

**Breeding Biology of the Barn Owl (*Tyto alba*)
in the Lower Mainland of British Columbia**

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Abstract.—Breeding of the Barn Owl was studied from 1990-1992 in the Lower Mainland of British Columbia, the northern limit of the species' North American range. Over 3 years, mean clutch size was 6.5 ± 3.5 , mean brood size at time of banding was 3.3 ± 2.0 , and mean number of nestlings fledged was 2.6 ± 2.1 . Clutch size ranged from 2 to 18 eggs. There were no significant differences in fledging success rates between years. Severe weather in 1991 resulted in high Barn Owl mortality. If the number of nestlings banded per year is used as an index of productivity and the number of barn owl carcasses reported per year is used as an index of mortality, the year of 1991 has both the highest mortality and the lowest productivity of the 3 years. The use of man-made sites by Barn Owls for roosting and nesting provides increased thermal cover and security from predators which may be vital for the species at the northern limit of its distribution.

The Barn Owl (*Tyto alba pratincola*) is classified as "uncommon to very rare" throughout British Columbia (Campbell *et al.* 1990). The species was first recorded in the province in 1909 and there were no breeding records until 1941 (Cowan 1942), making the Barn Owl a relatively recent addition to the province's fauna. The Barn Owl favors open habitat and is often closely associated with agricultural areas (Bent 1961, Campbell and Campbell 1983, Marti 1992a). The Barn Owl's primary prey species in the Lower Mainland is the Townsend's vole (*Microtus townsendii*), which inhabits old fields and other grassland habitats throughout the Lower Mainland (Campbell 1983). It is probable that the clearing of forested lands and the development of agriculture in the Lower Mainland provided the open habitat necessary for the Barn Owl to expand its range northward into British Columbia. Today the British Columbia population of Barn Owls is estimated to be about 1,000, with the species breeding from southern Vancouver Island through the Lower Mainland as far east as Hope (Campbell and Campbell 1983). The

Barn Owl is a blue-listed species (vulnerable or sensitive species) in the provincial wildlife listing system. Current breeding records of Barn Owls elsewhere in Canada are extremely rare. The Lower Mainland population represents the northernmost edge of the Barn Owl's North American breeding range (fig. 1).

Barn Owl populations are declining in many parts of the world due to changes in agricultural practices and climate (Bunn *et al.* 1982, Shawyer 1987, Marti 1992a). Barn Owls are intolerant of cold winters in general and long-lasting snow in particular (Stewart 1952, Henny 1969, Glue and Nuttall 1971, Marti and Wagner 1985, Madge and Tyson 1987, Shawyer 1987, Taylor 1989), and the species breeds successfully only in temperate climates. Barn Owls have narrow thermoneutral zones, relatively poorly-insulating plumage and scant fat reserves (Johnson 1974). Deep snow provides a physical barrier between the Barn Owl and its small mammal prey and appears to greatly diminish hunting success. Research on the Barn Owl in British Columbia has been confined mainly to food-habits studies (Cowan 1942, Dawe *et al.* 1978, Campbell 1983, Campbell *et al.* 1987). Without data on the owl's reproductive and mortality patterns within the Lower Mainland it is difficult to devise management options to conserve the species. The objectives of this study were to

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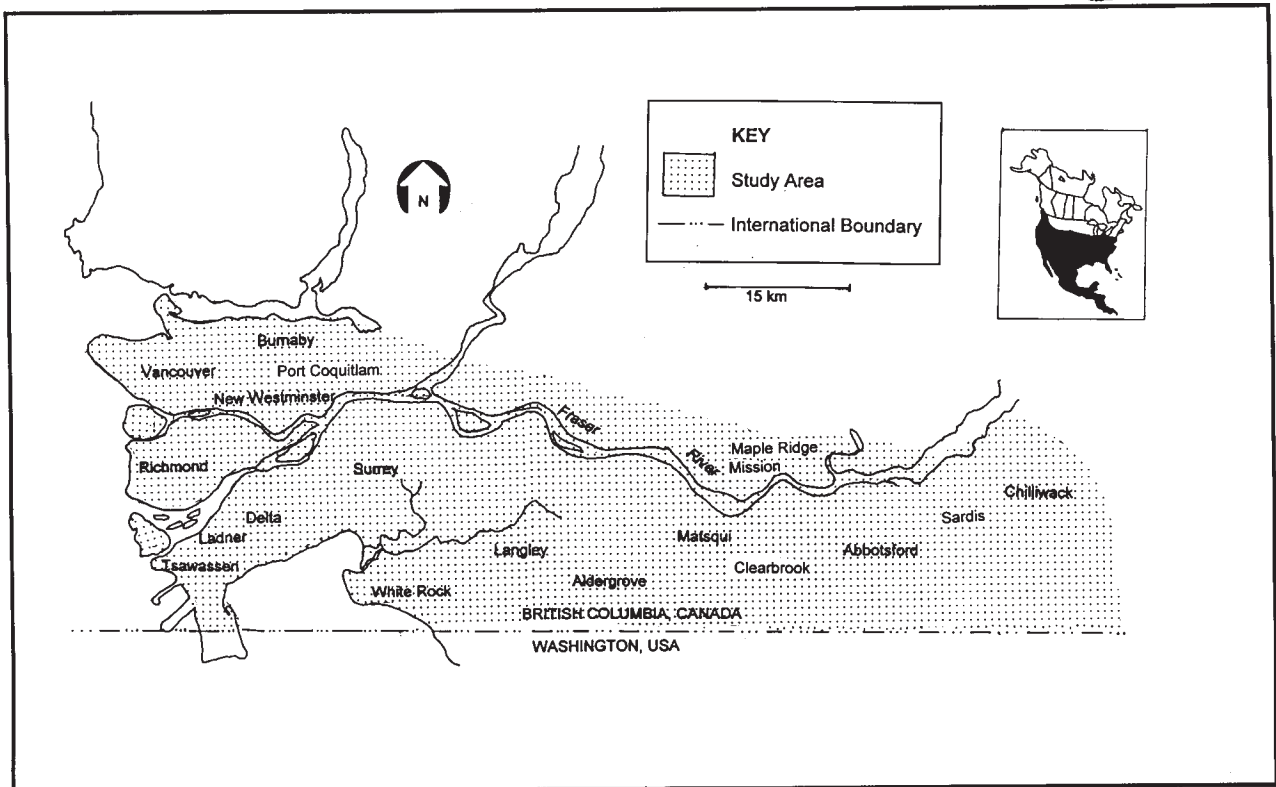


Figure 1.—The study area in British Columbia's Lower Mainland. Inset: the Barn Owl's North American breeding range (redrawn from Marti 1992a).

gather baseline data on reproductive success and mortality and to correlate it with environmental conditions.

STUDY SITE

The Lower Mainland region of British Columbia constitutes approximately 300,000 ha in the extreme southwest corner of the province (fig. 1). This area includes the districts and municipalities of Vancouver, Burnaby, Richmond, Delta, Tsawwassen, Surrey, Langley, Alder Grove, Matsqui, Abbotsford, Clearbrook, Port Coquitlam, Pitt Meadows, Mission, Maple Ridge, Sardis and Chilliwack. The Lower Mainland is bordered by the North Shore Mountains to the north, and by the United States to the south. Westward, the area is bounded by the Strait of Georgia, while to the east the mountains of the Coastal and Cascade ranges form a natural barrier. The Fraser River travels a sinuous course through the middle of the Fraser Valley and is a major influence on topography and vegetation. Very little of the original virgin coniferous forest now remains in the Lower Mainland, but extensive areas of second-growth forest exist in the adjacent uplands.

The study site lies in the Coastal Western Hemlock (CWH) biogeoclimatic zone (Meidinger and Pojar 1991). The main subzones are the CWH dry maritime (CWHdm) and the CWH very dry maritime (CWHxm). The climate of the region is moderate, with cool summers and mild, wet winters (Stager and Wallis 1968). The mean annual temperature is approximately 10°C, with January temperatures usually above freezing. The number of frost-free days per year is usually well above 200. Between 750 to 1,016 mm of precipitation falls per year, with 30-40 percent occurring during December, January, and February. Only 4-6 percent of the precipitation occurs as snow (Stager and Wallis 1968). The Lower Mainland has the mildest climate in Canada (Hunter 1996).

Approximately 2 million people reside in the Lower Mainland (Hunter 1996). Urban areas cover approximately 91,000 ha, and land classified as undisturbed (mainly second-growth forest) makes up a further 72,000 ha. Most of the remainder is agricultural land (Moore 1990), including mixed farms, large dairy farms, small hobby farms, and berry farms.

METHODS

Sites used by Barn Owls were located by a variety of methods. Drive-by surveys began in January of 1990 and were conducted in rural areas to locate structures that might be used by owls. Posters explaining the project were distributed to farm supply, feed and pet stores, and were posted at agricultural exhibitions and shows. Two local wildlife shelters provided addresses of persons bringing in orphaned or moribund Barn Owls. Television and newspaper reports publicizing the project identified potential nest sites, and the local Ministry of the Environment office (Region II) referred others to us.

Non-breeding Barn Owls frequently roost at the same locations where they breed. Sites where nesting had occurred or could potentially occur were monitored. Nest inspections were done periodically from January 1990 to May 1993. Level of effort to visit nests was reduced during the fall of 1990. Other than this, similar levels of effort were made in all 3 years to visit nests, but due to access problems with property owners it was not possible to visit the same sample of sites every year. Attempts were made to visit each site monthly during the prime breeding season (March to November) to determine if nesting had been initiated and at least once during the rest of the year. Barn Owls frequently desert nests if disturbed during incubation. If nest inspections flushed an incubating owl, the clutch was counted and observers then left the area as quickly as possible. If observation at a distance revealed an incubating owl, the bird was not flushed and no data on clutch size was recorded.

Nestling owls were large enough to band after the age of about 3 weeks. The normal procedure was to climb to the nest, one by one place each nestling into a deep plastic pail and lower the pail by means of a rope to an assistant. Standard measurements (wing chord, tarsus length, tarsus width, talon length, and beak length) were taken, and weight was determined with a spring scale. The number of nestlings in the brood at the time of banding (brood size) was recorded. All nestlings were banded with Canadian Wildlife Service standard numbered aluminum leg bands. Each nestling was then hauled back up in the pail and replaced at the nest. Handling and banding of nestlings was assumed to have no effect on fledging success (Taylor 1991).

Each banding site was revisited after the young had fledged. Accumulated pellet material in the nest site was sifted to find any remains (bands and bones) of nestlings which failed to fledge. The area for 50 m around the nest site was also searched for nestling remains. If no remains were found, all nestlings were assumed to have fledged successfully.

Information on mortality patterns of wild, fledged Barn Owls was obtained from British Columbia Ministry of the Environment (Region II) taxidermy permit records. Members of the public finding dead owls brought them to the Ministry office for taxidermy permits. Staff biologists examined, weighed and measured each carcass, and assigned a probable cause of death based on the condition of the carcass (i.e., broken bones, emaciation) and recorded other information from the finder. Information on local weather patterns was obtained from published Environment Canada records from the meteorological station at the Vancouver International Airport.

RESULTS

Two hundred thirty-six sites used by Barn Owls for roosting and/or nesting were located in the Lower Mainland. All but nine of these were man-made sites. Barns made up the greatest proportion of Barn Owl sites, comprising 72 percent of the total. Nesting attempts were recorded at 48 different sites during the 3-year study. A total of 119 Barn Owl carcass records from 1990-1992 were tabulated. Further examination of Barn Owl mortality data will be presented in another paper (Andrusiak and Cheng, Canadian Field-Naturalist, pending).

Two successful nests per year at the same site were recorded once during each of 1990 and 1991. Three instances of two successful nests at the same site within the same year, and three replacement nests (of unsuccessful breeding attempts) were recorded in 1992.

A summary of Barn Owl reproduction over the 3 years is presented in tables 1 and 2. There were no significant differences in clutch size over the 3 years, probably due to the small sample size. Clutch sizes varied from 2 to 18, with 5 eggs being the most common. Included in the data are observations of two unusually large clutches (14 and 18 eggs), both of which failed to hatch, recorded in consecutive years



Table 1.—Barn Owl reproductive success in the Lower Mainland of British Columbia, 1990-1992—all nests.

Year	Mean Clutch	N	Mean Brood	N	Mean # Fledged	N
1990	7.4 ±4.0	5	3.2 ±2.3	18	2.9 ±2.2	18
1991	4.0 ±1.6	3	2.2 ±1.3	17	2.1 ±1.2	15
1992	6.7 ± 3.4	15	3.8 ±2.0	35	2.7 ±2.3	29
Total	6.5 ±3.5	23	3.3 ±2.0	70	2.6 ±2.1	62

Table 2.—Barn Owl reproductive success in the Lower Mainland of British Columbia—successful nests only (at least 1 young fledged).

Year	Mean Clutch	N	Mean Brood	N	Mean # Fledged	N
1990	8	1	4.1 ±1.7	14	4.1 ±1.9	14
1991	4	1	2.5 ±1.2	11	2.4 ±0.9	13
1992	6.0 ±1.8	9	4.1 ±1.9	20	3.8 ±1.9	21
Total	5.8 ±1.8	11	3.7 ±1.8	45	3.4 ±1.8	48

at the same nest site. It is possible that these were produced by the same pair and that both members of the pair were females, although same-sex pairs have not been documented for this species.

The number of juveniles observed at banding (brood size) from nests where incubation was known to occur ranged from 0 to 8 (fig. 2). Mean brood size and the mean number of young fledged per nest were not significantly

different over the 3 years (tables 1 and 2). Unusually large and long-lasting snowfalls were notable for 1991. There was an inverse relationship between the total number of nestlings banded per year and the number of days with snow cover the previous winter (fig. 3). Less variation in brood size (number of nestlings per nest) was noted during 1991 (fig. 2).

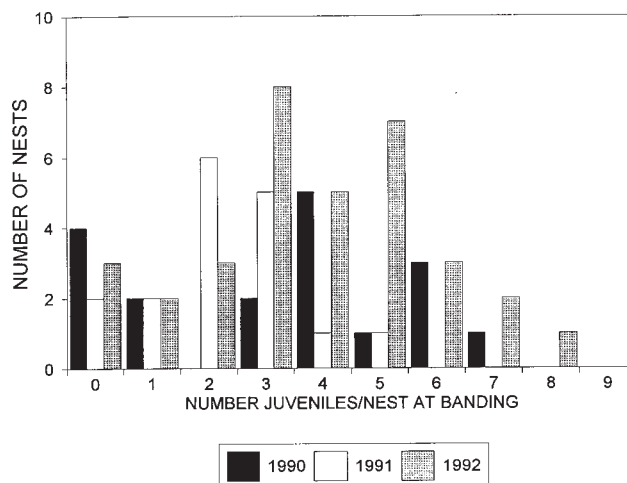


Figure 2.—Barn Owl brood sizes in the Lower Mainland of British Columbia 1990-1992 (N=70).

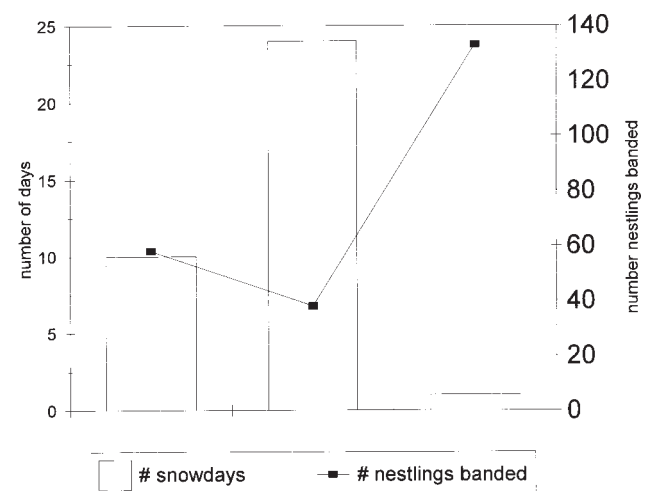


Figure 3.—Number of days of lying snow (snowdays) per winter in the Lower Mainland of British Columbia and number of Barn Owl nestlings banded the following summer.

The seasonal pattern of reproduction was bimodal, with the largest peak in numbers of nestlings banded occurring in late spring to early summer, and a second, smaller peak occurring during the fall (fig. 4). In 1991, peak numbers of nestlings were banded 1 month later than in 1990 or 1992, demonstrating that egg-laying was delayed that year.

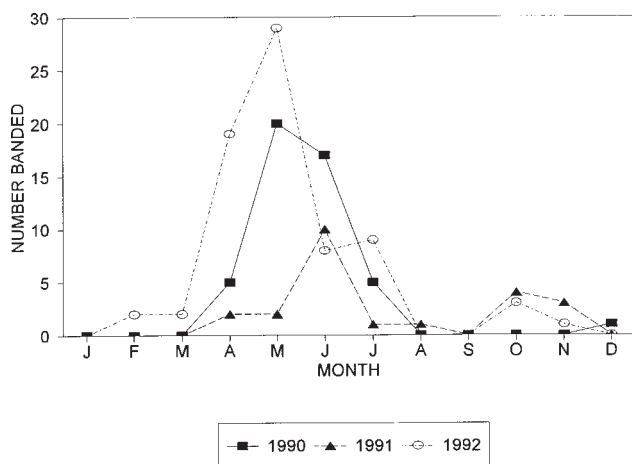


Figure 4.—Number of nestling Barn Owls banded by month, 1990-1992 in the Lower Mainland of British Columbia.

If the total number of nestlings recorded/year is used as an index of productivity and the number of carcasses turned into the Ministry of the Environment is used as an index of mortality (fig. 5), 1991 had both the highest mortality ($\chi^2 = 11.58$, $p < 0.05$, $df = 2$; Bonferroni z test) and the lowest productivity of the 3 years ($\chi^2 = 38.01$, $p < 0.05$, $df = 2$; Bonferroni z test). The greatest proportion of successful nests also occurred in 1991 (table 3). Seventy-seven percent of the observed nests over the 3 years successfully fledged young, and the overall percentage of nestlings fledged was 80 percent. In Mali, most Barn Owl pre-fledging mortality occurred before Day 15 (Wilson *et al.* 1985). If this is also the case in the Lower Mainland, most nestling mortality would have occurred before the nestlings were banded (counted), resulting in the small observed difference between the mean brood size and mean number fledged.

DISCUSSION

Productivity declined and mortality increased during 1991, a year noted for its snowy, cold winter. These results were probably due to a

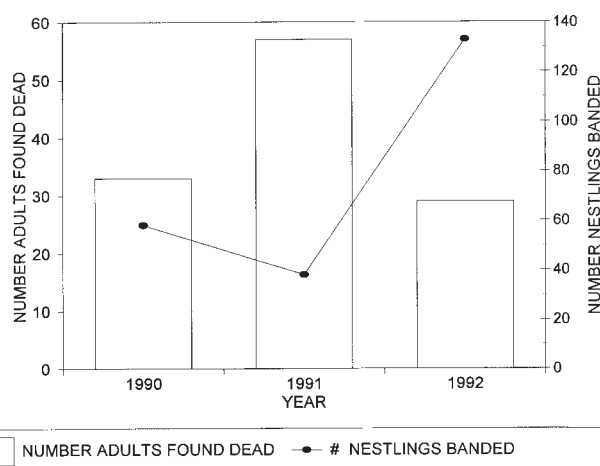


Figure 5.—Barn Owl production and mortality, 1990-1992 in the Lower Mainland of British Columbia.

Table 3.—Percentage of successful Barn Owl nests and nestlings fledged in the Lower Mainland of British Columbia.

Year	N	Successful nests	Nestlings fledged
----- Percent -----			
1990	18	78	93
1991	15	86	89
1992	29	72	71
Total	70	77	80

combination of fewer owls surviving the winter to breed and poor foraging weather during the nestling season. Yet, the same year (1991) also had the greatest proportion of successful nests. This apparent contradiction may be due to young owls making up the largest proportion of winter deaths and therefore relatively fewer young owls nesting the following spring. It is likely that impaired hunting success due to persistent snow cover would be most serious for younger birds with less hunting experience. If older birds are initiating the majority of the nesting attempts, their parental and hunting experience may account for the larger proportion of successful nests. It is also possible that young owls may delay the onset of reproduction under poor conditions. Female Ural Owls (*Strix uralensis*) have been observed to postpone their first breeding attempt when faced with poor environmental conditions (Pietiainen 1988).

Other studies have found similar variations in Barn Owl reproduction with environmental



conditions. The number of nesting attempts, mean clutch size, and mean number of young fledging from successful nests all declined the year following a severe winter in Utah (Marti and Wagner 1985). Marti (1992b) also found that persistent snow cover and low winter temperatures significantly delayed the onset of egg laying and reduced the number and success of breeding attempts during a 16-year study of Barn Owl reproduction in Utah. Braaksma and de Bruijn (1976) reported Barn Owl population fluctuations with climate in Holland, and Henny (1969) found that annual rates of Barn Owl production varied.

The increase in double broods and replacement broods noted in 1992 demonstrates that the population has the potential for rapid expansion after a poor year. The Barn Owl's relatively large clutch size and its ability to raise more than one brood per year under good conditions allow populations to swiftly recover. This reproductive potential is consistent with an r-selected life history strategy (Colvin *et al.* 1984).

In the Lower Mainland Barn Owls appear to depend heavily on farm buildings, especially barns, for use as roosting and nesting habitat. Considerable research has been done on the microclimates of roost and nest sites and the effects of nest insulation (Calder 1973; Bartholomew *et al.* 1976; Francis 1976; Mayer *et al.* 1982; Walsberg 1985, 1986; Millsap and Millsap 1987), and some studies have found relationships between microclimate and birds' energy budgets and/or reproductive success (Kendeigh 1961, White *et al.* 1975, Austin

1976, Kelty and Lustick 1977). Other researchers (Johnson 1974, Campbell and Campbell 1983) have suggested that the use of man-made structures is particularly important to Barn Owls inhabiting the northern limits of their range. A sheltered place to roost may enable an owl to conserve energy otherwise lost to thermogenesis, thus increasing survival when temperatures are low and small mammals are scarce or unobtainable due to snow cover (Hayes and Gessaman 1980).

Although sample sizes are limited, some general observations can be made from the nest and reproduction data. Excluding the two abnormally large (and unsuccessful) clutches, clutch sizes were consistent with that reported elsewhere (table 4). Brood size and number of fledged young per nest, although consistent with that from other studies, were somewhat lower (table 4). Given the similarities to other studies in regards to the type of nest site (barns), foraging habitat (grass fields), and prey base (*Microtus* spp.), but more challenging weather conditions (colder temperatures), our results are consistent with that which might be expected for an animal on the edge of its range. Of note is the apparent magnitude of the population change between years. Further study may offer insights as to the causal mechanism behind the annual fluctuations. Investigations on the Townsend's Vole have indicated that while numbers of this important prey vary yearly from field to field, it does not appear to cycle uniformly across the lower mainland of British Columbia (Mary Taitt pers. comm.).

Table 4.—Comparison of Barn Owl reproductive data from various sources.

Source	Area	Clutch size	N	# Fledged/nest	N
This study	British Columbia	6.5 ± 3.5^1	23 ¹	2.6 ± 2.1	62
Ault 1982	Oklahoma	-	-	2.8 ± 0.3	55
Millsap and Millsap 1987	Colorado	4.6 ± 0.4	14	2.3 ± 0.6	14
		5.3 ± 0.8	10	3.9 ± 0.8	10
Otteni <i>et al.</i> 1972	southern Texas	4.9 ± 1.4	91	$2.0 - 3.2$	71
Marti 1992b	Utah	7.2	275	5.1	275
Shawyer 1987	Great Britain	4.9	125	3.0	290
Wilson <i>et al.</i> 1985	central Mali	6.1 ± 1.5	140	1.8 ± 2.5	136

¹Clutch size calculations includes two unsuccessful nests containing 14 and 18 eggs. Excluding these from the sample gives a mean clutch size of 5.6 eggs/clutch.

Management strategies intended to maintain Barn Owl populations in the province will need to recognize the species' vulnerability to severe winter weather. Although recovery following a bad year can be swift, a succession of poor years might decimate the small Lower Mainland population. The population would, however, probably be supplemented by immigration from the south and recover its present level over several years.

CONCLUSIONS

Productivity and mortality of Barn Owls in the Lower Mainland appears to be correlated with the persistence of snow cover during the winter. Increased duration of snow cover results in higher levels of adult winter mortality as well as decreased productivity during the following breeding season. Barn Owls in the Lower Mainland appear to depend heavily on man-made structures for roosting and nesting, perhaps due to the shelter they provide. The Barn Owl's vulnerability to severe winter weather has important implications for conservation of this species in Canada.

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