

Population decline of Japanese Lesser Sparrowhawks breeding in Tokyo and Utsunomiya, central Japan

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Abstract The breeding distribution, breeding success and nest site selection of Japanese Lesser Sparrowhawks *Accipiter gularis* were studied in the suburbs of Tokyo and Utsunomiya, central Japan from 1987 to 2005. The number of nest sites increased from the late 1980s to the early 1990s but decreased thereafter in both of the study areas. After the late 1990s the hawks increasingly abandoned their nests because Jungle Crows *Corvus macrorhynchos* attacked them. In Tokyo, few sparrowhawks bred in a large grove dominated by Jungle Crows after the mid 1990s and bred mainly in a small grove with few pine trees where they selected tree species other than pines for nesting in. In Utsunomiya, a large number of Japanese Red Pine trees remained in a small grove and there hawks used pine trees for nesting in more frequently than in Tokyo. These results suggest that the increasing population of Jungle Crows has detrimental effects on the breeding distribution, the breeding success and nest site selection of Japanese Lesser Sparrowhawks.

Key words *Accipiter gularis*, *Corvus macrorhynchos*, Japanese Lesser Sparrowhawk, Jungle Crow, Population decline

The Japanese Lesser Sparrowhawks *Accipiter gularis* is a small raptor with a wide range spanning northeastern Asia (Brown & Amadon 1968). The species expanded its breeding range to include suburban areas during the 1980s (Endo et al. 1991), probably because food was more abundant than in suburban areas than in their original breeding grounds in mountainous areas (Hirano & Kimizima 1992; Ueta 1992). Recently, however, their range has begun to contract due to the increasing population of Jungle Crows *Corvus macrorhynchos* (Ueta 2000; Hirano 2002). Many raptor species have shown similar population trends in Europe; there, they increased during the 1970s and 1980s because of a reduction in the effects of pesticides (Newton 1998; Kjellén & Roos 2000), but then decreased during the 1990s (Kjellén & Roos 2000; Raven & Noble 2005) for unknown reasons.

Since Ueta (2000) and Hirano (2002) reported on the breeding distribution and breeding success of Japanese Lesser Sparrowhawks (sparrowhawks), further changes have occurred, and Jungle Crows are

now implicated in affecting not only the breeding distribution and breeding success of the hawks, but also nest site selection. Here, we present information on changes in breeding distribution, breeding success and nest site selection of sparrowhawks and their possible causes in suburban Tokyo and Utsunomiya, central Japan.

METHODS

The study sites were located in residential areas with isolated cultivated fields and groves in the suburbs of Tokyo and Utsunomiya, central Japan. The study was conducted in small groves scattered in areas of approximately 25 km² in Tokyo and 43.5 km² in Utsunomiya. The groves ranged from one to 20 ha in area and consisted primarily of Sawtooth Oak *Quercus acutissima*, Japanese Snowbell *Styrax japonica* and Japanese False Cypress *Chamaecyparis pisifera*. No major change in vegetation was recorded during the study period.

We surveyed the study sites in the early morning almost every day (except on rainy days) between April and May, from 1987 to 2005 in the case of the Tokyo study area and from 1989 to 2005 in Ut-

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sunomiya, in order to check whether sparrowhawks were breeding. Since they frequently call on their breeding grounds during spring (Hirano 1994), it is easy to detect them when they are breeding. When a breeding attempt was confirmed, we visited the nest every three to seven days between May and August to obtain breeding data, such as nest tree species, breeding status and the causes of breeding failure.

We divided the whole study period into five periods (1987–1990, 1991–1994, 1995–1998, 1999–2002 and 2003–2005), in order to be able to analyze the population trend of the hawks during the whole study period. The same nests were not used every year, so in order to avoid counting the same nest site more than once during a period, we considered nests within a distance of 500 m each other to be the same nest site, unless simultaneous breeding attempts were confirmed in the nesting area. We did not use the data collected from 1989 to 1990 in Utsunomiya because new nest sites were discovered after the period. Instead we used the nest sites known in 1991–1994 to analyze changes in the breeding distribution. All of these data were used, however, to analyze breeding success and nest site selection. When sparrowhawks abandoned their nests after being repeatedly attacked by Jungle Crows, we attributed the breeding failure to the crows.

RESULTS

1) Changes in the number of breeding Japanese Lesser Sparrowhawks

In the Tokyo study site, five Japanese Lesser Spar-

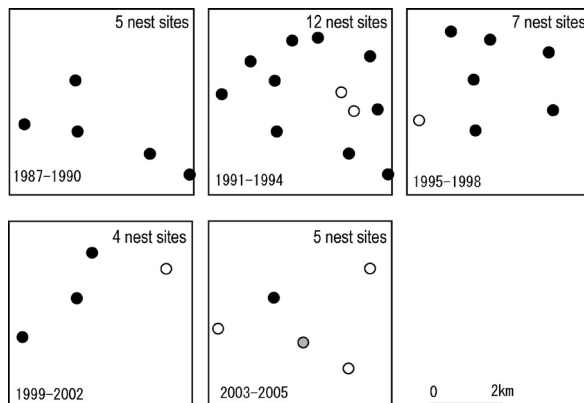


Fig. 1. Changes in the breeding distribution of Japanese Lesser Sparrowhawks in Tokyo during 1987–2005. Solid circles: successful nest sites at least a year. Shaded circles: nest sites where fledglings were depredated. Open circles: unsuccessful nest sites.

rowhawk nest sites were discovered during 1987–1990, 12 during 1991–1994, seven during 1995–1998, four during 1999–2002 and five during 2003–2005 (Fig. 1). During 2003–2005, however, only two pairs fledged young and all the other breeding attempts failed. Furthermore, Jungle Crows predated the fledglings of one pair shortly after they fledged. The number of hawk nests increased once, but decreased after the 1991–1994 period.

In Utsunomiya, 14 nest sites were discovered during 1991–1994, nine during 1995–1998, 10 during 1999–2002 and six during 2003–2005 (Fig. 2). The number of breeding sparrowhawks also decreased in the Utsunomiya study area.

2) Changes in breeding success

The number of fledglings raised in Tokyo from all

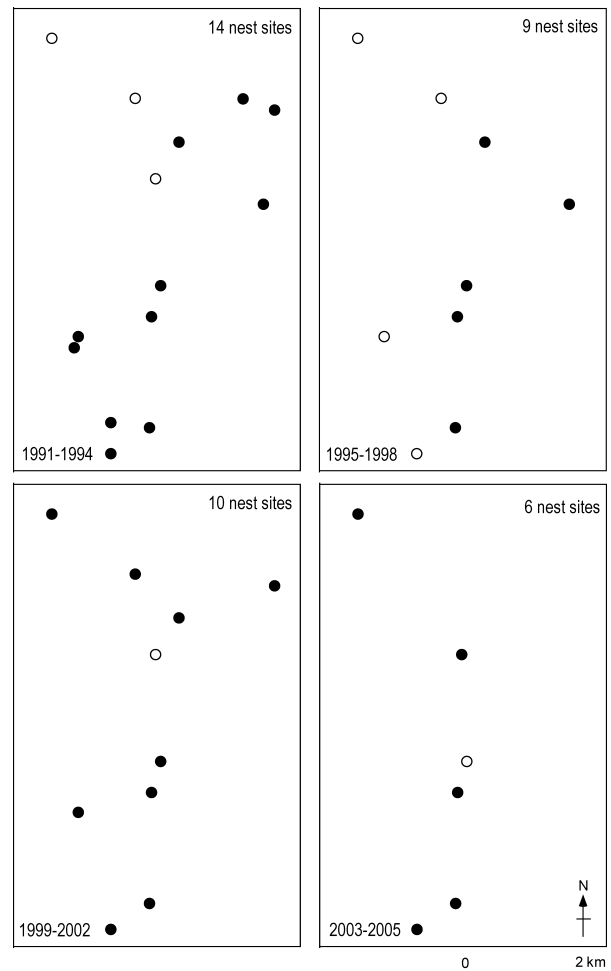


Fig. 2. Changes in the breeding distribution of Japanese Lesser Sparrowhawks in Utsunomiya during 1991–2005. Solid circles: successful nest sites at least a year. Open circles: unsuccessful nest sites.

of the sparrowhawk nests in which eggs were laid was 3.89 ± 1.8 ($N=9$) during 1987–1990 (Fig. 3). The number decreased to 2.5 ± 2.3 ($N=19$) during 1991–1994, as the number of nests collapsing increased. Although no nests fell down during the 1987–1990 period, six of 19 nests fell down during the 1991–1994 period. Nest collapse also occurred during the 1995–1998 period (two of nine nests), but no nests fell down after 1999. Breeding failure due to disturbance by Jungle Crows was first recorded in 1995 and frequently occurred after 1999 (seven of 23 nests). Jungle Crows, whether breeders or non-breeders, had a serious effect on the breeding of Japanese Lesser Sparrowhawks. The hawks abandoned their nests after being repeatedly attacked by crows.

The number of fledglings from successful nests with at least one fledgling was stable during the 1987–1998 period (Fig. 3), but decreased during the 1999–2002 period when only 2.6 ± 0.8 ($N=7$) young fledged. Differences in the breeding success of sparrowhawks in Tokyo over the whole study period were significant (ANOVA $F=6.54$, $P=0.001$), as were differences between the 1999–2002 and 1987–1998 periods, and between the 2003–2005 period and the 1987–1990 and 1991–1994 periods (Turkey's HSD test $P<0.05$).

The number of fledglings in Utsunomiya was stable, both for all the nests (2.0 ± 1.9 to 2.9 ± 1.5) and for all the successful nests (2.7 ± 1.1 to 3.4 ± 1.0) during 1987–2002 (Fig. 3). The number decreased after 2003, however, with only 0.8 ± 1.1 ($N=17$) young fledged for all the nests and 1.9 ± 0.9 young fledged for the successful nests. Differences in the breeding success of sparrowhawks in Utsunomiya over the whole study period were significant (ANOVA $F=5.03$, $P=0.001$ & $F=2.58$, $P<0.05$) as were those between the 2003–2005 period and the 1991–1994 and 1999–2002 periods for all nests, and between the 2003–2005 period and the 1995–1998 and 1999–2002 periods for successful nests (Turkey's HSD test $P<0.05$).

3) Changes in nest tree species

During the 1980s Japanese Lesser Sparrowhawks used Japanese Red Pines *Pinus densiflora* as nesting trees both in Tokyo and Utsunomiya (Fig. 4). In the 1990s, however, sparrowhawks began to nest in other tree species as well. In Tokyo they nested in other conifers and in broad-leaved deciduous trees as well as in Japanese Red Pines. In the 2000s they nested primarily on broad-leaved trees instead of pines, and

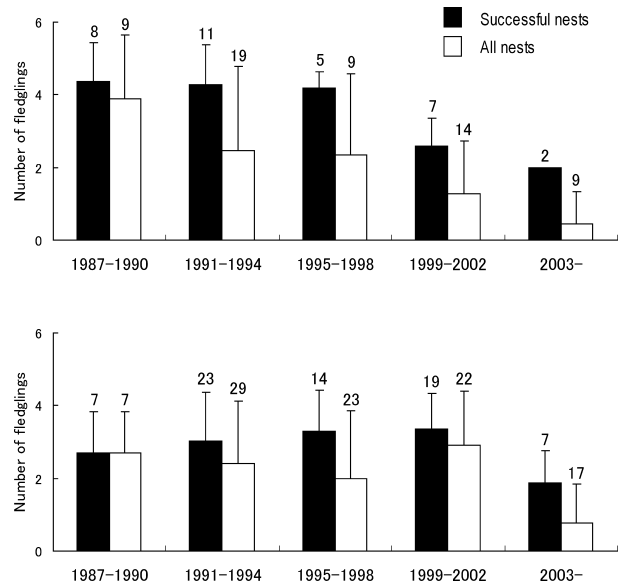


Fig. 3. Changes in the breeding success of Japanese Lesser Sparrowhawks in Tokyo (upper) and Utsunomiya (lower). Successful nests: number of fledglings / nests with at least a fledgling. All nests: number of fledglings / nests with eggs. Figures above bars represent sample sizes.

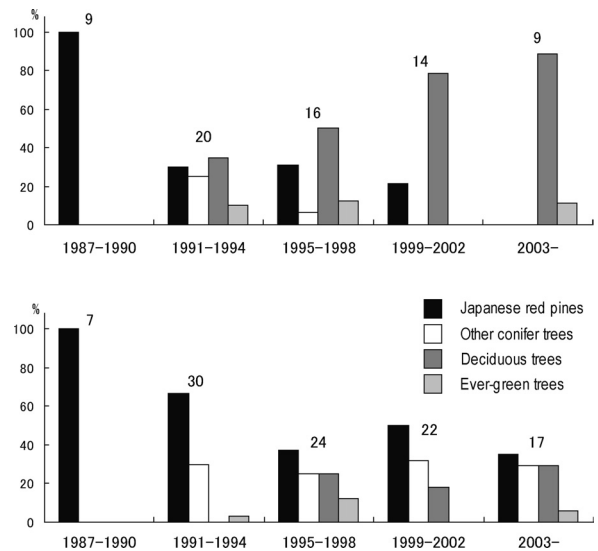


Fig. 4. Changes in the nest trees of Japanese Lesser Sparrowhawks in Tokyo (upper) and Utsunomiya (lower). Figures above bars represent sample sizes.

no nest was built in pines after 2003.

There was also a trend away from nesting in pines in Utsunomiya. Although pines were still a major nest tree (66.7%, $N=30$) there, some pairs nested in other coniferous trees during the 1991–1994 period, and after 1995 sparrowhawks nested in other conifers

and broad-leaved deciduous trees as well as pines.

DISCUSSION

In Tokyo, Japanese Lesser Sparrowhawks increased from the late 1980s to the early 1990s and decreased after that period. In Utsunomiya, they declined during the 1990s. The species was first recorded breeding in Utsunomiya only in 1988 (Hirano et al. 1988). Thus sparrowhawks probably increased from the late 1980s to the early 1990s in Utsunomiya as in Tokyo.

The number of small birds was shown to be significantly larger in suburban areas than in mountainous areas (Hirano & Kimizima 1992; Ueta 1992), thus it is suggested that an abundant supply of prey contributed greatly to the sparrowhawk's increased breeding population in the suburban areas of Tokyo and Utsunomiya. After the late 1990s, however, the number of the sparrowhawks breeding in the suburban areas declined.

The crow population has increased in both Tokyo (Ueta et al. 2003) and Utsunomiya (Hirano 2000). Jungle Crows in particular are assumed to have a detrimental effect on the breeding success of sparrowhawks, because after 1999 seven of 23 pairs of sparrowhawks abandoned their nests in Tokyo after crows (breeders and non-breeders), attacked them. In Utsunomiya, harassment by Jungle Crows caused one or two sparrowhawk pairs to desert their nests annually (Hirano 2002). In Tokyo, Jungle Crows have increased since the 1980s, and especially so through the 1990s. The majority of crows roosted in the urban area of Tokyo, then during the 1990s, they began dispersing to suburban areas too (Ueta et al. 2003). The number of Jungle Crows also increased in the two study areas (Hirano 2000, Ueta 2001). The period when sparrowhawk numbers began to decline corresponds to the period when the number of crows in suburban areas increased. Thus the increasing population of Jungle Crows probably resulted in the decline of sparrowhawks breeding in Tokyo and Utsunomiya. In contrast to the situation regarding Japanese Lesser Sparrowhawks, Kawakami and Higuchi (2003) found that the suburban population of Northern Goshawk *A. gentilis* has been increasing since the 1980s. Goshawks are much larger than Japanese Lesser Sparrowhawks, thus Jungle Crows may not pose a major threat to them.

The breeding success of Japanese Lesser Sparrowhawks decreased both in Tokyo and in Ut-

sunomiya. Breeding failure was primarily attributed to crow disturbance and nest collapse. Since we did not study either the clutch or brood sizes of the sparrowhawks, however, we were unable to determine the factors responsible for the decline in the number of young fledging from successful nests; these factors may have included reduction in clutch size and increased mortality of nestlings. Nest collapse frequently occurred in Tokyo during the 1991–1998 period, which was probably related to the change in nest tree species. Whereas few nests built in pines collapsed, those built in other tree species frequently fell down (Ueta 1997). After 1999, however, no nests fell, despite the fact that sparrowhawks nested mainly in non-pine species, perhaps indicating that the sparrowhawks learned to build their nests in more suitable positions.

Sparrowhawks increasingly chose to nest in trees other than pines. In the Tokyo study sites the dominant nest tree species were deciduous trees such as oaks, Japanese Snowbells and Japanese Zelkova *Zelkova serrata*. Japanese Red Pines do not usually occur in small groves; they are planted mainly in parks and on college campuses. Before 1990, sparrowhawks nested in pines in parks and on college campuses, but after 1991 they expanded their breeding range to include small groves with few pine trees, which resulted in the use of other tree species in the new nest sites (Ueta 1996). The change in selection of nest tree species during the early 1990s in Tokyo was due probably to the expansion of the breeding range (Ueta 1996). After the mid-1990s, however, the increasing population of Jungle Crows is assumed to have been responsible for the change. Since parks provide suitable habitat for Jungle Crows (Kurosawa et al. 2000), crow numbers have increased markedly in parks, which previously provided sparrowhawk nesting sites. Rising crow numbers prevented sparrowhawks from breeding in parks (Ueta 2001), therefore they have been forced to breed in small groves where few pine trees were available to them. In contrast, in Utsunomiya, a large number of pine trees grow in urban parks, small groves and schoolyards. Japanese Lesser Sparrowhawks, however, lose out in competition for nest sites with Jungle Crows, because the crows start to breed earlier than the sparrowhawks (Hirano 2001). Therefore sparrowhawks do not have access to pines in groves where crows breed. Since the number of Jungle Crows was smaller in Utsunomiya than in Tokyo, sparrowhawks had opportunities to nest in areas that lacked breeding pairs

of crows. Furthermore, in larger groves sparrowhawks were able to breed alongside crows (Hirano 2001).

These results suggest that the increasing population of Jungle Crows has a detrimental effect on the breeding distribution, breeding success and nest site selection of Japanese Lesser Sparrowhawks through interactions between the two species that include nest site competition, harassment, nest attacks and nest predation by crows.

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