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Breeding Status of Northern Goshawk (*Accipiter gentilis*) and Ural Owl (*Strix uralensis*) at the Imperial Palace and Akasaka Imperial Grounds, Central Tokyo (2001–2025)

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Abstract. Forests embedded within highly urbanized city centers may function as important habitats for forest-dependent wildlife; however, their ecological quality and capacity to sustain top predators over the long term remain poorly understood. This study presents long-term breeding records of two forest-dwelling raptors, the Northern Goshawk (*Accipiter gentilis*) and the Ural Owl (*Strix uralensis*), from two historical urban forests located in central Tokyo: the Imperial Palace and the Akasaka Imperial Grounds. Both sites represent mature forests that have been continuously protected and managed for more than 400 years since the Edo period, constituting rare green spaces within the core of a densely populated megacity. Breeding records were compiled from standardized bird censuses and targeted field observations conducted between 2001 and 2025. Annual data included breeding occurrence, nest use, and the minimum number of fledged young. For the nocturnal Ural Owl, additional surveys conducted from 2022 onward improved the detection of breeding events. All breeding records presented in this study were obtained under natural conditions, without the use of nest boxes or other artificial breeding aids. Northern Goshawks bred intermittently at both sites but showed relatively low reproductive output compared to records from less disturbed forests, and breeding was no longer confirmed after 2022. In contrast, Ural Owls established breeding later but showed more consistent reproduction in recent years, including the establishment of two breeding territories within the Akasaka site in 2025. These contrasting patterns are consistent with species-specific ecological traits, including differences in home-range size, prey specialization, and sensitivity to urban disturbance. Although the limited spatial scale of the study sites precludes strong statistical inference, the compiled records provide valuable baseline data on long-term raptor breeding dynamics in central Tokyo. The results indicate that historical urban forests can support forest-dwelling raptors, while habitat suitability differs among species and may change in response to urban ecological processes. Continued long-term monitoring, together with integrative studies incorporating surrounding green spaces and prey dynamics, will be essential for understanding and managing urban biodiversity in megacities.

Keywords: *Accipiter gentilis*, breeding status, the Imperial Palace, long-term monitoring, *Strix uralensis*, Tokyo, urban forest.

Introduction

In recent years, as environmental degradation in natural and rural areas has become increasingly recognized, the importance of biodiversity conservation in urban areas has also been more widely acknowledged. Therefore, the quality of green spaces within city limits needs to be re-evaluated for its ecological values, next to for example its recreational functions (McKinney, 2002).

Forested parks in urban areas provide multifaceted ecosystem services such as purifying the atmosphere, mitigating high temperatures, contributing to people's physical and mental health, preservation of cultural values, and allowing infiltration of rain water. Now, added to these functions come nature conservation objectives, such as providing habitat and opportunities to nest and reproduce for diverse organisms, from insects to birds and mammals. Unlike natural forests, forests in urban areas are typically relatively small in size and isolated, and are maintained under strong anthropogenic management. However, they can still hold diverse biota, such as varied insect life and transit points for migratory birds. Also, urban forest patches can serve to support the ecosystem of the larger city. But it is an environment where various anthropogenic disturbances such as soil and air pollution, and sudden changes in habitat occur, potentially threatening its function to uphold biodiversity (McDonnell and Pickett, 1990).

Tokyo is a highly urbanized metropolitan area that retains several extensive green spaces with long management histories. This characteristic is partly associated with cultural traditions in Japan that emphasize the value of trees and forested landscapes. The present study focuses on the Imperial Palace and the Akasaka Imperial Grounds, which are urban forests in central Tokyo which have been continuously managed for more than 400 years since the Edo period. These sites represent rare examples of long-standing mature forests within the core of a densely populated city. The continued presence of these forests is partly associated with cultural traditions in Japan, that emphasize respect for forests and continuity in land stewardship. At both locations, long-term interdisciplinary biological surveys have been conducted by the National Museum of Nature and Science and other specialists, resulting in detailed documentation of flora and fauna, including insects, birds, and mammals (NSMT, 2006; 2014).

Birds of prey are top predators in forest ecosystems and are often used as indicators of ecological conditions. In the Imperial Palace and Akasaka Imperial Grounds, a diurnal raptor species such as the northern goshawk (*Accipiter gentilis*) has been recorded over several decades, reflecting the persistence of forest-dependent predators within these urban forests. More recently, breeding of Ural owls (*Strix uralensis*) has for the first time been documented in the study area, and central Tokyo. This study examines the first ecological data of these two raptor species in central Tokyo.

The northern goshawk typically maintains a relatively large home range, often extending over several square kilometers, and primarily preys on birds. It also exhibits strong territoriality and depends on a network of forested habitat patches (Kenward, 2006; Rutz, 2006). In contrast, the Ural owl generally occupies a smaller home range, in the order of several tens of hectares, and feeds mainly on small mammals, such as rodents (Mikkola, 1983; Higuchi unpublished data). This species shows high site fidelity and a strong dependence on mature forests that provide suitable nesting structures, such as tree cavities (Saurola, 1997).

The purpose of this study is to present the current breeding status of these two raptor species in long-established urban forests of central Tokyo, based on long-term monitoring data. The findings are discussed in relation to the ecological function and management of historical urban green spaces. Importantly, breeding records presented in this study are naturally occurring breeding events, without the use of nest boxes or other artificial breeding aids. Thus, the breeding records represents spontaneous colonization and reproduction of both species within long-established urban forests.

Study area and Methods

Study area

The survey was conducted at two sites in central Tokyo: the Imperial Palace located in Chiyoda Ward, and the Akasaka Imperial Grounds located in Minato

Ward (hereafter referred to as the Imperial Palace and Akasaka, respectively). Both sites are situated on thick loam deposits derived from volcanic ash.

The Imperial Palace covers approximately 115 ha, of which about 70 ha consist of forested land. Akasaka is located approximately 1.1km west of the Imperial Palace and has a total area of about 50 ha, including approximately 35 ha of woodland. Although both sites are completely surrounded by highly urbanized areas, they support mature forest stands with heterogeneous tree species composition.

The forests of the Imperial Palace are bordered by a peripheral water moat and are dominated by a mixed evergreen–deciduous broadleaf forest, primarily composed of *Castanopsis cuspidata* and *Quercus myrsinifolia*, together with other oak species (*Quercus* spp.). Stands containing large-diameter trees such as *Cinnamomum camphora*, *Zelkova serrata*, *Cryptomeria japonica*, and *Chamaecyparis obtusa* are also present, and coniferous trees account for approximately 15–20% of the total tree composition.

Akasaka similarly supports a mixed evergreen–deciduous broadleaf forest with a minor coniferous component (also approximately 15–20%). Despite its smaller area, Akasaka maintains a relatively quiet forest environment that is effectively buffered from surrounding urban disturbance. Access by the general public is restricted at both sites, and overall human disturbance is low.

Breeding monitoring

Monthly bird censuses in the imperial palace have been conducted by the Yamashina Institute for Ornithology and the National Museum of Nature and Science since April 1965, and the first breeding of goshawks was comfirmed in the Imperial Palace in 2001 (e.g.; Kuroda and Komeda, 1983; Nishiumi *et al*., 2014; Kuroda *et al.*, 2024). From 2022, detailed owl surveys were conducted 1-3 times per month, from afternoons into the early nights. Based on these observations, from 2001 to 2025, the presence or absence of breeding birds was mainly established by sight and call observations, finds of occupied nests, and witnessing fledged offspring. For owl surveys, playback methods were used to a minimum and in the first year only. Nest occupation and (minimum) number of chicks was confirmed annually to study possible changes in breeding performance over time.

Results and Discussion

Breeding status of Goshawk

At the Imperial Palace, Goshawks first bred in 2001, and the breeding status until 2025 is summarized in Table 1. Of the 8 years in which breeding was successful the number of reared chicks was recorded only in 7 years, and mounted to an average of 2.7±0.49 (range 1-3). In 10 years, seven different trees were used to build a nest (red oak, camphor tree, metasequoia, cedar, ginkgo biloba; Figs, 1-2), and 3 nests were used twice.

At Akasaka Imperial Grounds breeding was first confirmed in 2012 by Garden Division, Imperial Household Agency. The average number of reared chicks in 8 years from 2013 to 2025, in which breeding was successful, was 1.5±0.53 (range 1-2; Table 2). In the nine years goshawks have been nesting at Akasaka, there have been only two nest sites, and the same nesting tree, a black pine, has been used for eight years (Figs, 3-4a, 4b).

It is unknown how many individual adult birds made up the goshawk breeding pairs in either area. Therefore, the breeding performance may not be strictly habitat-related, but may also strongly depend on the individuals that make up the breeding pairs. However, overall, the number of chicks reared per nesting attempt is rather low; broods of 4 or 5 nestlings have not been observed at all, and broods of 3 were uncommon. If brood size reflects habitat quality, these results suggest that habitat conditions in central Tokyo may not be optimal for goshawks, as the area deviates substantially from their preferred forest-edge habitat.

The absence of breeding pairs should be considered even more carefully. Frequent failure to breed may be a sign of poor habitat quality. However, within the central city of Tokyo and especially when a population consisting of multiple breeding pairs is still being established or in decline, failure to breed may just be an indication of an absence of birds, irrespective of habitat quality. Further indications of habitat quality may be derived from clutch size, egg size, adult turn-over rates, adult breeding age, and data relating to the

Table 1. Annual breeding records of the Northern Goshawk (*Accipiter gentilis*) and the Ural Owl (*Strix uralensis*) at the Imperial Palace, central Tokyo, from 2001 to 2025.

Imperial Palace

Year	Goshawk				Ural owl		
	Breed or not	Number Fledged	Nest	Tree Specis	Breed or not	Number Fledged	Nest area
2001	●	3	N1	*Quercus acuta*			
2002	▲	0	N1	*Quercus acuta*			
2003	×	0					
2004	×	0					
2005	×	0					
2006	×	0					
2007	×	0					
2008	×	0					
2009	×	0					
2010	×	0					
2011	×	0					
2012	×	0					
2013	●	3	N2	*Cinnamomum camphora*	Found primary fether		
2014	×	0					
2015	●	2	N3	*Metasequoia glyptostroboides*			
2016	●	3	N4	*Cinnamomum camphora*	●	1 *	K1
2017	●	3	N4	*Cinnamomum camphora*			
2018	×	0					
2019	●	3	N5	*Cinnamomum camphora*	●	2	K2
2020	×	0					
2021	●	1 *	N6	*Cerdrus Deodra*			
2022	●	2	N7	*Ginkgo biloba*	●	2	K3
2023	▲	0	N7	*Ginkgo biloba*			
2024	×	0			●	2	K3
2025	×	0			●	3	K3
Total		**20 ***				**10 ***	

For each year, breeding status, number of fledged chicks, nest identity, and nesting tree species (goshawk) or nesting area (Ural owl) are shown.

Breeding status is indicated as follows: ● = successful breeding, ▲ = breeding attempt without fledging, × = no breeding recorded.

Asterisks (*) indicate minimum numbers of fledged chicks confirmed, where the exact brood size could not be determined.

Nest and nest-area codes (e.g. N1–N7, K1–K3) are used to anonymize exact locations to avoid disturbance to breeding individuals.

The total number of fledged chicks represents the cumulative minimum number confirmed during the study period.

Fig. 1. Nesting locations of the Northern Goshawk (*Accipiter gentilis*) and nesting areas of the Ural Owl (*Strix uralensis*) within the Imperial Palace, central Tokyo. Circles labeled N1–N7 indicate goshawk nest locations corresponding to those listed in Table 1. For the Ural Owl, exact nest sites are not shown; instead, breeding areas are indicated by broader zones (K1–K3), reflecting uncertainty in precise nest location and to avoid disturbance to breeding individuals.

food base of goshawks. But little is known about these parameters from the study sites.

Interestingly, Goshawks in both areas were not recorded as breeding birds anymore from 2023 onwards. This might be coincidence, but can also indicate significant habitat changes, which will be further discussed below.

Breeding status of Ural owl

It is difficult to observe nocturnal owls during daytime, and the first indication of the presence of an owl territory consisted of the finds of owl primary feathers in Fukiage Garden in 2013 at the Imperial Palace (Table 1). After that, in 2016, the Imperial Palace Garden Division, Imperial Household Agency observed owl chicks for the first time in Fukiage Garden (Fig.1, Fig.4). In 2019, two chicks were identified during a bird census. From June 2022, daytime and night surveys were conducted for more detailed observations of owls. Of the 5 years in which breeding was confirmed, the number of chicks was established in 4 years and averaged 2.25±0.5 (range 1-3; Table 1).

In Akasaka, owl flight feathers were found for the first time during the 2013 bird census too. Breeding was first confirmed by night surveys in2022, and since then breeding has been successful every year. In 2025, breeding was for the first time confirmed in two locations on the Akasaka (Table 2). The average number of chicks was 1.6±0.55 (range 1-2). In 2025, the number of chicks in each of the two locations was one.

There are giant trees on the premises of both the Imperial Palace and Akasaka, and there are many tree holes, but all of them are in tall trees. Because the owls are very vigilant, it was impossible to pinpoint the exact nest sites, even in the breeding season. Unlike Ural owls in more natural habitats, within Tokyo they are extremely silent, also when they bring food to the nest. Some sites, identified as possible nest locations did, upon close inspection, prove not be nest sites at all. However, the general nesting area was identified from the location of the chicks' calls immediately after fledging (Figs, 1-2).

As with Goshawks, and with the same precautions about habitat quality versus individual performance, the number of raised young was lower at Akasaka compared to Imperial Palace. Perhaps, this is a forest-size dependent trait. Interestingly at Akasaka, which represents the smaller forest, the establishment of a second breeding pair broke the continuous production of two young per nest, lowering it to one young per nest. Therefore, the establishment of a second pair at Akasaka cannot be regarded as a sign of better habitat quality compared to Imperial Palace, and perhaps, is more a sign of a lack of space for a growing breeding population.

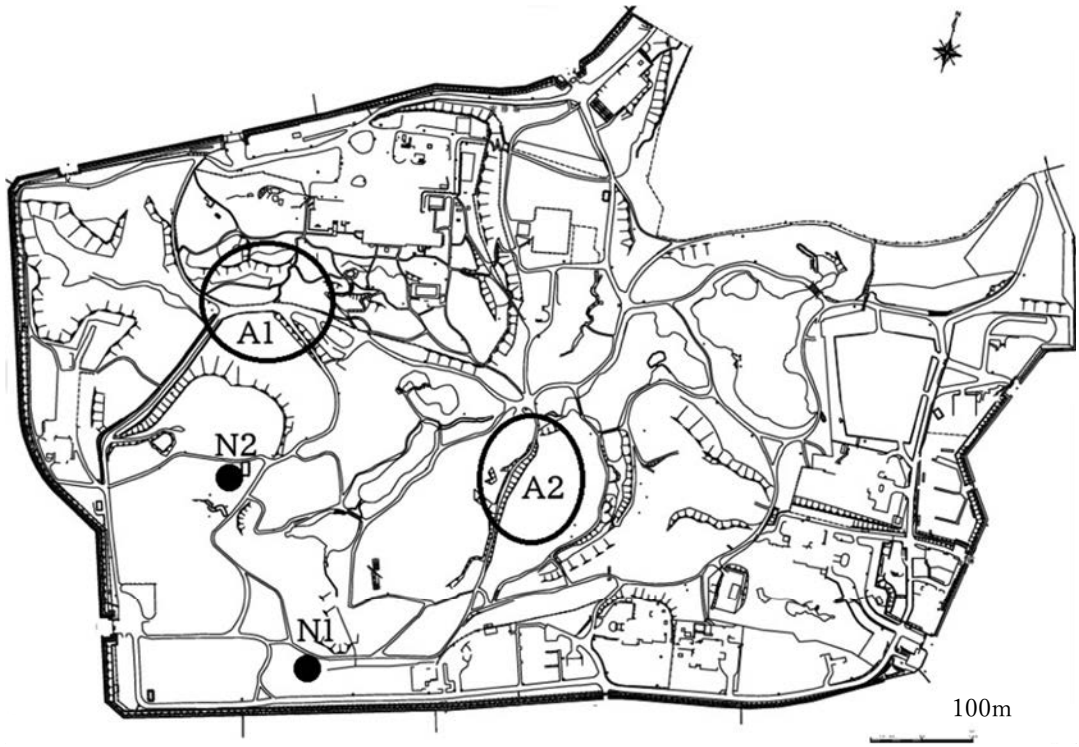

Fig. 2. Map of nesting locations of the Northern Goshawk (*Accipiter gentilis*) and breeding areas of the Ural Owl (*Strix uralensis*) within the Akasaka Imperial Grounds, central Tokyo. Circles labeled N1–N2 indicate goshawk nest locations corresponding to those listed in Table 2. For the Ural Owl, exact nest sites are not shown; instead, breeding areas are indicated by broader zones (A1 and A2), reflecting uncertainty in precise nest location and to avoid disturbance to breeding individuals.
In 2025, breeding of Ural Owls was confirmed in two distinct breeding areas (A1 and A2) within the Akasaka Imperial Grounds.

Urban ecology and raptors

Obviously, both presented raptors differ in the way they exploit their urban habitat. There is not only this clear difference in diurnal versus nocturnal life-styles, but also, however related, differences in prey choice, hunting behavior, prey detection, and home range size. Therefore, these two species do not top off the same food pyramids within the urban landscape and habitats and they will be affected differently by changes in urban ecology. For example, pellets and prey remains found on the premises in 2022-23 showed that goshawks were dependent almost exclusively on birds (Higuchi, unpublished data). Also in the Nature Education Garden, another isolated green space in Tokyo, more than 80% of goshawk chicks were fed by birds (Inoue *et al.*, 2024). In contrast, the Ural owl relied primarily on house mice, and catching crows was rare (Higuchi, unpublished data).

The results indicate clear differences in the occurrence and breeding patterns of the two raptor species at the study sites. Owing to the limited spatial extent of the two areas, it is not possible to assess large populations or to draw statistically robust conclusions about urban raptor ecology.

Nevertheless, the observed patterns are unlikely to be entirely attributable to random variation, as both species were absent from central Tokyo in the recent past but are now established as breeding birds. These temporal changes suggest underlying ecological processes associated with urban environments. Therefore, the present observations allow for cautious hypotheses regarding species-specific responses to

Table 2. Annual breeding records of the Northern Goshawk (*Accipiter gentilis*) and the Ural Owl (*Strix uralensis*) at the Akasaka Imperial Grounds, central Tokyo, from 2001 to 2025.

Akasaka Imperial Grounds

Year	Goshawk					Ural owl		
	Breed or not	Number Fledged	Nest	Tree Specis		Breed or not	Number Fledged	Nest area
2001	×	0						
2002	×	0						
2003	×	0						
2004	×	0						
2005	×	0						
2006	×	0						
2007	×	0						
2008	×	0						
2009	×	0						
2010	×	0						
2011	×	0						
2012	●	?	N1	*Pinus thunbergii*				
2013	●	1*	N1	*Pinus thunbergii*		Found fether		
2014	×	0						
2015	●	1?	N2	*Cinnamomum camphora*				
2016	●	2	N1	*Pinus thunbergii*				
2017	●	1*	N1	*Pinus thunbergii*				
2018	●	2	N1	*Pinus thunbergii*				
2019	×	0						
2020	●	1	N1	*Pinus thunbergii*				
2021	×	0						
2022	●	2	N1	*Pinus thunbergii*		●	2	A1
2023	●	2	N1	*Pinus thunbergii*		●	2	A1
2024	×	0				●	2	A2
2025	×	0				●●	2	A1&A2
Total	**12＊**					**8＊**		

For each year, breeding status, number of fledged chicks, nest identity, and nesting tree species (goshawk) or nesting area (Ural owl) are shown.

Breeding status is indicated as follows: ● = successful breeding, ▲ = breeding attempt without fledging, × = no breeding recorded.

Double symbols (●●) indicate breeding at two distinct nest areas within the same year.

Asterisks (*) indicate minimum numbers of fledged chicks confirmed, where the exact brood size could not be determined.

Nest and nest-area codes (e.g. N1–N2, A1–A2) are used to anonymize exact locations to avoid disturbance to breeding individuals.

The total number of fledged chicks represents the cumulative minimum number confirmed during the study period.

Fig. 3. Nesting tree N7 (*Ginkgo biloba*) used for Goshawk in Imperial Palace.

urban habitats and provide insights into key factors that should be considered in future studies of wildlife ecology in urban landscapes.

For both species the production of young is lower compared to references from wild breeding records. This indicates that for both species the quality of the habitat may be inferior to more natural conditions. Which aspects of habitat quality limit reproduction within cities remain unclear. It is unlikely that, perceived food shortage limits settlement in urban areas. However, obtaining it may be a different problem, especially for shy bird species, which seems even more true for Ural owls than goshawks. The actual hunting grounds may consist of only the quiet parts within the home range, as the busier sites may be unsuitable for hunting. As the studied parks are closed for public, there may be a size effect of these quiet forest patches not only for breeding and roosting, but also for hunting and hence achieving (limited) reproductive success. This would mean that to uphold such raptors in the urban environment, there should be enough of such quiet patches, and these should stay

Fig. 4a-b. Nesting treeN1 (*Pinus thunbergii*) used in 8 years for Goshawk in Akasaka Imperial Grounds.

Fig. 5. Ural Owl chick discovered for the first time in the Imperial Palace. 9th May 2016.
(photo provided by the Garden Division, Imperial Household Agency)

as such, despite public interest to open up now closed spaces in the future. Perhaps the quiet of the urban areas during the Corona pandemic also aided the Ural owls to come into Tokyo city.

Interestingly, the Ural owls have recently become more established as a breeding species, whereas goshawks seem in decline. Although it is tempting to speculate about a direct effect of Ural owls on goshawk numbers, there is no strong data to support such speculations although, in individual cases, such a factor may play a role. However, it is also possible that changes in the habitat occurred that promote Ural owl, while being disadvantageous to goshawks. Clearly, this would give the same population development pattern. Crow numbers have come down due to the improvement of garbage dumps and the extermination of crows which were concentrated in the city, and this development can also be seen from the trend in the number of crows exterminated in the Imperial Palace (Fig. 4). This change must have reduced the food base of goshawks, and may have caused them to decline. Within the same time frame there was a rapid increase in rats and possible house mice due to the decrease in the number of wild cats (due to contraceptive measures by volunteers). The increase in rodents must have benefitted especially the food base of Ural owls. Also, if crows' numbers dropped, the food base for rats likely increased, because of lowered food competition with crows. To really understand such urban ecology dynamics, research should not only focus on the top predators, but also prey species (and potential pest species) such as crows, pigeons, rats and mice should be monitored. This cannot be all over the city, and therefore combining site-specific prey monitoring data with data from top predators that 'sample' a larger range of urban habitat is an ideal combination.

The fact that Ural owls and goshawks differ in the way they exploit urban green spaces and build-up areas makes it important to include both species when adopting such an approach. Goshawks have much larger home ranges (Moser and Edward, 2019), and are not tightly connected to their nest sites during the winter. As such they survey a large part of the city (Kenward, 2006). Ural owls, in contrast, stay close to their nest site year-round as relate to the local habitat much closer (Lahti, 1972; Saulora, 1997). Their food base follows that of the city as rodents migrate in and out of the parks, balancing population density

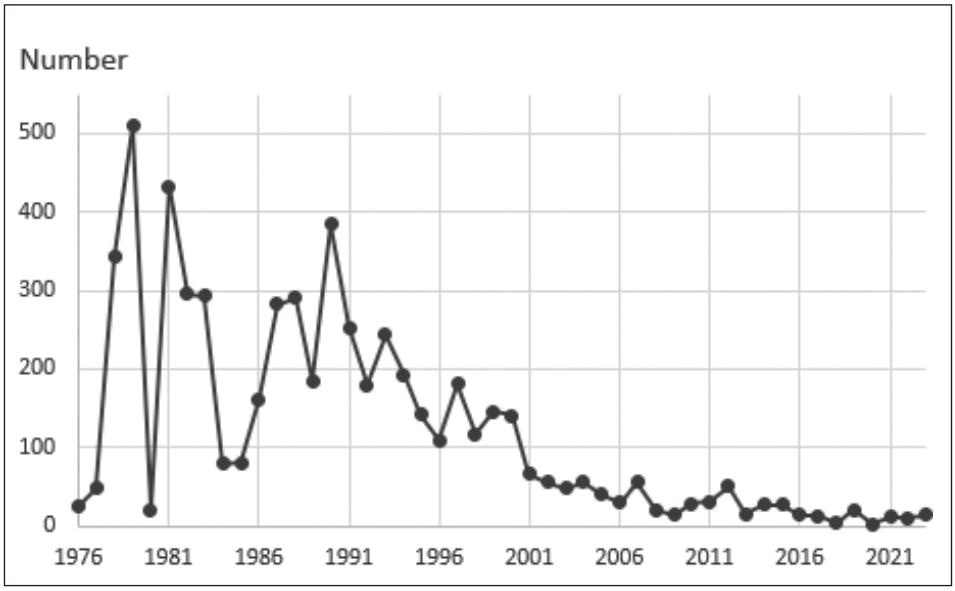

Fig. 6. Changes in the number of crows exterminated by the Imperial Household Agency's Garden Division. (Data provided by the Garden Division, Imperial Household Agency)

developments in both the green spaces as build-up areas.

Future research

Thus far monitoring goshawks and Ural owls indicated two possible determining factors of urban raptor ecology that need to be considered in more detail. These are (1) size-dependent aspects of quiet, preferably green spaces and (2) quantitative assessments of prey abundance in combination with continuing raptor monitoring. Therefore, future research will aim to include these aspects for the better understanding of raptor urban ecology and more robust advice for city wildlife management, inside and outside the public restricted parks.

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皇居と赤坂御用地におけるオオタカ（*Accipiter gentilis*）と フクロウ（*Strix uralensis*）の繁殖状況（2001–2025年）

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高度に都市化された都市中心部に点在する孤立林は，野生生物にとって重要な生息地となりうる一方で，その生態学的特質や，食物連鎖の上位に位置する捕食者を長期的に支える機能については，十分に明らかにされていない．本研究では，東京の中心部に位置する皇居および赤坂御用地という二つの歴史的都市林において，近年繁殖が確認されている二種の猛禽類，オオタカ *Accipiter gentilis* とフクロウ *Strix uralensis* の繁殖記録を整理した．両調査地はいずれも江戸時代以来400年以上にわたり継続的に保護・管理されてきた成熟林であり，巨大都市の中心部に残された緑地として世界的にも稀有な存在である．調査地で初めて繁殖が確認された2001年からの繁殖の有無，営巣状況，ならびに確認された巣立ちヒナの最小個体数を年ごとに整理した．すべての繁殖記録は，巣箱などの人工的な繁殖補助構造物を用いず，自然条件下で確認された繁殖事例である．その結果，オオタカは両調査地において断続的に繁殖したものの，より自然度の高い森林で報告されている事例と比較すると繁殖成功度は低く，2022年以降は繁殖が確認されていないが，フクロウは繁殖開始が遅かったものの，近年は比較的安定した繁殖が確認され，2025年には赤坂御用地において二つの繁殖エリアが成立した．これらの違いは，行動圏の広さ，餌資源の利用，都市的撹乱に対する感受性など，両種の生態的特性の違いを反映している可能性がある．大都市の中心に位置する皇居および赤坂御用地が森林性猛禽類の生息地として重要な機能を果たしていることを示すとともに，その適性が種によって異なり，都市生態系の変化に応じて異なる影響を受けうることを示唆している．今後は，周辺の緑地を含めた統合的な研究と長期的なモニタリングを通じて，大都市における生物多様性の理解と，適切な都市緑地管理を進めることが重要である．