

MERLEWOOD RESEARCH AND DEVELOPMENT PAPER

Number 56

THE GENETIC EFFECTS OF INTRODUCTIONS
(paper read to the Discussion Meeting,
held at Monks Wood on 6 and 7 December 1973)

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R. & D. 74/56
March 1974

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THE GENETIC EFFECTS OF INTRODUCTIONS

Most biologists would agree with the comment of a recent paper (Ratcliffe, 1973), 'That the message of evolution is one of impermanence for species in time; in the continuity of life there is constant change with one set of species being replaced by another'. At the same time, it is probable they would also agree that the rate of replacement will depend on the frequency of fluctuations in the environmental pressures and the hereditary capacity of the organisms to adapt themselves to changing conditions. In nature, dramatic changes are usually associated with major climatic shifts, when a relatively stable period gives way to a new one in which there are changes in the relationships of the flora and fauna. However, there is no doubt that man's cultural activities produce replacements both directly and indirectly and one of the indirect ways is through the introduction of an exotic or 'improved' species into a habitat already occupied by a closely related one.

An example which is often cited is the Rice or Cord grass hybrid Spartina townsendii, which evolved through the bringing together of the British species S. maritima and the American S. alterniflora. According to Charles Elton (1958), the hybrid first made its appearance in Southampton water in 1870 and, until the twentieth century, was comparatively local. Since then, it has spread to large areas of salt marsh both here and on the Continent and, in the New World, has largely suppressed or driven out the American parent.

Under natural conditions, hybridisation between related taxa does occur, but it is usually confined to regions where the natural ranges meet or the habitat requirements are of an intermediate nature. The ranges of the Hooded and Carrion crow, for example, meet in Central Scotland and intermediates or hybrids are found in this area, a broad belt which is gradually moving northwards as the range of the Carrion expands, whilst that of the Hoodie retreats.

However, hybridisation increases and introgression appears in situations considerably modified, particularly those altered by man in search of food, shelter and sport, where his cultural measures involve the introduction of exotics into habitats already occupied by their relatives. An illustration of this kind lies in the history of the dominant vegetation cover in Britain, namely oak woodland. It is rather ironic that the difficulties experienced in the past by botanists in distinguishing Sessile from Pedunculate oak, and the popular belief in widespread hybridisation which arose from their confusion, are a reflection of a situation created by man himself.

Dr. E. W. Jones was the first person to question the popular view in this country; he found that the number of hybrids or intermediate individuals, even in mixed populations, in areas of the south of England where the two species were regarded as native, was surprisingly low. The belief, that hybridisation was extensive and common, was also questioned on the Continent, where accumulated evidence pointed to the different habitat requirements of both species. In general terms, Pedunculate oak is the species of the wetter valleys, with Sessile oak confined to the dry hill slopes. Intermediates or putative hybrids are usually limited to the ecotone between them.

In Scotland, however, several foresters, in particular the late Professor Anderson, adopted the view, on historical grounds, that the Sessile oak was native to that country and that the Pedunculate oak was an introduction. Anderson's review (1967) of the situation showed that Pedunculate oak of exotic origin had been used extensively in place of Sessile oak in re-planting operations over a period of 500 years. The research of John Cousens (1962), using the modern techniques for studying introgression, indicated that the remaining tentatively pure Sessile oakwoods were few in number; the majority of the populations either bore the hall-marks of introgression or were composed of hybrid swarms. Thus, the effect of an introduced organism in an altered environment is well illustrated here and, from what we know of provenance experiments, it is not unreasonable to suggest that local races of Sessile oak have either been considerably modified or have vanished altogether.

Amongst other woodland trees which may have been similarly affected is the Scots pine. It is only in comparatively recent times that the value of re-stocking woodland with native races has come to be recognised. But, in the past, substantial quantities of exotic seed from various European and Scandinavian countries were imported for re-afforestation and it is probable that some miscegenation has taken place. At an intra-specific level, differences between provenances may be of a subtle nature and difficult to detect by casual observations. However, replicated trials show that important differences in growth rate and physiological behaviour do exist.

An example of the considerable modifications that can arise if allied taxa are brought together, is reported in a paper by Turcek (1951) from Czechoslovakia. Two Asiatic species of goat were introduced into the European ibex population of the Tatra Mountains, with results that can be described as disastrous; not only were there changes in physical appearance but, more seriously, in physiological responses. The true ibex breeds in mid winter and the young are born in April-May. Both introduced species normally breed in the late summer and their offspring are born in February-March. Interbreeding produced a population whose breeding season became identical to that of the Asiatic goats and the young were born during periods of heavy snow storms and sub-zero temperatures, and survival rates were badly affected. Measures were taken for protection and feeding, which, unfortunately, had to be suspended during the Second World War. It appears that, at the time of reporting, the surviving stock has been reduced to four ibex-like females.

In Britain it has been the custom or practice of sportsmen for many years, to introduce exotic races, generally raised in parks, into native herds of Red deer for the purpose of improving the trophy quality of the heads. This has produced a spectrum of variation ranging between stocks of

Red deer with little or no known admixtures of park lineage to herds derived from park animals only. Recent studies have demonstrated differences in skull-shape between British, European and Asiatic Red deer, although there is a fair degree of overlap between different provenances. However, within the present Red deer stocks of Britain it is still possible to discriminate between native or neo-native stocks and park animals; a distinction which conservationists are anxious to maintain.

A more serious question is the increase in the number of reported sightings of hybrids between Red and Sika deer, which have resulted from the adaptation of the latter species to British woodlands. On the Cartmel Fells, south of the Lake District, is a stock of Red deer of park origin in which hybrid deer are frequently observed. The danger in this case lies in the proximity of the Grizedale and Martindale herds of Red deer, which, in the present state of knowledge, are the only native herds of Red deer resident in England. Hybrid deer in the Cartmel area are not always easily identifiable in the field and those which have been shot and studied indicate that F_2 and possibly backcross generations are involved. A much more advanced state of introgression between the two species is being examined in Ireland; here one meets with animals ranging from Red-like stags that whistle like their Sika counterparts to the reciprocal condition.

In another sporting sphere, recent reports show that freshwater fishermen are concerned about the introductions of non-native fish species to British rivers and one account by Wheeler and Maitland (1973) lists nineteen species which have been introduced either by design to meet the increasing demand for coarse fishing, or by accident. In this connection a brief note in the Shooting Times (November 17, 1973) states that the best fish caught in a BFSS competition on the Little Ooze in November of that year was a roach/bream hybrid.

Another British animal which has undergone similar treatment is the British or Light-tailed squirrel, Continental

aces, which lack the light tail in summer, have been introduced either as former pets or directly into woodlands. Observations carried out so far in the Lake District, where the Red squirrel is still found in broadleaved woods, indicate that the animals are no longer of the pure British race. It is to be hoped that areas such as Strathspey, where the British form is still found, will remain free from miscegenation.

From the examples cited, I believe it is clear that by introducing exotic species or races into environments occupied by their relatives we can effect considerable changes in the genetical structure of both taxa, manifested by physical and physiological modifications to the phenotype. However, the attitude 'so what' is often the background of the question 'does it really matter whether a local race or subspecies disappears in a hybrid swarm?' In the case of the European ibex, where the balance was upset between the genetical constitution of the animals and their environment, the answer is self-evident. The decline, partly through this means, of the Sessile oak in Scotland, a species which has a greatly enhanced position in the silviculture of the present time, is another example. Plant breeders have been anxious for many years to conserve, as valuable gene reservoirs, the local races which have evolved naturally over long periods. The process of introgressive hybridisation destroys these populations, renders a situation, for a time at any rate, unstable, and leaves the breeder with a genetical hotch-potch of doubtful parentage and value.

It is also necessary to stress that amongst the ecological conditions favouring hybridisation between related organisms are those environments which have been considerably changed by man in his search for food, shelter and sport. Thus the people whose work it is to conserve the remaining elements of our native flora and fauna have an unenviable task because in Britain we must be particularly vulnerable to changes of the type described in this paper. It seems reasonable to ask therefore, that their difficulties are not increased and

that extreme care is taken in the handling of such concepts as 'diversification', 'environment enrichment' and the 'vacant niche'.

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