PROPOSED TIDAL LAGOON, SWANSEA BAY

TRANSCRIPT OF FISH SESSION AT ISSUE-SPECIFIC HEARING 18TH SEPTEMBER 2014

Mr Amos, ExA: Right thank you for that, and we'll go to the agenda then. The next item is item 10 on fish and recreational fishing.

Mr Gibbs, ExA: Right, I'm leading on this topic, and let me clarify how we're going to be dealing with it. Within the agenda what we wrote down was, first of all, impacts on migratory fish as just a heading, and linking that with trends in salmon and sea trout populations in the two rivers, the Tawe and the Neath, and we had of course data on salmon rod catches from the NRW, which helps us to a certain extent with that, but we just want to look briefly into that issue, and then much more concentration on the second part, which is the confidence in modelling relating to impacts on migratory fish, and here I anticipate there being two elements of the debate. The first of all a migration issue, which is disruption of olfactory trails, and the effect of outwashes from the turbines on the desired paths of the fish, I think particularly migrating from the bay into the rivers, and in particular the Tawe. And secondly, the effect of – rather more drastic effect of – the turbines themselves in terms of collision, and fish who inadvertently decide to go into the lagoon via the turbines. We would like to have a bit more explanation of what is intended in terms of monitoring of such impacts so that I understand that process a bit more, and expectations on mortality rates and such like. So I think we can deal with the very first item, which is the trends in the salmon and sea trout populations, relatively quickly, then get on to the two part confidence in modelling relating to migration in relation to disruption of migration patterns and potential collision with turbines. Is that understood? Any comments on that proposed structure? Mr Bassford.

Mr Bassford for TLSB: No.

Mr Gibbs, ExA: Right, let's go to the data provided by the NRW on salmon rod catches, and really I suppose there's a very brief note which I can read out in the context of that. This is our question 7.22c, and graphs of returns on catches for the two rivers has been produced, and has also been averaged as a five year moving average to try to take out some of that amazing degree of variation that one always faces with salmon runs, and the general comment made by NRW I will read out. It's three sentences, three *short* sentences.

"*Salmon rod catches have generally increased on both rivers since 1976. This is a general pattern observed across South Wales rivers during the 1980's and 1990's where salmon populations recovered in industrialised rivers. Then a decline on both rivers is evident in recent years, which again reflects national trends.*"

Now the first area where I just wanted a little bit of comment from NRW is the extent to which salmon rod catches can be relied on as indicative of broad trends, or whether they're indicative of other trends in terms of the amount of fishing that is done. So perhaps you could help us with that, Mr Lewis?

Mr Lewis for NRW: Yes Sir, if I could introduce the officers to my right. I'm joined by Ida Tavner and Lily Pauls, both of whom have been working on these issues. Can I ask Miss Tavner in the first instance to deal with that technical matter?

Mrs Tavner, NRW: Good morning, yes I mean regards to rod catches that is the way that we measure in England and Wales the national catch statistics. There are obviously some amount of effort taken, or the number of rods is obviously a concern, which can reflect the numbers. However, we do carry out all the Environment Agency, and in our calculations we take account into effort, it is also checked on a number of rivers which… against counter data. So it is in that sense the measure by which we have chosen to record the rod catches, and effort, although not directly recalculated as…

Mr Gibbs, ExA: I think the question that I'm putting to you is the extent to which one can put much weight on the rod catches as reflecting the general population of salmon within these various rivers, and the increase and then the decrease from the 1990's.

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Mrs Tavner, NRW: I believe that those figures are correct, that it is not just reflecting a decrease in effort, and numbers of people fishing, they are correct in the sense that they reflect salmon population. This is also backed up by some juvenile data which shows the same trend in terms of decreases for some.

Mr Gibbs, ExA: Would you say the same for sea trout as for salmon?

Mrs Tavner, NRW: Yes, generally I would say it is the same. The sea trout model is more complex because sea trout return a number of times to spawn in the same river, while salmon in terms of modelling population can be said to be taken out of the equation and only spawn once. So the model we have for measuring sea trout population is more complex, but we still believe that it is the best, and we believe it's accurate.

Mr Gibbs, ExA : Right, I'm proposing to move on to the second part of our discussion, unless anybody wishes to come in on that, and the applicant may wish to come in on it?

Mr Bassford for TLSB: When you say the second part, you're speaking about confidence in modelling.

Mr Gibbs, ExA : Indeed, and effects of olfactory trails and collision monitoring.

Mr Bassford for TLSB: I think we have some comments on the assertions that National Resources Wales has made. For this purpose you need to hear from Dr Andy Turnpenny, who has led the modelling effort, and also from Dr Jay Willis who has supported that exercise. I would ask Dr Turnpenny to introduce himself and say a little bit about his experience, because that actually is important in the weight that you give to the information that is before you.

Dr Turnpenny for TLSB: My background goes back a long way. I did a degree in zoology at Nottingham and then came down to South Wales to do a PhD in Cardiff on salmonid populations in South Wales rivers. Went on to join the Central Electricity Research laboratories and ran the marine biological laboratory in Southampton where I had considerable experience in relation to the 1980's to 1997 tidal power programme, and we carried out seminal research on mechanisms of fish damage in turbines, which has gone on to become the basis for developments in the United States on fish friendly turbines, and so on. And that is the basis on which the model that we're going to be talking about, the stripe model is developed. Subsequently I was engaged as a peer reviewer at the recommendation of the Environment Agency on the Severn strategic environmental assessment of the 2000s era, and have more recently been an advisor to the Environment Agency on matters of fisheries engineering, fish screening, and alike, in relation particularly to new nuclear power development. So I've been involved on the expert panel for Hinkley Point C nuclear power station. So a lot of experience around this sort of general area.

Mr Bassford for TLSB: both promotion and regulation?

Dr Turnpenny for TLSB: Yes, on both sides of the equation. Regulation and…

Mr Gibbs, ExA: Just to clarify for me, when you, I think you referred to the Severn strategic environment assessment, was that the Severn barrage strategic environmental assessment, or was it more broadly… the Severn water body?

Dr Turnpenny for TLSB: Yes, it was the Severn water body where various options, embayments and barrages were looked at.

Mr Gibbs, ExA: So very much in the context of tidal energy, but not a particular scheme?

Dr Turnpenny for TLSB: No.

Mr Gibbs, ExA: And do you have a comment on the broad population pattern that we're being…

Dr Turnpenny for TLSB: The rod catch data, while there are obviously inevitably some disconnects between rod catch and the status of the actual populations, it would be obviously nice to have independent fish counter data, but we accept that this is used nationally as an index of the status of stocks. Just one point I think is worth drawing your attention to, and that is that during our discussions with the angling bodies in July, they drew attention to their views that the NRW's policy on encouraging anglers to put back fish was discouraging effort, and therefore although there is a decline shown in numbers in the last couple of years,

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we're suggesting that perhaps there might be an effort related element to that, and NRW might wish to comment on that.

Mr Gibbs, ExA: I think we're aware of that element of the debate without necessarily feeling that we're going to resolve it, but there is a broad acceptance as an index of stocks with some concern related to the effect of catch and release. Mr Bassford, is your other witness going to say anything at this point, in relation to the modelling stage?

Mr Bassford for TLSB: Dr Willis will speak in relation to the modelling, I don't know if it would be helpful if he would introduce himself, though?

Mr Gibbs, ExA: Well let's have that delightful process, yes.

Dr Willis for TLSB: I'm Jay Willis and I did my PhD in 2008 in the representation of large fish in eco system models, and since then my scientific contribution has been on animal navigation, and specifically in fish and hydrodynamic models. And sort of similar work, I worked on the strategic environment assessment of the Severn tidal power schemes, which included lagoons and barrages, and the potential re-entrainment of salmon smolts in those turbines. So quite similar discussions, and I also recently worked on the Thames tideway tunnels project, which involved the modelling of fish impacted by constructions within the tidal Thames, and therefore how very juvenile fish managed to climb up through the Thames in those conditions. And that's me, basically.

Mr Gibbs, ExA: Thank you very much. Move to the second part of the agenda and disruption of patterns of migration. As I understand there is obviously discussion about olfactory trails, and the extent to which the amazing ability of salmon to choose to go back to a river which tends to be the one that they originated in is driven by forces that are most likely related to smell, but as I understand it most likely, rather than anybody actually understanding what drives the salmon back to its natal river. So, there's disruption of olfactory trails, but I also have felt that one of the factors being raised particularly by the PASAS group has been about the sheer process of navigating across the discharge from the turbines. Now I may be wrong in that, but that's one of the other points that I understood is being made, and if we can I think start with the applicant on both of those, I imagine that… well we'll see how NRW and any other parties wish to respond, but we will take the applicant first.

Dr Turnpenny for TLSB: Okay, thank you. The way I would like to handle this, if it's okay with you, is to sort of paint a general picture, and then perhaps bring in my colleague, Dr Willis, to answer some of the more specifics.

Mr Gibbs, ExA: And you're aware of the constraints of time?

Dr Turnpenny for TLSB: Yes.

Mr Gibbs, ExA: Though you and I both delight in going into great detail on this, it obviously is at a broadish level.

Dr Turnpenny for TLSB: Okay, well first of all my colleague Jay has mentioned the type of model we're using, individual base model in which we look at the behaviour of individual fish, and mass the data together to get the population response. And I think that in our discussions with various bodies, that nobody has argued with the type of model that it's most appropriate, and it has, for instance, been recommended recently by the Crown Estates as the appropriate method for looking at salmon migration, the impacts on salmon migration of marine renewables in Scotland. It's also used by the US corps of engineers to manage fisheries, fish movements around dams and sluices, so it is very relevant to this application. One of the issues that has come up repeatedly in our discussions with NRW and other bodies is whether the model can sufficiently replicate the complexities of a salmon trying to get to its home river, and I thought it would just be useful to mention something that was on the news programs a couple of weeks ago, where a university in the UK has used the same type of model for looking at how a sheep dog rounds up sheep and gets them into a pen, and in some ways this is rather similar, if we think of the pen as being the home river. And what they showed was that although it might look a complex situation, that actually only two behavioural rules were required to replicate the behaviour in the model, and to get the dog to round up the sheep. And it doesn't, it's because the two appropriate variables that control that

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situation. We have only sort of three basic variables within our model, but they're highly focused. My experience in biology is that if you make something complicated, you've probably got it wrong, and you've only got to think of the laws of natural selection to understand the complexity that can arise from a simple rule. So we believe that the rules that we have within our model are perfectly adequate for explaining how fish react, we don't take into account… we use the olfactory trail, we use depth and we look at the swimming speed ability of the fish. We don't need to know how they're reacting on meeting a predator or something like that, that's just noise around the situation. And we don't need to look at things like salinity because that is almost perfectly correlated with the olfactory trail. So we can distil this down. What we're doing is distilling the process down to the absolute essence of what is required.

Next point is that the… we've been questioned about whether the data that we've used to calibrate the model are appropriate, why haven't we put in thousands of fish into Swansea Bay and measured them directly. And the answer is because we have very good peer reviewed, validated, scientific data from tracking studies in other parts of… in other associated waters around the British Isles and Northern Europe, including Scandinavian waters, and the… we've been asked what is the relevance of data in the Scandinavian waters. Well the species are the same, the processes are the same, the navigation is largely driven by magnetic fields at a distance, and olfactory as they're getting close, and the main difference is in the water temperature; it's cooler. So that affects the swimming speeds; they're slower in cooler water. Slower swimming speeds generally increases the risk because it means fish can be in the vicinity of the lagoon for longer during their migrations. So all of our modelling is based on some rather conservative assumptions about water temperature and swimming ability, and this is evidenced by the fact that in the one track that we do have of a smolt coming out of the Tawe and being trapped through Swansea Bay, it swam much faster than the data that we'd used to calibrate the model. The result was that the mortality, if we plugged in that same data and rerun the whole model using that swimming speed data alone then it gave a lower mortality rate than using the data that we'd used, so it helps to establish our position, that we're using worst case in this, and we're using conservative values.

And the final, fourth point I want to make is that the… we've been questioned about whether we have truly encompassed worst case, and in our submission we put a number of videos of the model runs available on the website, and we cited a number of examples of still frame grabs in the report, in the environmental statement, and the ones that we presented show fish approaching from the west, so we were asked about whether we had considered fish going from the east, or other positions. We had done a lot of additional runs from which we had selected the worst cases and presented. We've now made those other cases available so that people can see that what we have chosen are worst case examples, but the fundamental thing controlling that is the gyre of movement in Swansea Bay, which means that basically wherever you feed the fish in they end up going round Mumbles Head and going in that way. I'll pause there, in case there is any comment at this point.

Mr Bassford for TLSB: Yes, what I think we would like to discuss now is to enable a discussion about our confidence in the modelling of the various species crossing the discharge, the strength of the discharge, whether it is disruptive, distractive, what happens if it is extremely high, what happens if the rivers are in spate, and how those have been looked at. And I think this is for Dr Willis, is it not?

Dr Willis for TLSB: Yeah, just to sort of set the scene with regard to salmon, if we fitted an adult salmon trying to get back into the Tawe with his own GPS and he was able to read exactly where he was and he had a good map, then they'd never encounter the turbine. So if we gave the model salmon perfect information about where it was in relation to its natal river, there would never be any encounter because we know it's got the kind of motor to get past the kind of currents it will face. So really the model is trying to understand how bad salmon are at navigation, or how uncertain we are about how they find their way in the ocean, and we basically start with the premise that they do get back to their natal rivers, we know this is a fact, and work down from that sort of zone of truth. In the model there are only three main parameters. There's a load of housekeeping stuff so that things don't turn up on the beach and things like that, but really in terms of what differentiates one fish or another, there are only three parameters which define the fish, and one is the speed it travels; that's the instantaneous speed that it travels, and we have literally years and years of data on salmon of how fast they can swim, they're physiologically capable of swimming, how fast they do swim, and how fast they're comfortable swimming, and their energy dissipation at those rates, and

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so forth. So we're rather limited in specifying the speed. So the other two parameters which matter are two navigational parameters, and they basically relate to how often the fish gets good navigational information, and how good the fish is at staying on target once it's got good navigational information. And broadly speaking in the sort of animal navigation area of science these are metaphorically called map and compass. So the first is map; when does it get good map information? The second is, how good is it staying on a bearing? And those two parameters define how bad the fish are at navigation, and in order to calibrate the model, in order to sort of twiddle the buttons on the model to make the model fish act as close as we can to natural fish, we identified the studies we used. One in Norway, Davidson et al 2013, they tagged 56 salmon of this species over several years, therefore lots of different environmental conditions, and also very importantly, lots of different sizes of fish, and capabilities of fish. So we have a kind of area of uncertainty, because what they gave us in that study, over 14km, at the very point where they're motivated most strongly to go towards their natal river, they effectively defined for us the wiggliness of those tracks. They didn't show us the tracks, but they did show us the ground speed, and we know how fast salmon swim at various temperatures, and we know the variation in swimming speed, so we effectively know how wiggly the tracks were, and we can feed that into our model and replicate that uncertainty across Swansea Bay, the same level of uncertainty, and it's clearly explained in the ES hopefully, we've been as clear as we could, is that's how we tuned the model to that level of uncertainty. So rather than the idea of a salmon slavishly following an olfactory trail, the olfactory trail is really just a rough idea of where the salmon will be going based on the water quality model. And the salmon very, very badly follow that trail, and they are pushed around by the currents, and there's uncertainty added due to the water model, due to the actual random nature of the water model, but there's also uncertainty added on top of that which relates to turbulence below the spatial scale of the model, and there's uncertainty added to that which relates to the salmon's own ability to keep a dead reckoning, you know, keep in the same direction, and uncertainty about how often the salmon has good information, and that's how the model works. So there is only really three parameters, and those two related to navigation; map and compass, define how wiggly the tracks are, and therefore how likely it is that in a case of many, many thousands of fish that some adult salmon is going to be going in the wrong direction, and get entrained therefore, or encounter the turbines, with absolutely no avoidance behaviour whatsoever, he just happens to think he's going towards the Tawe, and he happens to be going the wrong direction, and if he encounters a turbine in that situation we count him as an encounter. So we haven't put in any kind of avoidance behaviour, or any kind of complex behaviour, which we know these fish have. We've just used those navigational parameters to say how much uncertainty we have around their navigation capabilities. So that's the sort of philosophy behind the model, and that's why we can have quite high confidence in the results because we believe the envelope of uncertainty is quite wide, and we maintain it…

Mr Gibbs, ExA: Can you expand on and justify that last statement? It was an interesting one, it sounded to me that because you have uncertainty therefore you can know, but

Mr Bassford for TLSB: The point is that if we say that because we are aware of the amount of uncertainty we are confident, it sounds like a contradiction.

Dr Willis for TLSB: I'll give you an analogy. I used to work with pigeons, so if I threw a pigeon off, say, Blackpool Tower, and I know that pigeons can survive in the air for say five hours, and fly at say 20mph, I can draw a model then of where the pigeons are liable to land. So my envelope of uncertainty, as I call it, is a ring around Blackpool Tower 100 miles in radius. And since maybe I know exactly that no pigeon has ever stayed in the air for more than five hours, I can be absolutely certain that the pigeon will land inside my envelope of truth. So by having that envelope, my certainty has in that case increased to nearly 100%, even though it is very uncertain, they've got a huge ring. And to take that analogy further I could say that's not just any pigeon I threw off Blackpool Tower, that's my pigeon, and I live in Newcastle and he's my homing pigeon, and 99 times out of 100 he gets to my loft in exactly four hours. Now my envelope of uncertainty is suddenly narrowed; has collapsed from this huge thing to a very small uncertainty. And time, you know, he's ten minutes late, he's ten minutes early, it rained, it slowed him down and so on. So suddenly, by adding information such as his motivation, I can collapse my area of uncertainty and I'm very certain about that, because I've measured him coming home a hundred times. And that's the kind of… that's what I mean by being certain about our uncertainty…

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Mr Gibbs, ExA: I understand that in broad terms, but where we have to make an assessment is that we're talking about a situation which exists, which salmon navigate, they find their way to their natal rivers to a large degree, but there are elements of disruption being introduced to this system in the form of discharges from the turbines, sucking into the turbines, and all those sorts of things. And what we need to understand is why we can still have a degree of confidence that they're going to find their way to their natal rivers.

Dr Willis for TLSB: Yes, well if we get back to the… hopefully I've explained the idea of uncertainty. When the fish are modelled in the current field, then they are affected, they are pushed around by the currents, and how big the fish is determines how fast it swims, and therefore determines the amount that it is at the mercy of the currents, rather than its own behavioural volition. So if you get a very, very large fish then it can more or less overcome any currents, and its movements are defined purely by its motivation, whereas if you get a larval fish, or an egg, for instance, then it is completely determined on the current. So the amount of effect that the outflow from the turbines is going to have is very much dependent on the size of the fish, and its swimming ability and so on. And that's really what the model is focused on. In terms of what happens when a fish doesn't have navigational information, then that, as I say, is explicitly modelled in the model, about how often the fish knows where… can direct itself via the olfactory trail to the river. And to do that we go on the calibration that we used in the Norwegian study, and we go on literally 50 years of science about how fish follow olfactory trails. The general feeling of… since about 1951-53 were the first time these things came up, and again, if people are unfamiliar with these kind of models, the first of these kind of models was made in 1963, you know, Pacific salmon returning to their natal rivers, and models very similar to the one we're using here were made in 1991, again with Pacific salmon. So there's a long history of these models, and the general opinion is that the fish can smell their natal river, so they can pick up that olfactory trail from 50-20km away from the river.

Now the way that water quality, we don't know what they're picking up in terms of the smell, so we don't know how it degrades in the water, we don't know if they can smell its old or young, we don't know if it degrades, or they change what they're sniffing as they go along, so there's an awful lot we don't know about how salmon do navigate by olfactory trail, but we know, or the evidence is, that they pick it up from 50 to 20km away. And because of the way that substances disperse in sea water, that means they're picking up extremely low values. And what we're talking about here is much closer to their natal rivers, and the edge, the extent as it were. Even then, as I say, they're following their olfactory trails very uncertainly, and therefore they're directing themselves, and in the real situation, if a salmon lost its trail it would carry on and pick it up on the other side kind of thing.

Mr Gibbs, ExA: Right, we're going to NRW in a moment. I've got one point, and I'll raise it and then Mr Bassford come on in. And my point is literally this one about physical issues about swimming past the discharges, because I think that's something that has been raised by objectors, and I would like you to cover. But Mr Bassford…

Mr Bassford for TLSB: Just to take the data you have just received from Dr Turnpenny and Dr Willis, what the model has done is that it looks at the individuals, that is an individual based model, so it doesn't ascribe the same characteristics to every one of the individuals that it contains. They are ascribed characteristics based upon the population that is under consideration. So they represent a real population. It takes account of the natural environment because it has a hydrological component as well, which can then be modified to include the effect of the project. So for instance the turbine flows coming into Swansea Bay. We can model how the individuals will go to their natal rivers, the Neath and the Tawe in this case, of particular interest, but not only those particular natal rivers, and we know the characteristics of the fish, so we see the individual particles representing the individuals interact with those flows, and whether they're likely to interact with those flows based on the wiggliness that Dr Willis has described. So we can see how they interact, and then because the individual particles are still imbued with the behavioural characteristics of determination to reach their natal river, and they're imbued with the characteristic of their swimming speed, you can see how they respond to the change in flow. Now, that is my understanding, I hope I have encapsulated that. I'll just defer, Dr Turnpenny finishes off quite briefly, because these are processes which you'll know run on rails.

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Mr Gibbs, ExA: Sorry, one other point if he takes up at this point, I think that's the concern raised about actual attraction to the turbines itself.

Dr Turnpenny for TLSB: Just to give you the figures on velocities around the turbines, the velocity at the highest point through the section of the turbine, which is where the runner blade spins round, depending on the flow ranges from about eight metres a second to about 12 metres per second, and these are velocities that even large salmon would struggle to try and get through. So we don't think there's any risk of fish actually swimming the wrong way through the turbines when the flow is going from inside to out. The turbine chambers themselves are basically conical, or square cone in shape. So by the time it gets to the edge of the wall it's down to about a maximum of 2.2 metres a second. When you get out to 20 to 30 metres, the velocity is down to around 1.1 to 1.2 metres per second, so it decays very quickly with distance. So when you see pictures of sort of large plumes of water being emitted, or jets of water, actually the decay of velocity with distance from it is very rapid, and by the time you get to 20 to 30 metres out, even fish the size of a salmon smolt, a bass or an adult herring would be perfectly capable of avoiding this. In my studies we have measured in the laboratory, swimming speeds of 20,000 fish on behalf of the Environment Agency's program, so we know a lot about that aspect.

In terms of actual attraction to the flow, there is no evidence. I've searched and searched to try and find evidence of attraction of migratory salmonids to salt water flows, and can find absolutely nothing on that. When you look at the scenario of a salmon, or sea trout adult in migrating towards the home river, searching for the olfactory scent trail, then whatever little bit of it might get nipped into the lagoon with the flow is so low in concentration compared with what the hydraulic model shows, it will happen out in the reach between the turbines and the western shores of Swansea Bay and Mumbles Head. The fish will be attracted along the concentration gradient which will take them away from the turbines and towards that trajectory, and that is exactly what the modelling shows, and all the different variations of runs that we've done.

Mr Gibbs, ExA: I'm going to turn to Natural Resources Wales, because you may have some questions or comments.

Mrs Tavner, NRW: Yeah, there is a couple of things I'd just like to come back on that. NRW don't as such have a problem with the modelling, or with the olfactory trail modelling, and we accept those. However, I think our sort of qualms about the uncertainty level is precisely maybe because you are reducing the model into those three parameters; swim speed, navigational route, and navigational ability. With swim speed I would certainly agree that there are no issues about those, however it's the last point, which is the motivation of a fish to reach its natal river. For salmon, I would agree that they could be considered highly motivated, but we do know that there are instances where fish may not be able to enter the river due to low flows, or due to other environmental conditions which means that they won't necessarily be going straight up the river, and the other thing is that with sea trout, which is obviously a considerable part of the migratory fish population in the rivers in question, that that motivation again, is not as strong, necessarily, as it is for salmon. Sea trout do tend to stay in coastal areas, a lot of sea trout, quite a large, sizable population of sea trout actually just pop out to the estuarine and coastal environment and come back, even spending as short as a couple of months in that environment.

Mr Gibbs, ExA: Are you saying that their behaviour would be more like fish generally in the bay, rather than particularly the migratory aspect?

Mrs Tavner, NRW: Yes, I think that that population, or sea trout population is less likely to be so highly motivated from that trip from sea to river, as a salmon will be, and there are indeed quite a lot of research which backs that up. So NRW's concern with it is basically that for a lot of fish you can't, this high motivation that it's based on is an issue. The other thing is that obviously this is… and I take the point made earlier, that we don't know what will happen to that motivation when we have the lagoon in place. So those were the sort of…

Mr Gibbs, ExA: inaudible

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Connor Whiteley, Swansea Env Forum: We have a similar sort of concern with Natural Resources Wales on the interplay of the flow of the rivers, and the motivation that the fish will express, and how long they will linger within the bay before they actually make the progression up the river, and that's pretty much it.

Mr Gibbs, ExA: Mr Bassford?

Mr Bassford for TLSB: The first thing to say before I hand over to Dr Turnpenny, is that if you had believed that the approach to salmon was the beginning and the end of the approach that TSLB has taken you would be incorrect, because the behaviour of different fish species, and individuals within the range of characteristics within those species have been considered, and the other thing, when you hear Dr Turnpenny on this, also remind you that he is not just a modelling expert, but also a behavioural scientist expert in the behaviour of fish. So when he speaks about the behaviour of different species within this environment, it is also informed by exactly the sort of considerations that have been brought to you, and there is an evidential point obviously here which is this is the modelling that is before you. There is no other modelling that suggests that the fears that have been raised by NRW or Swansea Environmental Trust actually have any grounding in fact, and on the contrary there is a long history of modelling not just of salmonids, but of many other species which supports the approach that TSLB is taking. Dr Turnpenny.

Dr Turnpenny for TLSB: Thank you. Yes, I mean first of all we have acknowledged in the limitations appendix on the modelling that in relation to migratory fish; salmon and sea trout, the model is primarily dealing with the ontogenic migrations, in other words where the fish are heading for the river. So in the case of sea trout, we're not dealing with the kind of milling behaviour or general coasting around the bay as such, we're dealing with what happens to them when they are motivated to go into the river, and we have made that clear. With respect to the idea of sea trout moving out into the estuary and local coastal waters, I think it's far from clear as to how huddled and close to the coast they are, but certainly we have carried out now I think five quarterly surveys around the bay for fish, using a variety of techniques, and I think only in the last quarter survey that we carried out did we pick up a sea trout. And the gears that we were using would pick them up as well as, or at least one of the gears that we're using, the otter trawl, would be capable of picking them up. So we don't believe there is any kind of high density of sea trout milling around the bay, and that's not to say that they're not a little further out, or clinging to other areas.

The second point is concerning the fish that are hanging around at the mouth of the Tawe, for example, and waiting to get into the river, and this clearly has been identified as a problem with the Tawe barrage that the fish are delayed more there, and waiting for over topping flows and so on to make a successful entry into the river. And under those circumstances they're disadvantaged. But the paper that we were referred to, I think by NRW, certainly by some of the stakeholders, there was one by Solomon and Sambrook where they looked at the fate of salmon trying to get into UK south coast rivers, and being held up by things like dissolved oxygen, low dissolved oxygen concentrations, and actually the point that the paper makes is that those fish are, because they're held up and losing their physiological opportunity, they're geared up for going into the river and are frustrated in their attempts to do that, that the authors assume that the majority of them die. So they're not sort of, most of them are not making it elsewhere, or not making it back into the rivers. Therefore, as far as our modelling is concerned, when we put fish in those positions, our model would predict that if they move out again they would behave very much like the smolts in terms of their reactions to the water currents, which would in any case take them away from the turbines.

Mr Gibbs, ExA: At the moment we're not so much talking about the collision with the turbine, but the extent to which they're managing to find the mouths of the river. So are you saying it would affect their chances of finding the mouth of the river?

Dr Turnpenny for TLSB: No, we don't believe it would, no.

Mr Bassford for TLSB: I think you are saying that if it was in that position it's perhaps not going to find it anyway, and if it moved out it would be at the same risk as it would have been if it wasn't out migrating.

Dr Turnpenny for TLSB: Yes, yes. What we're saying is that if they've got themselves into that position at the mouth of the river where they're frustrated they're no worse off than they would be without the lagoon, basically.

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Mr Bassford for TLSB: And then furthermore, if that isn't right, and they move back out again, the model shows how an out migrating fish would be affected, and so therefore that is assessed also, and that can be understood with confidence and be ascribed a reasonable impact.

Mr Gibbs, ExA: I want to move on to the actual collision considerations. First of all I think it will help us if we are told how the turbine monitoring of collisions will operate. I don't know whether you've got the right witness for that.

Mr Bassford for TLSB: We have, we're just deciding which one of us is going to speak about it. As with everything, I can always tell you what I think, but somebody that…

Mrs Lock for TLSB: Good morning, the issue of monitoring turbine encounters in the updated AEMP as objective F1, which is summarised in table 8.1 in the document, and what we propose to do is the actual monitoring would be using the Didson cameras is what we're thinking of using, which have been tried and tested. I think Dr Turnpenny could probably provide you with more information about those, and how they're actually able to detect fish. The Didson cameras, we would basically be able to stop them…

Mr Gibbs, ExA: Sorry, you would have cameras and…

Mrs Lock for TLSB: Didson cameras they're called. I don't know whether Dr Turnpenny can actually provide more information on that…

Mr Bassford for TLSB: It is important to understand the way this functions as part of the monitoring and mitigation, because we have obviously predicted a certain impact, and in our impact we assume that if a fish is entrained it is lost to the population. So it is a very precautious… or rather, if it is entrained we then apply the striker model. So what we need to understand is how many fish are actually brought into the turbines when it is operating. In order to do that a particular device, which is called a Didson camera.

Mr Gibbs, ExA: It's not digital, it's Did…

Dr Turnpenny for TLSB: D I D S O N.

Mr Gibbs, ExA: Right, okay.

Mr Bassford for TLSB: It is not an ordinary camera, or indeed a camera like you or I would ordinarily understand it, and that is why Dr Turnpenny needs to explain it. And also perhaps some of the uses and some of the things it's shown, because it is important to understand that this is a very effective monitoring tool.

Dr Turnpenny for TLSB: Yeah, this is something that will be very familiar to my NRW fisheries colleagues, but the Didson camera is widely used within NRW and the Environment Agency for monitoring fish, and it is what's known as an acoustic daylight camera. So that whereas an ordinary sonar system sends out a sonic ping, and it bounces back off the fish, this system takes the ambient noise in the environment and its reflections of the fish, in just the same way as using an ordinary photographic camera, daylight bounces off structures and we photograph them.

Mr Gibbs, ExA: Before we get too far, where is this operating? Is it in the approach to the turbine, or is it attached to the turbine blades?

Dr Turnpenny for TLSB: Not to the turbine blades, it would be on the wall of the turbine house so that it was monitoring… typically you can monitor a section that is perhaps a cone 30 metres in extent from the camera. And so these cameras could be mounted on rails and slid down to the appropriate position, and then it is filmed, and then there are computer programs that can analyse the images to collect information on what fish are present. Those can then be moved to different turbines on different occasions to sample across the whole suite of turbines.

Mr Bassford for TLSB: If you refer them to the draft AEMP to page 75 to 76, this is described and a picture of a mounting is on figure 8.3. Pictures of the cameras themselves and also the information, and…

Mr Gibbs, ExA: I had seen those pictures without taking in exactly what they were.

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Mr Bassford for TLSB : The important thing is, in figure 8.1 is the most impressive in terms of evidence because what this shows is that even though we're talking about sound, this is not a ping on a sonar screen, you will be able to see there is actually quite high resolution for a sound generated image, and the Didson camera is able to distinguish between different fish species, or an interpreter can distinguish between different fish species.

Dr Turnpenny for TLSB: Yes up to a point. Like all of these sonar systems, we have to do a bit of ground truth validation by netting fish in the area, so that would be part of the program.

Mr Gibbs, ExA: The question is what is it measuring? Is it measuring individual fish events, or is it….

Dr Turnpenny for TLSB: It will measure the encounter rates of fish with the turbines, but it will also identify groups of fish that may be just swimming there happily, feeding on crustacea and tiny fish that are coming through. So it gives you a window on a place that would be otherwise very difficult to see and sample. So the Environment Agency and NRW are using these, for instance, to look at numbers of eels that are getting drawn into intakes.

Mr Gibbs, ExA: I suppose what I'm really saying is how do you make that transition between having the snapshot of what's happening in the approach to the turbine, to mortality levels?

Mr Lewis for NRW: We can assist on this.

Mr Gibbs, ExA: Yes please?

Mrs Tavner, NRW: Sorry, not on that point. The point I want to make is just that while Environment Agency and NRW use these extensively, they do use them in freshwater system, and the range of species that we use them to distinguish is maybe a handful, while in the marine environment you would be looking at trying to distinguish between, you know, 50 odd species. It has taken a lot of years for them just to be trying to establish what is salmon, what is sea trout, and with camera work on itself you would not be able to distinguish various species of fish, it would take some validation, and it is extremely labour intensive. You get a lot of other bits of floating debris, etc. So I think there are some limitations in the systems which we are keen to discuss with Tidal Lagoon in terms of what can actually be seen on a Didson camera.

Mr Gibbs, ExA: That's the level of refinement of the raw data to actual species. The question I was asking was about the movement from collection of the data about fish in the neighbourhood of the turbine to collision rates, can you help us on that?

Mrs Tavner, NRW: I would defer to TLSB to what they've got to say.

Dr Turnpenny for TLSB: Yes, the last point that I was making was that the… you wouldn't use these without ground truthing them, and the ground truthing would require doing some netting operations in the vicinity as well to see what you've actually got.

Mr Gibbs, ExA: What about my movement from… to collision rates?

Mrs Lock for TLSB: If you look at… in that objective we just talked about at F1, it then expands further about additional surveys which are proposed, which is survey 23, which is turbine passage, which is basically netting on the other side to see actually what comes through, and then we'd use that information to then cross calibrate back to our modelling which we've undertaken to basically re-validate it, or demonstrate the results were as predicted, or as we think, worse case predictions in the ES.

Mr Bassford for TLSB: And you will see the methodology for that, which is currently proposed subject to approval with… and bear in mind these are the headlines of the AEMP, the final AEMP would need to be approved by the relevant local planning authorities in consultation with NRW. The proposal is to use netting downstream of the turbines either side, and that is to be found at paragraph 8.3.1.16 in the draft AEMP.

Mr Gibbs, ExA: I suppose the next question is to what extent is this evolving technology, to what is it proven technology?

Dr Turnpenny for TLSB: This is, I think, second generation technology now in this respect. This type of equipment was originally developed by the naval research people, and has emerged out into the wider

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environmental field. The mentioned Didson, and actually we show a different make of camera, which is even better, as the example given in the AEMP, and it is now… the technology itself is very well established, and I think what is now also well established is the post processing of the information from it to interpret it. But certainly we would not put this up as something you can use in isolation, it's got to be used and calibrated against ground truth data obtained by netting, or other methods. Netting itself is quite a difficult operation because of the high flows involved, and therefore is not something that you would want to do every week sort of thing. So the idea is you carry out the calibration exercise with the nets, and then you more frequently operate the technology.

Mr Gibbs, ExA: Am I right in saying the collision with the nets in itself could be damaging, whereas at that stage the fish might well have gone through the system without much damage? Is that part of the problem with the netting?

Dr Turnpenny for TLSB: That is part of the problem. What the netting will show easily is strike damage, where they've been hit by the blade. It will not show things like scale loss caused by areas of high turbulence, because the netting itself will do more damage probably than the passage through the turbine.

Mr Gibbs, ExA: Right, anybody else wish to come in on this? NRW do you wish to come back? Maybe, there's reference I think to eel studies, and I don't know whether there is any knowledge from that that you have which is worth throwing back at us?

Mrs Tavner, NRW: Not in reference to eel, but again I would just, I don't know whether TLSB has got any experience of where they have been employed in… where Didson has been employed in marine situations, and used for this purpose, if they had any…?

Dr Turnpenny for TLSB: I've been involved in studies in California where they've been used in tidal estuarine systems, and essentially the issues are much the same. They have to deal with, obviously, debris and so on, as NRW have pointed out.

Mr Gibbs, ExA: Right, looking at my colleagues, anything you wish to say in closing on this area, Mr Bassford? When I say closing, I don't really mean closing, but in summary…? Right, I think we can move on. Back to you, Mr Amos.

Mr Amos, ExA: Right, in that case we'll move to agenda item 11, which we'll make a start on before we have a break. This is an item on commercial fishing, 11.1. My colleague, Captain Doctor Widd I'm told is the correct title, is unable to be here today, however I will be addressing a number of these issues. Initially these were addressed for a Mr Wisby, I don't think we have anyone here representing the commercial fishing operations, do we? No. In which case I think, as regards questions little 1 to little 5, you will have spotted that 4 is not actually a question, my intention would be to ask the applicant and any other interested parties whether they wish to make any general response to those points. One which I would like a response on is a view on the return of whelk potting at the vicinity of the outfall area, once it's been relocated. Mr Bassford, I'm happy to come to the applicant first.

Mr Bassford for TLSB: In relation to those items 1 to 3, and we'll come to 4 and 5 shortly, the first thing is to say that we consider we have addressed the concerns of Mr Wisby, and he and his colleagues, I understand he has already withdrawn his representations, and if his colleagues have not already done so, my understanding is they will do, or are doing so very, very shortly. In relation to the whelk potting return to the end of the outfall area, when relocated, the applicant's point is that there is no reason to suppose it won't. So it is to be expected that whelks will resume their activity, and whelking people will resume their activity once the outfall extension has been completed.

Mr Amos, ExA: Do any other participants at the table wish to respond to little 1, 2, 3 or 5? I'm not seeing a flurry of hands, right. In which case I will then move to – thank you for that, Mr Bassford – I'll move to little 6, as on the agenda, and Dr Harrison will perhaps ask one or two questions, then we'll have a break.

Dr Harrison, ExA: Thank you, Chairman. Similarly because of the withdrawal of the objection with regard to the local fisherman's group, I would suggest that we don't need to cover little 6, unless the applicant has anything further to say about that.

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Mr Bassford for TLSB: Sorry to disappoint your agenda by inconveniently reeking arrangements with people, I don't think we need to say any more.

Dr Harrison, ExA: In that case we'll move on to item agenda 7, which was a matter raised by NRW in their written rep with regard to the impacts upon the sprat populations in the bay, and their concern that they hadn't been assessed, and my question here is whether the further information supplied by the applicant has now addressed that matter, if NRW could comment I'd be grateful. Thank you.

Lily Pauls, NRW: The short answer is no. In response to our written rep, TLSB have stated that the sprats are primarily driven by large scale climatic effects, and as such the overall impact of the project is considered significant.

Dr Harrison, ExA: Are you in discussion with the applicant on this matter?

Lily Pauls, NRW: Not so far, no.

Mr Amos, ExA: Did you say significant or insignificant?

Lily Pauls, NRW: Insignificant.

Mr Amos, ExA: Ah, okay, could have been important.

Dr Harrison, ExA : Is there anybody else around the table that would like to comment on this matter?

Dr Turnpenny for TLSB: Yes, thank you, I would like to comment. Sprat, actually we did assess sprat, but not as an individual species. We took what were considered to be the key valued ecological receptors individually, and we did grouped assessments for remaining pelagic and demersal species, and so they were technically assessed within the ES. As a little broader answer to it, the value of sprat in terms of the local community, as a commercial fish stock. They have very low value indeed, they are used as… they form a large part of sprat that are commercially caught are used in the industrial fishery for fishmeal, and it is a fishery whereby if the boats catch sprat, and then find there is something else for a better value, they will ditch them overboard and go and catch, land the more valuable species. So that's the sort of broad context. As a species they're rather like the krill of the fish world, they are ubiquitous around UK coastal waters. They form very large schools. We have problems at some coastal power stations where hundreds of tonnes of sprats will come into the intake and close them down, but this is not a concern to the marine fishery regulators, the only concern there is with actually protecting the power stations. In the ecological context of Swansea Bay, then they are very common, they occur frequently in the catches that we've recorded during our quarterly surveys, and they are an important food resource for some of the fish eating piscivorous fish, such as bass and cod, and they also see associated sea birds. We have been over to La Rance to the tidal power scheme there, and there is a recorded history of small fish, including sprats, going through the turbines and then being predated on by sea birds and fish like bass. So in that context they are still providing that trophic function within the bay within the La Rance scheme, and would do so within the Swansea scheme. In terms of the quantities that are going to arrive in Swansea Bay, anything that's taken out by the birds will, on a sort of statistical basis, be replaced by others that come in with the tides and I just think it is unrealistic to think that there would be any kind of dip in numbers as a result of the scheme operating. We have got the assessment team to look at that and how they would assess it in relation if it was being assessed as a single receptor, and on the basis that the fluctuations in sprat shoals are controlled by large scale random, climatic and hydrographic factors, and that they are ubiquitous, they merit only a local significance in this case, and we've come up with a minor adverse effect.

Mr Amos, ExA: Thank you, just a general point, rather than on particularly sprats, but the point about going through the turbines, you also have sluice gates. So there will be transmission of species through not just the turbines, that's correct, as I understand it?

Dr Turnpenny for TLSB: That's correct, yes. So the sluice gates will be more or less… passing through those because they're so large would be more or less harmless to the fish.

Mr Amos, ExA: At that point I think we'll take a break, if we can please come back at 11:50am. Thank you.

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