

Science and Technology Committee

Oral evidence: [Ocean acidification](#), HC 860

Wednesday 22 March 2017

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Members present: Stephen Metcalfe (Chair); Victoria Borwick; Jim Dowd; Chris Green; Dr Tania Mathias; Carol Monaghan; Gareth Snell; Graham Stringer; Matt Warman.

Questions 93 - 150

Witnesses

I: Dr Thérèse Coffey MP, Parliamentary Under-Secretary of State for the Environment and Rural Life Opportunities, Department for Environment, Food and Rural Affairs; and Professor Ian Boyd, Chief Scientific Adviser, Department for Environment, Food and Rural Affairs.

Written evidence from witnesses:

- [Department for Environment, Food and Rural Affairs](#)

Examination of witnesses

Witnesses: Dr Thérèse Coffey and Professor Ian Boyd.

Q93 **Chair:** Good morning. Welcome. Thank you for joining us for the final session of our ocean acidification inquiry. Perhaps for the record you would state your name and in what capacity you are here before us this morning.

Dr Coffey: I am Thérèse Coffey. I am Parliamentary Under-Secretary of State at DEFRA with special responsibility for the environment and rural life opportunities, but in this case environment. I took on the marine conservation brief when we did a shifting of portfolios last July. I should be clear at the beginning that, while I have marine conservation overall, there are certain aspects connected to fish on which Minister Eustice still has the main focus, but I will do my best.

Chair: Thank you very much.

Professor Boyd: I am Ian Boyd, chief scientific adviser at DEFRA.

Q94 **Chair:** Welcome and thank you very much for joining us. We will start with the reasoning behind the UK ocean acidification research programme established in January 2010. What prompted it? What were its aims?

Dr Coffey: I am led to believe it all started with something at the Royal Society. It was decided, because we are an important coastal marine state, that the UK would instigate the research programme as part of its, in effect, global leadership, which we want to maintain. We managed to work with partners from Germany, the United States and some other European countries and in partnership with the research council—NERC. The intention was to understand that area of science better, recognising it was an emerging theme—the fact that the sea is alkaline but its alkalinity is reducing slightly, significantly more so in the last 50 years.

Professor Boyd: Yes. I agree entirely with what the Minister said. The 2005 Royal Society report highlighted some real challenges from ocean acidification but also some gaps in our knowledge. As soon as you have gaps in knowledge, one tends to roll back to a very precautionary position with respect to the kind of policies one can put in place. From a UK perspective, as the Minister said, we wanted to take a global lead on trying to inform ourselves much better about what ocean acidification really meant, particularly in a policy context. As a result of the UK ocean acidification programme, we are now in a much better position to know where the risks lie and to design policies that are much more fit for purpose.

Q95 **Chair:** The programme has finished now, has it not?

Dr Coffey: That particular phase of the research was done. It was a five-year programme. It was comprehensive in assessing that, and a key outcome was that carbon dioxide is the driver. Whether or not you want



to do more specific research on knowing something to the nth degree, we know the challenge that is ahead of us. The next useful element of looking at oceans in this regard was to consider acidification's interdependencies with other marine stresses, whether it has, depending on whether you are a chemist, catalytic effects, or if you are a biologist, synergistic or antagonist effects. That interdependency is now the next phase of looking at the impacts.

Q96 **Chair:** You said we wanted to be a global leader in this area, and that is what lay behind the programme and support for it. Is there a danger that the expertise that was built up over the five years of the programme will be lost, or do you think the programmes you are now talking about will lift up those experts and bring them on to continue to lead the world in this field?

Dr Coffey: It is fair to say that the evidence we gathered has now been entered into the agenda, whether it is looking at marine frameworks, evidence that went into the convention on biodiversity, particularly thinking of Aichi target 10, or other elements where we have been working with other people—I think we also submitted to OSPAR. To some extent, it is firmly on the agenda; it is on the G7 agenda. The next phase is the natural step: what are we going to do about it? We know clearly about the carbon that we need to do—the carbon dioxide. We now need to understand further, because there are still things to understand in the marine food supply chain, and what stresses are there. Just looking at acidification in isolation will not help us develop the mitigation strategies we need for the future.

Q97 **Chair:** Have the discoveries had any impact on DEFRA policies yet?

Dr Coffey: I would suggest they have. It has reinforced the need for us to continue to work with BEIS as the lead on addressing climate change, with particular focus on CO₂. Ian, do you want to add some more?

Professor Boyd: Yes. The CO₂ emphasis is the most important one. It has allowed us to focus our attention on what works and what might not work, so the CO₂ one is the driver. As the Minister said, the synergy or the antagonism between ocean acidification and other stressors in the system is really important.

To go back to your earlier point about what it has done for the UK as a leader in this field, we have trained a lot of PhD students, for example, in the area. Those PhD students have generic skills that cut right across ocean acidification and a lot of other areas of marine biogeochemistry, and they can apply them in a broader sense. Within the context of the science funding that already exists from Government, and particularly through the Natural Environment Research Council, those professionals have an opportunity to develop their skills and their discipline in the future through the normal funding routes that we have for marine science.



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Q98 **Chair:** When the Minister talked about the next phase, is that what you mean as well? Can you give us an indication of what that next phase might look like, and perhaps the Minister can as well?

Dr Coffey: It links to the Shelf Sea Biogeochemistry programme of work. There is also another programme called PLACID, which is putting ocean acidification in a marine fisheries context. We are continuing to use evidence and outcomes from the research initially, as well as those further developments in what really needs to be a global response. A key thing, which I am sure your scientific experts in the first session shared with you, is that the impact varies according to where you are in the world. There are greater impacts happening on the Pacific side; there is a much greater impact on their aquaculture than we are seeing in our waters. Understanding that and thinking about whether we need to develop work with the overseas territories are some of the things we might want to take forward, but it is really important that it is on the G7 agenda, because it needs to be tackled globally.

Q99 **Chair:** Recognising that and the fact that resources are finite, where would you say the importance of further investigation in this field lies from a DEFRA perspective?

Dr Coffey: We are conscious that the health of the oceans is really important for biodiversity. Acidification is one element of a stressor on that, so it is about combined work, understanding the differences in what is happening with temperature, acidification and other stressors, to understand better the impact on our biodiversity. That is where it comes in from the DEFRA angle. BEIS will take the natural lead about climate change, being in effect the owner of that overall, focusing on its carbon policies.

Q100 **Chair:** Is it high on the list of priorities? That is what I am getting at. Compared with other areas for which DEFRA has to take responsibility, how important is this? Is it something you are actively looking at or is it something you think requires a global response and therefore is not really high on DEFRA's list?

Dr Coffey: Marine conservation is certainly high on our list. You will be aware of the manifesto commitment about the blue belt and increasing that element. It is fair to say that DEFRA's and my top priority is addressing air quality, but there is a substantial amount of work ongoing in the marine science area, so it is still important for us. However, if you were asking me today what I would choose, I am choosing to devote my time at the moment to air quality, but that is not necessarily about loads of science but about the focus of my policy mind. As I said, marine is an ongoing situation where we are undertaking all that work on the blue belt.

Professor Boyd: Maybe I could expand slightly on that. From a DEFRA perspective, we see a lot of different stressors in the system. There is temperature, oxygen saturation in the water column—or desaturation in



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the water column—and pollutants and ocean acidification. Ocean acidification sits in there with all of those, and we have to look at them for their relative impacts. Right now with respect to a UK focus, temperature is probably the biggest driver around the change that is going on, but temperature and acidification vary with each other, so it is not that it is not a focus. With a UK overseas territories focus, however, acidification is very important because of its impact on coral reefs. It depends which focus you use.

Q101 Dr Mathias: Minister, I am very pleased that you are focused on air quality, and lots of people living under the Heathrow flight path are grateful to you for that. On the acidification programme, we were told there was not a lot of research in our overseas territories. Is that true and, if so, why?

Dr Coffey: It is accurate to say that most of our focus has been around our coastal waters in the United Kingdom. Clearly, the overseas territories are an important part of the wider blue belt, and it may be that there will be opportunity in the future to develop our understanding of what is happening around Bermuda or Pitcairn where there are particular reefs, but obviously Bermuda has a role to play in instigating that.

Q102 Dr Mathias: DEFRA's written statement said that "it would be desirable to have...monitoring in...Overseas Territories." Is there analysis on how much that would cost? Do we have 14 overseas territories? Is that right?

Dr Coffey: Off the top of my head, I cannot remember exactly how many overseas territories there are. As the Government have put across, it is desirable. I am not saying that it is going to happen in the next month or two, but it is something that is being considered and it may be—Ian and I were discussing just yesterday whether it could be—eligible for some support from our Darwin Plus initiative. But at the moment—

Q103 Dr Mathias: You are looking into the funding.

Dr Coffey: It is probably a little too early—we are talking about ideas—to talk in terms of numbers.

Professor Boyd: We have to be a bit careful about jumping to conclusions that need monitoring in all our overseas territories. This is a global problem and we need monitoring on a global scale, but we need to think carefully about how we want to do that monitoring. One of the great advantages of the UK ocean acidification programme is that we now have sufficient understanding to be able to design a monitoring programme that is fit for purpose at a global and local scale. One could imagine a programme that includes the overseas territories but is hierarchical in the way it looks at ocean acidification on different scales. A lot of work needs to be done as a result of the outputs from the ocean acidification programme to understand the best way to look at that. It is probably better to look at it through the G7 or the OSPAR processes, because we need to partner with a lot of other countries to do it effectively.



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Q104 **Dr Mathias:** Bearing in mind our blue belt and our territories, are we not in the prime position to lead on that?

Dr Coffey: I should probably correct something. I may have indicated that nothing is happening in Bermuda. There is stuff happening in Bermuda.

Q105 **Dr Mathias:** As we know, Bermuda is funded by the US. Are we looking into collaborating with other nations to see how they would fund more monitoring?

Dr Coffey: Those discussions are ongoing as part of the G7 process about how we engage a wider number of countries in this. Ian made an important point about having an agreed way to move forward on the actual monitoring, whether that needs to be continuous, whether you can do it gridded, where you can sample and so on.

Q106 **Dr Mathias:** It just seems that we are in a unique position.

Dr Coffey: We are in a position to provide global leadership and that is what we are doing, but things do not necessarily happen as quickly as one wants.

Q107 **Graham Stringer:** I do not suppose, Minister, you have had time to read through the written submissions to the Committee.

Dr Coffey: Not all of them, I am afraid.

Q108 **Graham Stringer:** That does not surprise me. It was not a trick question. If you had, you would have seen that some of the university submissions are completely consistent in what they say about monitoring. They say the most valuable monitoring is to have a long time series, over different seasons and with other variables as well as acidity; as well as pH, you need acidity, salinity and temperature. Both you and Professor Boyd seem to be saying that that is not the case and that you have to think about this, and that the series you did in the acidification programme has stopped and will allow you to design new programmes. It is simple: you just need a large number of series over time.

Dr Coffey: It might be best if Professor Boyd answers this one, if that is okay, if you want to know the research methodology.

Professor Boyd: With respect, I do not think it is that simple. We need long-term time series, so I agree with the submissions on that. The question is: how many and where? Those are questions that the community needs to look at very carefully, because there is a cost-benefit trade-off. Those types of monitoring stations are not simple or cheap to run. We have some over the UK continental shelf and they operate very well, but we need to look quite seriously at the question of where they need to be. We want to keep them going over the long term, if we possibly can.

Q109 **Graham Stringer:** How many do we have?



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Professor Boyd: We have two that operate at the moment. There is L4, just off Plymouth, and Marine Scotland works off Stonehaven. There are two stations, one on the western approaches and one in the North sea. There is a question as to whether that is enough, and we need to address that question. At the moment, we do not have an answer.

Q110 **Graham Stringer:** We have a lot of sea and coast. There is enormous variability in both temperature and pH around the coast. I am not an expert in this area, but two, given the length of coast we have around the United Kingdom, seems relatively trivial when there is potentially a threat to our fish and mussels and to all sorts of commercial activities around the coast.

Professor Boyd: It depends what question you are asking. If the question you are asking is what are the long-term trends—

Q111 **Graham Stringer:** I am asking what we know and how we can know what we know if we do not monitor.

Professor Boyd: I am a scientist and I ask questions, and I want answers to those questions with the best methodology available. It depends what question you are asking. If the question we are asking is what the long-term trend of ocean acidification is around the UK, two are probably enough to be able to answer it. What you must understand is that two stations are our measured points in a broad understanding of what the ocean is doing, mainly through ocean modelling. We have a broad understanding, so you could predict from two points what is happening elsewhere, depending on our understanding of the variability of pH in the ocean as a result of upwelling, ocean currents and coastal effects and those sorts of things.

We need to work on making sure that that understanding is sufficient, but simply putting monitoring stations in places where we are not quite sure whether they are going to have a useful output is not something we should be stepping forward to do right now. We need to do the analyses to understand what the appropriate numbers are and where to put them.

Q112 **Graham Stringer:** That is very interesting. It is not in the written evidence. Could you send us references to the modelling?

Professor Boyd: Could you say that again?

Graham Stringer: Could you send us references that would enable us to look at how the modelling is done and how accurate it is?

Professor Boyd: I can certainly send you references to ocean modelling. That is no problem.

Q113 **Graham Stringer:** There is only one observatory dealing with carbonate chemistry, and that is at Plymouth. Do you think that is sufficient as well?

Professor Boyd: I would love to see more monitoring stations around the UK. However, I would also want to see the rationale for how many we



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need, what they need to measure and where they need to be. Right now, I have not seen that rationale.

Q114 **Graham Stringer:** Whose responsibility would that be? Is that not a departmental responsibility?

Professor Boyd: The scientific community is perfectly capable of producing that rationale.

Q115 **Graham Stringer:** As well as pH, the concentration of carbonate ions is absolutely critical, isn't it, to the build-up of shells on shellfish?

Professor Boyd: Absolutely.

Q116 **Graham Stringer:** That is what the station at Plymouth is doing. Why would we not be looking, say, in the Menai straits where there is a lot of sea shellfishing? Why would we not be looking at what is happening there?

Professor Boyd: One could do that and maybe we should do that, but I go back to what I said: I have not seen a justification for necessarily doing that. The outputs from the UK ocean acidification programme suggest right now that the risks relative to some other risks from other factors in the marine system, such as temperature, tend to be relatively small. Admittedly, shellfish are likely to be affected more than finfish, for example, but whether measuring next to shellfish beds is useful to do in terms of formulae about the management of shellfish is something that, I think, has not been decided.

Dr Coffey: I think I am right in saying, Ian, that the CEFAS analysis, building on the UKOA and the PLACID programme, is that temperature is the main driver on our commercially important species rather than acidification, but this is where, as I say, the further work that we are taking under the SSB helps us to understand the interdependencies of the different stressors. That is the intention of it anyway.

Q117 **Graham Stringer:** Just before you came in, Minister, we had people talking about the future space programme. The point about that is that there is a national space agency that looks across the issues. Do you think there should be a national body looking at our oceans that might help you and Professor Boyd ask the right questions and come to the right conclusions? Do you think bringing everything together would be helpful?

Dr Coffey: I think CEFAS undertakes quite a lot of that role.

Professor Boyd: In the UK, we have some excellent marine science institutions: CEFAS, the National Oceanography Centre, Plymouth Marine Laboratory and Marine Scotland, for example, are all excellent. They already act as a single unit in many areas.

Q118 **Graham Stringer:** I agree with that. The question is: do you think we would benefit from a formalisation of that into one agency that could be



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focused and deal with some of the points you have been making about where we have an absence of knowledge?

Professor Boyd: If we were to start from a clean sheet of paper now, I do not think we would have the distribution of agencies that we have, but the question is whether it would be desirable, with the disruption it would cause, to throw a lot of those agencies together. There is some strength in diversity as well.

Dr Coffey: CEFAS is supposed to be our UK Government's main lead on that. Marine Scotland is under the auspices of the Scottish Government. With the level of working we have, I agree about structural change: will it make a difference to the outcomes they have by working together? I would be more interested in focusing on the outcomes than the structures.

Q119 **Graham Stringer:** I have a final question. You said that as far as you are concerned, the most important variable is temperature.

Dr Coffey: That was CEFAS's analysis of commercially important fisheries, yes.

Q120 **Graham Stringer:** Do you have information that you can send us about what the threats of temperature, pH and carbonate ions in the sea are to both shellfish and finfish?

Dr Coffey: I am going to turn around to find whether we have any useful information that we can share, because quite a lot of this is, "We don't know," which is why we are doing more interdependency research. We might be able to come up with something that could help inform the Committee.

Graham Stringer: Thank you.

Q121 **Carol Monaghan:** The evidence we have had is that shellfish are greatly affected. On the information that you have given us just now—that it is warming that affects fish—are we talking particularly about fish-fish rather than shellfish?

Dr Coffey: Shellfish are more affected by acidification. Interpretation of the analysis shows that shellfish are more affected than finfish in regards to acidification, but the overall analysis in the CEFAS assessment so far is that temperature has a greater impact than acidification.

Q122 **Carol Monaghan:** Even on shellfish.

Dr Coffey: Yes. That is my understanding, but, if I am incorrect and I have misinterpreted what I have heard from CEFAS, I will inform the Committee.

Q123 **Jim Dowd:** In response to Graham's questions on coastal waters and how important they are, particularly to an island nation or nations, you covered a lot of the ground I was going to ask about. Can I look at the connected issue of nutrient pollutants around our coastal waters, which of



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course is critically important to industries and communities on our coasts? Do you recognise that as a considerable problem, and what is DEFRA doing about it?

Dr Coffey: I gave my caveat at the start: when it comes to the preservation of fish stocks, Minister Eustice takes the lead on that side, but Ian may be able to impart some scientific assessment.

Professor Boyd: Nutrient pollution is a significant issue. Obviously in a policy context, controlling nutrient pollution is a terrestrial issue, so it is one for the Environment Agency, because most of the nutrient pollution comes down our rivers from sewage outlets, farming and that sort of thing. Once it gets into the ocean, its effects are essentially to culture algal blooms. Those algal blooms suck up oxygen a lot of the time and will change the ecology of the coastal seas and the oceans. That can cause deoxygenation and, as a result, could affect various aspects of our fish stocks and have commercial impacts.

To respond to your question about what we are doing about it, the constraints that the Environment Agency puts on those who emit nutrients in the terrestrial system are the main policy lever to reduce those effects. Basically, that is it.

Q124 **Jim Dowd:** What about any pressure—it might be a different department but still within DEFRA—to encourage agriculture, farmers, to have more regard to what they are putting on the land and therefore, ultimately, what will end up in the seas?

Dr Coffey: We have just issued, or will shortly be issuing, guidance with a mind to trying to make sure that we continue to avoid pollution run-off and pollution getting into the water environment. That is something we take seriously. It will also help things like soil health if we can work with farmers to make sure they are fully up to speed with the latest and best ways of achieving that, which would have multiple benefits—as I say, improving soil health and yield and reducing run-off and pollutants into the water environment.

You were talking about nutrients more broadly. From some of the other work, the bad news is that apparently acidification is great news for jellyfish, but we are uncertain about—

Jim Dowd: They are of limited nutritional value.

Dr Coffey: Exactly and that is why I am saying it is bad news, because it is great for jellyfish. We still have to understand our work on things like plankton, seaweed and other elements of the food chain in the marine environment.

Q125 **Jim Dowd:** Finally, we heard evidence in a previous session that the National Oceanography Centre, for one, had tried to collaborate with the Royal Navy but ran into various technical issues. They are already working with ferry companies and other shipping agencies, but



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apparently there are technical and insurance barriers preventing their collaboration with the Royal Navy. Is DEFRA aware of that issue and, if so, have you tried to speak to the MOD about it?

Dr Coffey: I am not personally aware. I will have a quick looksee through the Q and A, but I am not aware that it has been drawn to my attention.

Q126 **Jim Dowd:** If you do not have the answer immediately, that is fine, but perhaps someone could address that and say whether you have or not.

Dr Coffey: We will look carefully at the evidence given by them and see what we can do.

Q127 **Chris Green:** Some of the points I wanted to raise have already been touched on. In terms of global leadership there would be a certain expectation of continuity in our funding and resources to laboratories and the people in those laboratories. Water samples collected in the UK to monitor ocean acidification were analysed at the National Oceanography Centre until the funding for that facility was ended last year. Is there any point in monitoring our seas if we cannot analyse the data collected?

Dr Coffey: My understanding is that that particular laboratory was established to go with the programme, so, when the programme finished, the funding for that particular laboratory finished in regard to assessment, but there are other places in the United Kingdom that have the facilities to do that. If it is a growing area, obviously, there will be opportunity, potentially, for more.

Q128 **Chris Green:** It does not sound consistent with global leadership if you develop skills and experience in a department over a period of time, a project comes to an end, those people presumably go off and get different jobs, the facility is mothballed, and then at some point in the future you open it up again. Dr Poulton said, "We are still analysing samples on an ad hoc basis." There may be facilities that can be used, but surely it is not as good as having a specialist facility geared up specifically for the task at hand.

Dr Coffey: You will be aware of the way a lot of funding happens; it happens for programmes. As far as I am aware, the laboratory is still there and they are developing their capabilities. It is just that the specific funding connected to that was connected to the UKOA programme. That is kind of how funding of research projects happens.

Professor Boyd: Can I talk a little about what global leadership means? It does not always mean Government stepping in and saying, "We want it done this way." It means that Government overall are creating a marine science community that can lead on behalf of the UK. What is happening is a very good illustration of that actually. The Government have had a programme of work on ocean acidification, a laboratory was set up under that programme of work, the programme of work comes to an end, but it has stimulated the community to work at a higher level. We are now



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seeing the community self-organising to provide that analytical capability. It is actually at Plymouth and in Scotland—Marine Scotland. That is exactly what should be happening. We stimulated the process, and the community itself is driving it forward in future. We would obviously like to keep an eye on it, but the fact is that the UK will have the capability in the future and it will be self-generated from within the science community.

Q129 Chris Green: Professor Boyd, what is your role in identifying the scientific areas where DEFRA needs to develop its understanding and national research capabilities, and how do you prioritise that?

Professor Boyd: My role in that is partly because I have oversight of all DEFRA's policy areas and am continually looking at how those policy areas would benefit from science input. I also sit with fellow chief scientific advisers in other Departments and very regularly meet the Government's chief scientific adviser, Sir Mark Walport, to look at that in a cross-departmental context as well.

Over the last year or so, we have been developing generalised statements about what Government need in terms of research in different generic areas and, as a result, we are able to articulate what central Government are interested in for science, and we can have productive discussions with research councils, for example, about where their priorities might lie. I sit on two of the research councils, and that is where those discussions happen. I am there to translate the ideas that DEFRA has for science, to support its policy into a form that can be digested, if you like, by the research councils and the wider research community.

Q130 Chris Green: They set the priorities.

Dr Coffey: I was about to say that Ministers also get a bit of a say.

Professor Boyd: Absolutely.

Dr Coffey: We had an exchange not long ago about our priorities. Although DEFRA may not have the answers to everything on a particular issue, such as air quality or resource efficiencies—another paper you have done recently—we say, "These are our priorities, so let's try to see what we can do to support some of that, if science is going to help us achieve the outcome."

Q131 Chris Green: The Natural Environment Research Council told us that it is currently assessing what its national capabilities should be, such as facilities for testing the carbonate chemistry of oceans. How much does DEFRA feed into that?

Dr Coffey: That is a good question.

Professor Boyd: We feed into that. We feed into it at the strategic level, in terms of DEFRA making sure that the Natural Environment Research Council is aware of where our major interests lie, one of which is in ocean



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acidification. We also feed in at various other levels, at official level, where we have strong liaison between ourselves and the Natural Environment Research Council. Some of the people who do that job are sitting behind me now, and they do it extremely well. There is continuous dialogue between ourselves and the Natural Environment Research Council about trying to make that work for the country as a whole.

Q132 Carol Monaghan: I understand that DEFRA funded the PLACID programme, which places ocean acidification in a wider fisheries context, if I have that correct, to understand the social and economic impact of acidification. Do we now have a good grasp of how acidification will impact the UK fishing industry, or are there any gaps in knowledge that we need to look at?

Dr Coffey: CEFAS pulled together their analysis from that, and that is where the response I gave about temperature being the primary driver rather than acidification came from. I am sorry, remind me—

Q133 Carol Monaghan: Are we happy that we have a good grasp of how this is going to affect the fishing industry?

Dr Coffey: It is fair to say that there are still—which were the two species that we were relaxed about? Was it herring and—

Professor Boyd: The work was done on herring and sea bass, I think.

Dr Coffey: We are very relaxed about herring and sea bass. We think there is not going to be much impact at all. There is, as was highlighted earlier, more impact on shellfish. We have not seen the same changes that have affected, say, the Pacific, where there has been a significant impact on their aquaculture. I understand that further work is happening, because we are seeing smaller growth, and we need to understand the impact of that for the future development of the industry and the wider marine environment system. It is fair to say that there are still questions that need to be investigated further. At some point, you will get a beautiful copy of the document I have here, which I think is fairly hot off the presses. Those are the kinds of emerging issues we want to look into.

Quite a lot of the work that CEFAS did was looking at food webs, which is the way they describe it, and recognising that there are challenges. There are some species that I must admit I had never heard of—pteropods—that are key to food chains. Looking in more detail at some of the impacts—the multiple stresses—is the next phase of the research, as far as I am aware.

Professor Boyd: Maybe I can amplify that a bit. The impact on fish and fisheries is much less likely to be because of acidification itself on fish. It is much more likely to be through the food that the fish eat, because many fish are planktivores, and even if they are not planktivores they rely on planktivores. The Minister mentioned pteropods. Fish tend, in our system, to be reliant on pteropods for a very short time of the year, but that might be just what they require in order to get through winter, for



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example, so there could be impacts. You asked about gaps, and right now I think there is a gap in knowledge there.

We have modelling systems that allow us to understand roughly what the removal of pteropods might do to finfish, but marine systems, like many ecosystems, have ways of compensating for those sorts of things that we do not fully understand, so it could be that there is relatively little long-term effect. On the other hand, we know that there are sometimes tipping points in the system, and it could change very rapidly. We have a lot of uncertainty about that.

Q134 Carol Monaghan: If I could go back to Graham's earlier question, you gave evidence about the effects of warming, but there was a 2016 study, which I believe was part-funded by DEFRA, that reported that acidification and warming together could reduce the UK's fish and shellfish by 30% by 2020. That is a hugely worrying statistic. How is DEFRA acting on that finding?

Dr Coffey: I will not pretend I am aware of that study, so I will have to get back to you.

Professor Boyd: I am not aware of it either. It sounds to me like an extreme. What we know of the response of shellfish—the kind of shellfish that we would normally farm in the UK: oysters and mussels, and so on—is that they have more capacity to acclimate and adapt than we previously thought. That is partly because of their physiology. I would like to see that study and understand whether it was really taking the acclimation process into account.

Q135 Carol Monaghan: I am looking to the Clerks. I am sure it can be found. The Marine Science Co-ordination Committee is due to review the findings of the PLACID programme, but it only meets twice a year. Is that frequency enough to fully evaluate what is happening and address the study's findings?

Dr Coffey: I am not aware that we limit the committee to meeting only twice a year. If the committee felt it wanted to meet more often, it would be open to it to do so.

Professor Boyd: It has four sub-committees as well that meet throughout that period of time, and there is a continuous process of dialogue. The plenary sessions are important, but it does not mean that work only goes on at those particular meetings. There is a lot of work that goes on between times.

Q136 Carol Monaghan: It is not as stark as it would appear to be.

Professor Boyd: It is not as stark as it looks.

Q137 Carol Monaghan: Okay. This is my final question. DEFRA submitted evidence to this Committee that said that the Marine Science Co-ordination Committee was going through a "strategy refresh." What is



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that and why is it happening?

Dr Coffey: It is normal for all our organisations to review their focus from time to time.

Professor Boyd: Yes. Soon after the Marine Science Co-ordination Committee was set up in 2010 or 2011, they produced a UK marine science strategy. It was thought that it is time to have a look at that and to refresh it, basically, which I think is very sensible.

Dr Coffey: It is not about trying to stop anything. It is just a convenient time.

Q138 **Victoria Borwick:** Taking us back to the G7 in 2016, my understanding was that the G7 science Ministers agreed several actions to address sustainable development goal 14 on the oceans. Can you give us a quick update on what progress has been made on implementing those recommendations?

Dr Coffey: My understanding is that we continue to work with our partners in trying to progress those aims, but I do not have specific actions that I can share. We contribute, apart from what I referred to earlier, and we have been presenting our findings for the different scientific conventions, such as the CBD, sharing that information with others and sharing it with the EU. In terms of progressing our knowledge about the oceans, that is probably where we have made the most contribution.

Q139 **Victoria Borwick:** You said progressing our knowledge—just so that I have understood.

Dr Coffey: Yes.

Q140 **Victoria Borwick:** Are you concerned that forthcoming cuts or any other changes to your financial arrangements will limit our ability to implement those?

Dr Coffey: Can you say that again?

Victoria Borwick: Are you concerned that financial cuts might restrict our ability to implement the actions?

Dr Coffey: You will be aware that we are a Government who aim to try to live within our means and we have to prioritise where we do that, but my expectation is that science will continue to have an important role as part of our innovation and technology, and will contribute to our industrial strategy. I am not the science Minister, so I am not going to talk about his budget.

Q141 **Victoria Borwick:** No. Thank you for that reassurance. A number of our previous witnesses suggested that the UK could offer to co-chair the informal preparatory groups for sustainable development. Do you happen to know if DEFRA has been in touch with the United Nations at all about that possibility?



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Dr Coffey: To co-chair the—

Victoria Borwick: The informal preparatory groups on sustainable development goals—sorry, I am not speaking very clearly at the moment.

Dr Coffey: I understand that Carol Turley, who I think gave evidence to you, is a member of the SDG. We certainly will be sending people to that, but I am not aware of us co-chairing anything. If I find out more information, of course I will update the Committee.

Q142 **Victoria Borwick:** No problem. It is a way of getting involved without necessarily—

Dr Coffey: We are involved; let's put it that way.

Victoria Borwick: Okay. That completes my brief.

Q143 **Gareth Snell:** In 2016, the Government announced that they had a plan to double the area of ocean under marine protection around our 14 overseas UK territories. Are you able to update us on how successful the Government have been in implementing, managing and monitoring those protection areas?

Dr Coffey: The decision has been taken forward with our overseas territories, and it is important that they are heavily involved. It is fair to say that we are still considering our management proposals for the blue belt, and we hope to conclude that this year so that we can get on with the measures that we intend, to get the outcomes we are seeking on increasing biodiversity; so, it is nothing done yet.

I should have said that it is a pleasure to meet you for the first time properly.

Q144 **Gareth Snell:** You come from an excellent county, second only to Staffordshire, of course.

Obviously, there are a number of overseas territories so it is impractical to try to implement everything everywhere at the same time. Do the Government have any form of hierarchy of preferred overseas territories where they wish to start the process?

Dr Coffey: Bermuda has had an ongoing programme. I think Ian was referring to the fact that we need to identify exactly which elements we want to observe, and how that would help improve global knowledge. I am not aware of the progress we have made specifically on some of the other overseas territories. Obviously there is the British Antarctic stuff that has been going on for 70 years. I was under the impression that we were looking at Pitcairn.

Professor Boyd: Yes. There is the Indian Ocean Territory as well, the Chagos archipelago.

Dr Coffey: Yes, I apologise.



Professor Boyd: All those are important. I am going to repeat myself slightly, in that I think we are not yet in a position to say where the priorities lie; but, with respect to ocean acidification, clearly warm water coral reefs are very vulnerable and we would want to satisfy ourselves that we had sufficient ongoing knowledge about the potential impacts of ocean acidification on warm water corals, and the effect that might have on the economy of the overseas territories.

Q145 **Gareth Snell:** Given some of the stark statistics we have heard throughout this evidence session this morning, and given—you are quite right—the vulnerability that some of those quite complex ocean habitats find themselves in, what sort of timescale are the Government looking at to start implementing some of the expanded MPAs in the overseas territory areas?

Dr Coffey: Some of the MPAs have already been designated. I know the one in Pitcairn has. It is about moving to the actual management measures, which I think took some time to agree, and we need to bottom that out and then progress. Then we can use it as monitoring to see the effectiveness of it. We are hoping to try to get that—

Professor Boyd: Some of these are extraordinarily isolated places. One of the things we are looking at is using Earth observation satellite capabilities to provide us with as much information as possible about those areas.

Q146 **Gareth Snell:** I don't want to push my luck, but I would like to press for an indication of a timescale. I appreciate there is a lot of work to be done, but if you were able to have everything lined up correctly as you would want it, when would you be aspirational about saying those will be in place, or that at least one or two of them will be fully designated with a proper management process? Ideally, what would you be aiming for?

Dr Coffey: Within 12 months.

Professor Boyd: For full management capability for some of those areas, 12 months is a big ask. In 12 months, we could have a plan in place. To get actual implementation will take—

Dr Coffey: The officials behind me are getting worried now.

Professor Boyd: Incrementally, it would take a lot longer than 12 months to get management in place. It is an incremental process. Understanding what we can do with the resources we have here and now—for example, I mentioned satellite imagery, which is mostly available for these areas—we could probably do things quite quickly, but actually having people and assets on the ground is something that is going to take quite a lot longer.

Q147 **Gareth Snell:** I do not wish to be belligerent about it, but when you say quite a lot longer—



Professor Boyd: I will give you an idea of the timescales. The kind of assets we have are the sorts of ships that are run by the Natural Environment Research Council, for example. Their programming is done three to four years ahead. If we wanted to do a programme in Pitcairn or in the Indian ocean, it is those sorts of timescales to get assets on the ground. There are practical limitations to the rate at which you can do those sorts of things.

Q148 **Gareth Snell:** Thank you. I have one more question, if you will indulge me, Chair. It is linked to the point you made earlier, Professor Boyd, about your networking with other chief scientific advisers across various Departments. I am told you have been an adviser since 2012.

Professor Boyd: That is correct.

Q149 **Gareth Snell:** How have you seen the network of chief scientific advice develop over that period of time, and what do you think could be done better to integrate scientific advice across all Departments?

Professor Boyd: It is evolving continuously, partly because there is continuous discussion across Departments between chief scientific advisers, and we are gaining a much better common understanding of the significant differences between Departments about how they use scientific advice and how they use chief scientific advisers as well. That difference is quite good.

How could it be done better? We have the creation of UKRI coming up and, from the point of view of a departmental chief scientific adviser, I would see it as a huge opportunity if UKRI and the research councils that sit within it were very engaged with the agendas of Departments of State in general and the chief scientific advisers could act as the liaison between the Departments into which they have a significant insight and the UKRI priorities. That is what could be done better, and I think we have structures coming into place that will allow it to be done better.

Q150 **Chair:** Thank you very much indeed. Thank you for joining us this morning. I am sure you look forward to seeing our report—and the recommendations—in due course.

Dr Coffey: It was a pleasure to be at the Science and Technology Committee.

Chair: Thank you for joining us this morning.