HOUSE OF LORDS

Science and Technology Committee

Corrected oral evidence: Nature-based solutions for climate change

Tuesday 14 September 2021

11 am

Watch the meeting

Members present: Lord Patel (The Chair); Baroness Blackwood of North Oxford; Baroness Brown of Cambridge; Viscount Hanworth; Lord Holmes of Richmond; Lord Kakkar; Lord Krebs; Lord Mitchell; Baroness Rock; Lord Sarfraz; Baroness Sheehan; Baroness Walmsley; Baroness Warwick of Undercliffe; Lord Winston.

Evidence Session No. 4 Virtual Proceeding Questions 37 - 50

Witnesses

Professor Hilary Kennedy, Emeritus Professor, School of Ocean Sciences, Bangor University; Professor William Austin, School of Geography and Sustainable Development, University of St Andrews; Professor Rick Stafford, Marine Biologist, Bournemouth University.

USE OF THE TRANSCRIPT

Examination of witnesses

Professor Hilary Kennedy, Professor William Austin and Professor Rick Stafford.

The Chair: Good morning to our witnesses, Professors Kennedy, Austin and Stafford. Thank you very much for joining us today. We are enormously grateful to you for making time to help us with our inquiry with the next session. I think I am on the right page now. Lord Krebs, please.

Q37 **Lord Krebs:** Thank you to our witnesses for joining us to give evidence. I want to kick off with a general question about carbon emissions and carbon storage in the marine systems. What is the potential scale of the contribution of marine nature-based solutions to greenhouse gas abatement or sequestration in the UK, and what are the uncertainties in your estimates?

Just to give a bit of context to this, looking at the numbers in our briefing, the ONS estimates that the total potential is somewhere between 10 and 60 megatonnes of CO_2 equivalent per year, but when I add up the numbers for sediments, kelp salt and seagrass, it comes to about 3 megatonnes. So I am puzzled by that discrepancy. Setting that against what we have heard about peat, it seems as though the marine system might be a bit player compared with the potential of peat. That is my perception. Could I start off with Professor Stafford and ask him to give us a view?

Professor Rick Stafford: A lot of that depends on what we class as a UK marine system and whether we include the overseas territories. Including the overseas territories, in total we are probably looking at an offset of about 9% to 10% of UK emissions at the moment. It will be a lot less than that, because the majority of that is captured in deep sea sediment, which may have been missing from some of those calculations. It is not particularly efficient per unit area just because of the volume of it—it is really large—whereas some of the more efficient things per unit area would be quite small, and even if we were to restore things like seagrass beds to historic levels we may only be talking about 0.1% of UK emissions.

Lord Krebs: To be clear, the ONS figure probably includes the UK overseas territories. Is that why it has come up with such a big number?

Professor Rick Stafford: I have not seen how it has calculated that. I could look into it and let you know, but I do not know.

Lord Krebs: Thank you. Professor Austin?

Professor William Austin: I think it is important here to make the distinction between habitats that can be accounted in the greenhouse gas inventory and those that cannot, and of course we follow the guidelines of the IPCC here. The national greenhouse gas accounting using IPCC methodologies, which are in the UK NDC through the adoption of the 2013 wetlands supplements to the 2006 IPCC guidelines, would include two potential habitats in the UK—saltmarsh and seagrass—but, in those

habitats, you are right that the sequestration and long-term carbon storage potential is relatively small and would be a smaller figure than the number you have quoted.

So I suspect this includes what are strictly not blue carbon habitats. These blue carbon habitats are coastal vegetated systems that fall within the frameworks for greenhouse gas accounting. As Professor Stafford said, if you include marine sediments, we have vast stores of carbon in those marine sediments, but that is a different matter in terms of the existing accounting frameworks.

Lord Krebs: Thank you very much. Professor Kennedy, perhaps you could offer a view, particularly about the uncertainties, because in discussing peatland carbon storage we learned of a great many uncertainties in the calculations. Could you give us a bit of insight into that for the marine system?

Professor Hilary Kennedy: I concur with what Professor Austin has said. For tidal marsh and seagrass, we have relatively small amounts of sequestration. The potential is there for kelp and marine sediments, but we do not have enough evidence yet to be able to give good values. Having said that, with tidal marsh and seagrass, we still have uncertainties.

For tidal marsh, we certainly know something about the stores that we have in the UK. We know less about the sequestration. For seagrasses, we are in a more difficult position, because we do not even know where our seagrass meadows are. We know some of them, but we are definitely an order of magnitude out on knowing their total area. We can use inventory values for the global value for sequestration for tidal marsh or seagrass, but that may not be representative for the UK. One of the uncertainties is that we need to provide national values for inventory values for storage and sequestration.

Lord Krebs: Thank you very much. In our background briefing, some of these sequestration rates are given to the second decimal place, which seems a little optimistic in light of what you have told me. I can see Professor Austin smiling. I think, Lord Chair, I have a very clear answer to the question about uncertainty.

Q38 **Lord Kakkar:** I should declare an interest as a member of the advisory board of the Royal Society. I want to build on some of the issues that have been addressed in the previous question in terms of our certainty with regard to the scientific understanding and the evidence base for marine nature-based solutions, and whether that science base is sufficiently robust in comparison to our understandings for ecosystems such as woodland and peatland for us to be able to include these marine nature-based solutions, both in major funded projects and inventories, and, if not, what needs to be done for us to take ourselves to a position where we would have greater certainty to prioritise these systems. Perhaps we should start with Professor Kennedy.

Professor Hilary Kennedy: We now have the IPCC guidance for including both tidal marsh and seagrass in our national greenhouse gas

inventory. In the UK we have not done that yet. Globally, there are a number of countries now that have included tidal marsh—I am sorry; I have been forgetting mangroves—but no country yet has included seagrass. The potential is there, and has been taken up by some countries. The UK has not taken this up partly because of uncertainty. In the past, there may have been a lack of research in that area, but that is certainly improving very largely for saltmarshes, whereas we are still in our infancy in terms of seagrass. So, for tidal marsh, we need better resolution of the available data as stocks and sequestration will change over different regions or environmental settings. We need to have a better database so that we can disaggregate our emissions and removals values.

For seagrass, although we have a few measurements for stocks, we certainly need to expand that spatially. Also, we currently have no sequestration rates in the UK. So we have not had the research potential to be able to define these values well enough for us to include them in the UK inventory.

Professor William Austin: This is a great, focused question. I would encourage, and I think this is happening, attention to be paid to our saltmarsh habitats—these are coastally vegetated (blue carbon) habitats. Our understanding of carbon stock now is improved and is pretty good. We are getting very close to full UK national stock estimates for these saltmarsh habitats. As Professor Kennedy said, we can begin to apply default IPCC emission factors, and of course we have an improved understanding of appropriate management intervention.

I think the most exciting opportunity is probably through coastal realignment that can deliver coastal flood protection, for example. There is now investment readiness funding in place for a new saltmarsh carbon code for the UK, which signals an opportunity to highlight investment potential in the carbon credits that could accrue from the additionality of carbon that accumulates in managed realignment schemes. Of course, that is quite an exciting way to enhance the services that these schemes provide, coastal flood protection often being the key, but biodiversity gains, opportunities for the habitats and so on.

Saltmarsh habitats are probably going to be key, and I think we are getting very close to that happening. As Professor Kennedy said, there is a commitment within our NDC to move in that direction now.

Professor Rick Stafford: I would agree. I think the highest level of certainty is for saltmarsh. There is variability as well as uncertainty between different habitats or between different areas of saltmarsh, which may also need to be considered. Equally, I think we are in a reasonable position to do that. We are not quite there with seagrass. There are not many estimates of UK sequestration rates, but we do know that the storage rates seem to be relatively similar to things in the US, for example, where there are sequestration rates. So it could be relatively easy to get to a not too bad level, although, as Professor Kennedy says, we do not necessarily know where all the seagrass is. The rest of it is probably too uncertain at the moment.

Lord Kakkar: I have a further point. If there were to be substantial investment in restoration projects for these particular environments, how resilient are they likely to be to changing conditions—environmental, economic, or climate change—in comparison to other restoration projects for woodland or peatland? Would Professor Kennedy like to start?

Professor Hilary Kennedy: I am sorry—I forgot the first part of your question. It is resilience, is it not?

Lord Kakkar: Resilience, yes.

Professor Hilary Kennedy: Professor Austin talked about tidal marsh. In terms of seagrass and their resilience, part of that is to do with what is occurring in the adjacent terrestrial system. A lot of seagrass is dependent on the amount of light for it to grow. Rivers supply both nutrients and sediment. Activities in the adjacent catchment cause erosion and nutrient enhancement. The nutrients supply growth to microscopic plants and they reduce the water clarity, and so does the sediment that comes down from erosion. So it is important to say that seagrass resilience is dependent not just on local conditions but on our adjacent terrestrial processes. A catchment-wide approach would help the resilience of seagrasses.

In terms of climate change, it depends on the rate of sea level rise and the water quality. The better we can keep the water quality—that is, the transparency of the water—the more likely it is that seagrasses can migrate along with sea level rise, as they have for the last 10,000 years, and be maintained. The other terms of resilience are heat waves. Locally we have had high temperatures, and this has had an adverse effect on the particular species of seagrass we have in the UK, but, generally, the whole of the seagrass meadow is not affected. So, in the species we have, it can regenerate quite quickly and seems to be quite resilient to that kind of climate change.

As to economics, I will leave that one for the moment

Professor William Austin: I spoke a moment ago about the research opportunity, and particularly if we are to focus on our saltmarsh habitat I would highlight the need for improved understanding of the greenhouse gas fluxes so that the net additionality of these habitats is better understood. As Professor Kennedy said, we have a good understanding of the stock in the soils, and that stock is very important because it has taken hundreds and thousands of years to accumulate. We need to protect what we might call those irrecoverable carbon stocks, but we also need to improve our understanding of flux.

The question about resilience is a very good one in the context of the recent IPCC reporting and code red for global warming, and the projections for future sea level rise. Sea levels will continue to rise—this is not in doubt now—and these coastal habitats need to accommodate through their resilience and the resilience of design for managed realignment those sea level rise components. Saltmarshes are actually very good at doing this, and if they have sufficient sediment supply they will accrete and keep up with sea level rise; they do this naturally. The

challenge we face is the way in which we manage our coastlines and allow for that inland migration. We cannot do that everywhere, of course, so we need to look more closely at adjacent land and the opportunities for realignment of our coastlines.

I think the economic resilience and the climate resilience can be built into the schemes that are currently being reviewed.

The Chair: Thank you very much.

Q39 **Lord Holmes of Richmond:** Good morning to the witnesses. Thank you for taking the time to give your expertise this morning. What views do you have on which major blue carbon ecosystems should be prioritised for research in the UK? Perhaps I could start with Professor Kennedy, please.

Professor Hilary Kennedy: There are different reasons for prioritising these different ecosystems. For the ecosystems that are already in the IPCC guidelines, I think we should prioritise gaining enough data to be able to provide national values so that we can implement this policy if the Government so wish.

On another of those ecosystems, mangroves, which we have not talked much about, there are in certain overseas territories with large amounts of mangroves, but actually we know very little about any of their stores or sequestration rates. They perform a very important role, especially in the Caribbean. I think that is important.

Quickly on kelp and marine sediments, although we know there is probably a very large potential for effective management in relation to greenhouse gas emissions, we just do not know enough at the moment about the processes that cause change in those stocks and sequestration rates, and actually the fate of the carbon. With kelp, where does that carbon eventually reside within the ocean? For marine sediments, it is mostly management in trawling—what happens to that carbon that may be remobilised due to those processes.

Lord Holmes of Richmond: Professor Austin?

Professor William Austin: I agree with Professor Kennedy. I would make the practical argument that we should focus on our saltmarsh habitats here in the UK. I would certainly agree with threatened mangrove ecosystems in our overseas territories. Those are being lost at an extraordinary and alarming rate.

The great challenge ahead is to address the impact of bottom-contact fishing on the far more extensive (than the equivalent terrestrial) stores of carbon within our UK EEZ and within the larger blue belt of the overseas territories. Increasingly, there are calls to look at the impact of bottom trawling on these stores. The challenge is that the evidence we have is very limited at the moment.

Lord Holmes of Richmond: Professor Stafford?

Professor Rick Stafford: I would agree. I think there are two scales of research there. There are the fine tunings of some of the habitats such as

saltmarsh, but the real potential is looking at sediments and even things like kelp. If kelp does act as a nature-based solution, it is going to be through trapping some of that plant material in the sediments. The role of fishing is really important, partly in terms of how much that disturbs the sediments and releases the carbon, but from very early research there is quite a good likelihood that fishing and changing the trophic levels of the ocean cannot but affect carbon sequestration and productivity.

Lord Holmes of Richmond: Thank you very much.

Q40 **Viscount Hanworth:** I fear that my designated question overlaps with others that have already been asked. I understand that the current measurements are doubtful. Nevertheless, how effectively can we verify the impacts of marine nature-based solutions regarding the subduction of carbon dioxide and emissions of methane? Indeed, are there any significant developments in the methodology that are currently under way? Perhaps we can start with Hilary Kennedy.

Professor Hilary Kennedy: At the moment, to monitor our stocks and fluxes, we mostly have to go out in the field to measure them, but there are technological developments that could help us improve this, with sensors that will automatically send us data—water based or air based—and automatically measure gas fluxes in the field. Then there is satellite imagery, which is advancing very strongly, especially with artificial intelligence and machine learning, so that we can look at changes in aerial extent, we can look at the health of, say, mangroves, and using radar techniques we can look at different land use changes. We need to work on both. We have methods that we can use now, but we need to scale up to be able to use much wider-scale technologies in the future.

Viscount Hanworth: We need better surveys and radically improved technology. William Austin, do you have an opinion to contribute on this?

Professor William Austin: Yes. I would certainly agree with the need for national scale estimates of the habitats, the stocks and the fluxes. One of the great successes of the peatland work has been to understand the greenhouse gas fluxes using these flux tower approaches and field-based measurements that Professor Kennedy has referred to. We are a little further behind in research in that field, so I think there are some opportunities there.

I would also agree that, in terms of the land use change and the understanding of land use change, particularly acute historical losses of these habitats both here in the UK and overseas, those remote sensing techniques that Professor Kennedy alluded to are very powerful for highlighting the loss of nature and the loss of services that go along with the reduction in the area of these habitats. That understanding can be readily gained through remote sensing data.

Q41 **Viscount Hanworth:** Can I pursue a perplexity that I have? How significant are the subductions occurring in coastal regions and adjacent marine settlements in comparison with the subductions of the

phytoplankton in the oceans at large? Does anyone have an answer to that? It may sound naive, but I am completely at sea on this.

Professor William Austin: It is a great question. Of course, the oceans are a key element in the cycling of carbon. A large proportion of the earth's carbon cycle is cycled through the oceans, and phytoplankton play a key role in this, but it is a cycle. The difference here in the habitats that we have been discussing is that they build up a store of carbon. The analogy there is the peatlands. Sequestration rates—the subduction, as you refer to—can be quite low annually, but over time will build up important stores in the underlying soil. Those blue carbon habitats are the most effective on the planet for that sequestration, area for area, and store components. If we want to focus and work on a particular area, blue carbon habitats are very effective places to think about nature-based solutions for carbon and the other services that they provide.

Viscount Hanworth: So we should be thinking of stocks rather than flows, or at least the accumulation of flows. Rick Stafford, do you have anything on either the current issues or the previous ones?

Professor Rick Stafford: One thing to think about in sampling is simply the cost of doing it under water and the need for divers and boat times. If we are looking at the amount of carbon, it can be expensive, and there are a limited number of scientific divers. In things like phytoplankton, as Professor Austin said, the majority is ultimately respired, so while it does capture a huge amount of carbon dioxide, the majority goes back into the system through respiration. Probably about 1% that reaches the ocean floor is then carried in the sediments. The key thing with ocean nature-based or marine nature-based solutions, regardless of whether they are coastal, is the burial of organic matter in the sediments.

Viscount Hanworth: Could the respiration of phytoplankton be affected by the increasing acidity of the sea?

Professor Rick Stafford: Potentially. I think the amount of phytoplankton may be altered. The amount of zooplankton may be altered. We are in quite uncertain territory there. It is definitely an area for further research, but, yes, I think the estimates are that, potentially, the amount of photosynthesis may decrease with climate change.

Viscount Hanworth: Thank you, all three of you.

Q42 **Baroness Brown of Cambridge:** We hear quite a lot about the co-benefits—potentially biodiversity and tourism, and things like that—of these blue carbon projects in reducing flooding and coastal erosion. I would be interested to know which of these co-benefits we have really strong evidence for, and what the relative value of these co-benefits is versus the carbon sequestration benefits. Perhaps I could start with Professor Kennedy.

Professor Hilary Kennedy: We have really quite good evidence for most of the co-benefits. Perhaps the best seagrass measures are for nursery or feeding grounds for fish, which relates on to commercial fisheries as well as to food security and nutrient removal. So to an extent

they will remove nutrients from the environment and clear up the water clarity. To a limited extent, they also help to limit coastal erosion and flooding, but this is far expanded if it is linked with, say, mangroves or with tidal marsh in adjacent land masses.

I could give you a few numbers. Unfortunately, I do not have numbers particularly for the UK, but for Sweden it is in the order of—for fisheries, it was £27,000 per kilometre squared per year; for nutrient regulation it was £47,000 per kilometre squared; for climate mitigation, the social cost—storm damage and so on—it was £19,600 a year. In terms of tidal marsh, the values to flooding are much higher, and maybe Professor Austin would like to talk about that.

Baroness Brown of Cambridge: Thank you. Can anybody give us a relative sense of the carbon benefits in comparison to those? Professor Austin?

Professor William Austin: This is an important question. I think it boils down to the broader question of nature and environmental economics that would flow from valuing nature and all those services, and that can be difficult to do. I think Sir Partha Dasgupta's review for the Royal Society has helped to shed some light on this.

In terms of the large managed realignment schemes that our Environment Agency might develop here in the UK, blue carbon, the carbon services, would probably be a relatively small fraction—I would estimate probably about 10%—but it may be that the carbon service and the credits that can be sold to investors as part of a restoration scheme perhaps focused on coastal flooding, for example, could push it over the line and could be an important element of the investment package.

We probably need to view these things as a whole range of benefits, working with the environmental economics and the local stakeholders, to enable all these services to help us leverage the opportunities for nature. That is ultimately why we are interested in doing this, of course.

Baroness Brown of Cambridge: Professor Stafford, is there anything you want to add quickly to that?

Professor Rick Stafford: Not really, no. Generally, all these solutions, whether they are seagrass or kelp, are beneficial for biodiversity. They have climate adaptation benefits from things like storm surges, and obviously they sequester carbon, so they tend to be a win-win situation, at least from those perspectives.

Baroness Brown of Cambridge: I am sensing that we do not have very strong data to confirm that. If you, particularly Professor Kennedy, have other data that you can put your hands on, we would be delighted if you could send it to us. That would be very helpful. Thank you.

The Chair: Thank you very much. I agree that it would be good if you could send it in, and it will be recorded as evidence.

Q43 **Baroness Blackwood of North Oxford:** I would like to thank the witnesses for taking us through some of the available benefits and

potential solutions, but I would like to understand what are at the moment some of the regulatory or even non-regulatory barriers that are preventing more widespread investment into some of the marine nature-based solutions in the UK, and what might be the ways in which we could overcome those. Perhaps Professor Austin could start.

Professor William Austin: I have to admit that I am not an expert in this area, but one barrier potentially is the move towards the implementation of the habitat (saltmarsh) into our national greenhouse gas inventory. That happens at the UK level as a decision by BEIS and is very much based on the available evidence. The discussion we have had this morning, I think, points to the need for greater evidence before we can implement the habitats into the national greenhouse gas inventory. That is primarily due to limited greenhouse gas flux understanding. Once that happens, I think it will drive quite large-scale restoration projects.

The other opportunity, and it is non-regulatory in a way, is to think about carbon credits and their value to investors. I think those schemes are gaining in popularity. I am not sure how they are going to be regulated, but there are regulated and non-regulated schemes around. That would be a potential mechanism to draw investors into these sorts of schemes.

The other area, of which I know very little but in which I am interested in the context of marginal coastal land, would be through the payments to agriculture and what may happen as we are going through the European exit. Grazing densities on farmland could be managed at scale across this habitat (saltmarsh) and could deliver some environmental carbon benefits. That would require a payment scheme. So there are some quite interesting opportunities on the horizon for that type of investment in nature, I suppose.

Baroness Blackwood of North Oxford: Thank you, Professor Austin. Professor Stafford?

Professor Rick Stafford: There are limited opportunities for private finance beyond carbon credit schemes. They are developing, but they are still quite limited. Some are things I would not necessarily want to endorse, such as being able to develop somewhere and being able to set up nature-based solutions somewhere else. There are better ones that may involve companies looking after things such as clean water supplies, but they are limited. One of the key things is that there probably does need to be more public finance rather than private finance to support these initially.

Baroness Blackwood of North Oxford: Thank you. Professor Kennedy?

Professor Hilary Kennedy: As to non-regulatory—I know very little, unfortunately, about the regulatory—financing is certainly an issue for restoration. In a very successful seagrass restoration project in the USA with the same species as we have here—the restoration of a 7 kilometre square project—the carbon credits value only represented 10% of the cost of the restoration. In a way, that shows you the limitation of a further carbon nature-based solution aspect, but it also explains why we need to value the other co-benefits that come to finance these projects.

There is the voluntary carbon standard, which is a very good-quality standard, and that allows both restoration and conservation—we have not really talked about conservation—of the three main blue carbon ecosystems.

Besides cost, we need to be able do this at scale. We have to find large enough scales, so we may need to aggregate different projects, whether they are within the same ecosystem or with different ones.

The only other aspect perhaps that I can cover relates to our marine protected areas, which are mostly supported for things other than carbon, so we could include within our marine protected areas some kind of aspect relating to carbon protection or storage.

Q44 **Baroness Blackwood of North Oxford:** Thank you. My only follow-up question was going to be whether there are ways in which we can co-ordinate across devolved nations or overseas territories in order to maximise the benefits. I can see Professor Austin is nodding away, so perhaps you can give an opinion on that.

Professor William Austin: I think that is a great suggestion. I have a role with the Scottish Government advising on blue carbon here in Scotland, and one of the things we would benefit from across the UK is some joined-up thinking perhaps in the form of a forum. Perhaps Defra might organise something like this, which would share best practice and these sorts of opportunities. I think that is a great idea and something that really ought to happen, but, of course, in terms of the carbon, this is a UK-led decision for greenhouse gases so, again, it will come back to BEIS. It is very important that we are joined up on this and that there are moves across the devolved Administrations, which are not necessarily in sync. I think your suggestion is a very good one.

Baroness Blackwood of North Oxford: Thank you. That is all I have.

Q45 **Baroness Sheehan:** My question refers back to Lord Holmes' question about which of the major blue carbon ecosystems should be prioritised for research. I wanted to ask in particular about marine sediments and how they might be affected by industrial seabed mining. I think the pilot projects are imminent now.

Professor William Austin: I do research on deep sea sediments—shelf sediments in particular—and we are focused at the moment on the major pressure that we understand. The spatial track of fishing vessels is monitored, so we have quite a good understanding of these pressures on the seabed. We do not fully understand what that does to the release of carbon from these long-term stores. In the deep sea, where these stores have perhaps taken much longer to accumulate and where the ecosystems may be far more vulnerable, I would urge caution. This is something that we may come to regret, but, beyond that, I cannot really comment other than that I think caution is necessary.

Baroness Sheehan: There is a pilot scheme about to start. Has any research been done on release of stored carbon?

Professor William Austin: I am not aware of evidence relating to the release of stored carbon from sediments, but there is evidence of damage to benthic ecosystems in the deep sea.

Q46 **Lord Krebs:** I think Professor Austin has partly answered my question, but it was in the same vein as that of Baroness Sheehan. It is about the trade-offs between fishing and carbon storage in marine systems and whether the policy framework that was established in the Fisheries Act 2020 is sufficient, because the Government rejected the idea of ecosystem-based fisheries management that would take these things into account and, instead, opted for fisheries management based on maximum sustainable yield. So would you just say a little about that trade-off between fisheries and carbon storage?

Professor William Austin: I appreciate the trade-off and the stakeholders involved here in our fishing industry, of course. Key here is probably the move towards these highly protected marine areas and the recognition now by the new arrangement in Scottish Government to recognise blue carbon, which is a reference to stores of sedimentary carbon in some of these vulnerable areas. Highly protected marine areas could be designated for blue carbon. I think the Benyon review has pointed towards this and some of our research would support that view.

Lord Krebs: Professor Stafford may want to add something.

Professor Rick Stafford: It was really in agreement. Highly protected marine areas will be really important in this. A study last year found that, if we put in 5% highly protected marine areas worldwide—about double what we have at the moment, in fairness—we can boost fisheries catches by 20%. So there are win-win situations from this. They have to be strategically placed, but they are likely to be in areas of high productivity, which are likely to be the areas where the most carbon is also captured.

Lord Krebs: Thank you.

Q47 **Baroness Brown of Cambridge:** My question follows on in this area of trade-offs. I need to declare that I am a board member of Ørsted, the renewable energy company. I was interested to know whether you think there are any tensions between our need to develop more infrastructure in the sea to deliver net zero, to get towards, for example, 100 gigawatts of offshore wind. Will that be a challenge for the blue carbon sequestration, or, alternatively, are there even opportunities because wind farms create these areas that, once they are established, are undisturbed? Should we be doing things like growing kelp around wind farms perhaps, because there is obviously no fishing and no trawling? I will start with Professor Stafford, as I think that is sort of your area.

Professor Rick Stafford: First of all, offshore infrastructure or coastal infrastructure can be made good for biodiversity. There are benefits from that. But you are absolutely right: things like kelp farms around turbines will potentially be very good. A lot of that depends on the fate of that kelp at the end. Some is harvested. If it is harvested and the carbon is preserved, it would actually be a good carbon sink. If it is harvested and

allowed to decompose, obviously that carbon goes back into the atmosphere. Some of it depends on the fate of the carbon, but, generally, I do not really think there are major tensions.

Baroness Brown of Cambridge: Professor Austin, were you nodding?

Professor William Austin: I was nodding in agreement. It is a great suggestion. I think it is the right way forward. The licensing of the offshore renewables also creates a revenue stream that could be used as support for these sorts of initiatives. Closed areas around offshore wind farms would be perfectly suited for some of those suggestions.

The other challenge we face is with the North Sea infrastructure in an ageing oil and gas field, and what to do with that. Do we leave it? Do we remove it? The evidence points to the fact that some of these structures are supporting high biodiversity communities and may well also, ironically, be sequestering carbon in and around those structures. So I think there is a lot of interesting thinking to be done about how we manage the development of our shelf seas to create wins for nature.

Baroness Brown of Cambridge: Thank you very much.

Q48 **The Chair:** Sticking to this theme of kelp, there seems to be a lot of interest in growing giant kelp, but obviously that might not apply to UK-based waters but more to equatorial waters. Apparently it grows very fast, it sequesters carbon very quickly, and, when it decays, it increases biodiversity. So is there much focus on giant kelp, Professor Stafford?

Professor Rick Stafford: There is focus on all sorts of kelp, including kelp around the UK. It is a growing area of interest. There is a lot of kelp in the UK, and particularly the British Isles, if you take Scotland and Ireland collectively. What we do not know yet is what happens to that kelp. Best estimates, and they are uncertain at the moment, are that it is about 5% of productivity, which can be quite a lot. It can be buried in deep sea sediments or ocean sediments in general. I know there are ideas about growing giant kelp and letting it sink to the deep sea. We need to know what the fate of that kelp will be. Will it get captured in the sediments and properly sequestered? We also need to know what affect it has on the nutrients and phytoplankton dynamics. I think there is huge potential, but there are a lot of uncertainties.

The Chair: Does anybody else want to comment quickly before I move on?

Professor Hilary Kennedy: I could say something. Not specifically for kelp but certainly for seaweed, there is very large interest in seaweed farms. Where you are growing seaweed in the coastal environment, it is much easier to relate the productivity of that seaweed to what is stored in the underlying sediment. With kelp, the carbon may be stored in the sediment at great distances from where the actual kelp is growing. There is a global study going on at the moment that is trying to quantify this, so this may be an area of interest in the future.

Q49 **The Chair:** The last but very brief question is this. When we talk about

marine restoration projects, are the stakeholders involved, and are the policy regulations good enough in the UK to promote this? Professor Kennedy?

Professor Hilary Kennedy: If I may, I will talk about seagrasses again, and perhaps the others could fill in on the other environments. I think there is good stakeholder engagement for the restoration of seagrass, but unfortunately it is on a very small scale and at the moment on a scale that I do not think will have any particular influence on our greenhouse gas removals. But it is very important for biodiversity and, as we have said, with the co-benefits for fisheries and so on.

Also, people buy into this quite often for iconic species. Our seagrass supports seahorses, so people are willing to pay for the restoration of seagrass or have interest in it because of trying to keep those iconic species. There are two major restorations going on in the UK for seagrass, and a wide range of stakeholders are involved, including larger funding agencies such as the World Wildlife Fund and Sky Ocean Rescue. So I think there is a good involvement.

The Chair: Professor Stafford or Professor Austin, do you want to comment?

Professor Rick Stafford: Another example is the Sussex kelp restoration project, which I believe has just got the go-ahead. Again, there were some good economic models of the benefits of that. There are lots of stakeholders, including the local inshore fisheries and conservation authorities, obviously having the fishing community on board. It can happen because, over time at least, there will be benefits to fishing, particularly inshore fishing. So it is possible to get those stakeholders together.

Professor William Austin: For our saltmarsh habitats, the Wildfowl and Wetlands Trust and the RSPB have been doing a great job in restoring these habitats. They engage stakeholders, often bird watchers, into nature in that coastal environment. These are very accessible places, and great places to engage a wider public audience in the restoration work. The exciting thing is that those organisations are now realising the additionality that carbon sequestration adds to their projects. Again, if we were to move these habitats into the UK greenhouse gas inventory, this will create all sorts of additional opportunities for the public to engage with these sorts of habitats.

Q50 **The Chair:** Okay. One minute each for you. What should the UK Government do at COP 26 to promote marine-based ecosystem restoration?

Professor William Austin: I would encourage the UK Government, who have a focus on nature as one of their five themes for COP 26, to highlight their ambition for nature; and, in the context of marine, I think to focus on our NDC commitment and to identify saltmarsh habitats as their priority. We are very close now, and I think a little push in that direction would be extremely helpful and a very positive signal.

Professor Rick Stafford: I would agree with Bill—Professor Austin—about getting saltmarsh acknowledged, but, I think, just recognising the multiple benefits, the co-benefits—biodiversity, climate adaptation and climate mitigation—and the lack of trade-offs within the nature-based solutions would be important.

Professor Hilary Kennedy: As well as a UK focus, I think we ought to also consider overseas. We have our overseas territories with mainly mangroves, so there should be a focus here because they are so important for storm damage, and that is what has impacted in the Caribbean. But we should also look to a more global overview, not just the UK's, on protecting and restoring these blue carbon ecosystems, many of which are mostly in the underdeveloped countries. We can provide a lot of help to those countries to develop the skills that they need to protect and restore these environments.

The Chair: In that respect, is there a global framework that underpins the principles of restoration of marine-based ecosystems?

Professor Hilary Kennedy: I am not quite sure what you mean, but there are lots of non-governmental organisations definitely promoting the conservation and management of these blue carbon ecosystems.

The Chair: Any there any other comments any of you would like to make in conclusion?

Professor William Austin: If I may, Lord Patel, in answer to the question you have just asked Professor Kennedy, there is now a UNESCO international partnership for blue carbon. Defra is a member, and that creates a framework opportunity. We also have a global blue carbon initiative, which is leading on some of the accreditation schemes for carbon. That has been a very important driver, of course, for investment.

The Chair: Professor Stafford, the last word.

Professor Rick Stafford: I would just mention again, in relation to the last question, that there is also a UN high seas treaty under negotiation, which is more for protection, but in a lot of cases protecting the marine habitat automatically leads to its restoration. It is not necessarily the case for things like the vegetated habitats, but, in a lot of cases, if we leave marine systems alone, they recover and they provide the benefits that you get from them.

The Chair: Thank you very much, all three of you—Professor Kennedy, Professor Austin and Professor Stafford—for helping us. It was a most interesting and informative session. On reflection, if there are any other areas on which you might feel additional information would be helpful, we would be very pleased to receive it as our official evidence. So feel free to write in if you have anything, but, for today, thank you very much indeed. We are very appreciative of your time. Goodbye and all the best.