

TOTAL BROOD MORTALITY IN LATE-NESTING CLIFF SWALLOWS

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Mayhew (Condor 60:7, 1958), in his study of the Cliff Swallow, *Petrochelidon pyrrhonota*, in California, found that individual broods vary considerably in their state of development at any one time in a large nesting colony, apparently because adults arrive at these colonies over an extended period of time. He suggested that a second brood rarely, if ever, occurs in the Sacramento Valley, since 42 to 48 days are required to produce and raise a single brood, and adults remain at the colonies only about 70 days after the first eggs are laid.

Mayhew found that less than 17 per cent of the nests he examined failed to produce successful broods, but he apparently did not inspect nests after the adults had abandoned them. In a nesting colony in the same area (a double bridge over Chickahominy Slough, 5.6 km NNE Winters, Yolo Co.), I found that eggs and dead nestlings often were present after adults had abandoned all nests. In 1964 all adults had emigrated by 21 June, when I removed and examined 71 nests from the north side of both bridges; seven nests contained one or two eggs, two nests contained one egg and one dead nestling, and 20 nests contained one to three dead nestlings in various stages of development up to fledging size.

As a result of the previous year's nest removal, all nests on the north side of the west bridge in 1965 were newly constructed. All 79 of these were completely removed for examination in October, but 63 were first numbered and examined one to three times in late April and May, during brood development; these early examinations were made by breaking off the necks of the flask-shaped mud nests, removing and counting eggs and nestlings, and then replacing them. In all cases nest necks were rebuilt by birds between examinations. In October, of 79 nests, 39 had one to four eggs, six had both eggs and dead nestlings, and seven had one to four dead nestlings in various stages of development. Of the 39 nests which had been both examined in the spring and had contained eggs or dead nestlings in the fall, 29 gave positive evidence that second broods had been started in the same nests, since in these cases the spring broods were more advanced at last examination than the dead broods found in the fall. Nest examinations were not related to this mortality, for of the 16 nests not examined in the spring, 13 contained eggs or dead nestlings in the fall.

In 1966 swallows again built new nests where the previous ones had been removed; but before then, on 29 March, I suspended 32 artificial nests (designed in the manner described by Mayhew) from the side of the west bridge. These nests were inspected through trap doors in the nest ceilings every three days from 19 April to 12 June, when adults were no longer found at the nesting site. Eggs were laid in 11 artificial nests, and broods of two or three nestlings were successfully reared in seven of them. Eggs first appeared in one of these nests on 19 April; this nest was apparently in synchrony with the new natural

nests, because egg shells were first found beneath the latter on the day that the eggs in the former nest were found to have hatched. The last artificial nest to support a brood first contained eggs on 16 May.

In the five artificial nests with eggs hatching by 16 May, fledglings left the nests 18 to 24 days later; the nestlings had shown arithmetically linear weight gains up to 12 to 15 days after hatching, and then the weights decreased slightly or stabilized before the fledglings left. But in the two nests with eggs hatching by 28 May and 31 May, respectively, the fledglings left between 12 and 18 days after hatching. In the latter nest the nestlings disappeared by 12 June while they had still been gaining weight in a linear way, but in the former nest the weight gains were reduced on 6 June and 9 June, and one nestling was dead and another gone on 9 June; the third nestling was gone by 12 June. Thus, the premature departure of young birds coincided with emigration of adults, and reduced weight gains shortly preceded it.

On 6 June I examined six natural nests each from the east and west bridges and found that those on the west bridge contained neither eggs nor nestlings, but all of those on the east bridge contained eggs or very young nestlings. By 9 June the necks of none of the examined nests had been repaired by adults, and the nestlings were dead. On 14 June I removed and examined the remaining natural nests on the north sides of both bridges; of 38 nests on the west bridge, five contained one to four eggs, and of 16 nests on the east bridge, eight contained one to four eggs, one contained two dead nestlings and one egg, and three contained one to three dead nestlings. The uniform departure of adults from the colony previous to these examinations was observed at several nearby nesting colonies at the same time, so it was probably not due to my disturbances. It appears that the swallows nesting on the east bridge started laying eggs much later than those on the west bridge, but all swallows able to fly left the nesting site at the same time, so the late nesters allowed their broods to starve to death.

An extreme example of late nesting occurred on the Winters Overpass bridge (1.6 km E Winters and 0.8 km from the nearest established colony), where nest construction had barely begun on 3 June 1966, and only some nests had been completed by 9 June. Swallows were still active at this site on 17 June, but by 5 July they had gone. Of 10 nests that were removed and examined, one contained three eggs and another contained four dead nestlings.

The observations in 1966 showed that second broods did not occur in many nests. But in the artificial nest that had contained the earliest successful brood (fledged by 28 May), an adult was found on 31 May, and three eggs were present by 9 June, suggesting that the same pair starts a second brood, though this remains uncertain.

Regardless of whether pairs of swallows often attempt to raise more than one brood in a single breeding season, the above observations support the conclusion that although there is a wide variation in the time that broods are initiated, there is a narrow span of time during which broods are reared; thus broods initiated late in the breeding season suffer total mortality.

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