

If the first egg produced was the infertile egg and the egg with the dead embryo was the second, then the three eggs hatched, or were due to hatch, on a perfect thirty-two day interval from the date of laying. This is two to three days longer than the time interval (29 to 30 days) listed in the literature as being the normal incubation period for Peregrines. However, the death of the chicks so quickly after hatching suggests weakened chicks that may have been in the egg too long. The naturally hatched nestling could conceivably have been killed mechanically by having the large dead pigeon roll down onto it (and later removed) or by accident by one of the adults. Neither seems likely. In view of the obvious difficulty encountered in hatching by the other two chicks, it seems more probable that the cause of death was that of too much energy being expended in getting clear of the egg. Possibly there was an inadequacy in the diet of the adult falcon at the time of ovulation or possibly there was insufficient humidity in the nest. While the general humidity during incubation and at the time of hatching was never below sixty percent, and the turf surrounding the eggs was damp enough to support some growth of the grass in the turf, the gravelly sand in which the eggs lay was very dry. Moreover, and this may be important, the depth of material directly under the eggs was not more than two inches; there was an inch or so of gravel and sand, then a one-inch thickness of wood, below which was air. The eggs could have dried from below. There is a suggestion here that the artificial nest site should be constructed to take the form of a built-up ledge of some material such as turf or concrete, in constant contact with the ground, that will conduct moisture to the eggs from below, instead of a soil or gravel-covered shelf.

The possibility of the death of the chicks being due to pesticide poisoning seems unlikely, yet should not be disregarded. Analyses are to be made of the 1967 eggs and nestlings.

Conclusions

On the basis of the 1966 experiments the successful domestic reproduction of the Peregrines appeared likely. It would seem to be important to have pairs that have been taken as nestlings and raised to reproductive age in close association both with mankind and with one another. To date there are only three recorded instances of females taken as nestlings being provided with natural mates and given a physical situation under which reproduction could be attempted, and it is significant that reproduction was attempted in all three cases.

Stevens, who began his experiments with a seven-year old female that did not produce eggs until her ninth year, felt that the length of time required for the female to reach reproductive age probably constituted a major problem. However, the experiment with the Raptor Research pair proved that ovulation can occur as early as the third year and may indicate that the need of a preconditioning period of some duration in company with a male may have been the reason for the two-year delay in ovulation observed by Stevens.

There is an appearance of a low fertility in the experimental pairs. Of the nine recorded nestings by three females and four males, all four initial attempts were failures and in two of these the cause of the failure appeared to be infertility. Two second, and one third nesting, all by Waller's female, resulted in fertile eggs, yet Stevens' pair produced infertile eggs on the third nesting attempt. The fertility or otherwise of the eggs produced in the two previous attempts by his pair is not known. Obviously the sample is too low to be indicative of anything conclusive. Even in the cases where the eggs were apparently infertile, the reason is not clear, and it is not known whether the male failed to produce sperm or whether the failure was due simply to a lack of attempted or effective copulation. No attempts at copulation were observed with the Raptor Research pair, but the same was true of the successful nestings by Waller's pair. Observations of natural pairs, where copulations have been recorded, indicate that while fairly frequent prior to egg-laying, it is also very brief and could easily escape observation (Cade, T.J., Univ. Cal. Pub. Zool. 63:151-290, 1960). At the same time the lack of fertility of at least some initial nestings, and this may extend to birds in the natural environment, may be due to nothing more than apprehension or inexperience on the part of the male.

However, when the experimental data are examined comparatively, one fact appears at once significant. This is the advanced timing of egg-production in the captive females. Except for Stevens' bird, which laid eggs in April, all eggs were produced from two to six weeks earlier than the normal dates of egg production of wild Peregrines living at the same latitude. Even assuming that the males--excluding the wild-caught male used by Waller--were not actually biologically infertile there would appear to be a good chance that the females were nevertheless laying eggs some weeks in advance of any potential sexual capability on the part of the males. If this were so, then any means of delaying or extending the ovulation period of the female might result in fertility. Oologists have long been sure that Peregrines breeding in the mid-latitudes will regularly lay a second, and sometimes a third set of eggs if the first set is taken before incubation is very advanced. It was therefore decided that if eggs were produced in 1967 before the first week of April they would be removed as soon as the set was completed.

Waller's experiments, while twice productive, remained inconclusive in that the successful hatchings were relative to the use of an adult, wild-caught male. While he recorded one fertile egg as having been produced by his falcon when in company with the first male, the validity of this report had been questioned, especially when Stevens was unable to obtain fertile eggs from his pair in which both sexes had been taken as nestlings. There now appears to be no valid reason to doubt that Waller did, in fact, obtain fertility on the second attempted nesting of his original pair.

The failure of Stevens' pair to attain fertility is more difficult to explain, especially as his falcon was producing eggs in April when the male should, presumably, have been as sexually advanced as the female. There is a suggestion here, when taken in context with the uniform failure of initial attempts by all pairs so far recorded, that prolonged association with an ovulating female may be a great stimulus toward sexual activity on the part of all males, and perhaps a necessity to some.

The uniformity with which such a very small number of experimental pairs has attempted to reproduce is indicative that a very high percentage of eyas pairs will make similar attempts if given the opportunity, and there now appears to be no reason why a good many of them should not be successful. All experiments to date indicate that Peregrines are extremely devoted both to incubation of the eggs and to care of the young.

Finally, it would now appear certain that the spatial requirements of Peregrines, and, by inference, of the other large falcons, differ in no significant way from those of other raptorial birds and many of the mammalian carnivores, being conditioned much more by an abundant food supply than any other single factor. Even the apparent minimal half-mile that normally separates the closest aeries may be much more a reflection of the average distance required by the male Peregrine to overtake prey from a starting point close to the aerie site without interference from the male of an adjacent pair, than to any inherent hostility toward other adult Peregrines. At any rate it is now definite that close confinement is no barrier to normal reproductive activity of either sex, and may be a stimulus to the female (see discussion in the Appendix of this paper).

The tendency of Peregrines to nest relatively close together in areas of high availability of food would further indicate that themuch closer proximity of other pairs breeding in confinement should also have no negative effect on reproduction. Enderson's Prairie Falcon studies (Auk 81:332-352, 1964) indicate that even the exchanging of mates of mature birds might be possible and at times advantageous.

Future Plans and Suggestions

A long term objective of the Raptor Research Foundation is the acquisition and distribution of potential breeding stock and the working out of practical techniques by which such stock can be retained in good health and with a minimum risk of loss for the two or three year interval prior to reaching reproductive age.

Some of the experiments to date indicate certain advantages to a course of training during this pre-adult period. In the first place, the regular handling then involved accustoms the birds to intimate contact with humans and the birds become reasonably tame. Equally important is the high degree of trust and tolerance between the sexes which can be effected if, beginning at an early age, they