NEST AND EGGS OF MUSK DUCKS *Biziura lobata* AT MURRAY LAGOON, CAPE GANTHEAUME CONSERVATION PARK, KANGAROO ISLAND, SOUTH AUSTRALIA

KEVIN G. McCRACKEN[1,2,3], ALAN D. AFTON[2], and DAVID C. PATON[3]

[1]School of Forestry, Wildlife, and Fisheries, Louisiana State University, Baton Rouge, LA 70803, U.S.A.
[2]U.S. Geological Survey, Louisiana Cooperative Fish and Wildlife Research Unit, Louisiana State University, Baton Rouge, LA 70803, U.S.A.
[3]Department of Environmental Biology, University of Adelaide, Adelaide, S.A. 5005, Australia

ABSTRACT

We measured nests and eggs of Musk Ducks *Biziura lobata* at Murray Lagoon, Cape Gantheaume Conservation Park, Kangaroo Island, South Australia, following a period of unusually heavy winter rainfall in 1995. Thirty-seven nests were discovered from September to November in the first two of three consecutive breeding seasons (1995–97). Thirty-five nests were in seasonally flooded cutting grass *Gahnia trifida* at the southeast edge of the main lagoon; two nests were over water in forks of tea trees *Melaleuca* spp. Nest materials in cutting grass sites consisted of dry cutting grass stems and small amounts of down, whereas nests in tea trees were made of sticks and bark. All but four nests in cutting grass habitat possessed hoods composed of folded grass stems. Mean clutch size (± SD) for nests observed in 1995 was 3.7 ± 1.8 (n = 31, mode = 4 eggs, range = 1–9 eggs). Observed nest success was 19% (n = 6 of 31 nests), mean number of eggs hatching per nest was 2.8 ± 1.2 (mode = 2 eggs, range = 2–5 eggs) and mean hatch date was 16 October ± 12 days (range = 1 October to 5 November). Mean clutch size of the nests discovered in 1996 was 2.7 ± 0.5 (n = 6, mode = 3 eggs, range = 2–3 eggs); however, none of these nests hatched. No nests were discovered in 1997 despite approximately equal annual search efforts. Mean dimensions (± SD) of 130 Musk Duck eggs measured in both years were 83.73 ± 3.82 mm x 53.80 ± 1.71 mm (egg length range = 74.0–91.1 mm, egg width range = 48.5–59.0 mm). We observed a decline in nesting activity in cutting grass habitats between years in response to retreating water levels. Our data further underscore the strategy of Australian waterfowl to exploit ephemerally flooded habitats in wet years and breed successfully, but to forgo breeding activity at the same localities in dry interludes.

INTRODUCTION

Musk Ducks *Biziura lobata* exhibit extreme dimorphism in sexual size, peculiar secondary sexual features and a musky odour. Musk Ducks also display a striking array of behavioural traits. The most notable traits include lek behaviour and promiscuity, extraordinary splashing displays, an unusually effective aggressive countenance and absence of paternal care (e.g. Marchant and Higgins 1990; Johnsgard and Carbonell 1996; McCracken 1999). Female Musk Ducks are notable for their comparatively small body size, unusually large, elliptical, green eggs and the unusual trait among waterfowl of providing young with food from the time of hatching until fledging (Frith 1967; Marchant and Higgins 1990; Brown and Brown 1997; Todd 1997). Despite such peculiarities, very little is known about the nesting biology and egg-laying habits of this species. With the exception of the accounts of Frith (1967), basic traits such as mean clutch size, length of the incubation period and average hatching success have not been documented (see Marchant and Higgins 1990).

We present here descriptions and measurements of over-water nest sites, egg laying characteristics and hatching success of Musk Ducks at Murray Lagoon, Cape Gantheaume Conservation Park, Kangaroo Island, South Australia. Our data were collected following a period of unusually heavy winter rainfall in 1995. Our study spans three consecutive breeding seasons (1995–97), provides the first data for this area and is a useful addition to the limited breeding data available for this species.

METHODS

We measured nests (n = 37) and eggs (n = 130) of Musk Ducks at Murray Lagoon, Cape Gantheaume Conservation Park, Kangaroo Island, South Australia (35°55'S, 137°25'E; Figure 1) between 30 September and 11 November 1995 and 9 September and 16 October 1996. Despite approximately equal annual search efforts, we found no nests in 1997. Murray Lagoon is the largest deep-water, permanent wetland on Kangaroo Island and has a flooded area that generally occupies 750 to 1,000 hectares, depending on variations in annual rainfall and runoff (A. MaGuire, National Parks and Wildlife S.A., pers. comm.). Like other coastal wetlands on the south coast of Kangaroo Island, Murray Lagoon is surrounded by dense stands of tea tree *Melaleuca* spp. and former pasture-land interspersed with large clumps of cutting grass *Gahnia trifida*. In midwinter, these marginal areas usually are dry, but in exceptionally wet years, the lagoon can overflow its banks to a depth of several metres and approximately double in surface area, as occurred in late August and September 1995 (McCracken 1999).

We began nest searches in early September and conducted them weekly until the middle of November of each year. We searched all areas containing cutting grass at the southeast perimeter of Murray Lagoon, which is the only major cutting grass habitat at Murray Lagoon. We also searched flooded tea trees between the cutting grass and outlet of Timber Creek. Upon discovering a nest, we measured (± 1 cm) nest outer diameter, wall thickness, rim height above the water, inner diameter, hood height above the nest rim (if present), ramp length, and water depth with a retractable tape measure. We measured width and length of each egg (± 0.1 mm) with dial callipers. Unusually thick egg shells made candling impossible, so embryo age was estimated by egg flotation (e.g. Westerskov 1950) using a buoyancy scale calibrated for Musk Ducks (McCracken unpubl. data). Active nests were re-visited every three to four days thereafter, and embryo age was re-estimated. Nests were considered active if they contained down or eggs were warm. Nests were recorded as successful if one or more eggs hatched. Nests were recorded as predated by birds if eggs showed circular puncture holes.

RESULTS

Murray Lagoon experienced a period of unusually heavy freshwater inundation following heavy winter rainfalls in July 1995 (total July rainfall = 133.0 mm; A. MaGuire, National Parks and Wildlife S.A., pers. comm.). By the time water levels peaked in late September, water had risen 1.75–2.0 m above early July levels and flooded more than 500 hectares of former pasture-land on the east side of Murray Lagoon (A. MaGuire, National Parks and Wildlife S.A., pers. comm.). On 30 September 1995, we discovered the first two nests in flooded cutting grass on the southeast perimeter

Figure 1. Aerial photograph of Murray Lagoon, Cape Gantheaume Conservation Park, Kangaroo Island, South Australia, October 1996. Northwest corner of the main lagoon area is depicted in the foreground; referenced study sites are visible at the southeast.

of the flooded area. An additional 29 nests were found in the same area between 1 October and 5 November 1995, after which no more nests were discovered until the following year. In 1996, no major runoff events occurred such as those observed in 1995. Water that persisted in areas flooded the previous year dropped 0.75–1.0 m in depth between the end of September 1995 and early July 1996. Nonetheless, Murray Lagoon water levels rose 0.3–0.5 m in response to light winter rainfall that year (total July rainfall = 72.2 mm), and an additional six nests were discovered between 9 September and 16 October 1996. Four nests were found in cutting grass, and two nests were in flooded tea trees. The following year was very dry (total July rainfall = 39.8 mm), and by September 1997 water levels within the lagoon receded entirely from the areas flooded in August and September 1995. By November 1997, the lagoon dropped an additional 0.25–0.5 m to a level below that observed at the onset of previous flood events. We did not find any Musk Duck nests in 1997.

Measurements of Musk Duck nests discovered between 30 September 1995 and 16 October 1996 are provided in Table 1. Nest materials in cutting grass habitat consisted of dry cutting grass stems and small amounts of down in some cases (Figure 2). Mean total mass of down (± SD) from six nests was 0.677 ± 0.630 g (range = 0.150–1.859 g). The two nests in tea trees were made of sticks and bark. One of these was composed of new material, and the other was composed of older material and possibly was constructed the year before. All but four nests in cutting grass habitat possessed hoods composed of folded grass stems (Figure 2). One of the two tea tree nests was sheltered by fallen branches. Many of the nests placed in cutting grass had smaller secondary entrance and exit holes.

In 1995, mean clutch size (± SD) was 3.7 ± 1.8 (n = 31, mode = 4 eggs, range = 1–9 eggs), and observed nest success was 19% (n = 6 of 31 nests). For the six nests that hatched ducklings, mean (± SD) number of eggs hatching per nest was 2.8 ± 1.2 (mode = 2 eggs, range = 2–5 eggs), and mean hatch date (± SD) was 16 October ± 12 days (range = 1 October to 5 November). Of the remaining clutches (n = 25) observed that year, 28% (n = 7) were abandoned after little or no incubation, and 52% (n = 13) were abandoned after partial incubation or after two or more eggs fell in the water. An additional 8% (n = 2) of failed nests were predated by birds, and 12% (n = 3) were abandoned after incubating females were trapped on the nest, potentially under-estimating true nest success. Mean clutch size did not differ between nests that hatched eggs and those that did not (t-test $P > 0.94$). One nest that did not hatch ducklings contained nine fresh (or barely incubated) eggs, and thus may have been a dump nest. This nest was one of four nests without hoods, and the only nest placed in open view. We observed indirect evidence of intra-specific nest-parasitism in two additional nests; single, out of sequence Musk Duck eggs appeared between nest visits during the late stages of incubation. One additional nest contained four Blue-billed Duck *Oxyura australis* eggs and one

Table 1. Means (± SD) and ranges of nest dimensions (cm) by vegetation type for Musk Ducks at Murray Lagoon, Cape Gantheaume Conservation Park, Kangaroo Island, South Australia, 1995–96.

Measurement	***Gahnia trifida*, *n* = 35** mean (range)	***Melaleuca* spp., *n* = 2** mean (range)
Outer diameter	38.4 ± 5.0 (27–51)	41.5 ± 2.1 (40–43)
Wall thickness	12.1 ± 3.3 (6–23)	10.5 ± 6.4 (6–15)
Rim height above water	32.1 ± 12.4 (16–78)	17.0 ± 1.4 (16–18)
Bowl depth	11.9 ± 3.8 (7–27)	10.0 ± 2.8 (8–12)
Inner diameter	21.2 ± 3.0 (16–27)	22.5 ± 3.5 (20–25)
Hood height above rim*	15.5 ± 4.7 (6–33)	20
Ramp length	55.6 ± 27.6 (17–140)	26.0 ± 1.4 (25–27)
Water depth	27.1 ± 9.4 (4–42)	70.5 ± 10.6 (63–78)

*Number of nests with hoods in each vegetation type: *Gahnia trifida*, *n* =31; *Melaleuca* spp., *n* = 1.

Musk Duck egg. However, no down was present in this nest, and the nest was predated at the time of discovery. Consequently, we are uncertain whether it was a Musk Duck nest parasitised by a Blue-billed Duck or vice versa (see also Attiwill, Bourne and Parker 1981). Mean clutch size (± SD) of the six nests discovered in 1996 was 2.7 ± 0.5 (mode = 3 eggs, range = 2–3 eggs); however, none of these nests hatched eggs. Two (33%) were abandoned with little or no incubation, and three (50%) were abandoned after partial incubation or after two or more eggs fell in the water; the sixth nest (17%) was preyed upon by a bird.

Mean dimensions (± SD) of 130 Musk Duck eggs measured in both years were 83.73 ± 3.82 mm x 53.80 ± 1.71 mm (egg length range = 74.0–91.1 mm, egg width range = 48.5–59.0 mm). Eggs of Musk Ducks are relatively large for their body size, distinctly elliptical, and pale green, unlike the buff-white or slightly green, more typically anatid-shaped eggs of Australian Blue-billed Ducks (Figure 3).

DISCUSSION

We found flooded cutting grass to be an important nesting habitat for Musk Ducks at Murray Lagoon. In 1995, flooded cutting grass was abundant, and additional breeding habitat became available. But there was very little flooded cutting grass in 1996 and no flooded cutting grass in 1997. Consequently, we observed a decline in nesting activity in cutting grass habitats among years in response to retreating water levels. Such areas flood seasonally, and depth may or may not be sufficient for nesting in any given year. Nonetheless, cutting grass probably is an important nesting site for ducks throughout south-eastern Australia, and every effort should be made to conserve this natural resource. In contrast, only two nests were discovered in the forks of tea trees. Musk Ducks may not commonly place their nests in the forks of tea trees, particularly when more sheltered sites such as cutting grass, reeds and rushes are available. Clutch sizes and egg

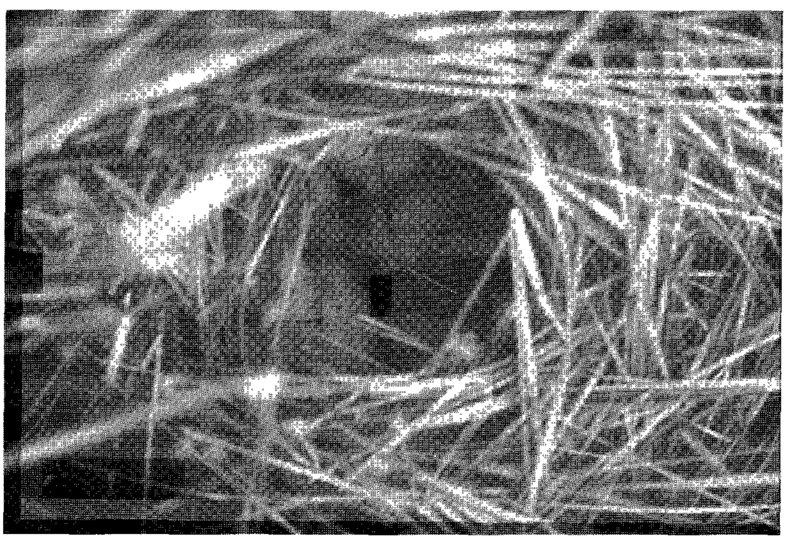

Figure 2. Two photographs of a Musk Duck nest placed in cutting grass *Gahnia trifida* at Murray Lagoon, Cape Gantheaume Conservation Park, Kangaroo Island, South Australia, 1995: (a) Bottom; close-up of nest bowl with hood, and (b) Top; entrance to the same nest.

dimensions were typical of those reported by Frith (1967) and Serventy and Whittell (1976). It is unclear whether the rate of nest-abandonment observed in 1995 is typical for Musk Ducks, as nest success and hatching success have not been documented previously. Concurrent banding activity may have been one potential contributor (15 females were banded in 1995, one in 1996, and one in 1997; McCracken 1999). Relatively dense nesting concentrations in the cutting grass may have been yet another factor. Many nests, though hidden in the cutting grass, occurred within eye-sight of one another.

Salinity also might have contributed to declining nesting activity. Like many other coastal wetlands, Murray Lagoon has no outlet to the sea or any out-flowing creeks or tributaries. During dry periods, when the lagoon retracts to its median size, salinity levels typically rise to 22,000 parts per million (A. MaGuire, National Parks and Wildlife S.A., pers. comm.). In wet years, such as 1995, however, salinity levels in newly inundated areas are typical of brackish water, e.g. 3,000–4,000 parts per million. What impact increased salinity has on the development of young Musk Ducks is unknown. But it is possible that the effects are detrimental, at least at the early stages of development, and thus, inhibit breeding activity. On the other hand, records of Musk Ducks breeding in saline wetlands in Western Australia and at sea on protected coastal waters in areas of freshwater upwelling suggest that newly hatched Musk Ducks may be able to tolerate some exposure to salt (Goodsell 1990; M. McKelvey and P. Bartram,pers. comm.; but see Halse 1986). Further study is needed to determine salinity tolerances of ducklings.

Our data further underscore the abilities of Musk Ducks and other Australian waterfowl to exploit ephemerally flooded habitats in wet years and breed successfully, and then forgo breeding activity at the same localities in dry interludes. Such irruptive breeding habits are common for Freckled Ducks *Stictonetta naevosa* and Pink-eared Ducks *Malacorhynchus membranaceus* (e.g. Frith 1967; Blakers, Davies and Reilly 1984; Marchant and Higgins 1990) and, based on our data, probably also are common for Musk Ducks inhabiting such localities. From 1984 to 1995, Murray Lagoon overflowed its banks in a similar fashion on three other occasions, 1984, 1989, and 1992; Murray Lagoon has not overflowed its banks since 1995 (A. MaGuire, National Parks and Wildlife S.A., pers. comm.). Water levels also were moderately high in 1986 and 1987, and similar flood events in 1910 (prior to most agricultural land clearance) and 1956 (at the height of land clearance) suggest that patterns that have occurred recently also might have persisted in the past. A relatively long life-span (greater than 23 years in captivity; Marchant and Higgins 1990) also suggests that individual Musk Ducks are capable of surviving long enough to experience favourable breeding conditions repeatedly. In this respect, intermittent exploitation of ephemerally-flooded coastal wetland habitats probably has been important in the overall reproductive ecology and population dynamics of this species.

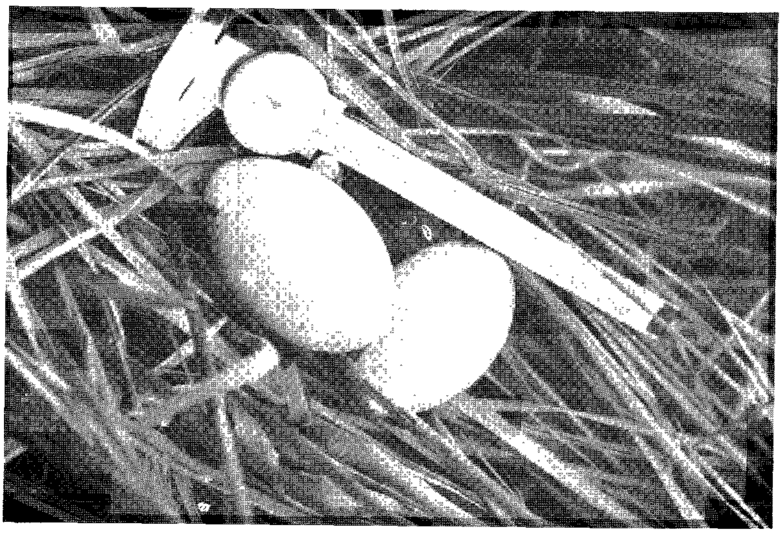

Figure 3. Photograph of Musk Duck eggs and callipers placed in *Gahnia trifida* at Murray Lagoon, Cape Gantheaume Conservation Park, Kangaroo Island, South Australia, 1995.

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Kevin G. McCracken: University of Alaska Museum, University of Alaska Fairbanks, Fairbanks, AK 99775-6960; tel. 1 (907) 474-7505; email: kmccrack@darwin.helios.nd.edu; fax 1 (907) 474-5469

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