The Avicultural Society of New South Wales (ASNSW)
(Founding in 1940 as the Parrot & African Lovebird Society of Australia)

The 'Ins' and 'Outs' of Inbreeding

(AVIDATA: Official Journal of the ASNSW May - June 1976 New Series No. 3)

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There are few topics discussed among bird breeders which provoke more lively interest than inbreeding. Viewpoints vary greatly. To many, inbreeding is the cardinal sin. However if we look at some of the well founded reasons in favour of sensibly controlled inbreeding, I hope we may end up with a better understanding of it and perhaps even modify some of our thoughts on it.

For a start, what is inbreeding?

It is the mating together of related birds, either close or distant, e.g., very close as in brother to sister, medium as in father to daughter or granddaughter, or as distant as the pairing of second cousins. Inbreeding, though not always referred to by just that name, is used to advantage in all sorts of breedings. Horses, cows, dogs, or poultry, for example. Studs of any of these are usually inbred to some degree in order to develop a particular desirable strain, which may highlight that stud. Getting back to birds, or in particular, cage or aviary birds, probably the most comprehensive studies of inbreeding effects are available for budgerigar breeders. As a budgerigar breeder who is also interested in many other aviary birds, I have attempted to glean some relevant information on the subject - information which should apply to all types of birds.

Probably one of the best known and most commonly adopted methods of inbreeding is of course 'line-breeding'. An example of line-breeding could be the mating of some outstanding cock bird to several different hens or perhaps a hen to several selected cocks. The original cock could then be mated to his daughter and then granddaughter, and at the same time 1/2 brother to 1/2 sister, or son to mother, the progeny of which matings may then be mated back to the original cock. This may take some time to set up in the early stages, but soon we will have a good stud, all line-bred from the original, and all carrying as least some of his genotype. The most important thing of course in the whole operation is to try and mate the best specimens, even though a bird's progeny is a better indication to his value than his pedigree, as not all the good points of the cock will be displayed in all offspring, as I shall attempt to explain later. A most relevant adage in the breeding of exhibition standard birds is "feed, breed and weed". The ringing of birds and the keeping of accurate breeding records is also of great importance if one is to know which birds are related and how.

To better understand some of the advantages of inbreeding, we should have some understanding of very basic genetics. The characteristics of a parent bird passed on to its progeny on genes which are carried by chromosomes of which a number (13 pair for budgerigars) make up a single living cell. This cell becomes the basic unit of life, and the body of a particular bird is made up of a very large number of these cells, each one being identical in that it is made up of an exactly similar set of chromosomes, which carry the genes. These genes will control the bird's size, colour, sex, deportment, fineness of feather, fertility, colour of eye, and in fact every single thing about the bird. When a female egg cell and a male sperm cell unite and divide and multiply in the original foetus, the good and the bad points are transmitted in all directions. Their pairing up to produce the genetic constitution of the offspring seems to be largely a matter of chance, but still within some bounds. However we would expect that related birds would be more alike in the genetic constitution than unrelated ones, as they are more likely to carry many similar genes, which control that makeup.

Broadly speaking birds could be divided into two groups when being considered for an inbreeding operation. 'Homozygous' meaning that from a breeding pair, when sperm and egg cells meet, the genes which pair up are similar ones, and 'Heterozygous ' meaning that the genes which pair are not contrasting types. In budgerigars, referring to the gene controlling colour, a true breeding blue is Homozygous for that gene, whereas a green/blue is not true breeding and is therefore Heterozygous for the colour gene. These terms apply equally for any of the genes controlling any trait. Therefore birds are probably very seldom even close to being completely Homozygous unless inbred to the extreme. Very few of the characteristic traits transferred in this complex genetic interchange are easily recognisable outside size, type, colour, etc. Even the all important, fertility, will require testing.

Now to return to the inbreeding process.

If birds homozygous for particular genes are mated, all the progeny will be homozygous for those genes. However if birds heterozygous for those genes are mated the young birds will average 50% heterozygous and 50% homozygous for those genes. Therefore we can conclude that inbreeding will increase the proportion of genes present in homozygous state and conversely, out crossing increases the proportion present in the heterozygous state. Remembering now that homozygous type breeding paired similar type genes, whether good or bad, their manifestation in the highest degree should be exhibited by this type of breeding. Therefore inbreeding should tend to concentrate both the good and bad points. This is where ruthless weeding of inferior birds must be exercised. At this point inbreeding could be likened to a rendering pot over a fire, containing good and bad genes from a particular line of birds. To the surface will come both the cream and the scum. The scum must be eliminated from the breeding programme and the cream put back for further refining.

The terms 'dominant', 'recessive' and 'sex-linked' are ones that are very frequently used in connection with budgerigar breeding. However they should not be discounted as applying only to these birds. Mutations of many other varieties of birds, from Zebras, Stars, King Quail, Quarrions, Ringnecks and African Lovebirds, to name just a few, all appear to come under the same general rules of breeding as do budgerigars. It should be noted that many mutations are possibly present in our breeding stock right now, either being controlled by recessive or sex-linked genes, which, unless they are correctly bred will never show themselves. These are heterozygous genes, which, unless they are inbred correctly will probably be lost. Even some of the mutations which are carried by dominant genes will not necessarily show themselves unless transformed into the homozygous state. Again this is not impossible to be done by chance, but the greatest chances will come with selective inbreeding. Genes of course may be dominant or recessive in their ability to influence the outcome of a mating. Sex-linked genes will only govern the type and/or colour of the progeny when the colour genes and sex genes are on the same chromosome. Birds with undesirable characteristics transmitted by dominant genes should immediately be eliminated from the breeding programme. However unless inbreeding is used, many of the recessive traits will never be known, whether good or bad. Fertility is thought to be governed by a recessive gene and although not a proven theory this could account for the so called 'loss of fertility being caused by inbreeding'. This is not necessarily so, if a sensible system of inbreeding is being used. Generally it could be said that the percentage of progeny which lack a suitable level of fertility would approximate the percentage fertility of the combination of recessive genes which produced it. Below par birds should be eliminated from the breeding programme. In this way, theoretically and genetically it should be possible to improve fertility by inbreeding. Feed, breed, weed. It may seem that if we oust all the birds which show this or that fault, we won't have many left. This may be true, but a least what we have is top class, and once a good strong strain of bird is achieved, the breeding results thereafter should be considerably improved and well worth the effort.

The type of inbreeding which is undesirable and which unfortunately has become so closely linked with the word 'inbreeding' as to give it a 'bad word' sound, is where, for some breed of bird, especially when stock is a little on the scarce side, an intending breeder buys a full brother/sister pair, because they are the only ones obtainable. If these birds are bred, the young birds are sold to another intending breeder, and of course these birds are also full brother/sister pairs, and this sequence is repeated over and over. The birds are never out-crossed because the breeders claim that as all the birds are related, indiscriminate inbreeding could only be harmful. This is partly true of course and unless some out-crossing is achieved, then a very inferior class of bird will result. If however, the first pair were of reasonable quality, size, and fertility, or at least the best available, then a new line bred stud should be started by breeding father to daughter and mother to son, selecting the best progeny and breeding father to granddaughter, etc. Had another breeder or the original breeder done the same thing, after several generations of selective inbreeding, two of the line bred studs should be out-crossed to each other, possibly by swapping a pair of birds. I feel that this is the only road left open for many species, and unless it is pursued with all haste, yet systematically, many of the birds we now enjoy will either be lost to Australian aviculture or at least become greatly inferior to the ones we now know.

This is very similar to a recent method of inbreeding, which has been used with great success in the breeding of improved strains of pigs and poultry, called 'heterosis'. This method involves two separate, very closely inbred lines. If the best available brother/sister matings are followed in two separate breeding lines for six to eight generations the young bird's genetic composition should be nearly completely homozygous. Now if several of the progeny from each line are out-crossed to each other the resulting birds should be almost completely heterozygous, that is, the genes paired were very unalike. These birds should be larger, more vigorous and show greatly improved fertility. I have seen this effected with budgerigars and was very impressed. It does work.

A great deal too much importance is sometimes placed on blood lines when discussing inbreeding. Completely homozygous pairs will breed true to blood lines, but of course we've already seen that very few birds would ever be completely homozygous for all genes and neither is it very desirable that they be so. Genotypes made up of heterozygous pairs may be split many ways. Even a bird split for only two genes can pass on half its complement of four genes in four different ways. Likewise four heterozygotes may be passed on in any of 16 ways and so on. Therefore the term '1/2 blood' may not mean very much. A paired cock and hen may pass on genetic variations which differ greatly from the 50/50 which might be expected. Even if the cock is back crossed twice to daughter and granddaughter in a line breeding operation, the progeny, which should have 7/8 blood of the stud cock, may have a comparatively low similarity of genetic make up. It may of course, just as easily, be very highly similar. This is where the selecting of the breeding birds is so important.

So, to sum up:

Selective inbreeding leads to stability of breeding characteristics and uniformity of qualities in successive generations - it reveals hidden characteristics, both good and bad - and it does not produce undesirable qualities in the progeny, but rather concentrates the weaknesses which are already present in hidden form, bring them to the surface where they might be eliminated, either by out-crossing to a train not hindered by that particular weakness, or by weeding out of the breeding stock, birds which exhibit the weakness.

I hope that these few notes on inbreeding and out-breeding have been of some interest to you. Whether you are for it, or against it, think about it. All this may seem an awful lot of trouble. Perhaps this is one of the reasons for the degeneracy in the quality of some of our aviary birds. Of course not all birds are as easily handled and interbred as budgerigars, but where at all possible it should at least be tried. I hope I have managed to impress upon you the difference between indiscriminate inbreeding which is very bad, selective inbreeding which can be very good and out-breeding which at some stage is always necessary. Ample proof has been supplied by the many millions of budgerigars bred and the dozens of different mutations, all of which have been moulded into strong healthy strains by the use of selective inbreeding. I feel sure it could equally apply to most of our aviary birds. By keeping accurate breeding records and openly discussing our achievements and failures, some day many of our aviary birds will be heading towards the maze of successes through which the budgerigar cult has already passed.