. They diffuse wave action and therefore protect the coast from erosion. Importantly they are a nursery for so many fish species including many commercially sensitive ones.

Interestingly seagrass is already legally protected yet unenforced under the WCA because of the species that live there and it is also recognised as a BAP habitat. Internationally seagrass is protected for all of the reasons above and the legal protection afforded here in the UK should be enforced; the legislation is in place it should be enacted upon.



Photos 22 and 23 Anchor chain scrapping across seagrass



Photos 24 and 25 Anchor chain scrapping across seagrass before and after the seagrass has been scrapped away completely leading to loss of the seagrass

Conclusion

The British Seahorse Survey (BSS) and its sub project, the Studland Bay Seahorse Tagging Project (SBSTP) have both been running for many years now and as a result they have generated much needed information about the two British seahorse species and confirmed or denied previously suggested ideas about seahorse ecology and behaviour.

The BSS and its database; the National Seahorse Database (NSD) is the longest running survey of its kind and recognised nationally and internationally for its content; it is also the model for similar surveys that are being set up around the world in areas such as Cambodia, Malta and Australia amongst many other countries.

The sub project at South Beach in Studland Bay has allowed us to study individual seahorses over long periods of time and given a greater insight into these cryptic, elusive animals.

As a result of the BSS both British species were afforded full protection under the Wildlife and Countryside Act (WCA) in 2008, with a level of protection which is the highest in the land. To date little has been done to implement this protection but recent talks and agreements between, The Seahorse Trust and Natural England will lead to a greater enforced protection in years to come.

The work carried out at South Beach is being done under strict license from the Marine Management Organisation (MMO) and each year a report is submitted to them conveying an outline of the research throughout each year's study.

At the start of the tagging project at South Beach, floy tags were used to identify individual seahorses and this allowed the survey to generate a great deal of information about the seahorses. After a number years, this background information allowed the project to change the style of identification to using photographic identification and the use of unique spot clusters that are found on each and every seahorse; these spot clusters act like individual finger prints, identifying each seahorse. The switch has been made to using photo ID and is used fully in the project.

Throughout the project, seahorse welfare is paramount, and this was one reason behind the switch to photo identification but it was also realised that observing others in the way they used flash and lights when photographing seahorses, (we have never used either from the start of the project) could be detrimental to the seahorses. After putting together a report and recommendations to MMO a decision was taken to ban the use of flash in the wild in the UK (also in Malta). This has not been received well by some divers but it is the seahorse's welfare that is paramount at all times.

The BSS has always collected a wide range of data in its survey and it was aimed to do the same on the SBSTP. It is important not to waste time collecting unnecessary data and so certain criteria were identified and only relevant data has been collected, which includes location (with grid ref.), identification of the sexes, morphometric data, habitat information, species and depth.

The survey has been coordinated by the project Office (PO) who has decided where and when to dive, has collected and collated the data and ensured seahorse safety at all times. There is a core team of divers who are also under license from the MMO (under the direction of the PO) and they have become highly proficient in finding seahorses; if the seahorses are there, they will usually find them. The ongoing repeat sightings are testament to their skill and they have guided many volunteers who act as extra eyes under water. The survey area is fully covered and each section of it is finger-tip searched and each and every seahorse is known when they settle in the area for the season within the South Beach area.

Prior to the inception of the BSS there were many theories and myths about seahorses and their movements and with the gathering of the data (over 800 confirmed sightings listed) it has been possible to confirm or dispel many of these. It is now known that seahorses pair for seasons and not for life, they set up territories with the female territory overlapping the male's territory; he has a much smaller territory than previously though and it can be as small as only a few square metres. The pair times their breeding with the lunar cycle to benefit from the advantage of higher tides, maximum plankton production and a greater pull in tides and currents to distribute the fry.

Migration has been confirmed to be more localised than was historically thought and seahorses will only migrate if environmental conditions force them to. There is still recruitment from across the English Channel by rafting and free drifting but the idea of seasonal migration across the channel has now been dismissed and the confirmation of a native British population has been confirmed. There is full evidence of adults, sub adults, juveniles and fry and of breeding males and pair formation.

On exposed coastlines seahorses do migrate into deeper water in the autumn at the onset of the first storms and stay in deeper water until the day length gets longer and the seas begin to warm. Migration back inshore coincides with an increase in sea temperature with the seahorses at South Beach never returning before the temperature reaches 9 degrees or more. They also time their arrival with growth in the seagrass fronds, to allow for full protection from predators and strong light.

Our relatively benign environment is due to the influence of the Gulf Stream, without which we would not have such a wide range of species, all of which are reliant on plankton; the building blocks of life.

During the period of the survey it was noted that the seagrass was being damaged by overuse from boats and extensive work has been conducted by our project partners, Dr Ken Collins and his team at the National Oceanography Centre at Southampton University. They have produced evidence to prove this and the site has been put forward for a number of conservation measures such as becoming a Marine Conservation Zone (MZC) and to have Environmentally Friendly Moorings (EFM's) installed. These conservation measures are still being considered but the legal protected status of seahorse means that something has to be done t protect them and the habitat they occupy, plus all the other protected species on the site, such as English Oysters, Undulate Rays and Truncated Anemones to name a few.

It is worth noting in graph 10, page 22, that although yearly temperature does not vary much, seahorse numbers have dropped dramatically; this coincides with the fragmentation of the seagrass meadow as reported by Drs Jackson and Collins in their report (**see references**). This graph shows a direct correlation with the fragmentation of the seagrass and the loss of seahorses, giving a clear indication that the reduced number of seahorses is directly correlated with habitat and therefore food chain breakdown. This adds weight to the urgent need for conservation and management measures on the site before both the seagrass and seahorses are lost for good.

British seahorses are a unique fish species and as has been shown by the BSS and SBSTP there is a need to enforce the legal protection they have. There is unprecedented pressure on our shallow seas and if nothing is done to conserve it then we are in very serious danger of losing from our island nation the this unusual little 'horses of the sea'

APPENDICES

APPENDIX 1

Diver Guidance for Studland

Seahorses were protected under the Wildlife and Countryside Act (1981 schedule 5, section 9) on the 6th of April 2008, so it is now an offence to kill, destroy or take seahorses in the wild. It is also an offence to destroy or disturb their place of rest or occupation, especially during the breeding season.

As a protected species you are required to have a Marine Management Organisation (MMO) license if you are looking for and/or photographing seahorses, this is to make sure that seahorses have as little disturbance as possible in their natural habitat.

These guidelines have been prepared to advise divers on the best practice when diving in areas where they may encounter seagrass and seahorses. The protocol has been based on common standards for diving in environmentally sensitive areas, as well the general Seasearch, PADI/BSAC and The Seahorse Trust principles of safe diving.

DIVING SAFETY

- Studland is a sensitive seagrass habitat that has a multiple of users on it and as such should be treated in a very careful manner, be respectful of others right to use the site, it is equal to yours.
- Prior to the start of your dive ensure you are familiar with the site and its potential hazards such as boat movement and traffic.
- Use a Surface Marker Buoy (SMB) – an SMB will allow boat users in the area to safely avoid you and track your movements. If you have an A flag deploy this to show where the divers are, if in doubt stop diving, remember safety first.
- If a diver finishes a dive before their companions then they should surface and make their way ashore on the surface, so they can be seen by the boat traffic and others.
- If you get separated from the group under water then search for 1 minute and then surface carefully and wait for your dive buddy's to join you, likewise if your dive buddy goes missing for more than minute, surface and wait for them to join you.
- Dive in buddy pairs- It is always safer to dive in a pair but particularly in popular recreation areas such as Studland.
- Maintain good buoyancy control - by swimming just above the seagrass and the seabed and avoiding trailing yourselves and your gear in the substrate.
- Check that all of your equipment is safe, working and within test date when participating in the dives.
- Keep SMBs closely reeled in to avoid entanglement with buoys – there may be many boats, permanent buoys and moorings, creating the potential for SMBs to become entangled.
- Keep on an eye on your air, time and your buddy. Maintain good communication throughout the dive with your buddy and surface safely if you encounter difficulties.

- Keep diving gear tidy- attach loose hoses, survey equipment and other dive gear securely. This will also avoid damage to the habitat as well preventing equipment loss which adds to the marine litter.
- Avoid sharp, sudden changes in direction when in the seagrass- fins and the wash created by them can stir up the sediment and potentially damage the seagrass. When in the habitat, change direction slowly and kick gently. Moving with care will also help maintain the visibility.
- Do not pull at or hold onto the seagrass, even if you are drifting. If you need to slow down or stop, brace yourself gently on the seabed and settle carefully.

Disclaimer

The Seahorse Trust encourages cautious and respectful diving to others and the environment. To safely conduct any dive, participants must rely on their own abilities, training and knowledge of local conditions, including tide, weather and boating activities. The Seahorse Trust provides the above information to help advise and encourage the safe conduct of any dive but accepts no responsibility for anyone who disregards their training or any safety advise or takes unnecessary risks.

APPENDIX 2

SEAHORSE SAFETY

- One of the first things a seahorse does when you approach it to turn its back to you; this is a defensive and natural reaction. It hopes you can't see it. If you sit quietly it will settle and turn back again but a lot of divers are impatient and try to turn the seahorse which only causes it immense stress and is against the law. It is against the law to touch a seahorse without a license.
- As a Seahorse gets stressed, its colour starts to darken and it bends its head downwards to present less of a profile. If this is continuous then it could in the long term lead to the death of the animal, so move away and leave the seahorses in peace if it exhibits any of these symptoms.
- Strictly no touching of the seahorses it is against the law.
- Do not hover over the seahorses this stresses them.
- The use of flash photography is banned by MMO when photographing seahorses on any site in England and Wales even with a license, if in doubt leave your flash behind or make sure it is turned off prior to the start of the dive.
- If there are a number of divers do not surround them (a semi-circle is better) so the seahorses can move on if they want to.
- If they do move off do not chase them, this is disturbance and is against the law.
- Maximum of 6 to 8 divers near any one seahorse (preferably less), if there are a number of divers take turns to see the seahorse.
- DO NOT chase the seahorses.

- Spend no more than a maximum of 5 minutes on the seahorses to stop them getting stressed and then move on.
- Any seahorses seen need to be reported to The Seahorse trust to help with the research
- To actively seek out seahorses and photograph them, a licence is required.
- Do not chase, disturb or touch seahorses. Seahorses are a protected species and it is an offence to disturb them. It is an exciting experience to see one but it is best for you and the seahorse to keep your distance and calmly observe. If the seahorse swims away, do not pursue it.
- Please send details of any sightings to www.britishseahorsesurvey.org or www.theseahorsetrust.org

Thanks to

Both the BSS and the SBSTP would not be possible without the input of hundreds of volunteers putting in so much time and we would like to thank them all for their amazing input.
The BSS would never have started without a single picture of a seahorse being sent to us by underwater film maker Sue Daly from Jersey.
The Studland project would also never have started without the input of Julie Hatcher and Steve Trewhella, both committed conservationists who reported the seahorses of Studland to us, allowing us to develop and conceive the tagging project. We would like to publically thank Sue, Julie and Steve for their foresight in reporting the seahorses to us, which has allowed us to go on and understand so much more about these unique fish.

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Diagram 2	Measuring overall body length of the seahorse	copyright The Seahorse Trust
Diagram 3	female/male seahorse	copyright Neil Garrick-Maidment

Graphs

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Maps

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Photographs

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Photograph 2	Spiny Seahorse	copyright Neil Garrick-Maidment
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Photograph 4	South Beach	copyright Google Earth
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Photograph 15	Washed up seagrass fronds	copyright Neil Garrick-Maidment

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Photograph 23 Seagrass being scrapped away	copyright Neil Garrick-Maidment
Photograph 24 Seagrass being scrapped away	copyright Neil Garrick-Maidment
Photograph 25 Seagrass being scrapped away	copyright Neil Garrick-Maidment

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