BREEDING BIOLOGY OF THE MAGPIE GOOSE

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Summary

A BREEDING pair of Magpie Geese was studied at the Wildfowl Trust during one breeding season and part of a second. Nest-building was performed by both sexes and was done in the typical anatid fashion of passing material back over the shoulders. Nests were built on land of sticks and green vegetation. Two copulations were observed, both of which occurred on the nest, and precopulatory as well as postcopulatory behaviour appears to differ greatly from the typical anatid patterns. Eggs were laid at approximate day-and-a-half intervals, and the nest was guarded by both sexes. Incubation was also performed by both sexes, with the male normally sitting during the night. A simple nest-relief ceremony is present. The eggs hatched after 28 to 30 days, and the goslings left the nest the morning after hatching. Unlike all other Anatidae so far studied. the goslings, in addition to foraging independently, are fed directly by their parents and a special whistling begging call associated with a gaping posture is present. It is suggested that the bright bill colouration and unusual cinnamon-coloured heads of downy Magpie Geese are also related to this parental feeding. The parents constructed a " brood nest " of herbaceous vegetation that the goslings rested and slept on, which is also unique among the Anatidae. Family bonds are strong, and a rudimentary form of " triumph ceremony " is present. Development of the young and moulting sequences of downy, juvenal, and immature plumages are described; the presence of separate juvenal and immature plumages which are distinct from the adult plumage is apparently unique. It was also found that the juvenal rectrices are moulted shortly after fledging, which occurred on the 84th day, and the first remiges are moulted during the seventh and eighth months rather than at the end of the first year as is the usual anatid situation. A fully adult appearance, and presumably sexual maturity, is reached before the third year.

The Magpie, or Semipalmated, Goose *Anseranas semipalmata* (Latham) of Australia is unique among the wildfowl in that it constitutes individually one of the three currently recognized subfamilies of the family Anatidae, the Anseranatinae. In addition to this, the Magpie Goose is believed to represent the most generalized evolutionary condition of all the Anatidae and thus should provide the closest living " link " between the Anatidae and the other bird families. It is now generally held that the three species of South American screamers (Anhimidae), which together with the Anatidae comprise the order Anseriformes, do exhibit certain structural similarities with the Magpie Goose (Delacour, 1954), and it is of interest to compare the breeding behaviour and biology of the Magpie Goose with that of screamers as well as with the more typical wildfowl.

While the Magpie Goose may be rightly called the most generalized living species of the Anatidae, it is not altogether justifiable to refer to it as the most " primitive," since any species which is currently living has been subjected to natural selection for millions of years and is bound to be, in at least some respects, highly specialized. We may say, however, that the Magpie Goose has retained a greater number of primitive characteristics than has any other of the living species of wildfowl, and it is these characteristics which are of the greatest evolutionary interest. A rapid review of the structural peculiarities typical of the Magpie Goose that might be considered primitive may be mentioned here, before the biological peculiarities of the species are considered.

The semipalmated, or incompletely webbed, feet of *Anseranas* set it apart from the rest of the Anatidae (two other species of geese have slightly reduced webbing) and indicate a terrestrial or semi-aquatic habitat. Likewise the hind toe is long and is at the same level as the other toes, providing an

obvious perching adaptation. The screamers agree with *Anseranas* in both these respects. The second major feature of the Magpie Goose that sets it apart is the greatly elongated trachea, longer in males than in females, which loops between the pectoral muscle and the skin on the left (rarely the right) side of the sternum. Some swans have tracheae which convolute within the sternum, and male screamers have enlarged but not convoluted tracheae. However, males of some species of curassows (Cracidae), which are arboreal gallinaceous birds, have tracheae which are similarly convoluted between the skin and breast muscles. In addition, the structure of the syrinx and the associated musculature in the Anatidae, Anhimidae and the Cracidae are remarkably similar (Beddard, 1898), indicating that the nearest relatives of the Anseriformes are probably the Galliformes. Delacour (1954) has listed six skeletal features of *Anseranas* which deviate from the other Anatidae and agree with the Anhimidae, and Miller (1919) has mentioned several other anatomical features which set *Anseranas* apart from the typical wildfowl.

General Biology

The most striking single characteristic of flying Magpie Geese is their broad, rounded wings and associated ease of flight, conferring a stork-like or vulturine aspect on the birds when they are observed at any distance. Although many typical wildfowl perch frequently (particularly the perching ducks of the tribe Cairinini), Magpie Geese are superb perchers. Several observers of screamers have commented on their perching abilities as well as on their soaring flight. Magpie Geese do not swim often except when leading young, but can swim readily, floating high in the water. They have not been observed to dive. Screamers also swim well, no doubt partly because of their remarkable degree of skeletal pneumaticity and their subcutaneous air spaces. Magpie Geese are vegetarians. In captivity they consume practically any growing plant, from tree leaves (especially *Salix*) to rushes (*Juncus*) and even nettles (*Urtica*). They often dig up roots with their strong and pointed bills. In the wild they subsist primarily on swamp grasses (*Paspalum, Oryza* and *Echinochloa*) and the underground bulbs of certain sedges (*Eleocharis*), according to Frith and Davies (1958a). Where rice (*Oryza sativum*) is cultivated Magpie Geese have become a major agricultural problem. Screamers are likewise vegetarians and possess a bill that is somewhat similar in shape, but smaller and more pheasant-like than that of *Anseranas*.

Magpie Geese, in common with screamers and typical wildfowl, are gregarious and in the wild occur in flocks comprising up to tens of thousands of birds. Although they do not migrate as such, major flock movements do occur between the wet and dry seasons (Frith and Davies, 1958b). Observations on captive birds indicate that family bonds are strong, and it is likely that pair bonds are relatively permanent. Screamers likewise probably pair for life (Gibson, 1880). Frith and Davies (1958a) believe that there is no dominance hierarchy in Magpie Goose flocks, and that the basic social unit is the pair or family. As in geese, however, all birds react to danger signals and flight intention movements as a single unit. Lateral head-shaking, similar to the flight intention head-shaking of almost all Anatidae, is the primary pre-flight movement and is used in conjunction with mutual calling among the birds as they prepare to take flight. The sexes of birds eight months old or older may be readily judged by the pitch of the voice, that of the males

being lower than the female. In this respect Magpie Geese agree with screamers, which are most easily sexed by the lower-pitched voice of the male (Stonor, 1939). In the true geese the male has a higher-pitched voice than the female, and in only a few species of swans does the male have a distinctly lower-pitched voice.

Breeding Behaviour

Relatively little is known concerning the breeding of the Magpie Goose in the wild state. Frith and Davies (1958b) state that nesting occurs at the end of the wet season, in the deeper and more heavily vegetated parts of swamps. Nests are built over the water surface by trampling the swamp vegetation, followed by adding other plants to the heap of material. Thus nests tend to be bulky and according to Frith and Davies from four to 14 eggs may be found, indicating that two females often lay in the same nest. These authors (1958a) believe that sexual maturity is reached in the second or third year, possibly even later. There is a high mortality of eggs and goslings under wild conditions.

Although Magpie Geese have been kept in captivity for over a century, they have bred under captive conditions only a few times. The first case was in the San Diego Zoo, in 1945, and the same pair bred in 1946 (Delacour, 1954). However, little information on the breeding behaviour resulted from these nestings. Later, a pair of Magpie Geese bred at the Wildfowl Trust in 1956 (Johnstone, 1957). This pair has since bred each year, and is the pair I studied in 1960. The female was at least 20 years old at the time of her first nesting, and the male was at least ten years old.

Nest-building. Nest-building by Magpie Geese is done by both sexes, with the male probably doing the greater share. This is also the case among the true geese and swans. In 1955 the male constructed one nest, but nothing came of it, and in 1956 no less than seven nests were built on dry land in various parts of the pen (Johnstone, 1957). Each took about two days to complete, and all consisted of bulky piles of sticks and vegetation. Magpie Geese, in common with all other Anatidae, lack the instinctive ability to *carry* nesting material, and instead only stretch their necks forward, grab a bill-full of material, and pass it back over the shoulder and drop it. This is first done on the nest site, and later at various distances from the nest, so that eventually a considerable quantity of material is amassed at the nest. It is uncertain if screamers build their nests in the same manner. Gibson (1880) states that the nests of *Chauna chavaria* are of rushes, and situated in the water, suggesting that they are similar to those of Magpie Geese. In captivity, screamers have built large, bulky nests on dry land (Sclater, 1905). Both sexes of at least one species of screamer (*C. torquata*) help build the nest, beginning by " carrying about sticks in a rather aimless manner " (Stonor, 1939). This would suggest that screamers do actually carry nesting material when building nests. Although most gallinaceous birds do not carry material to the nest site, it is evident that the Cracidae, which nest in trees, must do so.

In recent years the Magpie Geese at the Wildfowl Trust have not built so many " dummy " nests, and in 1960 two piles of straw were placed in early spring near the previous nest sites. The birds did fashion both piles into heaps resembling nests, but only in one did they go so far as to develop

a cupped top. Work on the nest was done in a desultory fashion until after the middle of May, when one or the other bird was usually to be found near or on the nest site. A second female, which has shared the pen with the breeding pair for several years and has assisted in the care of the downy young in past years, was not observed to help with the nest-building. This female, a younger bird, could be identified by certain bill markings. When the nest was completed, it was approximately five feet in diameter, two feet high, and slightly cupped. The cup was lined with green vegetation and small twigs, but no down or feathers whatsoever were present.

Copulation. Previous to the present study no published accounts of copulatory behaviour in Magpie Geese were available, and indeed almost nothing had been recorded regarding sexual behaviour in this species. However, on 2nd April, Major L. T. C. Shakespear observed the Magpie Geese treading. This occurred in the early afternoon and the birds were at the rear of the pen near one of the piles of straw. His attention was attracted by the calling from the two birds, and upon investigating he observed that treading was taking place. This lasted about half a minute, with both birds calling loudly but remaining relatively motionless. After treading was completed both birds " bowed and scraped " to one another a good deal, but did not perform any wing-flapping or bathing.

On the afternoon of 23rd May I chanced upon a similar situation when checking on the progress of the nest-building. As I approached the nest which obviously was the " chosen " site, I saw both birds on the nest. The female was sitting very low in the nest with her neck and head hanging over the side, and the male was already mounted on her back. Both birds were so motionless and quiet that I was at first uncertain that I was actually witnessing a copulation and, unlike all other wildfowl copulations I have seen, the male was not grasping the female's nape. Upon seeing me the male dismounted and began to preen, and soon the female also got off the nest and began to preen as well. There was no calling during the entire time but I had obviously disrupted the copulation attempt before it could be completed.

The first egg was laid on 26th May, and one more observation of copulation was obtained on the morning of 27th May. I had arrived at 9.15 a.m., at which time the male was guarding the nest and its single egg, and the female was standing nearby. When I approached the nest both birds threatened me. After I left and hid behind a tree some ten yards from the nest site, the male remained standing on the nest, calling softly and repeatedly as he placed material on the nest at a rapid rate (about 20 building movements per minute). At 9.35 the male left the nest and joined the female, whereupon the two walked back to the nest together, both calling and shaking their wings occasionally, as well as rapidly opening and closing their bills in the familiar manner which is typical of Magpie Geese. The male climbed up on the nest immediately, but the female wandered off again and began to feed. At 9.40 the male again left the nest and returned with the female in exactly the same fashion. This time the female went directly up on the nest and settled down as the male " mandibulated " very rapidly. The male quickly climbed up the nest and immediately mounted the female without any more preliminaries. The male then remained motionless on her back except for tail adjustments for approximately two minutes. There was no calling, and in this case too the male did not appear to grasp the female's nape although my

view was partially obscured. The male then dismounted and began nest-building while the female remained on the nest. Finally she too began to work on the nest. There appeared to have been no post-copulatory display at all, so the copulation was probably unsuccessful. The post-copulatory nest-building of the male was vigorous (about 25 building movements per minute), while the female's behaviour consisted of re-arrangement of the nest cup itself. At 9.50 the male stopped building, stood " guard " a few minutes, then went to sleep in a standing position.

These observations, although incomplete, indicate that copulation takes place on the nest site. Pre-copulatory behaviour appears to consist of mutual calling, wing-shaking, and " mandibulating " (technically the raising and lowering of the maxilla). Post-copulatory behaviour seems to consist of the " bowing and scraping " by both birds that was observed by Major Shakespear. In only two other species of Anatidae known to me does copulation normally occur on land (the Ne-ne Goose *Branta sandvicensis,* and the Cape Barren Goose *Cereopsis novae-hollandiae*), and in both of these the pre-copulatory and post-copulatory displays are unlike those of the Magpie Goose and are closer to the behaviour of the typical geese. I know of no accounts of the corresponding behaviour in screamers, and it would be of interest to compare the copulatory (especially pre-copulatory) behaviour of screamers with these observations. Stonor (1939) does state that the courtship behaviour of the Common Screamer (*Chauna torquata*) consists of mutual preening around the neck region, but does not state whether this is related to copulation. Mutual preening in Magpie Geese is rare, and I have observed it only during nest-relief ceremonies.

Egg-laying and Incubation. The interval between the laying of each egg is, in most Anatidae, either one or two days. An interval of two days is the usual situation among the swans and geese, although the Ne-ne's interval appears to be closer to one and one half days (S. T. Johnstone, pers. comm.). The Common Screamer also lays every other day (Stonor, 1939). Benchley (in Delacour, 1954) indicates that the Magpie Goose at the San Deigo Zoo laid six eggs in six days, and Johnstone (1957) reports that in 1956 the female at the Wildfowl Trust laid eight eggs in 13 days. This latter would suggest an interval of roughly 36 hours between eggs. Such an interval between eggs also appears to have been the case in 1960. The first egg was laid during the afternoon of 26th May. The time of the second laying is uncertain, but probably occurred after 10 a.m. on 28th May. The third was probably laid in the early morning of 30th May. The fourth egg was apparently laid after 5 p.m. on 31st May, and the fifth egg was laid before 8.30 a.m. on 2nd June. The sixth egg was laid between 3.50 p.m. and 4.35 p.m. on 3rd June.

On 3rd June it became evident that both the females in the pen were spending time on the nest, and although I believe that the first five eggs were laid by the older female (which is thought to have laid all the eggs in earlier years), the younger bird apparently laid the sixth egg of the clutch. The seventh egg (laid presumably by the older female) was laid either late in the day of 3rd or on 4th June, and the eighth egg was laid before 9.00 a.m. on 5th June. These eight eggs were taken from the nest on the morning of 6th June and were replaced by seven wooden eggs. One last egg was laid on

the afternoon of 6th June, and I was fortunate enough to observe the act of oviposition.

The younger female had replaced the older bird on the nest at 2.40 p.m., when I noted that there were only the seven wooden eggs in the nest. At 3.40 the male replaced her for a short time when I again looked at the nest. However, she was back on at 4.30 and at 4.47, as I watched and waited for her to stand up so that I might count the eggs, she suddenly reared back sufficiently for her breast to be well free of the nest and almost immediately she deposited an egg on to the pile of wooden eggs below her. After this act, which appeared to have been performed without any evident strain, she settled back down on the eggs and was still in this position when I left at 5.15 p.m.

In the true geese and swans it is usual for the female to assume incubation duties, and only in the whistling ducks (*Dendrocygna*) and a few species of swans (*Cygnus atratus*, sometimes in *C. olor* and rarely in others) does the male assist in incubation. In the screamers both sexes incubate; Stonor (1939) found that in the Common Screamer the male usually incubated during the late morning and late afternoon. In both the Anatidae and the Anhimidae incubation does not normally begin before the laying of the last egg.

Although in previous years the breeding pair of Magpie Geese at the Wildfowl Trust has followed the usual pattern of leaving the eggs largely untended during the period of laying, in 1960 one or both of the birds were invariably on or beside the nest from the time the first egg was laid. Since no down is used in the nest, the eggs are exposed whenever the nest is left, and thus it is perhaps the usual situation for the nest to be closely guarded during the egg-laying period. The fact that no down is utilized for nest lining appears related to the fact that both sexes incubate, and therefore the eggs are never left uncovered from the time incubation commences. This same situation is true of whistling ducks, and Black Swan nests usually have only slight amounts of down present.

During the period of egg-laying there was no distinct daytime pattern of nest guarding by the birds, although the male apparently always sat on the nest from early evening until early morning. The male was also on the nest a good deal of time during the day, probably whenever the female was not in the process of laying. On 3rd June it became evident that both females were sitting on the nest, although the younger female may have previously spent some time on it unknown to me. Thereafter all three birds sat on the nest, but the older female did so less and less and the younger female tended to replace her.

Nest-relief ceremonies in the Anatidae other than the Magpie Goose are known to me only for the Black Swan and the Mute Swan (*Cygnus olor*), although it is possible that such ceremonies are also present in whistling ducks. Rayner (1948) has described these ceremonies for the Mute Swan, and my own observations on the Black Swan are in close agreement with his account. Briefly, the relieving bird swims or walks up to the nest while calling vigorously with the usual neck-stretching movements used in the " triumph ceremonies " of these species. The bird on the nest calls in a like manner, and the former bird walks up on the nest and gradually pushes the incubating bird off the eggs. This bird appears reluctant to leave the eggs, and before getting off the nest usually performs extensive nest-building

movements. Stonor's (1939) description of nest relief in the Common Screamer is very similar except that before the incubating bird leaves the nest both birds preen one another. Nest-relief in Magpie Geese did not appear to be highly ritualized, and often occurred when the nest was approached and the birds rushed to the nest to defend it. When " normal " nest relief did occur, it was preceded by mutual calling by both birds, and as the relieving bird approached the nest both would " mandibulate " rapidly. Sometimes this mandibulating developed into a preening or nibbling of the other's back and neck feathers, although this was certainly not the usual case. The sitting bird was eventually pushed off the nest, and both birds then usually performed nest-building movements.

It is not certain at what time incubation actually began, although the birds appeared to begin incubation with the first egg. It is more likely, however, that they simply covered the eggs, without actually settling over them. Since no down is used in the nest there is of course no brood patch present. On 1st June one of the females appeared to be definitely incubating, since she settled down low in the nest with ruffled body feathers.

Turning and prodding of the eggs by the bill occurred as soon as the first egg was laid, usually when one bird had replaced another on the nest. This was done in the same manner as in other species of wildfowl, by pulling upwards and backwards with the tip of the mandible. The eggs were not all systematically turned at one time, indeed egg-turning appeared to be rather haphazardly performed.

When the clutch was completed, there was much less shifting of birds on the nest. The male still appeared to incubate during the night while the younger female did most of the daytime incubation. After two weeks of incubation the wooden eggs and the single real egg were removed from the nest. Two of the eggs removed earlier hatched on 30th June and the last egg hatched on 4th July. This would indicate a 28 day incubation period for the last egg and an uncertain period for the other two. Only the last gosling that hatched survived from this clutch, and it seems likely that the poor hatching and survival of the other young resulted from the conflicting incubation and laying tendencies in the two females.

On 4th July the younger female was observed nest-building in a clump of nettles about 30 feet from the earlier nest site. On the next day I investigated the site and saw that three eggs were present in a rudimentary nest. All three birds defended the nest vigorously. Another egg was present on 5th July, and when the nest was again visited on 10th July it had been raised to a foot and a half, about three times as high as it was when I first noticed it. At this time eight eggs were present. Thus five eggs had been laid in six or seven days, apparently all by a single female. On 11th July the female definitely appeared to be incubating. Both females incubated this clutch during the daytime, while the male again sat on the nest at night. Four of the eggs from this clutch hatched on the morning of 9th August, indicating a probable incubation period of 30 days.

Nest Defence. The nest site was slightly defended even before it was completed, and on 25th May, the day before the laying of the first egg, both birds defended the nest fiercely as I approached. The male hissed at me (the first time I had ever heard a hissing noise uttered by Magpie Geese), erected

his scapulars and spread his tail somewhat. The female did not hiss, but assumed the same posture. Both birds " mandibulated " strongly.

After eggs were present in the nest the approach of a person would stimulate the guarding bird to honk excitedly. The other bird would then run to the nest and both would climb up on the nest and face the intruder with extended necks and bills ready to strike. Although the female often would spread her wings over the nest to cover the eggs, the wings were not used as the primary weapons as the case with swans and geese. The sharp and powerful bill is a much more effective weapon than the wings, and the concerted defence of the nest by both (or all three) birds was certainly effective. Stonor (1939) has described nest defence in the Common Screamer, and states that both birds defend the nest by standing on it in a similar fashion to that described for Magpie Geese. However, screamers utilize their wings primarily during defence, striking down with the nearer wing and attempting to slash the intruder with the sharp spur of the wrist.

Hatching and the Downy Plumage. Although the Magpie Geese hatched their clutch on 9th August, it was not until the following day that they were observed off the nest, by which time the goslings were strong and apparently hardy youngsters. On that morning all four goslings were actively feeding with their parents near the nest.

The downy plumage has already been described (Johnstone, 1957; Davies, 1957), but a short description might be desirable here. The body is an unspotted dark grey above, fading to light grey below. The head, neck and upper breast are a rather bright cinnamon red, and are almost the same colour as the orange facial skin, bill, and feet. The bill is not quite uniform in colour, since the large, terminal nail is a darker orange, although it fades towards the tip. The sum effect is as if the babies " had fallen into orange marmalade up to their shoulders " (L. T. C. Shakespear). This downy plumage is totally unlike that of any other waterfowl or the screamers, the latter having relatively unicoloured downies. Unlike the other Anatidae, the down feathers are not entirely out of their sheaths when the gosling hatches, but these sheaths are shed the first day.

Care and Feeding of the Young. Care of the young by both parents is the usual situation among the whistling ducks (Dendrocygnini), swans and true geese (Anserini), shelducks and sheldgeese (Tadornini), and a small proportion of the other true ducks (Anatinae). Likewise, both parents care for the young in screamers. This situation is equally true in Magpie Geese, in which family bonds are strongly developed.

The Magpie Goose does deviate from the other wildfowl in two important points concerning the care of the young. Foremost is the fact that adult Magpie Geese directly feed the goslings in a bill-to-bill fashion. This parental feeding was observed the first day that the downies were off the nest, although even by then a good deal of independent grazing and picking up of food particles was done. Frequently, however, one or more goslings would suddenly tilt its bill slightly upwards, gape, and utter a loud, sibilant whistle. This note, sometimes repeated once or twice, is much louder than the " conversational " chittering that is almost constantly emitted. The call usually had the effect of stimulating one of the adults to feed that particular gosling. Often one gosling's " begging " call would apparently stimulate one

or more of the others to utter the same call, and at times these goslings would bite one another. Parental feeding was most conspicuous during the first week after hatching, but was observed as late as five weeks after hatching. The parents took the goslings to water several times on the second day after hatching, and much material was brought to the surface by the adults and fed to the young. This included plant material as well as grain which was scattered for them, and the latter would be picked up by the adults and then gradually allowed to " dribble " out of their bills as the goslings gathered around the adults' bills. At times the adults would honk softly when they had food, and this call certainly had the effect of attracting the goslings. In view of the bright head and bill colouration of the downy young, unique in the Anatidae, it seems possible that this bright pattern serves as a " target " for parental feeding in an analogous manner to the coloured head and gape markings of newly-hatched young in other bird groups in which parental feeding occurs. I have not been able to discover if screamers feed their downy young in the same manner as do Magpie Geese, but since downy screamers lack any special head or bill markings it is possible that they do not.

Although the defence of the nest site ceased on the second day after hatching, the parents were very aggressive to other smaller waterfowl near the brood. After attacking such birds, the male would return to the family while calling with horizontally outstretched neck. Both females normally answered the male while facing him in the same posture, and all the adults would " mandibulate " rapidly. Usually they would vigorously shake their folded wings and ruffle their scapulars during this behaviour, which seems to function as a rudimentary form of " triumph ceremony " analogous to what Heinroth (1911) has described for true geese and swans. Since "mandibulating" and wing-shaking also occur in aggressive situations, this " triumph ceremony," in common with those of geese and swans, gave the impression of being " redirected " threat behaviour.

Whenever the newly-hatched downies stopped foraging to rest or sleep, the adults would begin to pull grass and, using typical nest-building movements, pile it around (and often on top of) the young. All the adults worked vigorously at this, the male often averaging over 30 such movements per minute and the females slightly under 30. As a result, a " brood nest " soon took shape on the grassy area which the birds adopted as a resting site. This " nest " was at first no more than a scattered pile of grass and a few herbs, and had no cup as would a true nest. The females would brood the family on this nest during the night-time as well, and to my knowledge did not return to the true nest after the second day following hatching. The brood was occasionally observed on the " brood nest " up to about two weeks after hatching, but it was gradually abandoned. It seems likely that such " brood nests " do function in keeping the downy young warm, and it would be of interest to learn if the building of such nests is also typical of wild Magpie Geese. I have not observed this behaviour in other wildfowl, although I have seen a female Black Swan drop bits of grass around her resting brood. Whether it occurs in screamers is unknown to me.

Plumage Changes and Development of the Young. As Davies (1957) has pointed out, the soft part colours of the downy Magpie Goose change rapidly, and the original orange to dull claret colour fades to a yellow in three to five days. The legs begin to turn grey near the end of the second week, and

the bill begins to turn grey at about the same time. The bill and legs are soon entirely a lead grey and remain thus for several months. The downy tail feathers are, surprisingly, replaced by juvenal tail feathers during the first week, these latter feathers reaching a length of one and a half inches by the end of the second week. In all other wildfowl the juvenal rectrices appear much later, after body feathering is apparent. By the time the bird is between six and eight weeks old the last trace of the downy plumage is gone. The head, throat and breast are a uniform greyish black, with slightly lighter feather tips. The underparts are white, the feathers being long, pointed, and practically lacking barbules. The upperparts are a rather uniform greyish black except for a few white feathers at the base of the tail and on the lower back. The bill is a lead grey, with a lighter nail. The juvenal rectrices are fully grown, and are four and a half inches long, pointed, and brownish black. The primaries and secondaries break through their sheaths when the bird is six weeks old, and fledging occurs at 84 days.

The juvenal plumage begins to be moulted during approximately the fourth month, and an immature plumage is assumed. The head, neck and breast feathers are moulted in a distinct " wave " down from the head during the fifth and sixth months, and the greyish-black feathers are replaced by uniformly black ones. The lower breast and underparts remain white, while the upper flanks remain greyish-brown. The scapulars of the immature plumage first appear at about four months, and are a mixture of white and black feathers. Moulting of the juvenal rectrices is begun at about the time of fledging, and these are replaced by long (five inch), broader, square-tipped tail feathers. The central rectrices are moulted first and, as the long juvenal rectrices are dropped, a curious " scissor-tailed " appearance is presented for a time before the rectrices of the immature plumage are fully grown. At the age of four months eight of the 14 rectrices of the immature plumage are fully grown. The fully grown wings are brownish above, with a few white feathers in the upper coverts. The under-wing coverts are white. The brownish-black primaries and secondaries are, strangely, moulted during the seventh and eighth months. The primaries are moulted in outward sequence, and the secondaries are moulted in outward sequence from the " elbow," with those nearest the wrist replaced somewhat after the outermost primaries have been replaced. This is the only species of Anatidae known to me in which the first flight feathers are moulted before the bird is a year old, and is one of the very few species (*Chloephaga rubidiceps* and perhaps two other species of that genus are the others) of Anatidae in which the flight feathers are moulted gradually rather than simultaneously, so that the power of flight is never lost. In *Chloephaga rubidiceps* the primaries and secondaries are moulted in outward sequence from the " elbow," with the outermost primaries dropped last, rather than in the sequence described for the Magpie Goose. Screamers also have a gradual wing moult, apparently similar to that of Magpie Geese.

At four months the birds still have the high-pitched peeping voice typical of the downy young, and the trachea of both sexes is still unconvoluted (that of the male exhibits a slight kink at this age and is 14 inches long as compared with 11 inches in females). At about six months the first real " honking " is apparent. A real difference in the voices of the sexes is first distinguishable at seven and a half months. By the time the males are eight months old they

are easily distinquished from females by their vocalizations, and a trachea of a male of this age is 28 inches in length. Three-year-old and older males have tracheae approximately 50 inches long.

The grey legs gradually turn to a pale yellow as the immature plumage is assumed, and the soft parts of the bill and the lores change from a grey to a greenish colour, which eventually (when the birds are about one year old) becomes yellowish and, finally, pink.

Following the moult undergone at the end of the first year, the plumage is of the adult type, differing from the immature plumage in that the mantle (scapulars and inner wing coverts) is pure white and the flanks are likewise white. The bill is a pale flesh pink at the base, as is the bare skin around the eyes. There is a black mark at the sides of the bill near the nail which seems to vary in size individually or with age. The surface of the bill also assumes a somewhat " pebbled " appearance. The bright yellow to orange legs are attained by the end of the first year.

The bony crown on the head of males is first noticeable in birds between the first and second years, and is almost fully developed in males two and a half years old. At about this same time the unfeathered facial patch begins to extend upwards to the front of the crown, forming an acute point which is yellowish in colour. I suspect that this enlarged crown of males between two and three years old is an indication of sexual maturity. Thereafter the only outward change in appearance is a slight additional enlargment of the bony crown. Females show no obvious change in appearance after the first year.

Conclusions

The Magpie Goose exhibits several characteristics in its breeding biology that show affinities with the other Anatidae, such as the manner of nest-building, flight-intention movements, strong family bonds, etc. It also shares some of the characteristics of the screamers (Anhimidae), such as the mutual preening during nest relief and similarities in anatomy, perching, and flying. Finally, in some of its characteristics, such as the behaviour during nest defence, the unusual moulting, the building of " brood nests," and perhaps in the direct feeding of the downy young, the Magpie Goose appears to correspond neither to the screamers not to the other Anatidae. Some authors (Miller, 1919; Boetticher, 1943) have recommended that the Magpie Goose be placed in a separate family (" Anseranatidae "), since it is at least as distinct as some of the families of the Galliformes. In any event, it may be concluded that *Anseranas* at least deserves subfamiliar distinction and seems to constitute a direct link between the Anatidae and the Anhimidae. This whole group, collectively termed the Anseriformes, probably was originally derived from a gallinaceous ancestor perhaps remotely related to the present day Cracidae.

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