HOUSE OF COMMONS

# Environment, Food and Rural Affairs Committee

## Oral evidence: Sealife Mortality off the North-East Coast, HC 796

Tuesday 25 October 2022

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Watch the meeting

Members present: Sir Robert Goodwill (Chair); Ian Byrne; Geraint Davies; Rosie Duffield; Barry Gardiner; Dr Neil Hudson; Robbie Moore.

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### Witnesses

I: Rachel Hartnell, Science Director, Centre for Environment, Fisheries, and Aquaculture Science; Jerry Hopkinson, Executive Chairman, PD Ports; Trudi Wakelin, Director of Licensing, Marine Planning and Global Marine, Marine Management Organisation; and Mark Rice, Deputy Director for Water and Land Quality, Environment Agency.

II: Dr Gary Caldwell, Senior Lecturer, School of Natural and Environmental Sciences, Newcastle University; Dr Rodney Forster, Reader in Marine and Coastal Ecology, Hull University; and Tim Deere Jones, Marine Pollution Consultant.

III: David McCandless, Chief Officer, North Eastern Inshore and Fishing Conservation Authority; Joe Redfern, Secretary, Whitby Commercial Fishing Association; and Stanley Rennie, Fisherman, Whitby Commercial Fishing Association/North East Fishing Collective.

# Examination of witnesses

Witnesses: Rachel Hartnell, Jerry Hopkinson, Trudi Wakelin and Mark Rice.

Q1 **Chair:** Welcome to the sitting of the EFRA Select Committee looking at this very serious issue—certainly in my part of the world—of sea life mortality off the east coast. I thank the public for their interest in this session. A lot of people have contacted the Committee with evidence. The purpose of this session is to hear that evidence, and it will be an opportunity to test the arguments and the possible causes of the mass mortality of crustaceans, and to hear about the impact on local communities.

The Committee is not a scientific body, although we do have scientists as members of the Committee, so we will not be able to come to a definitive view on the cause, but at the end of the session we will consider what action we think appropriate, which may involve contacting statutory bodies, Ministers and so on.

Starting with Trudi on my left, I will ask you to introduce yourself and to state your role and who you represent.

***Trudi Wakelin:*** I am Trudi Wakelin. I am the director of Marine Planning, Licensing and Global Marine with the Marine Management Organisation. We are the body responsible for the regulation and consenting of marine development in English marine waters.

***Mark Rice:*** My name is Mark Rice. I am deputy director for Water and Land Quality with the Environment Agency. Our role is to take out pollution investigations, and to work with our colleagues on environmental monitoring.

***Rachel Hartnell:*** My name is Rachel Hartnell. I am a science director at CEFAS, the Centre for Environment, Fisheries and Aquaculture Science. My role here is to represent some of the science investigations.

***Jerry Hopkinson:*** Good afternoon, everyone. My name is Jerry Hopkinson. I am the chairman of PD Ports. PD Ports is the port operator on the River Tees and the statutory harbour authority for the river and the estuary.

Q2 **Chair:** You are all very welcome indeed. I will start the questioning with Rachel from CEFAS. The DEFRA-led joint investigation concluded that "no single consistent causative factor was identified for the mass deaths of crabs and lobsters, although a harmful algal bloom in autumn 2021 was identified as of significance"—I think that was the word used. What evidence points to an algal bloom as the likely cause?

***Rachel Hartnell:*** In the area at the time, there is good evidence to suggest algal blooms, plural. The first bloom, as we understand it, identified both by satellite data and through some testing in and around the areas, is proposed to be something called Karenia mikimotoi. This is a bloom that forms very large, dense blooms. It was almost certainly

present in the area at the time. The data that we have showed that the bloom appeared to persist up until around about a week into the incident, whereupon the temperature of the water dropped and we believe that the bloom disappeared, potentially crashing. When such blooms crash, they can cause oxygen depletion on the sea floor, which may well have been implicated in the incident. There are at least 10 peer-reviewed publications that describe the health impacts on crustacea from blooms and it is recognised that about 22 species of harmful algae can impact crustacea.

We have reviewed the literature, and worldwide, including in the UK and the south of Ireland, there are at least 23 incidents of something similar happening in the past, including one in the UK and one in the south-west of Ireland. That alone does not constitute cause, but at the same time we know in the area that there was another type of algal bloom—the type that you cannot see from satellite data but is the cause of something called diarrhetic shellfish poisoning, which is a regulated suite of toxins that we regulate for bivalve molluscs from a human health perspective.

We tested impacted crabs for those toxins and we found quite high levels of the toxic compound okadaic acid in the crab tissue. We suspect that there was a large Karenia mikimotoi bloom in the area, which the evidence that we have suggests crashed around the time of the mortality.

Q3 **Chair:** That one is not a toxic algal bloom?

***Rachel Hartnell:*** No, that is correct.

Q4 **Chair:** When it dies and falls to the bottom it causes—

***Rachel Hartnell:*** The blooms will die as a result of perhaps a temperature drop in this case. We cannot be certain of any of this, but this is the hypothesis. When the blooms crash to the bottom of the sea, they take out the oxygen, which causes this localised anoxic condition. We postulate that, coupled with the diarrhetic shellfish poisoning toxins, okadaic acid is the most likely cause of this mass mortality event.

Q5 **Chair:** How closely did the area identified through satellite imagery correspond to the area where shellfish were killed?

***Rachel Hartnell:*** The resolution of the satellite imagery very close to the shore is not perfect, but it was corresponding with the area.

Q6 **Chair:** Some have argued that algal blooms are unlikely to target only crustaceans, and deaths of other sea creatures would be expected. Why do you think this algal bloom mainly seemed to affect crabs and lobsters, not fish or seals or seabirds?

***Rachel Hartnell:*** In other instances of this type that have impacted predominantly crustacea, it is theorised that other benthic life that can move away from those oxygen-depleted conditions do that. Fish swim away; the crabs and lobsters have less opportunity to do so. Here, though, we are also saying that the presence of an additional toxin from

this second bloom that was in the area at the time, and I think that is what makes it unusual, had an additive impact upon those species.

Q7 **Chair:** Understood. We have also heard that larger algal blooms have occurred in the North Sea without causing the associated mass die-offs. Why do you think this particular algal bloom in and after September 2021 was so deadly?

***Rachel Hartnell:*** Again, we are not certain about this and we are certainly trying to test this hypothesis at CEFAS at the moment. It is the oxygen-depleted conditions on the seabed, coupled with the presence of the toxin from the diarrhetic shellfish poisoning bloom, the okadaic acid. That is what we are focusing our work on, going forward.

Q8 **Chair:** Could the discolouration of the sea water picked up by the satellites be picking up, for example, material associated with the dredging of the River Tees that was washing down the coast?

***Rachel Hartnell:*** Yes, there is certainly some uncertainty around the satellite data. From our collaboration with the Plymouth Marine Laboratory, who have a model that looks particularly for Karenia mikimotoi, the Karenia bloom is what we suspect was present here. Our colleagues at the Plymouth Marine Laboratory also corroborated this.

Q9 **Barry Gardiner:** Ms Hartnell, my understanding is that in September to October, the bloom reached levels of 15 micrograms per litre, but in general, isn't it the case that a bloom is considered dangerous around 30 micrograms per litre—double that?

***Rachel Hartnell:*** Absolutely. We do not have our readings of cells from the area at the time, so we cannot be certain of the levels, but there is certainly evidence that is consistent with a bloom. We cannot be certain about the density of it.

Q10 **Barry Gardiner:** I am not quite clear what your response to that question was. Is it correct that normally it would be considered dangerous at 30 micrograms per litre?

***Rachel Hartnell:*** Yes.

Q11 **Barry Gardiner:** The evidence, such as we have it, shows that the blooms on this occasion may have reached up to 15 micrograms per litre.

***Rachel Hartnell:*** We don't have good evidence of the bloom concentration predicted at the time, because we don't have cell counts when we predict the bloom.

Q12 **Barry Gardiner:** You believe that the submission from the Plymouth Marine Laboratory on that point is otiose.

***Rachel Hartnell:*** What I would have to do for the Committee, if you do not mind, is to go back and check those data. We can submit that at a later date.

Q13 **Barry Gardiner:** Thank you very much; that would be helpful. The image phenomenon seemed to centre on the Tees mouth area, rather than the whole affected area—is that correct?

***Rachel Hartnell:*** Yes, although the bloom did spread down the coast to an extent.

Q14 **Barry Gardiner:** You would confirm that blooms usually occur in bays or inlets, rather than in the open sea; is that correct?

***Rachel Hartnell:*** Usually, yes.

Q15 **Barry Gardiner:** In this case, that is not the case.

***Rachel Hartnell:*** Well, the weather conditions were very calm. It was very warm.

Q16 **Barry Gardiner:** I understand that although sea temperatures were higher than normal, blooms such as this are very rare at that time of year, and an historical record of the temperatures in the area shows that they are far below the optimal temperatures for a bloom. Is that not also correct?

***Rachel Hartnell:*** Although you are right that this was towards the end of the bloom season, we have good evidence to suggest that there was a bloom of Karenia in the area at the time. That is consistent with the seawater temperatures, which dropped quite suddenly by around 2 degrees. It then crashed, or certainly disappeared from the satellite.

Q17 **Barry Gardiner:** Why was the joint investigation declared closed, given that the findings were not conclusive?

***Rachel Hartnell:*** Is that a question for me?

**Barry Gardiner:** I assume you were part of the closing of the investigation, but I am very happy if anybody else feels better qualified to address it.

***Rachel Hartnell:*** Not at all. The investigation was closed because there was no further evidence to suggest that anything else could have been causal. At the time the investigation had closed, we had been investigating for around six months. It was very difficult then to go back to that environment and test anything else.

Q18 **Barry Gardiner:** The findings at that stage were not conclusive, but equally you had no further evidence to proceed on.

***Rachel Hartnell:*** On the balance of probabilities, it was felt that it was the most likely cause. As I have said, we are testing that hypothesis going forward.

Q19 **Barry Gardiner:** In effect, the investigation has been reopened?

***Rachel Hartnell:*** I would not say reopened. I would say that we were testing a hypothesis.

Q20 **Chair:** Mark, could you maybe add to that, in terms of the extent that you were involved?

***Mark Rice:*** The Environment Agency was involved in the initial incident response, doing the water quality sampling and supporting the investigation, yes. As we did not find evidence that water quality caused this issue, then that was handed over, in terms of investigation, to DEFRA back in December 2021, and the Environment Agency supports that investigation.

Q21 **Barry Gardiner:** If I could throw a curveball to Mr Hopkinson, on the BBC documentary recently, you said that, on the subject of the Orca dredger, only virgin sands from the Tees mouth were taken. Is that correct?

***Jerry Hopkinson:*** Yes, it is.

Q22 **Barry Gardiner:** That is not true, is it? The sand always contained background levels of contamination even while the infamous south bank wharf was derelict. There is evidence in the document known as SLAB 5, which measured contamination levels of sediment in dredging drop zones around the country, that the highest levels were found in Tees Bay; that was last reported in 2014. It is not the case that it has always been just virgin sand, is it?

***Jerry Hopkinson:*** While I would not claim that I was seeking some form of licence in my description of the material, what I was trying to make explicit to the viewers of the documentary was that the materials that we had picked up and taken out to the designated spoil ground were materials that, by the action of the sea, we had previously removed and repeatedly removed on the cycle of climate action, which continuously frustrates our attempts to maintain the navigable channels into and out of the port.

**Chair:** We are going to come back to dredging later in a future question.

Q23 **Barry Gardiner:** I will leave the dredging issue there, then, for you to dredge up later, Chair. Ms Hartnell, how likely is it that the further investigations that you are now doing, which are due to conclude in March of next year, are able to come up with a more definitive conclusion? Is the data that you need to draw further conclusions still available?

***Rachel Hartnell:*** The hypothesis that we are testing through our experimental work is that the action of okadaic acid—the toxin we know was in the crabs, because we measured it—coupled with anoxic conditions on the seafloor, which we can reproduce in our laboratory, are likely to cause the clinical signs we saw in the animals at the event. We can do that experimentally. It is quite a difficult set of experiments to run, but we can test that hypothesis experimentally. Therefore, we will, I am assured, by the end of March be able to give very much greater clarity on whether or not this hypothesis—and I stress it is a hypothesis,

in the absence of anything else that anyone could determine—was likely to be implicated here.

Q24 **Barry Gardiner:** If I can summarise, you are saying that you are creating in the laboratory a cocktail of Karenia mikimotoi and its collapse, and you are then overlaying that, or undergirding that, with the other toxin, monitoring if it has the effect that was evinced in the crustaceans.

***Rachel Hartnell:*** Almost, but not quite; but, yes, the principle is the same. What we are doing is recreating anoxic conditions, the conditions that were modelled. If we go back to your question about the likelihood of Karenia causing the oxygen depletion via crashing, that has been modelled using previously published work. With the bloom densities, we have a predicted oxygen-depleted level at the seafloor at the time of the incident. The experimental protocol recreates that oxygen depletion condition. We do not use Karenia to absorb the oxygen from the water, but we do introduce okadaic acid and the Dinophysis toxin—these toxins that we know were there—into the animals through exposure and feeding. The answer is: yes, but we artificially deplete the oxygen in the water, rather than using a crashed algal bloom to do so.

Q25 **Barry Gardiner:** Is that because you are convinced that a crashed algal bloom would have no material difference on the anoxic state of the water?

***Rachel Hartnell:*** In experimental science, you have to really try to control as many variables as possible, as I am sure you know. We are interested in anoxic conditions, so we are testing anoxic conditions.

Q26 **Barry Gardiner:** If an algal bloom was the chief cause, has human activity such as sewage or pollution and climate change made algal blooms more likely? Can anything be done to reduce the likelihood of further such conditions being prevalent?

***Rachel Hartnell:*** Algal blooms are natural, but they are influenced by human activity. They are influenced by warming water temperatures, so there are potentially linkages with climate change. They are also linked to changes in nitrogen phosphate ratios in the water from eutrophication conditions, so run-off and human activity. Therefore, yes, but they are also a naturally occurring event.

Q27 **Barry Gardiner:** It is possible, in the circumstances that we are looking back at, that there were other factors that could have influenced the crash and the subsequent decline of the crustaceans?

***Rachel Hartnell:*** Absolutely, but I will defer to my Environment Agency colleague with respect to potential sewage contamination, which I believe was ruled out as part of the investigation early on.

**Barry Gardiner:** Forgive me—no discourtesy intended to the panel—but I was due in another Select Committee three minutes ago, and I have to leave.

Q28 **Robbie Moore:** I want to focus a little bit on the ruled-out causes. Mark, will you pick this up to start with? Then we will come to the others.

The joint investigation ruled out potential causes, including sewage, animal diseases, seismic activity, windfarms, undersea cabling, temperature fluctuations and severe storms. The report explains why diseases were ruled out but says little about the other factors. Putting aside dredging and pyridine, how confident are you about safely ruling out other causes?

***Mark Rice:*** The Environment Agency's job is to respond to major incidents like this. Obviously, this was a serious concern to the community, and we responded immediately to the reports of dead and dying crabs. It was a risk-based and hopefully proportionate investigation looking for a cause of pollution. That is the presumption you start with: a cause of pollution, and that you will be able to find someone who has caused that pollution and potentially take enforcement action.

The water quality work indicated that we were not able to establish a cause of pollution. We looked at lots of different lines of enquiry. We looked at previous reports of pollution incidents in the area. We checked water-treatment works and associated infrastructure. We have regulated industry teams. They looked at permit compliance on Teesside with an emphasis on those sites that discharge into the Tees Estuary. We have talked about agriculture. We checked around the area to look for agriculture and other diffuse pollution sources, visual observations on the coastline to see if there was anything unusual. Odour is a good way of picking up potential chemical pollution. We also undertook a desktop type of study to identify any industrial sources of pyridine. This was once we had identified pyridine in the crab tissue. None of that indicated the levels of pollution that would cause the type of incident that occurred.

Q29 **Chair:** If I could interrupt briefly, are you talking about a level that would precipitate an algal bloom through eutrophication or a pollution incident, where the pollutant itself would have been toxic and caused animals to die?

***Mark Rice:*** That is right, yes. One that would cause that kind of significant impact on the environment, yes.

Q30 **Robbie Moore:** You were going through potential sources there and ways in which you carried out your investigation. Did you consider potential industrial sources?

***Mark Rice:*** Yes, we certainly did. As I said, we have a regulated industry team based up in the north-east area that regularly monitor and ensure compliance with our permits. We specifically looked into permit compliance by industry on Teesside with a focus on those sites that discharge into the estuary. We found no evidence of pollution to back up any of the issues that occurred.

Q31 **Robbie Moore:** From your position, what measures are in place at the

moment to ensure that construction works do not pollute watercourses or, indeed, the sea? Are you confident those are sufficient?

***Mark Rice:*** That might be something that Trudi can answer.

***Trudi Wakelin:*** In respect of the construction that is happening terrestrially, the MMO does not have any involvement in that activity.

Dredging works per se—I am conscious the Committee may wish to come back with more specific questions—is an activity that statutory harbour authorities have the ability or statutory power to undertake under their own legislation. However, there are circumstances in which conditions are placed on licences to protect water columns from impacts of surplus materials, and then consider how the dredged material is disposed of.

During the time of this incident, maintenance dredging was being carried out under the port's permissions. The licence that was regulating that work was for the disposal out to the permitted site offshore.

Q32 **Robbie Moore:** Is the EA reassured enough that those measures are sufficient?

***Mark Rice:*** The EA has consulted on these issues, but our primary role is incident response and regulating onshore sources of pollution as opposed to offshore.

Q33 **Robbie Moore:** Rachel, do you mind if I go back to the original question? The report explains that diseases were ruled out but says very little about other factors. Putting aside dredging and pyridine, how confident are you that we can safely rule out other causes?

***Rachel Hartnell:*** My organisation carried out testing for aquatic animal diseases and we are very confident that animal diseases can be ruled out.

Q34 **Robbie Moore:** Mark and Rachel, I don't know who wants to come to this first. Have you investigated whether the deaths of other animals in the area could have been linked to these pollutants?

**Chair:** There was a big thing about dogs dying and people getting ill at the time, you may remember.

***Rachel Hartnell:*** I do remember that. Previously dog deaths have been linked to algal toxins. There was no evidence to suggest that in this case any of the dogs or other animals dying were in any way associated with this event. That was backed up by veterinary evidence at the time. There were sick dogs that had not been in any way associated with the shoreline.

Q35 **Robbie Moore:** I know the report is obviously inconclusive, but do you think several factors could have led to what has happened, rather than just a single cause?

***Rachel Hartnell:*** The environment is a hugely complex thing. Algal blooms are the most likely cause, but even there we are not talking about

perhaps just one. We are talking about algal blooms plural, the potential for anoxic conditions on the seafloor and the cumulative effect of another toxin of which we do not know the impact upon crustacean physiology.

Q36 **Robbie Moore:** Mark, on the same question?

***Mark Rice:*** Could you repeat the question?

**Robbie Moore:** Around multiple causes or a single source, what is your view on that?

***Mark Rice:*** As I said, our job is to provide the data and the monitoring in terms of water quality and so on. Therefore, I do not think I am qualified to answer that.

Q37 **Robbie Moore:** Jerry, anything you wanted to add to those questions or any other points?

***Jerry Hopkinson:*** No. I am happy to talk about the dredging and the mechanics of what was undertaken in due course, thank you.

**Chair:** Dr Neil Hudson, who is a scientist.

Q38 **Dr Neil Hudson:** Thank you, Chair. Can I go to Rachel Hartnell first on the potential multifactorial nature? It is very hard in science to prove definitively causation, as opposed to association.

You mentioned that in the tissue samples of some of the crustaceans there were high levels of some of these algal biotoxins. Did you look at control animals, taken from fishing vessels outside this region, to see what the normal baseline was for some of these toxins and some of these other elements you were testing?

***Rachel Hartnell:*** No. We were looking for algal toxins—specifically those indicated by the clinical signs in the animals, so neurotoxins in the first instance. In the UK, we have no baseline monitoring programme for algal toxins in crustaceans, so we do not have baseline information.

Q39 **Dr Neil Hudson:** In that sense, it is quite hard to compare control animals that are not showing clinical signs with animals that are showing clinical signs.

***Rachel Hartnell:*** That is absolutely right. Therefore, we are not making that claim. What we are observing in the tests that we did on affected animals, and some animals that were not affected, is that there does seem to be high levels in affected animals. We are yet to demonstrate the statistical significance of that.

Q40 **Dr Neil Hudson:** In answer to my colleague, Mr Gardiner, you were saying that you are going to be testing some of these hypotheses moving forward in the laboratory.

***Rachel Hartnell:*** Yes.

Q41 **Dr Neil Hudson:** In follow-up to my colleague Mr Moore's question about

the multifactorial nature, have you looked in the literature for other variables so that you can then say, in a multifactorial analysis, whether they are involved or not, or whether it is just one particular factor? You have said, "We are looking at this one. There seems to be a strong association, so our studies will close."

***Rachel Hartnell:*** In the first instance, we are looking at anoxic conditions and okadaic acid because there is a reasonably compelling theory that suggests that could be causal. When we get to the end of those studies we will of course publish that data, take stock and see what else we need to do.

Q42 **Dr Neil Hudson:** Are people working with the university sectors, and academics in this field, as well?

***Rachel Hartnell:*** We have had a series of meetings now with our academic colleagues. Absolutely, everybody wants to get to the bottom of this. We stand ready and are collaborating with our academic partners.

Q43 **Dr Neil Hudson:** Thank you, that is encouraging to hear. Mr Rice, analysis based on Freedom of Information requests from the Environment Agency suggests that some crab tissue samples from affected areas contained much higher concentrations of the harmful chemical pyridine than baseline samples taken elsewhere. I have asked about baseline in terms of some of the other studies. Do you accept that analysis?

***Mark Rice:*** We certainly carried out analysis of crab tissue. The test that we carried out was not accredited for testing crab flesh for chemicals; it was adapted from a water quality test. Therefore, essentially that test cannot be relied on to give figures on the levels of pyridine found—it just tests the absence or presence of the chemical. If you did look at the levels from the test, the levels of pyridine found in crabs in affected and non-affected areas was fairly well spread, so picking the highest and lowest tends to misrepresent the data. Yes, it is true that we certainly did identify pyridine levels in affected crabs, but the technique we used is not really designed to assess the level in the tissue.

Q44 **Dr Neil Hudson:** You detected levels both in the affected area but also in crustaceans sampled from areas outside the affected area. Both the experimental side and the control side had levels of pyridine, but you are not able to say that there were statistically significant higher levels in the affected area. Is that right?

***Mark Rice:*** That is right. We found that a healthy crab from the Norfolk Wash had nearly 10 times the concentration measured in an impacted crab from Runswick. Therefore, yes, there is quite a spread in the environment of pyridine levels in crabs.

Q45 **Dr Neil Hudson:** You are talking one crab there?

***Mark Rice:*** Yes.

Q46 **Dr Neil Hudson:** You do not have huge numbers, in terms of statistical

analysis, in either the affected area or in areas where you are not seeing crustaceans showing these clinical signs, or not seeing death?

***Mark Rice:*** That is correct, yes.

Q47 **Dr Neil Hudson:** I guess more work needs to be done, then. Would you conclude that?

***Rachel Hartnell:*** Yes. Could I pick that up? I am conscious from the very beginning that when we are making really important decisions on the basis of test results, the methods that you apply should be very well validated and, if possible, accredited. That was the case for the methods in water and not, as Mark describes, for the methods that were applied to the crab tissue for pyridine testing.

One of the most important elements of the CEFAS work commissioned by DEFRA post-investigation is to develop such a method for pyridine in crab tissue. Once we understand the performance characteristics of that method, we will be able to understand the variability. We will be able to apply those tests to animals that were impacted at the time, healthy animals now, and really explore what this finding—which suggests that there are levels of pyridine in crabs post-mortem—really means.

That hypothesis is part of what we are testing at CEFAS, where the presence of pyridine in the tissues of these animals after death is associated with endogenous production of pyridine as part of the breakdown process, the disruption of cellular processes after death.

Q48 **Dr Neil Hudson:** Thank you. It is interesting that there is a slight difference between the EA and CEFAS. In the EA's studies of pyridine, you are looking at pyridine levels in the affected area but, also, you are sampling crustaceans in different areas. With the algal biotoxins, what you have said to us is that you have sampled it in the area, but you do not have baselines outside. Is that something that CEFAS will start to look at in the future, to get a baseline in other areas?

***Rachel Hartnell:*** Certainly, baseline information in any sort of environmental testing is really important.

Q49 **Dr Neil Hudson:** Thank you. Why was pyridine ruled out by the joint investigation as a potential cause of the mass mortalities, then? Is that a fair comment? Has it been ruled out, or are you still open to testing that hypothesis?

***Mark Rice:*** In terms of Environment Agency water quality monitoring, both at the time and since, we did not detect pyridine in the water. We have not detected pyridine in the River Tees since 2018. We can detect it in extremely low levels now, down to 0.01 micrograms per litre. The highest levels we detected in the Tees was back in 2012, which was at 2.4 milligrams per litre. I suppose we did not find evidence of pyridine in our water monitoring.

Q50 **Dr Neil Hudson:** The low levels made you rule it out, then?

***Mark Rice:*** That is right, yes.

Q51 **Dr Neil Hudson:** Would you agree with that?

***Rachel Hartnell:*** I would. There did not appear to be any credible source of pyridine in the environment. The other thing that perhaps I could add is that the chemical properties of pyridine do not predict that it absorbs well in sediments, or that it bio-accumulates in animals.

Q52 **Dr Neil Hudson:** Further to that, can pyridine accumulate in sediments and damage sealife on the seafloor?

***Rachel Hartnell:*** There is no evidence of that, to the extent that pyridine is excluded from the European Chemical Agency compounds required for bio-accumulation tests. Therefore, it is not considered at the moment—we are always mindful that new evidence can come to the fore—to be a chemical of concern.

Q53 **Dr Neil Hudson:** That tees me up for my final question of this section. Do you think that further research is needed to better understand the impact of pyridine on the wider ecosystem?

***Rachel Hartnell:*** The short answer would be yes. However, perhaps one of the most interesting elements here is to understand whether or not the pyridine was produced from within the animal itself as a product of cellular breakdown processes after death, which is very interesting.

If I could elaborate on that slightly, pyridine is a molecule that is in many biological processes. If we think back to our O-level biology, when we learnt about cellular respiration, pyridine nucleotides are the coenzymes that help to produce energy at the cellular level. It is possible, and predicted perhaps, that pyridine is generated to the point where we can detect it and its derivatives after death. That hypothesis is supported by the use of pyridine nucleotides as markers of post mortem.

Q54 **Dr Neil Hudson:** Finally, are you monitoring the presence of pyridine and also some of these algal biotoxins in animals that prey on crabs and lobsters, and other animals, in the marine ecosystem? When you pick up seals and marine mammals on strandings or in bycatch, are you monitoring both pyridine and algal biotoxins?

***Rachel Hartnell:*** Let me take one at a time. First, there is no monitoring programme for algal biotoxins outside the official control testing for bivalve shellfish, which is a piece of UK-retained legislation. When we hear of incidences that are potentially connected with accumulation through the food chain of biotoxins, we test as part of our own investigative work.

Q55 **Dr Neil Hudson:** Do you test any animals—seals, dead porpoises or anything—in the area?

***Rachel Hartnell:*** Not as part of this investigation, but we have done in the past. As I say, there is no routine monitoring outside that of bivalve

shellfish. In CEFAS we do not monitor for pyridine. The development of the validated test method pointed out in that crab matrix, which is quite complex compared to water, will enable us to look further and more for that in the future.

Q56 **Dr Neil Hudson:** Mark, would you suggest that there could be some routine monitoring of pyridine in bycatch or in dead animals and so on?

***Mark Rice:*** In terms of the Environment Agency's responsibility for water quality and land-based sources of pyridine, yes, we do monitor for presence in the environment. As I said, we have not detected it in recent years in the Tees Estuary.

As part of the investigation, we also looked at potential sources of pyridine from land-based sources and where it was previously discharged. Neither of those discharges are currently producing pyridine and releasing it into the environment. In terms of a regulatory role for the Environment Agency, we did that work as part of our investigation.

**Dr Neil Hudson:** Thank you. Back to you, Chair.

Q57 **Chair:** Before we move on to Rosie Duffield, you said you picked up very low levels of pyridine in 2012?

***Mark Rice:*** yes.

Q58 **Chair:** How regularly do you test the water in the Tees?

***Mark Rice:*** We have a monthly monitoring programme of water quality in the Tees.

Q59 **Chair:** Rachel, if you are comparing pyridine levels in a crab that has been dead for some time with pyridine levels in a crab that had been landed as a healthy crab to go into the food chain, could those two tests be seen as comparable, or could things that happen after the crab dies change the amount of chemicals in the crab?

***Rachel Hartnell:*** The important thing here is to have a method that we can be certain about in terms of its reliability. That is really what the focus of part of the work in CEFAS is at the moment: to produce a method that is the same level and standard as those that we would use in regulatory testing, so that we can have confidence in the quantities that method returns. Once we have that, we will be able to examine freshly dead animals, long-dead animals, and animals that may or may not be environmentally contaminated. It is really about having a method where you can be as certain as possible—certainly when there is as much at stake as there is here—that we have reliability in those test results. There are really important decisions being made on the basis of those results and they need to be as robust as possible.

**Chair:** Thank you; that is helpful.

Q60 **Rosie Duffield:** This is more of a broad question to all the panel. Leaving aside pyridine, could the dredging of polluted sediment lead to death at

this scale and geographical extent, as some university computer modelling has suggested?

***Trudi Wakelin:*** Part of the process that the MMO goes through when we receive any marine licence application for dredging activity is, first, that a sample plan is required by the applicant in order to determine and agree the number, location and determinands of samples that need to be taken in order to understand the nature of the material that is proposed for disposal. We use CEFAS as our scientific advisers for that process. They refer to the OSPAR Convention, the list of chemicals for priority action, in order to identify likely chemicals of concern. They also use their knowledge of local historical industrial activity to ensure that the sampling suite is as robust as possible.

Having had those samples taken and analysed, we consult again with CEFAS on the likely impacts of the volume of material—things like smothering potential, and sediment plumes that could be created—on the location of where the material is intended to be disposed of. There are a number of licensed disposal sites around the coast. Again, CEFAS holds a significant database with information from previous dredging campaigns and the likely impacts that could be felt from that.

All of that is considered on a site-specific and application-specific basis, to ensure that we can be assured that the material is appropriate for disposal at sea and, also, that any potential risks or impacts from that proposed activity can be, if necessary, mitigated through licence conditions—for example, by controlling or restricting the volume of material that is placed, the location or the time of year when it is placed, and how it is spread within the disposal site.

Q61 **Rosie Duffield:** Thank you. Would that have included taking into account the decommissioned coke ovens that produced lots of pyridine? Going back to pyridine again for a second, would that have been a consideration?

***Trudi Wakelin:*** As has already been said, pyridine is not on the list of chemicals of concern. As the UK is a signatory to the OSPAR Convention, we have to act within the regulatory framework in order to be consistent with how other European countries undertake the regulation of this activity. That will have been considered, and samples will have been allocated accordingly. Rachel may wish to follow up with further detail on that.

***Rachel Hartnell:*** To be honest, I cannot give very much more detail than Trudi has provided. The licensing conditions were met. Using the weight-of-evidence approach, the conditions were met.

**Rosie Duffield:** Does anyone else want to come in on that one? Mark?

***Mark Rice:*** I suppose the key point to make is that dilution, mixing and dispersion from the North Sea and tidal action, on any pollutant and any chemical, would indicate that it would have had to have been a significant

release to have had this kind of impact. If it had been such, we would have identified that in our monitoring, both at the time and subsequently. As we have not, we are fairly confident that it was not a pollution source that caused this event.

Q62 **Rosie Duffield:** This particular event was not expected and came out of nowhere. Do you think that it will change the way that that is looked at in the future? Will there be other things taken into consideration from now on?

***Trudi Wakelin:*** As part of our role, in order to ensure that we are enabling sustainable development, the MMO will take the "best available evidence" approach. We are extremely keen and working very closely with our regulatory colleagues, and with DEFRA, through this process to ensure that any additional evidence that comes out of this study informs future considerations. At the moment, from the "weight of evidence" approach that has been identified to date, there is no further reason to add additional controls to the dredging.

Q63 **Rosie Duffield:** This one is for Mark and Trudi. There seem to be conflicting reports about how polluted the Tees seabed is. Do we know much about the material at the bottom of the Tees estuary, and whether the pollution levels are high enough to cause crustaceans to die off? We have kind of covered that, but is there anything else you want to add to that—anything that perhaps has not come under consideration before?

***Trudi Wakelin:*** There are contaminants in the River Tees. What we know from the long-term dataset—and I think we need to remember that maintenance dredging activity has been taking place in the Tees for decades; this is not a new activity—and what we can see from the trend on that long-term dataset is that, overall, the position is improving. Through natural accretion of cleaner sediments that come in and overlay historical deposits, the levels that we are now finding are reducing over time.

We have also found, through more recent sampling for activity that is planned, other chemicals of concern. Dredging has been restricted, and the material has to be disposed of at licensed disposal sites on land, because it is not suitable for disposal at sea. There is that ability to take preventative action.

***Mark Rice:*** We will continue to be an active regulator in the Tees area and ensure the very highest standards of environmental protection. We will assess all future reports and respond to those as best we can, in terms of identifying sources of pollution, and taking enforcement action if we find anything.

Q64 **Rosie Duffield:** The next question is for Rachel. Modelling by CEFAS suggests that any plumes of polluted material at the dredge disposal site would be relatively confined and not large enough to cause widespread death. Was any modelling done for the distribution of sediment at the

dredging zone, as well as at the disposal site?

***Rachel Hartnell:*** There was plume sediment modelling run using the TELEMAC-2D hydrodynamic model for shallow water. There were two campaigns that were examined, which were focusing on campaigns in late September using data from the MMO. These were the models. I think they were based on the assumption that the material was around about 75% silt. They used data from tidal ellipses and from the National Oceanographic Centre. The model was run for 72 hours.

The results showed that the sediment plume would have moved down towards Redcar in a south easterly or southern direction. For the duration of the model, it would have remained in suspension. Yes, we saw the potential for that sediment plume to move down across the affected area.

Q65 **Rosie Duffield:** Jerry, local media has reported that there was some particularly intense dredging before the mass mortality event. Have you looked at whether the timings of dredging match up with the die-off of crustaceans? Also, local media have said that campaigners and fishing groups are absolutely convinced that the pyridine and the dredging were linked.As a result of this event, some fishers are saying they are going to be out of business. Have you looked at those reports in the local media, or addressed them? If you do not believe that is true, how can you reassure the fishers who we will see in a couple of panels' time?

***Jerry Hopkinson:*** It is a very fair question. When this die-off was initially reported, as a major business on Teesside—we are the largest employer in Redcar—we are hopefully a major driver of providential change in a region that is facing a profound socioeconomic challenge. We view this not simply as an SHA, statutory harbour authority, not simply as a business, but also as a significant player in the local community.

In the immediate aftermath of the die-off, we awaited scientific evidence as to precisely what had caused it. The reason why we did so was that we knew that, in terms of the dredging that we had been undertaking, we had, throughout that period and prior to it and in the aftermath of that die-off, been doing what we call maintenance dredging.

If I can just explain, we have a licence to dredge in specific areas along the River Tees to specific depths. As long as we do not stray outside those areas or go below those depths, we are licensed to remove that material. The river accretes rapidly. Consequently, we are dredging likely six days a week for quite a protracted period—probably eight to 10 hours a day, six days a week, utilising two dredges.

Q66 **Chair:** Is that material coming from the sea, or does it come from upriver?

***Jerry Hopkinson:*** Both, Chair. The material that is up river is washed down ultimately from the Pennines, and that largely comprises silt. The material that is down river is washed in from the sea, and largely comprises sand. We are essentially, and certainly in the downstream area

of the river, picking up material that we have previously picked up, I suspect many, many, many times, and redepositing it back on the dredge disposal site.

Sorry, I will now come to your question. We were clear that we were doing nothing more than our normal maintenance dredging. I went and saw the fishermen in the first instance at Hartlepool earlier this year, late spring. It was very clear to me that that community had suffered a very significant issue.

You realise any television programme is highly edited, but I expressed my real concern to the guys at that time. The chap said to me, "You brought in a super dredger. You brought in this very big super dredger and you have taken out roughly 40%, 50% of your allowed dredge volumes in the space of 10 days. We watched it. We watched this dredger at work". The dredger that we brought in was exactly the same size as the two dredgers in our own fleet. In terms of its mechanical operation, it is exactly the same. It is a trailer suction dredger. It is, in effect, a vacuum cleaner. It has a pipe that goes down to a drag head, which empties into a hopper and is pumped into that hopper as the dredger pursues a path.

Q67 **Chair:** Is that the same as each of the other two, or the same as both combined?

***Jerry Hopkinson:*** No, the same as each of the other two. For the avoidance of doubt, a similar LOA, length overall, of about 80 metres, similar beam, similar mechanical operation. The reason that we brought it in was because we had a slippage in that area of the river, and we had outage of one of the dredgers under Lloyd's inspection. I was asked by our harbour office to sanction the disposition of this dredger, and we did so. We dispelled the myth.

It is understandable that people are upset. They are looking for a cause. They are looking for something to blame. It is absolutely understandable. We dispelled the myth objectively that this was some extraordinary dredger that we had brought in. Secondly, we looked at the volumes that we had removed. We are licensed to remove the thick end of 3 million tonnes; 2.9-odd million tonnes of dredge spoil per annum, we can take out. With this dredger, we took out just short of 150,000 tonnes. We did it over a 10-day period. If we had been operating our own dredgers it would have probably taken 20 to 30 days to remove that, as we would have worked much shorter days and not a continuous period.

What we also made clear to folk was that the area in which this dredger was working was approximately 2 kilometres out into the River Tees bay. It started its operation within the arms of the River Tees—the two gears that protect the river—then went out in a straight line along the channel that ships come in. We are consented, so we are permitted by statute to dredge to a depth of 15.4 metres. We dredged along that area to a depth of 14.6 metres. How do we know that? Because, first, we monitor both

the route and therefore the boundaries of this dredger's operation throughout its activity, through our harbour office and its VTS—its vehicle tracking and control systems in there—and, secondly, we surveyed the area as soon as we could get out there after the dredger had departed.

I think the survey was undertaken about two weeks after the dredger had departed. The reason that the survey was delayed was because of the wave conditions that we were encountering out there, and there was simply the issue of getting the survey craft into position to take the appropriate soundings.

I am sorry, that is a long-winded answer to a question. I just want to make it explicit to you how concerned we are about this, and why I personally, as the chair and leader of the business, do not believe that dredging—certainly maintenance dredging—on the River Tees, which is what we have been undertaking, is causal to this.

**Rosie Duffield:** Thank you for your thorough answer. Rachel, I think you wanted to come in.

***Rachel Hartnell:*** I was going to add something about some of the pyridine modelling carried out at the time by CEFAS. I suppose this is helpful, in terms of us not really understanding how there could have been such a source of pyridine under the circumstances.

We have said before that pyridine's properties mean that it is buoyant; it floats. It is highly volatile and it is soluble. That means that it is not thought to bio-accumulate in the way that we would see with other chemicals, and it is not thought to readily absorb to sediment. That is important here. As I say, there may be other evidence that suggests that internationally the chemical agencies have got this wrong, but certainly that is the thinking at the moment.

When we looked at pyridine modelling, to see how a chemical released into the environment might act, that was done at CEFAS at the time using three modelled concentrations of pyridine in the disposal site, from 100 to 10,000 litres of the chemical. The model predicted that over 40% of the compound would evaporate from the surface of the water. The rest of it would be mixed into the water column, and the enormous dilution factors made it very difficult to understand how exposure to pyridine could be singularly causal here. We are not saying that pyridine is not toxic to marine organisms, but we are saying that it is very difficult to see how we could not, with the Environment Agency tests, have picked it up in the water if it was released at the site and dispersed along the coast, as may have happened.

**Chair:** Even at the disposal site, let alone 25 miles away?

***Rachel Hartnell:*** Yes.

Q68 **Rosie Duffield:** Just a bit more. Are all of you confident that you can rebuild relationships or trust with the fishers? We will get the chance to

ask directly in the next couple of panels, but are relations at an all-time low, or do you feel that there are conversations, and that they are at least confident that you are looking at this and listening to them, and hearing their instincts or their belief in an industry that they are absolute experts in? Obviously, you are experts in it too, in your own way, but is there any way of coming together on it?

***Jerry Hopkinson:*** I have had two long sessions with the potters, with representatives from both Hartlepool and Whitby. I absolutely get the issues that these guys have faced. I remember one of these guys, Pinkie, saying to me, "When was the last time you got paid? Because I didn't get paid last month, and I didn't get paid the month before." There is no satisfaction in listening to a man say that to you. You cannot help but question your moral compass if you are going to sit in front of people and seek to mislead them.

You are going to hear from one of the guys a little later. He is a guy called Stan Rennie. I would not say that we have got to know one another, but I would say that we have got to know the measure of one another. As relatively old guys in the industry, we both reflected that he cannot recollect anything like this happening in the 48 years that he has been potting off Hartlepool. While I have only been on Teesside for the last 15 years or thereabouts, I cannot remember a similar incident to this in my tenure on Teesside or, indeed, in my time in the port industry.

Do I believe that maintenance dredging is the cause of this? No, I do not. Do I believe that the guys encountered an issue? Yes, I do. Have we definitively identified the cause? No. What we have identified is probabilities. Do we need to be extremely cognisant of this going forward? Yes, we certainly do.

In respect of maintenance dredging, from my perspective, in terms of the governance of our business, it is absolutely imperative that we totally stick to the remit, both in terms of scope, extent and activity, that we are given under statute. It is a precious privilege, and frankly we should not abuse it. We have plans to undertake capital dredging on the river. We have a great scheme to bring liquified natural gas on to Teesside. We have a fantastic scheme to develop a deep-water container terminal in our port infrastructure. Do we need to look very, very carefully at the permits and consents? Yes, of course we do. Will we join that process? Yes, of course we will. There is absolutely no ideological or logical purpose to operating a business—and we are a successful business—that harms our environment in its operation. That would be my position on this for PD Ports.

**Chair:** Thanks Rosie. Geraint, we have covered one or two of the points that we discussed you raising.

Q69 **Geraint Davies:** I have a few points to make. Before turning to Jerry on the dredging, I would like to clear a few things up with Rachel on the science. First, can you confirm that pyridine kills crabs?

***Rachel Hartnell:*** Pyridine in certain concentrations is toxic to crustacea.

**Geraint Davies:** Exactly. You will be aware of emerging evidence from Newcastle University that in very small quantities, pyridine kills crustaceans, in particular crabs and lobsters. That is correct, isn't it, so that we are clear on this?

***Rachel Hartnell:*** I have heard, through conversations with our academic collaborators in Newcastle and elsewhere, that that is what their results—

**Geraint Davies:** All right; that is all you have found out before this inquiry, when it has been all over the media—the research that they have done and the tests. You have just said you have heard something.

***Rachel Hartnell:*** If I may, excuse me. We have had presentations from our academic colleagues on the data that they have produced so far.

**Geraint Davies:** Pyridine kills crabs, yes?

***Rachel Hartnell:*** That certainly is what is being reported. What we have not seen yet—and we are very keen to do so—are the full reports of that work. Certainly, it would be very important to have a thorough peer review of that report. We are very keen to work with the academics on the work that they are doing.

**Chair:** That has not been published yet.

Q70 **Geraint Davies:** If I can go on, Chair. Secondly, as well as pyridine killing crabs, you would confirm that pyridine dissolves very quickly on contact with oxygen and water. In other words, if it is dredged up, it disperses very quickly. As Jerry mentioned, if you were to test it two weeks later, in all probability, it would no longer be there. The killer would have gone off in the night. That is correct, isn't it?

***Rachel Hartnell:*** I am going to defer to the Environment Agency on this, if I may, but pyridine does dissolve in water and it is volatile, so, yes, it could.

Q71 **Geraint Davies:** Yes, so it does dissolve in water. I will come back to you, Jerry, in a moment, but I will pursue the scientific questions with Rachel, so that we are clear. We know pyridine is toxic to crabs; we know that if it is churned up, it disappears quickly. We also know from Newcastle University, as I understand it, that they are finding pyridine 20 centimetres below the surface of the sediment. There is concern, therefore, that as you dig deeper, there will be greater concentrations from industrial waste—from coke ovens, from which it is produced. That is true, isn't it?

***Rachel Hartnell:*** Certainly that is what has been reported so far in the work that has happened at Newcastle, yes, and I know that we will hear more about that later on.

Q72 **Geraint Davies:** Turning to Jerry on the dredging side, if crabs and

lobsters tend to walk along the bottom of the ocean, to a certain extent because they do not swim around like fish, and if pyridine is toxic to crabs and lobsters and is found at a 20-centimetre depth and then disappears, you have just testified that you have been digging on your maintenance at 15.4 metres, which is a much greater depth than 20 centimetres. Therefore, would you accept that, given you did your surveys two weeks after dredging, you could have churned up an enormous amount of toxic pyridine, killed enormous numbers of crabs and lobsters, come back two weeks later and said, "Where is it?" The answer is: it had dissolved.

***Jerry Hopkinson:*** First, my apologies. You may not have understood what I said. I said that the depth that we are consented to dredge down to in that particular area where the UKD Orca was operating was 15.4 metres. You have heard the 15.4 correctly.

**Geraint Davies:** I think you said that you did 14.6. You were consented for 15.4, and you did 14.6 metres. I am saying that at 0.2 metres, there is pyridine being identified by widespread sampling from Newcastle University.

***Jerry Hopkinson:*** I am genuinely not ducking the question. The answer is: I do not know. I know that the material that we took out we are permitted and consented to remove. Coincidentally—and it is coincidental to the completion of that dredge—we surveyed the area to ensure that the depths that we had achieved were what I am telling you. Shortly thereafter, sampling was undertaken by us, which was submitted through the MMO, of the dredge sediment areas, in line with our triannual sampling regime.

Q73 **Geraint Davies:** In that dredge sediment sampling, how much pyridine was found?

***Jerry Hopkinson:*** I would have to defer to the scientists.

Q74 **Geraint Davies:** Who is that? I am not sure who we are talking about. Mark Rice, this is above your pay grade, isn't it, this level of analysis? You just do water quality, right? I am not trying to be rude. What we want to establish is whether there are concentrations of pyridine in the dredge from coke that has been identified. As I say, Newcastle University, who are experts in this, have found it at just 20 centimetres. If there is a lot more a lot deeper, then obviously it is going to cause a lot more mass death, isn't it? Is there any further light anyone can shed on this? No.

Q75 **Chair:** Who did you submit the samples to? To MMO or to the Environment Agency?

***Jerry Hopkinson:*** The process is that the samples are gathered and tagged. There is a probity system to ensure the integrity of the samples. They go through to CEFAS or a similar governmental agency for analysis.

Those results are submitted to the MMO, and we are given the green light to continue to undertake dredging.

Q76 **Geraint Davies:** In addition to this, my understanding is that there is some sampling—maybe you can tell us a bit more about it—from the Tees itself, but there is not sampling from the licensed dumping site. It is dumped en masse and it is not being sampled there. That is true, isn't it?

***Trudi Wakelin:*** The material is tested in advance of the dredging being undertaken. We also have an annual monitoring survey, where we review a selection of licensed disposal sites around the country. We tested the inner Tees disposal site in April 2021, and we also tested the outer Tees disposal site in October 2021. The April report is now published. Again, we commissioned CEFAS to undertake that survey work for us, and there were no issues of concern raised during that. The October 2021 report is not yet published, but from the draft report that we have seen, again we have found no indications of any concern about contamination levels at the disposal site.

Q77 **Geraint Davies:** Are you saying to us that the port authorities dredged at 14.6 metres into sediment in which Newcastle University has found pyridine at 20 centimetres; you tested it; and you have not found any pyridine? Do we have that right, so that I am not confused?

***Trudi Wakelin:*** For the purposes of the marine licence application, the sample plan sets out the suite of determinands that are required to be tested, and pyridine is not one of those elements.

Q78 **Geraint Davies:** You do not test for pyridine, so it has not been tested.

***Trudi Wakelin:*** It was not tested ahead of the incident occurring. The sediment has been tested subsequent to the incident occurring, and pyridine was not found.

Q79 **Geraint Davies:** Is that because it dissolves in water and it had been churned up, do you think?

***Trudi Wakelin:*** I would have to defer to the scientists to relate the methodology to you.

Q80 **Geraint Davies:** Therefore, it might have been. Mark, do you have anything to say on that? It does dissolve. It just disappears after killing crabs.

***Mark Rice:*** As I say, we undertake routine monthly surveillance of water quality in the Tees—chemicals, nutrients, dissolved oxygen, chlorophyll and phytoplankton. We have been doing that for years, and we have found no evidence of significant levels of pyridine in the environment. That is what our water-quality monitoring programme demonstrates.

Q81 **Geraint Davies:** The worry and the issue here is that the natural environment, namely the sea, can absorb certain amounts of pyridine in a safe way to crabs. The issue here is that if a sudden bout of dredging

occurred—correct me if I am wrong, Jerry; you said that you did 150,000 tonnes in 10 days, where you would normally do it in 30 days—

***Jerry Hopkinson:*** Yes.

**Geraint Davies:** Yes, you did quite a lot all at once.

***Jerry Hopkinson:*** Twenty to 30.

**Geraint Davies:** The nature of pyridine is that it will come up and it can kill a lot of crabs, but if you do it more slowly, it will dissolve and it will not be problematic. The concern here is that the speed and depth at which the dredging was occurring was allowing a concentration of pyridine to occur that would lead to mass deaths in crabs.

Can I ask about the specific method of dredging? In particular, do you use what is called remediation dredging, which they use in Belgium? You described something akin to it; you said it is a sort of vacuum cleaner attempt to dredge up a material that then is not allowed to dissipate. Do you also use metal fencing—the so-called curtain approach, with sheet-pile walls? The ideas is that you would have walls, and then you would have suction, and you would minimise the prospect of contamination and leakage of pyridine in particular. Do you use those methods? If not, why not?

***Jerry Hopkinson:*** No, we do not use a method of containment around the drag head. Our view is that the amount of disturbance that this causes, in terms of the drag head across the seabed, is minimal. I am certainly more than happy to look at any containment mechanisms but, having talked to colleagues internally about this, they are satisfied that our methodology is in accord with good practice.

Q82 **Geraint Davies:** Finally, the dredged material that you dredge up, which has pyridine in it—is that all put on land, or is some of that simply dumped in the sea?

***Jerry Hopkinson:*** No, the material that we are dredging up in terms of maintenance dredging goes to an offshore disposal site, which is the one mentioned by Trudi.

Can I just make one other comment, please, in answer to your suggestion that this intense operation, which replaced an activity that probably would have taken 20 to 30 days for us to undertake, was somehow causal to this? While I would not suggest to the Committee that we are bringing in a dredger to supplant the operation of our own dredgers on a regular basis, it is by no means an irregular activity to bring in dredge support to undertake dredging where we have had significant slippage in the river channels into the River Tees.

I can supply the Committee with further information with regard to precisely when we have done this in the past. I would ask you to reflect on my earlier assertion that, in my 48 years undertaking maintenance

dredging in accord with the methodology that I have described—without the added sophistication that you have alluded to, but in accord with what we believe to be good practice—we have not had an issue like this on the River Tees. That is why I continue to assert that the maintenance dredging operation on the River Tees has not been causal to this incident. It is coincidental that the dredger arrived at a time when these crustacean mortalities occurred, but frankly I think that we are looking in the wrong direction.

Q83 **Geraint Davies:** So that I am clear here, you do accept that pyridine is toxic to crustaceans, that there is pyridine in the sediment, that it was quickly churned up, and that it dissipates? Are you asserting here that there is no relationship between the dredging up of pyridine and the death of crabs, on the basis that crabs did not die before, so they cannot be dying now?

***Jerry Hopkinson:*** I am asserting that, in terms of the maintenance dredging that we are undertaking, we have done nothing different from what we have been doing for the last 40 to 50 years on the River Tees without these issues occurring.

Q84 **Geraint Davies:** Sorry, I am a bit confused. I thought you said that you did 30 days of work in 10 days—150,000 tonnes. That is different, isn't it? I am asserting that because pyridine dissipates, if that concentration of work generated an extra concentration of pyridine, that might have tipped it over into a mass-death situation. Something that you were doing differently could explain that. That is true. I know you are saying that it could not, but that is true, isn't it?

***Jerry Hopkinson:*** I am not going to say, "No, it could not." This type of relatively intense dredging was not a one-off occurrence. We will have done this many times over the last 40 or 50 years. The issues that we have encountered, in terms of the mortality of crustaceans, have not previously been experienced.

Q85 **Geraint Davies:** In light of what has happened, do you think that there is a case for a precautionary principle from you, namely for doing slower dredging, and for having more mitigation—steel shields or whatever—and using remediation dredging? I know you said that you had looked at it before, but in light of what has happened and the emerging science, do you think that it would be reasonable, from a precautionary point of view, to now do things a bit more slowly and take a more proactive precautionary approach?

***Jerry Hopkinson:*** I think that we are extremely proactive as an organisation. With great respect, I don't think the Committee should form a view that this is an organisation that does not care about the environment, does not care about the impact that our activities have on people, and does not constantly review the operating methodology that we are following. Can I just illustrate that?

**Geraint Davies:** I am sure you do care. I am suggesting that you should

do more in light of what has happened.

***Jerry Hopkinson:*** Thank you. Can I give you an illustration of that, which is a piece of best practice that we have adopted in the past few years?

**Geraint Davies:** We are probably running short of time. I am sure there is lots; I am just wondering if you could do a bit more best practice in these things that I have just mentioned in light of what has happened.

***Jerry Hopkinson:*** Sure, we will continue to—

Q86 **Geraint Davies:** Finally, because the Chair will tell me to shut up in a minute, can I ask Rachel a question? There has been a theory put forward that this is an algae bloom killing crustaceans. I accept that algae bloom does cause the death of crustaceans. What has also been said is that a sufficient reason for the deaths could be pyridine. Assuming both of those were true, if there was a conjunction of those two impacts at the same time, would that help explain the level of death that we have seen?

***Rachel Hartnell:*** It is difficult to say. I would draw attention to the huge spatial extent of the impacted area, which is interesting in terms of the pyridine hypothesis, as is the duration over which this very regrettable incident appeared to take place. It was probably over two months plus that we saw animals dying. We do not have evidence of a point source of pyridine that was identifiable in the environment from the EA's testing. We know the chemical properties of pyridine from the European Chemicals Agency; I will not repeat them now. If pyridine is in the environment at levels that could be toxic to animals—recognising that it is not thought to bio-accumulate, so the crabs would have to be almost actively seeking it out—it is difficult for it to persist for long enough over a wide enough spatial extent to be plausibly linked to the incident.

Q87 **Geraint Davies:** We are not talking about persistence here. We are talking about an explosion of pyridine through dredging. It suddenly gets into the ecosystem, into crabs and lobsters, which then die. We are not talking about a complexity here. That is possible, isn't it—in fact, very probable?

***Rachel Hartnell:*** I do not have evidence to suggest that it is not possible, no.

**Geraint Davies:** You do not have evidence that it is not possible. I will leave it there. Case closed.

Q88 **Chair:** On concentration, given that pyridine dissolves, as we have heard, if pyridine were killing crabs 25 miles down the coast, what were the concentration levels likely to be at the dumping point of the dredged material, the dilution?

***Rachel Hartnell:*** I would have to get back to you with a modelled number, but they would have been very high.

***Mark Rice:*** It is worth pointing out that we will be doing additional water-quality sampling around the proposed dredge areas between October and December this year, so we will have a better picture of additional monitoring in response to what has happened.

**Geraint Davies:** Sorry, but isn't it the problem that pyridine just sort of leaves the scene of the crime? This is the point about it, isn't it? If you do your monitoring now of what happened months ago, obviously it will not be there anymore. The issue is what the concentration was at the time of deep dredging on an enormous scale that tipped the balance, in terms of the life expectancy of the concentration. I will leave it there, Chair.

**Chair:** Thank you. This is the last section with this panel.

Q89 **Ian Byrne:** I want to pick up on something Jerry mentioned about the economic driving factors behind the freeport. I have been on this Committee since 2019, since I got elected, and I have never had so many e-mails from the north-east—the region of concern on this topic. In a lot of the e-mails, the writer feels that the economic and political capital invested in the freeport agenda by certain leaders means that the environmental impact is now a secondary consideration to the rolling out of this project. Is that a fair analysis?

***Jerry Hopkinson:*** I have read very similar articles, Ian, and I have reflected on this quite a lot. I am answering your question as a layperson. I am not a politician. I am an apolitical guy running a business. I know how important the levelling-up agenda has been to people living in the north-east, irrespective of which side of the political divide you sit on. I know the levels of expectation on Teesside have been enormous. I know that the freeport has been projected as a panacea in many ways. You may know that I have gone on both national and local media to say that the evolution of a freeport on Teesside is definitely no silver bullet for the region.

As for the suggestion that some kind of collusion has taken place to suppress this issue, on the basis that it could be damaging to a Government agenda, with great respect to my professional colleagues sitting here, that does huge injustice to a lot of very earnest scientists and environmental specialists.

Q90 **Ian Byrne:** There has been a shutting down of evidence. The next panel will be coming along. When they say, in their learned manner, what their research is, it is shut down. People are looking at that as purely political. That is not a good place to be, because if there is evidence, it needs to be accepted. Regardless of where you are with the freeport agenda, we have to protect the environment. I am not casting aspersions on the panel. I am just saying that in my e-mails, there are lots and lots of people who believe that it is this agenda and nothing else matters.

***Jerry Hopkinson:*** Yes, but, Ian, common sense leads me to question this. Bear in mind the whistleblowing policies across the Civil Service and

across a business like mine; in my business, there is direct recourse to my owner in Canada. If people feel that they are being coerced or doing something wrong—

**Ian Byrne:** They would come out and say it?

***Jerry Hopkinson:*** They do. I think so.

Q91 **Ian Byrne:** Thanks very much for that answer. Trudi, how can we be sure that future capital dredging works, particularly for the new freeport on the south bank at Teesside, are safe? For people watching, they have probably been blinded by science in the last hour. What is the difference between maintenance and capital dredging?

***Trudi Wakelin:*** First it is important to remember that the dredging that was undertaken at the time of this incident was maintenance dredging that was not connected to the freeport development. The freeport development was only consented to subsequent to that incident. It is also important to remember that the Marine Management Organisation is a non-departmental body specifically set up to ensure independence around the regulation for marine development.

To go back to Ms Duffield's question relating to relationships, the Marine Management Organisation also has a role as England's fisheries manager. We work day in, day out managing the activities of fishermen and it is of absolute imperative urgency to us that we understand what has taken place here—indeed, as it is for the whole of the DEFRA group—which is why the investigation was set up and why everybody has worked so hard and so collaboratively to try to understand what is happening here. We all have a role in protecting the marine environment.

On the difference between maintenance and capital dredging, to put it simply—because I am not a scientist; I am an engineer by background—in the approaches to a port through the navigable channel, or indeed the berths within a port, there is an accepted depth that needs to be maintained for safe navigation. There must be under-keel clearance, so that, at all states of the tide, vessels can access the port.

As the term "maintenance" implies, that level is set. Because of the natural accretion that takes place, both from upriver sources and the sea, those berths—which tend to be slightly deeper than the surrounding area, the berth pockets—need to be regularly maintenance dredged in order to ensure that that depth is maintained. That tends to be the cleaner deposit material that is coming in; the underlying bed is not impacted or affected.

As for capital dredging, there are two definitions that we use. It is any dredging that has not been undertaken in the last 10 years, and so cannot be claimed to be routine; and any dredging that increases the overall depth of the approach channel or of the berth pocket. The regulation that is in place to look at capital dredging, therefore, is more

thorough. We would look very carefully again at what likely determinands might be required to be sampled, given the historic nature of potential contamination from industries that might have taken place. That would influence the sample plan that the applicant would need to submit and comply with in order for us to be reassured that that material would not be harmful and could be disposed of to licensed disposal facilities at sea.

As I mentioned, the OSPAR Convention is the oversight body that looks at material disposed of at sea for the whole of the North Atlantic and the signatories to it. The UK is a signatory to that; accordingly, we have to be compliant and consistent with regulation that is imposed. We also have to provide returns to OSPAR on a six-monthly basis that set out what has been done, where and in what volumes, so that that data can be collected.

As part of the sampling process, if any material or any of the samples that are taken exceed what are termed action levels, that prompts further consideration. There are two action levels that are used, not for the full suite of determinands. The first one is action level 1: "This is of concern; we need to consider whether or not it is appropriate in the local environment". That is where some of the site-specific consideration comes in.

Action level 2 would be, "This is too high. It cannot be permitted to go to sea". That does not mean that it cannot be dredged, but in those circumstances, refusal to dispose of the material at sea results in the need for the material to be taken and disposed of at a licensed disposal facility onshore, which then moves into the terrestrial regulatory regime. That is what is happening at the moment with material that is being dredged.

Q92 **Ian Byrne:** That sounds very comprehensive and exceedingly professional, but we have heard in the last hour and a half undcertainty about what the causes of this could be. You touched on the fact that you had not tested for pyridine, and now you do. Is what is happening here making you review what you are reviewing and what you are testing for? I am worried that nobody knows here what has happened. We will have another panel saying a different thing in a minute, and it has been debunked by Rachel to a degree. My worry is: can we definitively say, with all the uncertainty, that capital dredging is safe in that area?

***Trudi Wakelin:*** With the best available evidence that we currently have, my answer is: yes, it is safe in that area. However, as we have said, we continue to follow up on these lines of inquiry that have been exposed through the work that has been done to date. We are very happy to collaborate on the work being undertaken by the academics, and to share the data that we all hold, so that we can determine whether changes are required, whether to the regulatory framework, the protection, or the action levels required.

Q93 **Ian Byrne:** That is a partial answer, I suppose. You touched on this:

there are lots of concerns about dredged material from the south bank escaping back into the Tees. What controls are you putting in place to prevent this, and how will this material be disposed of in the future? Again, there is uncertainty about what is in that material and what it could potentially do to the marine environment, which you have already said it is your priority to protect. How are we going to ensure that that happens?

***Trudi Wakelin:*** There are a number of licensing conditions that are applied to the consent that has been granted to the applicants. As I have said, they control the volume and the location of disposal, where material can be dredged from for disposal at sea, and where it cannot. Our compliance and enforcement local staff monitor the dredging to ensure compliance with those conditions.

Q94 **Ian Byrne:** is that in real time? Obviously, Geraint's line of questioning was about the instantaneous disappearance. Are we ensuring, with this uncertainty about how long pyridine stays within the water, that we are actually monitoring it?

***Trudi Wakelin:*** For the incident that occurred last year, as part of the DEFRA-led investigation, we reviewed the activity that had been undertaken in order to ensure compliance retrospectively. In the current works, we are working very closely with the contractors so that we know what they are doing and when they are doing it. They are supporting us with the monitoring that we are undertaking, and we are inspecting both the dredging activity and the disposal activity.

**Ian Byrne:** This is for dredging now, is it?

***Trudi Wakelin:*** Yes.

Q95 **Ian Byrne:** It has been a long session. Jerry, as regards the uncertainty, we know that there are councils that have called for a halt to the capital dredging until we get more evidence and until we get a clear understanding of what has happened. Should a ban on dredging be put in place until we have absolute certainty of what has happened? I mean capital dredging. What are your thoughts on that, Jerry?

***Jerry Hopkinson:*** As Trudi has said, there are processes that these guys are being statutorily forced to follow, in respect of the grab of the material in an enclosed bucket, the movement of the material on to land, and the disposal on land. They also have to stick within the curtilage of the dredge area. As long as they are following those rigorously—I have absolutely no reason to suggest that they are not—I think is questionable. We need a very definitive view as to why it should be stopped. The crustacean die-off did not occur when these guys were undertaking dredging on south bank. There was no dredging activity taking place at that time.

Q96 **Ian Byrne:** When did that start?

***Jerry Hopkinson:*** A couple of months ago.

**Ian Byrne:** September?

***Jerry Hopkinson:*** Yes, it would be about then.

Q97 **Ian Byrne:** So we are still assessing any impacts?

***Jerry Hopkinson:*** Yes.

Q98 **Ian Byrne:** To finish, what do you see as the main weakness in the dredging arguments that we should put to the next panel? Is there anything that you want me to bring forward to the next panel? That is probably for Trudi and Jerry to finish. If there are not, that is fine.

***Trudi Wakelin:*** No, nothing from me, thank you.

***Jerry Hopkinson:*** I have already told the Committee the historical nature of this, and set out the continuity of the activity that we are undertaking. I realise that I could not give examples of the improvements that we have made, but they are improvements.

**Ian Byrne:** You can put that in writing, Jerry.

***Jerry Hopkinson:*** I can do, by all means. Thank you very much.

**Geraint Davies:** Can I ask one very short question?

**Chair:** We are up against time, because we have overrun by about half an hour already. If it is a short yes-no question.

Q99 **Geraint Davies:** It is a factual question. Jerry, you say the history of dredging has not caused problems. As we move towards the freeport, is the dredging activity going to increase significantly and therefore, in my mind, increase the risk?

***Jerry Hopkinson:*** You ask a great question. The short answer to that is that there will be a peak in the activity that is ongoing at the moment, which is the capital dredging that Trudi has alluded to. Once that capital dredging is undertaken, then we are into maintenance dredging to maintain the navigable channels into and out of the freeport. I think that there could be a minor increase in terms of volumetric amount withdrawn annually. If you asked me to make a guess, I would say circa 100,000 tonnes of material, which is a big number, but it is set within the context of 3 million tonnes.

**Geraint Davies:** Increase?

***Jerry Hopkinson:*** Yes. Depending on how successful this is, if the freeport, in particular in terms of the offshore wind sector that south bank is focused on, can get some of these big contracts, there could be an increase. These vessels are fairly big and often can be quite deep in terms of the draught. However, this will not be a seismic shift in the

volumes that we would anticipate having to dredge. Does that answer your question?

**Geraint Davies:** Yes.

Q100 **Chair:** Are there any final points any member of the panel wants to make before we finish this session?

***Rachel Hartnell:*** Thank you so much for all your time this afternoon. I want to add one last thing on pyridine, which is being now spoken about as the cause here. We talked at the very beginning about the uncertainty of the test results and, Dr Hudson, you indicated the small sample sizes of the animals that were tested at the Environment Agency initially. I would like to say again that, even with the uncertainty of the test method, pyridine was found, within the range of affected animals, in animals from outside of the site. It is curious that we were able to find evidence of pyridine in animals that were apparently unaffected and a very long way away from the Tees. I just wanted to draw the panel's attention to that.

**Chair:** Understood. Thank you for putting that on the record. I thank the panel. This has taken longer than we anticipated, but that is no bad thing, It involves my constituents in Whitby, and it is important that we test the evidence and get as much information as possible. Thank you very much indeed.

## Examination of witnesses

Witnesses: Dr Gary Caldwell, Dr Rodney Forster and Tim Deere Jones.

Q101 **Chair:** Welcome to our second panel. We have two witnesses here in person and one online. Mr Deere-Jones, can I check that you can hear us and we can hear you?

***Tim Deere-Jones:*** Yes, I can hear you. Can you hear me?

**Chair:** We can. Wonderful. Can I ask our witnesses to introduce themselves and say what their role is in this matter, maybe starting with Mr Deere-Jones, who has already spoken briefly?

***Tim Deere-Jones:*** Hello. Nice to meet you all, Committee members. I am a marine pollution consultant. I sent a CV, of sorts.

Q102 **Chair:** Yes. We are broadcasting this and not everybody watching will have read the CV.

***Tim Deere-Jones:*** I have been working as a marine pollution consultant since the 1980s. I trained at Cardiff University, where I did a modular degree in maritime sciences, which was aimed at producing managers of

marine pollution incidents. I am not a biological chemist or a chemical analyst but I will admit to being a generalist. I was taught research methods as part of my degree course, and there I am. I have a long history of working in the marine environment on pollution issues and a number of dredging issues to boot.

Joe Redfern of the Whitby Commercial Fishing Association contacted me in the autumn of 2021 on the basis of having read a document of mine that was lodged in one of the local libraries, where I had done a review of the available data on Tees pollution back in 2007, at which stage it was recognised as possibly the most polluted estuary in England. That is me.

**Chair:** We will come on to that during the evidence, I am sure. Thanks for that introduction.

***Dr Caldwell:*** Good afternoon. Thank you for the opportunity to speak to you today. My name is Dr Gary Caldwell; I am a senior lecturer in applied marine biology at Newcastle University, where I have been working for the last 18 years. To put my credentials on the table, my specialisms are in marine ecotoxicology, marine poisons and venoms, and naturally occurring toxins. I have a long history of working in the marine systems, and in understanding the nature and risk of toxicity that human activities pose to it.

**Chair:** I am a science alumnus of Newcastle University, so you are doubly welcome.

***Dr Forster:*** Thank you to the Committee for inviting me to give evidence. Rodney Forster, director of the Hull Marine Laboratory at the University of Hull. My role in this inter-university co-operation, which also includes the universities of York and Durham, who could not be with us, is looking at the algal bloom hypothesis and reworking and looking back at the original images. That is one part of the work. Another is that, with a little bit of funding from the Fishmongers' Company, we will start fieldwork this year in 2022 out in the North Sea to try to increase our understanding of the north-east coastal system.

Q103 **Chair:** Thanks very much. If you agree with the evidence that one of your colleagues has given in this session, do not be frightened to say, "I agree with him" and move on.

We heard in the first session that the joint investigation led by DEFRA concluded that an algal bloom was the likely cause. Do you accept that an algal bloom may have played a role? If so, how central a role? Dr Forster might be the best person to start with.

***Dr Forster:*** Yes and no. Some of my work supports those ideas and some of it contradicts it. First I should say that the number one cause of shellfish mortality events globally is generally algal blooms—red tides—often associated with low-oxygen events, but also with direct toxicity.

That is probably the main cause, and that is an indication that we should be looking in this direction.

Where I came into the investigation, we saw the first draft of the report from CEFAS and the Environment Agency around about March or April of this year. The first thing that I noticed was that they had a map of chlorophyll concentrations from September last year.

Q104 **Chair:** Was this the Plymouth University satellite image?

***Dr Forster:*** Plymouth was mentioned. I think that came in later on. I looked at the satellite images, and the chlorophyll concentrations were in my view higher than I would expect on the north-east coast. The other thing was that the period just before the event, up until 6 October, was very cloudy, so the satellite image database is not very good. Bear that in mind. It is not a comprehensive view of what has happened. We need clear skies to see the sea surface.

**Chair:** It is sometimes difficult with these images; when somebody has drawn a line around it, it is hard to tell if it is definitively as clear as is suggested by the line.

***Dr Forster:*** I have gone back to the same information, which is from the Sentinel-3 satellite; it is a European satellite, very high quality and reliable. I have worked with it for quite a long time, and it is the best of the Plymouth and the CEFAS work as well.

Through the month of August 2021, we have a very settled situation. It was quite a warm month with very, very low chlorophyll, no sign of any blooms, and I am looking down the north-east coast from about Lindisfarne, Holy Island, south to Scarborough. That is the zone that I am calling the north-east coast. There is no indication of any algal blooms in the first week of September.

When we get into the middle of September, there are starts of indications of blooms developing, particularly in the south of the Tees area. In the third week in September there is a distinguishable bloom, not at very high concentrations—not the levels that we talked about, of 15 micrograms per litre. It was probably something up to about 3 or 4 micrograms of chlorophyll, but definite enough to be a bloom of something two weeks before the event. After that it starts to get quite cloudy. There is a major storm on 6 October that brings the material to the shore. That is the reason for the wash-up events, which most of us are quite used to working with. I should say something about wash-ups in general later on, because I did not think much of this, because wash-ups are quite common.

Even after that, there was a lot of sediment in the water. You have heard that sediment and chlorophyll in the water compete optically, so it gets more difficult to pick up the situation into October; there are not so many satellite images. However, I am quite confident that throughout

September we have enough. I do weekly averaging of the available satellite scenes, and you can see the development of a small bloom.

Q105 **Chair:** The evidence indicates there was a bloom, and it could have crashed, and the dead algae could have sunk to the bottom?

***Dr Forster:*** That is normally what happens. Where I disagree is that it was a large Karenia bloom; I do not think it was. I provided, years ago, some of the field data that feeds into Peter Miller at PML. He is the one who developed the Karenia algorithm on the North Sea. Karenia blooms are quite spectacular events. They dominate, for instance, the western part of the English Channel. In summertime, you get large Karenia blooms easily detectable from space. They are common down the north-east coast in England, particularly in August. Off the Scottish coast, they occur from Aberdeen down to the border. They are quite noticeable events. There is not one off the Tees in September; I am quite sure about that. The chlorophyll levels—well, there might be, but it is not a big bloom.

**Chair:** Thank you. Dr Caldwell.

***Dr Caldwell:*** Am I answering the same question on the algal bloom?

Q106 **Chair:** Do you think the algal bloom could have been associated with the mass shellfish mortality?

***Dr Caldwell:*** As my colleague was saying, algal blooms are a natural part of the rhythm of the seas at that time of year. It is very common in our temperate seas that you will have large blooms in the springtime and a smaller secondary bloom in the autumn. What we are seeing here in terms of the presence of blooms is entirely expected in the normal pattern of the behaviour of life in the sea.

At no point has anyone contested the fact that there was evidence suggesting there was a bloom there. Definitely not; the evidence is clear. There was certainly evidence of a bloom there, but that is pretty much all that can be said about the nature of the bloom. There is evidence that a bloom was there. As CEFAS said earlier, there were no cell counts and there is an awful lot of inference, and I would be very cautious about making definitive conclusions based upon inference.

The North Sea system is categorically a stressed system. There are many stressors acting upon it, among them algal blooms, variable oxygen levels and changes in temperature. That is compounded by additional stressors brought about by human activities, whether it is discharge of sewage or potential pollution caused through dredging.

All these systems have a certain level of tolerance to them. With anything in life, if you exceed the tolerance of a system, it will break. What we are seeing here is an event that occurred in the autumn of 2021 that caused that system's tolerance to break, and not just break but break spectacularly. We have seen with our own eyes and from all the evidence

that it was the last crustaceans—the decapods, the crabs, the lobsters—that were disproportionately affected by this event. That in and of itself is more than just a curio; that warrants investigation.

At this point do you mind if I bridge on to where I think a gap was missed in the investigation?

**Chair:** We are going to move on to pyridine after, if that is what you are going to talk about.

***Dr Caldwell:*** We will move on to that. To continue on your question, the previous panel put various points that there were toxic algae toxins present in the crabs, and there are, but here I am reading CEFAS's own report. Its conclusion is: "Overall, there was no clear indications of marine neurotoxins being present in the samples received at the levels that would cause concern."

Q107 **Chair:** The evidence we got talked about the asphyxiation of the crabs and lobsters because of the breakdown of the algae, rather than them being toxic algae. Am I correct in saying that that is the evidence that they gave us?

***Dr Caldwell:*** Not necessarily. The thing is, if it was predominantly down to deoxygenation, it would not just be the crabs we would be seeing; we would be seeing more or less a complete sterilisation of the benthic form in that system.

You have to ask yourself why it is predominantly crabs and lobsters washing up. If it was a mass deoxygenation event, that entire system would be killed. Looking objectively at the picture, it just does not stack up. As I said, this is a complex situation. The North Sea is a very stressed system, there are many things putting stress on organisms and all it takes is one event. Now hopefully this Committee will help us to understand what the nature of that one major event is.

Q108 **Chair:** Dr Forster was nodding his head when I suggested it could be an asphyxiation effect—were you?

***Dr Forster:*** I think it needs looking at seriously, and we are short of evidence on that matter. It is quite interesting that the CEFAS modelling is going down that route.

We do not have any in situ evidence of oxygen levels, either surface or benthos, in that part of the world and we need those kinds of measurements. 2021 and 2022 were exceptionally warm, settled summers. In 2022, that broke up earlier. The first storm event was in September this year, but last year, it was quite late. It is quite conceivable, and from our measurement we have certainly shown, that in the north-east coastal system, there is a stratification of the water. There is a warm surface layer and a cold pool below, which effectively is cut off from the surface. We need to find out more about that. There was a study in 2018 from the marine station in Blyth with a glider; an

underwater robot set off from shore from there. That studies the oxygen in some detail going off to the Dogger Bank and back. Some work I have been involved with further out shows oxygen levels can get quite low below the thermocline, but at this stage in our part of the world it is just speculation. It could quite easily be something interesting.

As for avoidance, herring would avoid areas with oxygen lower than about a 25% concentration. They would simply swim away. Crabs and lobsters are less mobile; they would not be able to escape, and because they are larger animals, with a higher oxygen demand, they might be in the first line of attack and more likely to turn up in a wash-up event. What did not get hit by this event is quite interesting.

The anecdotal evidence about birds is also interesting, less so from the oxygen point of view, but there is potentially a link to harmful algae. I was out of Staithes about mid-September last year, and there were dead guillemots and razorbills everywhere belly up. That was before bird flu reached the area. I am not quite sure if there was a proper investigation into that. Most people thought they had come down the coast from further north, but I have never seen so many dead birds, and that would be around about the origin of this event, about that time.

Q109 **Chair:** Understood. Mr Deere Jones, we will move on to your pyridine data later, but your report states that there is an lack of empirical evidence to support the Government's algal bloom theory. However, the Government did find traces of biotoxins in crab tissue that are associated with algal blooms. Does this, along with satellite imagery and water sampling, not suggest that an algal bloom potentially had an impact, or have you ruled that out completely?

***Tim Deere Jones:*** I was producing the initial reports up until June; they were subsequently superseded by the brilliant work that colleagues on the desk on front you have carried out. The algal bloom hypothesis came to me after I had pointed out the pyridine issue. It seemed like, "Okay, we will have a look at this." Initially, it was based, as far as I could see, on the satellite imagery. I queried the satellite imagery because I was sent photographs on a page that had been despatched to CEFAS by Plymouth Marine Laboratory. They had the images and they had a few statements. Among the statements put there by Plymouth Marine Laboratory was the fact that the satellite imagery could not define any specific algal species. It could have been any algae, benign or toxic, as far as Plymouth Marine Laboratory were concerned at that stage.

I did additional research into satellite imagery and discovered that also, particularly in the US and Australia, it has been remarked that satellite imagery may mistake the chlorophyll-type images for surface suspended sedimentary material, because a lot of the common analytical techniques applied to satellite imagery needed tweaking and enhancing in order to be able to confirm whether or not sediment was present in that imagery. I put that in a report to the Commercial Fisherman's Association, which I believe made DEFRA aware of that first report in which that was

mentioned. I had asked or suggested that those enhanced analytical techniques be applied to the satellite imagery in the context that the satellite imagery was contemporary or nearly contemporary with dredging activity.

As I am fully aware, both dredge dumping and dredging activity are likely to create plumes of fine sedimentary material that can rise to the surface and remain suspended for extended periods. The data I have indicates that such blooms may extend, particularly in terms of the fine sediment material, for at least 20 kilometres downstream. I questioned that hypothesis and never got the further responses that I was hoping to get—that is, that additional enhanced research into the imagery was produced and carried out.

**Chair:** Thank you very much. I will move on to Ian Byrne, who will talk about pyridine, which we have already mentioned.

Q110 **Ian Byrne:** I will direct this to Dr Caldwell. Why did your report identify pyridine as a more likely cause of the mass crustacean deaths than an algal bloom?

***Dr Caldwell:*** Let me first put in context why we came into this study, because I think it is important that the Committee understands why I got involved in it.

Whenever I looked at the joint report conclusions from the agencies, it did not make sense that pyridine was dismissed offhand and wasn't explored any further. If I give you an analogy, it is like if your car breaks down and you take your car to your trusted mechanic who you have faith in. Your mechanic sees there is a warning light for low tyre pressure, concludes you have a puncture and then chooses to ignore the steam and oil pouring out of your engine.

Where you have such a significant outlier in terms of a chemical showing up in testing, as a minimum you have to go in with an open mind and say, "Right, I am simply going to look at this to rule it out. Can we clear this from the investigation? If we can, wonderful! We can move on." That wasn't done here, and that is the reason why I got involved. From a purely pragmatic, scientific perspective, that would be the first thing you should do. If you see something, any kind of anomaly, any kind of outlier, you must question it. It wasn't questioned.

Second, it does not take any longer than a five-minute search of the scientific literature, even if you are not aware of the nature of pyridine, to think, "This is not something that can be dismissed without looking into it," because it is a well-known toxin. That is the rationale of why I got involved in this study.

The simple question that my laboratory asked is: can we find out whether pyridine is toxic to crabs or not? That was our very simple starting position. Our hope was that we would find it was not toxic, and that would be great; we could conclude that, and then other sources of stress

in the system could be found. However, when we undertook our rigorous scientific work that was done to international accredited standards, we found that pyridine was not just toxic, but exceptionally toxic to crabs in two different ways, which I will come on to.

Seeing the very powerful nature of the activity of pyridine on crabs triggered us to follow a process that we call STOP, source to outcome pathway, which is an innovative form of risk assessment that we are quite familiar with in our ongoing work in Norway. We decided to apply that approach to this example.

In these STOP pathways, you need to try to find out where the likely source of the contaminant in your environment is coming from. You then need to understand whether the source is resident or transitionary. What mechanism will turn that toxin and make it available to the organism? What mechanism will allow the organism to interact with that toxin? Does it accumulate? Is it another mechanism? How does that toxicity express itself in term of the crab? From there, you can extrapolate to population level effects.

Before we get on to the source, you need to understand the nature of the toxicity because it is quite striking. We used standard approaches in ecotoxicology. We exposed crabs that we collected outside the impacted area to pyridine of very carefully defined concentrations along a concentration range. We do this to generate what is called a dose response curve. That is a standard protocol in ecotoxicology that allows us to generate valid toxicity data.

Q111 **Chair:** Is that like the LD50?

***Dr Caldwell:*** Exactly. We followed the standard protocols and we assessed all the way down from 100 milligrams per litre to controls and respective steps in between. That allowed us to generate LD50, LD30 and LD10 values. We monitored that over the course of 24, 48 and 72 hours.

We were taken aback when we did these experiment; we were very much caught by surprise. We were not expecting pyridine to be as toxic as quickly as we saw, to the extent that we saw crabs die within a matter of hours. You need to understand the nature of how these crabs expressed their toxicity, and how that relates to the reports of dead and moribund crabs and lobsters in the field. Whenever they are exposed to pyridine, first of all, depending on concentration, at the higher end of the concentration, they go into very rapid, aggressive, violent convulsions, to the extent that the best way to describe it is the crabs were doing somersaults in the tank. That lasted for anything up to five or six minutes, whereupon the majority of crabs would come to rest on their back. Then they would enter into a phase of paralysis that lasted anything from 20 to 30 minutes, and that paralysis was progressive.

After that period, once paralysis had set in, we could see the crabs were still alive; we could still monitor the movement of their mouth

appendages, but they were all dying within the space of six hours. The nature of that response reduced, as you would expect, as the concentration went down, but we were still seeing paralysis and death even at concentrations of 20 milligrams per litre. At really low concentrations, 2 milligrams per litre, at which you would not think you would see any effect, the crabs were surviving the three days, but when you handled them, it was as if they were anesthetised. You would never put your hand into a tank with a crab without being very careful about what you were doing.

When crabs were exposed to 2 milligrams per litre, it is as if they were drugged. They were placid and pliable. You could pick them up and handle them without any threat to your safety. That is the smallest concentration we tested.

We looked beyond simply the behavioural and the survival data, because that is not enough for us. We wanted to know what was happening inside the tissues. We did that by sampling the gill, the hepatopancreas and the muscle. If I was going to see something, I would have expected to see signals in the gills and hepatopancreas. We were monitoring for signals of cellular stress, a group of chemicals called reactive oxygen species. They are a very natural part of every cell, but under stress, cells produce an awful lot of them, and they cause a great deal of damage. They will attack DNA and proteins; they will damage cell membranes. They are not something you want around in any cell. That is why we take in antioxidants. The job of antioxidants is to mop up those reactive oxygen species before they do harm.

I thought we would see a very strong signal in terms of ROS because we have very sensitive measures in the gills and the hepatopancreas versus the control. I was deeply surprised that we did not see any change in ROS levels in those two organs. However, in the muscle tissue, we saw striking change—I mean changes of an order of magnitude. We measured two types of ROS. We measured one called the cellular ROS, which is all the reactive oxygen species put in the cell, and that was a five-fold increase. Then we specifically measured the ROS produced in the mitochondria, which is the power station of the cell. That increased by 20-fold. It is almost off the charts. When you watch those crabs in the tank, they then tend to drop off their legs and their claws. That all coincides with this incredibly powerful stress signal in the muscles that is causing them to drop their limbs.

Therefore, you are looking at that range of toxicity from the paralysis. You look at the convulsions. You look at it from the mortality. You look at it from the cellular stress, and you start to put together a picture of what might be happening here.

At this point, I need to get a little bit more academic with you. I will try to keep it simple to understand. Faced with these kinds of data, given the low concentrations of pyridine and the fact that the chemistry of the

pyridine says it should not accumulate—I agree with CEFAS that it absolutely should not bio-accumulate—whey were we seeing the effects that we were? It took me a while for the penny to drop, but then the penny did drop because it reminded me of something that I teach my own students when I teach them about marine toxins and marine biotoxins. There is a family of toxins produced by a group of marine worms, called the bootlace worms or nemerteans. To you and me they are no great thing. You have to be a marine biologist and spend a lot of time on the shore to see these things, but they are there. They are both prey and predator of crabs, so they have to both protect themselves and have weapons in their arsenal to take down a crab. They do that through chemical warfare. They do that through producing compounds.

The interesting thing here is that some of the most potent compounds they produce are pyridine alkaloids, pyridine derivatives. They will pump those into their mucus, so if a crab comes along and grabs the worm, simply by touching the mucus, the crab knows it is dealing with toxins, and it will abandon the worm. That worm can then go around, attack the crab, inject venom and then, once it has done that, what are the symptoms? You have paralysis. You have convulsions. You have death. In fact, when these first venoms were discovered, if you go back to the early French literature, it was initially described as the crab convulsant factor.

What we are seeing in the lab is starting to make sense, as is what has been reported by fishers and by members of the public whenever they have seen moribund crabs wash up. The behaviour and presentation of the toxicity all matches. That does not address the question posed by CEFAS that it does not bio-accumulate. If it does not bio-accumulate, how can you see those features taking place?

I have to say here that I am grateful to one of the CEFAS colleagues working alongside me—one is a toxicologist—helping us bottom out the actual mechanism for this.

The reason why such low concentrations of pyridine and pyridine derivatives can enact such powerful mechanisms on crabs is because crabs have on their legs, outside their body, receptors that have been finely tuned over millions of years to detect pyridine and pyridine analogues. Therefore, it does not need to bio-accumulate. There simply only has to be pyridine in the water or pyridine in the sediment. The crab can only seek to avoid it.

To give you an analogy, we all understand that rattlesnakes are poisonous and venomous, and we avoid those by keeping well clear. That is a nice, safe mechanism. What would happen if rattlesnake venom flew to us in a fog that we could not escape from? That is the kind of scenario you are facing here with the crabs. You have an animal that has evolved over millions of years to have receptors for this type of molecule on the outside of its body. When it detects those chemicals it initiates a response

in its central nervous system and then, depending on the concentration of the chemical there, you can get a whole range of responses right the way through to what we have seen: convulsions, paralysis and death, so in terms of explaining the toxicity of pyridine, the case is there and clear to be seen.

The next step is understanding how pyridine, if it is released during dredging, could then be transported 50 kilometres down the coast and add that toxicity. For that I turned for help to my physical oceanographer colleague, who is an extremely talented marine physicist, and he used the most powerful models and simulations available for the North Sea—more powerful than those that CEFAS has used. He also ran his model for a month, unlike CEFAS's three days.

What is more, we have always taken a conservative—with a small 'c'—approach to our science. We have always underestimated every chemical we use. We have always underestimated all the parameters we use, so we would never run the risk of making false positives. The same goes for the modelling. We built into the modelling the actual destruction rate of pyridine. As was mentioned by the previous panel, pyridine is both lost to volatilisation and it is also aggressively attacked by oxygen. The US EPA had data for this in the 1980s. It showed that the half-life of pyridine—so losing 50% in water—is eight days.

As I said, we have taken a conservative approach in our models. We put that half-life to 90. We would actually remove pyridine from our simulation faster than it would be removed in reality. We modelled based upon the rate of pyridine on the same scale CEFAS used, so a total release of 10,000 litres. We ran the model using the tides and the currents affecting the coast on each given day that the dredging campaign took place and for the following weeks. The model clearly showed that pyridine in water would be transported all the way down to Whitby and Robin Hood's Bay. From that we could pull out toxicity values based upon what we had generated in my laboratory. We could then make reasonably sound estimates of the extent of population loss from the crabs and lobsters in that given area.

Let me start by looking at the epicentre, around about Hartlepool, Redcar and Teesmouth. Based upon our work, we predicted that half of the crab population would have died in the first 24 hours. Moving further down the coast to Runswick Bay, we predicted that 30% would have died within 24 hours. Then moving right the way down to Whitby, we believed that we would have lost 10% as a minimum of the population there.

Therefore, we have shown that pyridine is extremely toxic. We have identified the mechanism that means that bio-accumulation is out of the equation. We have identified the way that pyridine will be transported.

The next step is then trying to go back to that source to outcome pathway model and trying to come back to: well, where is the source of pyridine? As a professional scientist, I am satisfied that I can explain the

toxicity of pyridine. I am completely satisfied that I can defend that. I also need to identify likely sources. You heard from the previous panel that they do not believe there are sources in the Tees estuary. Unfortunately, I have news for them. There are at least three major point sources, two of which are historical, and one of which is much more contemporary.

You go right back to—as was mentioned—the coking industry; Redcar is internationally known for that. Pyridine as a by-product, again, is well known throughout the world. It is very well studied and there is a very high risk level with that. I found it very peculiar that pyridine is not monitored routinely in the Tees estuary, given what is known right around the world. You also have a source from when ICI were refining crude oil. Whenever they refine crude oil, there is a fraction called the C5. That is the fraction that has no clear market value, so they would pipe that to another plant in the north of the Tees where that naphtha fraction would undergo a thermal cracking process.

In effect, they heat it up to a very high temperature and they make those chemicals in the fraction form other chemicals. They will then extract from that those chemicals that have a market value. Anything that is not worth them selling was discharged directly into the river. Of course, pyridine was one of those chemicals that had no value to them and was discharged.

At a more contemporary level, we also have the company called Vertellus, which had its own specific pyridine and pyridine derivative manufacturing plants. It was using that for a range of products: rubber sizers, drugs, herbicides, pesticides, a range of products. There are significant questions to be answered with regards to how it handled its effluent discharge. It was meant to have had a functional wastewater treatment plant on site, and that appears never to have worked properly. It subsequently had to tanker hundreds of thousands of gallons of its wastewater effluent, including pyridine releases, to the Bran Sands water treatment plant run by Northumbrian Water.

Q112 **Chair:** Why didn't we get dead crabs then when all this stuff was going straight into the river?

**Dr Caldwell:** I am coming to that. We have three sources: two historical, one much more contemporary, and we must then look at the chemistry of the pyridine. As has been absolutely correctly talked about today, pyridine is unstable. In water it will defuse widely. It will evaporate very quickly into the atmosphere. It will be attacked by oxygen. Therefore, any attempt to measure pyridine in the water is a fool's errand unless you are literally on top of any kind of release. You are always onto a loser in that kind of scenario.

What pyridine does do when it gets into the sediment, if it is protected from oxygen it becomes stable—inert, if you like. In that sediment, it will build up over time. As long as it stays undisturbed in that sediment in an

oxygen-free environment, it is fine. No problem. It cannot do any real harm. However, if you have an event that comes along that allows that pyridine to be mobilised from the sediment, and brought back into the system, you have a problem on your hands.

As was mentioned in the previous panel, we have measured pyridine in the surface sediments down to a depth of 20 centimetres. It is important for the panel to understand that that 20 centimetres would be regarded as a pyridine destruction zone, so that part of the sediment will be being lost to the atmosphere where it will be diluted, where it will be being attacked by oxygen. Simply by the fact that we are measuring pyridine in the majority of our samples, in the Tees estuary and in the spoil zone, is a significant red flag that must be taken further, because it implies in those deeper sediments, where there is no oxygen present, you have a reservoir of pyridine there.

What we believe we were measuring in our surface sediments was effectively the diffusion or the percolation from that pyridine reserve. It was coming to the surface and being interacted with in that destruction zone, and that is what we were measuring. Again, simply the fact that we were measuring pyridine in the sediments, given what we know about the chemistry, is of great concern. That makes it equally puzzling to me why pyridine was not part of the standard risk assessment for any work being undertaken in the Tees estuary—certainly any work that involves any risk to disturbance of the deep sediment.

This is where we go on to the dredging. I don't know whether you picked this up from earlier testimony, but it was pointed out on two occasions that the extra dredging was in response to a slippage in the Tees. That is quite a significant piece of evidence that needs to be explored. How big was that slippage? How deep was it? Was it interacting or interfacing with an aerobic zone? Is that the mechanism whereby pyridine will have been mobilised from that safe reservoir and then been picked up in the maintenance dredging and taken offshore inadvertently? If that was the case, it is just unfortunate that it happened, but that is a tangible mechanism from source to open pathway.

You have identified three point sources of pyridine. You have identified the mechanism whereby pyridine would remain stable and resident in the sediment for decades. We have now identified a mechanism whereby an accident, a natural incident, could have caused that sediment to be moved and picked up and transported offshore through the maintenance dredging.

We know the discharge of pyridine will have been reaching the whole way down that coast. We have even seen that from the sediment. You speak to the fisheries when they put their pots out at Whitby and they are finding out their pots are being covered in fine sediment. That never happened before. You are not just getting water being transported carrying pyridine; you are also getting the sediment itself.

Therefore, the toxicity mechanism is there. The mechanism for crabs to respond to very, very low concentrations is there, as is the explanation for why you are getting this mass mortality within the impacted plume zone and not outside of it. I think you need to understand that. It is a very clear demarcation of where the crabs and lobsters were dying. When you try to trace that timeline of the movement of our simulated plume down the coast, it coincides with when the wash-ups were happening at each given location.

Someone mentioned that you are still getting crustations washing up two months after the fact. That can also be addressed. There are in fact two toxicity mechanisms for pyridine and pyridine analogues to crabs. There is one that I have told you about in terms of the thiophene, which is incredibly sharp, incredibly acute, and that would likely have been causing that first major wave of wash-up. However, crabs and lobsters that will have survived that initial exposure—we knew some of them did because we have seen it in our experiments too—then open themselves to a secondary toxic mechanism, because these pyridine compounds interfere with a protein called SARM1.

SARM1 has a very important job in maintaining nervous cells, the central nervous system and its function all the way from bacteria right the way through to us. If that SARM1 protein is switched on or damaged or made to function in any kind of way, it switches from its normal function, which is protecting the nerve cells, to switching round and becoming an enemy and it starts attacking and breaking them down, so it is a form of neurodegeneration. Think Alzheimer's and ALS for crabs, but on a much shorter timescale.

Here we are talking about not years for these things to set in but days. With the acute venom response, you are talking scales of hours to days. For the SARM2 protein, you are talking days to weeks. Those two different mechanisms of toxicity explain the really powerful and very disturbing high numbers of crab and lobster being washed up. It also accounts for the later wash-ups and the surviving crabs out there succumbing to the secondary toxicity as a result of the exposure.

For us to completely and with confidence say we have a rock-solid explanation of pyridine is the straw that broke the camel's back in the scenario. We just need to know how much pyridine is in the deep sediment. We cannot get hold of that data. We know boreholes have been drilled. We have not seen this data. We need to see more boreholes being drilled. We need to have an entire pyridine map across the entire depth of sediment in the Tees estuary. There is no point in coming up with any regulatory mechanism based upon monitoring pyridine in the water.

Q113 **Ian Byrne:** Who has done the boreholes, then?

**Dr Caldwell:** I suspect PD Ports. I don't know who has done them. We do not have the data. What I am saying is any kind of regulatory

monitoring based upon water for pyridine is not going to work because it is not just round long enough for it. For you to understand the nature of the risk of pyridine, and to manage any given system or any given development accordingly, you need to know what is in the sediment to a great deal of detail.

That is the case as we have collected and set it out. What we are not saying is that the dredging and the development around the Tees port should be stopped. Far from it. We are not the enemy of development and redevelopment of that site. Far from it. Indeed, my own job title is applied marine biology. My job title is all about extracting value and resource from the sea. What we would like to see by way of a solution is, first, a temporary moratorium on the capital dredge until we understand what is happening and the initial pyridine release is done and dusted, has done its terrible damage, and has moved on through the system.

We need to understand whether there is pyridine and other chemicals in the remainder of the sediment that has been earmarked to be dredged out for the south bank.

Q114 **Ian Byrne:** Are you dismissing the algae as the cause of this? Are you absolutely—

**Dr Caldwell:** As I said before, there are multiple stressors in the North Sea. I said there was a strong indicator that there will be one major episodic event that will have taken that stress system and broken it beyond repair. My argument is that in this case, algae bloom or no algae bloom, if it is there—and it is there for sure, yes—it is part of the background stress. However, what we are seeing with the pyridine story is a fast-acting toxic mechanism that does terrible damage. Given its chemistry, it just runs away. It was mentioned earlier that it can be the thief that hides in the night. It has that type of pattern to its chemistry.

We would put forward a range of what we think are pragmatic and sensible solutions based upon the science. We would like to see a temporary moratorium on the south bank dredge, until we do see this pyridine map in place and it has been independently verified. It must be independently verified. That is very important. We can then develop a sensible and precautionary risk assessment to allow the development to start again. We do not want to stop new jobs, new innovation, or Teesside becoming the next green industrial revolution hotspot. We are all for that, but we want to see that happening without effectively allowing our marine system to be ripped asunder.

I do not see there being any real conflict there. We can make sure we do both but it does take to have that measurement, that full detailed three-dimensional map of the pyridine all the way through the estuary out into the spoil grounds, and not just pyridine but all the other chemicals that are in that list and also anything else that is there that isn't routinely monitored. Who knows if there is another surprise waiting for us? If pyridine wasn't monitored and we know pyridine is toxic, we need to take

a much more broad holistic view and ask ourselves the obvious question: is the suite of chemicals that we test for enough? Should we be looking wider?

On that, we must look to the Tees industrial heritage and understand the chemicals that were produced and released from there. They should be on that list if they are not on already and they should become a very important chemical.

Q115 **Ian Byrne:** He has answered nearly every question, Chair. It has been a brilliant piece of evidence.

With the rollout of the freeports, are there concerns that this could happen in other areas that are similarly affected, from an industrial perspective?

**Dr Caldwell:** It is.

**Ian Byrne:** I am thinking of Liverpool

***Dr Caldwell:*** I am going to give a bit of a bleak perspective here. The event from last year is done. Whatever happened, the damage is done. We cannot do anything about it, but we can prevent any further damage from the ongoing dredging of the south bank and, as has been pointed out, we need to look more widely. We need to look at any other dredging activities for any other major ports around the country, whether it be freeports or any other aspect. We need to look carefully at the regulatory policies that these things are being granted under. Certainly, from my perspective, they are not fit for purpose for the Tees. It does make me wonder whether they would be fit for purpose for other estuaries and sites that have their own industrial heritage.

**Ian Byrne:** That is a really great comment on the freeports. Thanks, Chair.

Q116 **Chair:** Thank you very much. I think most of your points have been covered in that long diatribe, Geraint, unless there are any other bits you want to pick up. The only thing that occurred to me is that we had evidence in the first session that we have seen healthy crabs with levels of pyridine similar to levels found in the dead crabs. Is that something you would expect?

***Dr Caldwell:*** That is something that needs to be addressed. Again, I go back to CEFAS's own defence, in that its method is invalidated for tissues, so there is scope for making false positives. This is a common criticism that it has put to me whenever I have been talking about the toxicity. Even allowing it a 99% error rate in terms of its concentrations, it still has pyridine in the toxic range.

One more final point to add in, if I may. We have had three meetings as an academic group with the DEFRA agencies. In those three meetings they have become increasingly collaborative and increasingly productive.

Indeed, as output from the last meeting, I received a letter from NEIFCA representing colleagues from the Environment Agency and from CEFAS. They have asked me to share my unpublished data with them, so that we can work together to stop the dredging of the south bank. That was used twice in that letter "to stop the dredging".

From my perspective, from building up an evidence base and presenting an evidence case, I think what we have done, what we have shown, stands up to scrutiny. Again, applying a precautionary approach, I think my colleagues that have written to me think that is pragmatic and sensible that we explore these and we stop the dredging and we undertake further work.

**Chair:** When you say "stop the dredging", do you mean stop all maintenance dredging?

***Dr Caldwell:*** No, stop the capital dredging. Maintenance dredging is fine unless there is another slip event. That is perhaps something that PD Ports need to start monitoring if these slippage events do happen. Perhaps they need to be approached with a very precautionary principle.

Q117 **Geraint Davies:** That was an excellent piece of evidence. Can I just ask you a couple of questions? Are you saying that what we need to do is, first, get the boreholes, get the samples, find what is where, under the sediment, and find out at what depth it is, and at what concentrations? Secondly, until we know that, should we suspend non-maintenance dredging? After that, what advice do you have? I mentioned in the previous session some issues about whether there were methods for mitigating potential risk in terms of the nature of dredges and the containment. Is there any advice you have on that?

***Dr Caldwell:*** That comes into whenever that risk assessment is taking place, we believe it would be sensible and pragmatic with that information for dredging to be happening safely with the right kind of dredging technology, the right kind of mitigation, including metal sheet piling. That is very effective at preventing release of water and any kind of sediment into the system. Whereby you can prevent any release and contain it and take it away from the system so that it does not get released into the river and, as sure as heck, it should not be dumped at sea.

In that situation, whereby those mitigation steps and controls are put in place, there should not be any risk if that risk is managed sensibly, pragmatically. However, for that to become a reality, we have to know where the pyridine is and where the hotspots are. We do not have that information yet.

Q118 **Geraint Davies:** Again, it must be the case, as my colleague said, that we should do these boreholes wherever there is a freeport or, indeed, Swansea Bay, where we have this lagoon proposition, where we are going to take out sediment. Your advice would be, first, to do proper

testing and, secondly, if dredging is required, it should be done in a controlled, contained way, in a timeframe with suction and with walls.

***Dr Caldwell:*** Absolutely. If we do not take a precautionary approach we sacrifice one industry for another. We sacrifice our ecosystems, and it is avoidable.

***Dr Forster:*** It is probably not possible in an estuary like the Tees, with a lot of shipping traffic, to put those kind of measures in. I would imagine that where you are doing maintenance dredging of the main channel, it would mean closing the estuary. That would have to be risk-based on areas where there is significant industrial pollution there.

Q119 **Ian Byrne:** Which goes from the mapping, so that map is key to everything, isn't it?

***Dr Caldwell:*** It absolutely is.

Q120 **Geraint Davies:** I guess what we are saying is that in the event of a freeport, if there has to be a significant increase in the depth of extraction we obviously need to find out whether there is pyridine in there and, secondly, if there is that needs to be managed.

***Dr Forster:*** Estuaries have been getting dredged deeper and deeper. Our ships have got bigger over the years. I have done a lot of work on the Westerschelde estuary between the Netherlands and Belgium. The dredge there was from 12 metres. Now, this is not the depth of sediment. This is the lowest water level that is required for a ship to get in. The big container ship would probably need about 14 metres. The Schelde estuary was dredged to 15 metres all the way to the Port of Antwerp. It was quite a controversial thing because it changes the flows in the channel and the potential release of contaminants, so there may be another source of evidence to look at more carefully.

It is the same for the Thames. There has been a lot of work on the large dredge out of the Thames, which some fishermen claim has destroyed sole spawning grounds and so on. The marked channel, the approach to the Thames, is now much deeper than it was. Therefore, it is not a freeport issue. It is just generally the size of container vessels, particularly, or carriers or ships of 100,000 tonnes for a long, long time, so it has been dredged very deep for a long time.

**Chair:** There are issues on the Tyne as well. I remember our shipping ministry—of heavy metals—it had one of the shipyards—

***Dr Forster:*** With some of the big passenger cruise liners coming having enough space in the turning circle on the Tyne as well, yes.

Q121 **Geraint Davies:** Is there a case to possibly regulate the size of ships allowed in certain ports that have a history of heavy metals and their toxins?

***Dr Caldwell:*** The sediment has to be examined properly because it can be disturbed, either by the propellers of the ships themselves or by the dredging operations. That needs to be known.

**Chair:** Thank you. We have had very comprehensive evidence. I know we have not used Mr Deere Jones very much, but your evidence was mainly testing of crab, in particular, and published results in the period that you got by various mechanisms. Neil, do you want to come in?

**Dr Neil Hudson:** Yes. Are you finishing off?

**Chair:** I was getting ready to finish off, but come in briefly before we do.

Q122 **Dr Neil Hudson:** Yes. Thank you for your evidence so far. You described the convulsions, paralysis and death. CEFAS told us that it is going to be embarking on algal biotoxin studies in a similar format. Have you or anyone done any similar studies with algal biotoxins?

***Dr Caldwell:*** For me, no, not for the period of time that you have to expose the crabs. I do not have the infrastructure to do that kind of stuff.

Q123 **Dr Neil Hudson:** However, you can do it in the pyridine side of things. You talked about a delayed mechanism of neurotoxicity. Are your studies ongoing, so that you will be able to pick up signs of neurotoxicity in the crabs that are dying in the experimental setting as well? Or is this just something you are seeing—

***Dr Caldwell:*** It is very clear even at low levels. You can see that the crabs are agitated. You can see them tapping their legs. They do not have control over that.

Q124 **Dr Neil Hudson:** Have you found any nervous system pathology that goes along with that?

***Dr Caldwell:*** We have not directly measured it, but it is in the literature. This is old literature.

**Dr Neil Hudson:** Have you found that in your current studies?

***Dr Caldwell:*** Yes.

Q125 **Dr Neil Hudson:** You have. To your knowledge, the animals that were washed up and dead when these episodes happened, did any studies take place to look at that neuropathology—to look at reactive oxygen species in the muscle and the things that you have talked about? Was any of that done?

***Dr Caldwell:*** No, not that I am aware of.

Q126 **Dr Neil Hudson:** That is something that could be looked at if things like this happened.

***Dr Caldwell:*** If another event happened, yes. In those type of things, time is of the essence. We have to get samples very quickly.

Q127 **Dr Neil Hudson:** If algal biotoxins are potentially involved, could they produce similar secondary mechanisms in terms of free radical release, that side of things.

***Dr Caldwell:*** Yes, it could.

Q128 **Dr Neil Hudson:** It could be, but what you are saying is, "Don't discount the hypotheses. Look at both".

***Dr Caldwell:*** As I said, there are many stressors in there but, strikingly, pyridine seems to be the one that has broken the system.

Q129 **Dr Neil Hudson:** Finally, Dr Forster, you talked about some deaths of birds as well. In your studies in your group of universities, have you seen any evidence in other animals, such as seals and porpoises—anything that you can share with the Committee at all?

***Dr Forster:*** Anecdotal evidence on seal pups, I think.

***Dr Caldwell:*** This is what we are trying to get hold of. It is quite difficult. There is a population of seals in these seal sands. Every year there is a report put out by an organisation called INCA, which is funded by Tees port. Its current report said the seals had a bumper year in terms of calving. On face value, it seems they did. I cannot remember the exact number. It was in the forties. However, only four or five of those pups survived. You had a lot being pupped but the survival rate is incredibly low. Those that survived were in very bad condition. At the minute, we are trying to pull that data together independently. It will take time for us to do that, but we are looking at it.

Q130 **Dr Neil Hudson:** We have talked about some of the difficulties of measuring pyridine in tissues subsequently as well. With marine mammal strandings or bycatch or any marine deaths—I say this because we have a parallel inquiry on marine mammals at the moment—are there any grounds for sampling dead birds or dead seals in some way?

***Dr Caldwell:*** From what I have understood from the pyridine chemistry, it is unlikely to have had that effect on vertebrates. It seems to be highly evolved to crustaceans, but I am not ruling it out. I would say it would be less likely that pyridine would have been the cause for that. It might have been a background stressor, but I would say there would probably be other causes for those.

Q131 **Dr Neil Hudson:** I know I am jumping around species a lot, but I declare an interest as a vet. I know that the Small Animal Veterinary Surveillance Network at the University of Liverpool has looked at some worries about dogs that were having clinical signs of vomiting and diarrhoea. I think it concluded that that was perhaps not related and perhaps it was a circulating viral gastroenteritis or something like that. Have you had any dialogue with other academics?

***Dr Caldwell:*** No, we have not expanded the conversation any further beyond that.

**Chair:** Thank you. Before we finish, Robbie Moore has a question.

Q132 **Robbie Moore:** To pick up on the point you were making about maintenance dredging and capital dredging, are you aware of any sampling that was happening before capital dredging was taking place?

***Dr Caldwell:*** I don't have those data.

Q133 **Robbie Moore:** Do you think that data is important to have before coming to the conclusion that capital dredging should not take place and that maintenance dredging should be allowed to continue?

***Dr Caldwell:*** That is the point I was making. We need more data. We need to understand what chemicals are present in the sediment that will be dredged and discharged. Without that information, it is quite silly to risk releasing chemicals without understanding the nature of the risk.

Q134 **Robbie Moore:** If we had that data, we would have more knowledge on building up mitigation factors.

***Dr Caldwell:*** Yes, mitigations can then be put in place, but you must have the data. You must have that level of understanding first, and we do not have that yet.

Q135 **Chair:** I think the answer we got was that sampling is taking place, which is why some of this material will have to be disposed of on land, but they are not testing for some of the chemicals that we are talking about today.

***Dr Caldwell:*** Yes, but I would like to see the data being made more publicly available and taken more independently. Sadly, a lot of the DEFRA agencies have a bit of a credibility issue. It is desperately sad for me to say that, considering many of my students now work for DEFRA agencies. I think that credibility gap needs to be worked on and repaired going forward.

**Chair:** Thank you very much indeed. It has been very helpful to hear basically two scientific theories that we are trying to test. I think we all agree we need more data and we need to try to see what is happening, and if future dredging takes place it needs to be done safely.

We appreciate your time and for all the work you have obviously put into this subject as well. Thank you, Mr Deere Jones as well. I know we haven't used you a lot, but I read your paper last autumn when it was drawn to my attention.

## Examination of witnesses

Witnesses: David McCandless, Joe Redfern and Stanley Rennie.

Q136 **Chair:** Welcome to our third panel. I must say that two of the witnesses,

Mr McCandless and Mr Redfern, are old friends of mine. In fact, we were together last Friday in Whitby.

For the benefit of the rest of us, could you introduce yourselves and say what your particular role is?

***David McCandless:*** Thanks, Chair. I am David McCandless. I am the Chief Officer of North Eastern Inshore Fisheries and Conservation Authority. I am not sure if the panel are aware of the work of IFCA. We are the inshore fishery fisheries managers of the English coast. Our particular area covers from north-east Lincolnshire up to South Tyneside.

A little bit about my background, which I think is relevant. I am an academic. I have a degree in marine biology and oceanography and a Masters in fisheries, biology and management. I have worked in the region for 26 years and 22 of those as Chief Officer, so I think I am well qualified to hopefully answer questions of the panel.

Q137 **Chair:** You go out to 12 miles and most of these problems have happened within three miles of the shore, is that right?

***David McCandless:*** Currently six miles.

***Joe Redfern:*** I am Joe Redfern. I am Secretary of the Whitby Commercial Fishing Association and general manager of the Whitby Lobster Hatchery. I have a degree in marine biology and coastal ecology and a Masters in marine biology. I worked for the IFCA and David McCandless a few years ago, and I have been working in the fishing sector on the north-east for the past five years.

***Stanley Rennie:*** Good afternoon, Mr Chair. Thanks for allowing me to speak today to the Committee. My name is Stan Rennie. I have been commercially fishing for 48 years from part-time with two jobs up to full-time in the last few years. I am here to represent the fishermen, coastal communities and the North East Fishing Collective guys and ladies on the marine dives.

Q138 **Chair:** Before I start on the set of questions that we have prepared it may be appropriate to ask what your comments would be on what we have heard so far during the first two evidence sessions, starting with Joe—picking on you.

***Joe Redfern:*** It has been a long year since this happened. We have gone through many different iterations of what we have thought as a fishing community. We are very thankful to Tim Deere Jones who pointed us first towards the dredging theory way back in January. It is amazing to see the evidence that particularly Gary has provided today, where there seems to be such a growing body of evidence that I think it is now undoubtable that the dredging and pyridine has played a part in the mass mortality events that we have seen. I think, unfortunately, there has been a lot of inadequate science done by the agencies over the past year. I could go on but I am sure Stan will have some more to add.

Q139 **Chair:** David, perhaps you could say what stocks are like now because you will be monitoring what is going on.

***David McCandless:*** Yes. As Joe said, it has been very challenging since October. Where our organisation is placed as IFCA is right at the coalface, so if anything does happen on the coast we are normally the first point of contact. We started getting those reports in October last year of shellfish being washed up in the inner Tees, and then reports of gradual spread of issues down the coast. Those issues stretched as far south as Robin Hood's Bay. They did not quite touch Scarborough. To the north there were reports up to Seaham Harbour as well.

Therefore, very concerning and, as per usual with these sorts of events, the first consideration is a pollution incident. I guess the whole response started from that. The epicentre was very clearly the Tees and there was some pollutant factor. In that respect, the Environment Agency as the appropriate organisation stepped in first to commence the investigations. Then, as the whole event widened, more agencies got involved with the expertise and knowledge that we don't have. We manage fisheries and that is where our expertise is, in assessing stocks and managing inshore fisheries appropriately, so our role was very much to support the Government agencies, collecting water samples or anything that they requested, gathering intelligence.

There is a central intelligence unit that is managed by the MMO, and all intelligence was fed into that and all the reports that were drawn in. Yes, very challenging, very demanding.

Where the stock sits, we have done a piece of interim work and I have seen it waved about on social media, with some people suggesting that it says things are okay in certain areas, which clearly if they think that they have not read the report or read it clearly enough.

Q140 **Chair:** I think we have seen some landings in Hartlepool that are from further out.

***David McCandless:*** Yes, indeed. There has been a major spike in crab landings, particularly at Hartlepool, over the last couple of years to the tune of about 800 tonnes. That shows up in the national statistics, but that fishery is directed out in the central North Sea. It is largely nomadic vessels that have other ports of operation. They are not based locally in Hartlepool and they fish out in the central North Sea, out in the Dogger Bank area.

There is a very good series on the BBC at the minute, which is worth a watch because it does give you a really good insight into the challenges that the fishing industry faces, and some of the fishing vessels involved in that fishery featured in the first series of that. That has caused challenges. To take a wee step back, in terms of us trying to assess where the health of the fishery is placed, primary we have used government-derived catch-and-effort statistics. Licensed commercial

fishing vessels must submit catch-and-effort data that is gathered by the MMO. We have used that primarily. That right there is the challenge: to try to decipher out those ambiguities and try to get to the bottom of where the stock is.

Our most reliance catch-and-effort statistics come from Redcar because Redcar is primarily inshore boats between 4 and 8 metres in length. They are almost exclusively inshore. The catch-and-effort data from Redcar is the most reliable at the minute. I have to say the report covers only up to July. We have supplemented it with doing some of our own survey work. We have worked pots from our inshore fisheries vessel. I have put staff out with some of the commercial vessels that are working in the affected area. They are gathering data from the catch and some of the staff have been out and about with Mr Rennie. Then we have quayside observations and some questionnaire-based information.

Overall, the broad regional picture for lobster is reasonably encouraging at this early stage. At a broader regional level, it seems to be following seasonal patterns. As we progress towards the summer, catches increase. They drop off, as you would expect, following that. They are within average tolerances of the data we have available.

However, there is a big question mark over crab. Most notably and most obviously, the impact has been in the crab stock. That is borne out through the evidence presented across the day today. We know most prevalently to the north of Whitby is where the impact is most significant. Looking at the figures, we think landings are at least 50% down on where they should be in that area. Perhaps in some cases they may be higher, maybe up to 90% down. It is having a big impact. It is impacting more the smaller section of the vessel fleet, particularly the four to seven-metre or the four to eight-metre vessels that are far more restricted. They have less flexibility in where they can fish. They cannot move far offshore and so they are much more restricted to nearshore and inshore. I am sure other evidence on the panel is much more tuned into that, but that is our broad assessment at the minute.

Q141 **Chair:** Perhaps I can turn to Mr Rennie to give us some indication of the impact it has had on individual boats and individual fishing families and how people are faring. We are concerned about these traditional fishing families and their businesses.

***Stanley Rennie:*** Chair, prior to that, could I get the opportunity to answer the question about what you thought of the presentation?

Q142 **Chair:** We listen to the evidence and we will discuss what our response is. We have already come to a few conclusions. We take evidence and then we consider what we need to do. We hold Ministers and the Government to account and that is what we will do in this situation. Have no doubt.

***Stanley Rennie:*** I will talk on how it has affected local catchers. I find it so frustrating. David and I were in a public meeting last week and unfortunately I will say the same thing. NEIFCA's report is so misleading and so out of touch with the reality of what has happened in the die-off zone. Why NEIFCA, which is in control six miles out, would include nomadic super-crabbers working up to 4,000 pots each, fishing 90 miles off the coast, onto the lands of Hartlepool, would try and say the landings have gone up for the local fleet puzzles me. We have lost the Hartlepool inshore potting fleet in the last 12 months since the Orca dredge. Half of the fleet has been forced to the wall, boats sold—there are still a couple for sale—jobs lost and land jobs looked for.

I have a good friend, Paul Rudd, a fellow I have known all my life. I have fished alongside him for the last 30 years. He has two boats and he had one that he was doing up. When the Orca dredge occurred, I can imagine what a difficult situation he found himself in. He had to lay two of his sons off and a crewman whom he had just trained up because there was no money to be made.

To give an example of the catches, totally different to what NEIFCA says and how people find them, Paul's lobsters are 50% down. Undersized lobsters are 75% down. Berried hens—pregnant lobsters—are 75% down. Velvet crabs are 100% down; shore crabs are 100% down; and brown crabs are 100% down on the catches the previous year.

Q143 **Chair:** There is nothing there, in effect, crabwise?

***Stanley Rennie:*** No, not where he is fishing.

***Joe Redfern:*** It is centred round the Tees. That seems to be the epicentre. That is what we have seen. As you come further down the coast, you start to see some of the brown crabs, but they are 80% or 90% down, but none of the velvet. The shore crabs are completely decimated in that area. The epicentre seems to be focused around the Tees estuary and around Hartlepool.

Q144 **Chair:** A few years back I went out with Gordon Quinn, whom you may know, and we found that for every marketable lobster we found there were probably 10 or 12 undersize. How long does it take a lobster? If those are being taken out as well, how long would it be before the lobster that you are putting in the sea from your hatchery becomes big enough to be landed?

***Joe Redfern:*** Five to seven years of growth from a juvenile lobster to a commercially landable lobster, which has to be 87 millimetres across its carapace. It is five to seven years. For any measure they put in place now, we will see a lag phase until we see the impact.

**Chair:** Understood. Rosie, you wanted to come in?

Q145 **Rosie Duffield:** Thanks, Chair. Yes, you have covered a lot of this, but I particularly wanted to put this to Stan. You might not think that in

Whitstable in Kent we have a huge amount in common, but my fishing industry has been decimated by things like sewage and the outfall of the pipes. I totally feel for you. You have been doing this for 48 years and you have probably never seen anything this devastating, I would imagine, to your way of life.

It sounds like a simple question, but could you spell out to everyone watching how the local communities have adapted? Are people leaving the industry? Presumably, no one will want to come into an industry that feels this fragile.

***Stanley Rennie:*** Fishing is so heavily regulated now. We have no young recruits coming through. It is so difficult. This year, I have only a small boat of 6.92 metres or 26 feet. I normally fish in front of the window on the doorstep and the wife keeps an eye on us. I fished for 47 years of my 48 years with my own boats. My catches are down 80% for lobsters. I rely on the summer season, July to September, to get the majority of the money in that will get me through the year. My earnings last year in that period or my turnover was £8.761.84. This year it is £3,753.21. It is a 58% reduction but that is not just a 58% reduction of what is left. My working day has more than doubled.

I would never land anything that I would not eat myself and neither at Tees mouth. I certainly would not eat anything until I made sure it was safe. I have stuck to my principles. I have tried to get out of the die-off zone this year. I have been steaming an hour and a half a day in a little boat, seven and a half miles north towards Seaham, three and half miles off, putting weather away, what I shouldn't be in, and like I said I would catch some days out there. It is absolutely devastating.

It is the full marine ecosystem. There is nothing in the pots. There is none of the squat lobsters and everything we enjoy seeing. We have tried to fish lobsters sustainably for donkey's years, a lot longer than before berried hens could not be landed. I got two warnings from NEIFCA for v-notching my lobsters and letting them go because at the time you could not land a v-notched lobster.

Q146 **Chair:** Could you explain to people? There is a programme that the Government ran. If you catch a berried hen, you put it back in and you notch its tail, you get paid for that. If anyone else catches it before it sheds its shell, they are not allowed to catch it.

***Stanley Rennie:*** No, you do not get paid for it. You put a V in and it cannot be landed. The fisheries were buying lobsters off the buyers to v-notch and return. The likes of my colleague and I have put literally tens of thousands of lobsters in the last 20 years that we could have landed, v-notched them, berried hens, put them back, trying to build the stocks up and be sustainable. Other people are doing it. There are more lobsters about, around that area, up until 25 or 26 September last year than there were when I was a kid.

I started off with my own boat in 1974 at 13 years old. It has had a devastating effect on the coastal communities. As I said, we have lost half the fleet. There are boats down at Whitby. Fishing is all they have known. We have a proud heritage. We are proud people in the northeast. We fight till the last. It is not right that we have had to rely on donations from the public and the likes of the fishmonger's company to get this independent testing done, but how come we rely on the agencies, which have come up with fabricated—

***Joe Redfern:*** Before you go on, Stan, on the v-notching, boats out of Whitby have v-notched 1,000 lobsters and returned them and now they are coming to me and saying, "Is that sentencing them to death? Has the pyridine made the weigh-in simpler?" They have not seen any of those v-notched lobsters again. There is a real feeling of hopelessness within the fishing community because they are trying to do what they can to protect it but they are still not seeing anything coming back. The wellbeing and the mental health impact has been dramatic along the coast. A lot of people feel there has been a lack of support and a lack of trust and hopelessness in the industry and feel betrayed by the agencies as well.

Q147 **Ian Byrne:** There is the cost-of-living crisis as well?

***Joe Redfern:*** Exactly, yes. After the pandemic, we were severely hit with that, so much so that the Fishermen's Mission has now started doing regular health checks in the ports that are affected and are offering charitable hardship funds, which has all been money raised through our own campaigning.

Q148 **Rosie Duffield:** You feel let down and nobody is supporting the community. Is it your gut feeling, with your experience between you, that the community has changed forever or do you think it can come back?

***Stanley Rennie:*** In my heritage, fishing goes back on my mum's side 400 or 500 years. I have traced our family back fishing in front of my house on the beach. I think I will be the last one. How can we trust agencies? We have independent investigations being undertaken and they are coming out with a totally different thing. I did not find the first lot of evidence very good but we get the CEFAS and the Environment Agency reports coming out.

On 6 September last year, I reported a pollution incident when I was going out in my boat. It happens regularly. There was a scrap ship loading in Hartlepool. It was a flat, calm day. The scrap dust was coming all over the headland. It was going in the water. When it was getting near the quayside, it was sinking. The water was ginger about two feet deep. I reported it to the pollution hotline, like I have done dozens of times. They know what it is. In the CEFAS and Environment Agency report, they include one of my photos from 6 September of scrap dust pollution in the water. I can only think they are trying to push their theory of red algae—

***Joe Redfern:*** Yes, it says there, "Suspected red algae bloom", but they have used his scrap dust photo.

***Stanley Rennie:*** I have them on my phone and all the evidence I sent them when I did it. I did not get any feedback. Who can we trust? We need independent investigations here.

***Joe Redfern:*** To come back to your point, there is a lack of diversity in the region now. We used to catch whitefish and herring and have more variety of fish—I am sure that David McCandless could talk further on that—but today it is only crab and lobster. That is basically 99% of the boat and it is the mainstay of all the income for the northeast. It shows how fragile and vulnerable it is and the dramatic and drastic impact that an event like this has had.

***Stanley Rennie:*** I need to correct you there, sorry, Joe. It is not just the crab and lobster fleet. It is the prawn fleet. Prawns are shellfish. When the Orca dredging started last year and finished after 10 days, the prawn fleet was catching dead prawns around the dumps and the (inaudible PTV 17:49:32). If you bear with me, I have an e-mail from two boats from the last couple of days. They sailed for 10 hours and they got a grand total of four prawns each. It is not just that type of shellfish. It is all shellfish and lots of marine creatures.

Q149 **Rosie Duffield:** That will cost them?

***Stanley Rennie:*** It cost them £300 to go to sea for the day to make nothing.

***Joe Redfern:*** It seems to be the crustaceans.

***Stanley Rennie:*** Yes, they nest on the seafloor. Yes. I have worked seven days a week when I can get to sea because I have to go further out. Seven days a week, eight or nine hours a day, costs me over the summer quite a bit of money to go and do it, to try to get some money coming in.

**Rosie Duffield:** Thank you both very much.

**Chair:** Thank you. Robbie?

Q150 **Robbie Moore:** Yes, thank you, Chair. Following on, I wanted to touch on Government support. It is our understanding that the UK Government have not provided support to help fishermen and women affected by this problem. Is that the case? Has any local support been provided?

***Stanley Rennie:*** We have had plenty of local support from the likes of Jill. We had meetings with Jill. One of the lasses who works with Jill, Sally Clark, volunteered to do an evidence document that has been put in. We were collecting and sending all the evidence in. That is quite comprehensive.

Some of the local councillors have been brilliant from day one, supporting us from day one, because we knew there was something not right. My catches fell off a cliff. The Orca dredge started on 25 October. On 27 October we knew there was something wrong. I was throwing back 40, 50, 60 and 70 berried hens a day and the ones that I had not caught before I was v-notching. That is a day. I have not caught 70 berried hens this year to throw back added together all the summer. I was doing that a day.

***David McCandless:*** If you are talking about financial support, we have had no financial support from the Government or from local councils whatsoever. The only financial support that has been in place has come from local businesses such as Whitby Seafoods and has been given to the Fishermen's Mission, which is a charity, which has then allocated hardship funds since then.

Q151 **Robbie Moore:** The Government has mentioned making use of the Seafood Fund. What are your thoughts on that?

***Joe Redfern:*** It is not the fund in place for hardship. It is not for fishermen. It is for innovation. £65 million out of that £100 million is for infrastructure. It is for scientists. It is for local authorities to try to improve innovation. There is no allocation from that £100 million whatsoever for hardship and certainly not in response to the events that happened in the past year.

***Stanley Rennie:*** Most of that money was allocated last year. It is not new money.

Q152 **Robbie Moore:** What other support would you want to be put in place from the Government?

***Joe Redfern:*** There should be more grants in place for some diversification to try to help people to start looking at other fisheries and to try and maybe move away from their reliance on crabs and lobsters in their entirety, to give the fishing industry more options on that front. That is for those who are able to do that. It is probably more for the boats further out of the impacted area, places—I am sure Stan could go on to this—around Hartlepool, a decommissioning scheme when they simply cannot make a living. Give them the compensation to cover the debts that they might have on the boat, to cover the debts that they have in the business and to provide that support while they transition out of the industry because they do not have a choice.

***Stanley Rennie:*** The only financial thing we have had is two proposals. One was in the meeting that Jill was in at the fish quay. This is how desperate it is. People were suggesting decommissioning plus, where they would get decommissioning plus some losses of what they have experienced in not being able to go to sea again. That would give them two opportunities. That would let them get out of the industry and clear the debts and the boats would be chopped up and the Government would

keep the licence or, for the smaller boats, it might let them buy a bigger boat so that they can get out of the die-off zone safely and fish. That will put more pressure on the ground but that gives them an option to make a living. That is all that has been suggested.

We never once went to a meeting asking for handouts. If the lads had been offered food, they would not have taken it. They are proud people. Not once has it been mentioned in any of the meetings we have been to. The only thing that has been mentioned is to buy the boat off people and chop it up.

Q153 **Robbie Moore:** Is there anything else on that point, David, that you wanted to expand on as well?

***David McCandless:*** Yes, to add a bit more to what Joe and Stan have said, there is a lot of fundamental work at the national level that needs doing to restructure the fishing licensing system, access to other species in terms of quotas and so on. It will take quite a few years to sort that out. Joe is absolutely right. It is one of the fundamental issues of having been in the common fisheries policy and the challenges of being in that in terms of restrictions around quotas, to target white fish species and so on.

As a result of that, over the years, in our region in the northeast, most of the inshore fishermen are operating on capped licenses, which means they have only a limited, if any, take of species such as cod, haddock or whiting. Pretty much, as Joe said, those vessels are stuck now in 365 days potting for lobster and crab. When you get an event like this, which is unforeseen and certainly something I have never experienced in my career, which is long enough in that region, you get something like that that no one foresees and the fishing industry is under immediate and serious pressure because they cannot diversify. They cannot, for example, bring some pots in and set nets seasonally for cod. Even when I started, which was in 1996, we still had some inshore vessels that worked lines for cod in the winter. All of that has rapidly disappeared. The fishing industry is so reliant on potting for shellfish and that is under huge pressure with something like this, which no one could have foreseen. Yes, they do need a leg up. There is no doubt about that at all.

I have been in all of that work myself. We have supported the investigatory work through all the government agencies. At the minute, there are weekly meetings with the Government leads and so on. I have been all through that. I have sat through two or three ministerial briefs as well with different changes coming through. There is a genuine will to try to get to the bottom of what has happened.

I take my hat off to Joe and the fishing group. It is amazing how they have managed to pull together the collaborative research. Joe has done that from scratch. That was no mean feat to line up three or four universities with different experts and fund that. They were self-funded to do that research. There is a lot of good work going on there. I have found

the IFCA sets. That is where we are pushing hard. We sit between the cracks here, between the different Government agencies, and we have been working hard to try to keep the collaboration going between the fishing industry research that is being led on behalf of the fishing industry and the Government research.

It is not easy. We were pushing to do that. We have established a joint technical research group that draws in all the leads on both sides. We have had two meetings of that group. We will keep going with that. It is like banging heads together sometimes. However, there is a genuine will right across to try to get to the bottom of this. We need to get to the bottom of this because this would decimate the northeast fishing industry completely if it happened again.

There are so many gaps in the knowledge at the minute. We need a precautionary approach going forward here, very much so. Thank you.

***Joe Redfern:*** While we are trying to collaborate and to get to these answers, the fishing community is completely terrified that if this next round of dredging goes ahead, there will be nothing left and that will be the complete nail in the coffin. They are absolutely terrified. We are fighting to prevent that around the dredging until we are completely sure that there are no toxins and there is no impact. Hopefully, you have seen today that we are not completely sure.

With the algal bloom theory, we have not seen anything like this in the past 50 years. From the satellite imagery and from the data, it does not seem to be a once-in-50-years algal bloom that we are seeing. We have seen algal blooms like this over the past 50 years but we have never seen this sort of impact. We are really—I cannot stress it enough—terrified if this next round of dredging goes ahead, it will be the end of the northeast fishing industry.

***Stanley Rennie:*** Carrying on from one point David said, the important thing for the small fishers, the under-10 boats, is diversification. For all the time, most of people's lives, you would not target stock that was down. If there were plenty of crabs and lobsters on the ground in the winter, you would carry on fishing. You would leave the cod alone and the cod would come back.

Then, out of the blue, it has happened three times. The MMO has picked a reference. If you were diversifying from potting to netting or longlining and you had spent the full year at it because there was plenty of quota there and the catch was there and you left the potting alone and those stocks were growing up, all of a sudden, they have pulled a reference year out of the window and backdated it. If you had not landed so many crabs or lobsters that year, you got your licence capped so that you could not go fishing for crabs. Those boats were stuck on the fish. When the fish disappeared and there were plenty of crabs, they could not diversify onto crabs. We have ended up with lots of people getting their licences capped and not being able to diversify.

Getting on to a point Joe mentioned about the freeport dredging, I had a film crew up the river last week. We are terrified. The ecosystem is under an extinction threat for what must be a couple of hundred square miles in our area. There has been a migratory lobster catch in the summer, which you would expect, coming into cast, coming into mate and then going back out. People have had a reasonable summer, but I would not fish there because near the Tees mouth you do not know whether it is safe. They are going back now and are stuck to the local stocks. Whatever is left of those local stocks, there is nothing to replace them next year. Your pots are normally teeming with undersized lobsters and everything. Next year, there will be even less. It will be seven years before we see any improvement.

Our spawn from the lobsters goes down the coast quite a considerable distance. In seven years' time, they will not have a generation of fish. It has such a huge knock-on effect. I was up the river with a camera crew a week ago. I am sorry for overloading you with e-mails, but I sent a load of evidence in. One was a link to some footage that Joe had done for me. The freeport dredge started on 1 September and it is all supposed to be contained and going to landfill. If you look at that footage, you will see is a barge with a huge excavator on with the teeth on its bucket and a flat plate that comes over the top. It lifts the toxic dredge from the bottom and it is spilling out and it is dropping in the river. It puts it in the barge next to it. When the barge is full, they tow the barge a quarter mile up the river, where two excavators empty it. It is dropping all over the place. There are no silt cartons. There is nothing. They are opening those things up in the most toxic place where they said they had found the toxins. It seems up to the tides and the spurts of water and we are terrified it will be a tip-of-the-edge occurrence again.

***Joe Redfern:*** We have already started to see some more washups.

***Stanley Rennie:*** We have had washups since 1 September.

***Joe Redfern:*** Yes, and in the weeks that have gone on since then, it seems to have—

Q154 **Chair:** That is material that has to be disposed of to land because it has proven to be toxic when it is not contained.

***Stanley Rennie:*** Yes, but we had a meeting with the mayor and we asked him if he would test all of the testing samples for pyridine and he would not. He refused when we asked again. However, I cannot believe that the licence application and the subsequent licence being granted does not contain any reference to the Orca dredge or the die-offs. The risk assessment does not, the environment impact statement and the method statement. The live document, if you found something on the day, you would add it to it and you would counter it. There is no mitigation feature in place if this happens again. It wants to be coffer-dammed off. The river should be coffer-dammed off. That river must be wide enough to get a ship past—Jerry could answer that—to go half the

way across and dredge it out and take it away without anything escaping, and then do the same for the other side.

We are terrified. Our industry could be lost now. It is heart breaking. It is not just the industry and it is not a monetary thing. It is our ecosystem. We have tried to look after it. We enjoy seeing everything in there. We try to share it with people. I have never kept a big lobster in my life. I have never kept a lobster over six pounds, but I do like to bring them in and show Sarah, my daughter, or anyone who is about and weigh it and put it in my book and v-notch it and let it go again. All the lobsters we have put back and all that money we could have earned is lying dead on the ocean floor in the north-east.

**Chair:** We are getting very tight on time, so a very quick point and then I will go to Neil Hudson.

Q155 **Geraint Davies:** I know that Stan said you were not looking for compensation, but it does strike me that if you had, just by way of example, an investor in a country where the Government came along and stopped them working, they could sue that Government for the expected profits or revenues in future years. It does strike me that what you are saying is that had this event not occurred you could have looked forward to a lifetime of income and there is a case to be made, given the evidence we have heard, that this was an avoidable disaster.

***Stanley Rennie:*** Yes, it is, but what I am saying is that if somebody says to me, "Stan, I am sorry about what has gone on, here is £150,000 or your ecosystem back" we know what we would pick, our ecosystem back.

Q156 **Geraint Davies:** On that point, obviously a lobster takes five to seven years to mature, as you have just said. What would you like to see happening?

***Joe Redfern:*** First, the pollution must be stopped. In any measures that we try to regenerate the ecosystem we have to make sure that we are not putting any more pollution or damage in it. That is simple. Whatever we do, we have to make sure that it is safe to do so. There are measures such as habitat regeneration, artificial reefs and bioengineering. There is a lot of industry such as the wind farms going in around the area that will be rock-armouring their cables. They could all be made in a way that promotes reefs and promotes life. Redcar Council, from my personal perspective, things like stock enhancement with hatcheries can go to start putting something back. I think that it is very important that we make a stop to the pollution first.

***Stanley Rennie:*** I agree on hatcheries but it is just the tip of the iceberg with everything else, the different creatures that are being killed off. Gary would tell us if it was right, but it is as though they can take the pyridine for longer than other creatures. We ended up with the crabs and lobsters disappearing overnight, but we have had wash-ups of everything you can

think of, sea urchins, razor clams, worms, lots of seals dying and porpoises washed up on the beach this year. Everything you can think of in the marine environment has washed up. We do not know whether we will ever get it back because there are other creatures taking over now.

The pots are full of tiny whelks, absolutely covered from seven and a half miles north to the inshore waters around where I work, where you can get out and plodge half the time. I had never seen a brittle star in my life. I have never worked Long Scar. It was the first time in 48 years this year. I went to sea with Paul Widdowfield a couple of weeks ago. His crew was busy so I went to sea to work his pots. He has been doing a survey in Long Scar in the die-off zone. I couldn't believe it. The pots were absolutely covered in brittle stars, so the marine environment is changing already. Even though my bait was in bait bags, seven and a half miles away from the headland, which is three and a half miles away from the Tees mouth, trying to get out of the die-off zone, the lampreys and the devourers absolutely covering the pots. It is as though there is an explosion of that bottom of the food chain and it is going to change things for the worse, ruining our marine environment.

Q157 **Geraint Davies:** David, you talked about collaboration between Newcastle, Hull and so on and DEFRA, but it seems to me that what we have heard is essentially a DEFRA cover-up or a failure to investigate pyridine. Isn't there a risk that if there is a collaboration that there will be an attempt again by DEFRA to cover up the emerging evidence of Newcastle?

***David McCandless:*** I personally have not seen any direct evidence of anybody trying to hide or cover up, and I say that genuinely. As I say, I have been heavily involved throughout, from day one, and across all the meetings and discussions that we have had. I have always seen that as the way to get to the root of this and the only way is for everybody to collaborate, the industry-based research and the Government research, and forge that stronger collaborative approach to get to the bottom and learn more. There are so many gaps in knowledge.

Q158 **Geraint Davies:** Joe, is there anything that you want to add because you have the independent research?

***Joe Redfern:*** It comes back to the point that Ms Duffield made in the first panel when she asked about trust, and unfortunately Jerry answered that because he is a non-governmental agency. There have been a few events, I suppose, over the past year that has led to that and I think that this is maybe what you are talking about and where our perspective is as we are suffering from this.

The first public meeting we had was on 18 November with David McCandless and his deputy chief, Ian Davies. The main takeaway we got from that meeting was that they told us we should go and collect our own evidence, that we cannot trust the evidence that we are going to be presented by them and by the agencies, go and collect your own

evidence. That was a powerful thing to say and surprising, but that is what led us on to Tim Deere-Jones and pursuing that and getting our own evidence.

At the end of January, we presented that evidence to DEFRA and we said, "We are going to give you a time limit because we are a little bit through this and we want to know what your response is going to be to Tim Deere-Jones's dredging and pyridine theory", bearing in mind that we did not know a lot about it then. There was none of the work from Gary, it was just a theory. We presented that to DEFRA and gave it until 4 February to reply. On the evening of 3 February there was a big press release that came out from DEFRA, the investigation was closed, the algal bloom theory is the most likely cause. That is the only correspondence we got. I had to e-mail them and say, "Is this press release a reply to our correspondence?"

**Geraint Davies:** Unbelievable.

***Joe Redfern:*** I have never ever accused anybody of a cover-up and I do not want to, but from our perspective, when you are struggling like that and you come up against these things where this openDemocracy article had found e-mails that had said they were trying to push through the algal bloom theory as a rebuttal against the dredging theory, it is a struggle, really.

One more point I just wanted to make is about the pyridine theory and the similarities that we have seen in the industry. We have seen exactly the same symptoms with crab and lobsters, not only just the immediate symptoms of the convulsions and paralysis but also the long-term impact. In June 2022, so this summer, the Merchant in Whitby reported a 2,000% increase in dead lobsters in its tanks and the same with the Andrew Beavis. Everybody has been reporting that they are weak and they are showing these long-term symptoms. It is exactly the same geographical area as shown on the dredge plume model from Gary, and it is exactly the same pattern of mortality. In the plume model that Newcastle University produced, the plume starts outside the Tees and it takes two weeks to make its way down to Whitby. That is exactly what we saw. Every single symptom, every single event that we saw happened in the Tees, made its way down to the coast and we experienced it in Whitby two or three weeks later. There are just so many similarities between what has been proven experimentally by Gary and what we observed along the coast.

***Stanley Rennie:*** I have to admit, yes, I have accused people of covering up. When I get reports from CEFAS and the Environment Agency with a photo of an incident that I reported much before the die-offs, when we get reports that crab stocks are up and stuff like that when we know they are not—there is an e-mail here from a merchant on the mortality. He would estimate, "Approximately 10 to 15 kilogram a month we expected, less than 1%, but the animals that were weak when brought in by

fishermen would be put in a hospital tank where more often than not they would be revived and put back in with other stock. Towards the end of May we started to hear more and more reports of weak and dead lobsters. When the boats came in to land, they have had to physically inspect every lobster. They were having to check them every day in the tanks and they had lost 200 kilograms"—this is one buyer—"in one tank". They had to pay the fishermen and there is no recompense for them. Without the merchants we have no living anyway.

We just feel like we are being ignored. If it was anywhere else in the country, we feel that the agencies would have thrown the kitchen sink at it. In the back of beyond up in the north-east, no disrespect but half the people in the country think, "Yes, England finishes in Leeds" but it doesn't, it goes on to Berwick and we can be forgotten. This North Sea is an extinction episode and it just hasn't had anything done. It has not had the commitment of the agencies. To come up with theories, no, that is not good enough.

***Joe Redfern:*** It is the biggest lobster fishery in the whole of York along the north-east and for each of those jobs at sea there are seven jobs that they support on land. It is a huge fishery.

Q159 **Ian Byrne:** How many jobs are you talking about, Joe?

***Joe Redfern:*** What would you guess, David? I think that in Whitby you are talking about 150 connected, so further up the coast—that is just in Whitby alone. David probably has a better estimate, I am not sure.

***David McCandless:*** Yes, it would be in that region.

***Stanley Rennie:*** There is a lot of the fleet being lost in Hartlepool what with the licence cap and the EU boats coming in and plundering the seas and not getting our waters back as we thought. We just hope that it will recover.

***Joe Redfern:*** I did read this morning that £1.1 billion was compensated to the farmers for foot and mouth disease in 2001, £1.1 billion to slaughter those animals, so this is—

**Chair:** I am conscious of time. I will not apologise for going over time because I think that it is important we hear every single word of evidence that we need to.

Q160 **Dr Neil Hudson:** My final question I think you have answered a lot of, so I will wrap it up with a lessons learned final question. Thank you for your powerful testimony. A lot of today has been talking about the worry about the ecosystem, but I was very struck—Joe, I think that you first brought it up—by the impacts on people. It really overlaps closely with our mental health inquiry that we have been doing. We have been looking at acute episodes. You mentioned foot and mouth, infectious disease outbreaks, flooding episodes, that sort of thing, but also chronic stressors in terms of livelihoods as well. It seems to me that what we

have here is an acute episode, but you have said it is ongoing in terms of the fish stocks as well and the stress on people. You have mentioned the word "terrified" a number of times in terms of anxiety. What are your local communities doing to support each other through this? Then a recommendation for us to Government: what can Government do to help people with this real pressure on their mental health?

***Joe Redfern:*** On the first question, what we are doing as communities, first we formed the North East Fishing Collective. That was never a group before and that gave us that platform to work together and support each other. We reached out to people like the Fishermen's Mission to ramp up the support from them in the area. You are right, it has been a massive impact, people worried sick, losing sleep, unrelenting stress. There seems to be a knock-on to physical health as well for people along the coast because there is so much at stake.

On the second question about what Government can do to support, it is just putting those assurances and support packages in place to make sure that the people who have been most impacted by this have the support in place and the support from the Government.

***Stanley Rennie:*** It has been devastating to people but you have to look at health and mental health, haven't you, in the same vision? I might be pleasantly plump but I am a grafter. When the October die-offs came and I had to bring the pots in and there was nothing in the nets—you would normally get lobsters and what have you in the nets but there was just nothing to be had—for about six or seven months I wasn't working. I was waiting for the spring lobster fishery to show, which it did not. Then in the summer is obviously fishery into shore. Then because you are in an activity where you are used to grafting all the time, suddenly you get high levels of diabetes setting in. Now I have got back fishing for the summer, even though it is out of district and I have made nothing, it is back down again.

However, the mental health, I try to keep—from the north end I might bombard the north-east fishery group with e-mails. People send me e-mails saying, "Can you keep us up to date with whatever is going on because it is a big worry for us all?" I am up until 2 or 3 o'clock in the morning sorting e-mails out. I get up in the morning; my wife has been through everything. She gets up at 5 o'clock. She has been through everything. My daughter, Sarah, the mental health of just my wife and daughter, what this has had on them, never mind the fishermen, and for somebody in my position with no training, having grown men phone me upset on the phone and I am trying to give them guidance, it is harrowing, absolutely harrowing. That is how desperate it has been, and people having to sell up, forced to sell up. One of the lads had just bought a load of pots to go potting a couple of weeks before the die-offs occurred and he had to sell the pots. His boat is for sale and still for sale, but they are still suffering their anguish. They cannot get shot of the

boats, some of them. My half-cousin, Phill Coull, he had to sell up. He is a potter; he had to sell up. It is just terrible.

We need to ensure that this does not happen again anywhere else and we need to ensure that it does not happen again with the freeport dredge. The port authority and Mr Houchen and his crowd might be saying that was not a freeport dredge, but what they cannot say is that it was not to accommodate freeport ships, that Orca dredge. Do you know what I mean? It just seems to us that that has tipped the ecosystem over. All we are asking the Government for is help, help for the people affected and help for the ecosystem to somehow try to recover.

**Dr Neil Hudson:** Thank you. That is very powerful.

**Chair:** Rosie Duffield has one last short point, I hope.

Q161 **Rosie Duffield:** Yes, it is. I know that this must be incredibly difficult because you are proud working people, but is there a way that we can tweet out anywhere that people could donate to the community if they wanted to? You mentioned a fund. Is there anything that we could push out there?

***Joe Redfern:*** We do have a JustGiving page that has been paying for the ongoing investigations that we have been doing, and it has been used towards hardship as well. Yes, there is a JustGiving page for the North East Fishing Collective.

***Stanley Rennie:*** We want to thank everybody who has donated to that page. You know something, we would not have been able to get these independent investigations and we would not be where we are now. There are some really generous people and companies. We mentioned the fishermen's company. We have had anonymous donations into that fund of £2,000 and £1,000. The fishermen, the crews, the families who have put anything in, we have said that there are lots of people who cannot afford it and have suffered hardship and if they had a spare ten bob, even that ten bob counts, you know what I mean? That is how we have got to where we are now. I cannot thank all those people and the public enough.

***Joe Redfern:*** That said, and we are very grateful for that, we are going through a cost of living crisis and we should not be looking for people to give us charity. It should be coming from Government support.

Q162 **Chair:** Thank you very much indeed. I think the scientists can argue, as we have heard already this afternoon, but what we cannot argue about is the profound effect that this ecological disaster has had on fishing communities and those on land supported by those fishing communities. I know from my own constituency, which is Whitby, Runswick, those ports do rely on fishing, particularly for crab and lobsters. As a Committee, I think that we need to think very hard about what we have heard.

When this was going on, I was talking to the fisheries Minister, Victoria

Prentis, almost every single day, "What are you finding out? What do you know?" Now that we have the new Secretary of State—I hear that Thérèse Coffey is the new Secretary of State—I think that we need to ask some very important questions to them and find out what more can be done. There is probably more research that needs to be done to find out what exactly happened and not just draw a line under it. Stan, you can have the last word.

***Stanley Rennie:*** The last thing I would like to ask is to Gary. I was shocked last week at the public meeting at Hartlepool, but just to show you how much it has affected the whole ecosystem, could you give us the results of your square metre survey?

***Dr Caldwell:*** Yes. We have been running—

**Chair:** You may not be picked up by the microphone. It is not usual to have somebody else, but if you want to come and sit in David's seat for a second—

***Joe Redfern:*** We need to hear this.

***Dr Caldwell:*** We have been maintaining with Newcastle and Liverpool Universities a long-term monitoring dataset called the MarClim dataset. We monitor a number of sites around the UK and this is its 20th year. We analyse and collect data once a year in the summertime, in August. We have not had time to go through all the data yet, but we have pulled out the data just for the barnacles alone. Barnacles, if you know anything about marine organisms, are about as hardy an organism as you can ever hope to get. In fact, there is a billion dollar industry developed to find ways to kill them, so they really are as hard as nails. Yet there is a virtual extinction of the barnacle population at the Staithes site, which is halfway down the plume. Sites to the north and to the south are unaffected, but there is a virtual extinction and there is a complete loss of recruitment. This event happened and coincided with the natural breeding cycle, so not only have the adults at the Staithes site been killed, the entire next generation has been wiped out.

***Joe Redfern:*** Also note they are crustaceans as well so they are in the same—

**Chair:** I think that we will have to draw stumps there. Thank you very much indeed to this panel. You have been absolutely clear in what the problems are and, as a Committee, we will certainly consider what further steps we should take, having heard that evidence.