May 31, 1940

Dear Dr Russell,

I am now enclosing report on the papers by Dr Wood which you sent me. I hope this report has not been inconveniently delayed.

I found the papers somewhat difficult to read, partly, nowdoubt, due to my own unfamiliarity with the subject, and partly because Dr Wood frequently turns aside to discuss issues somewhat relevant to his studies, but which are not, so far as I can judge, at all vital to the main issues.

Although I have gone to considerable trouble in sorting out these and comparing the relevant evidence derived from different parts of these papers, I may well not have discussed in my report some of the particular points you have had in mind in sending me the material, and I should therefore be glad to supplement what I have said if in reply you care to raise any specific issue.

Yours sincerely,

REPORT ON PAPERS ON HERRING RACES

The two papers by Dr H.Wood touch on a great variety of topics arising in the course of his studies, but I imagine that what is wanted from me is an examination of the evidence which he brings forward for the view that the herring caught in the Scottish fisheries consist of three or more different races or interbreeding communities. This evidence apart from occasional confirmations of a very indirect character, the evidential value of which it is impossible for me to assess, is contained in the "Race investigation of the herring population of Scottish waters" of 1936.

The paper of 1936 consists logically of two parts. In the first of these the two observable characters, the number of vertebrae and of keeled scales, are determined for fish believed to spawn in a given region at a known season, while in the second part (Sections 5 and 6) this knowledge is applied to the recognition of the origin of immature and maturing fish caught at different times and places.

The fundamental data for determining the characters of the different spawning communities were obtained from commercial catches, samples of which have been examined for vertebra number and keeled scales, and also classified for maturity on a scale from I to VII. If the evidence of this paper is to stand by itself for the establishment of these characters, I should have liked to see rather fuller use made of this maturity classification than appears in the tables for the two observable numbers.

For example on p.10 the author notes, referring to Table I, "All the samples are fairly homogeneous with respect to maturity except

the sample from the Clyde obtained on Jan. 21, 1936. All fish at maturity stages I and II have been eliminated from the material used for the race analysis of the Spring spawners. And all samples from the same region in the same spawning season have been combined for the purposes of our present study."

I presume that the maturity stages give information as to the time interval between the date of capture and that at which spawning would have taken place. It may be that the time intervals from stages III to VII are so short that no considerable movements of fish are to be anticipated which would make the region of spawning differ from that of capture. None the less I should have ~~ft~~ felt it a useful precaution to tabulate separately fish of different maturity steges and, if it is a fact that these different stages are homogeneous, to let the fact be demonstrated by the data. Even setting aside the Clyde sample referred to, which has no fish of maturity later than IV, there are five samples among the remaining eleven with practically none earlier than stage VI, while of the remainder, stage IV predominates in two of them. Ideally it might be suggested that the metrical characters of spawners assigned to a given region and season should be ascertained only from fish caught shortly before spawning.

The metrical characters of the samples chosen as representing Spring spawners differ very decidedly and consistently from those of the samples representing Autumn spawners, and I do not imagine that ~~xxx~~ the precaution suggested above would, in fact, detract from this contrast, although it would seem to be a necessary one in a population

judged to change in the course of the spawning season as is said to be the case in the Firth of Forth. This difference shows itself equally decidedly in both of the two characters used; the Spring spawners having about 57.1 vertebrae and the Autumn spawners about 56.4. In keeled scales the Spring spawners have about 14.1 and the Autumn spawners about 14.85. Either character might therefore be used to distinguish these large groups. It is, however, impossible to judge to what extent they supply independent, and therefore corroborative, evidence, since the simultaneous distributions of representative samples in the two characters is not given; and therefore one cannot judge to what extent these characters are independent among members of the same, presumably homogeneous, sample. This point is likely to become of importance if, with further data, a multiplicity of spawning communities is postulated, since a single character may prove inadequate to distinguish them, and two characters, highly correlated among members of the same sample, may be little better than one.

Judging by the different samples tabulated in this paper, a high number of keeled scales is generally associated with a low number of vertebrae, and if this association is not also true within single samples it adds greatly to the assurance with which groups of fish may be assigned to these two races. But if there is such an association when individuals are cross-classified the evidence is practically that of a single character, and other characters will be needed if further races come into the study.

As I see the problem, the whole of the evidence respecting migration must at present rest on the accurate recognition of a sample

as having come predominantly from an assignable spawning community. It is for that reason that I have stressed the points that occur to me on which the- this evidence could usefully be strengthened. I should like to emphasize that there can be no doubt of the statistical significance of the major difference which Dr Wood recognises, i.e., that between those assigned to the Spring spawning and the Autumn spawning communities. If finer distinctions are to be drawn, or more complex situations unravelled, I think attention will need to be given to the following points:-

(i) Homogeneity of different maturity classes. These may often be homogeneous without being always so, and if ever they are not, the situation will be unnecessarily obscured by treating them as homogeneous.

(ii) Homogeneity of different catches ascribed to the same community. Standard errors based on single catches may be unduly small for a variety of causes if used as a basis for testing the ~~significa~~ significance of differences between real or supposed communities. The precision with which the characters of a community are determined must ultimately be judged by the agreement between different samples when any perceptible spacial or temporal gradients within a single assemblage are taken into account

(iii) The simultaneous distributions of two or more characters used is of equal importance with their individual distributions. Without it there can be no genuine corroboration of the testimony of one character by that of another.

May 30, 1940