Time budgets of Mandarin Ducks under semi-natural conditions

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Introduction

The chronology of waterfowl activity during the breeding season, including behaviour variations related to time of day and interactions between breeding pairs, is not precisely known (McKinney 1967). This is particularly true for the Mandarin Duck *Aix galericulata*, a species native to Asia but introduced into England. Except for a general study by Savage (1952), the activities of either feral or captive Mandarins have not been published. The purpose of our research was to describe in detail the daily behaviour patterns (time budgets) of marked, known-age individuals throughout the year for several years under semi-natural conditions. Such data provide a base for future studies of this species in the wild.

Studying birds under entirely natural conditions certainly is the optimum situation. However, McKinney (1967), using captive but full-winged Shoveler *Anas clypeata* in flight pens, observed daily and seasonal activity patterns that paralleled those of wild birds. He also concluded that, although flight-associated activities or displays obviously are hampered by pinioning, most of a bird's reproductive behaviours and activities are unaffected; thus insight into the behaviour of wild birds can be gained by using pinioned birds. As Collias & Jahn (1959) have demonstrated its value with Canada Geese *Branta canadensis*, the use of pinioned, free-ranging birds in the present study was felt justified by the relatively low occurrence of aerial displays in the Mandarin repertoire.

Methods

The study was conducted in a 10-ha estate along the Portage River in Ottawa County, Ohio. The estate contained two lakes (of 0·6 and 1·0 ha) and more than 350 varieties of native and exotic trees and shrubs in floodplain habitats.

During three years, more than 400 hours were spent observing 30 birds of both sexes ranging in age from one to nine years. All were marked with coloured and numbered polyurethane nasal-saddles. In 1973 time budgets were determined during 15-hr dawn-to-dusk observation sessions, one in each of the pre-laying, laying, incubation, post-incubation, and the summer and fall moult periods. These observations were supplemented by shorter ones of one to seven hours of both penned and free-ranging birds during the same year and in 1972. Two all-night observations were made during the 1974 post-incubation and summer moult periods with a Starlight Night Vision Scope.

During the 15-hr sessions the occurrence of behaviours and displays associated with social encounters and reproduction, and time spent in each activity (preening, feeding, loafing, etc.) of at least one free-ranging pair were recorded continuously. The activities and locations of the rest of the flock also were noted at 30 and 60 min intervals, respectively. More detailed methodology and descriptions of all displays can be found in Bruggers (1974).

Results and Discussion

Population time budgets

General daily patterns

The daily activities of Mandarins consisted primarily of repetitious feeding, preening, and loafing, with variations in these patterns related to the different social periods (Figure 1). A diurnal activity rhythm was not as evident during the spring and fall as in summer and fall. During pre-laying and laying periods intense feeding began prior to dawn, continued until 07.30, was followed by nest box inspection and then intermittent feeding during the remainder of the day. Extended periods of inactivity, in which more than 50% of the birds either loafed or preened, occurred in the pre-laying period only between 08.30–10.30 and 14.30–16.00 and during the afternoon of the laying period. Individual pairs followed feeding with short loafing and preening sessions.

The activities of the birds during the post-incubation period (i.e., prior to the onset of the pre-basic moult) and during moult into the basic (eclipse) plumage were similar. Morning feeding during these two periods finished by 09.30, but afternoon feeding began later than during the laying period and extended to twilight (17.30–21.00). Birds usually swim-fed between 16.15–17.00 and grazed from 17.30–18.30. Nearly all birds loafed during mid-day.

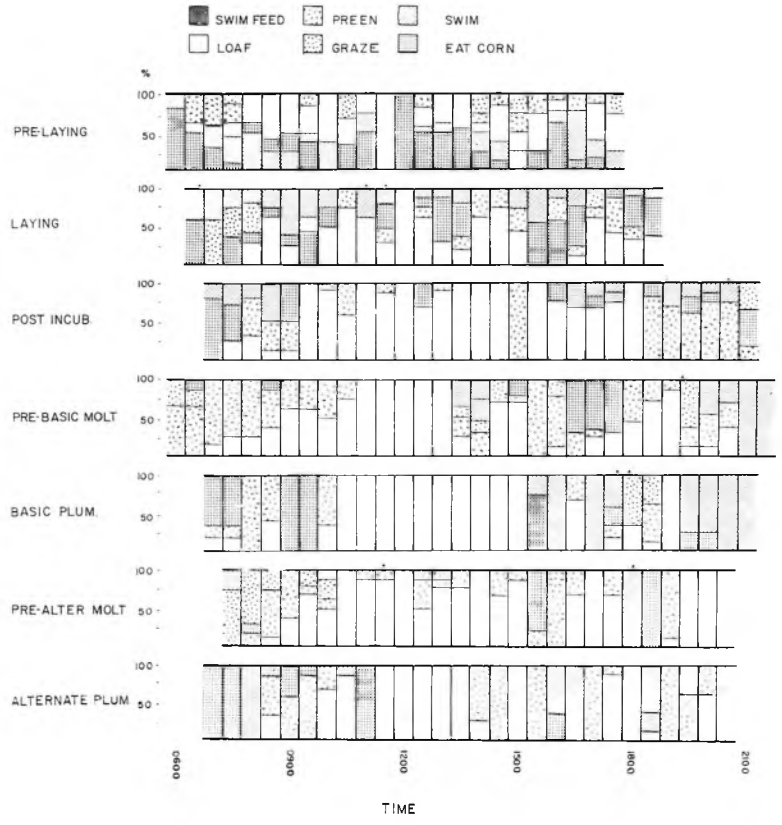

Figure 1. Proportion of free-ranging flock engaged in various activities at ½-hr intervals during full-day observations 1973. (n = 5–11).

In marked contrast to the post-incubation and the basic moult periods were the activities during the pre-basic and, to a lesser extent, the pre-alternate moult periods. Nearly all birds, preened between 06.00–10.30, slept until 13.30, and then resumed eating and preening. They presumably had fed prior to the initiation of observations at 06.00.

Display preening, unless highly ritualized (such as Preen-behind-the-wing), was difficult to distinguish from normal comfort preening. Some preening during September and much of it after the pre-alternate moult (October) seemed different from preening in the post-incubation period and undoubtedly was related to resumption of the breeding plumage and pairing. The birds did not pick or pull feathers (few feathers were found in the loafing spots) but instead touched and rearranged them. The belly, chest, and wings were preened more frequently than others. The preening movements were sometimes accompanied by Head-flick displays. Social facilitation of this activity was evident, for birds in a group preened simultaneously, males more vigorously than females. Most adults had paired by this date, as indicated by Mutual Caressing movements and Mutual Preening. The pair-drake led during many fall movements, the reverse of the situation in spring.

General swimming, associated with nest box inspection and pursuits, decreased with the end of the laying season. Increased swimming time during the pre-basic moult and basic plumage periods occurred as a result of the change in social patterns, from spring pairs to the flock condition, and as the birds entered the water to sleep.

Pre-laying and laying

Observations made on individual pairs during each period supported our findings for the flock (Figure 2). A pair, usually led by the female, was active most of the day during pre-laying and laying periods; but the extended mid-day inattentive period,

characteristic of summer and fall, was eliminated. The female spent nearly two-thirds of the day feeding. Extensive feeding during the nesting period was also observed for Gadwall *Anas strepera* by Dwyer (1974) and related to obtaining the food reserves necessary for laying.

Males fed respectively 38% and 14% less than their females during the pre-laying and laying periods (Figure 3). Bengston (1972) studying Harlequin Ducks *Histrionicus histrionicus* and Dwyer (1974), working on

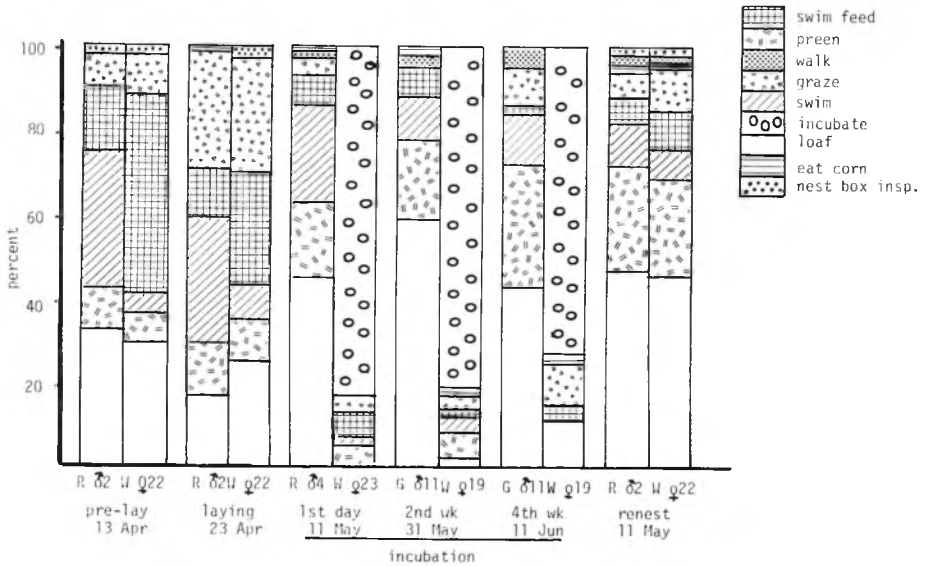

Figure 2. Chronological daily activity pattern of a free-ranging Mandarin pair during full-day observations in 1973. Agonistic encounters indicated by dots.

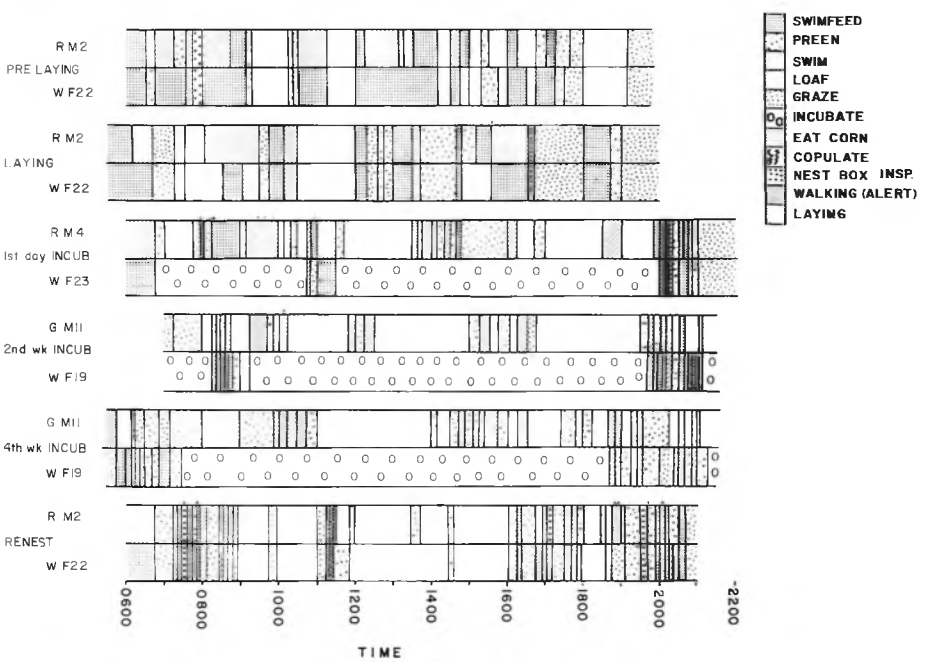

Figure 3. Activity patterns of Mandarin pairs during spring 1973. Proportions derived from the number of minutes spent in each activity by a pair during full-day (dawn-dusk) observations.

Gadwall, found that the male fed almost half as much as the female during the time the pair was together. Dwyer concluded that the male provided the seclusion necessary for the increased feeding at these times by chasing off other duck. Perhaps just as important for an isolated, non-social bird like the Mandarin, the male also was alert to warn the female of approaching danger, allowing her to feed intensely.

Incubation

The percent time spent in various activities by males was similar throughout the incubation period (Figure 3). Except for periods at noon and late afternoon, they remained constantly alert while loafing and even patrolled the nesting area and engaged in several agonistic encounters. They fed (usually grazing) while the female incubated. Savage (1952) has reported similar male activity rhythms for feral Mandarins. Although the male remained attentive to the female during the fourth week of incubation, his restlessness at this time was evident by his many brief activity periods and his partial association with other birds. His preening frequency increased 10%, probably associated with the pre-basic moult.

The females incubated and fed about 80% and 10%, respectively of the daylight hours each day throughout incubation. They were very active when off the nest, only loafing or sleeping on one of six recorded occasions. Incubation breaks consisted of feeding, bathing (usually), and preening; the prevalence of feeding decreasing during evening non-incubating periods from 80% during the first day of incubation to 40% in the last two weeks (Table 1). This initial extensive feeding may be a carry-over from the great amount of time spent feeding during pre-laying and laying periods. Males attended their females while they were off the nest, but participated in feeding only when their mates grazed (usually during the evening). The rest of the time (57–90%) males remained alert.

Renesting

Activity during the renesting (re-laying) period, following removal or loss of first clutch, was strikingly different from that during an initial laying (Figure 2). During renesting, the pair spent somewhat more time preening; the female, about half the time feeding. This decreased daytime feeding is not easily understood, unless renesting females actively fed throughout the night, a distinct possibility from early summer all night observations. Krapu (1974) found that renesting female Pintail *Anas acuta* weighed 25% less than their prenesting condition (presumably due to loss of fat reserves during initial incubation). This would increase the dependency of the renesting female on available food and should result in increased not decreased feeding.

Feeding patterns

Mandarins utilized a variety of feeding techniques but were predominantly surface feeders and grazers (Table 2). The specific nature of their food was difficult to determine without stomach analysis, but some con-

Table 1. Mandarin feeding patterns, based on the proportion of birds engaged in each type of feeding at ½-hr intervals during 1973.

		Feeding type						
	no. ½ hr observ.	graze	surface feed	fish	tip-up	corn	in-sects*	♂ alert
Pre-laying (4th–20th Apr.)	56							
males		15	37	0	5	5	0	38
females		16	35	0	7	6	0	36
average		16	36	0	6	6	0	37
Laying (21st Apr.–10th May)	100							
males		26	30	0	2	7	5	32
females		25	43	2	4	8	6	12
average		25	37	1	3	8	6	21
Post-incubation (11th May–10th Sept.)	115							
males		31	37	0	2	10	2	18
females		31	42	2	4	11	2	8
average		31	40	1	3	11	2	13

* Insects—from leaves or air.

Table 2. Percent time spent in various activities during two morning and three evening inattentive periods by a Mandarin pair during the incubation period, spring 1973. Data are based on the number of minutes spent by each bird of the pair in each activity.

	Percent time									
	morning						evening			
	2nd week		4th week		1st day		2nd week		4th week	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Feeding (total)	9	37	35	69	41	81	6	40	15	41
aquatic	0	20	0	34	0	32	0	12	0	0
graze	9	9	35	31	36	38	0	22	15	38
corn	0	8	0	4	5	11	6	6	0	3
Loaf or alert	63	31	21	0	20	0	33	0	29	0
Preen	12	15	32	23	14	11	49	40	35	51
Swim or walk	15	17	13	8	25	8	12	20	21	8
Duration of inattentive period (min)	65		120		56		85		143	

clusions seem possible. Mandarins generally fed during the early morning and late afternoon. The feeding activities of individuals of a pair during the spring and the flock during the summer were closely related. Feeding patterns were most influenced by changes in social activities, particularly the onset of nesting. Surface feeding occupied a far greater percentage of the day during spring. Birds swam along the shore and among algae mats, presumably picking at both vegetation and invertebrates and snapping at those insects that flew up. During terrestrial grazing they also seemed to search and pick, again probably taking both vegetation and invertebrates.

Morning and afternoon feeding patterns differed. While off the nest during the morning females surface-fed, presumably on aquatic insects, as reported by Swanson and Sargeant (1972), and also grazed. However, in evening feeding 67% of 140 minutes for the three observations were spent grazing; only 21% surface feeding.

The change in over-all feeding patterns from 50–90% surface feeding during pre-laying and laying to 27% during incubation supports the observations of Holm and Scott (1954) and of Swanson & Nelson (1970) that breeding females require high protein diets and consume a much greater proportion of aquatic invertebrates before and during egg-laying. A shift from morning surface feeding to evening grazing, also evident during early spring, presumably resulted in greater inconspicuousness and hence reduced susceptibility to predators during a time when large owls were highly active.

During June members of the flock rapidly zig-zagged across the surface, apparently catching emerging insects. I have never seen them dive for food, although Savage (1952) indicated that it infrequently occurred. Corn was provided for all ducks on the estate but was eaten for only a few minutes each evening by Mandarins and was a relatively minor part of their diet. Savage (1952) reported that in England Mandarins prefer beech mast, acorns, and chestnuts.

Night-time patterns

During the post-incubation and pre-basic moult periods, Mandarins entered the lakes at dusk and fed either actively or intermittently until 22.00 (Figure 4). They swam slowly or quietly along the shoreline, picking among the algae mats and occasionally snapping at emerging insects. One pair of Mandarins continued to feed with Chiloe Wigeons *Anas sibilatrix* and Australian and European Shelducks *Tadorna tadornoides* and *T. tadorna* as late as 02.00 on 4th June, but all feeding had stopped by 24.00 on 1st July. These observations, their similarity with dusk surface-feeding patterns of 1973, and night-time feeding observations on other waterfowl by Swanson & Sargeant (1972), indicate that Mandarins probably fed actively until early morning during the spring.

After feeding, the birds floated, heads drawn in and bill forward, concealed under the over-hanging shoreline vegetation. This was a different position from the head-tucked posture characteristic of most sleeping waterfowl (Johnsgard 1968), and from that of Mandarins sleeping on the shore, and may have been an alert resting position. (Our mortality data showed the Mandarins were most susceptible to predation during the

night, particularly prior to and after nesting.) Females did not leave their nests at night and their pair-drakes stood or swam near the nest throughout the night, as late as the third week into incubation.

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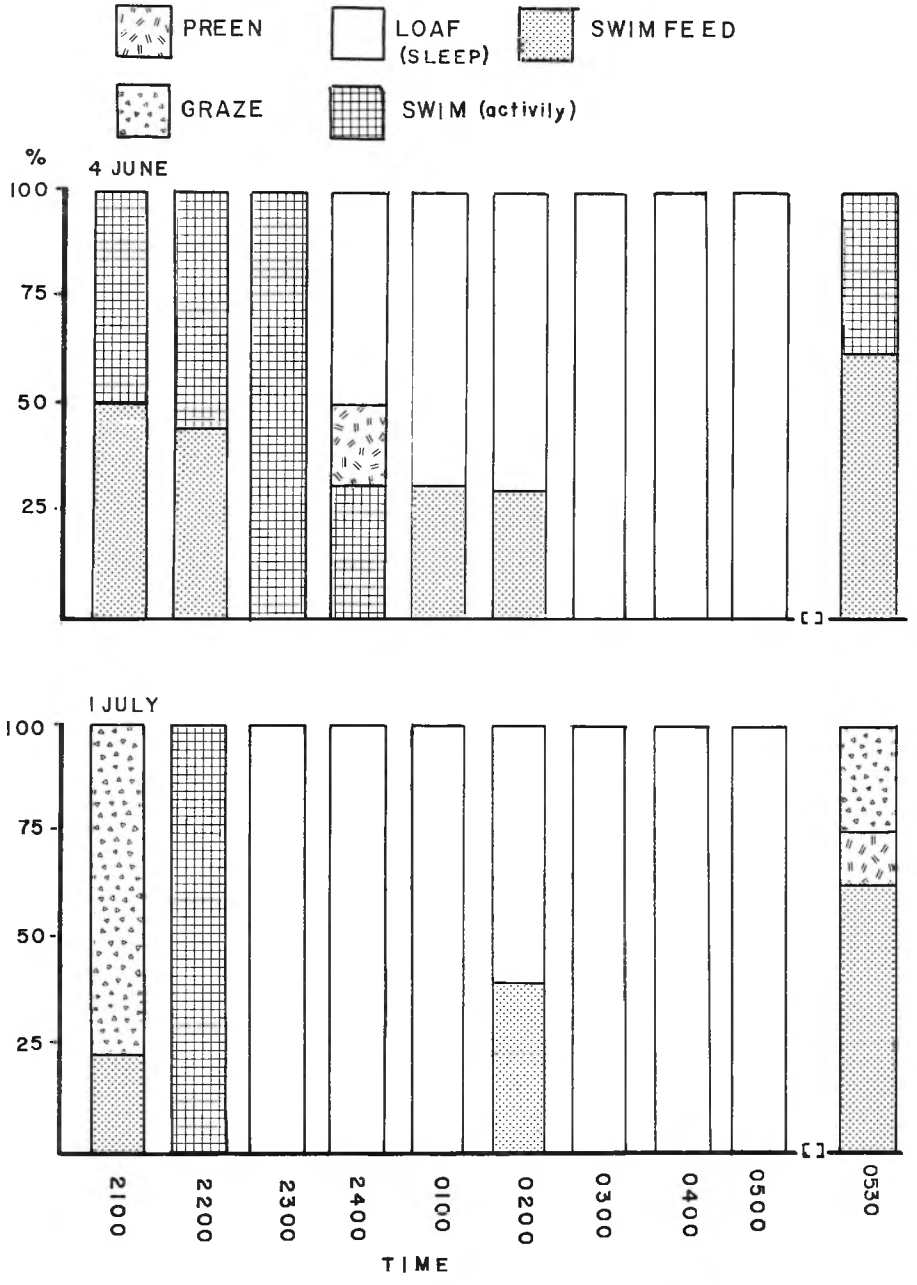

Figure 4. Night-time activity patterns of 5–8 Mandarins observed during the post-incubation (4th June) and pre-basic moult (1st July) periods 1974. Based on proportion of birds engaged in each activity at ½-hr intervals.

R. J. Greenwood, Northern Prairie Wildlife Research Center, Jamestown, North Dakota, for providing the nasal-saddles. The Starlight Night Vision Scope was provided by the Night Vision Laboratory, Ft. Belvoir.

Summary

The daily activity patterns of free-ranging, pinioned Mandarin Duck *Aix galericulata* consisted of repetitious feeding, preening, and loafing with variations related to the different social periods.

Diurnal activity rhythms were obvious only during the summer and fall when the birds fed and preened during the morning and late afternoon and loafed the rest of the day. Renesting time budgets were different from those on the initial nesting period, the females preened more and fed less.

Females spent 8 hours/day feeding (primarily surface feeding); their mates, considerably less. These instead remained alert, presumably reducing harassment to the female by other males and allowing her to feed extensively. During incubation females were on the nest 80% of the day and all night. They generally had pre-dawn and dusk periods off the nest each day. Males threatened conspecifics and waited for their incubating females at loafing spots (often in view of the nest) throughout incubation and attended them when they were off the nest, when the females fed 90% of the time, preened, and bathed.

Mandarins surface-fed, grazed, tipped-up, and caught fish and flying insects. The general feeding patterns changed during the day (swim-feeding in the morning and grazing in the evening) and during the season (from nearly exclusive surface feeding in pre-laying to only one-third in incubating periods).

Preening sessions nearly always followed bathing and feeding. Preening was greatest during the pre-basic and pre-alternate moults and after assuming the alternate plumage. Intense preening during the first two periods undoubtedly was related to irritation of feather replacement; during the latter period, perhaps to pairing.

During the summer evening Mandarins entered the lake and swim-fed along the shoreline until 22.00. After feeding they floated alertly, concealed under over-hanging shoreline vegetation the remainder of the night. One pair, however, continued to feed until 02.00. Night feeding also may occur during the laying and renesting periods.

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