The South Georgia Pintail *Anas g. georgica* in captivity: history, management and implications for conservation

A.R. Martin

Wigeon House, Dunkirk, Little Downham, Ely, Cambridgeshire CB6 2TY, UK
Current address: British Antarctic Survey, Natural Environment Research Council, High Cross, Madingley Road, Cambridge CB3 OET, UK. Email: arm@nerc.ac.uk

The South Georgia Pintail is the southernmost waterfowl taxon and an island endemic which survives year-round in some of the most hostile conditions encountered by any waterfowl. The wild population is currently secure, but small and vulnerable to natural and anthropogenic threats. After the importation of 17 birds in three separate groups over four decades, this pintail is now well established in captivity. The captive flock originally descended from a single breeding pair, and reproductive success diminished with successive generations, probably because of inbreeding. Breeding success markedly improved after the introduction of 12 new birds from the wild in 1998. With appropriate care and management, this taxon will breed prolifically, and a captive population could be approximately doubled each year. With 13 founders, the genetic diversity of the captive flock in 2002 is probably adequate for the maintenance of a healthy population in the short and medium term. The introduction of new birds from the wild may be necessary for longer-term genetic vigour. Results from this study allow predictions about the breeding biology of the wild population. These include a polygynous or promiscuous mating system with no territoriality, small clutches with eggs laid on alternate days, and an ability to lay multiple replacement clutches after earlier losses.

Key Words: South Georgia Pintail, *Anas georgica georgica*, captive breeding, conservation

The South Georgia Pintail *Anas georgica georgica* is endemic to the sub-Antarctic island of South Georgia and its adjacent satellite of Bird Island (54°S, 37°W), situated south of the Antarctic Polar Front in the South Atlantic. It is the world's most southerly taxon of waterfowl and one of two extant races of the Yellow-billed or Brown Pintail *Anas georgica*. The other, *A. g. spinicauda* is widespread and common on mainland South America. A third, *A. g. niceforoi*, restricted to Colombia, was probably extinct by 1956 (del Hoyo *et al.* 1992). It is not known how long the South Georgia Pintail has been resident on the island, but differences from the presumed mainland parent race in the shape, size and colour of the body, and in clutch size, relative egg mass and number of rectrices (Lack 1970; Martin & Prince 2002), demonstrate considerable evolutionary divergence, so colonisation cannot be recent. Indeed, del Hoyo *et al.* (1992) considered the two taxa to be full species.

The size of the wild population is thought to be in the low thousands (Prince & Poncet 1996; Martin & Prince 2002). Despite predation by Brown Skuas *Catharacta lonnbergi* and introduced Brown Rats *Rattus norvegicus*, the South Georgia Pintail population probably increased after whalers finally abandoned the island in the 1960s, having hunted this species along parts of the north coast for many decades.

South Georgia is 170 x 40km in size, mountainous and substantially glaciated. Pintails are restricted to the coastal margins and largely forage in the intertidal zone, especially in winter, when for long periods snow covers the land and all fresh water is frozen. Their diet is predominantly invertebrates and plant material including seeds, but the species also scavenges seal carcasses (Weller 1975; Martin & Prince 2002). As an island endemic, the relatively small total population of this pintail is potentially threatened by disease, exceptional environmental conditions (eg a series of unusually hard winters) and anthropogenic influences.

Captive breeding was first achieved in 1984, and the race is now maintained at many facilities across Europe and North America. This paper presents information gained from maintaining and breeding South Georgia Pintails under captive conditions, with particular reference to a facility in the UK that has specialised in this taxon.

South Georgia Pintail in captivity

Three collections of birds from South Georgia have been made for the purposes of establishing or strengthening a captive breeding flock. All birds were initially sent to the WWT, Slimbridge, UK, and thereafter they or their offspring were dispersed to other aviculturalists.

The first collection was made in 1959 (Tickell & Cordall 1959), but captive breeding did not result. In 1982 two ducklings were reared on Bird Island and sent as fully-feathered juveniles to

the Wildfowl Trust. The pair bred in 1984 (Richardson 1997) and within 15 years approximately 100 South Georgia Pintails were maintained outside South Georgia. By 1990, however, the captive population was characterised by poor reproductive success, a preponderance of male offspring and an unusually high rate of hatchling deformity, probably because of the extreme levels of inbreeding (Rave *et al.* 1998).

In 1998, 12 juveniles were flown to the UK having been reared from the downy duckling stage on South Georgia (8) and Bird Island (4). By the end of 2001, first or second generation birds deriving from the 1998 importation were held in six facilities across the UK. In this paper, birds descended from the pair imported in 1982 are subsequently referred as the '1982 group', and those imported in 1998 or descending from them are termed the '1998 group'.

Study facility

The results presented here refer to the largest captive flock of South Georgia Pintails, 55 birds in September 2002, situated in the fenlands of Cambridgeshire, UK (52°N, 0°E). The site is at a similar latitude to South Georgia and therefore has a similar day-length cycle. The climate of Cambridgeshire is temperate, however, with mean summer and winter temperatures of +15.8° and +3.5°, compared to +4.8° and -1.2° at South Georgia.

All birds were pinioned, and maintained in a wide variety of enclosure type, group size and group structure. Fresh water flowed into each water body and invertebrates were seasonally present in each, though they were not sufficiently abundant to form a substantial part of the diet. Nestboxes, both raised and situated on the ground, were available in almost all enclosures. Dense grasses and shrubs were also present in each. Clumps of mature pampas grass *Cortaderia selloana*, similar in form to tussac grass *Parodiochloa flabellata* which dominates the coastal vegetation on South Georgia, grew in three of the nine enclosures. Wheat and pellets (Fenland waterfowl range, Clark & Butcher, Soham, UK; maintenance and breeders pellets according to season; 15.5% and 17.5% protein respectively) were fed twice per day.

Results

Survival

Annual survivorship of adults at this facility was high (>90%), and illness was rare. A small number of deaths, perhaps averaging one or two annually, were likely due to predation. The only mortality event that involved more than one fledged bird occurred when 11 3-month old juveniles succumbed to aspergillosis during a period of exceptionally hot weather.

All the birds imported in 1998 (four males; eight females) survived to at least 18 months of age and 10 were alive in September 2002 (date of writing), at an age of 4-1/2 years. The

average annual survival of these birds from collection as a downy duckling to age four was 96%.

Breeding

Both sexes were capable of successful reproduction at one year of age, and normally bred annually thereafter if provided with a suitable enclosure. Eleven of the 12 birds imported from South Georgia in 1998 had produced young by July 2002.

Nests were usually made in dense ground vegetation (41%, n=41), ground nestboxes (27%) or elevated within clumps of vegetation like pampas grass (32%). When available, pampas grass was rarely ignored in favour of other sites. Raised boxes were never used.

Nests were deep cups constructed of the plant material within reach and lined with down when the clutch was nearing completion. In the 11 seasons between 1992 and 2002 the average date of the first egg was 8 April (range 9 March - 15 May), and the latest laying date was 11 August. Experienced birds tended to initiate their first clutch earlier. The breeding season was prolonged when ducks re-laid after loss of earlier clutches.

Eggs were laid on alternate days, with a mean clutch size of 4.9 (SD=1.4, range=3-9, mode=5, n=66). Re-nesting was common after clutch loss or removal, with a mean interval of 13.1 days (SD=7.0, range=5-26, n=16) between loss and re-laying. Three or four clutches were often laid by experienced females that had initiated breeding early in the season, and a fifth clutch was produced on one occasion.

The presence of more than one male in an enclosure during the breeding season usually resulted in poor egg production. Larger enclosures resulted in diminished aggression between males, although they were not apparently defending fixed spatial territories. At high density, breeding behaviour and male aggression was suppressed.

The mean incubation period was 25.9 days (SD=1.1, range=24-28, n=15). In parent-incubated clutches, the male took no part in the process except to escort the female during her one brief (5-20min) period off the nest each day, usually in the evening. Parents were wary and attentive, and mortality of ducklings was relatively low. Given that brown rats occur throughout most of South Georgia, it was notable that substantial duckling loss at the study facility occurred only during the short periods when this same predatory species was present. Brood defence was carried out exclusively by the mother, although the male often aided by maintaining vigilance. Polygynous breeding was routine, with up to three ducks producing young sired by a single male.

Table 1 shows the rates of fertility, hatching and survival of eggs. The 1998 group was more productive than the 1982 group in all measures, with 59% of the eggs hatching and 47% resulting in a young adult of breeding age. The sex ratio of ducklings at ringing age (2-3 weeks) was not significantly different

Table 1. Fate of eggs laid by the two groups of birds. In each case, the percentage shown is that of eggs laid. The value for survival to one year in the 1998 group excludes eggs laid in 2002.

	Eggs	Fertile	Hatched	Survived to ringing	Survived to one year
1982 group	242	156 (64%)	95 (39%)	64 (26%)	22 (9%)
1998 group	155	129 (83%)	91(59%)	74 (48%)	28/60 (47%)

from parity in either the 1982 group (32 males : 32 females) or the 1998 group (32:40). At reproductive maturity (one year of age) the sex ratio was exactly 1:1 (n=32).

Table 2 gives information for each breeding season at the facility. In seasons when productivity was maximised by the removal and artificial rearing of early clutches, an average of 10.5 eggs was laid by each potentially breeding female (ie all adult females in suitable enclosures, whether they laid or not). For the 1998 group, each such female annually produced on average 10.5 x 0.47 x 0.5 = 2.15 female offspring surviving to one year of age.

Table 2. Summary of productivity. The last column indicates whether the flock was managed that year for maximum productivity (see text).

Season	No. potential pairs	No. eggs total	No. eggs fertile	No eggs hatched	Survived to ringing age (14-21 d)	Productivity maximised
1992	1	10	7	2	1	Yes
1993	1	17	8	3	1	Yes
1994	2	29	24	15	11	Yes
1995	5	48	26	20	16	Yes
1996	6	54	36	22	16	Yes
1997	6	62	38	24	16	Yes
1998	4	17	15	9	3	No
1999	6	21	16	14	14	No
2000	7	15	11	4	4	No
2001	7	32	29	15	15	No
2002	8	92	75	58	41	No

Growth rate of a captive population

The growth rate of a captive South Georgia Pintail population managed for maximum productivity can be estimated using the annual productivity figure derived above (2.15 females surviving to breeding age per adult female) and a conservative assumption of either (a) two breeding seasons, or (b) three breeding seasons per female before death. The intrinsic rate of growth, $r=e^r$, of these populations would be (a) 1.93 and (b) 2.05, where

$$n_t = n_0 e^{rt}$$

and where n_t is the size of the (adult female) population, t years after the start (Brown & Rothery 1993). In other words, the two models predict annual growth rates of (a) 93% and (b)105%.

Discussion

The breeding biology of this taxon in the wild is very poorly known (Martin & Prince 2002). However, the results of the present study allow some predictions to be made about the reproductive characteristics and behaviour of the wild population (**Table 3**). All of the imported South Georgia Pintails that bred in captivity were introduced as ducklings, so the breeding behaviour reported here must have been inherited, albeit influenced by the local environment. Better nutrition, for example, might have had an impact on clutch size and inter-clutch interval. It was striking that the preferred nest site in captivity so closely mimics that of the few nests found in the wild - elevated and deep inside the crown of a stool-forming grass.

Sufficient experience of the South Georgia Pintail in captivity has now been gained to show that this taxon can be readily maintained and bred in suitable conditions. It is sufficiently robust and prolific in the wild to overcome a hostile environment and severe predation pressures; good nutrition and reduced predation in captive care allows the duck to flourish. Its longevity and fecundity are such that a captive population could be rapidly increased in size, approximately doubling each year, if an adequate number of birds contributed to the gene pool. For a short-term programme 10-15 founders may suffice. The longer-term maintenance of a healthy captive population may, however, require the periodic introduction of new birds from the wild. This would also be desirable in order that the captive stock should represent the genetic diversity of the wild population as far as possible, especially if a re-introduction was ever required. Any future importations should involve the obtaining of eggs or downy young. This would improve the likelihood of subsequent breeding success of the new birds and result in a negligible impact on the wild population by allowing parents to re-lay.

The size or shape of a breeding enclosure, especially for pairs and trios maintained without other waterfowl, seems of little importance. The key characteristics of an ideal breeding

Table 3 Predictions of breeding characteristics and behaviour of South Georgia Pintails in the wild, based on the study of a captive population.

Characteristic	Prediction
Age at first reproduction	One year
Mating system	Polygynous or promiscuous; non-territorial
Breeding strategy	Single brood reared to fledging each season, but ability to lay multiple replacement clutches after earlier failures.
Laying schedule	Alternate days
Clutch size	Smaller than most other Pintails; average five or less
Nest density	Low
Nest site	Elevated in dense vegetation.

enclosure appear to be (1) permanent access to freshwater for drinking, swimming and bathing; (2) adequate nutrition; a standard diet of wheat and pellets will suffice; (3) a choice of potential nest-sites including ground boxes, rank grasses about 30cm high, and clumps of mature pampas grass or similar (4) some dense shrubs under which the birds can shelter from the elements or hide; (5) sufficient space for the birds to feel at ease, this being dependent on the individual nature of the birds themselves and the density and type of any other waterfowl maintained in the same enclosure.

Egg production was usually increased by removal of clutches for artificial incubation and rearing. Most females readily laid two or more subsequent clutches, especially if the first was produced early in the season. This propensity to replace lost clutches has probably evolved through strong selectional pressure in the wild. On South Georgia rats probably predate eggs and young, and Skuas take ducklings.

The recently published South Georgia Environmental Management Plan (McIntosh & Walton 2000) supports the concept of a rat-eradication programme for the island. The removal of rats would likely improve the long-term stability of the wild pintail population, but great care would be needed to prevent the poisoning of ducks during the baiting campaign. Pintails and rats co-occur over much of South Georgia, and the broadcasting of a lethal cereal-based bait in all rat-

infested areas has the potential to destroy a large proportion of the duck population.

Currently, this taxon appears to be stable in the wild. Nevertheless, as numerous other waterfowl (eg Campbell Island Teal, Madagascar Teal, Auckland Island Merganser, Hawaiian Goose) have shown, endemic island avifauna are susceptible to natural and/or anthropogenic pressures. In these circumstances, captive populations can prove to be of considerable conservation importance, both as an 'ark' of genetic material and as a source of information not available from the wild (eg Preddy 1995; Richardson 1997; Williams & Robertson 1997; Young 2000). It is, therefore, of considerable conservation value to understand how the South Georgia Pintail can be maintained and studied under captive conditions.

Acknowledgements

I thank Professor Ian Boyd for inviting me to South Georgia, and to he and Ash Morton for their enthusiastic and good-natured support of this project in the field. The following individuals and organisations kindly facilitated the safe and successful movement of birds from South Georgia to the UK in 1998: Gilly Banks, the British Antarctic Survey (especially Dr Simon Berrow, Professor John Croxall, Captain Stuart Lawrence and Peter Prince), David McLeod, Royal Air Force air movements flight, the Government of South Georgia and the South Sandwich Islands, Nick Worth, and the Wildfowl & Wetlands Trust (especially Tony Richardson and Martin Brown). With skill and dedication, Gilly Banks carried out much of the avicultural work and record keeping upon which this study was based. Aspects of the paper were improved after discussions with Keith Reid.

References

Brown, D. & Rothery, P. 1993. *Models in biology: mathematics, statistics and computing.* Wiley, Chichester, UK.

del Hoyo, J., Elliot, A. & Sargatal, J. (Eds) 1992. *Yellow-billed pintail. In: Handbook of the birds of the World. Vol. 1, Ostrich to ducks*. Lynx Edicions, Barcelona. Pp 608-609.

Lack, D. 1970. The endemic ducks of remote islands. *Wildfowl* 21: 5-10.

Martin, A.R. & Prince, P.A. 2002. South Georgia Pintail *Anas georgica georgica*. In: Kear, J. (Ed.) *Bird families of the World: ducks, geese and swans*. Oxford University Press, Oxford, UK.

McIntosh, E. & Walton, D.W.H. 2000. *Environmental Management Plan for South Georgia*. British Antarctic Survey, Cambridge, U.K. 105pp.

Preddey, J. 1995. Campbell Island Teal *Anas aucklandica nesiotis* bred in captivity. *Wildfowl* 46: 69-71.

Prince, P.A. & Poncet, S. 1996. South Georgia distribution of the South Georgia Pintail *Anas g. georgica*. Map 2-28 in: Trathan, P.N., Daunt, F.H.J. & Murphy E.J. (Eds). *South Georgia: An Ecological Atlas*. British Antarctic Survey, Cambridge, UK.

Rave, E.H., Fleischer, R.C., Duvall, F. & Black, J.M. 1998. Factors influencing reproductive success in captive populations of Hawaiian Geese *Branta sandvicensis*. *Wildfowl* 49: 36-44.

Richardson, A. 1997. Aviculture at WWT over half a century. *Wildfowl* 47: 265-272.

Tickell, W.L.N. & Cordall, P.A. 1959. South Georgia biological expedition 1958/1959: Elsehul and Bird Island. Unpublished report, British Antarctic Survey Archives, Cambridge, UK.

Weller, M.C. 1975. Ecology and behaviour of the South Georgia Pintail *Anas g. georgica*. *Ibis* 117: 217-231.

Williams, M. & Robertson, C.J.R. 1997. The Campbell Island Teal *Anas aucklandica nesiotis*: history and review. *Wildfowl* 47: 134-165.

Young, H.G. 2000. The Madagascar Teal at Jersey Zoo: an ex situ breeding programme. *Threatened Waterfowl Specialist Group News* no. 12: 57-62.