Thesis

A comparison of male and female parental care in Barn Swallows (*Hirundo rustica*)

Submitted by

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We hereby recommend that the thesis prepared under our supervision by Brenda Johnson entitled *A comparison of male and female parental care in barn swallows (Hirundo rustica)* be accepted as fulfilling partial requirements for the senior thesis in Zoology.

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Introduction

Trivers (1972) defined parental investment as anything done by the parent for the offspring that increases the offspring's chance of surviving while decreasing the parent's ability to invest in other offspring. Trivers (1972) thought that the amount of parental investment of males and females in monogamous birds would be comparable, but other researchers believe that there is a difference in the amount of investment between males and females (Finke unpubl., Jones 1987, 1988, Moller 1988, Lombardo 1991). In birds, the sex which has the lower probability of renesting should invest more in current offspring to insure their success (Jones 1988). Females invest more energy in egg production than males do in sperm production, so it would be logical that females would take longer to start a new reproductive effort and thus have a lesser likelihood of renesting. Females should therefore invest more effort to ensure the survival of their offspring. This has been observed in some passerines; for example, the female starling (*Sturnis vulgaris*) incubates the eggs more and feeds the young more than the male (Coulson 1960).

Jones (1988) postulated that any sex-related differences in investment would be small in near-monomorphic species. Since only a slight sexual dimorphism occurs in swallows, sexual differences in investment are likely to be small and subtle (Jones 1988). My objective in this study was to compare parental investment between male and female barn swallows (Hirundo rustica). I specifically examined the amount of time spent in parental care.

Methods

I studied barn swallows on the campus of Weber State University, Ogden, Utah during the 1990 breeding season: July 20 through August 16. I followed one breeding pair from incubation to fledging (nest 1) and two other breeding pairs at different stages of the development of their young (nests 2 and 3). I collected data from nest 2 when the young were a few days from fledging until they fledged and from nest 3 when the young were a week old through the end of the week. Observations were originally made by videotaping the nests. Total observation time on nest 1 was one hundred hours; each observation period was approximately six hours per day throughout the breeding time. Recording time was staggered to cover all times of activity. Total observation time on nest 2 was 14 hours, and time on nest 3 was 16 hours. By reviewing the video tapes, I recorded the occurrence and duration of behaviors associated with reproduction.

The sexes were identified by various techniques. Plumage differences and length of tails were used to identify the sex of the individual parents; in barn swallows the bellies of females are lighter colored and males have a longer tails (Samuel 1971). The females from nest 1 and nest 2 were also color banded.

Five behaviors were examined in this study:

1. Incubation: Both parents incubate the eggs during the day. At night the female incubates the eggs and the male perches on the side of the nest. Only incubation time during the day was measured.

2. Brooding: Barn swallow chicks are extremely altricial at hatching. This is likely why both of the parents brood the young for the first week. Time spent brooding by each parent was measured.

3. Nest Sanitation: The parents continue to bring feathers to the nest after the young hatch, and they fluff the feathers periodically. They also check the nest for parasites. The fecal sacs are eaten by the parents for the first few days after the young hatch. The sacs are then carried away until the young can void off the edge of the nest at about 12 days (Bent 1942). The time spent in each of these activities was measured for each parent.

4. Provisioning of the young: Insects are caught on the wing and brought to the young in the nest. Parents generally only feed one chick each time they bring an insect, but there is some load splitting (Jones 1987) i.e., 2 or more chicks fed with one insect or from several insects brought in one trip. The number of feeding trips were counted during each observation.

5. Protection of the Young: The parents protect the young from intruders and chase intruders from the nest. Because of the limitations of the video recorder I could only observe the immediate area around the nest and many of the chases occur away from the nest (Lombardo 1991). Intruders, however, do come directly to the nest and the parents chase them away. The time spent guarding the nest and chasing intruders from the nest was measured.

Results

Incubation

The female incubated significantly more than the male in nest 1 ($P < .001$). Table 1 gives means for the sexes and statistical comparisons between them. The average time spent incubating per hour for the male and female are given in Figure 1. Although the female spent more time incubating each day than the male there appears to be a trend toward the female decreasing the time spent on the nest, with the male increasing his time there (Figure 1). However, the trend was not significant ($v > 0.05$). There were no data on incubation from the other nests.

Brooding

The female from nest 1 spent more time brooding than the male but, the difference was not significant ($P > 0.05$) (Table 1). The female did spend significantly more time brooding ($P < 0.01$) at the beginning of the brooding period than the male. As the brooding period progressed, the amount of time spent brooding by each sex was either equal or the male spent more time (Figure 2). The female significantly reduced the time spent brooding as the brooding period progressed ($P < 0.01$). Brooding was only observed on one day in nest 3. The female from nest 3 did spend more time brooding than the male on the day that it was observed.

Nest Sanitation

The female from nest 1 spent significantly more time in nest sanitation than the male (Table 1). Over the entire brooding period the amount of time that the male spent in sanitation did not fluctuate much, but the time spent by the female did change. The female greatly increased this activity on the day the chicks hatched, but

the activity then dropped to a lower, nearly constant level for about 2 weeks then dropped to no activity for the last few days that the chicks were in the nest (Figure 3). The female from nest 2 also spent significantly ($P<0.05$) more time in nest sanitation than the male (Fig 4). The female from nest 3 spent more time than the male in this activity, but not significantly so ($P>0.05$) (Figure 5).

Provisioning the Young

The male from nest 1 made more feeding trips than the female (Table 1). The number of feeding trips were about equal during the brooding period, but at the end of brooding the male made more feeding trips than the female (Figure 6). The difference in the number of feeding trips made by the parents in nests 2 and 3 was not significant (Figures 7 & 8).

Protection

There was no significant difference in the mean amount of time spent in protection of the young by the males vs. the females at any of the nests (Table 1). Typically, whichever parent was at the nest chased the intruder away. On several occasions an immature barn swallow fledged from another nest landed at the nest under observation and begged for food. The female at nest 1 fed the immature once. Another immature stayed at nest 2 for about 45 minutes. The parents made several feeding trips to the nest, but the immature was never fed. The immature attacked the resident chicks several times while it was in the nest. It was attacking one of the chicks when the female came to the nest and the female then chased it away. The immature barn swallows were unmarked, so I could not tell if they were actually the

same bird in these two instances. Figures 9, 10, and 11 show the mean time spent in protection of the young for the 3 nests.

Discussion

Although the male participated in all aspects of care of the young, he spent considerably less time incubating, brooding, and in nest sanitation than the female. These data are similar to those Lombardo (1991) found in the tree swallow (*Tachycineta bicolor*). One difference in Lombardo's findings is that the female fed the young more than the male in the tree swallow. In contrast, my study showed that the male barn swallow fed the young as much or more than the female.

The male and female spent about an equal amount of time in protection of the young. Lombardo (1991) found that male tree swallows chased more intruders away from the nest. These chases generally occurred approximately 6 meters from the nest. Since only the immediate area of the nest was observed in this study, I could not assess this type of protection.

These data support the theory of greater investment in parental care by the female who initially invests more in reproduction than the male. Finke thought that the level of male aid influences female reproductive effort, and that the female should attempt to increase the level of aid that her mate provides. The male does not have a great deal of investment to lose at the beginning of the reproductive effort, so he continues to invest less. But as the effort continues and his total investment grows the male would have much more to lose if the reproductive effort failed. There was a trend in my study for the male to increase the time spent over the reproductive period

(Fig. 2) Finke et al. (unpubl.) and Jones (1987) also found that males are considerably more attentive to their broods later in the season. When the male increases the amount of time spent, the female decreases the amount of time spent. These data support Finke et al.'s idea that the level of male aid influences female reproductive effort.

The behaviors that were measured in this study indicate that the female does indeed invest more time in parental care than the male. However, Moller (1988) thought it was unjustified to compare parental care without correcting for the differences in extra-pair copulation frequency. Finke (unpubl.) found that the availability of extra-pair copulations affects the amount of parental care the male gives. If the male is uncertain of his paternity he will invest less parental care in the young (Moller 1988). It is believed that the male can judge the number of extra-pair copulations that the female participates in by how often the female is chased by other males. The male will decrease parental care if the female is chased by other males during the fertile period. Extra-pair copulation information was not available for this study.

Acknowledgments

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TABLE 1. Sexual differences in parental care by Barn Swallows. Components are reported as mean ± SD per hour. The total time spent in incubation, brooding, sanitation and protection are in seconds, and the total number of feeding visits are shown in parentheses; n = the number of 1-hr observation periods, t = the value obtained from the t-test, P = probability that the difference is random, * = $P>0.05$, ** = $P<0.05$, *** = $P<0.01$.

Type of Care	Female	Male	n	t	P
Nest 1					
Incubation	1943.67 ± 120.16 (47634)	686.0 ± 174.42 (15474)	18	8.3976	***
Brooding	657.80 ± 573.07 (19733)	356.80 ± 292.23 (10701)	30	.9358	*
Sanitation	224.86 ± 223.37 (18854)	47.06 ± 30.88 (4214)	78	2.7208	***
Feeding Visits	7.62 ± 2.84 (525)	11.77 ± 4.44 (809)	70	2.7292	***
Protection	9.00 ± 12.99 (270)	9.17 ± 11.54 (275)	24	.01918	*
Nest 2					
Sanitation	12.43 ± 7.34 (214)	.60 ± .85 (11)	14	2.2655	**
Feeding Visits	12.57 ± 4.92 (166)	12.33 ± 4.70 (158)	14	.04848	*
Protection	1.57 ± .33 (22)	1.23 ± 1.74 (22)	14	.26555	*
Nest 3					
Brooding	848 (1697)	210 (419)	2		*
Sanitation	56.94 ± 29.92 (298)	69.94 ± 88.02 (279)	16	.22357	*
Feeding Visits	12.19 ± 2.83 (195)	11.31 ± 1.79 (181)	16	.45263	*
Protection	11.02 ± 17.43 (132)	8.50 ± 11.18 (102)	16	.27174	*

Table 1 Cont. Cumulative data on the 3 nests. Brooding data are from nests 1 and 2 only. The other data are from all 3 nests.

Type of Care	Female	Male	*n*	*t*	*P*
Brooding	689.58 ± 527.94 (21430)	332.25 ± 272.36 (11120)	36	1.3450	*
Sanitation	159.40 ± 201.80 (19366)	47.01 ± 52.55 (4504)	100	2.3990	***
Feeding Visits	9.30 ± 3.93 (886)	11.80 ± 4.07 (1148)	100	2.7292	***
Protection	8.91 ± 14.61 (424)	7.74 ± 10.76 (399)	100	.4991	*

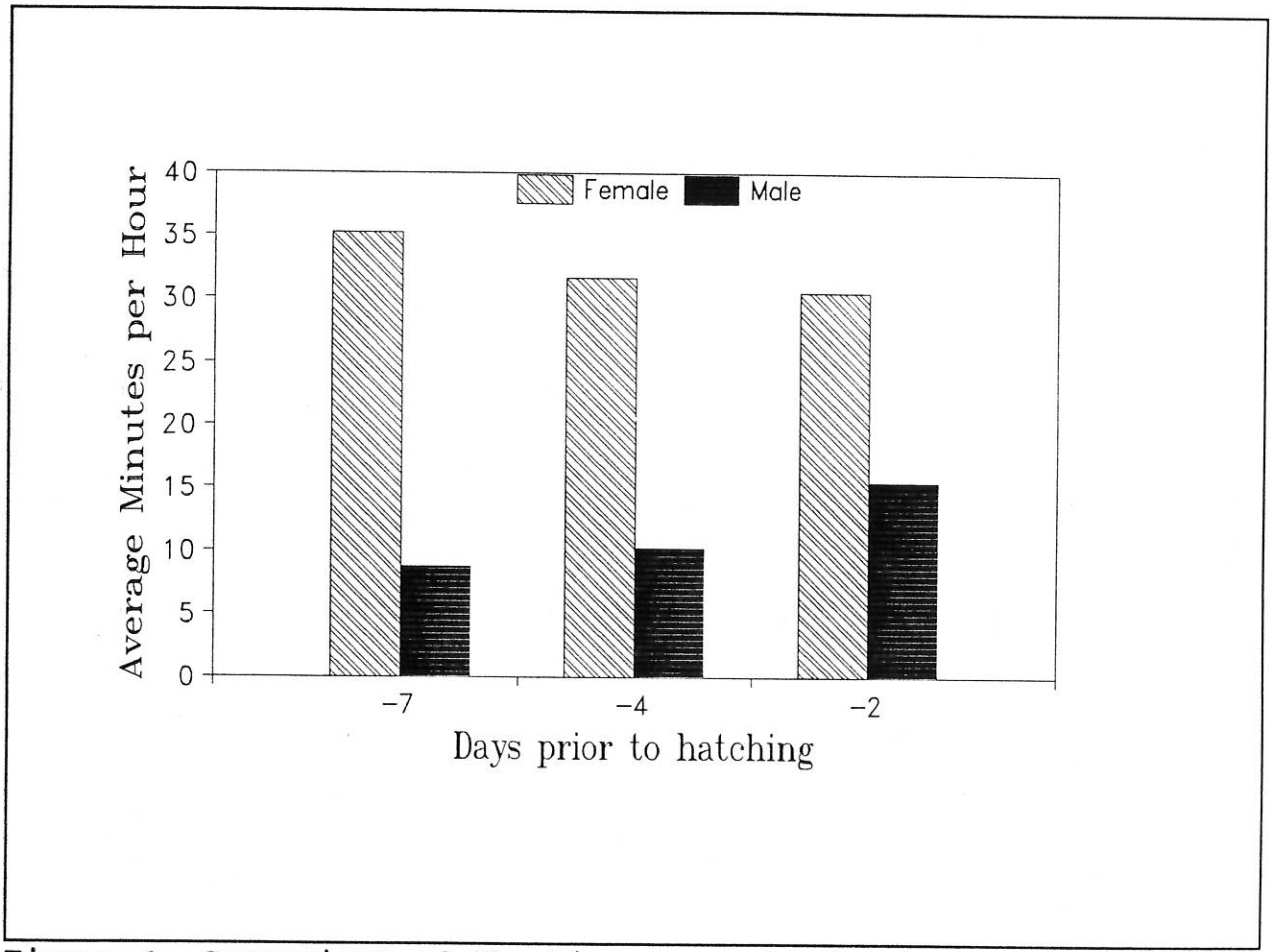

Figure 1. Comparison of the time spent incubating by the male and female barn swallow at nest 1. Mean time in minutes per hour spent incubating each day.

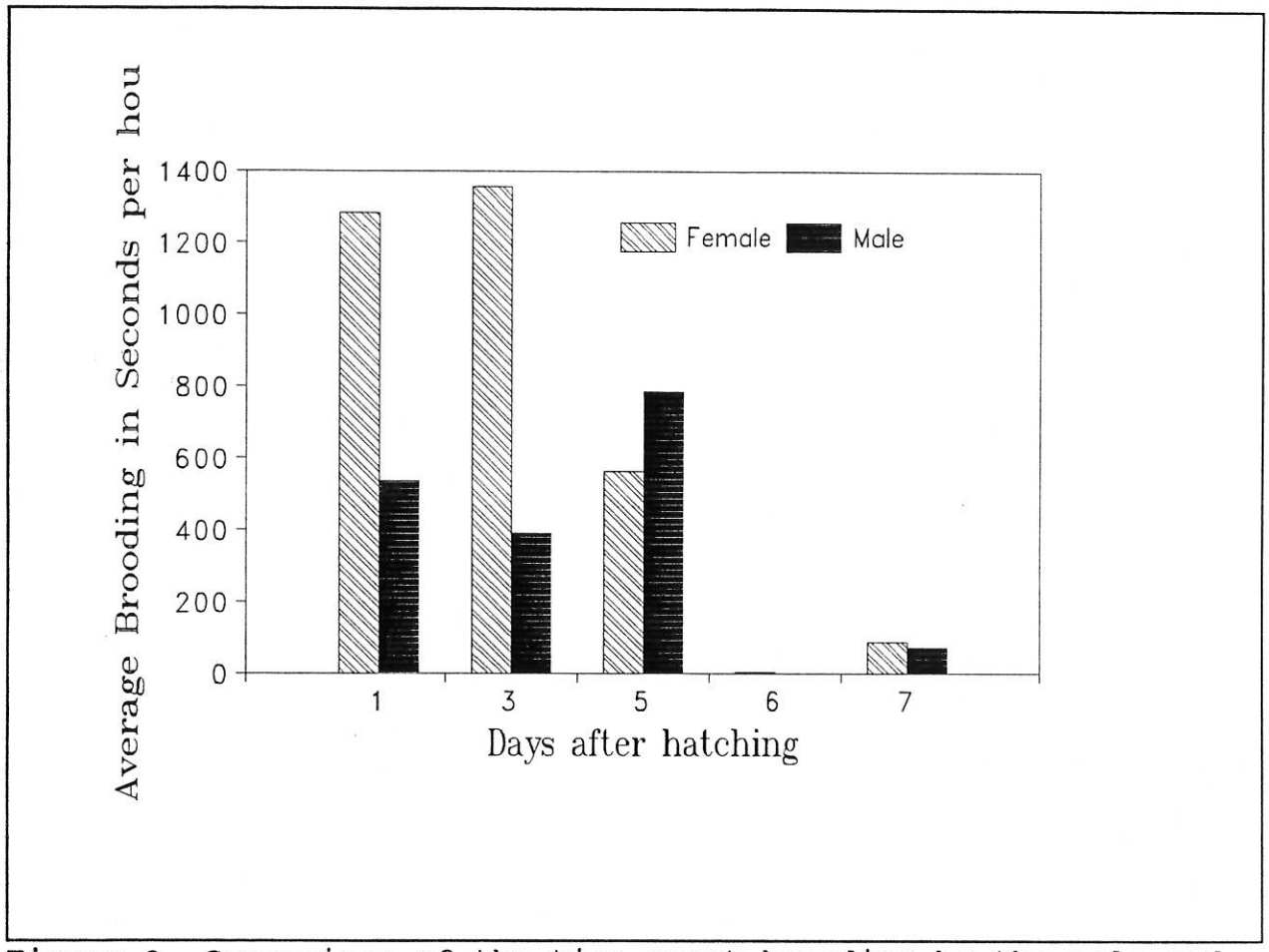

Figure 2. Comparison of the time spent brooding by the male and female barn swallow at nest 1. Mean time in seconds per hour spent brooding the young each day.

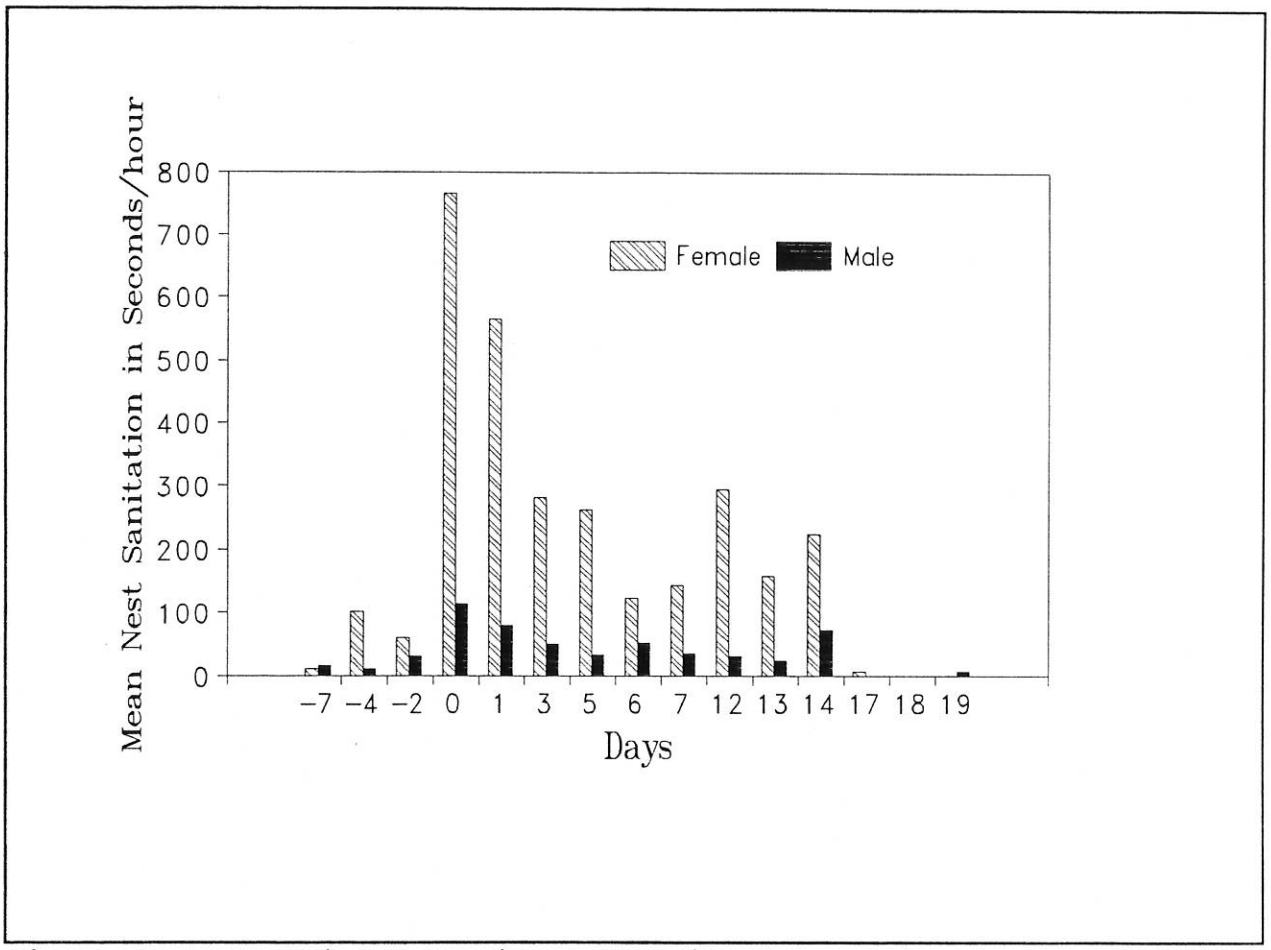

Figure 3. Comparison of time spent in nest sanitation by the male and female barn swallow at nest 1. Mean time in seconds per hour spent in nest sanitation on the days prior to hatching and thru brood rearing.

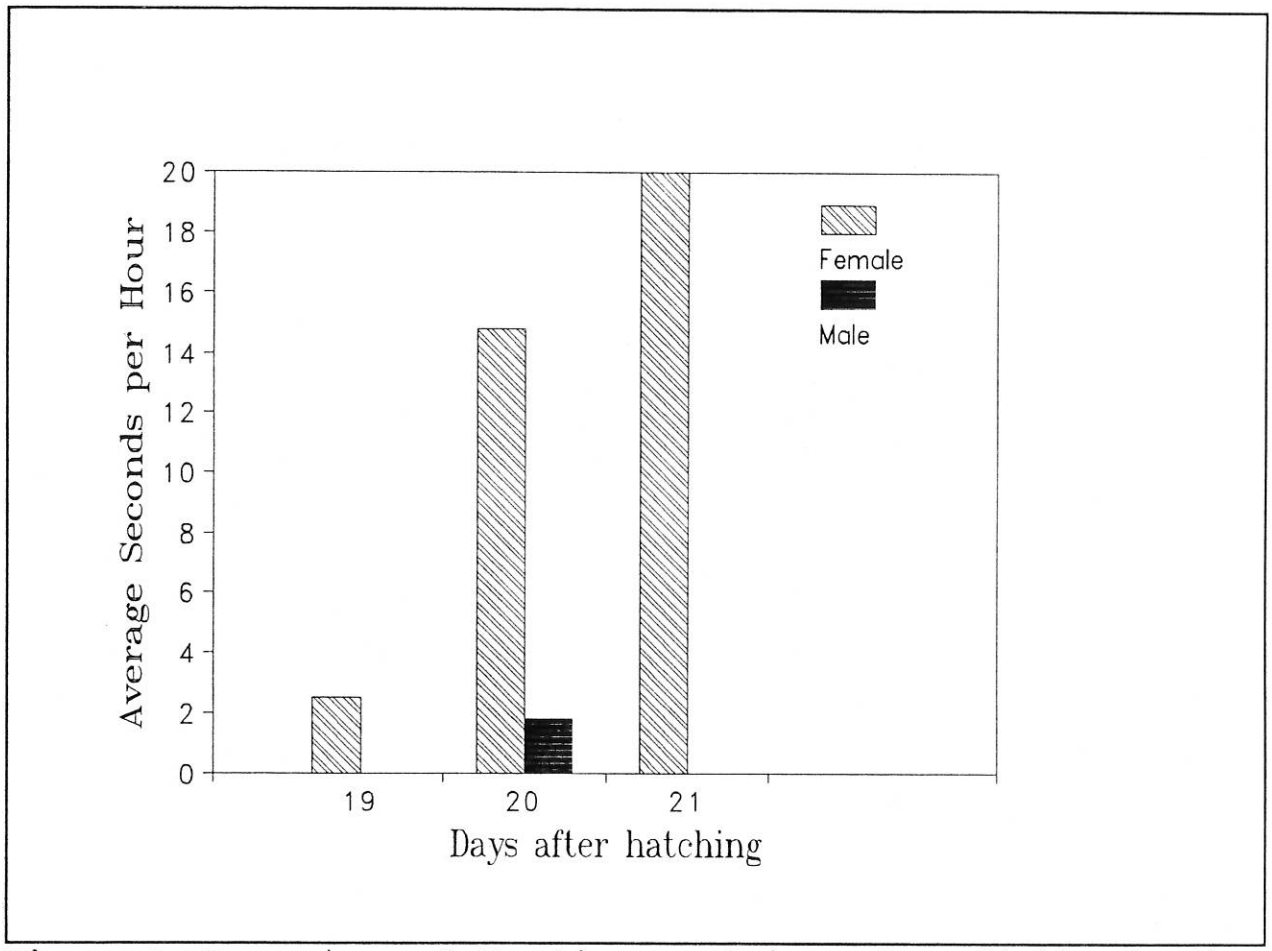

Figure 4. Comparison of the time spent in nest sanitation by the male and female barn swallow at nest 2. Mean time in seconds per hour spent in nest sanitation each day.

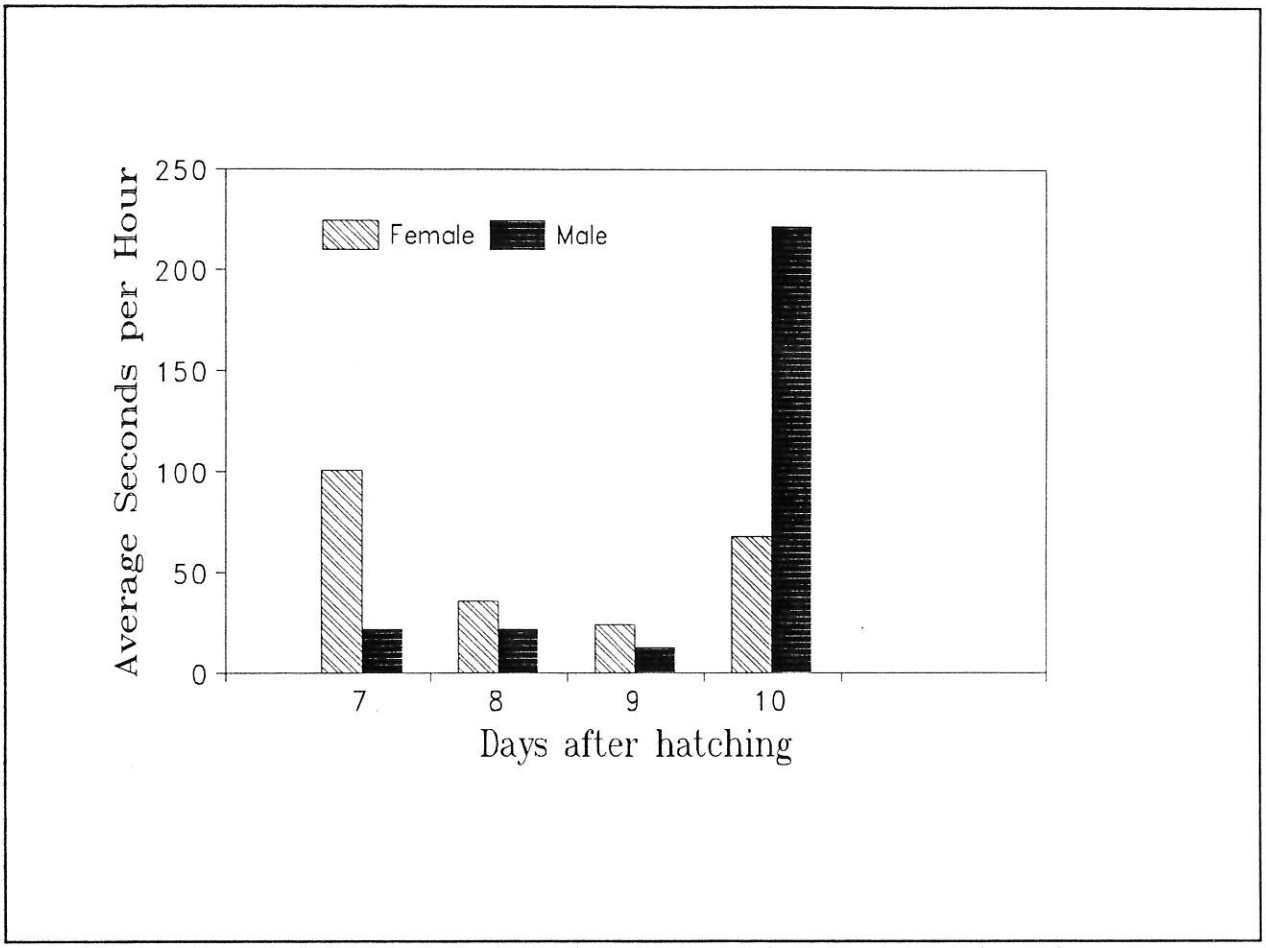

Figure 5. Comparison of the time spent in nest sanitation by the male and female at nest 3. Mean time in seconds spent per hour in nest sanitation each day.

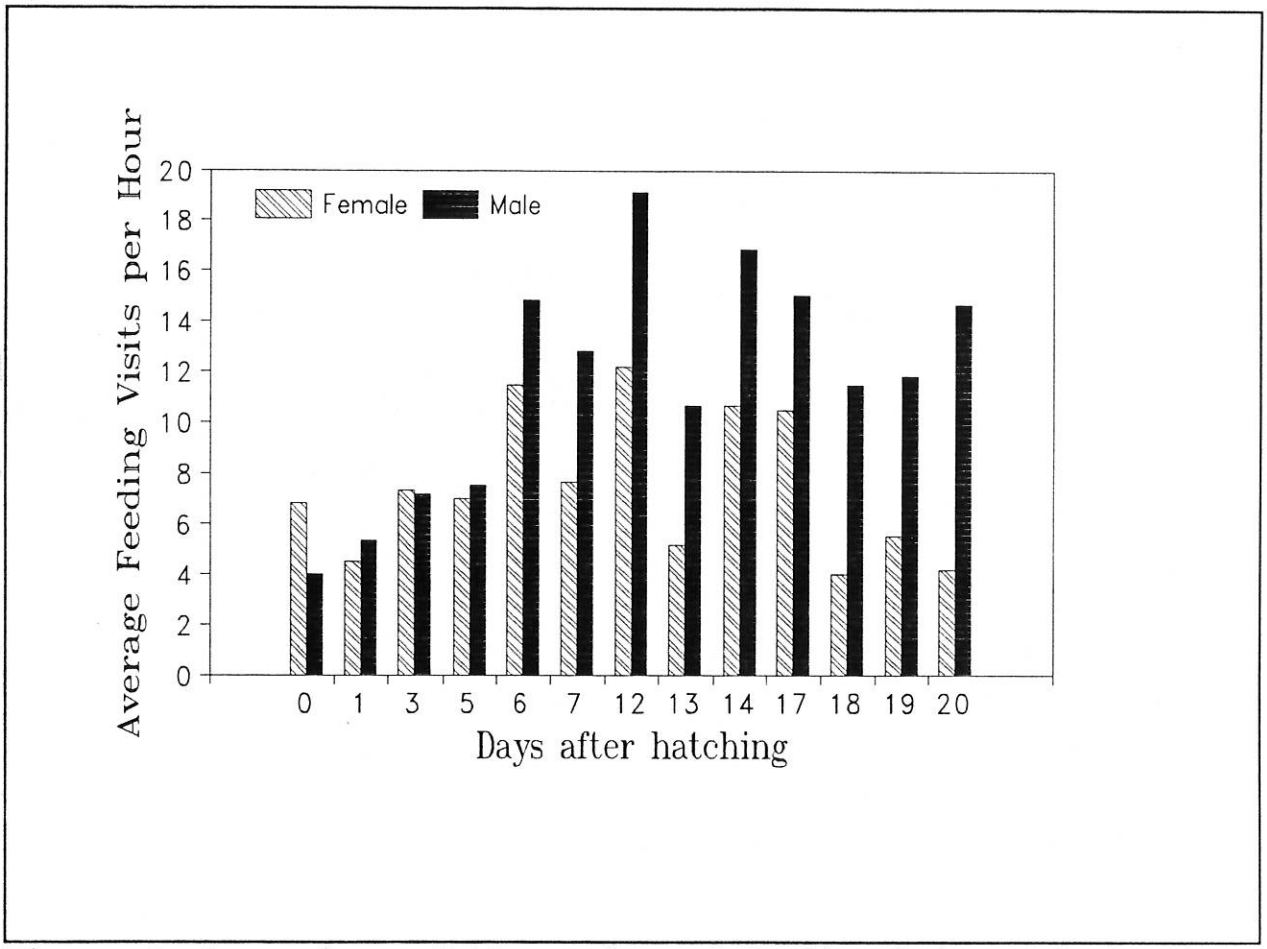

Figure 6. Comparison of the number of feeding trips made by the male and female barn swallow at nest 1. Mean number of feeding trips per hour each day.

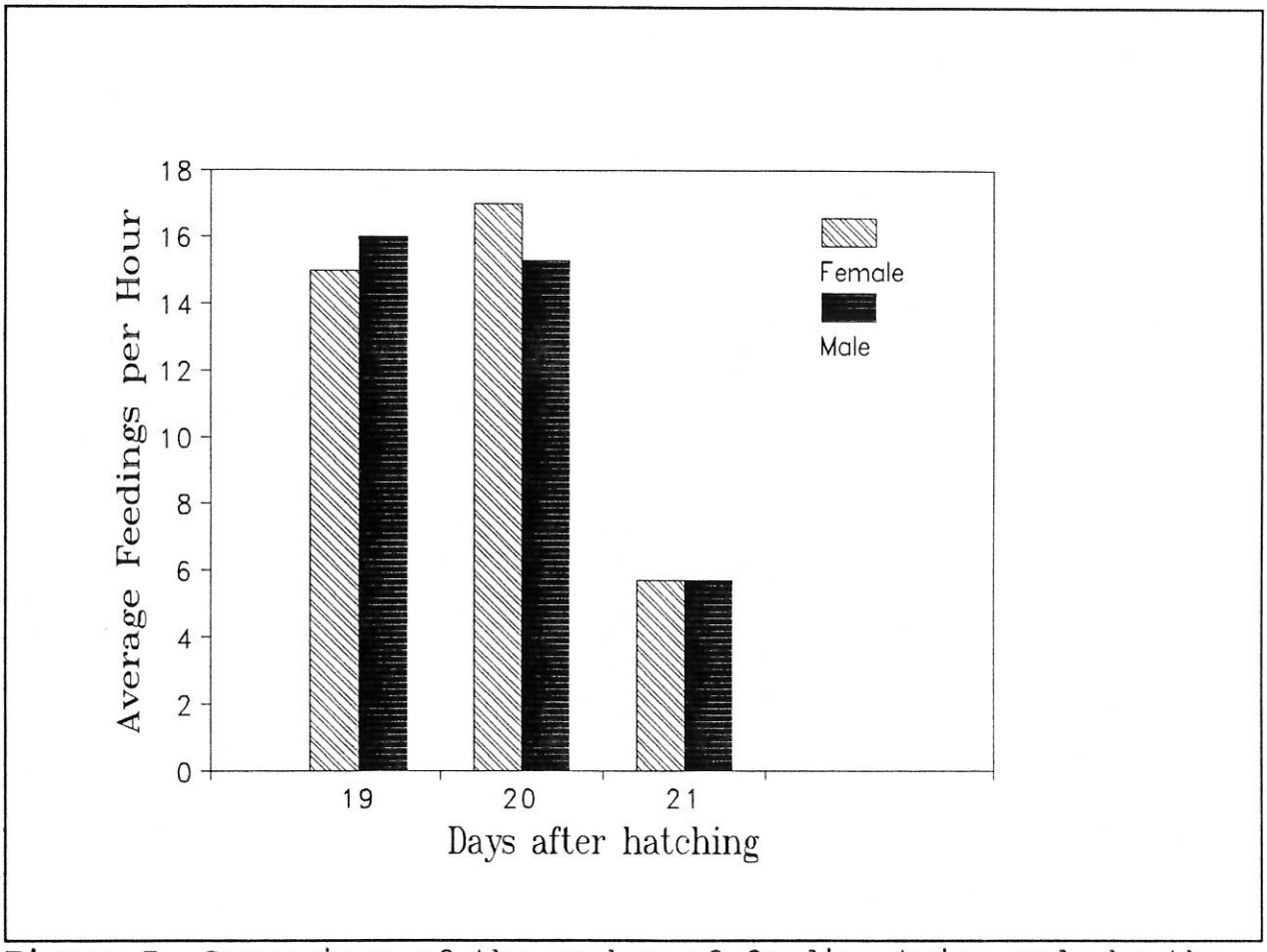

Figure 7. Comparison of the number of feeding trips made by the male and female barn swallow at nest 2. Mean number of feeding trips per hour each day.

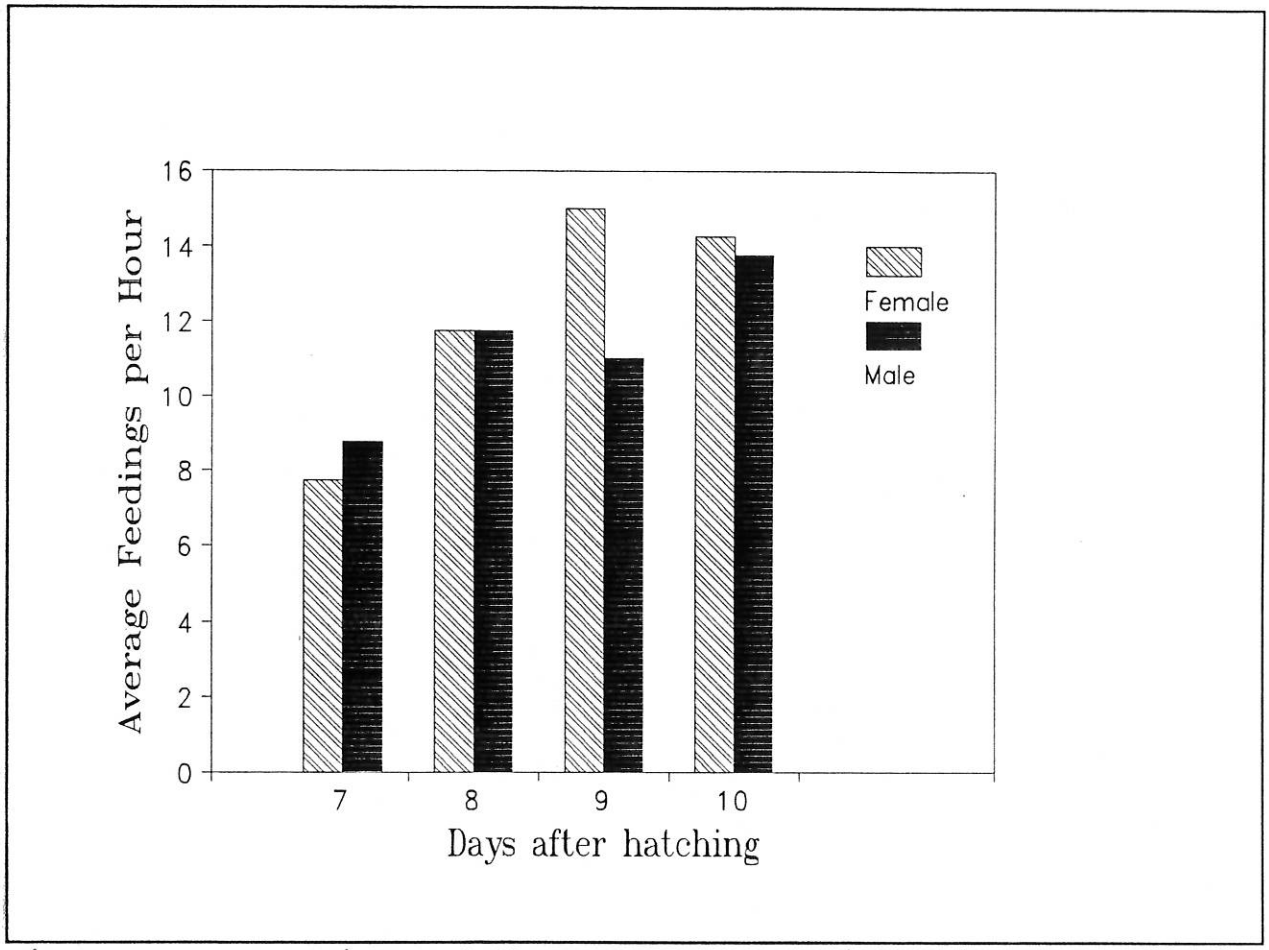

Figure 8. Comparison of the number of feeding trips made by the male and female barn swallw at nest 3. Mean number of feeding visits per hour each day.

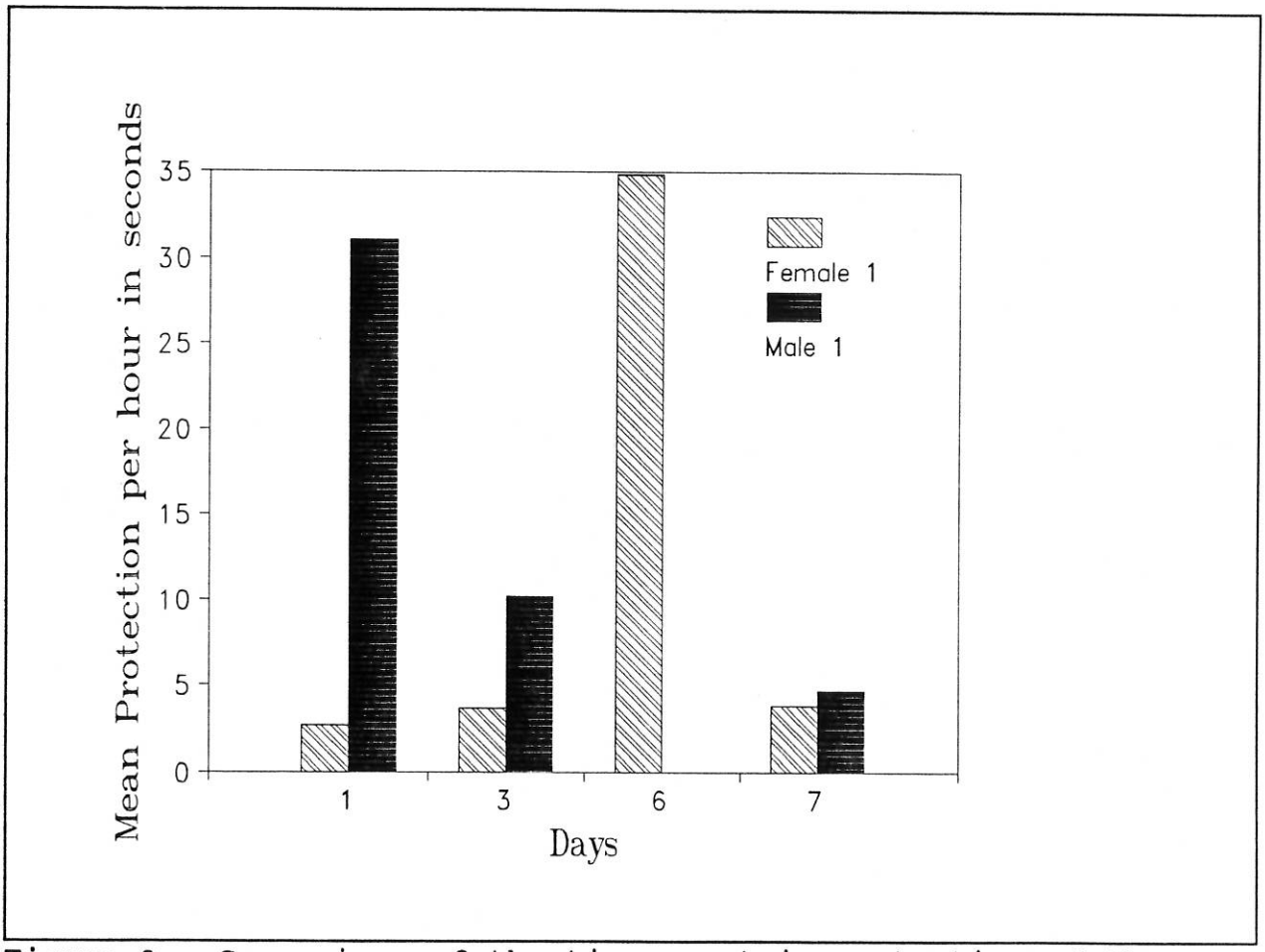

Figure 9. Comparison of the time spent in protection of the young by the male and female barn swallow at Nest 1. Mean time spent in seconds per hour each day.

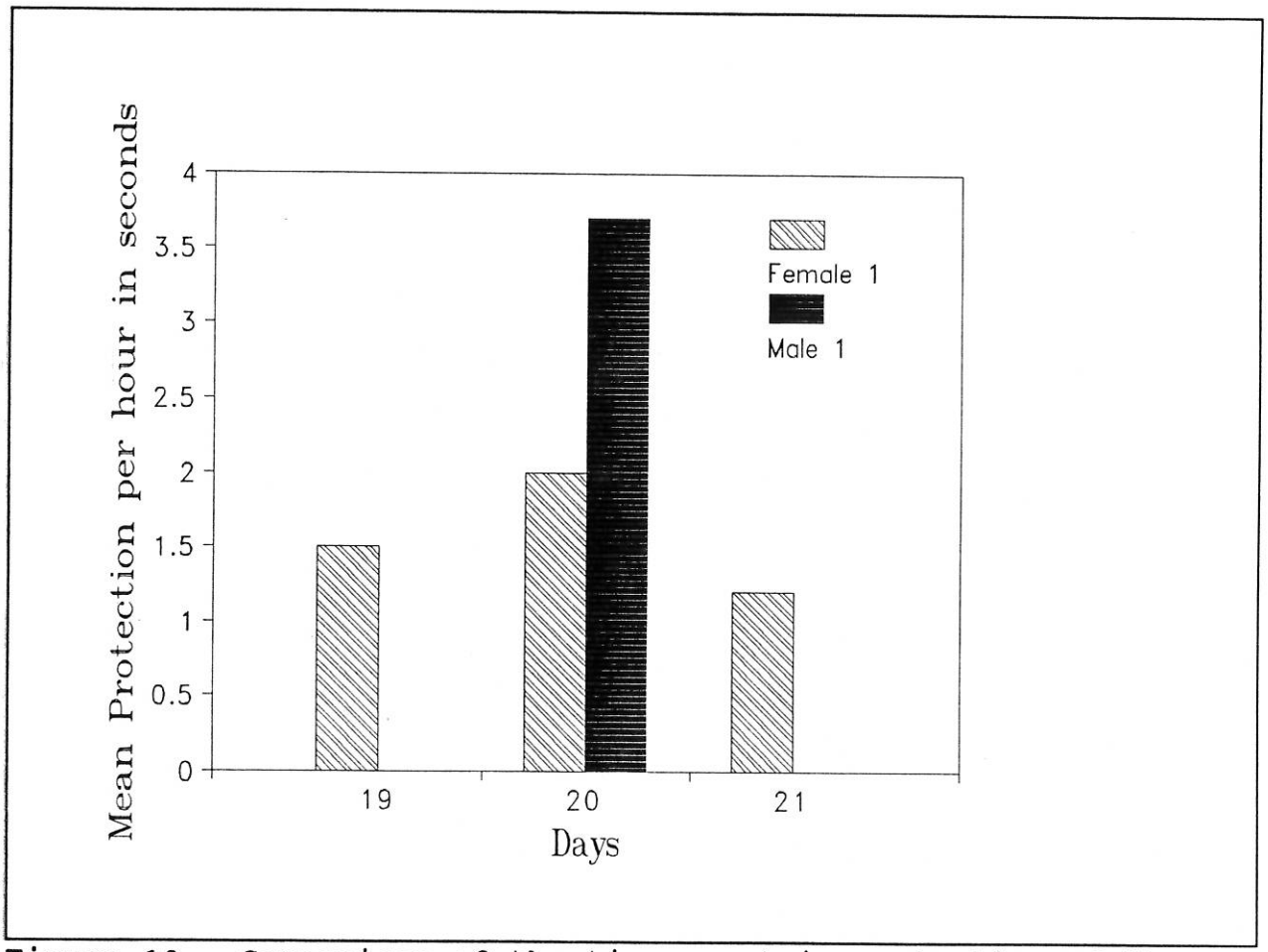

Figure 10. Comparison of the time spent in protection of the young by the male and female barn swallow at nest 2. Mean time in seconds per hour each day.

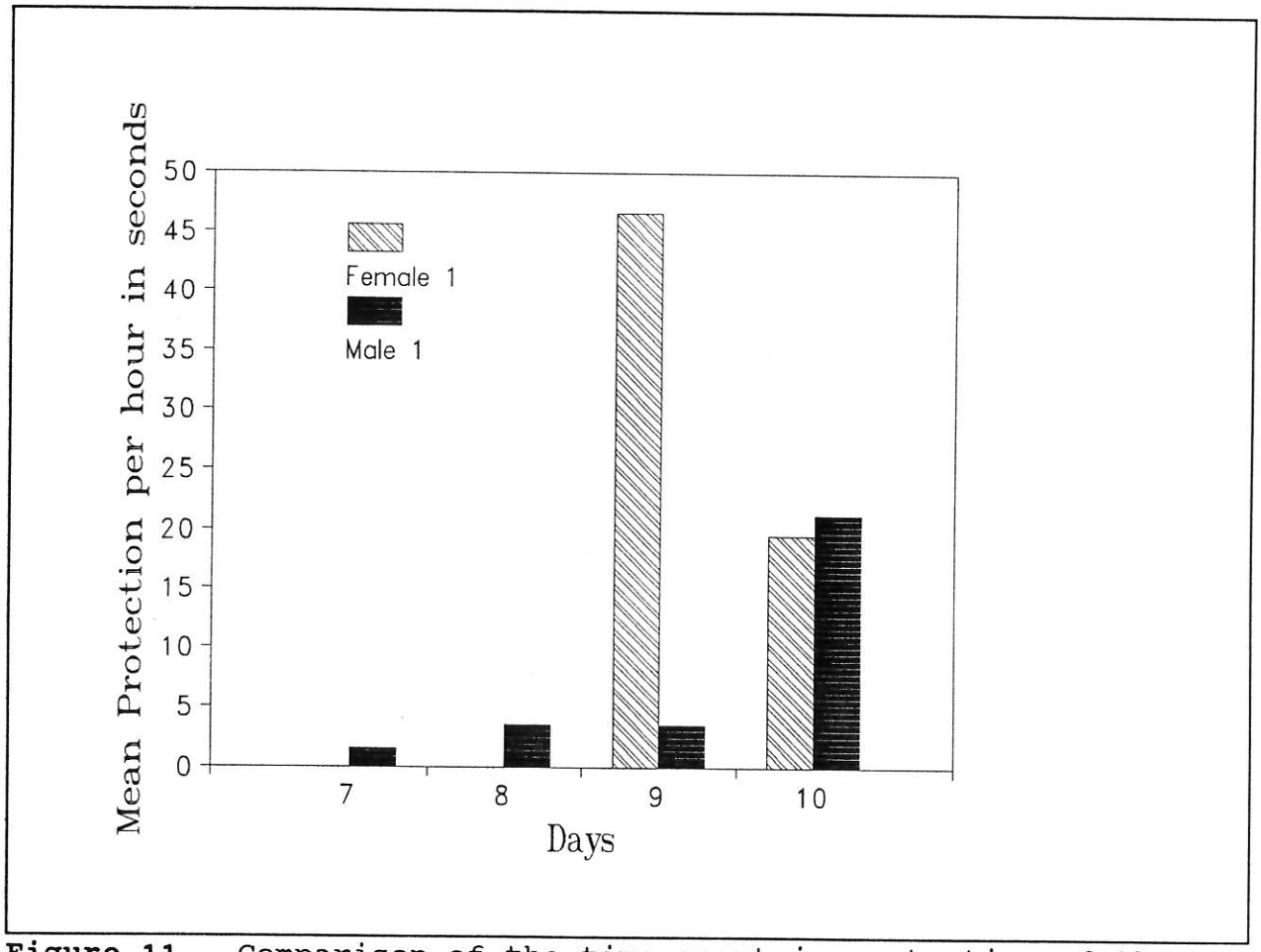

Figure 11. Comparison of the time spent in protection of the young by the male and female barn swallow at Nest 3. Mean time in seconds per hour each day.