A COLONY OF THE LITTLE SHAG AND THE PIED SHAG IN WHICH THE PLUMAGE FORMS OF THE LITTLE SHAG FREELY INTERBREED

By MICHAEL J. TAYLOR

ABSTRACT

During 1977-1985 a colony of 80-120 Little Shags *(Phalacrocorax melanoleucos brevirostris)* was studied at Hobson Bay, Auckland City. The breeding season of Little Shags was from August to March or April. Pied Shags *(Phalacrocorax varius)*, which joined the colony during the study period and have tended to displace the smaller species, have nested throughout the year. For both species highest numbers of nesting pairs were present in spring (October-November). Little Shags of the pied form constituted one-third of the colony and interbred freely with birds of the white-throated and smudgy plumages. Fledglings have either the pied or totally black plumage and both can occur within the same brood. Aspects of behaviour are described and a detailed account of the colony is given.

INTRODUCTION

Many New Zealand ornithologists have shown an interest in the plumage variations of the Little Shag *(Phalacrocorax melanoleucos brevirostris)* and their records are to be found in the Classified Summarised Notes published annually in *Notornis*. Most observers have adopted a simple division into two categories, 'white-throated' and 'pied' birds, although the numbers of smudgy adults and fully black immatures have sometimes been noted in addition. Among the fuller records are those of Poppelwell, who found a proportion of 16.6% pied birds on Otago Harbour over a 9-year period (Poppelwell 1972), and of Moisley, who repeatedly counted roosting birds at Clevedon, south-west Auckland, during April 1960, finding 25 pied birds in tallies of 75-117, averaging 100 (Moisley 1960). In the Far North of New Zealand proportions above 50% have been cited, an example being c. 120 pied and c. 40 white-throated for Parengarenga Harbour, 3-6/4/53 (Prickett 1954). Four reports, totalling 323 birds, show 194 (60%) to be of the pied form. Records for the rest of the North Island yield a proportion of pied birds of 15% (179 out of 1190 in a total of 26 reports spanning 40 years). For the South Island the proportion is 8% (25 out of 293 in 9 reported counts). These published data therefore indicate that the dark form of the Little Shag is in a higher proportion in the south of the country than in the north.

The New Zealand Checklist (1970) treats the Little Shag as a dimorphic subspecies with some intermediate variants. The pied form is regarded as identical with the Little Pied Cormorant of Australia (Falla *et al.* 1979). The fact that the name White-throated Shag has been widely used arises naturally from this being the most abundant form in New Zealand.

This study began as a contribution to the survey of shag nesting colonies initiated by OSNZ c. 1976. Ready access to the colony encouraged me to pursue the observations in greater detail with two particular objectives: to measure how successfully shags nest within the bounds of a large city and to investigate the various plumages of Little Shags at a breeding colony. I also took note of behaviour during nesting, and my findings generally agree with those of recent work in coastal Manawatu (Matthews & Fordham 1986).

METHODS

The colony under investigation is situated on a tidal arm of Hobson Bay, Auckland City, 100 m west of Orakei Bridge, in two adjacent mature pohutukawa trees, with a sheltered, northerly aspect. The trees are c. 15 m high. Little Shags have nested at this site since 1972, when 13 nests were recorded on 16 October (S. M. Reed 1973; P. Smith, pers. comm.), and the colony may have existed for some years before that. My own observations began in 1977.

Pied Shags *(P. varius)* joined the colony in the 1978-79 breeding season, probably because of the decline of the Pied Shag colony 1 km further inland in Orakei Creek, adjacent to Lucerne Road. The Orakei Creek colony, in a single dilapidated macrocarpa tree, still holds a few nests (in 1986) and is frequently the roost of a flock of Little Black Shags *(P. sulcirostris)* between May and August each year. The Orakei Creek colony is not used for nesting by Little Shags, perhaps owing to the open situation of the nest sites which it provides.

The nests of Little Shags in the Hobson Bay colony are built at heights of 5-15 m, usually but not always over water at high tide, and are often well hidden among the foliage. Nests are sometimes no more than 1 m apart, but neighbours tolerate one another, although sitting birds sometimes gape threateningly towards an intruder. The Pied Shags sharing the colony choose more open nest sites and contribute to the opening up of the tree by removing small branches. This activity rather than the guano seemed to be the factor which eventually damaged the tree because parts of the tree used only by Little Shags have remained healthy, as have adjacent pohutukawa trees used all year by Pied Shags for roosting but not for nesting. The nests of the two species do not differ much in size, being about 0.5 m across. Little Shags make more use of leafy material than Pied Shags, which use thicker twigs and sometimes include pieces of wire and plastic tape in their nests.

As the nests are quite high and supported by thin branches, I did not try to reach them. Instead, I observed them at eye level or from below from the steep bank on which the trees are growing. Although the clutch size is given as 3 or 4 (Falla *et al.* 1979), only on a few occasions did I see three small chicks in the nest, never four, and the number raised was usually one or two. I visited the colony for about 1 hour every 3-5 days throughout the 1977-78 and 1978-79 breeding seasons, then at intervals of 2-4 weeks during later seasons.

Great care was taken not to disturb the colony. Early in the season (August) the birds sometimes took flight, but later inspections could be made

without their leaving nests. Before nest building began, pairs would perch side by side at their chosen site, enabling me to record individual plumage patterns. After the first three years, the growth of shrubs blocked my view of some nest sites, and so I concentrated my later investigation on following the size of the colony.

During the two seasons of intensive study, I mapped the individual nests by making sketches from several vantage points and cross-checking between these points. On every inspection I recorded the activity at each nest and noted any extra pairs or lone birds in the colony. I recorded the plumage type of each bird that I could see clearly and the number and condition of chicks large enough to be seen alongside the attending adult or while being fed. I noted such adult behaviour as courtship displays and greeting calls. The level of activity and various calls and other reactions of the chicks were also noted. Tape recordings of the calls of adults and chicks have been deposited with the British Library of Wildlife Sounds.

RESULTS AND DISCUSSION

Behaviour in the colony

The display, nest building and chick-feeding behaviour of Little Shags I observed was similar to that described elsewhere (Harley 1946, Goodwin 1956, Vestjens *et al.* 1985, Matthews & Fordham 1986). Incubation was shared but I did not establish whether one sex took a greater share. The birds greeted each other at the nest but left silently.

Three distinct calls were recognised. One, a greeting call *uh-uh-uh-uh* . . . in a series dying away, is used by birds of either sex when arriving to change over during incubation or to feed chicks and is met by a similar response from the mate. Another, *oo-oo-oo*, a rhythmical sound, accompanies the display movement of repeatedly swinging the head downwards in a vigorous bow, performed by the male bird when seeking to attract a mate. This usually takes place at a chosen nest site or on a partly completed nest, and it is sometimes the prelude to copulation. A different call, *ow-aah*, is given by the male during bouncing or squatting movements performed on the partly build nest. I observed the squatting display much less often than bowing, but have watched sequences in which a bird squatted several times before changing to a series of bows. The ensuing exchange includes the bird pulling and shaking the tail of its mate. Harley (1946) referred to the calls given during display as "cooing", and Matthews & Fordham (1986) described them as having one or two syllables *(uh-aah)*. I maintain that the call while bowing has two or three syllables, but we are obviously seeking to describe similar sounds and behaviour. In a busy colony, chicks are likely to be squeaking continuously, and the greeting calls can be distinguished from this background and can be traced to the bird which is bowing or squatting. Thus, one can interpret what is going on in a colony just by listening carefully.

Breeding seasons of Little Shags and Pied Shags

Little Shags are absent from Hobson Bay colony between March and July when a few birds return to roost in the vicinity. Pairs are established

and start nest building or refurbishing the few remaining nest remnants in August, or occasionally in late July. Numbers then increase rapidly to a maximum in October or the first half of November. For the eight years 1977-1984 shown in Figure 1, the range of these maximum October/November counts was 27-60 breeding pairs, the average being 43 pairs. However these figures underestimate the size of the colony because other birds joined the colony later to begin nesting in December or January. Averaged over the eight seasons from 1977 to 1985, the highest counts of occupied nests in each month are as follows: August (14), September (30), October (43), November (39), December (27), January (17), February (12), March (4).

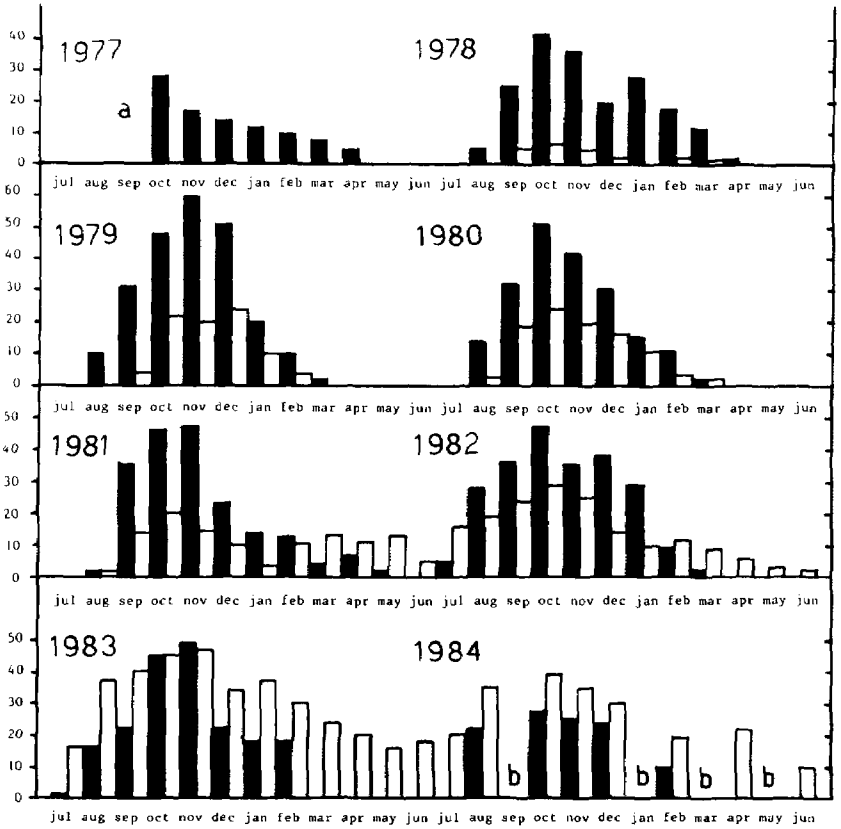

FIGURE 1 — Counts of nesting pairs of Little Shags (solid histogram) and Pied Shags (open histogram) at Hobson Bay in each month for eight years.
(a) Observations began in October 1977 when nesting was already under way.
(b) No counts were taken in September 1984 or in January, March and May 1985.

As Figure 1 shows, the numbers of breeding Little Shags increased during the first three years of the study 1977-1979, but then decreased, partly at least because of sites lost by damage to the nesting trees by Pied Shags. Pied Shags first attempted to nest in this colony in 1978, when nine pairs built nests, although only one succeeded in raising young. Pied Shag numbers increased in the following years until they exceeded the number of Little Shags. More than 40 pairs were present in the spring of 1983, and in October 1984 37 pairs of Pied Shags and 27 pairs of Little Shags were nesting.

The arrival of Pied Shags has allowed the seasonal behaviour of the two species to be compared. As Figure 1 shows, the nesting of Pied Shags has a spring maximum at about the same time (October/November) as that of the Little Shags. A difference is that, from 1981 to 1985, the Pied Shags kept nesting throughout the year. Year-round breeding has been recorded before for this species at colonies in the Auckland region (Millener 1973) and elsewhere in New Zealand (Lalas 1979). The present figures, although confirming the spring maximum, do not show the secondary peak of activity in autumn which has been found elsewhere.

In most seasons, new nests of Little Shags were still being started in January, and so the rearing of young extended into March or April. At the end of the 1981-82 season three late nests were present on 9 May, one with two chicks and the others with sitting adults, perhaps on infertile clutches. No Little Shags were present at the next inspection on 29 May, although nine Pied Shag nests remained, each with one or two young. Instances of prolonged incubation by Little Shags have been reported previously (Taylor 1979).

During the 1978-79 season I recorded the outcome of all the nesting attempts by pairs of Little Shags in the following categories:

Failed to complete the nest	12	(13%)
Nest lost owing to storm damage	14	(16%)
Nest deserted during incubation	20	(22%)
Birds displaced at an early stage by another pair	6	(7%)
All chicks died in the nest	6	(7%)
One or two chicks raised to fledging	32	(35%)

The total of 90 nesting attempts exaggerates the size of the colony as it includes the second attempts of at least ten pairs after loss of their first nest. Usually I could not tell what caused birds to desert their nest, but human disturbance did not appear to be an important factor. A dip in numbers for December 1978 was the result of nest losses in a severe storm and was followed by intensive rebuilding.

In summary, the nesting season of Little Shags at Hobson Bay typically extends over eight months of the year. After a spring maximum, nesting is prolonged by some birds rebuilding after losing their nests and also by the arrival of late nesters. In New South Wales a later season, extending from October to May, with a peak of egg-laying in January has been found for this species (Miller 1980).

My observations of Little Shags, using plumage patterns to recognise individuals, indicate that most birds find a mate and begin nesting soon after joining the colony and that they leave the colony when their young have fledged. I saw no immature and few unattached adult Little Shags. In contrast, Pied Shags, both adults and immature birds, use the site as a roost at all times of the year.

Plumage forms of the Little Shag

In describing the various adult plumages, I found the following classification to be practicable. I have used the term form (or morph) rather than phase so as not to imply that changes may occur with age once the bird is out of its immature plumage. This aspect requires further study.

White-throated form: White plumage apparent only on face, sides of head and throat, sometimes extending on to the neck, Figure 2, A and B.

Pied form: White over the whole of the breast and belly as well as face, neck and sides of head, Figure 2, C. Compared with the white-throated form, pied birds tend to have more white plumage on the head, often extending upwards to leave only a narrow black strip on the crown.

Smudgy form: The white of the head and neck extends on to the upper part of the breast and is accompanied by a white patch or patches on the breast and underparts, Figure 2, D. Early in the study, I had hoped that the various patterns of smudgy birds would enable me to identify individuals away from the nest. In practice, this method proved unreliable, but I did use simple sketches of the extent of black and white areas on birds to help me recognise individuals at or near their nests.

Notes: 1. If a pied bird had a few dark feathers on the breast or a mainly dark bird had a few white feathers, I ignored them in assigning such birds to the pied and white-throated categories respectively.

2. A few birds had a persistent rufous staining on their white feathers, usually on the neck and upper breast. This has been noticed before in the plumage of this species (Harley 1946, McKenzie 1965, Edgar 1972). Australian work attributes it to ferric staining (Keast & D'Ombrain 1949). The birds probably acquire the stain while feeding, much of which they do by swimming close to the bottom in shallow water to catch food such as small eels and freshwater crayfish (Potts 1977, Miller 1979). The feeding involves a series of dives during which the birds submerge for 9-20 seconds with intervening rests of 5-10 seconds (Stonehouse 1967).

Using this classification, the 84 birds (42 pairs) which comprised the colony on 10 October 1978 consisted of 46 white-throated birds (55%), 27 pied (32%) and 11 smudgy (13%). Similar proportions (white-throated 51%, pied 32%, smudgy 17%) were scored for pairs formed over the entire 1978-79 nesting season at Hobson Bay. See Table 1.

The plumages of breeding pairs of Little Shags and their offspring

Throughout the study period mating took place among the different plumage forms and analysis shows this to be random (Dowding & Taylor, this issue). This result is contrary to the hypothesis that, in mixed colonies,

birds of similar plumage tend to pair. This hypothesis was formerly used to support subspecific status for the White-throated Shag (Oliver 1955).

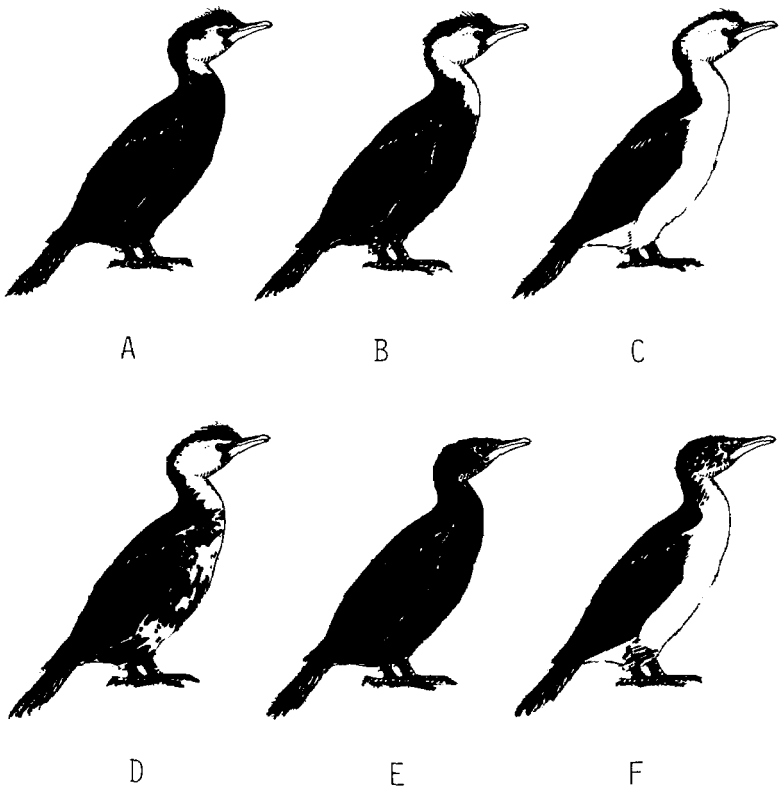

FIGURE 2 — Plumages of the Little Shag. A, B. White-throated form, which may have white throat only or white extending on to neck; C. Pied form; D. An example of the smudgy form, which can vary greatly; E. Dark fledgling; F. Pied fledgling.

As Table 1 shows, at the height of the spring 1978 breeding season the colony had all six mating combinations of the pied, white-throated and smudgy forms. There were more pairings between birds with dissimilar plumage than between like forms, and this situation prevailed for the 1978-79 season as a whole.

The Little Shag nestlings begin life with bare black skin, black bill, and pinkish scalp and gular pouch. A black downy stage follows, during which the pinkish white scalp remains bald and the birds have a bright pink gular pouch. This stage is well illustrated in Vestjens *et al.* (1985). Feathers grow through the down and the young remain in or near the nest until ready

to fly. I was able to keep records of their plumage development through to their leaving the colony. Two types of plumage were encountered: either the fledglings were black over the entire feathered parts or they developed white feathers over the whole of the underparts of the body and extending on to the neck, remaining black elsewhere. See Figure 2, E and F.

TABLE 1 — The plumages of nesting pairs of Little Shags at Hobson Bay

Combination	Number of pairs	
	10 Oct. 1978	1978-9 season
White-throated x pied	20	36
White-throated x white-throated	11	18
White-throated x smudgy	5	14
Smudgy x smudgy	2	3
Smudgy x pied	1	8
Pied x pied	3	5
	42	84

Black juveniles that have just left the nesting colonies can be distinguished from the Little Black Shag by their short, thick bill, whereas the bill of the Little Black Shag is long and thin. The remains of the gular pouch of nestlings can sometimes also be seen. The age at which the throat feathers become recognisable so as to turn the birds into "White-throated Shags" is not known exactly. Totally black Little Shags have, however, been recorded in August and September around Auckland. These must be from the previous season's nesting and therefore at least 6 months old.

Juvenile Little Shags that are pied can be distinguished from pied adults by the lack of a crest and by appearing darker around the head and neck until feather development is complete in these areas. An Australian study (Miller 1980) recorded that immature Little Pied Cormorants can be "distinguished from adults by lack of broad white superciliary line".

Among my records are several of contrasting pied and black young in the same brood. This striking feature of the nest observations does not seem to have been noted previously. I saw no "smudgy" fledglings. Little Shags in their first feathers are clearly differentiated, being either totally black or black above and white below.

During the 1977-78 and 1978-79 breeding seasons, I made a determined attempt to follow to completion the raising of chicks in all the nests I could see clearly. Over this period 43 pairs raised a total of 62 young (1.4 per nest), and Table 2 gives the numbers of dark and pied fledglings from all 43 matings. The 16 white-throated x pied matings yielded 25 young (1.5 per nest), indicating that there is no disadvantage in mixed pairings. The genetic implications of the parent-offspring data in Table 2 are considered in detail by Dowding & Taylor (this issue). This analysis shows that polymorphism in the Little Shag is controlled by a single gene, with 'dark' incompletely dominant over 'pied'.

TABLE 2 — Relationships between the plumages of adult and fledgling Little Shags at Hobson Bay, 1977-79

Adult pairing	Number of pairs	Fledglings	Number of occasions
White-throated x pied	16	2 dark	5
		1 dark & 1 pied	4
		1 dark	5
		1 pied	2
White-throated x white-throated	11	2 dark	6
		1 dark	5
White-throated x smudgy	8	2 dark	3
		1 dark	5
Smudgy x smudgy	1	1 dark & 1 pied	1
Smudgy x pied	6	1 dark	1
		1 pied	5
Pied x pied	1	1 pied	1

CONCLUDING REMARKS

The Little Shag is widespread in New Zealand. During the period of this study Little Shags have nested at six other sites in the Auckland region. Two of these sites are marine and four are on freshwater lakes. All are smaller than the Hobson Bay colony, and some have been used only intermittently.

The Hobson Bay colony has been observed for 8 years. Little Shags have bred successfully each year. In 1978-79 one-third of nesting attempts led to young being raised to fledging, and this proportion probably holds for the other seasons in which the colony was less intensively studied. The nesting of Pied Shags in the same tree has caused some decline in the number of Little Shags attempting to nest.

The various adult and juvenile plumage forms of the Little Shag are described in this paper. All combinations of the white-throated, smudgy and pied forms interbreed at Hobson Bay, and this situation presumably holds elsewhere, although suggestions to the contrary have been published (Oliver 1955). Young birds whose first feathered stage is black and those in which it is pied have been found as siblings in the same brood. This observation and the genetic analysis (Dowding & Taylor, this issue) show conclusively that the plumage forms of the Little Shag constitute a single subspecies. Additional records of the plumage forms of the Little Shag from other parts of the country will enable the genetic analysis to be extended.

This study raises a number of questions which OSNZ members may be able to answer. These include questions of the timing, success and nesting habits at colonies elsewhere in New Zealand. Counts of plumage forms at other Little Shag colonies would be valuable. The plumage development from juvenile to adult requires attention, particularly for smudgy birds. No banding studies have been undertaken for the Little Shag and we do not

know whether this rather shy species would tolerate the disturbance which such studies might entail. Even without banding studies much can be learned by careful watching of behaviour in the field, especially at roosts and nesting sites.

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MICHAEL J. TAYLOR, *28 Awarua Crescent, Orakei, Auckland 5*