Eelgrass and Anchoring: an Overview of the Evidence

by Michael Simons, September 2014, for the Boat Owners' Response Group

1. Introduction

It is acknowledged that fixed chain moorings cause bare seabed scars, due to repeated scouring by the heavy mooring chain. This is different to the effect of normal boat anchoring as (a) the chains are much heavier than boat anchor chains, and (b) the ongoing scouring action is confined to exactly the same area of seabed. However, as they are fixed at one end to the sea floor, the scars' positions and size are fixed, and despite speculation, there is no evidence of a scar spreading beyond the (usually circular) area swept by the chain. So damage is caused, but it is limited and finite, perhaps 0.2% of the total eelgrass area in Studland Bay. It is not considered further in this overview.

It is also acknowledged that there is evidence that certain other species of seagrass have been significantly damaged by leisure boat anchors, however these species have very different resistance and recovery characteristics to eelgrass (*Zostera marina).* Further, anchoring practices can differ in the parts of the world in which these grow.

This overview considers evidence which relates to the possibility that leisure boat anchoring might cause significant damage to eelgrass beds or the eelgrass habitat, in Studland Bay, Dorset, and elsewhere in England, and for the most part will refer to articles already published by the author on the website of the Boat Owners' Response Group. These in turn draw on the worldwide published scientific literature on eelgrass, the most comprehensively studied of all the species of seagrass, and full references are given in the articles. Active links to relevant articles and papers are given in the text of this overview.

2. Eelgrass and anchoring in the worldwide scientific literature

The author is aware of no published paper which demonstrates damage to the eelgrass habitat by leisure boat anchors. A paper by Collins et al (2010) claimed to study anchor-damaged areas, but failed to demonstrate that the areas concerned had actually been affected by anchoring (http://boatownersresponse.org.uk/Workshop_presentation7.pdf see slides 9 and 10).

This challenge – that there is no paper in the worldwide literature showing anchor damage to eelgrass – was presented by the author in 2012, since when nobody has come forward with any such paper. There are papers showing damage by propeller scarring and boats grounding, and a good number dealing with damage by fishing gear, but not, to the author's knowledge, by anchoring.

This conclusion is based on the use of internet search engines, although the possibility always exists of a reference being missed. However a clear negative result is given by a recent paper on Nordic eelgrass (CHRISTOFFER BOSTRÖM et al 2014 which surveys the status and health of **all the eelgrass in the Nordic countries**, up to **2000 sq km** of it, in the Baltic and the Norwegian Atlantic coast. The paper runs to 25 pages and cites 113 references. A word-search of the entire document showed that **the words anchor or anchoring do not occur even once**. Anchor damage is clearly not an issue there, although leisure boating in the Baltic, and in Sweden and Denmark particularly, is very popular. The map, right, shows the area covered by the study. See http://onlinelibrary.wiley.com/doi/10.1002/aqc.2424/full

3. Eelgrass and anchoring in Studland Bay

Studland Bay has been a popular and well-used anchorage for decades. It has also been closely studied, and the evidence shows healthy eelgrass beds which have been steadily expanding.

A study carried out by Seastar Survey Ltd (http://www.thecrownestate.co.uk/media/5290/Seastar%20survey%20Studland%20Bay%20second%20seagrass%20monitoring%20report.pdf) conducted methodical dived surveys in the central anchoring area and in October 2011, that area was found to have dense eelgrass at 55% coverage with an average shoot density of 208 shoots per sq metre, which the report said was "typical for the wider Weymouth and Portland area". Full details of the observations are given in the Dive Logs in the Appendix of that report.

An **historic series of aerial images** of Studland Bay covering the years 1972, 1985, 1990, 1997, 2008 and 2011 may be found here (http://boatownersresponse.org.uk/Aerial-1972-2011.pdf). They show that, far from declining, the eelgrass beds in the Bay have greatly expanded over that period, and gaps in the beds filled in with new growth, although leisure vessels have been anchoring there throughout the period. New growth is moving inshore at a rate of 2 metres a year. The Seastar Survey report (above) provides ground-truthing for the central part of the 2011 image, and the inshore fringe of vegetation is known to be eelgrass from reports from divers and by observation at low tide.

These images also show that the mooring scars have not been expanding, indeed in 1985 there was little or no eelgrass in the moorings area – it has moved in since.

Update Oct. 2016: An underwater HD video survey by the author in July 2016 shows abundant healthy eelgrass in the inshore areas off South Beach, Studland Bay, in areas used for anchoring. This provides photographic ground-truthing for the aerial images, and evidence in its own right of the inshore expansion. See http://boatownersresponse.org.uk/Studland_Underwater_Videos.pdf

4. How is eelgrass so robust against the potential effects of anchors?

A clear picture is emerging to explain why eelgrass can thrive in the presence of anchoring. Firstly it is robust against physical damage – see our article http://boatownersresponse.org.uk/Eelgrass-Raking-Study.pdf – and also shows great powers of recovery or resilience – see our article http://boatownersresponse.org.uk/Eelgrass-Resilience-and-Resistance.pdf .

The first article describes a paper by Boese (2002) in which patches of eelgrass were raked (the rake had 20 cm tines) in a way which simulated raking for clams, which is a reasonable analogy for the action of an anchor digging in. 100 x 1sq m plots were used, of which 50 were treated and 50 served as control (untreated) plots. This was done three times, with four weeks between each treatment. Two weeks after the last treatment, the treated plots were indistinguishable from the control plots in all measured characteristics, i.e. such damage as had occurred had repaired within **two weeks**.

The second article cites 12 published papers which show that eelgrass can recover from substantial small-scale (up to 4 sq m) physical disturbance within 2 years, and often, in the case of smaller areas, one year. This would normally be considered rapid recovery, or high resilience.

The next consideration is how much of an eelgrass bed could be subject to anchor disturbance in the course of a boating season, and it turns out that the great majority of the seabed will remain undisturbed. The calculations are explained at http://boatownersresponse.org.uk/anchoring-density.pdf and it turns out that using estimates for Studland Bay we expect that less than 1% of the seabed in the anchoring area as a whole will be impacted by anchors during a boating season. Further, it is straightforward to estimate a general "closest approach" case which suggests that the maximum possible area impacted, given normal anchoring good practice, will be around 1.6%.

So the theoretical explanation of the observed lack of damage, and indeed in the case of Studland Bay the ongoing expansion of the eelgrass beds in the presence of ongoing anchoring, is given by an inherent resistance of eelgrass to physical damage, a high resilience or rapid recovery when damage does occur, and a small percentage area impacted anyway. Any damage sustained by this small area is thus rapidly repaired.

5. The "evidence" advanced to show eelgrass vulnerability

So far, this overview has been concerned with real evidence, drawn mainly from the scientific literature. We now turn to the arguments advanced by those who have argued that anchors kill eelgrass. The "anchors kill" narrative, which is devoid of actual direct evidence, appears to be based on analogy, speculation and fabrication. We shall point out the defective nature of each of the three strands of the narrative.

5.1 *Posidonia oceanica:* the wrong type of seagrass

Reports of anchor damage to the Mediterranean seagrass *Posidonia oceanica* were interpreted as showing that the entirely different seagrass (from a different plant family) *Zostera marina,* or eelgrass, must be similarly vulnerable.

Those who make this claim appear not to have read the excellent primer on European seagrasses*: European seagrasses: an introduction to monitoring and management ,* ed. J Borum, CM Duarte, D Krause-Jensen and TM Greve (2004).
(http://www.seagrasses.org/handbook/european_seagrasses_high.pdf)
On p.13 the authors state the horizontal rhizome elongation rate for *P. Oceanica* to be just **2 cm/yr**, as against **26 cm/yr** for *Z. Marina*. On p.38 they describe recovery of an area of a *P. oceanica* meadow in France which was destroyed by a bomb in WW2: growth into the devastated area from the surviving meadow has been proceeding at just **3.4 cm a year.** In contrast, the shoreward expansion of the eelgrass meadow in Studland Bay, as explained above, has been proceeding at **2000 cm a year**.

With such incredible differences there is no way in which *P. Oceanica* can serve as a model relevant to eelgrass. Further differences are described in the European seagrasses book, and a comparison table of certain properties is given at
http://boatownersresponse.org.uk/Workshop_presentation7.pdf (page 8).

5.2 The "rhizome mat" speculation

The "anchors kill" narrative suggests that eelgrass beds are stabilised by a coherent "mat" of rhizomes, although the author is not aware of any description of such a mat in the literature for eelgrass. *P. Oceanica* on the other hand does form an interlocking 3-dimensional rhizome structure, so perhaps this is another case of mistaken identity. Anyway, the speculation goes that if the integrity of the "mat" is breached, it all breaks down. The paper by Collins et al (2010) (section2 above) speculates that wave action can then erode the seabed away in the exposed areas, causing a "scar" to expand.

Well, the paper by Boese (2002) (section 4 above) states that some rhizomes were removed by the raking treatment – yet the eelgrass was fully recovered within 2 weeks. Removal of some of the rhizomes caused no problem in that case. The historical aerial photograph series (section 3 above) does not show growth of the fixed mooring scars over the years, so scar expansion is not supported by that evidence from Studland Bay.

Another study by Boese (2009) in which **all eelgrass including rhizomes** was removed from 2m x 2m plots within a bed showed significant regrowth within 12 months round the edges of the plot, and regrowth over the whole plot within 2 years, and a similar study by Ruesink et al (2012) showed recovery over the whole 2x2m plot in 2 years. In these cases the rhizomes were completely removed, yet full recovery took place fairly rapidly. (Details at http://boatownersresponse.org.uk/Eelgrass-Resilience-and-Resistance.pdf pp 4 – 6). So recovery can even occur in the complete absence of rhizomes in the affected area (it proceeds by lateral growth from adjoining healthy plants).

Update Oct. 2016: Detailed still photographs from the underwater HD video survey by the author in July 2016 show an area of seabed in a moorings scar. They show no evidence of an exposed rhizome mat, nor of the downward step described by Collins. Examination of the videos covering 300 m of seabed shows no sign of sharp edges nor of exposed rhizome mat, nor indeed of holes in the seabed. The rhizome mat speculation is not supported by this phogtographic evidence. See http://boatownersresponse.org.uk/Studland_Underwater_Videos.pdf

5.3 The MB0102 Matrix fabrication

To help in assessing sensitivities of features to particular pressures in the MCZ process, a “sensitivity matrix” of hundreds of feature/pressure combinations was commissioned by Defra. The particular combination which concerns us is the sensitivity assessment of the **seagrass beds habitat** to the pressure **“Shallow abrasion/penetration: damage to seabed surface and penetration”**, and the following comments are not directed at any other assessment.

This assessment asserted that eelgrass was “highly sensitive” to physical abrasion and surface penetration, that it has **No** resistance and **Very Low** resilience to the pressure.

This assessment is a small part of a 970 page document, and clarifying how it was arrived at took a degree of forensic analysis. The results were truly shocking, for despite the science-y sounding gift wrapping of the title (MB0102 Sensitivity Matrix), the box was, scientifically speaking, empty.

- **No evidence was presented**
- **No reasons were given**
- **The assessment was by “expert opinion”**
- **The experts were not identified, despite a request by the current author**
- **The actual expertise of the “experts” (eg how many papers written on eelgrass) is unknown**
- **Their opinion is contrary to an existing MarLin assessment**
- **The assessment is flatly contradicted by a large number of published scientific papers worldwide**

A detailed critique and rebuttal of this assessment, with supporting evidence from the published literature, is published at http://boatownersresponse.org.uk/Commentary-on-MB0102.pdf

Our view is that this assessment is not evidence at all, it is sheer fabrication, and as such is quite unsuitable for informing public policy. Sadly, we understand from Natural England that they still intend to use the assessment “to inform management measures”. If it is used for this or as “evidence” of eelgrass vulnerability the Boat Owners' Response Group will continue to expose it for the nonsense which it is.

The document containing (deep within its depths) this assessment may be found at http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=16368 then select MB0102 – Report No. 22: Task 3

Update Oct. 2016: The underwater HD video survey of July 2016 shows abundant healthy eelgrass in areas used for anchoring. Such growth is quite incompatible with the MB0102 Matrix assessment, as is spelled out at http://boatownersresponse.org.uk/Studland_Underwater_Videos.pdf . We adhere to the basic principal of science that evidence is the test which theories or assertions must meet.

Summary

There appear to be no studies showing significant leisure boat anchor damage to eelgrass in the worldwide scientific literature for eelgrass (*Zostera marina*). Local evidence for Studland Bay shows healthy and expanding eelgrass beds despite ongoing anchoring for decades. The likely explanation is that only a small fraction of the seabed is directly impacted by anchors each year, and that eelgrass is robust against physical disturbance, having strong vegetative powers of recovery (high resilience) – a factor consistently overlooked by the “anchors kill” brigade. Further, such evidence as has been produced by the “anchors kill” faction is readily discredited and appears to be based on false analogy, speculation and fabrication. In our view, leisure boat anchoring as practised in the UK is a sustainable activity in the presence of eelgrass beds.

(No list of references is given here, they are all accessible through the links within the text. This article is published at http://boatownersresponse.org.uk/Evidence-overview-Sept14.pdf).