

Wester Ross spring spawning herring recorded on video to the west of Red Point, near Gairloch

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As well as being a traditionally important food for people in Scotland, herring are also a vital link in marine food webs. Herring larvae and fry are eaten by other small fish including sea trout and juvenile salmon as they migrate to sea in April and May, and by many sea birds; larger herring are food for larger fish and for seals and cetaceans including minke whale and porpoise.

Following the rediscovery by scallop divers of a large area of seabed covered by herring eggs near Gairloch in March 2018, <http://www.wrft.org.uk/news/newsitem.cfm?id=214> underwater cameraman, Andy Jackson of Subsea TV, expressed much interest in attempting to film herring spawning in the area in 2019. The Skye and Wester Ross Fisheries Trust was keen to assist Andy and to provide support in collaboration with several local boat operators and other local enthusiasts.

Search for herring

The search began in February following reports of maturing herring caught by local fishermen (as by-catch) around the Gairloch area and also near the Summer Isles. Unusually, a few herring had been found inside shellfish creels.

Female herring caught in a shellfish creel to the west of Red Point on 18th February 2019. The roe have been dissected out.



The herring caught on 26th February near Gairloch were not quite ready to spawn, suggesting that the main spawning period was still over a week away. We looked for the herring shoals reported just beyond Loch Gairloch on 27th and 28th February; however no signs were found.



On Tuesday 5th March, the sea was calm and the sun shone as we set off from Gairloch harbour on local tour boat, K-2.

In addition to Andy, cameraman George Brown of Inverness Diving Club and Noel Hawkins of the SWT Living Seas project were both on board to join the search. Our skipper, John Mackenzie, took us steadily out past Badantional and Port Henderson.

Andy Jackson, John MacKenzie and George Brown on board K-2 on 5th March 2019.

On rounding Carr Point at the mouth of Loch Gairloch, many gannets could be seen diving in in the distance. So we headed towards the feeding area about 1.5km to the west of Opinan. Over a dozen grey seals were gathered in the same area. As we approached, it took a moment to realise that the depth to the seabed had not just suddenly changed from 20m to 12m as indicated by the sonar; the '12m' reading was the top of a tightly bunched shoal of fish (*right!*)!



The water was full of fish scales; the shoal was evidently large and attracting many predators. With rod and line, John caught a female herring almost ready to spawn. Andy and George prepared for their first dive,

and with cameras running, entered the water. We watched and waited. A porpoise surfaced. Squinting into the glare of reflected sunlight, gannet activity could be seen for several hundred metres further south. Andy was the first to resurface. However he'd only seen one herring, an injured one, drifting by. A few minutes later George also surfaced. He'd also been unlucky; by the time he had descended to the seabed, the shoal had gone.

Noel Hawkins and Andy Jackson recording porpoises surfacing near the herring shoal.



After a bite to eat we headed further south towards the area where herring eggs had been found on the seabed in March 2018. No signs of fish were encountered until in water about 20m deep on the edge of the shallower bank. For the next dive Andy entered the water slightly up current from where the shoals appeared on the sounder.

John moved the boat away from where the divers had been dropped; we waited. By now there was a gentle breeze; the sea was no longer smooth and it was only just possible to follow Andy's progress from his bubbles breaking on the surface. This time when he resurfaced he took his mouth piece out: a big smile (*below*)!

Video of herring swimming around and above him had been captured. The shoal was so dense that the amount of light reaching the seabed was barely enough for the camera. However there was no indication of herring spawn on the seabed or of spawning activity.

On his next dive, George collected a bag of maerl gravel from the seabed for an aquarium which was set up in the SWRFT office after returning to the shore.

That evening, we headed back out. One of the scientific papers describes how spawning activity can take place during the night time (Skaret et al, 2003), so we thought that the shoals might have moved from the edge of the bank into shallower water after sunset. Both Andy and George entered the water in darkness in the hope of finding spawning herring. However no success; and the camera lights seemed to frighten away any herring that were seen.



The next day (Wednesday 6th) the wind had picked up and the waves were too big for a diver to enter the water. Shoals of herring were found to the west of Red Point viewpoint. There were plenty of hungry gannets, seals, and an occasional porpoise surfacing. However, the fish were still tightly grouped and at a depth of about 20m. Thursday was too windy. On Friday morning (8th March) Andy watched from the shore near Red Point viewpoint. Back in the office, I was enjoying pointing out small hermit crabs, featherstars, brittlestars and tiny chitons that had emerged from the maerl gravel in the aquarium to visitors, when John appeared: Andy thought that the herring were spawning as there was much gannet activity closer to the shore than before; the plan was to set off at 2pm. So we headed out again. There was indeed much gannet activity, but the waves were much too big to contemplate a dive.

Spawning herring located

Alas the weather forecast for the following week was not good with a series of vigorous depressions passing over. However there appeared to be just one opportunity for a possible dive early on 10th March with light winds forecast for a few hours before mid-morning.

We were out just after 7am, dropped Andy plus camera over a shoal of spawning herring, and back in again by just after 10am. This time Andy had been able to film the herring close to the seabed, describing the visibility as like being in a sandstorm, with evidently much spawning activity nearby. Later in the day, from the shore, around 200 gannets could be seen over the area where herring were spawning. There was also a turquoise 'slick'; several people also reported that they could smell herring. I watched a White-tailed eagle fly from the shore out over the spawning area where it circled for at least 20 minutes.

Hatching success?

Andy had also been able to collect a sample of eggs from the seabed. These were subsequently transferred very carefully into the aquarium in the office. Although the eggs were stuck to fragments of maerl gravel, most looked OK. However I was rather pessimistic about their prospects: salmon eggs are very sensitive to movement during the early stages of embryo development so I assumed that herring eggs would likewise also be very sensitive and most would not survive. With no more good weather windows in prospect in the near future, Andy headed home the following morning. Over the next few days, the Gairloch area was subject to gale force winds and high seas, so there was also concern for the eggs on the seabed.

Andy returned to Gairloch on Tuesday 19th March primarily to revisit the spawning area near Red Point. A weather window on 21st March provided the perfect opportunity and two dives were completed. Large areas of seabed were still covered with a 'carpet' of apparently healthy 'eyed' eggs; however there were some areas around the margins of the eggs layer where water turbulence associated with big waves appeared to have disturbed the spawn. However even here, most of the eggs looked like they were still alive.

Most of the eggs in the aquarium had also survived. Andy was also able to film the eyed embryos moving inside the eggs. The water temperature in the aquarium (at between 10C – 12C) was a few degrees warmer than the sea and many eggs hatched on 20th March. By the end of the week hundreds of herring larvae, each sustained by a yolk sac, could be seen. By 25th March most of the herring larvae in the aquarium had grown to around 10mm in length.



Andy recording herring eggs in the maerl aquarium in the SWRFT office.



Conclusions and some questions

Observations this year have again demonstrated that herring spawned in early March close to Red Point (to the SW of Loch Gairloch).

Spawning took place during a period of unsettled weather. Gairloch was close to the centre of a low pressure system when spawning activity was recorded during the morning of 10th March. The days before and after were characterised by strong winds and high seas.

The spawning area was also surveyed on the 18th March by a boat chartered to Marine Scotland and Scottish Natural Heritage. Herring eggs were found in two areas, both within an area of about 800m – 1000m in extent. The habitat was described by the SNH team as coarse sand with live maerl between ridges. Andy's video shows mostly gravel composed of broken maerl and shell fragments with much live maerl.

Various questions remain unanswered. For example, **why do the herring spawn where they do?** Do the herring shoals actively seek out the most suitable seabed habitat in the area during the weeks and days prior to spawning; or are there other factors which determine where they spawn? Do herring shoals avoid some areas because the seabed is unsuitable for egg incubation? Maerl is a fragile habitat. Herring eggs were again recorded mainly inside the Loch Gairloch 'closed' [to mobile fishing gear] area where the maerl gravel is in relatively good condition. Outside this area, to the north of Gairloch (where older fishermen reported that herring formerly spawned), scallop dredging has broken the maerl down into smaller fragments and the amounts of finer sandy sediment are generally higher. However in both dredged areas and areas where there is no dredging the seabed is occasionally moved about by big storms; hence the 'mega-ripples'. One difference may be that the maerl gravel - coarse sand may be 'cleaner' where there has been no dredging; so the cohesive egg 'carpet' may be better oxygenated from both sides (top and bottom) if deposited over a mostly gravelly seabed of high porosity?

Secondly, **to what extent do herring 'home' back to a spawning area in the same way that salmon do?** One would assume that herring larvae are far too small and at too early a stage of development when they hatch and drift away to have any recollection of origin? Some local fishermen reported that in past years shoals of herring gathered in Loch Gairloch in the late autumn and early winter; these shoals included both maturing fish and immature or perhaps recently spawned herring (autumn spawners?) [e.g. Mackintosh, *pers comm.*]. Perhaps previously spawned herring help to guide the first-timers? Recent genetic research suggests that in some areas at least, spring spawning herring and autumn spawning herring may not be closely related (Barrio et al., 2016, Lamichhaney et al., 2017)

Thirdly, **do herring also spawn elsewhere around Wester Ross, and during the autumn?** There were no signs of many gannets diving in between Loch Gairloch and Rhu Reidh to the north of Gairloch on 10th March, so no indication of spawning thereabouts. In previous years maturing herring have been caught in Loch Ewe in September. In other parts of their range herring may spawn in both spring and autumn; however spawning grounds are not always in the same areas. So there is still much to learn.

A Wester Ross herring poster can be found on the downloads page of this website <http://www.wrft.org.uk/files/WesterRossHerringPoster19June2019reworked.pdf>.

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(all photos by Peter C)