

Diurnal activities of Green-winged Teal and Pintail wintering in Louisiana

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Introduction

The main aim of this study was to elucidate the distribution pattern of surface feeding ducks within a given wintering area in Louisiana, USA, their most important diurnal activity rhythms on the resting grounds and their nocturnal feeding dispersal. The Louisiana marshes were selected because of their large acreage and of the abundance of waterfowl. American Green-winged Teal (*Anas crecca carolinensis*) were chosen in order to provide a comparison with a previous study on European Green-winged Teal *A. c. crecca* wintering in the Camargue, France (Tamisier 1972b, 1974). Observations on Pintail *A. acuta* were added since both species have several ecological and behavioural similarities.

Study area

The Louisiana coastal marsh extends over about 16,000 km² mostly on the western side of the Mississippi River Delta on the Gulf Coast (Figure 1). Its geographical formation, its soil and water composition and its main phytosociological features have already been analysed (Chabreck 1972; Kniefen 1968; Jinton 1968; Lytle 1968; Palmisano 1970). The Louisiana coastal region is one of the

most important North American duck wintering grounds: estimated numbers are at least two to three million dabbling ducks (mostly Mallard *A. platyrhynchos*, Green-winged Teal and Pintail) and one million diving ducks (mostly Lesser Scaup *Aythya affinis*) in addition to several hundred thousand geese (Blue and Snow Geese *Anser caerulescens* and White-fronted Geese *A. albifrons*) (Bateman 1974 and pers. com.; Lynch 1968; Smith 1961).

The study area extends over c. 3,000 km² including very shallow (60–80 cm) fresh to salt water marshes and two large lakes. The fresh and intermediate marshes have a very plentiful plant coverage (69 to 80%) of *Spartina patens*, *Sagittaria falcata*, *Panicum hemitomonum* and *Alternanthera philoxeroides* (Chabreck 1972). The marsh area is limited northwards by wet pastures and agricultural fields, mostly ricefields which are flooded during several of the winter months, and supply valuable waterfowl resources (Bardwell 1962; Junca 1962). The marsh area itself is considered as a good feeding ground (Jemison and Chabreck 1962; Kimble and Ensminger 1959) provided the previous summer conditions were dry enough for grass plants to grow and germinate (J. Lynch and J. Valentine, pers. com.).

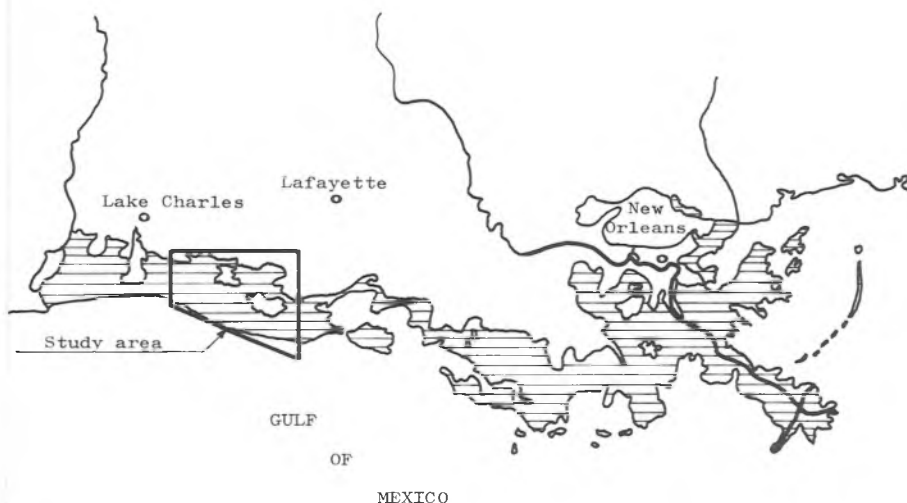


Figure 1. The Louisiana coastal marshes that extend over 16,000 km² constitute one of the best winter quarters for North American ducks. (Map after Chabreck 1972).

During the 1973–1974 season, the non-shooting zones of Lacassine Refuge and a large private hunting club (Pan American Hunting Club), both located within the study area, contained some of the best duck concentrations in the Louisiana marsh. Both areas have an artificial fresh water pool. Pan American Pool is 2.4 km² and its water-level, controlled by a pumping station, is usually low enough to provide wide, slightly sloping, beaches. It was drained at the end of October 'to prevent the ducks from overexploiting the food natural resources' according to the pool's manager. Lacassine is a permanent pool (1 m deep) extending over 6.4 km² and almost completely covered with floating vegetation (*Brasenia schreberi*, *Nymphaea odorata*, *Bacopa caroliniana*, *Nelumbo lutea*). Emergent plants consist mainly of *Panicum hemitomum* and *Sacciolepis striata* (Fruge 1974; J. Valentine, pers. com.). The soil is nowhere emergent except on some artificial levees. In late autumn and winter, many floating plants die and sink, usually leaving two large open water areas that constitute preferred gathering areas for the ducks. The dead leaves and stems with the bulbs and rhizomes make a very thick mass of organic matter which remains 'half-floating' below or close to the water-level.

The Louisiana climatic conditions are 'sub-tropical humid' (Kniefen 1968) and the 1973–1974 season had an abnormally rainy late summer and autumn (so that most of the marshes never dried out) and a mild winter with a rainy January followed by an early spring.

Methods

Aerial waterfowl counts were made to find both the distribution and the total number of Teal and Pintail present. Many additional data were obtained, mostly from S. Woodson's personal flights.

Activity rhythm analyses were made on ducks on their resting grounds according to the method previously used in the Camargue (Tamisier 1972a). Four main types of activity were recorded: preening, sleeping, swimming (including displaying), and feeding. At least every 15 minutes from sunrise to sunset without break, the percentage or actual number of ducks behaving in each of those ways was recorded. Then these numerical values were transcribed into time values. If 50% of the group under observation is feeding for one hour this is equivalent to 100% feeding for half an hour. Hence the actual number of hours spent by the ducks in every

activity was calculated for the whole day. Meanwhile the precise distribution of ducks according to their activities on the resting area, the sex-ratio, and every local movement was recorded. The time, nature and duration of disturbances were also measured, and the number of ducks involved. From October to February 162 and 185 hours (20 and 22 days) of observations were devoted respectively to Green-winged Teal and Pintail activity analysis.

Observations were made both on morning and evening flights around the resting grounds. As in the Camargue, data on the evening flights are more reliable since in the morning many ducks return to the resting area before first light and cannot be counted. Moreover frequent fog hid and disturbed timing and directions of morning flights. A total of 47 evening and 25 morning flight observations were made from the main concentration areas on both species.

Sunset and sunrise times were obtained from Standard Time at Lake Charles Louisiana (Nautical Almanac 1965), minus two minutes for Lacassine Refuge and minus three minutes for Pan American Hunting Club.

RESULTS

1. Number fluctuations (Figures 2 and 3)

Transient ducks, mostly Blue-winged Teal *Anas discors* were already numerous in late August, concentrated (ca. 100,000) first at Pan American (S. Woodson, pers. com.) then in late September and October at Lacassine Refuge (30,000 to 50,000). Nearly all the Bluewings left the study area in mid-October and came back in numbers in April. The first concentrations of Green-winged Teal appeared at the northwestern part of Lacassine Pool (NW Lacassine) in the beginning of November (30,000 to 50,000) and a little later at NE Lacassine and Pan American. Then the pool of Pan American was drained and only NE and NW Lacassine received large concentrations. A drastic drop occurred around the year-end, and many new Teal arrived for a short time in January (up to 80,000) leaving for their breeding grounds in the first two weeks of February.

Pintail arrived in two waves, the first in October at Pan American where they were pushed out (by draining) before the end of the month. These ducks left Louisiana probably to more southern wintering grounds. New Pintails started to arrive in November and used NE and NW Lacassine, as well as Pan

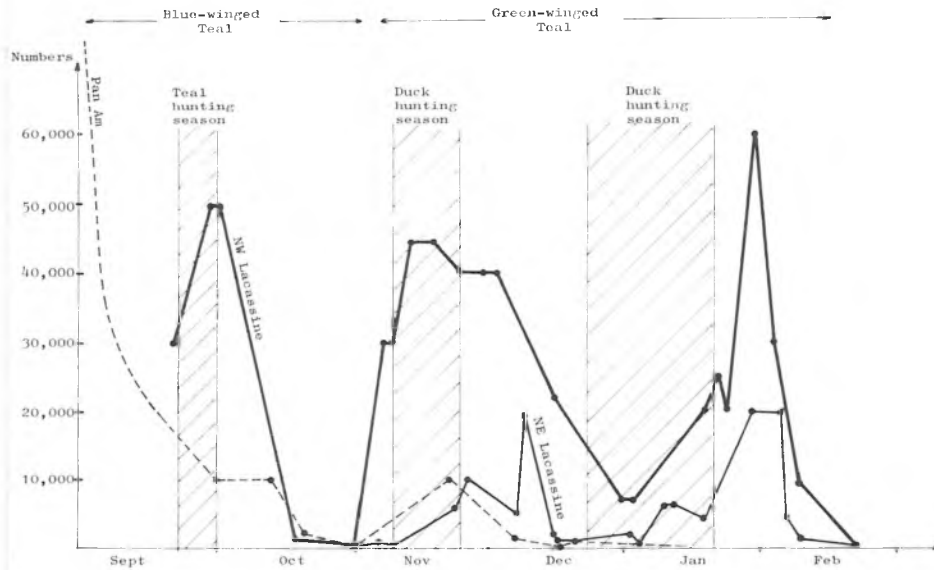


Figure 2. Fluctuations of Teal numbers in the three concentration places of the study area. No relation can be found between hunting periods and the gathering of Teal on the concentration area.

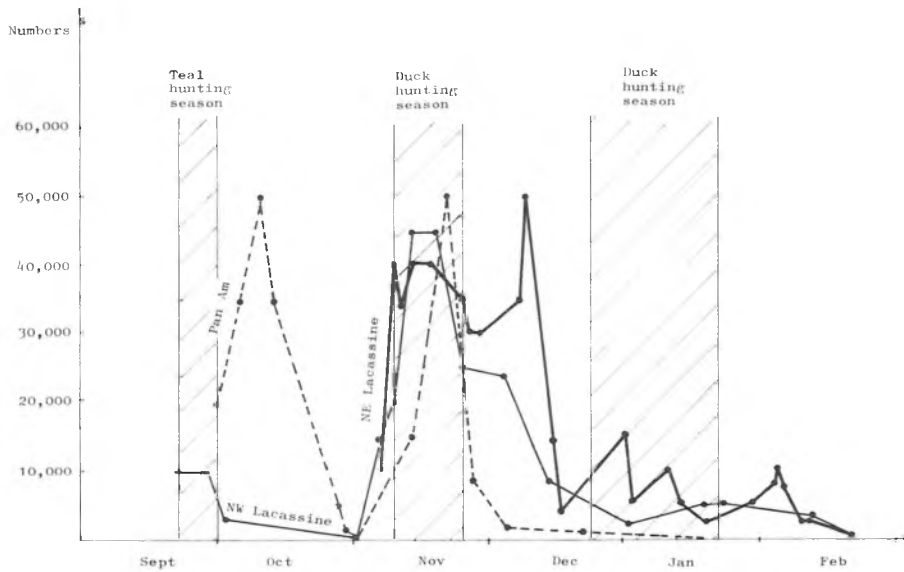


Figure 3. Fluctuations of Pintail numbers.

American which had partly refilled during two weeks of heavy rains. Nearly all these ducks seemed to have left the study area around December.

So the distinctive features of this migration are an important passage of migrating Blue-

winged Teal and Pintail in September-October, and a gap until the arrival of new ducks in the first weeks of November. This variation seems to have fairly reflected the situation in the whole study area, on an average 80 to 90% of the counted ducks were

gathered on the concentration areas. On some occasions, small groups (up to 3,000) used ricefields and other flooded agricultural fields.

General water-level influences the distribution. Permanent pools become more attractive for ducks as the other areas dry up. Nevertheless even when most of the fields and marshes are flooded, Teal and Pintail still gather on the concentration areas. During the first two weeks of December, while the whole area was flooded, nearly all of them were in Lacassine.

Hunting pressure is an important factor which can modify the natural distribution pattern. Disturbed ducks are generally thought to be attracted by quiet areas and choose the refuges and other safe marshes. But no trend for ducks to gather on these reserves during the shooting seasons was apparent (Figures 2 and 3), nor one for them to scatter at other times. The resting places were used throughout the winter season as soon as the ducks arrived, whatever the water-level or the hunting activities outside.

Sex-ratios

Homogeneous species groups show a high predominance of males. For Pintail, the sex-ratio was 2.57 males per female (number of observations $n = 11$, total number of ducks counted $N = 626$). It is a little higher than the 2.24 determined from the 1973 wing-collection survey in Louisiana (W. Crissey, *in litt.*). For Teal, the winter average was 2.89 ($n = 20$, $N = 1402$) but an important change occurred during the season. Until the first days of January, the value was 2.66 ($n = 14$, $N = 924$) and from 12th January to February it was 3.39 ($n = 6$, $N = 478$) indicating a replacement of the population. In fact, it should be related to the fluctuations in numbers (Figure 2); 2.66 applies to the first Teal sub-population, and 3.39 to the next one. And this second sub-population had a quite distinct general behaviour on its resting area (see below). Such male predominance is stronger than the 2.04 obtained from the 1973 wing-collection survey: the difference is probably due to females being more vulnerable to hunters than males (Bellrose & Chase 1950; Geis 1959). Moreover the sex-ratio obtained from direct counts is biased by several sex-specific behaviour patterns (Tamisier 1972a) and possibly also by females having a more randomized distribution pattern, being less attracted than males by the large concentrations (Tamisier 1974) and so more likely to escape observation (see below for variation of sex-ratios according to duck activities).

2. Teal behaviour analysis

A. Activity rhythms on the resting areas

Early in the morning the ducks fly to the resting areas where they spend the whole day. All the observations on large permanent concentrations (more than 5,000 and up to 50,000) are from NE and NW Lacassine except one from 'Plongee', a small pond near Gueydan. The first behaviour of Teal at the resting area is rarely recorded as it occurs in the dark. The commonest activity is probably swimming and preening for a few minutes, rapidly followed by sleeping (Figure 4). During the first two months, preening can be observed throughout the day and mostly in the afternoon. Later in the season it becomes scarcer and restricted to the last hours of the day. In rainy conditions preening lasts longer, starting soon after the first drops and continuing long after the rain stops. At this time oil-preening predominates and keeps the plumage waterproof. Likewise after a flight, even a short one, many Teal preen, probably in order to set their feathers.

Swimming occurs with a similar periodicity and involves sexual activity and social displays. Their duration is rather short and at any one time only a relatively few individuals are concerned. In many cases, swimming looks like an undefined behaviour, individual Teal slowly move from place to place before stopping again and sleeping.

Most sleeping and preening are performed when standing. The ducks choose floating vegetation thick enough to carry them. Large beds of *Bacopa caroliniana* are often used for this purpose, as well as the edges of *Sacciolepis striata* stands. There Teal face the sun head under the axillaries, and rotate on their feet in order to remain facing the sun throughout the day. On windy days Teal face the wind rather than the sun. Late in winter when open water is more extensive and when preening has become less important, Teal spend longer sleeping on the water, swimming to avoid being drifted by the wind.

Feeding rarely occurs by day on the big resting areas. It was not recorded for more than 5% of Teal at any one time. However it was always possible to find some ducks feeding among the emergent or floating vegetation. Most of the time, they feed on food or slowly swimming, head (and neck) below the water. Up-ending is rather rare and does not last for more than a few successive minutes.

On resting areas used by small temporary concentrations (up to 3,000 for one or two weeks), feeding behaviour lasts 0.9 hours per

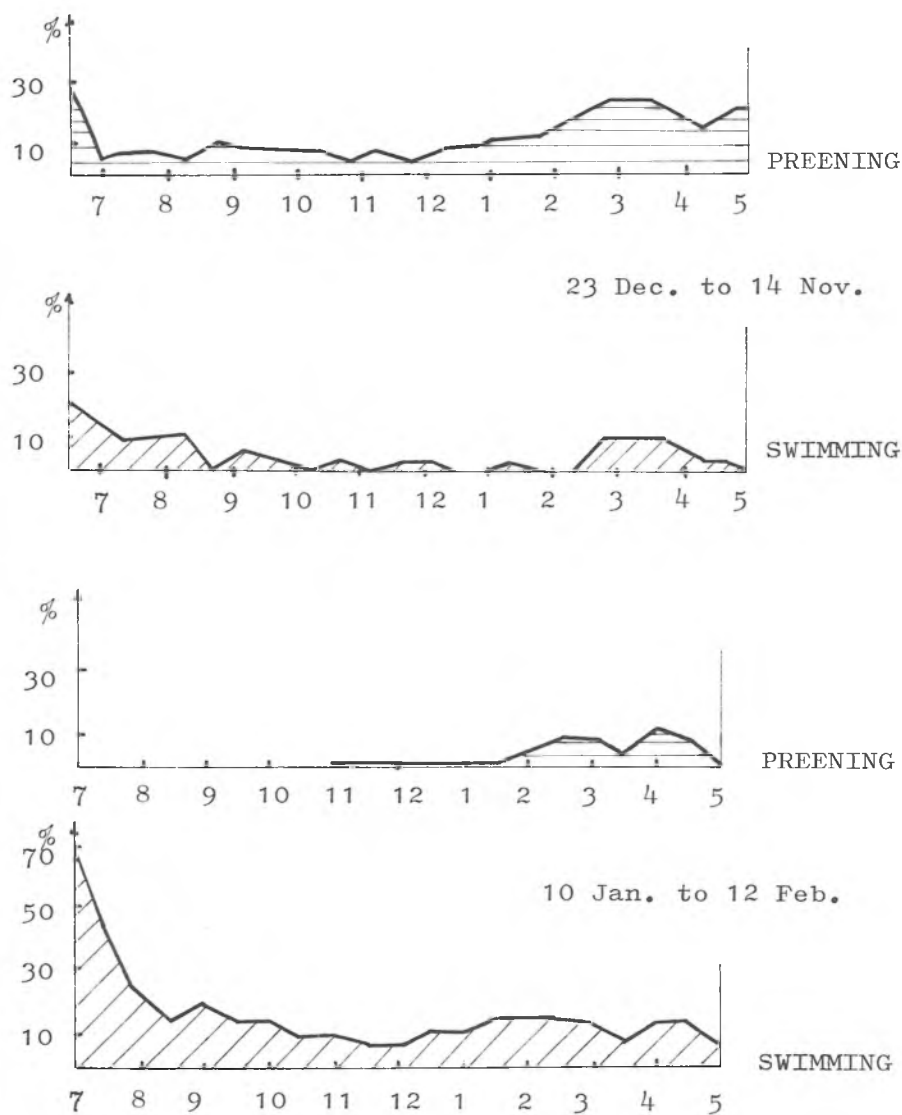


Figure 4. Daily periodicity of preening and swimming activities of Green-winged Teal.

day (obtained from only two days of observations at 'Les Ecrevisses', near Duson). Those individuals therefore might have higher energy requirements that are fulfilled in a few days. They then leave these locations and join the 'regular' concentration areas.

As already mentioned, only a small proportion of the wintering population are found in these lesser concentrations. Many single birds can also be found, and they probably have similar daily activities or even a longer daily feeding time. But when compared to the whole

wintering population, these separate groups or individuals have a minor numerical importance and their behaviour can hardly be considered as the general behaviour of wintering Teal.

Calls are heard almost constantly through the day with a maximum in the morning, soon after the arrival on the resting area. Both males and females call very frequently at dawn, though within two to three hours male calls are preponderant. Disturbances markedly increase the number of calls. A sudden

cessation of female calls generally precedes the flight off. Back on the water, males and females call again quite intensively for up to five minutes.

Since preening and sleeping ducks need some standing places, they look for thick masses of floating vegetation, emergent islands or slightly sloping beaches. At Lacassine, beaches are quite absent and standing occurs only on floating vegetation, recalling a similar behaviour of Garganey *Anas querquedula* in Mali and Sénégal (F. Roux, pers. com.). As this need for standing prevails throughout the day, the distribution of Teal follows that of the marsh vegetation. Swimming birds also very often choose those parts of the area where scattered floating leaves of *Brasenia schreberi* or *Nymphaea odorata* prevent them from being carried too far by the wind and shaken by the waves. Teal are more spaced on quiet days.

An analysis of the sex-ratio of distinct groups of Teal reveals a segregational distribution according to sexes. Standing ducks have a much higher percentage of females. At Lacassine from October to December, when the average sex-ratio was 2.66, standing Teal gave 0.44 ($n = 15$, $N = 508$). Again, in January and February, when the average sex-ratio was 3.39, standing Teal gave 1.73 ($n = 8$, $N = 374$). The trend recalls Camargue observations (Tamisier 1972a). It means that the areas where ducks can stand are much more attractive to females than to males (two to six times). Since standing Teal mostly preen and sleep, females appear to need to indulge more in these activities. Preening should be related to moult as the old feathers need to be removed and growing ones probably give some irritation. In the Camargue European Teal females have a longer moulting period than males (Tamisier 1974).

Likewise the sex-ratio of feeding Teal is rather lower, 1.78 ($n = 5$, $N = 295$). Females probably have higher energy requirements or they feed more on the resting grounds. Similar results were obtained in the Camargue (Tamisier 1972b).

The diurnal duration of all these activities (Figure 5) varies according to month. Preening is at its height in October (2.9 hours per day) and decreases to a minimum in January and February. In the Camargue Teal have their highest daily preening duration before visible moult (body feathers) reaches its maximum, when the new feathers have not yet grown but require some special care. With Green-winged Teal, the longer duration in October has probably the same significance.

Swimming lasts less than one hour per day

until January and occurs mostly when regrouping after disturbance, when some display sexually and show social excitement by jumping into the water and diving (Johnsgarc 1965). After January, sexual displays become longer, more frequent and involve many more Teal. Thus swimming, which includes displaying, increases markedly to 2.9 hours a day. The last observations of February, made on a new population of ducks, revealed very little swimming and sexual displaying, mostly sleeping. Those Teal reached Louisiana right after a local heavy rain period and bad weather conditions in the northern States (Alabama, Arkansas, Missouri). They may have come from the latter states where the usual colder climate had kept them sexually inactive.

Sleeping is the most extensive diurnal activity, lasting between 7.3 and 9.2 hours per day, more than 70% of the time spent on the resting area. There is little variation and the highest value in February may be related to the physiological conditions of those new and weary ducks coming from the north.

B. Disturbance and local flights

Teal are prey for some predatory birds. They are very sensitive to any disturbance and react by flying. During the 20 days of observations, a total of 115 disturbances was observed and their importance was estimated (Table 1). The first response reaction of Teal to the sight of a predator is to move to the open water area where they swim together in denser flocks than usual, and fly off when necessary. Marsh Harrier *Circus cyaneus* was the predator most frequently involved (4.2 times per day). Since on average 18% Teal fly off for every Harrier's passage and the disturbance lasts 24 sec., therefore every day 76% of the whole Teal population have to fly for a total period of 101 sec. because of this predator.

Ducks can be disturbed by large Gulls too (Herring Gull *Larus argentatus* and Ring-billed Gull *L. delawarensis*) even though these birds are not hunting. Man (walking, or in a plane or a truck) causes Teal to react in larger numbers (60%) and for longer (42 sec.).

Flights also occur without any apparent cause, but become more numerous as disturbance flights increase.

C. Feeding dispersal

(a) Evening flights

At the end of the day, all the ducks of the resting area fly off to their nocturnal feeding

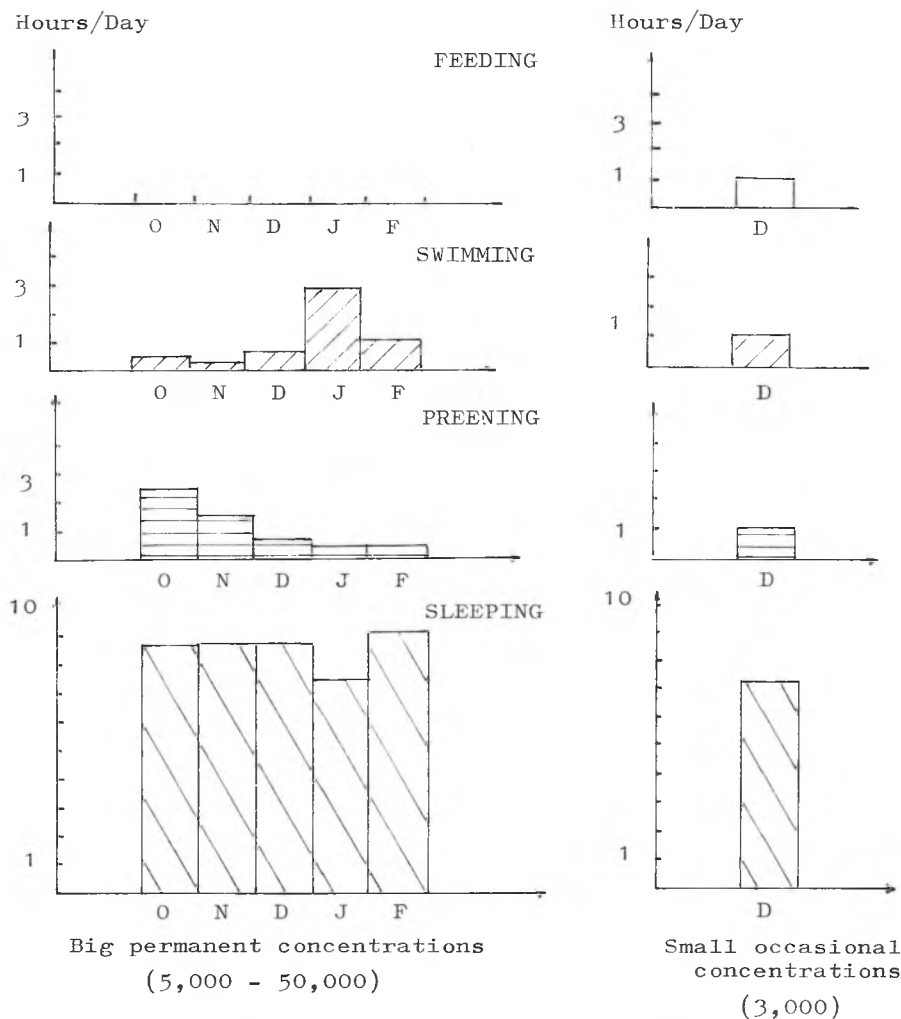


Figure 5 Mean duration of daytime activities of Green-winged Teal, showing monthly variation. Sleeping is main activity. Preening is important at the beginning of the season. Feeding occurs only on the small occasional concentration areas.

Table 1. Nature and importance of disturbances on Green-winged Teal at the resting areas.

	Total number observed	Mean no. per day	Mean % of Teal in flight	Total % of Teal in flight/day	Mean duration (sec.)	Total duration per day
Marsh Harrier	84	4.2	18	76	24	101
Gulls	13	0.7	15	10	12	8
<i>Falco</i> and <i>Buteo</i> spp.	2	0.1	29	3	20	2
Misc. (man, plane, etc.)	16	0.8	60	48	42	33
Total disturbances	115	5.8	24	137	25	144
Unexpected flights	20	1.0	31	31	34	34

grounds. Timing (related to sunset) and directions of these flights were the main aspects analysed (Figure 6). The birds left about 25 minutes before complete darkness. This relation held good though sunset varied from 18.05 in late September to 17.12 in December. The whole population of the resting area left in less than 20 minutes. Almost every evening more than 50% passed over within a five-minute period. Disturbance from hunters did not affect this timing. Weather conditions, on the contrary, were very effective (Hochbaum 1955; Tabberer *et al.* 1971; Tamisier 1966). Cloudy sky, rain and wind made the flights earlier. When the moon was up at sunset and large enough to lighten the night, all the flights were postponed some minutes.

The flight directions are summarized on Figure 7. At the beginning of the season, when only the northwestern part of Lacassine was used by Teal (mostly Bluewings and a few Greenwings) 60% left northwestwards, and only 10% to east-north-east. Apart from the first days of November, both NE and NW areas were used by Greenwings. Flight paths were very narrow, as 90% of the whole population used the same line (west-north-west from NW Lacassine, and north-east from NE Lacassine). Meanwhile fewer Teal left the western area to fly east-north-east. From

January to February, this direction was completely abandoned. Southwards flights never occurred. Blue-winged Teal resting at Pan American during September and October had a very restricted and constant northward direction.

Throughout the season, no Teal leaving one resting area had to fly over the other. Likewise excepting the very small numbers involved in east-north-east direction (in November and December), Teal belonging to one resting area did not meet Teal belonging to the other. Their flights did not converge to the same feeding grounds.

(b) Morning flights

It appears that about 90% of Teal were on the resting area itself 20 to 30 minutes before sunrise. Hunting had no apparent effect on the timing of these flights. Flight directions were opposite to those of the evening flights, indicating that Teal leaving the area returned to it on the next morning. But the directions were not so narrow as at nightfall. Ducks leaving to the east-north-east on the evening returned at dawn from east through to north-east.

(c) Feeding grounds

The exact location of the feeding grounds is

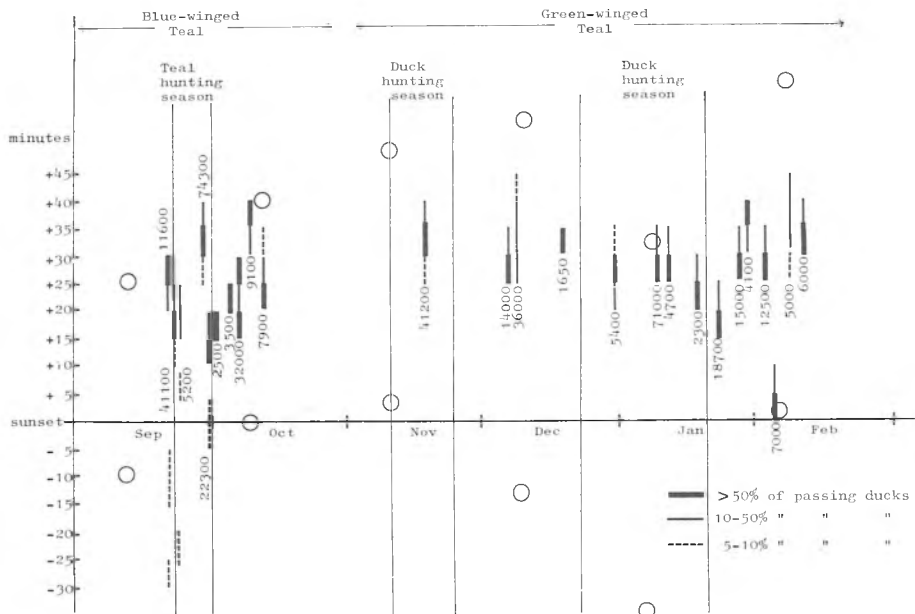


Figure 6. Timing of the evening flights of Teal. Numbers indicate the size of total flights per day. Open circles indicate the time of moonrise.

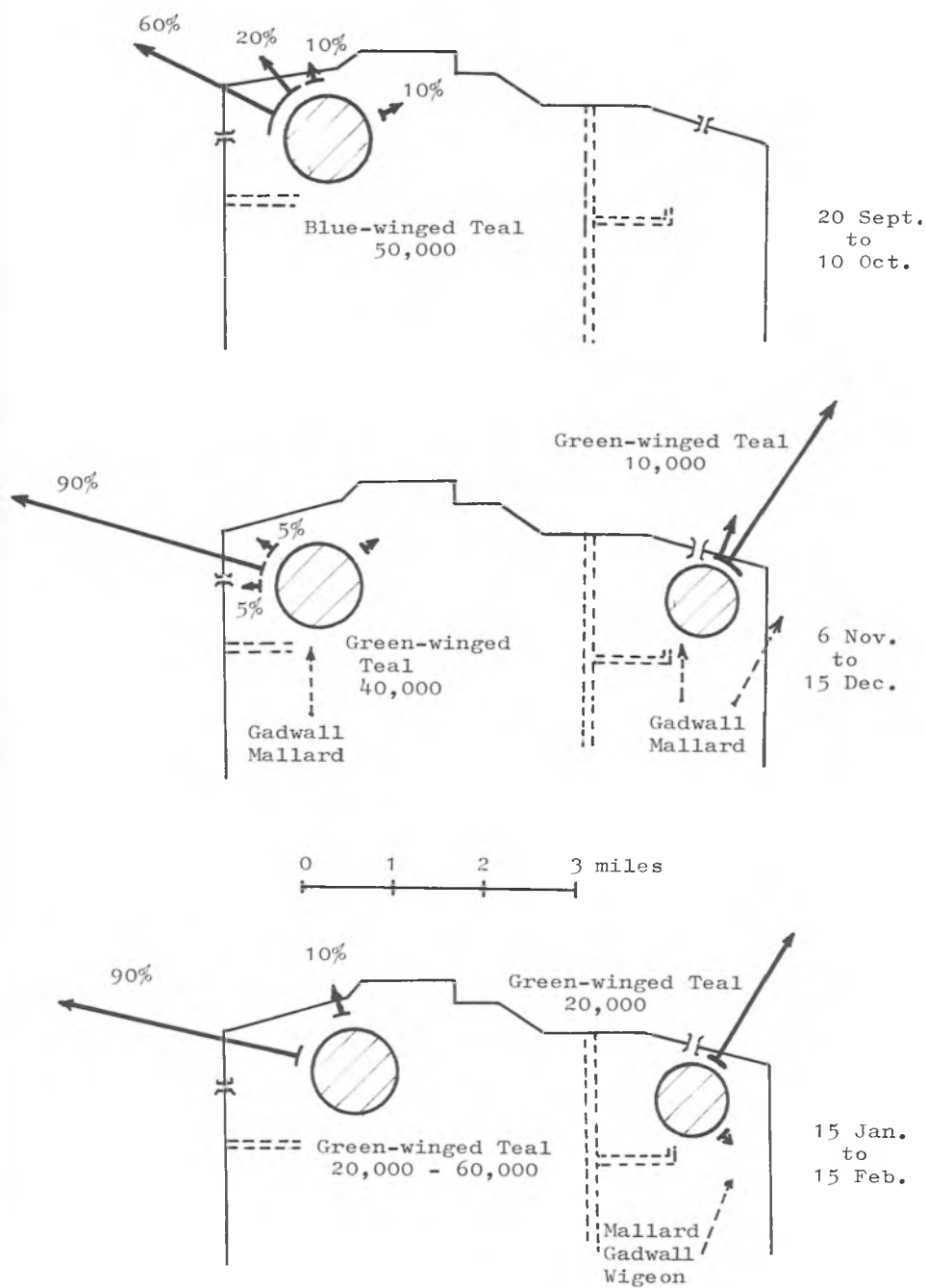


Figure 7. Directions of the evening flights of Teal from Lacassine Refuge. Teal leaving both NE and NW Lacassine have quite distinct directions and do not cross each other.

not known. They are within an agricultural area, where rice-fields are predominant and remain flooded for several months. Because of their physical condition (water-level, light texture of the soil) and of their important food content (Davis *et al.* 1961; Harmon *et al.* 1960), they are favoured feeding grounds for Teal (Bardwell 1962; Dillon 1957). During the 1973–1974 season, these grounds were very little disturbed except by moderate hunting at crepuscular hours. Soybean fields or pastures were also used whenever they were flooded. Therefore the precise locations where Teal feed could change according to waterlevel. But throughout the season, the flight directions were rather constant and could not be related to the appearance of a recently flooded locality.

The time spent on the nocturnal feeding grounds varied from 11.0 to 12.5 hours per day (Figure 8), the lowest value occurring in October and the highest in December. Comparison with Camargue data show that Teal presumably had time enough for feeding during these months.

3. Pintail behaviour analysis

A. Activity rhythms on the resting areas

Pintail like Teal mainly use large permanent concentration areas and also smaller temporary ones. Close similarities were found between the activity rhythms of these species. On the permanent concentration areas (10,000 to 50,000 ducks) in October preening is fairly important. An activity peak occurred early in the morning (07.00 to 08.00). Ducks often alternate some sleeping and preening phases, while nearly always standing and facing the sun. During the hottest days of

October, instead of sleeping head under the axillary feathers as they usually do, they sun-bathed, keeping the head above the breast and gasping. After November, most preening took place in the afternoon. Like Teal, Pintail spend several hours standing close to or in shallow water. A good example was a flooded ploughed field where all 3,000 Pintail were standing on the top of the furrows, looking like swallows on a wire.

Pintail usually swim after their arrival on the resting area, but this lasts only a short time. It is rare for all the ducks to swim together, except in case of a disturbance or when they perform a social excitement behaviour—fast swimming, flying off, jumping and splashing mixed with sexual displays.

Calls, mostly by males, are rather irregular and more frequent early in the morning or late in the afternoon. They increase markedly as soon as Pintail are aware of a potential danger (e.g. the sight of a predator) and last long after it disappears.

The mean durations of these activities (Figure 9) are reminiscent of those of Teal. Preening lasted as much as 3.6 hours per day in October, probably a consequence of moult. Feeding only occurred in some small groups and lasted only a few minutes. Although the sampling is fairly small ($n=3$, $N=113$), females were more often seen food-searching than males, the sex ratio being 0.97 against an average 2.57. As for Teal, female Pintails probably have higher energy requirements. On smaller concentration areas (up to 3,000) Pintail spent almost four hours feeding per day in November and December.

Throughout the day, about 50 to 80% of the ducks are standing on emergent places (levees, slightly sloping shores, floating

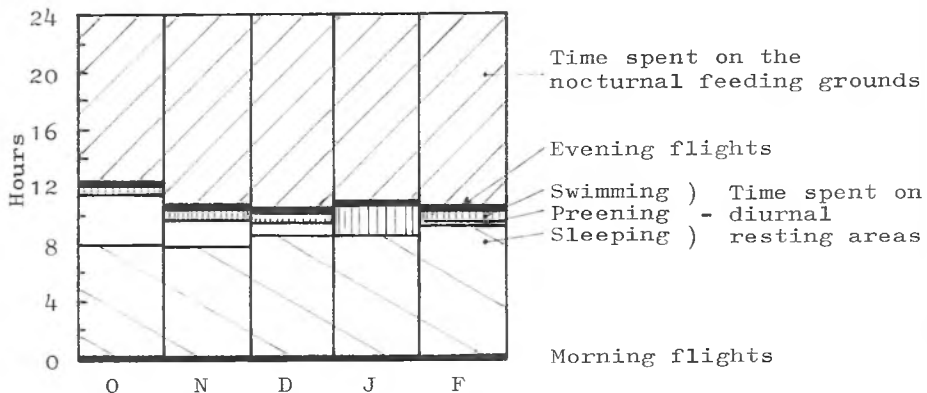


Figure 8. Mean duration of the time spent by Teal on diurnal resting and nocturnal feeding grounds.

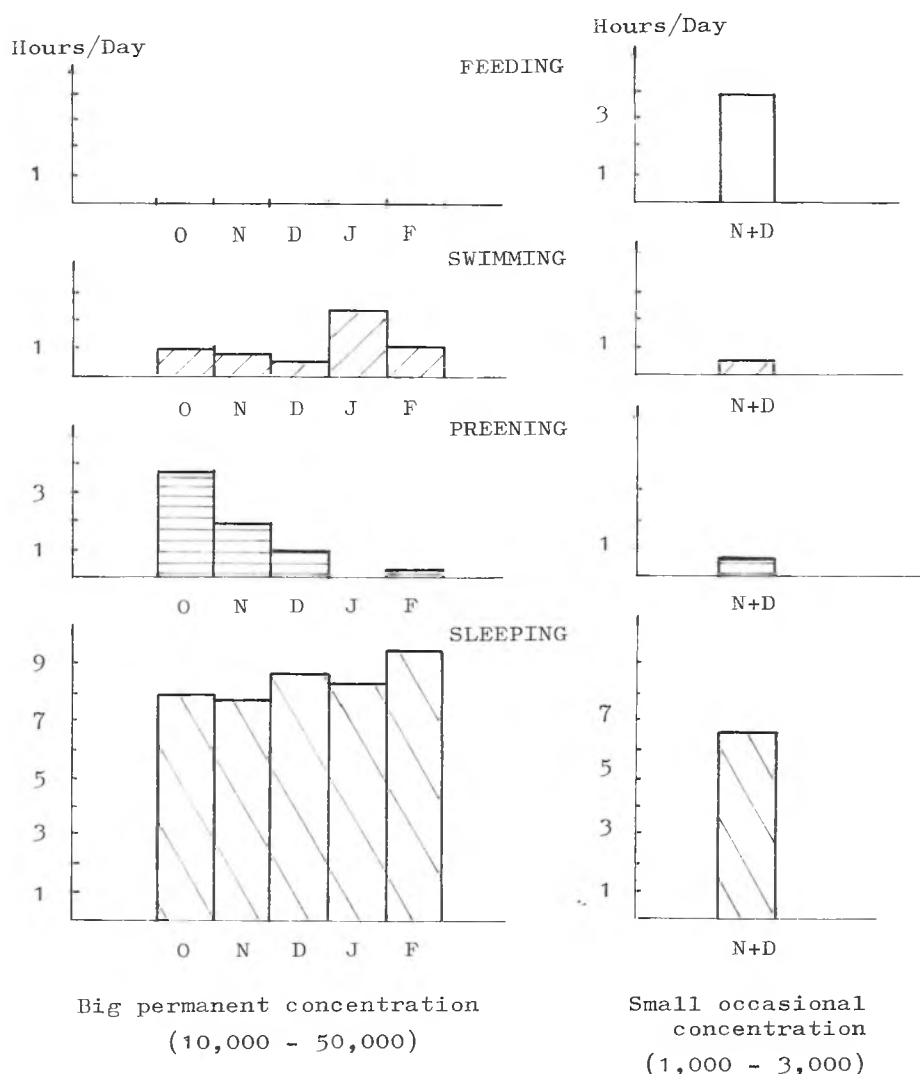


Figure 9. Mean duration of day-time activities of Pintail, which, as for Teal, feed only on the small concentration areas. On the big permanent ones, Pintail mostly sleep.

organic matter). Like Teal they often choose very shallow locations, for immediate proximity of water seems to be a requirement for preening.

Intra- and inter-specific competition

Intra-specific competition took place more often among Pintail than Teal. Densely-flocked Pintail chased each other when the inter-individual distance became too short, probably because of a lack of standing room. As the same resting areas were used by both

Pintail and Teal, inter-specific competition might also occur. Detailed observations from NE Lacassine showed that as long as Pintail were alone, they occupied the whole area. After the arrival of Teal, both species used distinct areas. Pintail rested closer to extended beds of emergent Graminae. Teal were more localized near several holms of floating organic matter. When flocks were mixed, one species was usually more abundant. Either specific requirements differed, or use of distinct areas avoided a direct competition for space.

Table 2. Nature and importance of disturbances on Pintail at the resting areas.

	Total number observed	Mean no. per day	Mean % of Pintail in flight	Total % of Pintail in flight/day	Mean duration (sec.)	Total duration per day
Marsh Harrier	44	2.0	16	32	29	58
Gulls	3	0.1	4	0.4	43	4
Peregrine Falcon	9	0.4	8	3	19	8
<i>Buteo</i> spp.	3	0.1	15	2	17	2
Misc. (man. plane)	16	0.7	41	29	27	19
Total disturbances	75	3.3	20	66	20	66
Unexpected flights	40	1.8	19	35	32	58

B. Disturbance and local flights

Bird predators were less disturbing to Pintail than Teal in both frequency and mean duration (Table 2). The same was observed in Senegal (R. Mahéo & F. Roux, pers. com.) and may indicate a better adaptation of Pintail to its natural predators (R. I. Smith, *in litt.*). Peregrine Falcon *Falco peregrinus* presumed to be hunting, were observed on two occasions when about 2,000 Pintail flew off on sighting the raptor, were pursued by it and suddenly landed on the water so as not to be caught. This behaviour reflects the conflict situation of the ducks. It would be more efficient for Pintail not to leave the water, but they take wing in front of a Peregrine as they do with any other predator bird.

As for Teal unexpected flights should be related either to disturbance or to a search for better conditions. At Pan American, when the water level was too low, Pintail flew throughout the day from one to another part of it looking for a deeper area.

C. Feeding dispersal

(a) Evening flights

It took generally 20 minutes for all the Pintail to leave and they were less densely flocked than Teal. Generally Pintail left first and Teal a few minutes later. No relation could be found between their departure time and the shooting periods. The moon brightness at nightfall was efficient in postponing the departures of Pintail some minutes, and windy, cloudy or rainy conditions made the flights earlier.

Flight directions from the resting area were rather constant throughout the season. Pintail from NW Lacassine flew northwestwards. None flew either eastwards or southwards. Pintail resting at NE Lacassine flew

northeastwards on a quite narrow route. As for Teal, the flights from the two concentration areas did not cross each other. Pintail at Pan American had a regular northeastern flight direction. So Teal and Pintail had the same flight direction from only one resting area (NE Lacassine). Elsewhere the flight pattern radically differed in direction, leading the two species to distinct feeding grounds.

(b) Morning flights

Pintail usually returned to the resting ground 10 to 40 minutes before sunrise. Many others would arrive in complete darkness when only the wing whistling could be heard. On occasion some returned much later, up to half an hour after sunrise. On the whole, returning flights of Pintail lasted a long time, and their directions were not as precise as in the evening.

(c) Feeding grounds

Teal and Pintail used to feed in quite similar areas, ricefields and other flooded agricultural fields. Marshes were very little used. However most of the time each species reached different feeding grounds within these areas, avoiding a direct competition for food. Oesophagus and proventriculus analysis (Bardwell 1962) showed that both species wintering in Louisiana have a very similar diet when feeding on the same area (see also Wills 1971).

The time spent on the feeding grounds varied from 11.3 to 13.2 hours per day (Figure 10), so Pintail spent about half an hour longer on the feeding grounds than Teal. That might be related to higher energy requirements, as Pintail are two to three times larger, or to a lower efficiency of feeding if the time is devoted completely to feeding.

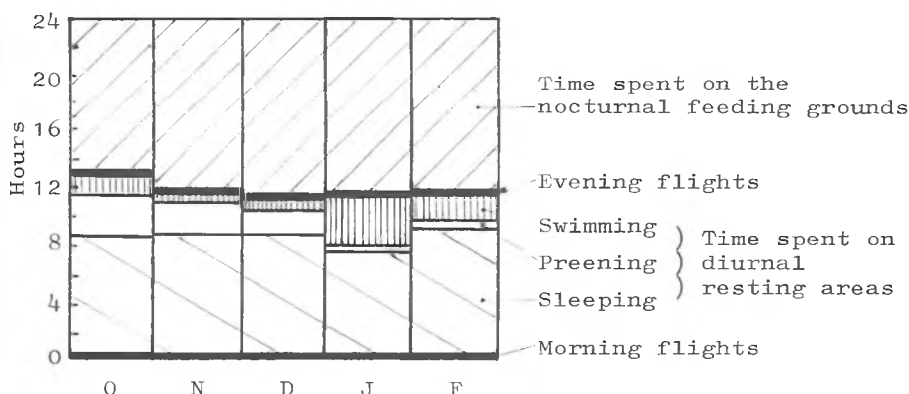


Figure 10. Mean duration of the time spent by Pintail on diurnal resting and nocturnal feeding grounds.

Conclusion

These observational data from Louisiana are quite similar to those obtained from the Camargue, which is one of the most important winter quarters of western Europe. They are reminiscent of many other observations on Pintail and Garganey in Senegal and on European Teal in Iran, where dabbling ducks have exactly the same diurnal and nocturnal behavioural patterns (Tamisier 1972b). They also recall very old data of the first European naturalists (Brehm 1868; de Buffon 1788). In Senegal and Iran very little hunting occurred and cannot be a responsible factor for the two-fold activity. This implies that both the diurnal gregarious behaviour and nocturnal feeding are more a fundamental requirement of wintering dabbling ducks than an adaptation to hunting or to any other human disturbance.

For the present this conclusion leads to some practical suggestions. Managing a resting area for wintering ducks does not mean providing them with food, since feeding is not a regular diurnal activity. There are examples of resting grounds having concentrations of several tens of thousands of ducks but no feeding opportunities. Probably the primary requirement by day is large open areas in which the ducks can stand in flocks close to the water. This is probably best met by slightly sloping beaches, so that whatever the water-level, there is a broad strip of shallow water and emergent ground. Providing such physical conditions within a traditional winter quarter should be a good way of building a diurnal resting area for large concentrations of ducks. Feeding areas must, of course, be available in the neighbourhood.

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Summary

Observations were made on American Green-winged Teal *Anas crecca carolinensis* and Pintail *A. acuta* wintering in Louisiana. Both species flocked by day in very large concentrations (up to 80,000 ducks) on some restricted resting grounds, both during the hunting periods and at other times. Lesser concentrations lasted no longer than one or two weeks. Teal and Pintail mostly sleep, preen and swim during the day. Preening lasts two to three hours per day at the beginning of the season and is related to the moult. Sleeping is the longest diurnal activity (eight to nine hours). Both these activities are often performed by standing ducks, flocked on the borders of the resting area or on floating organic matter where they face the sun the day long. Feeding is an insignificant diurnal activity.

Timing and directions of the crepuscular feeding flights are fairly constant. Ducks reach the feeding grounds at night and return the next morning to the resting area.

These data are quite similar to those obtained in the Camargue, Iran and Senegal and can be considered as characteristic of wintering dabbling ducks. Hunting pressure cannot be considered responsible for that diurnal gregarious behaviour and nocturnal feeding activity. An important diurnal requirement is large open areas where the birds can stand and sunbathe in flocks.

References

- Bardwell, J. L. 1962. Nutritional analyses of Pintail and Teal foods in Southern Louisiana. Unpub. Master's Thesis. LSU Baton Rouge.
- Bateman, H. A. 1974. Periodic Waterfowl Population Estimates in Louisiana. Unpub. reports Louisiana Wildl. and Fish Comm. Baton Rouge.
- Bellrose, F. C. & Chase, E. B. 1950. Population losses in the Mallard, Black Duck and Blue-winged Teal. *Nat. Hist. Survey Biol. Notes* 22: 1-27.
- Brehm, A. E. 1868. *La Vie des Animaux illustrée*. Vol. 4. Paris: Baillière.
- Buffon, M. de. 1788. *Oeuvres complètes*. Paris.
- Chabreck, R. H. 1972. Vegetation, water and soil characteristics of the Louisiana coastal region. *Agr. and Mech. Coll. LSU Baton Rouge Bull.* 664.
- Davis, J. P., Thomas, C. H. & Glasgow, L. L. 1961. Food available to waterfowl in fallow ricefields of southwest Louisiana. *Proc. 15th Ann. Conf. SE Ass. Game and Fish Comm.*: 60-6.
- Dillon, O. W. 1957. Food habits of wild ducks in the rice marsh transition areas of Louisiana. *Proc. 11th Ann. Conf. SE Ass. Fish and Game Comm.*: 114-9.
- Frugé, D. 1974. The vegetation of Lacassine Pool, Lacassine National Wildlife Refuge, Louisiana. *U.S. Fish & Wildl. Serv. Mimeo rep.* 51 pp.
- Geis, A. D. 1959. Annual and shooting mortality estimates for the Canvasback. *J. Wildl. Mgmt.* 23: 253-61.
- Harmon, B. G., Thomas, C. H. & Glasgow, L. L. 1968. Waterfowl foods in Louisiana ricefields. *Trans. 25th N. Amer. Wildl. Conf.*: 153-61.
- Hochbaum, H. A. 1955. *Travels and traditions of waterfowl*. Minneapolis.
- Jemison, E. S. and Chabreck, R. H. 1962. The availability of waterfowl foods in coastal marsh impoundments in Louisiana. *Trans. 27th N. Amer. Wildl. Conf.*: 288-300.
- Johnsgard, P. A. 1965. *Handbook of Waterfowl Behavior*. Ithaca.
- Junca, H. A. 1962. A quantitative study of the nutrient content of food removed from the crops of wild Mallards in Louisiana. Thesis. LSU Baton Rouge.
- Kimble, R. & Ensminger, A. 1959. Duck food habits in southwestern Louisiana marshes following a hurricane. *J. Wildl. Mgmt.* 23: 453-5.
- Kniefen, F. B. 1968. Louisiana, its land and people. Baton Rouge: LSU Press.
- Linton, T. L. 1968. A description of the South Atlantic and Gulf Coast Marshes and Estuaries. *Proc. Marsh and Est. Managmt. Symp.* LSU Baton Rouge: 15-25.
- Lynch, J. J. 1968. Values of the south Atlantic and Gulf Coast Marshes and Estuaries to Waterfowl. *Proc. Marsh and Est. Managmt. Symp.* LSU Baton Rouge: 51-63.
- Lytle, S. A. 1968. The morphological characteristics and relief relationships of representative soils in Louisiana. *La. Agr. Exp. Sta. Bull.* 631. 23 pp.
- Nautical Almanac. 1965. US Naval Observatory, Washington.
- Palmisano, A. W. 1970. Plant community-soil relationship in Louisiana coastal marshes. Unpub. PhD Diss. LSU Baton Rouge.
- Smith, M. M. 1961. Louisiana Waterfowl Population Study. *La. Wildl. and Fish. Comm.*: 254-61.
- Tabberer, D. K. 1971. The wood-duck roost count as an index to wood-duck abundance in Louisiana. *Proc. 25th Ann. Conf. SE Ass. Game and Fish Comm.*: 254-61.
- Tamisier, A. 1966. Dispersion crépusculaire des sarcelles d'hiver *Anas c. crecca* en recherche de nourriture. *Terre et Vie* 1966: 316-37.
- Tamisier, A. 1972a. Rythmes nyctéméraux des sarcelles d'hiver pendant leur hivernage en Camargue. *Alauda* 40: 107-35 and 235-56.
- Tamisier, A. 1972b. Etho-écologie des sarcelles d'hiver *Anas c. crecca* pendant leur hivernage en Camargue. PhD Diss. Montpellier.
- Tamisier, A. 1974. Etho-ecological studies of Teal wintering in the Camargue (Rhône Delta, France). *Wildfowl* 25: 107-17.
- Wills, D. 1971. Food habit study of Mallards and Pintails on Catahoula Lake, La. with notes on food habits of other species. *Proc. 25th Ann. Conf. SE Ass. Game and Fish. Comm.*: 289-94.
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