Temporal activity partitioning between Japanese weasels (*Mustela itatsi*) and sympatric carnivores in an urban river corridor in Japan

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A - Research concept and design, B - Collection and/or assembly of data, C - Data analysis and interpretation, D - Writing the article, E - Critical revision of the article, F - Final approval of the article

Abstract:
The Japanese weasel (*Mustela itatsi*), a small native carnivore in Japan, faces increasing threats to its survival from urbanization and competition from invasive species, yet its activity patterns remain poorly understood, particularly in urban environments. This study investigated Japanese weasel seasonal activity patterns and their temporal niche overlaps with sympatric carnivores in the Tama River Ecosystem Preservation Area in Tokyo. Using 12 camera traps across woodland, grassland, gravel and Sasa bamboo shrub habitat types, we monitored mammal activities from March 2021 to March 2022. Analysis of 121 independent detection events revealed the distinct seasonal activity pattern of Japanese weasels, namely diurnal activity during the warm season and cathemeral activity during the cold season. From temporal overlap analysis, temporal avoidance of larger carnivores influenced Japanese weasel activity patterns (overlap index Δ range: 0.219–0.560), serving as a strategy to minimize competitive interactions while maintaining access to resources. Temporal overlap between Japanese weasels and other sympatric carnivores was highest with red foxes (*Vulpes vulpes*) during the cold season and with raccoon dogs (*Nyctereutes procyonoides viverrinus*) during the warm season, and consistently lowest with raccoons (*Procyon lotor*) across both seasons. Reduced winter vegetation may increase Japanese weasel exposure to predation risk, potentially driving nocturnal activity shifts, although empirical validation is needed. Seasonal shifts in Japanese weasel activity may reflect established changes in its dietary preferences. We also deduce that multiple environmental drivers shape Japanese weasel activity patterns, including temperature, vegetation cover, and prey availability. Our findings suggest that temporal partitioning may serve as a crucial mechanism enabling Japanese weasels to coexist with other carnivores along urbanized river corridors, providing important insights for urban wildlife management and conservation strategies in increasingly urbanized landscapes.

Keywords: urban wildlife, Temporal partitioning, seasonal behaviour, Mustela itatsi, interspecies relationship, carnivore coexistence.

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Introduction

Continuing urbanization on a global scale threatens natural areas (Urban et al. 2024; Des Roches et al. 2021; Seto et al. 2012), leading to declines in the abundance and diversity of native species, the invasion of exotic species, and damage to ecosystem functions and resilience (Davison et al. 2021; Powers and Jetz 2019; Johnson and Munshi-South 2017; Šálek et al. 2015). In urbanized environments, the dietary plasticity of various mesocarnivores enables them to utilize anthropogenic food sources more effectively than larger carnivores, which have less capacity to coexist with humans (Tsunoda et al. 2018; Lewis et al. 2015; Šálek et al. 2015; Bateman and Fleming 2012). Understanding mesocarnivore interactions is thus central to assessing urbanized ecosystems (Gálvez et al. 2021). Sympatric intra-guild competitors can often coexist due to differences in resource allocation over time. This can be assessed through ecological niche differentiation along three principal ecological niche dimensions—space, time, and diet—which can effectively mitigate the negative effects of

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interspecific competition (Bu et al. 2016; Kronfeld-Schor and Dayan 2003; Schoener 1974). The capacity for competitive mammalian carnivores to segregate their hunting and activity regimes is in major part a function of their similarity, in terms of size and dietary niche (Tsunoda et al. 2020; Donadio and Buskirk, 2006; Palomares and Caro, 1999;); termed the 'niche variation hypothesis' (Bolnick et al., 2007; Van Valen and Grant, 1970; Soule and Stewart, 1970). Understanding the mechanisms underlying species coexistence, especially among ecologically similar carnivores, can ultimately help explain community diversity (Letten et al. 2017; HilleRisLambers et al. 2012; Chesson 2000). Among sympatric carnivores, competitive interactions tend to shape resource use patterns and population success (Linnell and Strand 2000; Ritchie et al. 2012), with larger species generally suppressing and displacing smaller ones (Palomares and Caro 1999; Donadio and Buskirk 2006; Pasanen-Mortensen et al. 2013; Newsome and Ripple 2015). These body size differences are a critical factor influencing carnivore coexistence, with larger predators capable of intraguild predation, while smaller predators have relative advantages in foraging efficiency (Bassar et al. 2023; Lesmeister et al. 2015; Woodward and Hildrew 2002).

Temporal avoidance is a key strategy for achieving coexistence, where smaller species may sacrifice foraging time to reduce the risk of encountering larger competitors (i.e., competitive displacement: Carter et al. 2012; Di Bitetti et al. 2009). Although often viewed as species-specific traits, activity patterns are plastic and shaped by ecological pressures such as seasonality, predation, and resource distribution (Gálvez et al. 2021; Bennie et al. 2014; Mech and Cluff 2011; Russo et al. 2011; Abramov and Baryshnikov 2000). Within the 24-hour activity cycle, many animals may exhibit peaks of activity or more complex patterns of activity at specific times, i.e., diurnal, nocturnal, crepuscular (Bennie et al. 2014).

Urban green spaces offer ecosystem services that have environmental, economic, and social value and play an important role in protecting biodiversity (Young 2010; James et al. 2009) through appropriate management practices (Aronson 2017). Corridors provide connectivity across habitats fragmented by urbanization, mitigating to some extent declining species richness and ecosystem degradation (Hilty et al. 2020; Wilson et al. 2016). Habitat along the Tama River provides an essential river corridor through the Tokyo metropolitan region in Japan (Suda et al. 2014; Cook 1991). The Tama River Environmental Management Plan was established by the Keihin River Office of the Ministry of Land, Infrastructure and Transport in 2001with aim of providing a recreational space for people while also preserving ecological functionality and species diversity (Keihin River Office 2001). To achieve these goals, Tama River's riverbank has been divided into eight functional spaces, one of which is termed Ecosystem Conservation Space, defined as being "valued by academic experts and others, with the aim of conserving valuable ecosystems in a broader sense" (Keihin Kawasaki Office 2001). The Ecosystem Conservation Space along the Tama River is inhabited by native carnivore species such as Japanese weasels (*Mustela itatsi*), Japanese martens (*Martes melampus*), raccoon dogs (*Nyctereutes procyonoides viverrinus*), red foxes (*Vulpes vulpes*) and Japanese badgers (*Meles anakuma*) (Kaneko and Kanda 2019; Okawara et al 2014), as well as by invasive North American raccoons (*Procyon lotor*) and masked palm civets (*Paguma larvata*) (Xu et al. 2024).

The Japanese weasel is a small native carnivore widely distributed across the Japanese archipelago (Okarawa et al. 2014; Mikuriya 1969). After its introduction in the early 20th century (Mikuriya 1969), competition from the invasive Siberian weasel (*Mustela sibirica*) led to a decline in Japanese weasel numbers on the islands of Shikoku (Kawaguchi 2006) and Kyushu (Sasaki 1996; Sasaki and Ono 1994), and in western Honshu (Kaneko et al. 2009; Watanabe et al. 2007). Conserving the Japanese weasel is therefore a conservation priority (IUCN 2025). The Japanese weasel is one of the few carnivores that inhabits the suburbs of large cities in Honshu and plays an important role as a predator in urban ecosystems (Fujii et al. 1998). Although non-natural dietary items, such as food scraps, are readily available in urban environments, Okawara et al. (2014) found that Japanese weasels in metropolitan areas do not consume these. Studies have shown that the preferred natural habitat of Japanese weasels is in riparian areas, such as along riverbanks, mountain streams, and around rice paddies. Here aquatic prey is abundant and rocks crevices, vegetation, and holes around tree roots provide shelter (Kaneko and Kanda 2019; Fujii et al. 1998; Sasaki 1996) and reproductive denning sites (Kaneko and Kanda 2019; Suda et al. 2014; Watanabe 2005), thus supporting their population success (Tsunoda et al. 2024). Japanese weasels rarely occupy intensively urbanized, human-made areas, but often frequent suburbs (Fujii et al. 1998; Sasaki 1996). As an apex predator, Japanese weasels are an important component of biodiversity and are informative as a bioindicator of habitat quality and environmental pollution (Tsunoda et al. 2024; Łopucki et al. 2019). While the invasive Siberian weasel population has not yet expanded in eastern Japan, the Japanese weasel's survival has been threatened by increasing urbanization in recent decades (Okarawa et al. 2014; Fujii et al. 1998; Sasaki 1996; Higashi 1988; Imaizumi 1986). With the ever-present risk of competitive pressure from invasive species, it is important to protect the Japanese weasel's ecosystem across eastern Japan. Existing studies have investigated its distribution, evolution, migratory range and feeding habits, but little research has been conducted on its activity patterns.

There is a paucity of research examining seasonal changes in the activity patterns of Japanese weasels; however, Jêdrzejewski et al.'s (2000) studied the seasonal activity patterns of common weasels (*Mustela nivalis vulgaris*) and found that patterns correlated significantly with ambient temperature. In comparison, a study conducted by Bu et al. (2016) in southwest China found that seasonal changes of Siberian weasel's circadian activity rhythm were predominantly influenced by interactions with other species.

To address these knowledge gaps, here we compared the ecological niche and activity patterns of the Japanese weasel with those of the native red foxes and raccoon dogs, and with invasive raccoons in terms of seasonal differences, dividing the year into warm (June to November) and cold (December to May) seasons. We tested three hypotheses, namely that: (1) Japanese weasels will undergo seasonal changes in their activity patterns in response to seasonal variation in temperature, inferred prey availability, and vegetation cover; (2) that Japanese weasels will tend to avoid temporal activity overlap with intra-guild competitor species, and (3) that the degree of temporal overlap between Japanese weasels and intra-guild competitors will vary seasonally, reflecting dynamic competitive relationships and responses to environmental variability. We then use our findings to discuss the interspecific relationships between Japanese weasel and sympatric carnivores in the Tama River urban corridor and to inform conservation recommendations for Japanese weasels in urbanised environments.

Methods

Study area

The study area lies approximately 52 km from the mouth of the Tama River and is located on the right bank of the middle reaches of the Tama River, straddling the cities of Akiruno, Hamura, and Fussa in greater Metropolitan Tokyo (Fig. 1). The study area was located within the ecosystem preservation area specified in the Tama River Environmental Management Plan and covered a predominantly forested area of c. 1 km^2 with a high water table. This site was then divided into four habitat types on the basis of topography and vegetation: woodland, grassland, gravels, and Sasa bamboo shrub, which occurred in mosaic patches along this stretch of riverbank. Various plant species, dominated by Amur silver grass (*Miscanthus sacchariflorus*) and Simon bamboo (*Pleioblastus Simonii*) were widely distributed in the high-water level areas of this site (Ministry of Land, Infrastructure, Transport and Tourism homepage). In addition, two highly invasive exotic plant species also occurred, big ragweed (*Ambrosia trifida*) and black acacia (*Robinia pseudoacacia*) (Goto et al. 2017). The surrounding residential area had a population density of c. 1092 people /km^2 in Akiruno city (urban area = 73.47 km^2), 5528 people /km^2 in Hamura city (9.90 km^2), and 5613 people /km^2 in Fussa city (10.16 km^2) (Statistics of Tokyo 2021). Recreational areas such as playgrounds

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and walking and cycling paths have been built along the riverbanks where people can spend leisure time along the Tama River (Keihin River Office 2001). Within our 1 km^2 study area, there was a play area covering c. 4000 m^2.

Data collection

A camera trapping survey was carried out from 16 March 2021 to 15 March 2022. Bushnell Trophycam XLT 30MP No Glow DC camera traps were used to record the activities of all mammal species present. used were. All camera traps recorded 60-second video clips, with a 20-second interval between clips, set at normal sensitivity. These cameras operated 24h a day and were powered by alkaline batteries.

A total of 12 camera traps were set, three in each of the four habitat types: grassland, Sasa bamboo shrub, gravels, and woodland (Fig. 1). Sampling effort equaled 3537 trap days from all 12 camera trap sites. Each camera trap site was active for on average 294.75 days. In grassland and Sasa bamboo shrub areas, soft vegetation made it difficult to fix cameras; therefore, cameras were attached to stakes inserted into the ground at a height of c. 40 cm. In woodland, cameras were attached to trees and attached to forest edge trees facing into the gravel habitat. All cameras were located adjacent to active wildlife trails.

Analysis

Video recordings were retained for further analysis if they included target mammal species. The ID, date, time, species name and number of animals observed were recorded. To avoid repeat counts of the same individual, if more than one individual of the same species was filmed within a 30-minute period, it was counted as a single recording (O'Brien et al. 2003). The seasonal calendar was defined as spring from 1 March to 31 May, summer from 1 June to 31 August, autumn from 1 September to 30 November and winter from 1 December to 28 February. Due to uneven sample size distribution relating to species detection across each season, we divided the year into warm (summer and autumn: June-November) and cold (spring and winter: December-May) seasons, following temperature distribution patterns (Bu et al. 2016).

To investigate the effect of intra-guild competitors on Japanese weasel activity patterns, we analysed overlaps with red foxes, raccoon dogs, and raccoons. Clips that included Japanese martens (n = 21) and masked palm civets (n = 27) were insufficient to support activity overlap analyses. Also, Japanese badgers were not active in the cold season, when they hibernate, and so were excluded from annual analyses. Temperature data were obtained from the Japan Meteorological Agency (Table 4.). We used kernel density estimation to generate activity pattern curves for each species to analyse peak activity periods (Ridout and Linkie 2009). Time was expressed in radians, ranging from 0 to 1, as required by the R package 'Circular' (Agostinelli and Lund 2024) to achieve an underlying continuous distribution and to avoid discontinuity at midnight. For temporal niche overlap between Japanese weasels and each species, activity curves were compared to calculate the overlap coefficient (Δ), using the R package 'Overlap' (Meredith et al. 2024). Δ_4 and Δ_1 were used when the sample size was ≥ 50 and <50 records, respectively. For small sample sizes, Δ_1 usually performs better than Δ_4, measured as the root mean square error (RMSE), while for larger sample sizes, the opposite applies (Ridout and Linkie 2009). Ninety-five percent confidence intervals (hereafter, CI) for Δ_4 and Δ_1 were calculated as percentile intervals from 10,000 bootstrap samples (Ridout and Linkie 2009). The Watson two-sample test was computed to test for significant differences in species overlaps. Analyses used the 'overlap', 'circular', and 'suntools' packages (Meredith et al. 2024). All analyses were conducted using R 4.3.2 (R Core Team 2023).

Results

A total of 121 valid videos of Japanese weasels were recorded, with approximately twice as many valid videos during the warm season (n = 81) as during the cold season (n = 40). Among sympatric carnivores, raccoons were filmed most often (n = 1,307 valid videos), followed by raccoon dogs (n = 1,128). Both occurred at a similar frequency during the warm and cold seasons. Red foxes were filmed more often in the warm season (n = 52) than in the cold season (n = 263) (Table 1). The largest same-species groupings of individuals in a single video was 6 for raccoon dogs, 4 for raccoons, 2 for red foxes and 2 for Japanese weasels.

Japanese weasels exhibited cathemeral behaviour during the cold season with 2 peak activity periods from 0700 to 0900 h and from 1900 to 2100 h. During the warm season they exhibited a bias toward diurnal behaviour with a peak activity period from 0800 h to 1000 h. The overlap index (Δ_1) for Japanese weasel activity times between the cold and warm season, estimated by bootstrap resampling, was 0.664 (95% CI: 0.532-0.800). The difference in Japanese weasel activity patterns between the cold and warm season was not significant (P >

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0.10) (Fig. 2; Table 2).

During the cold season, foxes had the highest overlap index with Japanese weasel activity times, at Δ_1 = 0.560 (95% CI 0.443 to 0.671; P<0.001) (Fig. 3b2; Table 3). Conversely, raccoons had the lowest overlap index with Japanese weasel activity times, at Δ_1 = 0.422 (95% CI 0.323 to 0.521; P<0.001) (Fig. 3c2; Table 3.).

In the warm season, raccoon dogs had the highest overlap index with Japanese weasel activity times, at Δ_4 = 0.338 (95% CI: 0.268-0.410; P<0.001) (Fig. 3a1; Table 3). Raccoons had the lowest overlap index with Japanese weasel activity times (Δ_4 =0.219; 95% CI: 0.151-0.293; P<0.001) (Fig. 3. c1; Table 3).

Discussion

The effects of seasonality on Japanese weasel activity patterns

We found support for our first hypothesis (H1), with Japanese weasel activity being more diurnal during the warm season and more cathemeral during the cold season; that activity differences between these seasons were non-significant may be due to relative sample sizes and unevenness. The warm season activity pattern we detected is consistent with Jêdrzejewski et al. (2000), who reported that common weasels are fundamentally diurnal to avoid nocturnal predators (including avian predators). The cold season activity pattern we detected is consistent Bu et al. (2016), who found that Siberian weasels are nocturnal in winter, where Zielinski (1988) proposed that nocturnal behaviour of weasels (*M. erminea* and *M. nivalis*) is

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related to of the peak activity in their small rodent prey. These seasonal shifts in Japanese weasel activity may also be affected by vegetation cover in the Tama river area (Kuramoto et al. 1993), suggesting that in the absence of winter vegetation cover for concealment while active, Japanese weasels switch to being active under the cover of darkness. Diurnal cover is also important for Japanese weasels because they are vulnerable to being predated by Goshawks and buzzards (Miller et al. 2014) which occur in the Tama River area (Shirata et al. 1998), although no owl species have been reported for this area that might pose a risk to weasels at night. Our results highlight the need for future work to examine relationships between weasel activity, raptor activity and predation pressure, and vegetation cover. Overall, our findings in relation to H1 corroborate that the activity patterns of *Mustela spp*. primarily respond to seasonal changes in prey availability and predation risks.

Temporal differentiation promotes species coexistence

We found mixed support for our second hypothesis (H2) with Japanese weasel activity tending to overlap with some potential guild competitors, such as raccoon dogs in the cold season and foxes in the warm season, more than others, where little activity overlap occurred with raccoons. The overlap coefficients observed in our study (0.219–0.560) low to moderate degrees of temporal differentiation between Japanese weasels and intra-guild competitors. Species reduce interspecific competition and achieve coexistence by differentiating themselves along different ecological niche dimensions (Colwell and Rangel 2009; Holt 2009; Pulliam 2000; Hutchinson 1957). Larger carnivores can force smaller subordinate species to exhibit avoidance behaviour, which reduces their efficiency as predators and may ultimately reduce their abundance (Bischof et al. 2014; Prugh et al. 2009).

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To cope with intra-guild competition and achieve coexistence, smaller species often undergo niche differentiation to partition their activity and/or diet from those of other, larger sympatric carnivores (Barros et al. 2024; Tsunoda et al. 2025; Colwell and Rangel 2009; Holt 2009; Pulliam 2000). This can involve either spatial or temporal niche partitioning (Ferreiro-Arias et al. 2021; Frey et al. 2017; Schoener, 1974). In the case of our study, Japanese weasels feed primarily on fish and fruits during winter, while in other seasons they consume coleopteran insects, rodents, and orthopteran insects (Kaneko et al. 2009; Okawara et al. 2014). This dietary diversity potentially alleviates direct feeding competition with other, larger mesocarnivores during the extent that their activity periods do overlap (Nagasaki et al. 2023). Furthermore, Japanese weasels are able to conceal themselves in riparian vegetation, even when active simultaneously with foxes or raccoon dogs, reducing small-scale spatial contact (Kubo et al. 2025).

In urban settings in Japan, dietary competition between Japanese weasels and raccoon dogs is limited by raccoon dogs feeding mainly on seeds, fruit, earthworms and insects, and very occasionally animal carcasses and artificial materials such as leftovers (Enomoto et al. 2018; Sasaki and Kawabata 1994; Yamamoto 1994). Similarly, dietary differentiation from foxes living in in metropolitan Japan arises because foxes often consume a large proportion of anthropogenic food items in addition to their natural diet (Handler et al. 2020; Kaneko et al. 2019; Kaneko et al. 2001; Saunders et al. 1993). The consistently low overlap we observed between Japanese weasels and raccoons throughout the year may also arise due to raccoons opportunistically consuming human food waste and scraps in this urban area (Xu et al. 2024; Osaki et al. 2019).

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Differences in intraguild activity overlaps in relation to season

Building on H2, we found strong support for our third hypothesis (H3), noting substantial variations in species activity patterns and extent of overlap between Japanese weasels and other mesocarnivores between seasons.

Different seasonal responses among sympatric mesocarnivore guild species can cause seasonal changes in the extent of their activity patterns overlap. The overlap between Japanese weasels and red foxes was significantly greater in the cold season ($\Delta_1 = 0.560$) than in the warm season ($\Delta_4 = 0.267$), as red foxes increased their activity during daylight hours in the cold season, while Japanese weasels increased their nocturnal activity. Their reduced extent of cold season overlap h may be indirectly related to the alleviation of dietary competition, with foxes tending to predate more small mammals rather than fruit or invertebrates (Hisano et al. 2022; Zhou et al. 2013) in winter to increase their protein and fat intake (Hisano et al. 2022; King and Murphy 1985), while Japanese weasels shift to feeding more substantially on fish and fruits (Okawara et al. 2014). Similarly, the overlap between Japanese weasels and raccoon dogs was substantially greater in the cold season ($\Delta_1 = 0.550$) than in the warm season ($\Delta_4 = 0.338$), with raccoon dogs typically increasing their winter insect consumption (Enomoto et al. 2018; Xu et al. 2024). That Japanese weasels overlapped least with raccoons was consistent across both seasons (warm: $\Delta_4 = 0.219$; cold: $\Delta_1 = 0.422$), although cold season overlap was somewhat greater. This pattern suggests that raccoons maintained temporal separation from Japanese weasels throughout the year due to

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opportunistically exploiting anthropogenic food sources (Osaki et al. 2019), although with slight convergence of activity periods during the cold season (Levy et al. 2019).

Conservation recommendations for Japanese weasels in urbanized environments

Based on our findings, we recommend that the design of urban wildlife corridors should: (1) maintain the continuity of seasonal vegetation cover to provide year-round shelter for small carnivores vulnerable to avian predators and intra-guild competition; and (2) implement time-based zoning management to restrict human disturbance activities during peak activity periods of Japanese weasels (particularly during winter nights) or other sensitive species. However, we acknowledge the complexity of implementing multi-species and multi-purpose conservation strategies (García Márquez et al. 2017). In our study area, issues include ongoing raccoon control programs (Suzuki and Ikeda 2020), balancing the recreational use of the Tama park with broad conservation priorities (Yokohari and Amati 2005), and the consideration of the socioeconomic factors involved, such as public approval, participation, aging demographics, and municipal budgets, etc. (Xizi et al. 2024). There are also limitations to our study where, to better target future conservation strategies, it would be valuable to obtain synchronous monitoring data on vegetation structure and raptor activity, as well as to address seasonal imbalances in the sample sizes of activity detections.

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Table 1. Number of videos evaluated in camera trap survey from March 2021 to March 2022.

Species	**Spring and winter**	**Summer and autumn**	**Total**
Japanese Weasel (*Mustela itatsi*)	40	81	121
Red Fox (*Vulpes vulpes japonica*)	263	52	315
Raccoon Dog (*Nyctereutes procyonoides viverrinus*)	572	556	1128
Raccoon (*Procyon lotor*)	656	651	1307

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Table 2. Coefficient of overlap (Δ_1) simulated using bootstrap method (number of trails: 10000) with 95% confidence intervals (CI Low= lower, CI High= upper) and the results of Watson's Two-Sample test (WTt) in warm (summer and autumn) and cold (spring and winter) seasons for Japanese weasels.

Season	Δ_1	Simulated Mean	CI Low	CI High	WTt
Spring and winter vs. Summer and autumn	0.671	0.664	0.532	0.800	P > 0.100

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Table 3. Coefficient of overlap (Δ_1 and Δ_4) simulated using bootstrap method (number of trails: 10000) with 95% confidence intervals (CI Low= lower, CI High= upper) and results of Watson's Two-Sample test (WTt) in warm (summer and autumn) and cold (spring and winter) seasons between weasel and each species (raccoon dog, fox and raccoon).

Summer and autumn					
Species pairs	Δ_4	**Simulated Mean**	**CI Low**	**CI High**	**WTt**
Weasel-Fox	0.267	0.298	0.167	0.278	P < 0.001
Weasel-Raccoon dog	0.338	0.363	0.268	0.410	P < 0.001
Weasel-Raccoon	0.219	0.247	0.151	0.293	P < 0.001
Spring and winter					
Species pairs	Δ_1	**Simulated Mean**	**CI Low**	**CI High**	**WTt**
Weasel-Fox	0.560	0.581	0.443	0.671	P < 0.001
Weasel-Raccoon dog	0.550	0.555	0.434	0.662	P < 0.001
Weasel-Raccoon	0.422	0.445	0.323	0.521	P < 0.001

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Table 4. Monthly average of daily mean temperatures (°C) in Tokyo, from Mar 2021 to Mar 2022 (Japan Meteorological Agency)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2021	-	-	12.8	15.1	19.6	22.7	25.9	27.4	22.3	18.2	13.7	7.9
2022	4.9	5.2	10.9	-	-	-	-	-	-	-	-	-

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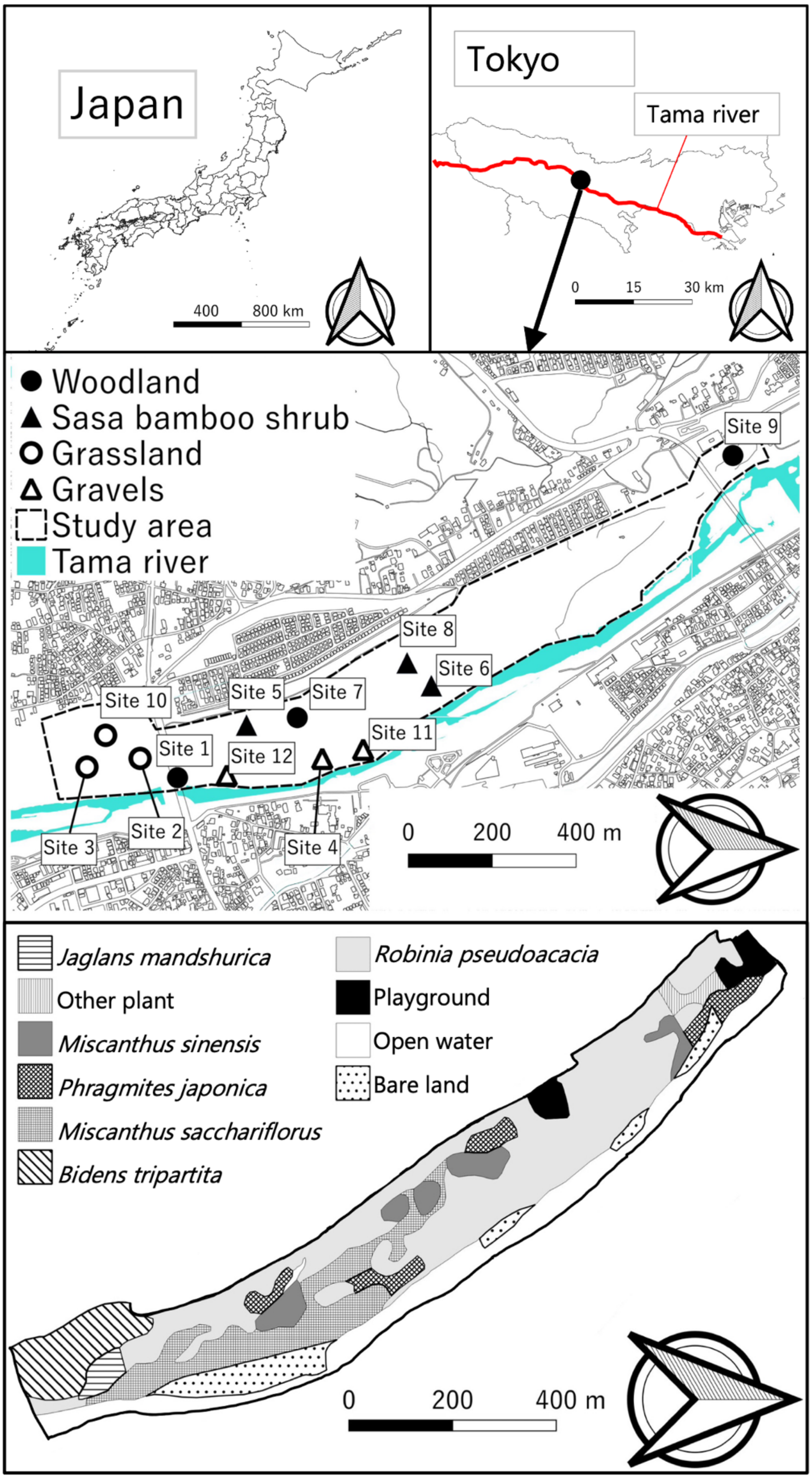

Fig. 1. Study area and camera trap locations. Circles and triangles represent camera traps and different environments in which they were set.

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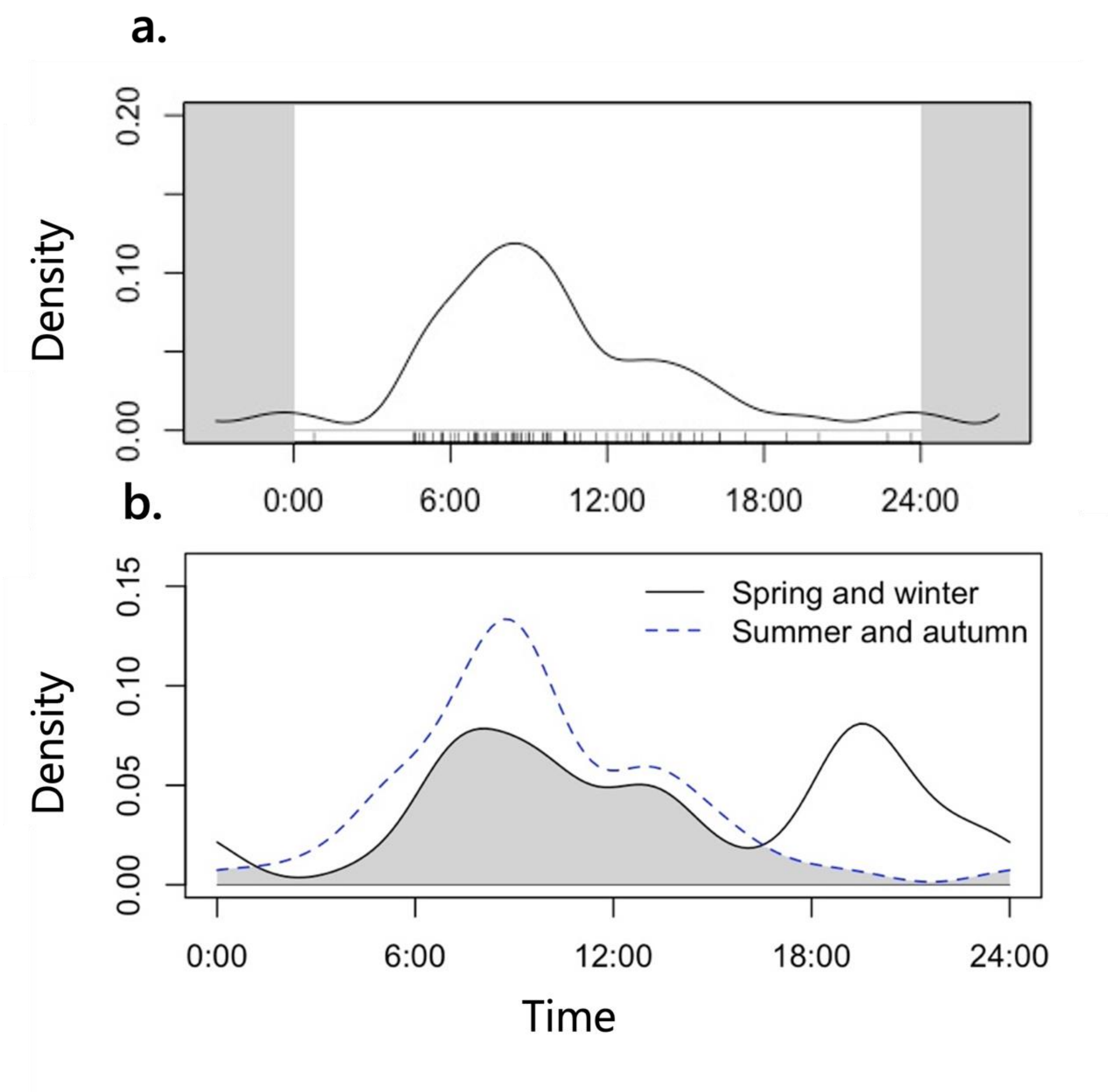

Fig. 2. a. Year-round activity patterns of Japanese weasels along Tama River corridor from March 2021 to March 2022. **b.** Activity time overlaps (gray area) between warm and cold seasons.

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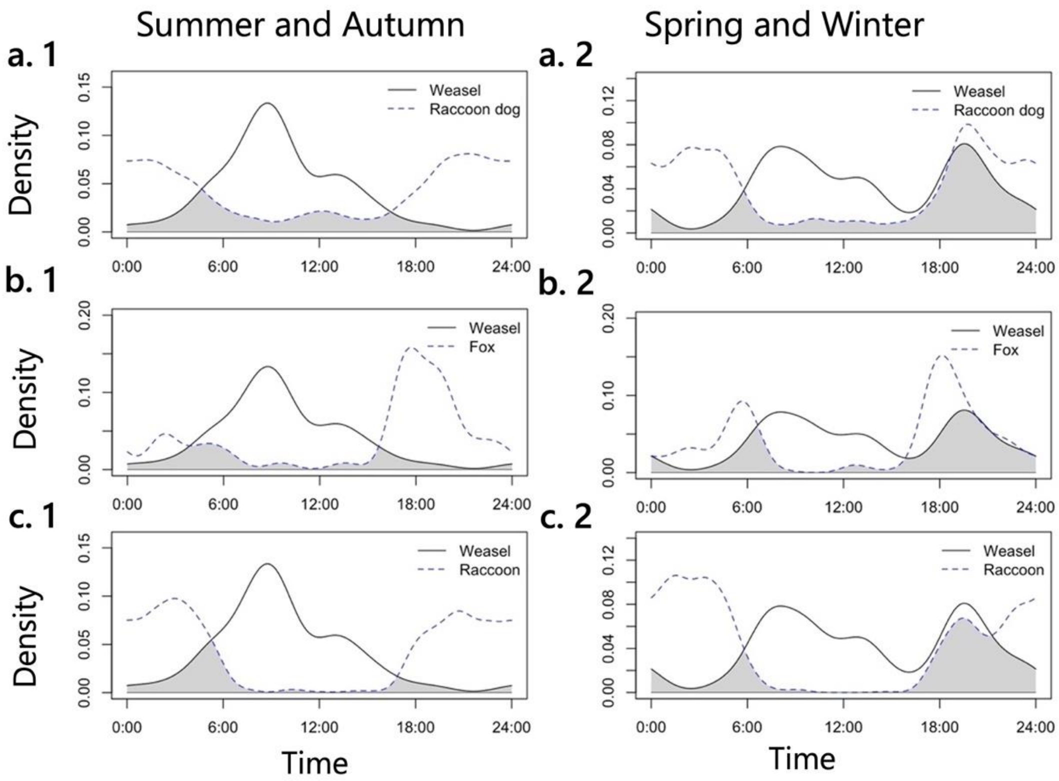

Fig. 3. Activity time overlaps (gray area) between Japanese weasels and three sympatric carnivores (a: raccoon dogs, b: foxes, c: raccoons) in warm (1) and cold seasons (2).

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