Marlborough Salmon Farm Relocation Advisory Panel

Dear Professor Skelton,

ASSESSING THE EFFECTS OF SALMON FARM RELOCATIONS ON KING SHAG

I was requested by The Ministry for Primary Industries (MPI) to report on the effects of salmon farming on the king shag from the perspective of king shag prey. This report was submitted as Taylor (2016). Since then I have noted that in his evidence, Mr Rob Schuckard refers to a feeding study (Schuckard & Melville, in prep.) that is additional to information that was available to me at the time of drafting my report. This recent feeding study provides useful insight into the range of prey species taken by king shag and variations in the relative proportions of prey species taken between colonies.

1. Points upon which I agree with opposing experts' views

Schuckard, Paragraphs 92, 93: Considering that my conclusion of 92% is based on the information to hand at the time of drafting my report (Lalas & Brown, 1998) but did not include results from the unpublished study Schuckard & Melville (in prep), I would agree with Mr Schuckard that the figure is high and that the relative importance of several other species is higher than they appeared at first. However, it is clear from the Schuckard & Melville (in prep) results that in all cases, witch (*Arnoglossus scapha*) is the predominant prey species in samples taken at all colonies included in the two feeding studies.

Schuckard, Paragraph 95; Fisher Paragraphs 128, 129 : I agree that the Schuckard & Melville study suggests a more diverse range of king shag prey species. I also find the variations in relative importance of prey species between colonies informative, demonstrating the highly flexible nature of king shag foraging.

Schuckard, Paragraph 96: I agree that the McKnight & Grange (1991) study is quantitative and I stated this several times in my report, where I was careful to use arguments that reflected this.

2. Points upon which I differ from the views of opposing experts

Schuckard, Paragraph 93: I note that Mr Schuckard has over-stated the effect of turbidity on the efficiency of prey selection and capture in visual feeding flatfish – in Livingston (1987a) the statement is made in reference to "high turbidity", a situation far more extreme than the merely "turbid conditions" referred to by Mr Schuckard..

Schuckard, Paragraphs 93-95: Note that I investigated the possibility of fishing pressure as a likely cause to determine whether the reported predominance of witch was possible, given that the major difference the Lalas & Brown feeding study indicated in contrast with other previously published information on witch diet. With the additional information from the unpublished feeding study, one can now more easily conclude that witch is likely the most important component of king shag diet.

Schuckard, Paragraph 97: I disagree strongly with the comment that offset through recovery is highly speculative and unsubstantiated in light of the work by Keeley et al. (2015) and refer the Panel to the bullet points submitted by Dr David Taylor for a more complete discussion on this matter.

Fisher, Paragraph 70: I question the implication here that king shag is a benthic feeder only. It is useful to note two pieces of information in this context. Firstly, according to work carried out by Livingston (1987b), the jaw morphology of witch flounder is typical of a midwater-feeding flatfish. Secondly, a number of the species listed as prey of king shag are pelagic.

Fisher, Paragraph 132: It would seem to me that the severity of the effect of the example given here is somewhat dependent on where in the water column king shag captures most prey. From the information we have, king shag is a generalist feeder with the ability to forage on a range of fish species. Although work on closely related species provides useful insight, conclusions about the feeding behaviour of king shag based on such information must be reached cautiously.

3. specific reasons why the Panel should prefer my views over those of the opposing experts

King shag appears to be a generalist feeder that can forage on visual and non-visual feeding prey species, both on the bottom and in midwater. The Marlborough Sounds are a productive environment producing a wide range of potential and known forage species for king shag. It seems that the arguments presented by the opposing experts place too much weight on information from other similar species and their foraging behaviour without due consideration of what we now know about king shag.

I regard the offsetting of relocation by recovery of the sites the eventual outcome of proceeding with the relocation, which is supported by the work of Keeley et al (2015). However, I note the paucity of available information in all areas related to this work on marine farms and I am very aware of the high cost of carrying out reliable, informative research. One benefit of relocating these farms is the opportunity it presents for undertaking research on the effects of such an exercise. A second is the generally positive outcome environmentally of moving the farms from low-flow to high-flow sites.

Yours Sincerely

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REFERENCES

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