

**Fireworks Anemone
distribution in
West Scotland 2009-2013**

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Introduction

During 2009 a number of Seasearch survey dives were carried out in upper Loch Fyne and Loch Creran in Argyll and Bute. The main focus of these survey dives was to continue work started in 2006 to assess the distribution and abundance of the Fireworks Anemone *Pachycerianthus multiplicatus* in the loch but Seasearch surveying was also carried out. Following reports of an extensive Fireworks Anemone bed in Loch Duich in Highland, survey dives were also carried out there in March 2011. This document reports on the findings of the surveys and includes an update on work carried out in 2013 at the Oyster bar moorings.

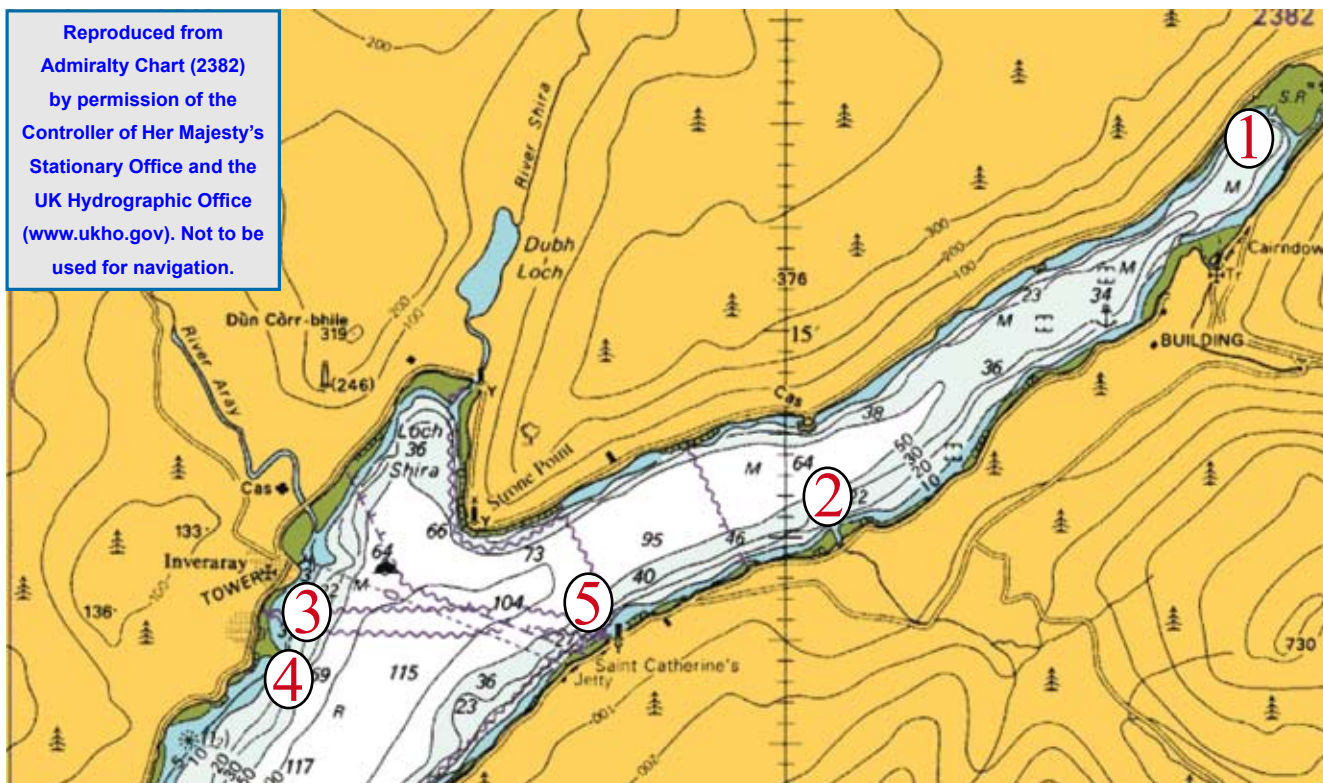


Chart 1: Location of 2009 Dive Sites in Upper Loch Fyne

The 2009 Surveys

The location of the five upper Loch Fyne dives are shown Charts 1 and 2 while the Loch Creran dive site is shown in Chart 3.

Table 1: Summary of the 2009 Surveys			
<i>Dive Site Number and Date</i>	<i>Location</i>	<i>Centre of Survey</i>	<i>Type of Survey</i>
1 (22/02/09)	Oyster Bar Moorings	56° 15.93N 04° 55.81 W	Fireworks Anemone
2 (22/02/09)	Ardno	56° 14.19N 04° 59.27W	Fireworks Anemone & Horse Mussel
3 (29/09/09)	Inveraray Bay	56° 13.7N 05° 04.2W	Fireworks Anemone
4 (29/09/09)	An Oitir	56° 13.4N 05° 04.3W	General Seasearch
5 (11/10/2009)	St Catherines	56° 12.6N 05° 03.3W	General Seasearch
6 (01/03/09)	Loch Creran	56° 32.7N 05° 16.5W	Fireworks Anemone

Dive Site 1: Oyster Bar Moorings

This survey took place in late February 2009 with a team of 6 divers operating from the shore. The

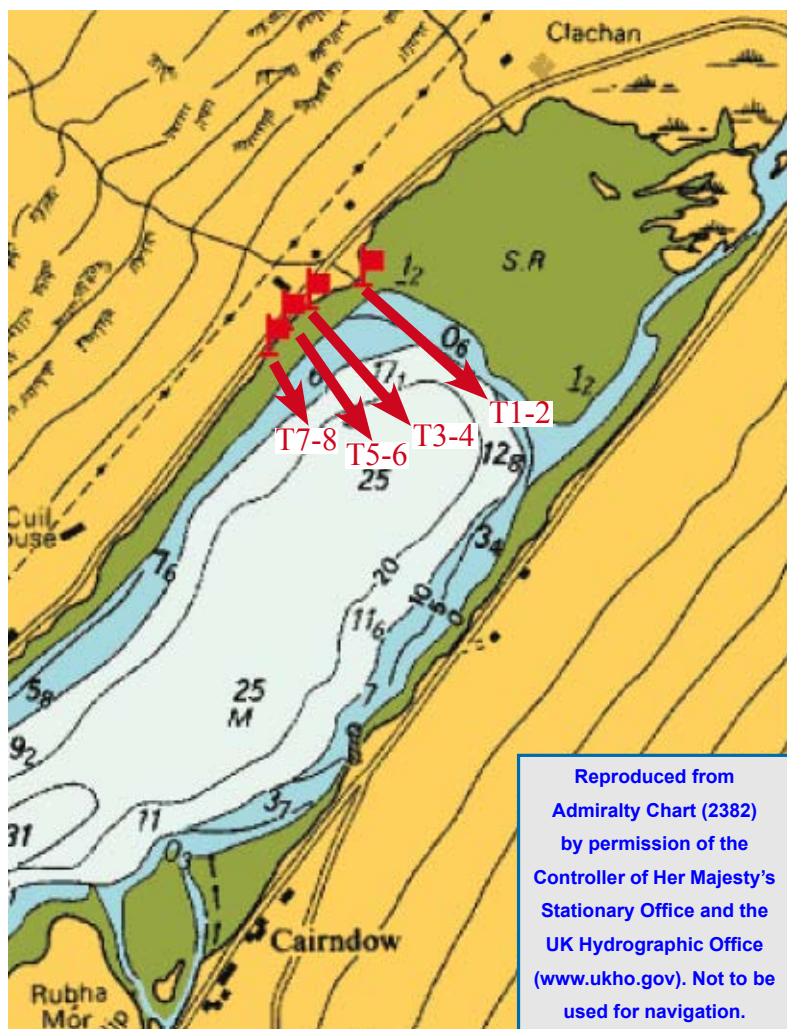


Chart 2: Position of Transects by the Oyster Bar Moorings in Upper Loch Fyne (for details see text).

conditions were challenging with cold water and poor visibility.

Methodology

The recording forms used for these surveys have previously been described in Paisley (2007). For this survey the procedure was modified slightly. Pairs of divers swam out on compass bearing until they reached a maximum depth of 30 metres or until their dive time reached 20 minutes. They would then turn north, swim approximately 10 metres parallel to the shore then head back to shore recording as they went. In this way each pair of divers recorded two transects running from the shore to their maximum depth. The position of each pair of transects is shown on Chart 2.

Results

The results of the Oyster Bar Moorings survey is shown in Table 2 below. Most of the anemones were recorded in the depth band 10-15 metres with fewer at depth. No anemones were found in the 5-10 metre band towards the head of the loch but they were recorded at these shallower depths in the southern transects, 5-7. The seabed in this area was

made up of flocculent mud with a several cm deep layer of leaves, twigs and other detritus. Naturally occurring *Beggiatoa* mats were a feature around the moorings indicating the presence of anoxic conditions at least part of the time. Apart from the Fireworks Anemones only a limited number of other species were recorded along the transects. The most notable of these included clusters of the anemone *Sagartiogeton laceratus*, the Common Starfish *Asterias rubens*, Hermit Crabs and the swimming crab *Liocarcinus depurator*.

Table 2: Head of Loch Fyne (T1 to T8 refers to transects shown on Chart 3)

Transect No	Depth Band (Metres)			Sub Total	Anemone size (Tentacle diameter cm)		
	5-10	10-15	15-20+		0-15	15-29	29+
T1			11	11	6	5	
T2		4	6	10	2	7	1
T3		10	3	13	4	6	3
T4		12	1	13	4	8	1
T5	7	6	1	14	7	6	
T6	2	8	3	13	10	2	
T7	4	6	*	10		4	3
T8	-	-	*	-	-		
Totals	13	46	25	84	33	38	8

* The dive along transect T7/8 was aborted at 15 metres due to poor visibility but seemed to be following the same pattern as T1-6. Of the 84 anemones recorded, 5 were fully or partially retracted so it was only possible to measure the tentacle diameter of 79 anemones.



Swimming crab and *Beggiatoa* at the Oyster Bar Moorings



Sagartiogeton anemones at the Oyster Bar moorings



A typical Oyster Bar Moorings specimen with a *beggiatoa* mat visible behind.

Dive Site 2: Ardno

This site is on the eastern side of Loch Fyne and sports divers had previously recorded high numbers of Horse Mussels, *Modiolus modiolus* in the vicinity. At this dive site, the divers encountered a shallow shelf stretching out from the shore which then dropped abruptly downwards. Fireworks Anemones were encountered in large numbers from about 10 metres depth down to 20 metres, the deepest part of the dive. As the visibility was very good on this dive it was possible to see the anemones continuing below the dive depth and other divers reported seeing them as far down as 30 metres. This site was unusual for a Loch Fyne Fireworks Anemone bed in that the sediment was very firm, almost like clay. However, in common with other sites there was a significant amount of terrestrial detritus such as leaves on the sediment as well as drift algae. No count of anemones was completed at this site though they were recorded as being common. One curious difference between the Ardno site and the Oyster Bar Moorings site was a lack of the anemone *Sagartiogeton laceratus*.



Two of the Ardno anemones with typical detritus lying between them.



One of the Ardno anemones showing how far above the sediment the anemone can extend.

<i>Species</i>	<i>Abundance</i>
<i>Pachycerianthus multiplicatus</i>	Common
Massive sponge sp.	Rare
<i>Pagurus</i> sp.	Common
<i>Nephrops norvegicus</i>	Rare
<i>Carcinus maenas</i>	Occasional
<i>Liocarcinus depurator</i>	Occasional
<i>Buccinum undatum</i> (+ eggs)	Occasional
<i>Asterias rubens</i>	Rare
<i>Arctica islandica</i> (empty shells)	Common

Dive Site 3: Inveraray

In the summer of 2009, one of the Loch Fyne creel fishermen reported pulling up strange black animals attached to his creels. He had been fishing in the area for some years and was mystified as to the identity of the creatures. A photograph and a specimen were sent to Millport Marine Laboratory, where it was identified as a Fireworks Anemone *Pachycerianthus multiplicatus*. At much the same time, a diving survey was organised to investigate the seabed in the area where the anemones were being pulled up. Towards the end of September, four divers operating from a RHIB, provided by Arran COAST, and accompanied by the creel fisherman, carried out a survey dive just off the town of Inveraray in upper Loch Fyne (*Site 3 on Chart 1*). Conditions were not particularly good, with a layer of peaty water reducing light levels and poor visibility at depth. The divers worked as two teams with the first swimming NW towards Inveraray Pier and the second swimming south-east.

The first team encountered a maximum depth of 19 metres and carried out a 40 minute dive. They found numerous Fireworks Anemones but little else in soft, gently sloping mud apart from a few burrows.

The Second team reported a dense Fireworks Anemone bed at a depth of 13 to 16 metres, with over 100 anemones counted during the 40 minute dive. The seabed was gently sloping soft mud. *Nephrops* burrows were present but scattered and usually surrounded by anemone tubes. The experienced surveyors reported that the anemones seemed generally smaller than those seen in neighbouring Loch Shira. Another interesting observation was the sighting of a *Marthasterias glacialis* apparently wrapped around a *Pachycerianthus* tube and feeding. Other species recorded during this dive are recorded in the table below.

<i>Species</i>	<i>Abundance</i>
<i>Pachycerianthus multiplicatus</i>	Common
<i>Cerianthus lloydii</i>	Rare (only 1)
<i>Myxicola</i> sp	Occasional
<i>Suberites</i> sp	Occasional
<i>Asterias rubens</i>	Occasional
<i>Ophiura albida</i>	Occasional
<i>Marthasteria glacialis</i>	Rare
<i>Liocarcinus depurator</i>	Occasional
<i>Nephrops norvegicus</i>	Occasional
<i>Lesuerigobius friessi</i>	Occasional
Goby sp.	Occasional
<i>Ascidella aspersa</i>	Rare

The creel fisherman involved reported that he had been working in upper Loch Fyne for several years and had never encountered the anemones before. It appears that when a creel lands on top of an anemone its tentacles become tangled in the mesh and the entire animal is pulled out. However assuming that the fisherman's information is correct, it would appear that the anemones have recently spread south from Inveraray.

Dive Site 4: An Oitir

An Oitir is a glacial spit extending for some 300 metres out into Loch Fyne. The seabed on the spit and in its immediate vicinity is mainly cobbles and gravel with occasional boulders. Not surprisingly no Fireworks Anemones were found at this site. Fireworks Anemones have been reported 3km to the south of the spit below Inveraray Caravan Park but only in very low numbers. It may be that the spit acts as a partial barrier to colonisation of the lower reaches of Loch Fyne. Life on the spit was abundant but included little of note apart from small clumps of Horse Mussels, *Modiolus modiolus*.

Dive Site 5: St Catherines

This dive site is almost directly opposite Loch Shira but does not have significant fresh water input. Only one Fireworks Anemone was recorded at a depth of 25 metres on mud. Other species recorded at this site are shown in the table below.

<i>Species</i>	<i>Abundance</i>
white sponge	Rare
<i>Suberites carnosus</i>	Rare
<i>Pachycerianthus multiplicatus</i>	Rare
<i>Metridium senile</i>	Rare
<i>Protanthea simplex</i>	Occasional
<i>Hydractinia echinata</i>	Occasional
<i>Myxicola</i> sp.	Rare
<i>Arctica islandica</i> (shells)	Common
<i>Aequipecten opercularis</i>	Occasional
Brittle star sp. (arms coming out of sediment)	Occasional
<i>Pagurus</i> sp.	Occasional
<i>Munida rugosa</i>	Common

Dive Site 6: Loch Creran

On 1st of March 2009, a comparative dive was carried out in Loch Creran using the same methodology as used at the head of Loch Fyne. Position of the transect is shown on Chart 3, while the results are shown in Table 6 below.

<i>Transect</i>	<i>Depth Band</i>			<i>Anemone size band (Tentacle diameter cm)</i>		
	<i>5-10</i>	<i>10-15</i>	<i>15-20+</i>	<i>0-15</i>	<i>15-29</i>	<i>29+</i>
LC1	0	0	4		2	2

Fireworks Anemones were found in Loch Creran but at a much lower density than Loch Fyne and none were found in depths less than 15 metres. The four anemones found were all quite large and none of the smaller, possibly younger, anemones seen in Loch Fyne were seen in Loch Creran.

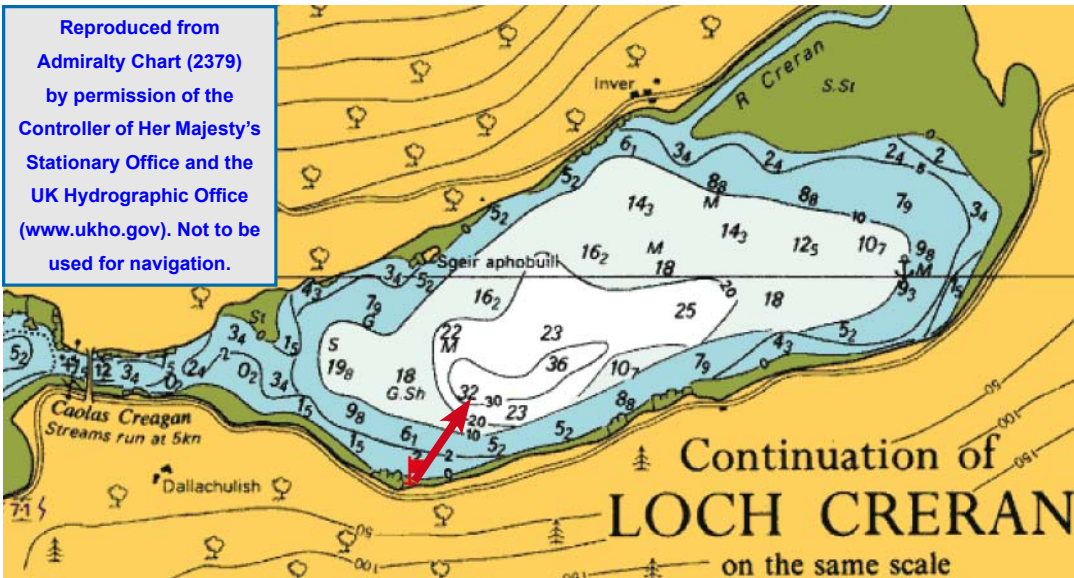


Chart 3: Position of Loch Creran Transect



Most of the survey dives recorded here took place in the winter months. While surface conditions can be extremely unpleasant, the clear winter water in Scottish sea lochs makes the discomfort worthwhile.



Considerable colour variation was noted both between and within sites. The all white specimen above was photographed in Loch Duich while the colourful pair on the right was photographed in Loch Shira.

Dives Sites 7 to 16: Loch Duich

Following reports of a dense Fireworks Anemone bed in Loch Duich, off Loch Alsh in Highland, a diving expedition was organised to Loch Duich during March 2011. Over the weekend 12/13th March, 8 divers carried out 9 survey dives in the locations shown on Chart 4. Conditions were cold with deep snow on the hills but underwater visibility was excellent. Results of the anemone surveys are shown in Tables 7 and 8.

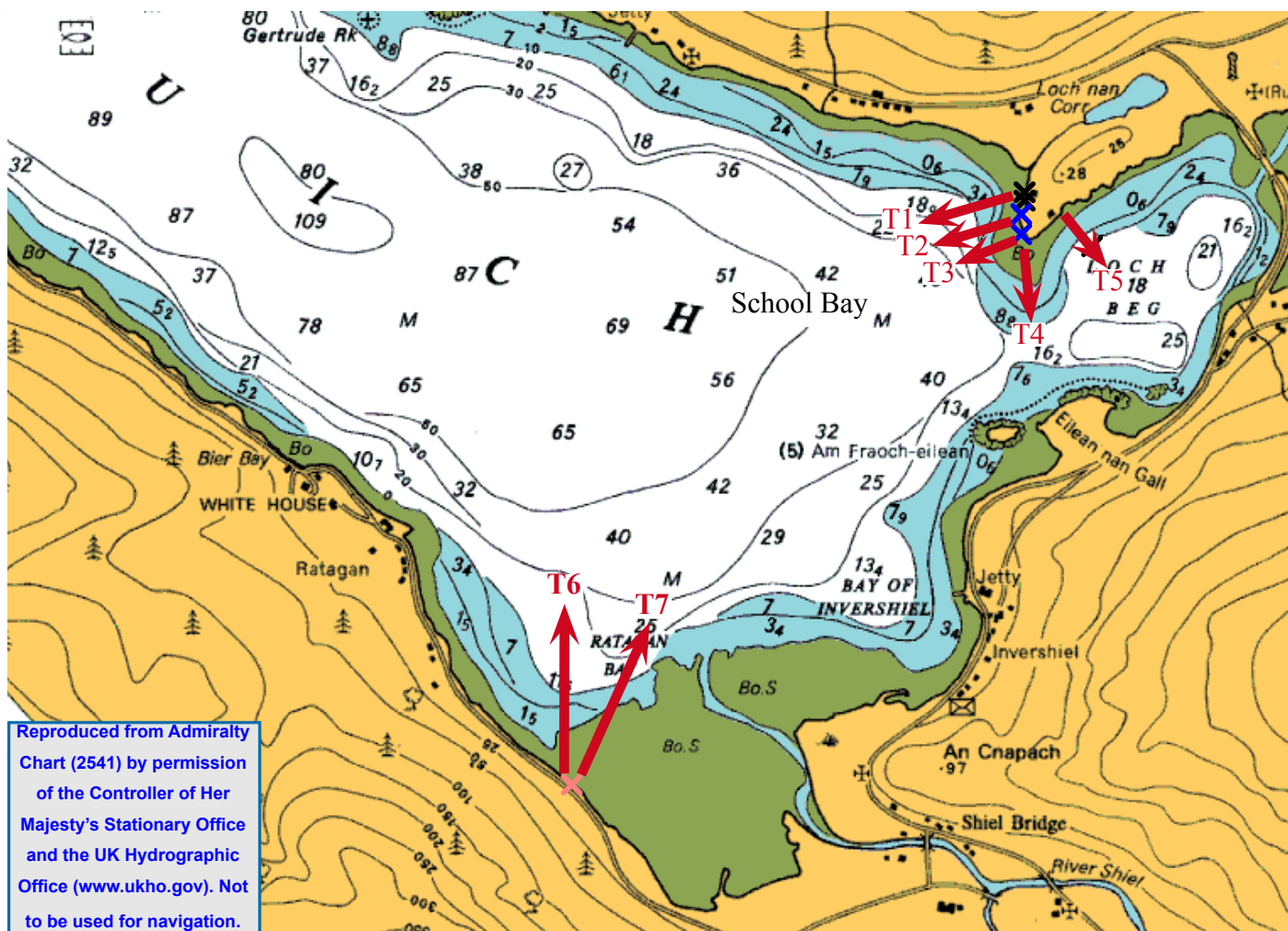


Chart 4: Loch Beg and upper Loch Duich ($57^{\circ} 14'N$ $05^{\circ} 27'W$) showing position of dive transects.



Loch Beg viewed from the southern shore. Divers entered the water from the beach to the right of the house

Table 7: Head of Loch Duich including Loch Beg, School Bay and Ratagan Bay (T1 to T7 refers to transects shown on Chart 4)

Transect No	Depth Band (Metres) and number of anemones in each depth band			Sub Total	Anemone size (Tentacle diameter cm)		
	5-10	10-15	15-20+		0-15	15-29	29+
T1 (School Bay)							
T2 (School Bay)			1	1			1
T3 (School Bay)			9	9			9
T4 (School Bay)							
T5 (Loch Beg)			28	28	10	18	
T6 (Ratagan Bay)			9	9	5	2	2
T7 (Ratagan Bay)			5	5	3	2	
Totals			56	56	18	22	12

* No anemones were recorded on Transects T1 and T4.

In addition to the anemones recorded in Table 7, a further 18 were counted by Wendy Northway and a further 31 by Owen Paisley making a total count of 77 anemones seen during a 38 minute dive by two observers in Loch Beg. This is a minimum count and the actual number of anemones in this area is much higher. The shallowest anemone seen was at 9 metres with several in the 10 to 14 metres area but the dense anemone bed did not start until 15 metres and probably continued towards the SE and centre of Loch Beg. No *Myxicola* were seen close to the anemones measured but one was observed adjacent to an unmeasured anemone. This is in stark contrast to the anemones seen a short distance west in School Bay where many of the anemones were accompanied by *Myxicola*, in one case as many as 6.

Table 8: Species Recorded in Loch Duich

Species	School Bay	Ratagan Bay	Loch Beg
<i>Pachyceriatrus multiplicatus</i>		Rare	Common
<i>Cerianthus lloydii</i>	Common	Occasional	Occasional
<i>Protanthea simplex</i>	Common	Occasional	Occasional
<i>Funiculina quadrangularis</i>	Rare	Occasional	
<i>Virgularia mirabilis</i>		Common	
<i>Pennatula phosphorea</i>		Rare	
<i>Alcyonium digitatum</i>	Rare		
<i>Arenicola marina</i>		Occasional	Occasional
<i>Myxicola</i> sp.	Occasional	Occasional	Rare
<i>Sabella pavonia</i>	Occasional	Occasional	Occasional
<i>Lanice conchilega</i>		Occasional	Frequent (<9 metres)
<i>Sporobis spirorbis</i>	Common	Occasional	
<i>Pagurus</i> sp.	Common	Common	Common
<i>Galathea</i> sp.	Common	Common	
<i>Liocarcinus depurator</i>		Occasional	Occasional
<i>Carcinus maenus</i>	Common	Occasional	Occasional
<i>Goneplax rhomboides</i>		Rare	Occasional
<i>Inachus</i> sp.	Occasional	Rare	
<i>Mysid</i> sp.	Occasional	Occasional	
<i>Caprella</i> sp.	Occasional		
<i>Chiton</i> sp.	Occasional	Occasional	

Table 8: Species Recorded in Loch Duich			
Species	School Bay	Ratagan Bay	Loch Beg
<i>Idotea</i> sp.	Occasional		
<i>Buccinum undatum</i>	Occasional	Occasional	Rare
<i>Pecten maximus</i>	Rare	Occasional	
<i>Mya</i> sp.	Occasional	Occasional	
<i>Philine asperata</i>			Common
<i>Aequipecten opercularis</i>		Occasional	Rare
<i>Mytilus edulis</i>	Occasional	Occasional	Common (shallows)
<i>Modiolus modiolus</i>	Occasional	Occasional	
<i>Asterias rubens</i>		Occasional	Frequent
<i>Psamechinus miliaris</i>	Occasional	Occasional	Rare (Shallows)
<i>Ophiothrix fragilis</i>	Occasional	Occasional	
<i>Echinus esculentus</i>		Occasional	
<i>Asciidiella aspersa</i>			Rare
<i>Ciona intestinalis</i>		Occasional	
<i>Raja batis</i>			Rare
<i>Gobiidae</i>			Rare
<i>Fucus serratus</i>	Occasional	Occasional	Occasional
<i>Chorda filum</i>			A (shallows)
<i>Ascophyllum nodosum</i>	Common	Occasional	A (shallows)
<i>Ascophyllum nodosum var mackii</i>			Occasional (clumps as deep as 15m)
<i>Fucus serratus</i>	Common		Occasional (shallows)
<i>Naked foraminifera</i>	Present		

Discussion

By its very nature a sub-littoral survey carried out by amateur divers in difficult conditions is going to suffer from gaps and inconsistencies. However, from the work outlined above a number of tentative conclusions can be drawn.

Of the three populations surveyed, Loch Fyne, Loch Creran and Loch Duich, the upper area of Loch Fyne appears to hold the largest population of Fireworks Anemones. There is a dense but localized population in Loch Beg, a side arm of Loch Duich. However, the density of the anemones drops sharply outwith Loch Beg possibly due to competition from other burrowing megafauna such as the Sea Pens, *Virgularia* and *Funiculina*.

Future survey work should be aimed at determining how far out of Loch Beg the anemones are found and if there are any other dense populations. Table 9 below lists 7 potential survey sites which may hold dense populations of Fireworks Anemones. Unfortunately, most of these are inaccessible from the shore but given the sheltered nature of the Loch, RHIB based divers would have no difficulty reaching these sites.

<i>Site Name</i>	<i>Latitude</i>	<i>Longitude</i>
Bay of Invershiel	57° 13.2 N	05° 25.4 W
Off Inverinate Jetty	57° 14.2 N	05° 27.1 W
Off An Leth-allt	57° 14.9 N	05° 28.5 W
North of Eilean Tioran	57° 16.7 N	05° 31.7W
Nostie Bay	57° 16.4 N	05° 33.7 W
Ardintoul Bay	57° 15.5 N	05° 36.1W
Aird A Mhuill Bay	57° 16.5	05° 36.1W

The sites which have a large population of Fireworks Anemones share the following attributes:

- A) Most obviously there is a muddy seabed.
- B) A significant source of fresh water input which periodically deposits large amounts of organic matter in the form of leaves, twigs, soil etc. This is seen at Loch Shira and the Oyster Bar Moorings in Loch Fyne as well as Loch Beg.
- C) Signs of periodic low oxygen episodes, either *Beggiatoa* mats or black anoxic layers near the surface of the sediment.
- D) Limited or no competition from other burrowing fauna such as Sea Pens, *Nephrops*, *Mya* sp.
- E) Some protection from mobile gear and no or limited static gear fishing.

The requirement for a mud seabed is not surprising given that the anemones live in burrows. However, the nature of the mud does vary between sites from very soft almost jelly like consistency in upper Loch Fyne to almost clay like in parts of Loch Shira. The anemones seem to cope with this variation though they have not been recorded in gravel/sand seabeds. Whatever the mechanism they use to construct their burrows they seem to need sediment made up of very small particles.

The fresh water input is a constant feature in all the areas where anemones are abundant. At the depths where most anemones are found it seems unlikely that salinity will be affected. However, there will be a constant rain of organic water which may discolour the entire water column at times of spate. This may be an important food source for the anemones. It is common to find the seabed around the anemones littered with leaves, twigs and other items of terrestrial origin. This constant rain of organic material may also hinder competition from other animals such as Sea Pens by clogging their feeding mechanisms.

Several of the sites show signs of periodic low oxygen levels with *beggiatoa* mats of varying extent commonly recorded around the anemones. It may be that the tall column of the anemones allows them to reach more oxygenated water giving them an advantage over smaller burrowing anemones such as *Cerianthus*.

During the course of these surveys, several hundred anemones have been recorded and of these only a small percentage have been classed as grouped - ie within a slates length (29cm) of each other. This suggests that the anemones do not reproduce by budding but also competition for space and food leads to a minimum favoured distance between anemones. On several occasions anemones have been observed with tentacles touching and it would be interesting to monitor some of these anemone pairs and see if they persist over the years.

Since the start of these surveys attempts have been made to measure the size of the anemones by placing a slate (which is 29cm long) across the tentacle crown and estimating the diameter of the tentacle spread. This was recorded as “small” (less than half a slate), “medium” (half to full slate) and “large” (wider than the slate). Obviously, if the anemone was retracting or retracted this was impossible, hence the discrepancy between the number of anemones recorded and the number measured.

The reasoning behind collecting size data is as follows. A large anemone is likely to be an older anemone. Therefore a mixture of sizes would indicate good recruitment and a healthy population whereas a same size population would indicate failed recruitment and a static or declining population. Alternatively, a large anemone could simply be in a place where more food is available and a small one could be suffering from lack of food. Lacking any data on growth rates it is difficult to prove either scenario. However, a summary of the data collected is shown below in Table 10.

<i>Site</i>	<i>Small <15cm</i>	<i>Med >15<29 cm</i>	<i>Large >29 cm</i>	<i>No. in sample</i>
Loch Shira	18	67	15	352
Head of Loch Fyne	42	48	10	79
Loch Creran	0	50	50	4
Loch Beg	36	64	0	28
School Bay	0	0	100	10
Ratagan Bay	57	29	14	14

Loch Shira provided the largest sample and here around 2/3 of of anemones were medium sized with the remaining 1/3 split fairly evenly between small and large. This gives the impression of a fairly stable population with a large number of middle aged anemones and smaller numbers of large mature anemones. With such a large population of anemones as Loch Shira it may be that larval settlement is difficult and only successful when there is no nearby adult, hence the fairly low proportion of young anemones.

In contrast, School Bay and Loch Creran only had the larger anemones with no sign of recruitment. These give the impression of populations which are hanging on and in the absence of a successful recruitment year may well die out.

Loch Beg has a similar proportion, around 2/3 , of medium sized anemones to Loch Shira. Interestingly no large anemones were recorded at Loch Beg and the remaining 1/3 were all classed as small. This could be due to a poorer food supply but large anemones were recorded in the vicinity of Loch Beg at School Bay and Ratagan Bay. This size distribution could be indicative of a population which has declined in the past but then enjoyed a few years of successful recruitment leading to a large population of mid sized and small anemones but no large ones.

Finally, Ratagan Bay has both large and mid sized anemones but over half of those measured were small indicating a relatively recent good recruitment year.

It is interesting that both in Loch Fyne off Inveraray and Ratagan bay in Loch Duich there are signs of an expanding population, an indication of something changing that benefits the anemones at the expense of other competing organisms. It will be interesting to see if the smaller populations in Loch Creran and other Clyde sea lochs also show increasing numbers in future years.

Oyster Bar Moorings 2013 Update

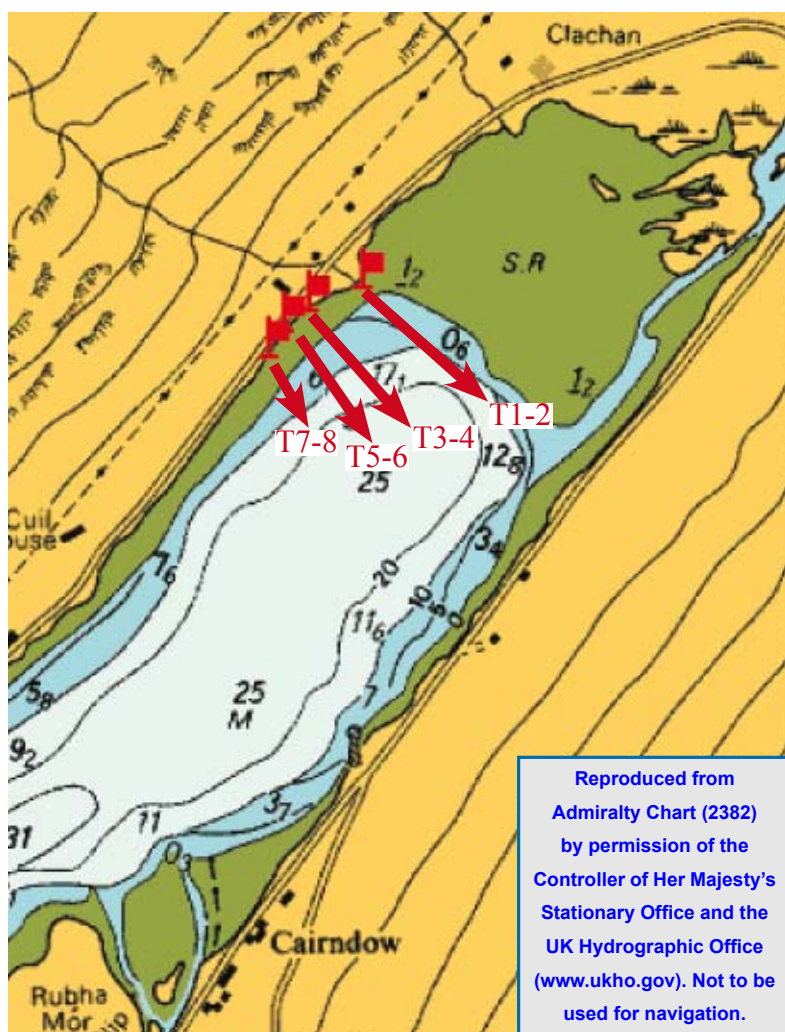


Chart 2: Position of Transects by the Oyster Bar Moorings in Upper Loch Fyne (for details see text).

In 2013 a repeat survey was carried out along the line of T5/T6 using the same methodology as previously. A pair of divers swam out on compass bearing recording as they swam until their dive time reached 20 minutes. They then turned north, swam approximately 10 metres parallel to the shore and headed back to shore again recording as they went. In this way two transects were recorded, the first from shallow to deep and the second deep to shallow. The position of transects T5/T6 is shown on Chart 2.

Results

The large number of anemones encountered meant that a maximum depth of 14.5 metres was achieved by the 20 minute cut off rather than the 19+ metres surveyed in 2009. However slightly more anemones were recorded (31) in 2013 as opposed to 27 in 2009. A comparison of the 2009 and 2013 results is shown in Table 11 below. A similar number of anemones were recorded in the shallower depth band in both surveys but half as many again were recorded in the middle depth band of 10-15 metres. This could be a genuine increase in numbers, a result

of surveying a slightly different area of seabed or an artefact brought about by many of the anemones being recorded around the 10 metre mark. However if the results for the two depth bands are added together (23 and 31) there still seems to be an increase in number.

Of perhaps more significance are the results from the tentacular spread measurements. In 2009 the majority of anemones recorded (68%) were in the small or 0-15cm category. The remaining 32 % were medium sized and no large anemones were recorded. In contrast the 2013 survey recorded the majority of anemones (74%) as being medium sized with only 13 % being small and an increase in large anemones from 0% to 13% of records. This changing size distribution would be consistent with a successful recruitment year some time prior to 2009 followed by 4 years of poor recruitment. As the anemones which settled prior to 2009 grew in size the proportion of smaller anemones would fall and the proportion of larger anemones rise.

Table 11 : Comparison of T5/T6 Surveys carried out in 2009 and 2013 at Oyster Bar Moorings (transects T5/T6 shown on Chart 2)

Year	Depth Band (Metres)			Sub Total	Anemone size (Tentacle diameter cm)		
	5-10	10-15	15-20+		0-15	15-29	29+
22/02/09	9	14	4	27	17	8	0
25/5/13	8	23	N/A	31	4	23	4

* Of the 27 anemones recorded along T5/T6 in 2009 2 were fully or partially retracted so it was only

possible to measure the tentacle diameter of 25 anemones.

In 2009 the seabed in this area was recorded as flocculent mud with a several cm deep layer of leaves, twigs and other detritus. In 2013 the mud was still very soft but the deep layer of leaves, twigs and other detritus much less obvious. There was also a lack of extensive *Beggiatoa* mats around the anemones though these may well have persisted in the deeper water. As in 2009 few other species were recorded around the anemones with the anemone *Sagartiogeton laceratus*, the Common Starfish *Asterias rubens*, Hermit Crabs and the swimming crab *Liocarcinus depurator* still present. Table 12 below compares the species lists for 2009 and 2013.

Table 12 Species Recorded 2009 along T5/T6	Abundance	Species Recorded 2013 along T5/T6	Abundance
<i>Chorda filum</i>	c	<i>Chorda filum</i>	c
<i>Ascophyllum nodosum</i>	c	<i>Ascophyllum nodosum</i>	c
<i>Fucus serratus</i>	c	<i>Fucus serratus</i>	c
<i>Saccharina latissima</i>	c	<i>Saccharina latissima</i>	c
Filamentous reds	c	Filamentous reds	c
		Diatom film	c
<i>Asterias rubens</i>	r	<i>Asterias rubens</i>	o
		<i>Echinus esculentus</i>	R
<i>Sagartiogeton laceratus</i>	o	<i>Sagartiogeton laceratus</i>	o
		<i>Protanthea simplex</i>	r
<i>Pachycerianthus multiplicatus</i>	C	<i>Pachycerianthus multiplicatus</i>	C
		<i>Sabella pavonina</i>	r
		<i>Arenicola marina</i> to 14 metres	c
		<i>Pleurobranchus membranaceus</i>	o
		<i>Buccinum undatum</i>	o
		<i>Carcinus maenas</i>	o
<i>Pagurus</i> sp	0	<i>Pagurus</i> sp	o
<i>Liocarcinus depurator</i>	0	<i>Liocarcinus depurator</i>	o
		Goby sp	o
<i>Beggiatoa</i> sp	C	<i>Beggiatoa</i> sp	o
		<i>Asciidiella aspersa</i>	o

The most noticeable change was a reduction in the area of seabed covered by *Beggiatoa* and an accompanying increase in the diversity and abundance of species other than *Pachycerianthus*. Some of this increase in abundance and diversity may simply be due to seasonal variation with the 2013 dive occurring much later in the year than the 2009 dives. However the presence of species such as *Buccinum*, *Arenicola* and *Carcinus* combined with a decline in the coverage of *Beggiatoa* all indicate an improvement in the bottom conditions. It will be interesting to discover if the abundance of *Pachycerianthus* is maintained or perhaps there will be a peak, then decline in numbers until the next time conditions are favourable for recruitment and survival of the Fireworks anemones.

Appendix: Raw data collected from Loch Duich/Loch Beg Survey

Dive Site: School Bay	Max Depth: 33m	Dive Time: 40 mins	Divers: Chris Rickard & Anne Buchan		Position at Start: 57° 13.833 N 05° 24.966 W	Date: 12/03/2011	
Anemone	Depth (m)	Diameter of tentacles (cm)			Full/half/retracted	speed of retraction	Other species
		5-15	15-29	>29			
1	26			*	Full	None	<i>Myxicola</i> x 3
2	29			*	Full	None	
3	30			*	Full	Fast	
4	30			*	Full	None	
5	30			*	Full	None	<i>Myxicola</i> x 3
6	31			*	Full	None	
7	32			*	Full	Fast	<i>Myxicola</i> x 2
8	30			*	Full	None	
9	26			*	Full	None	<i>Myxicola</i> x 4
Dive Site: School Bay	Max Depth: 24m	Dive Time: 45 mins	Divers: Wendy Northway & Ariel Northway		Position at Start: 57° 13.855 N 05° 24.952 W	Date: 12/03/2011	
Anemone	Depth (m)	5-15	15-29	>29	Full/half/retracted	Speed	Other species
1	22			* ?	Retracted	N/A	

Dive Site: Ratagan Bay	Max Depth: 19m	Dive Time: 45 mins	Divers: Chris Rickard & Anne Buchan		Position at Start: 57 12.937 N 05 26.314 W	Date: 12/03/2011	
Anemone	Depth (m)	Diameter of tentacles (cm)			Full/half/retracted	Speed of retraction	Other species
		5-15	15-29	>29			
1	16	*			Full	No	<i>Myxicola</i>
2	16	*			Full	Fast	
3	17	*			Full	Fast	<i>Myxicola</i> x3
4	17			*	Full	No	<i>Myxicola</i> x6
5	17	*			Full	Fast	
6	18		*		Full	Fast	
7	18			*	Full	Fast	
8	17	*			Full	Fast	<i>Myxicola</i> x 3
9	16		*		Full	Fast	

Dive Site: Ratagan Bay	Max Depth: 24m	Dive Time: 45 mins	Divers: Graham Bruce & Rachel Hope		Position at Start: 57° 12.919 N 05° 26.277 W	Date 12/03/11	
Anemone	Depth (m)	Diameter of tentacles (cm)			Full/half/retracted	Speed of retraction	Other species
		5-15	15-29	>29			
1	23	*			F	Slow	Surrounded by <i>Funiculina</i> with one phosphorescent sea fan One angular crab under tentacles.
2	23	*			F	No	
3	23		*		F	Slow	
4	23		*		F	No	
5	23	*			F	No	

Dive Site: Loch Beg	Max Depth: 17m	Dive Time: 38 mins	Diver: Owen Paisley		Position of Centre of Site: 57° 13.980 N 05° 24.687 W		Date: 12/03/2011	
<i>Anemone</i>	<i>Depth (m)</i>	<i>Diameter of Tentacles (cm)</i>			<i>Full/half/retracted</i>	<i>speed of retraction</i>	<i>In Group?</i>	<i>Other species</i>
		<i>5-15</i>	<i>15-29</i>	<i>>29</i>				
1	15.5		*		Full	None		
2	15.9		*		Full	Fast		
3	15.9		*		Full	Fast		
4	16		*		Full	None		
5	16.1	*	*		Full	slow	Yes, 2	
6	16.1	*			Full	Fast		
7	16.1		*		Full	Fast		
8	16.2		*		Full	Fast		
9	16.2		*		Full			
10	16.2		*		Full			
11	16.2		*		Full			
12	16.3		*		Full			
13	16.2	*			Full			
14	16.3	*			Full		Yes, 3	
15	16.3	*			Full			
16	16.4	*			Full			
17	16.5	*			Full			
18	16.5		*		Full			
19	16.5	*			Full		Yes, 3	
Dive Site: Loch Beg	Max Depth: 17m	Dive Time: 38 mins	Diver: Wendy Northway		Position at Centre of Site: 57° 13.980 N 05° 24.687 W		Date: 12/03/11	
<i>Anemone</i>	<i>Depth (m)</i>	<i>Diameter of tentacles (cm)</i>			<i>Full/half/retracted</i>	<i>Speed</i>	<i>In Group?</i>	<i>Other species</i>
		<i>5-15</i>	<i>15-29</i>	<i>>29</i>				
1	15		*		Full	Slow		
2	15		*		Full	None	Yes, 2	
3	15		*		Full	Slow		
4	15.2		*		Full	None	Yes, 2	
5	15.2	*			Full	None		
6	16.2	*			Full			
7	16.1	*			Full			
8	16.5		*		Full			
9	16.6		*		Full			

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References:

Paisley (2007) : Pachycerianthus Survey- Loch Shira October 2006.

Copies of this report are available on the Seasearch website www.seasearch.co.uk

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