DISTRIBUTION AND MANAGEMENT CONSIDERATIONS OF RACCOON DOGS AND MASKED PALM CIVETS IN URBAN AREAS IN JAPAN

– A CASE STUDY OF KASHIWA CITY, JAPAN –

A Thesis

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Advisor: Professor Makoto Yokohari

Co-Advisor: Associate Professor Maki Suzuki

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ABSTRACT

With the fast urbanization, biodiversity loss and lots of species lost their natural habitat, meanwhile, some species found their new habitat in urban area.

The increasing abundance of coming back wildlife on one side could be thought as a positive signal for urban biodiversity. However, on the same time, the increasing human-wildlife encounters lead to more human-wildlife conflicts happened in urban area. The conflicts include both existing damages (exp. economic loss) and potential risks (exp. outbreak of zoonoses).

According to the previous experience on human-wildlife conflicts in rural areas, without fully understand on the situation and proper management countermeasures, the level-up conflicts could cause negative impacts on both human side (exp. economic loss and outbreak of zoononses) and wildlife side (exp. eradication and unbalance ecosystem).

However, the current policy concern and academic research on human-wildlife conflict issue in urban area is still very limited. Managements base on fully understanding on the current situation of human-wildlife conflict happened in urban area is urgently needed. This study aims to investigate the basic current situation of ecological factors (distribution, presence and abundance of the population) and sociological factors (current politics and how humans respond to their presence and abundance) related to human-wildlife conflict issue in urban area.

A group of medium sized mammals (Japanese Raccoon Dog, *Nyctereutes procyonoides viverrinus*; Masked Palm Civet, *Paguma larvata* ; Raccoon, *Procyon lotor*) have been chosen as the research target, which have high resemblance in terms of appearance, behaviors and niche with each other. The encounters and conflicts between urban residents and these three species have been reported from several areas in Japan.

Kashiwa city (Japan) has been chosen as the study area, which is a representative city of the "satellite" towns of the mega city in Japan.

Camera trap survey, interview survey and questionnaire survey have been conducted in this research during January 2012 to March 2013.

The results of study could suggest that: 1) Distribution: Raccoon dogs and masked palm civets are found in nearly every randomly selected district in Kashiwa city, however, raccoon dogs and masked palm civets abundance and increasing rate might be different. Raccoons are still rare in Kashiwa city. 2) Habitat selection: Raccoon dogs showed preferences on *satoyama* landscape and urban forests (such as forest in the park), while masked palm civets showed preferences on urban land use areas. 3) Human-wildlife conflict: Both raccoon dogs and masked palm civets are causing conflicts with residents in urban areas. However, their different land use preferences, behaviors and available food resources in urban area lead to different types and levels (12% caused by raccoon dogs while 81% caused by masked palm civets) of human-wildlife conflicts.

The current wildlife management policy categorize species into different management methods basically according to they are native or introduced species in Japan and whether they caused agricultural related damages or not, therefore both raccoon dogs and masked palm civets are in the same category even masked palm civets are considered as introduced species in several academic studies.

Based on the results, we could provide a new aspect on building the proper categorize standard for wildlife management policy, including the considerations of each species' urban-adaptation ability, land use preference and the potential conflicts/damages they could cause in urban area.

This study will hopefully play a role as an initial step of study on human-wildlife conflict and wildlife management in urban area in Japan, and provide the hints of consideration factors for the further management and policy making process to achieve human-wildlife coexistence in urban area.

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1. INTRODUCTION

1.1 Sustainability Science and Urban Sustainability

The perception of sustainability as an important issue has gained popularity for several decades (Kajikawa, 2008; IUCN, 2006). Further, it became an emerging concern and attracted growing interest in recent decades, driven by widespread dissemination of the fact that a growing world population and the depletion of natural resources are threatening human being's sustainability (Clark and Dickson 2003; Kajikawa 2008).

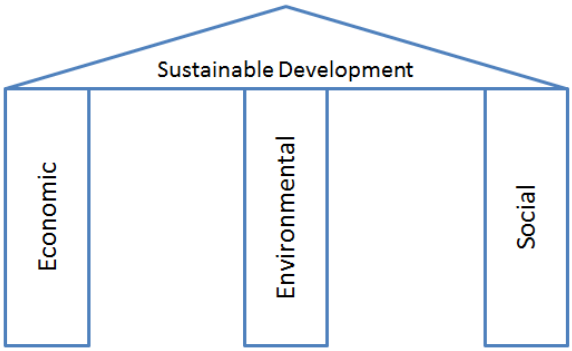
The need for sustainable development initiatives to mobilize appropriate science and technology has long been recognized (Clark and Dickson 2003) , where sustainability science has been developed as a new discipline towards to fill in this need.

However, as Clark and Dickson (2003) have been mentioned, sustainability science is not yet an autonomous field or discipline, but rather a vibrant arena that is bringing together scholarship and practice, global and local perspectives from north and south, and disciplines across the natural and social sciences, engineering, and medicine.

The core of mainstream sustainability thinking has become the idea of three dimensions, environmental, social and economic sustainability (Adams, 2006).

According to different understanding on sustainability and sustainability science, the relationship between sustainability and these three dimensions have been drawn in a variety of ways, as 'pillars', as concentric circles, or as interlocking circles as follow (Adams, 2006).

A)



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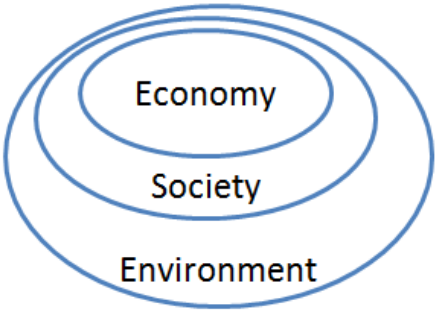

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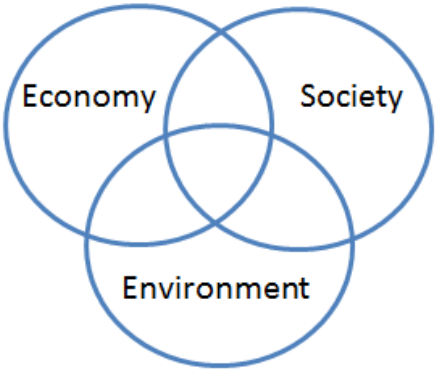


Figure 1: The three pillars of sustainable development. A) Pillar model; B) Concentric circles model; C) Interlocking circles model (Adopted by Adams, 2006)

The characteristics of sustainability are multidisciplinary, interdisciplinary, and transdisciplinary (Kajikawa, 2008, Figure 2). The key focus of sustainability science is on the dynamic interactions between nature and society (Clark and Dickson, 2003).

Within several aspects of studies on sustainability science, urban sustainability became one of the most pressing and challenging tasks facing humanity today because cities are the primary sources of major environmental problems. Urban sustainability denotes the dynamic capacity of an urban area for adequately meeting the needs of its present and future populations through ecologically, economically, and socially sound planning, design and management activities (Wu, 2008).

Urbanization occurs naturally from individual and corporate efforts to reduce time and expense in commuting and transportation while improving opportunities for jobs, education, housing, and transportation. Currently, there are over 50% of the earth's human population lives in cities (Cohen, 2003).

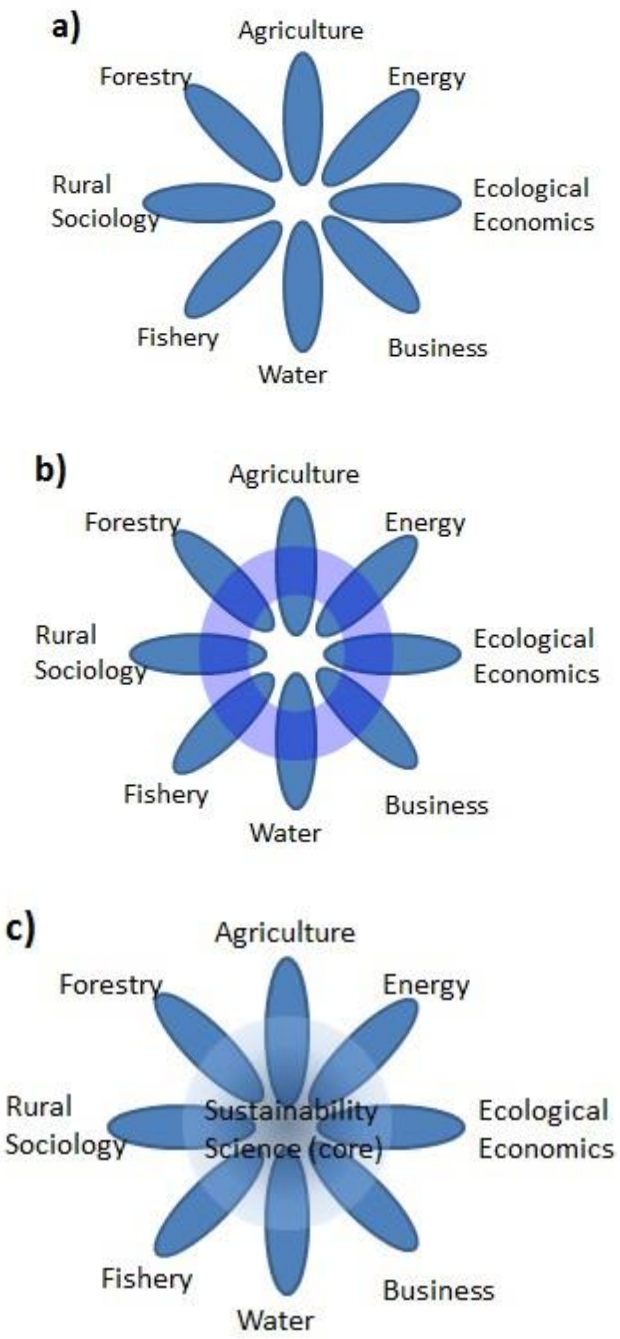


Figure 2: Relationship between sustainability science and related scientific fields: a) multidisciplinary, b)interdisciplinary and c) transdisciplinary interpretations of sustainability science (Kajikawa, 2008)

As urban populations expand, so does the urban landscape. (Dearborn and Kark, 2010). These increasingly urban landscapes have a number of profound environmental, economic, and social implications for the world's future. And the environmental impacts of urbanization are exceptionally intense locally and go far beyond the city limits to have regional and global consequences (Wu, 2008).

These environmental impacts include the local regional climate change, affect the water resources due to increase per capita use of fresh water and contamination of water sources by sewage and wasted in cities, and so on (Wu, 2008). And one of the hugest impacts on environmental aspect is that urbanization affects biodiversity and ecosystem services intensively and extensively. One research reviewed 105 studies of the effects of urbanization on the species-richness of mammals, reptiles, amphibians, invertebrates and plants, and addressed that for all groups extreme urbanization (as found in urban core areas) almost always reduces species-richness (Mckinney, 2008).

1.2 Urban Wildlife and Adaptation

Urbanization fragments the landscape, destroys habitat for many species, however on the same time it also modifies habitat of others and even creates new habitat for some species (Adams, 2005).

One previous research mentioned four factors that shape urban animal communities: 1) Direct impact of urbanization, 2) landscape patterns resulting from

urbanization, 3) synurbization , 4) introduction of species (Adams, 2005).

On one side a lot of species loss their habits under the urbanization process. On the other side, several species shows an increasing abundance in urban area, especially for birds and mammals (Luniak,2004). This phenomenon was defined as a new term-synurbization (Andrzejewski et al., 1978), which means adjustment of wild animal populations to specific conditions of urban environment (Luniak, 2004).

Population density of urban wildlife is affected by reproduction/mortality or immigration/emigration. The reproduction/mortality rate is controlled by food supply, available nesting or denning sited, predators, diseases and climate (Adams and Lindsey, 2010).

Urban ecosystems select for small- to medium-sized, highly adaptable predators (Adams and Lindsey, 2010). For the case of large-sized predators, because they require large territories with plenty of food resource, however the urban landscaped are usually fragmented and small for them.

Another rule in urban ecosystems is specialists decline in urban areas while generalists thrive (Adams and Lindsey, 2010). It means the species that have strict survival requirements regarding diet, habitat and den sites could not fit for the significantly altered existing habitat and their abundance mostly decreasing rapidly. On the contrast, the species with a general food resource and flexible den site selection could adapt to urban ecosystem easily. Even, when the specialists leave, the decrease in

interspecies competition for resources allows the generalists to not only survive, but to increase in numbers (Adams and Lindsey, 2010).

Human dimension should also be taken into consideration. Human's role could be 1) make the transition for the life in the country to city living. 2) Garbage provide food source for many urban generalists, particularly omnivores like raccoons. 3) Feeding behaviors provide supplemental food for wildlife even becomes a popular hobby (Adams and Lindsey, 2010).

Urbanization, and associated human actions, affects the behavior of wild species living in this system as well (Adams and Lindsey, 2010). In comparison with non-urban ones, urban synurbic populations showed several adjustments in the behavior and ecology to adapt to the urban ecological niches. The following list is general based on Luniak's (2004) research. 1) Living at much higher population density, reduction in the size of individual territories. 2) Disappearance of traditional migration activity. 3) Greater longevity connected with better winter survival due to favorable food and climatic conditions, and the reduction of migrations means the reduction of dangerous and exhausting activities. 4) The warmer temperature in urban area changed urban wildlife' behaviors including a longer breeding seasons (Adams, 1994) 5) Prolonged circadian activity, which might be connected with artificial lighting or the tendency to spend the hours of most intense human activity in shelters.6) Changes in nesting habits. 7) Changes in feeding behavior. 8) Tameness toward people 9) Increased intra-specific

aggression is observed.

Urbanization and the encroachment of humanity into former wild habitats will continue into the foreseeable future. Concurrently, there is a growing concern about human-wildlife encounters, especially those perceived to endanger the health and safety of humans and their companion animals (Adams and Lindsey, 2010). The number of nuisance wildlife complaints continues to rise, as does the number of private wildlife control businesses (Adams and Lindsey, 2010) and wildlife management related policy.

1.3 Human- wildlife Conflict and Wildlife Management in Urban Area

Human-wildlife conflicts traditionally have been thought of as just a rural or agricultural problem. The traditional wildlife management curricula produce wildlife biologists who focus their attention on game, nongame, or threatened and endangered species in nonurban habitats (Adams and Lindsey, 2010).

However, the expansion of urban areas into formerly natural environments has caused an increase in human-wildlife encounter, resulting in a variety of human emotions, explanations, and reactions in urban area (Adams and Lindsey, 2010).

Urban and suburban environments present a host of special challenges for wildlife professionals, both ecological and sociological factors combine to create urban wildlife

management challenges (Adams and Lindsey, 2010).

An urban ecosystems was identified as a system influencing, and being influenced by, human attitudes, behaviors, regulatory policies, and a sense of resource control throughout areas where humans live, work and recreate at moderate to densely populated social scales(U.S. Department of Agriculture, 1995). In addition, urban environments do not consist of one type of habitat. Examples of unique habitats within urban areas include parks, cemeteries, vacant lots, lakes, residential yards, school grounds, golf courses, airports, parking structures, and so on (Adams and Lindsey, 2010).

The human dimensions make the wildlife management issue much complex. The human dimension research topics investigate peoples' activities, attitudes, expectations and knowledge concerning wildlife (Adams and Lindsey, 2010, Decker et al., 2012).

A research shows in the US over 60% of urban and suburban households annually experience problems with wildlife (Messmer, 2010). Urban households reported a mean loss of $63 per household or a total loss of $1.9 billion because of wildlife damage, and urban residents reported spending over 260 million hours trying to solve or prevent these problems. On the same time, more (69%) said that they actively try to manage wildlife; urban residents annually spend an average of $60 and 22 hours trying to enhance neighborhood wildlife population (Messmer, 2010). This result indicates that regarding to the wildlife in urban area, a proper management is very important because people suffering damage caused by wildlife while appreciating wildlife in their

neighborhood as well.

Throughout most of the wildlife profession's history, management activities took place in rural setting, primarily on public lands and large tracts of private agricultural and forest land. Managers have long worked to motivate private landowners in rural areas to enhance their properties for wildlife (Decker et al., 2001). However, in the contrast, management of urban wildlife requires working with many private owners holding small parcels of land, which more sociopolitical factors will be involved in (Adams and Lindsey, 2010).

1.4 Current Human-wildlife Conflicts in Japan

In Japan, there is a long history of human-wildlife conflict in rural area (Knight, 2003).

Damage caused by wildlife to agricultural crops has rapidly increased since the 1980s (Sano, 2012).

Deer, wild boar and monkeys are considered the three largest nuisances to agricultural sectors in Japan (Sano, 2012). Nevertheless, a comparison of the results from the National Surveys on the Natural Environment of 1978 and 2003-2005 shows all seven representative large and medium size native mammal species: deer, wild boars, monkey, raccoon dogs, Japanese serow, Asian black bears and brown bears have expanded their distribution over the past two decades (Japan Wildlife Research Center,

2007).

These expanding were considered by three major reason: 1) decrease in number of hunters 2)changes in forest habitats 3) changed in land use and social structure in rural communities, the shrinking and aging rural community (Japan Wildlife Research Center, 2007).

As the damage caused by wildlife increases, the demands of rural communities and agricultural interests on elimination of the animals are growing (Sano, 2012).

Compare to the number of studies in rural area, the number of studies related to urban wildlife in Japan is very few, and the number of researches about human-wildlife conflict is much more less.

There were two studies investigated the urban and suburban resident's perceptions on small and medium sized mammals and possibility of human-wildlife co-existence according to current human's perception (Sonoda and Kuramato, 2004, Fukue et al., 2002).

The most well studied species might be crows (Corvidae). Previous studies focused on urban crows distribution (Ueda et al. 2003), diet (Kurosawa et al. 2003), breeding (Kurozawa and Matsuda, 2003; Kurozawa et al. 2004), population (Karasawa and Etsukawa, 2006) ,damage situations (Kurozawa ,2005) and so on. However, there are almost no researches on human's perceptions and reactions; the study focus is more

related to the ecological dimension but not sociological dimension.

Raccoon dogs(Nyctereutes procyonoides viverrinus), Masked palm civets (Paguma larvata), Raccoons (Procyon lotor) recently attracted a lot of attentions because of the increasing human-wildlife conflicts caused by these three species in urban area (Furuya, 2009), details will be discussed in the next part.

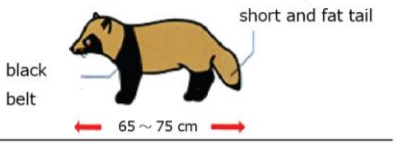
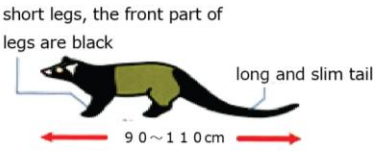
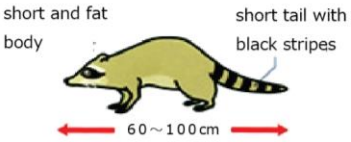
Besides these species, the animal species which cause conflict with urban residents also include insect species such like wasps (Vispinae), bird species such like pigeons (Columbidae); mammals such like mice (Myomorpha), domestic cats (Felis catus); and so on. However, regarding to the urban human-wildlife conflict issue, currently, there are more information provided by news and non-academic reports rather than academic researches.

1.5 Raccoon Dog, Masked Palm Civet and Raccoon in Japan

1.5.1 General Information about Three Target Species

This study chooses a group of mammals: Japanese Raccoon Dog (Nyctereutes procyonoides viverrinus), Masked Palm Civet (Paguma larvata), Raccoon (Procyon lotor) as the research target, which have high resemblance in terms of appearance, behaviors and niche with each other, and all have a significant growing tendency of interaction with humans in urban area in Japan (see Table 1)

Table 1: The differences between raccoon dogs, masked palm civets and raccoons (Source: Furuya, 2009. Modified by author)

Raccoon Dog	Den Site Weight Behavior	the space under the tree or huge rock 3~5 kg nocturnal		
Masked Palm Civet	Den site Weight Behavior	the hole in trees or rocks 2～5 kg nocturnal		
Raccoon	Den Site Weight Behavior	the hole in trees or rocks 5~10 kg basically nocturnal		

In the past a few decades, the agricultural related economic loss caused by these three species are rapidly increasing (Figure 3).

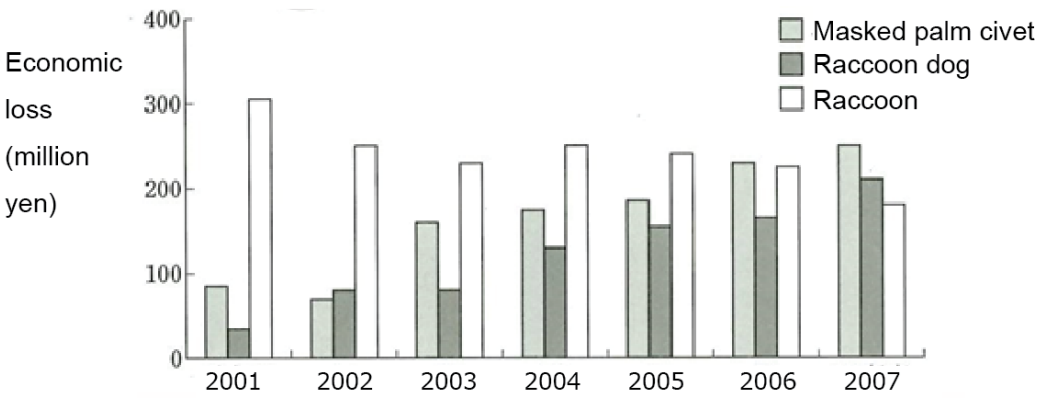


Figure 3: Agricultural related economic loss caused by Masked palm civet, Raccoon

dogs, Raccoons during 2001-2007 (Furuya, 2011)

Recently, the conflict between human and the target species are increasingly reported not only from rural area and shrines/ temples where they used to make troubles, but also from urban area, which made these three species became a trouble maker in urban area as well.

Previous researches regarding to these three species are mostly pure biological studies, and the research sample mostly from zoo or rural area (Okamoto et al. 2009, Sasaki and Kawabata, 1994).

There are a few researches on the target species' distribution. Figure 4 shows the research conducted by nature conservation office of Chiba prefecture office, shows the inhabitation of masked palm civets and raccoon dogs in Chiba prefecture.

Another is a research conducted by a nature lover, who was collecting raccoon dogs and masked palm civets witness reported from the residents in Tokyo via internet. The Figure 5 shows general distribution information of raccoon dogs and masked palm civets in Tokyo urban area during 2000-2012.

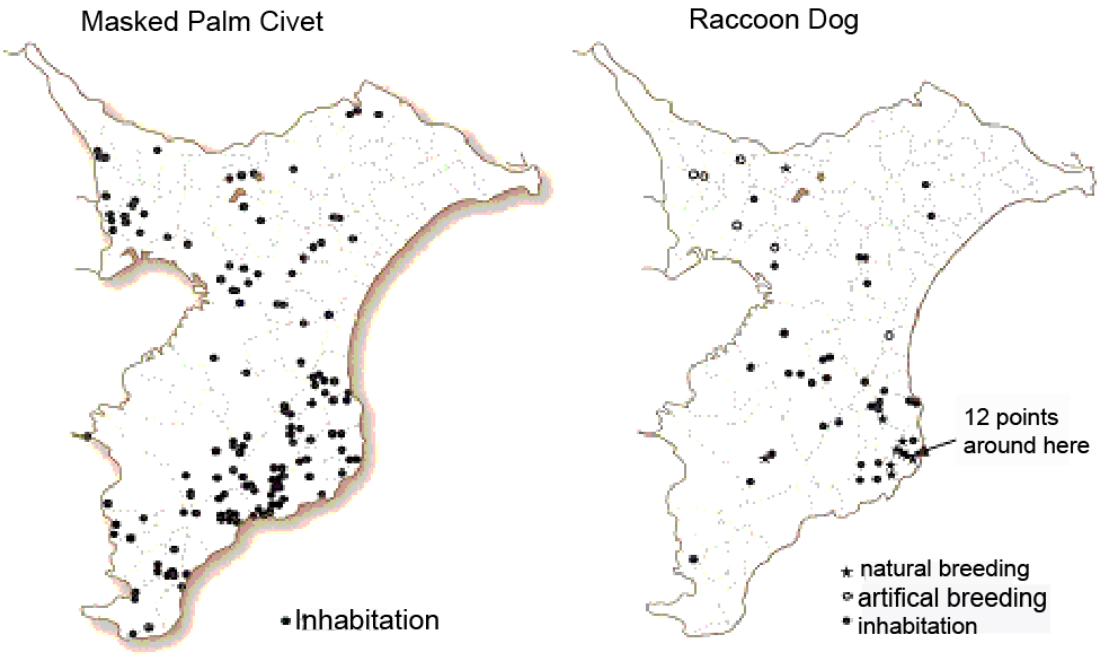


Figure 4: Inhabitation situation of raccoon dogs and masked palm civets in Chiba prefecture, Japan (department of nature conservation of Chiba prefecture, 2009)

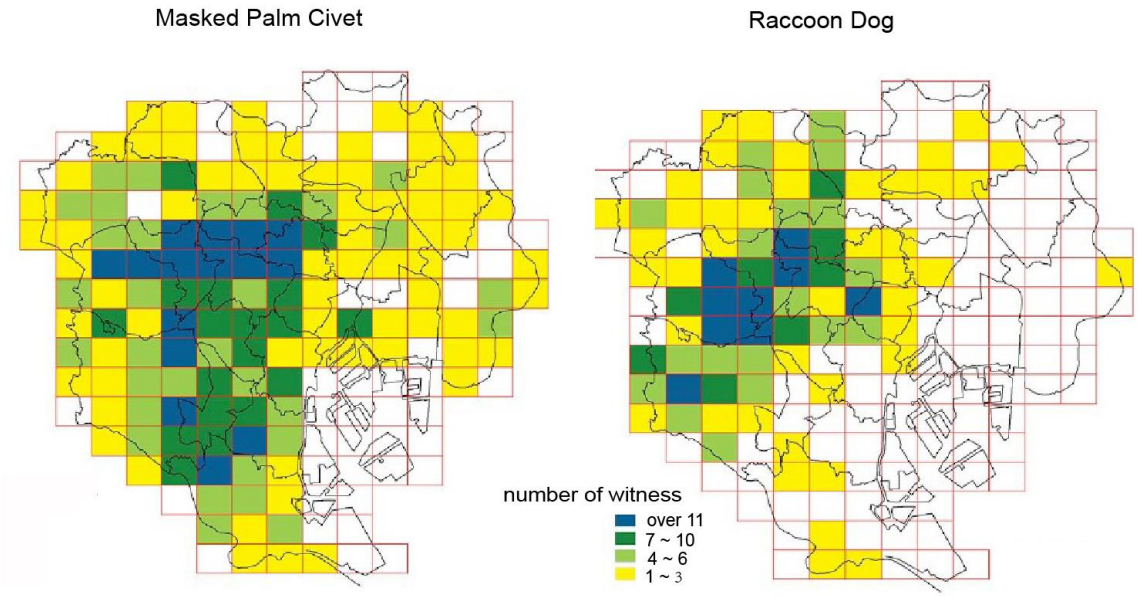


Figure 5: Sightings of raccoon dogs and masked palm civets from 2010 to 2012 in Tokyo city (23 wards area only), Japan (Miyamoto, 2013)

However, both of these two researches only have very rough location data and couldn't provide more exactly position information. Therefore they are difficult to provide further understanding on the target species habitat selection, such as the preference on land use patterns.

1.5.2 Policies and Laws

In Japan, there are a few of key laws regulating wildlife management.

The Wildlife Protection and Hunting Law (*鳥獣の保護及び狩猟の適正化に関する法律*), which the stated purposes are " to protect birds and mammals, to increase populations of birds and mammals, and to control pests through the implementation of wildlife protection projects and hunting controls." (Knight, 2007).

The Specific Alien Species Law (*特定外来生物による生態系等に係る被害の防止に関する法律*), which was issued on 2005, special focused on the alien species' management.

The law for human-wildlife conflict (agricultural related damage) prevention (*鳥獣による農林水産業等に係る被害の防止のための特別措置に関する法律*), which was issued on 2007, allow the nuisance killing of designated species which caused agricultural related damage to farmers and support farmers trying to prevent damage (see Table 2).

Sano (2012) has pointed out that policies related to wildlife management in Japan have bias in favor of the interest of farmers has resulted in the adoption of suboptimal conservation policies. Knight (2007) has also mentioned that some species are designated as game species despite the fact that they are highly endangered over a substantial part of their range such as Asiatic black bear (*Ursus thibetanus[japonicas]*).

According to the Wildlife Protection and Hunting Law, all the 3 target species (raccoon dogs, masked palm civets and raccoons) are designated as game species, which means they could be hunted by legal hunters.

On the same time, all of these 3 target species could be killed if they caused any human-wildlife agricultural related conflicts. It means they could be killed if they caused nuisance for agricultural sectors, however it also means they could not be killed even they caused damage to people who not belong to agricultural sectors.

Within these three target species, only raccoons have been designated as the specific alien species. Therefore they could be not only included in the law for human-wildlife conflict (agricultural related damage) prevention, but could be caught and killed no matter they cause any conflict with human being or not. Masked palm civets weren't designated in this list though most of scholars believe masked palm civets are introduced into Japan with in these few decades (see Table 3).

Table 2： Summary of laws and developments relating to wildlife conservation in Japan (Knight, 2007. Modified by author)

Year	Development
1918	Hunting Law (originally enacted in 1895) revised (designates game species; hunting districts managed by government established)
1931	National Parks Law comes into effect
1934	First national parks established
1947	Hunting Law revised (half of bird species and several mammal species removed from game list)
1957	Natural Parks Law comes into effect (regulates national and prefectural natural parks, and establishes a natural park system)
1963	Hunting Law renamed Wildlife Protection and Hunting Law (designates areas in which hunting is temporarily prohibited, introduces prefectural hunting license system)
1971	Environment Agency established
1972	Nature Conservation Law enacted (Establishes policy and framework for the preservation of natural areas, in conjunction with Natural Parks Law, Wildlife Protection and Hunting Law etc)
1992	Law for the Conservation of Endangered Species of Wild Fauna and Flora enacted
1993	Japan becomes signatory to the United Nations Convention on Biological Diversity
1995	National Biodiversity Strategy adopted (outlines basic principles for conserving biodiversity)
1999	Environmental Impact Assessment Law comes into effect Wildlife Protection and Hunting Law revised and Specific Wildlife Management Planning System introduced
2001	Ministry of the Environment established (restructured from the Environment Agency)
2005	Law for the Alien species enacted
2007	Law for preventing human- wildlife conflict (agricultural related) enacted

Table 3： The current management policy of raccoon dogs, masked palm civets and raccoons in Japan.

	Legal hunter	Be killed if they cause agricultural related conflict	Be killed in any situation
Raccoon Dog	●	●	×
Masked Palm Civet	●	●	×
Raccoon	●	●	●

1.5.3 Raccoon Dog in Japan

Japanese Raccoon Dog (Nyctereutes procyonoides viverrinus) is a typical native species in Japan which lives in Satoyama area and have a long history of interaction with Japanese people. There is another subspecies Nyctereutes procyonoides albus inhabits Hokkaido, including Okushiri island(Ohdachi et al. 2009).

In some area of Japan, the population of Japanese Raccoon dog has once decreased rapidly because of the development, and recovered gradually in recent few decades with a lot of conservation activities (exp. Yamaguchi prefecture, Mukoujima ; Chiba prefecture, ichikawa), and there are increasing exactly cases show that the population of urban raccoon dog is increasing rapidly (Miyamoto, 2008)

Raccoon dogs are omnivorous and nocturnal.

Their seasonal foods were characterized by leaves and flowers in spring, insects in summer, seeds in autumn, and birds/mammals and artificial foods in winter (Hirasawa et al, 2006).

Raccoon dogs use a wide range of habitats, including deciduous forests, broad-leaved evergreen forests, mixed forests, farmland and urban areas (Ohdachi et al. 2009), there mostly typical habitat is satoyama, which is a type of area where local people have influenced habitat through agriculture and forestry (Saeki et al.,2007). They also showed a difference in habitat use between raccoon dogs in Honshu area and Hokkaido area (Abe et al., 2006).

Their home range size varies greatly from 10 to 600 ha in Japan (Ohdachi et al., 2009), a mean home range size of 125.2ha (+_71.1 ha) with a 10.6 ha (+_12.8 ha) core area was reported in Hokkaido (Abe et al., 2006) and an averaged 111 ha home range size was reported by a research on satoyama landscape in south Chiba prefecture, Honshu area in Japan (Saeki et al.,2007).

Raccoon dogs could carry and be in infected by several diseases, an outbreak of canine distemper virus may cause local extinction (Ohdachi et al., 2009).

Since Japanese wolves (*Canis lupus hattai* and *Canis lupus hodophilax)* are extinct, the feral dogs could be current natural enemies for raccoon dogs (Kauhala and Saeki, 2004).

Raccoon dogs have often appeared in Japanese folklore (Ohdachi et al., 2009). Residents in urban area and suburban area showed a favorable impression on raccoon dogs (Sonoda and Kuramato, 2004, Fukue et al., 2002).

However, because raccoon dogs cause agricultural damage and economic loss, they are designated as game species and could be legal culling as well if they caused

agricultural-related damage, according to the current laws and policies in Japan.

Road kills, persecution, government attitudes, epidemics (scabies, distemper and rabies) and pollution (organotins, PCDDs, PCDFs and PCBs) remain the major threats to the species across its range. (IUCN red list, 2013)

1.5.4 Masked Palm Civet in Japan

Masked palm civet (Paguma larvata) is a civet species belongs to Viverridae family, Paradoxurinae subfamily. They are distributed from China, Vietnam, Laos, Cambodia, Peninsular, Malaysia, Thailand, and Myanmar to northern India. They are also found on Borneo, Sumatra, Taiwan, and the Andaman and Nicobar islands (Schipper et al., 2008). Their native habitats have been recorded in both evergreen and deciduous forest (Masuda et al., 2008).

They are arboreal, omnivorous and nocturnal.

They live in families composed of a mother and cubs. In average one breeding season one female could have around 2-3 offspring (Shi & Hu, 2008).

The average home range is around 30-120ha according to the previous study (Torii and Ohba, 1996, Matsuda et al., 2010), however the home range will be affected by the exactly environment where they are living and they can shift their range with long distance movement so that the total range through a year was considerable. Previous

research shows they are probable not territorial (Torii and Ohba, 1996, Matsuda et al., 2010).

There is still a discussion on whether masked palm civet (Paguma larvata) is an alien species (introduced species) in Japan or not. Although most of scholars believe that it is an alien species and introduced into Japan right after World War II (Torii and Ohba, 1996). The strongest supportive reason is: no fossil of any species from Viverridae family have ever been discovered in Japan.

On the other hand, the reasons which could support that masked palm civet might be a native species are 1) an ancient painting described an ancient species which shows similar features with masked palm civets. 2) The genes of masked palm civets in japan are different with masked palm civets in other areas.

However no matter it is an alien species or native species in Japan, as an omnivorous mammal, masked palm civet has high adaptation ability and flexible on their food /den site selection, and easy to settle down close to human dwellings(Ohdachi et al, 2009). The distribution of masked palm civet expanded rapidly in the past few decades in Japan.

According to current records, masked palm civet was first official report of the occurrence of masked palm civet was in 1945, Shizuoka prefecture in Japan, and the first catch report in Kanto area was in 1965 Ibaraki prefecture. The first case in Tokyo

area was reported in 1980 (Ohdachi et al.,2009)

With this rapid expanded distribution and their high adaptation ability, masked palm civets got more encounter with human being in several different landscape, including both rural and urban area. In consequence, the conflicts between human and masked palm civets are increasing rapidly as well.

Masked palm civets were designated as a game species which could be hunted by legal hunters since 1994 because of the increasing agricultural related economic loss they caused. However, before this law has been issued, masked palm civets were once considered as rare species in Japan and were designated as local “natural monument” in Yamanashi prefecture (on 1957) and Nagao prefecture (on 1975) (Upstream of Tianryugawa river Office in Ministry of Land, Infrastructure, Transport and Tourism, 2001)

Not only the managers and policymakers don’t have enough knowledge on masked palm civets, but also the public.

Fukue’s research (2002) investigated the urban/suburban resident’s preference on wild mammals and the rank of masked palmed civet was very low, in some area even lower than deer and monkey, who are causing much more serious damage to residents than masked palmed civet. Sonoda’s (2004) found masked palmed civet was ranked as 12th of totally 20 mammal species who are living close to human beings, but on the

same time masked palm civet took the first place of the people who chose “never hear about it” or “only know the name”, which means it is still a not well recognized species for urban residents.

1.5.5 Raccoon in Japan

Raccoons (Procyon lotor) were introduced as a pet animal from North America because of their cute appearance, but their fierce character let them run wild soon and became a dominant species in Japan (Ohdachi et al., 2009).

The first report of naturalization in Japan was from Inuyama, Aichi prefecture in 1962 (Agetsuma, 2004) and now has been reported in all 47 prefectures in Japan.

They are arboreal, omnivorous and nocturnal.

Their foods include insects, reptiles, crustaceans, birds, small mammals, fruits, crops and garbage (Ikeda et al., 2004).

In Japan, raccoons inhabit forest near water, especially forest edge (Abe et al.,2006), but they were also reported inhabit agricultural, suburban and urban areas (Ikeda, 2000).

Raccoons are good at climbing up trees and swimming (Ohdachi et al., 2009). They do not hibernate.

Male raccoons tends to keep more than one female in its home range, and come and go among several females in the mating season (Ikeda et al. 2004, Hauver et al.,

2010).

Home range size of raccoons varies depending on habitat, season and sex. Home range size in urban areas is smaller than in suburban and forested areas (Ikeda et al. 2004). They are up to 2,219 ha for males in forested areas and as small as 35 ha for females in urban areas (Ikeda et al. 2004) and a mean home range of raccoons in Hokkaido, Japan is 116.2 ha(+_ 203.8 ha) (Abe et al, 2006).

In Japan, raccoons cause serious agricultural damage (Furuya,2011). In addition, they can find a way into houses also cause problems in urban areas (Ikeda et al., 2004).

Raccoons showed a resource competition with the red fox (Vulpes vulpes) and the raccoon dog (Nyctereutes procyonoides) occurs and usually the red fox and the raccoon dog disappear after the raccoon invasion (Abe et al., 2006, Ohdachi et al., 2009).

Raccoons also pose the threat of infectious disease such as raccoon roundworm (Baylisascaris procyonis) infection which has not yet been detected in naturalized raccoons but has been detected in raccoons and other animals in captivity (Miyashita, 1993, Ohdachi et al., 2009)

There are no natural enemies for raccoons in Japan (Ohdachi et al., 2009).

However they were designated as the game species in Japan therefore the legal hunters could hunt them. In addition, because raccoons have been designated as the special alien species in Japan, they could be caught and killed if people found them.

1.6 Limitation of Previous Study and Research Objective

The traditional categories of the urban wildlife management considered three categories include management of endangered species, introduced species and feral species (Adams and Lindsey, 2010).

However, in the case of raccoon dogs, masked palm civets and raccoons in Japan, the category should be much complicated. Firstly, according to the limited researches and information, the ecological position masked palm civets is still unclear. Therefore it is impossible to make them into a clear category. Secondly, because these three species showed a lot of similarities on both appearances and behaviors, considering the interaction between these three species and the mistakes people always made on distinguishing them, the management should not be only to them one by one individually, but considered it as a group and make the special management as well.

In Japan, the number of studies regarding wildlife is very limited, especially comes to urban wildlife's case. Except a few researches on their food resources analysis (Hirasawa et al.2006, Ikeda et al. 2004), there is too little research about the target species' ecology, their behaviors, home range in urban area, breeding season, distribution and so on, which cause a difficulties or even misleading on the policymaking process and management implementations.

For finally realizing human-wildlife coexistence in urban area, reducing the

human-wildlife conflict while keep a healthy urban ecosystem with amount of urban wildlife species, a proper management, and the basic knowledge to support the management policy are needed.

Adam has been mentioned by knowing how different species and groups of species respond to different habitat sizes and patterns, I are better able to manage for them (Adams, 1994). And in his book he mentioned the conceptual model to analyze each human-wildlife conflict case as: Ecological and sociological factors work in concert to create and urban wildlife management dilemma. The ecology and behavior of the species explain the presence and abundance of the population (why the species is here and in what numbers). Sociological factors such as economics, politics, and culture set the framework for how humans respond to that wildlife presence and abundance" (Adams and Lindsey, 2010).

It could be realized that neither ecological factors nor sociological factors have been well understood in the case of raccoon dogs, masked palm civets and raccoons in urban area in Japan.

Therefore this study aims at investigating the basic current situation of ecological factors (distribution, presence and abundance of the population) and sociological factors (current politics and how humans respond to their presence and abundance). This study will play a role as an initial step of study on human-wildlife conflict and urban wildlife management in urban area in Japan, with the hope to provide the hints for what should be considered for the further management and policy making process.

2. MATERIALS AND METHODS

2.1 Study Area

Kashiwa city (Chiba prefecture, Japan) was selected as the study area of this study, which could be considered as one of the typical Japanese modern city.

Kashiwa city located in the northwest of Chiba prefecture, with an area of 114.9 km^2 and a population of 406 thousands (Kashiwa city office, 2013). The distance from the center of Kashiwa to the center of Tokyo is around 30 kilometers (Figure 6).

Kashiwa first became a town on 1926, developed as a military town in the 1930s, and was largely reconstructed during 1960s with a special fund from the central government, with the boom of developing new towns and apartment complex around Tokyo (Kashiwa city office, 2012). Kashiwa city was considered as one of the most important satellite town of the bigger Tokyo Metropolitan Area. Kashiwa was designated a “core city” of Japan on 2008 with increased local autonomy from the prefectural government.

2.2 Camera Trap

The camera trap survey was conducted from February 1st 2012 to December 31st 2012.

The survey has been conducted in 4 areas, which was considered as the potential

land use types of the target species. 4 cameras was set as one group in each research area, the setting period was mainly 2 months expect B area (see Table 4).

2.3 Interview

Open-ended interview sessions were conducted with local residents, city officers, manager in the pest Control Company and experts in the field of wildlife ecology. Each interview session was conducted in approximately an hour.

2.3.1 Local Residents

Several open-ended interview sessions were conducted with the local people who live around Oaota forest (suburban area) and *Akebonosancyoume* district (one of the selected area for questionnaire survey, urban area).

Each interview session was conducted in approximately 10-15 minutes in order to understand the current situation of the damage caused by the target species, people's reaction and perception on human-wildlife conflict issue in both urban area and suburban area.

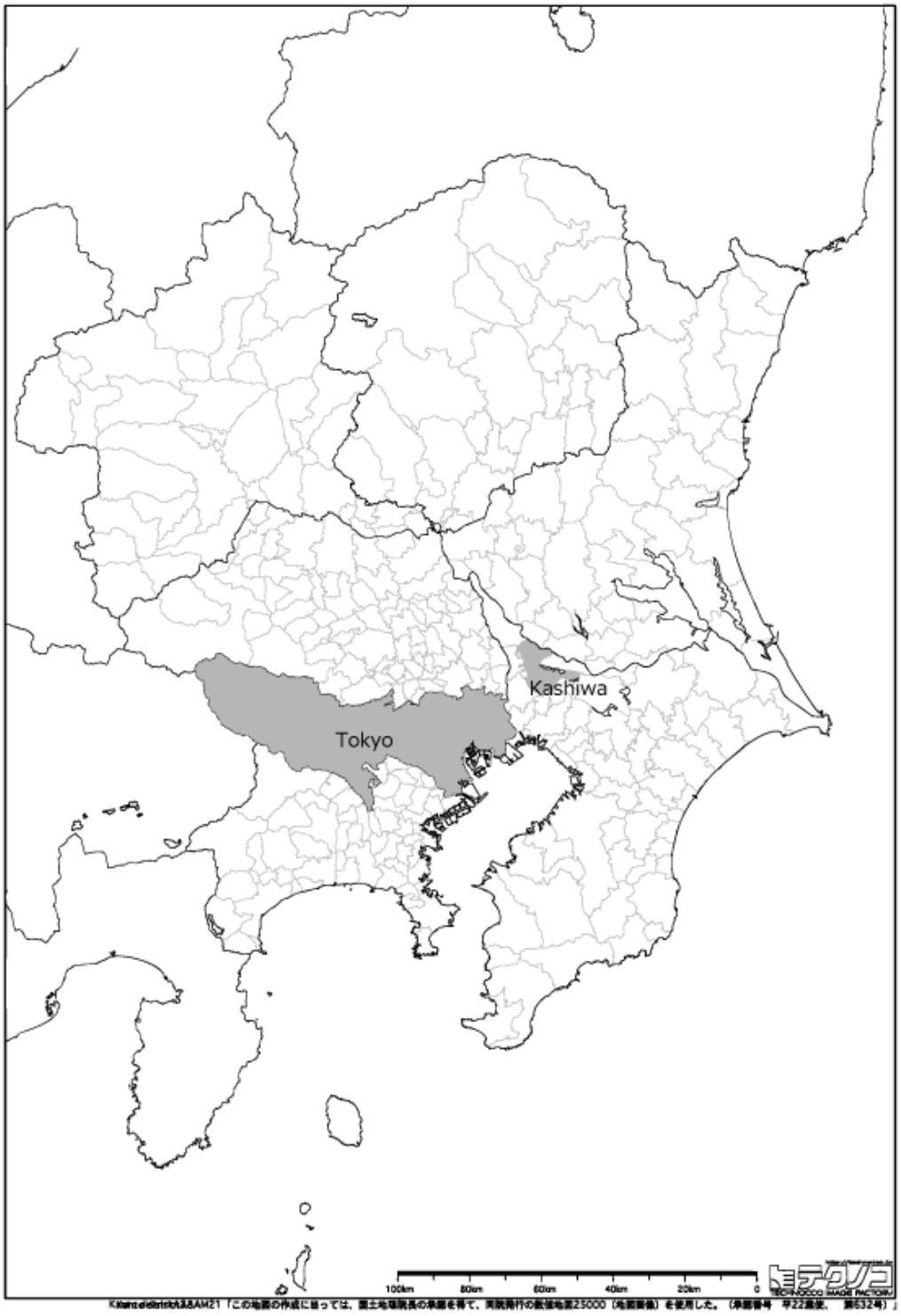


Figure 6: Location of the study area : Kashiwa city, Japan

Table 4： Information of the study area of camera trap survey

	A	**B**	**C**	**D**
Place	Oaota forest	Bush forest in the north part of Kashiwa campus of the university of Tokyo	Washinoya 199-1, Kashiwa city	Kashiwa International lodge
Attitude Longitude	N35°54′27.66″ E139°55′24.78″	N35°54′8.64″ E139°55′58.61″	N35°50′56.10″ E140°02′26.38″	N35°53′34.00″ E139°56′38.78″
Land use type	Satoyama	Bush forest	Backyard of vacant house	Public space of apartment
Number of camera	4	4	4	4
Setting period	2 months	1 month	2 months	2 months

2.3.2 Kashiwa City Office, Agriculture Department

Open-ended interview sessions were conducted with the officer from Agricultural department of Kashiwa City Office on May.31st 2012.

The whole interview session was conducted in approximately one hour in order to understand the current situation of the damage caused by the target species and the current policy related to the target species in urban area.

2.3.3 Private Pest Control Company C

Open-ended interview sessions were conducted with the manager from the private pest control company C on July 12th 2012.

The whole interview session was conducted in approximately one hour in order to understand the general situation of the damage caused by the target species in urban area, the current countermeasure and the exactly cases where have been suffered a damage.

2.3.4 Expert

Open-ended interview sessions were conducted with the expert from the science museum on August 28th 2012 and May 28th 2013.

The interviews were conducted twice in total 2 hours in order to understand the current education programs related to the target species and the interaction between the target species and human beings.

2.4 Questionnaire Survey (With Mapping Survey)

2.4.1 Design

The questionnaire included four main sections (Section A, B, C and D).

Section A consists of two scoring questions including 16 sub questions and three multiple choice questions. This section was aiming at figuring out the general situation

of vacancy inside cities and the public perceptions on vacancies. Since this questionnaire survey is a joint survey with the department of urban planning of Kashiwa city office, this part was mainly from their requirement.

Section B consists of five multiple choice questions and one optional feedback question. This survey selected 12 species including birds, insects and mammals, which could considered as the species who are inhabiting in cities or close to human's daily life (Kashiwa city office department of environmental conservation, 2011). Questions in this section aimed at understanding the general situation of wildlife in cities, including the witness, transformation, and perceptions.

Section C consists of nine choice questions and one optional feedback question, mainly included the demographic information and housing information.

Section D, which could be considered as the "Mapping survey" sections as well, consisting one mapping question and five choice questions. 30 maps of 30 selected districted (see questionnaire distribution part) were made for this survey specifically. This section was aiming at collecting the witness information of the target species (location, time, behaviors, etc.) and the damage if the respondent suffered any. To reduce (eliminate) the possibility of misidentification of the target species from the respondents, one simple guide picture was also included in this part (Furuya, 2011)

Several efforts were paid In order to achieve a better response rate (Kojima, 2010). The cover letter was in yellow color and the envelope was in light green color. The content of cover letter was written by native Japanese speaker and double checked by

several native speakers to make sure each of words are properly enough.

2.4.2 Questionnaire Distribution

Mail questionnaire survey has been conducted during the February, 2013. This survey selected a part of Kashiwa, without any large scale of farming land, forest, or large implementing new developing project as the study area, where could be considered as a stable urban area of Kashiwa city.

The survey randomly selected 30 districts from the selected districts (Figure 7). 100 questionnaires have been distributed to each of selected districts. In total the survey delivered 3000 questionnaires to 3000 household by post mail service on Feb.8th, 2013.

All the stamps were pasted manually but not postmark. A return postage-paid envelope was included in each survey package and participants were asked to mail the completed surveys back to the authors by the Feb.24th, 2013.

2.4.3 Spatial Analysis

The data from the responses of the questionnaire survey and the associated mapping survey were analyzed by using ArcGIS10 software.

All locations of witness reported were mapped on the map and the data of the land use in Kashiwa city is from Yokohari et al‘s research conducted on 2009 (not publish). The buffer analysis has been conducted to understand the preference of the land use pattern of target species. I overlapped the witness report layer and land use layer, made

buffer and they calculated the area of each type of land use inside the buffer area. The buffer size was set as 50m, 100m, 200m, 500m and 1000m, which could cover the general distance of raccoon dogs and masked palm civets home range (Torii and Ohba, 1996, Ohdachi et al., 2009, Matsuda et al., 2010). Although the witness reported area doesn't mean "den site" or "food resource area", the witness still means within their home range. Where has a high witness rate where has a high possibility to be close to their den site and food resource area. Therefore to understand the land use pattern around the witness reported area could still be helpful to understand their habitat selection preference.

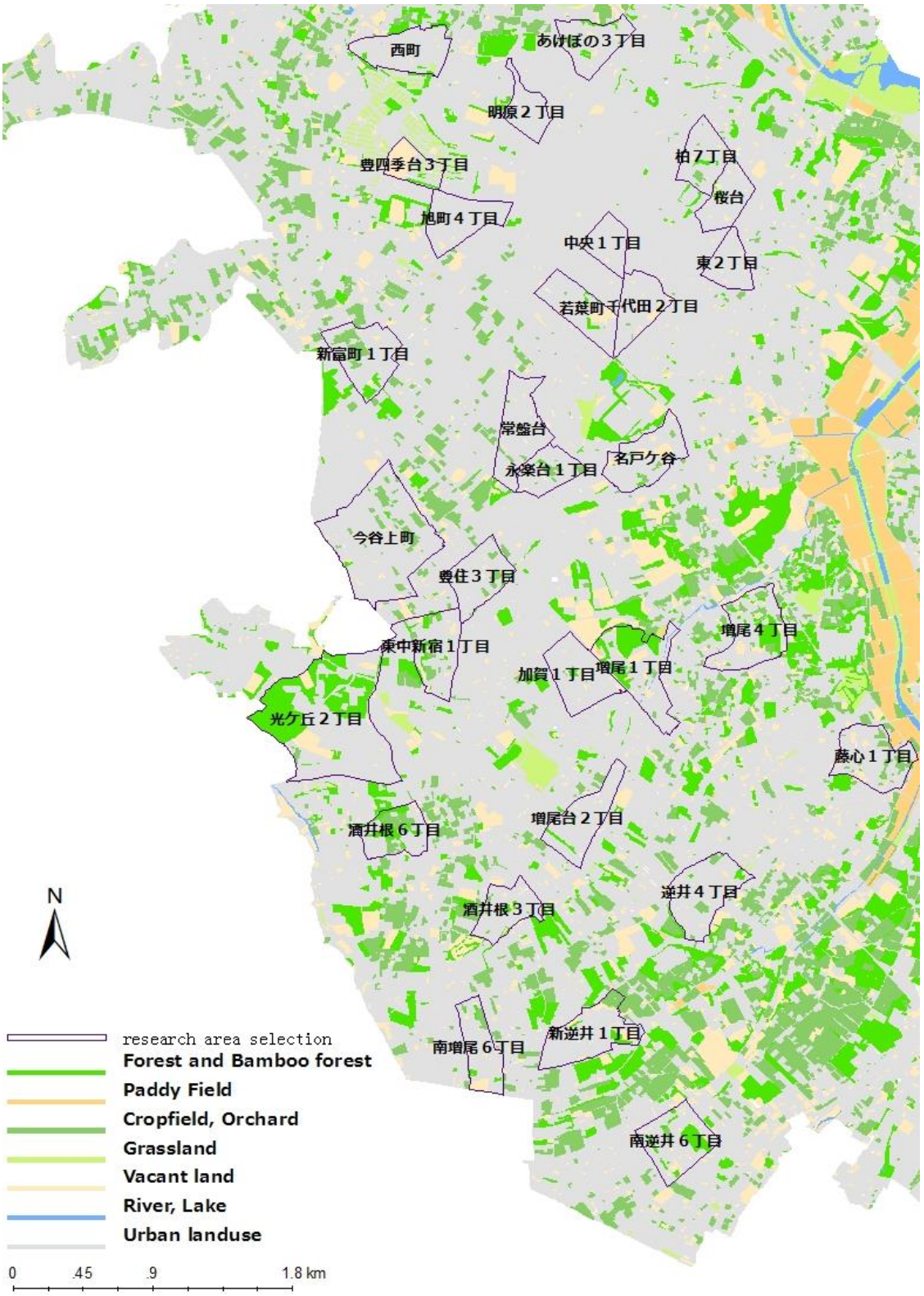


Figure 7: Randomly selected 30 districts inside the study area

3. RESULTS

3.1 Responses of the Questionnaire Survey

Survey response rate was 38.6% (1150 questionnaires returned out of 3000). Out of the 1150 responses, 266 people (8.9%) provided the witness information and mapped the exactly location on the map.

There are total 156 people said they saw raccoon dog around their houses within these 10 years, 152 people saw masked palm civet and 10 people saw raccoon.

There are 106 witness location of raccoon dog from the mapping response, 156 of masked palm civet, 6 of raccoon and 21 reported that they cannot distinguish which species it was but it must be one out of these 3 target species (Figure 8).

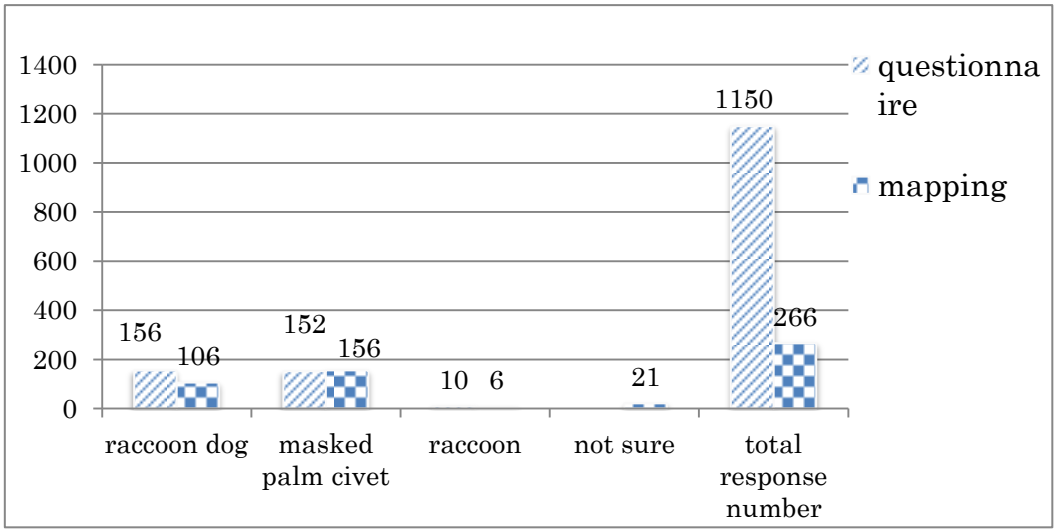


Figure 8: The responses number of questionnaire survey and the associated mapping survey.

The sightings of raccoon are rare in Kashiwa city according to the questionnaire responses, there is a possibility that because people cannot distinguish raccoon and raccoon dog very well and made the mistake when they response the questionnaire. However, according to the camera trap survey, interviews with the city officers and local residents, there are no raccoon witness was reported as well. Therefore there is a high possibility that raccoon is still not inhabit in Kashiwa city or the population of raccoon is still very low in Kashiwa city.

Because the information (response number) about raccoon is too limited to discuss the situation well, therefore this study could not and will not discuss about raccoon's situation in the following parts according to the small sample size.

3.2 Distribution of target species

The distribution information consist three parts. The camera trap survey provided the basic understanding on the land use type of target species active range and exactly proved the inhabitation of the target species in Kashiwa cities. The joint survey with the city office shows the current frequency of witness report. And the questionnaire survey with associated mapping survey provided exactly location of the witness reported.

3.2.1 Camera trap

There are no raccoon recorded by the camera trap.

Raccoon dog were caught by the camera on forests inside urban area and suburban area, in contrast masked palm civet shows up on the area where a high level of human activities has (see Table 5). In the backyard of vacant house, there was one picture I got that is difficult to judge whether it was a raccoon dog or a masked palm civet, however from the color of leg, the possibility as a masked palm civet is higher.

Table 5： Result of camera trap survey

	(A)Satoyama	(B)Bush forest	(C) Backyard of vacant house	(D) Public space of apartment
Raccoon Dog	+	+	+	-
Masked Palm Civet	-	-	+	+
Raccoon	-	-	-	-

From the picture I got by camera trap, all the individuals looks in a good health condition without any skin disease such like scabies (Figure 9).


a)
MOULTRIE
54°F
04/30/2012 01:10AM MYCAMERA


b)


c)
MOULTRIE
59°F
06/04/2012 09:32PM MYCAMERA


d)
MOULTRIE
59°F
06/18/2012 11:18PM MYCAMERA

Figure 9: Pictures took by the trap cameras: a) Raccoon dog at study area A; b) Raccoon dog at study area B; c) Masked palm civet at study area C; d) Raccoon dog at study area C; e) Masked palm civet at study area D.

It is difficult to judge the individuals I took pictures at the same study area are the same individuals or not just from the picture. Therefore it is difficult to estimate the abundance of target species by this data as well.

3.2.2 Claim Calls to Kashiwa City Office

The officer addressed that the department of agricultural, Kashiwa city office could receive the claim/ witness call related to the target species from the citizens very often, however because they are in charge of the agriculture issue only but the calls are from the urban residents, therefore they cannot provide any support and even didn't take any record for those calls till now.

The department of agriculture, Kashiwa city office was invited to join this research to make a record of the claim call or witness call from citizens about the target species from June 15, 2013 to August 15, 2013 (Figure 10).

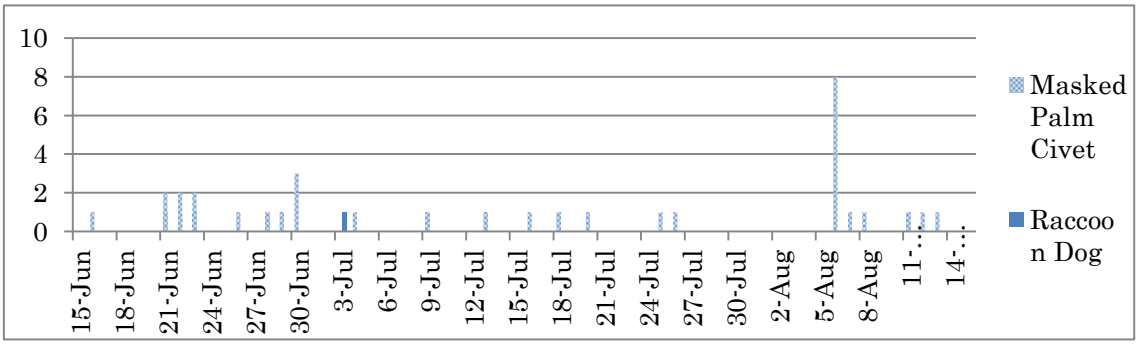


Figure 10: Number of claim/witness calls regarding to raccoon dogs and masked palm civets that the department of agriculture of Kashiwa city office received from June 15, 2013 to August 15, 2013.

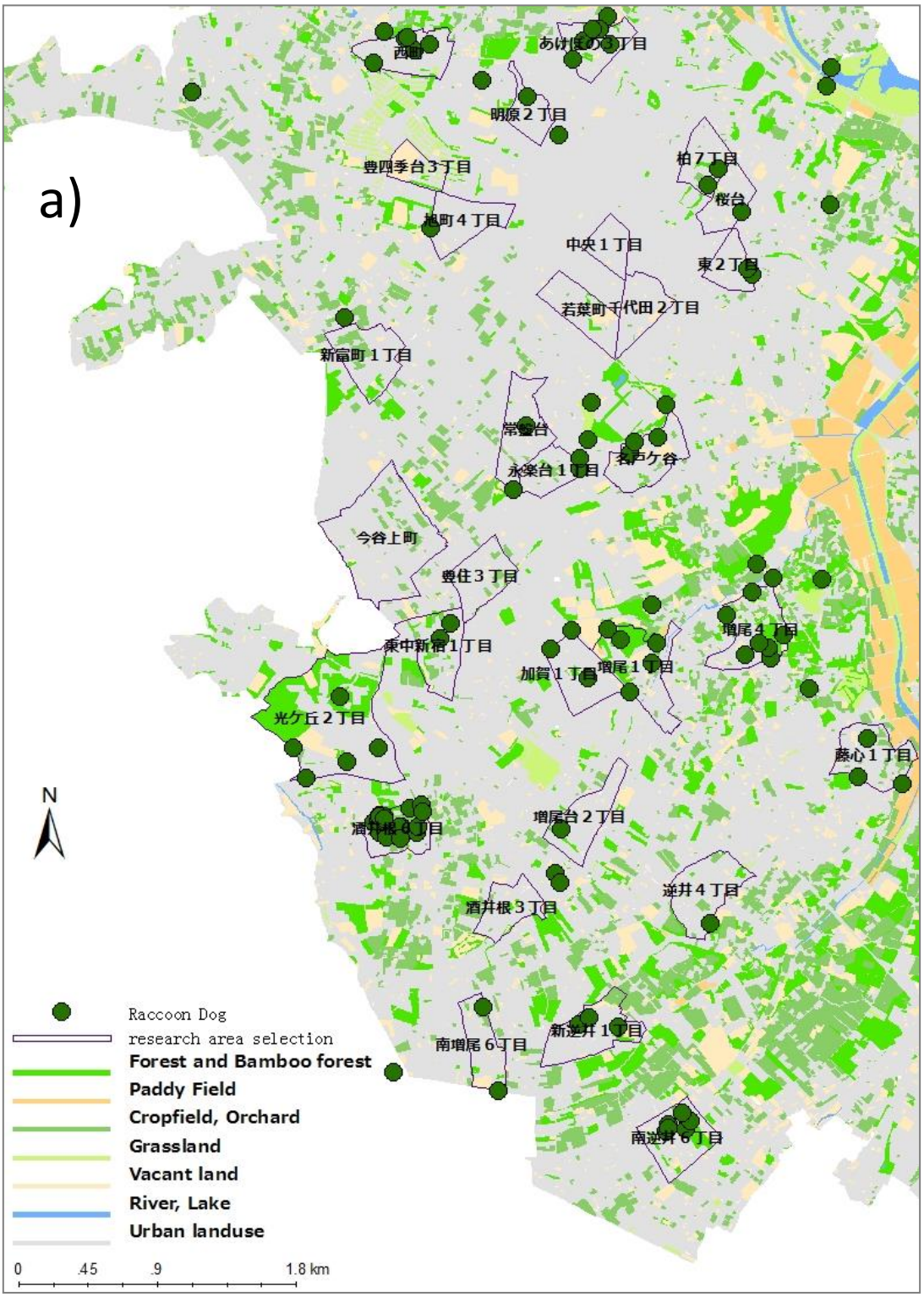
There are 34 calls (Masked Palm Civet:45, Raccoon Dog:1) recorded during these three months, means around every 3 days there is a claim/witness call about the target species to the department of agriculture, Kashiwa city office.

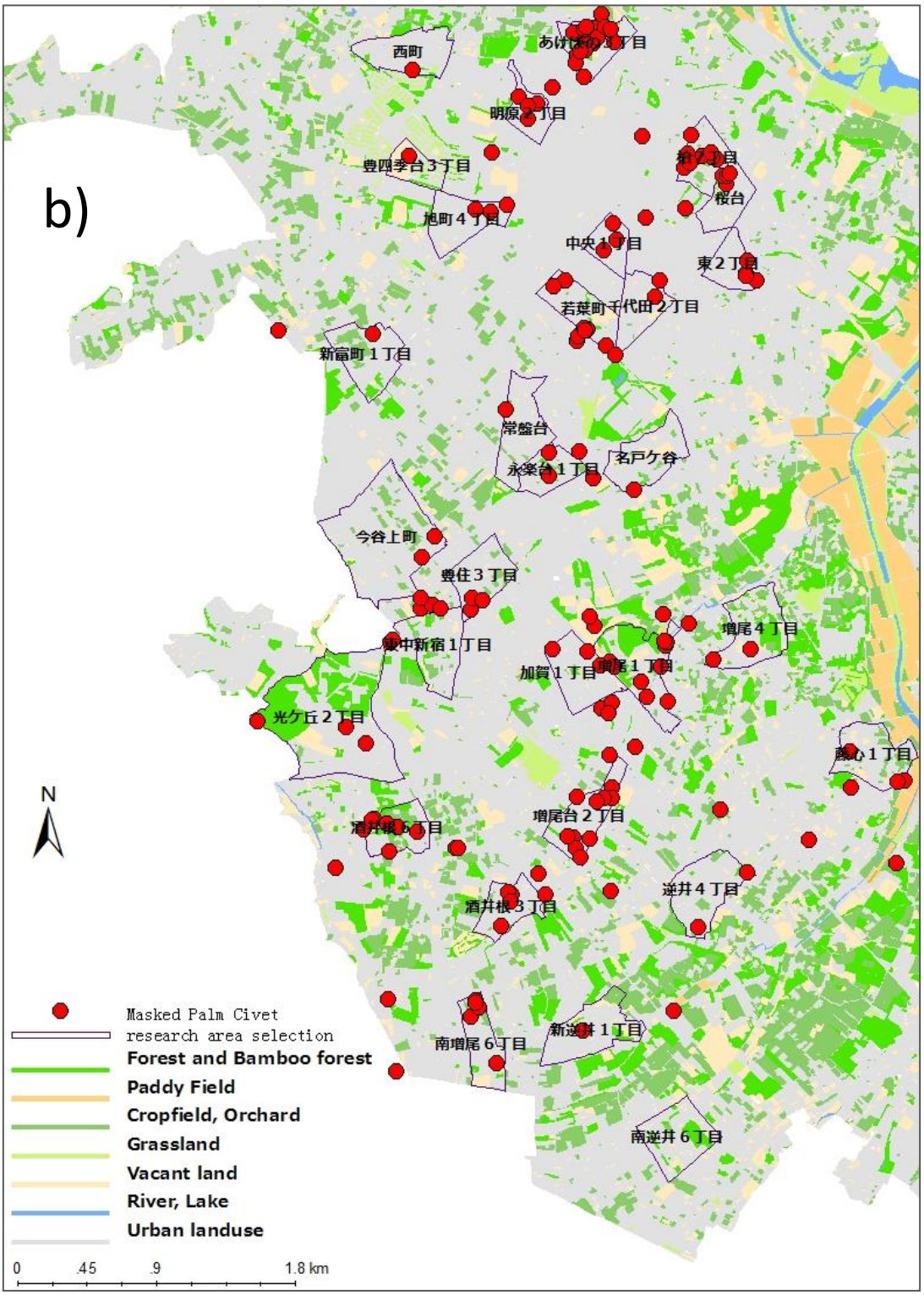
The high witness rate might relate to the high current population of the target species in urban area, especially masked palm civets. And the high frequency of calls also showed that citizens rely on the government when they find anything unusual therefore they call the city office to report it or ask for help.

3.2.3 Questionnaire Result of Distribution

All the mapping witness reports (n=266) was mapped on the map by using ArcMap (ArcGIS ver.10.0.0.2414) (Figure 11).

Respondents could not only map the witness information within the selected districts but also any place if they saw or they got any news about target species, therefore the witness reports are mapped even outside the selected districts.


a)
西町
あけぼの3丁目
明原2丁目
豊四季台3丁目
柏7丁目
桜台
旭町4丁目
中央1丁目
東2丁目
若葉町
千代田2丁目
新富町1丁目
常盤台
永楽台1丁目
名戸ケ谷
今谷上町
豊住3丁目
東中新宿1丁目
増尾4丁目
加賀1丁目
増尾1丁目
光ケ丘2丁目
藤心1丁目
N
酒井根6丁目
増尾台2丁目
逆井4丁目
酒井根3丁目
南増尾6丁目
新逆井1丁目
南逆井6丁目
Raccoon Dog
research area selection
Forest and Bamboo forest
Paddy Field
Cropfield, Orchard
Grassland
Vacant land
River, Lake
Urban landuse
0
.45
.9
1.8 km


b)
西町
明原２丁目
豊四季台３丁目
旭町４丁目
中央１丁目
東２丁目
桜台
若葉町
千代田２丁目
新富町１丁目
常盤台
永楽台１丁目
名戸ケ谷
今谷上町
豊住３丁目
東中新宿１丁目
加賀１丁目
増尾１丁目
増尾４丁目
光ケ丘２丁目
酒井根６丁目
増尾台２丁目
酒井根３丁目
逆井４丁目
南増尾６丁目
新逆井１丁目
南逆井６丁目
N
Masked Palm Civet
research area selection
Forest and Bamboo forest
Paddy Field
Cropfield, Orchard
Grassland
Vacant land
River, Lake
Urban landuse
0
.45
.9
1.8 km

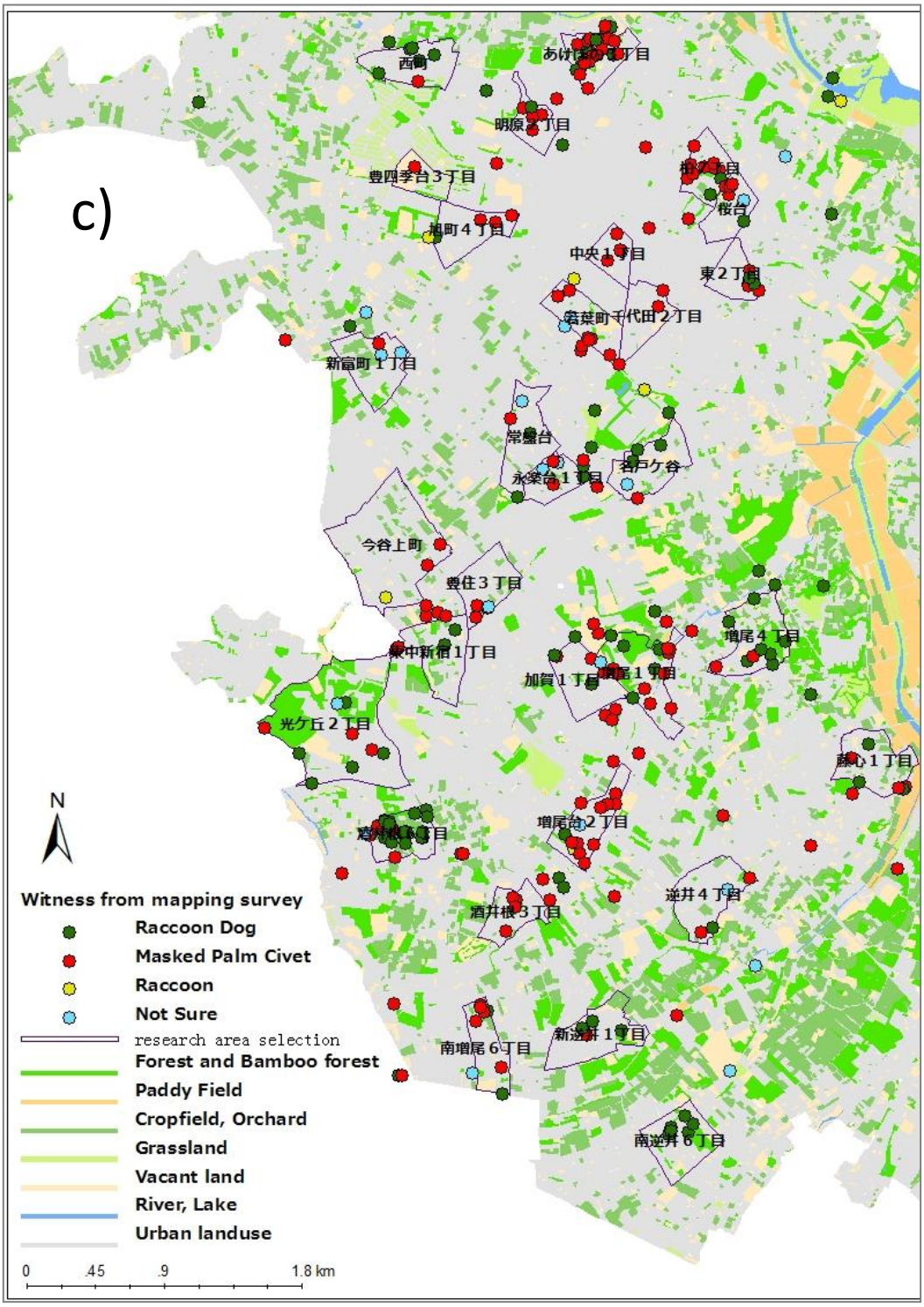


Figure 11: Sighting information of target species reported by the mapping survey respondents: a) Sightings map of raccoon dogs b) Sightings map of masked palm civet c) Combined sightings map of raccoon dogs, masked palm civets, raccoons and unsure (people can make sure it was one from these three target species but cannot distinguish it clearly)

3.3 Temporal analyses

The mapping survey has asked people to fill in the exactly time when they saw the target species. However, since most of people answered the question in a rough way, such as “three-four years ago”, “around five years ago”, in this research I decided to set three years as a time scale group (Figure 12), and also eliminated the responses without time information as invalid.

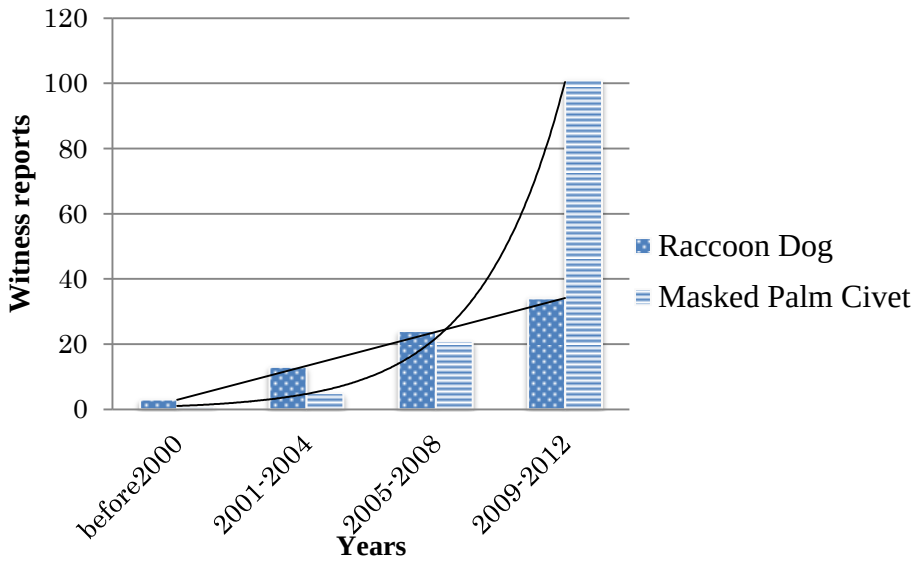


Figure 12: The number of witness reports on Raccoon Dog and Masked Palm Civet.

The result shows the number of witness reports of raccoon dogs is in linear growth, on the same time, the number of masked palm civets witness is increasing in an exponential relationship.

3.4 Land use pattern analysis

Then I used buffering analysis to find out the land use surround the witness reported place. From this study I could only get the location of witness reported but no exactly locations of target species' den site; however this is the only data I could get in the current stage. By accounting the total areas of each land use type within the buffer area, I found out the overall land use pattern surround all the witness position, which could reflect the land use pattern of target species' home range.

The comparison of land use pattern on the 50m, 100m, 200m, 500,1000m buffer zone of raccoon dogs and masked palm civet are showed in Figure 13. Because from the current previous research, it is difficult to set a exactly buffer zone size, therefore I set from 50m to 1000m which could provide several different scenarios to cover the shortest home range to the average longest home range of raccoon dogs and masked palm civets.

A comparison among the land use pattern on the 1000m buffer zone from the witness report of raccoon dogs, masked palm civets and the general land use pattern of the whole study area is showed in Figure 14.

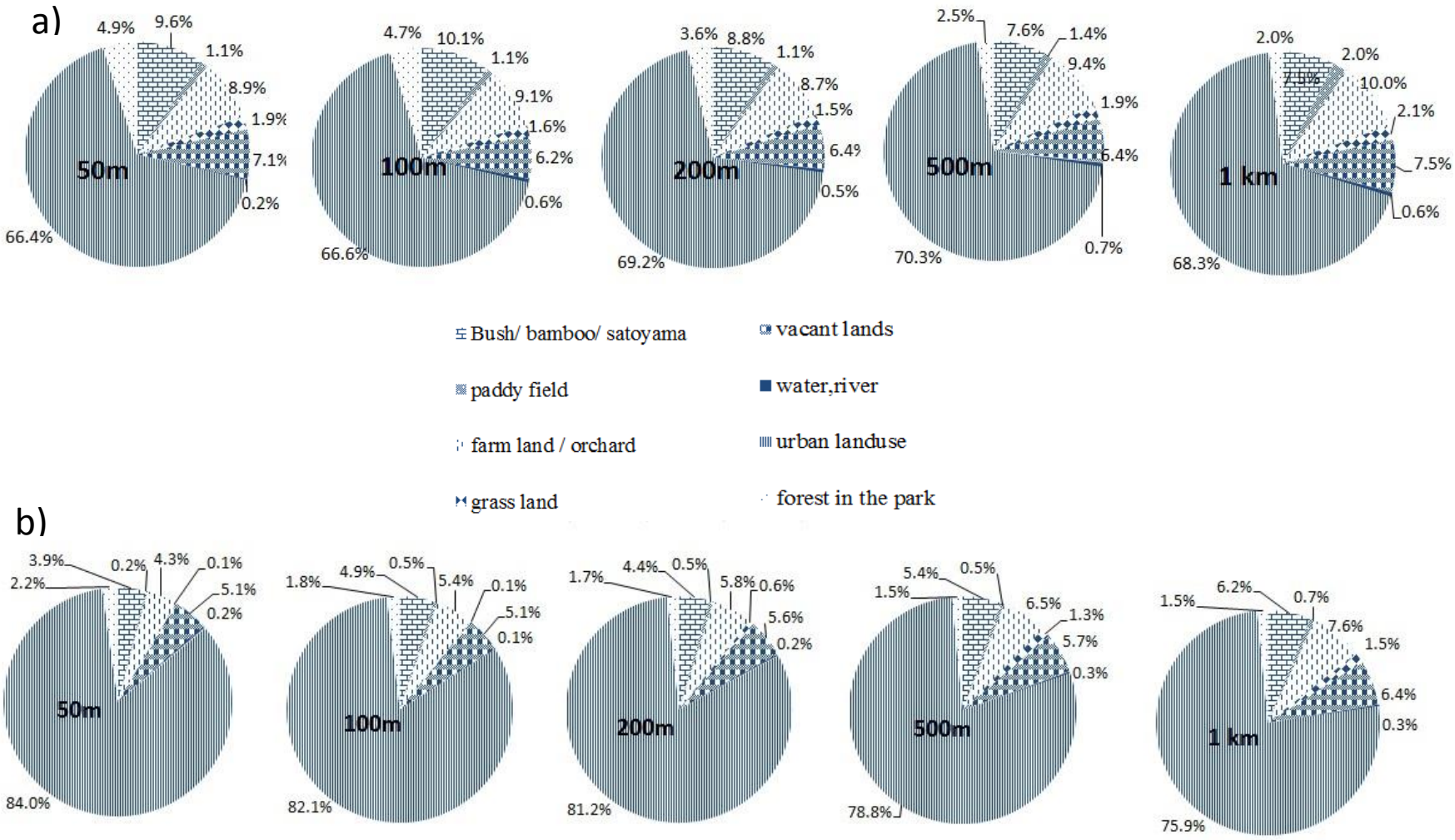


Figure 13: The land use pattern on the 50m, 100m, 200m, 500,1km buffer zone: a) Raccoon dogs; b) Masked palm civet

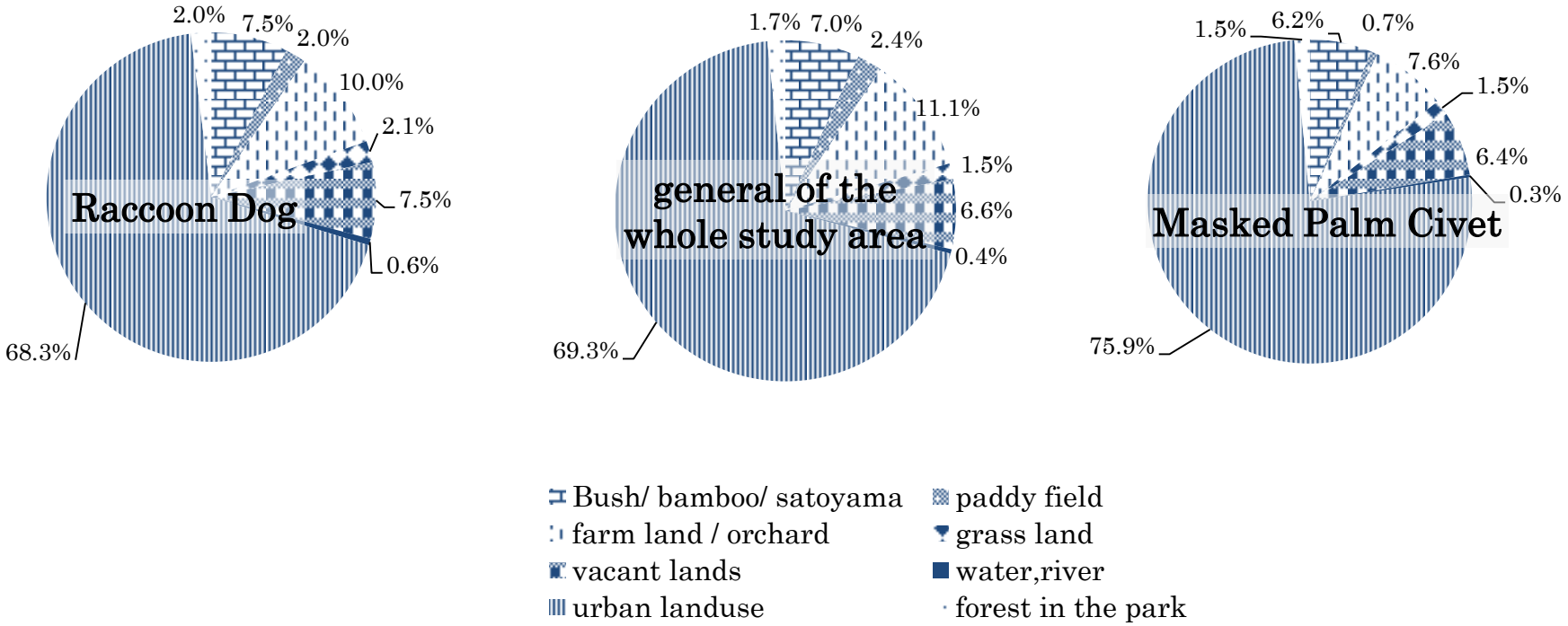


Figure 14: The land use pattern on the 1000m buffer zone from the witness report: a) Raccoon dogs b) the general (the whole) of study areas c) Masked palm civets

Generally, city residents are more active in urban land use area, therefore most of the witness reported from the urban land use area could not be difficult to understand. On the same time I could figure out from the result that raccoon dogs are still prefer the orchard, bamboo forest, park forest and satoyama as their activity area, however masked palm civets didn't show preference on those kind of green space land use but on the urban land use areas.

3.5 Damage Caused by Target Species in Urban Area

According to the questionnaire result, I found there are 42 people (15.79%, n=266) people who have ever seen these target species had suffered the damage caused by these target species (Figure 15).

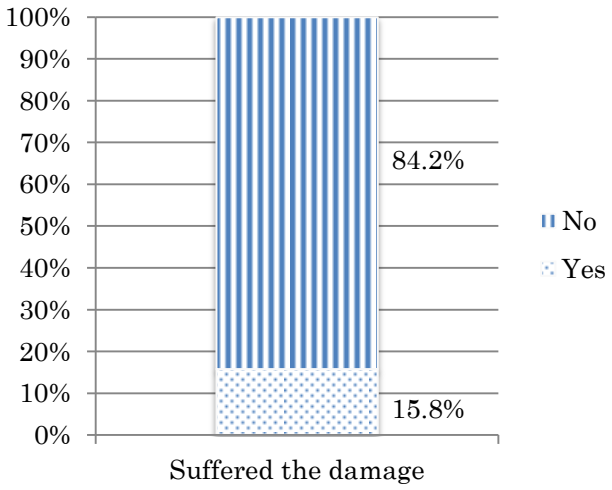


Figure 15: The rate of people who suffered the damages caused by target species

Among all of these damages, 81% damages are caused by masked palm civet, 12% caused by raccoon dog and 7% people said they don't know which animal caused this damage but they can make sure it is one among them (Figure 16).

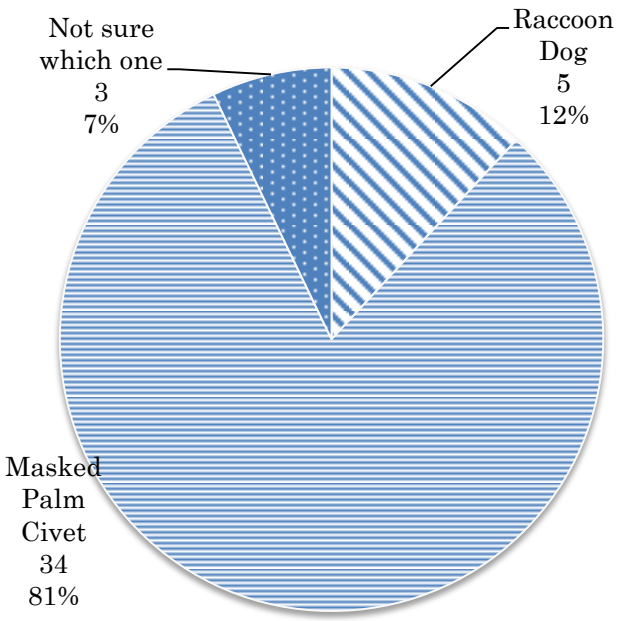


Figure 16: The percentage of damages caused by each of the target species

The damages caused by raccoon dog are mostly traffic accident that raccoon dog caused and agricultural damage such as "they ate the fruit/vegetables in my yard/community garden".

The damages caused by masked palm civet are "their dung is dirty and smelly", "they ate the fruit/vegetables in my yard/community garden", "they ate the garbage", "made noise", "trouble with pets", "feel annoying", and "risk of getting disease" (Figure 17).

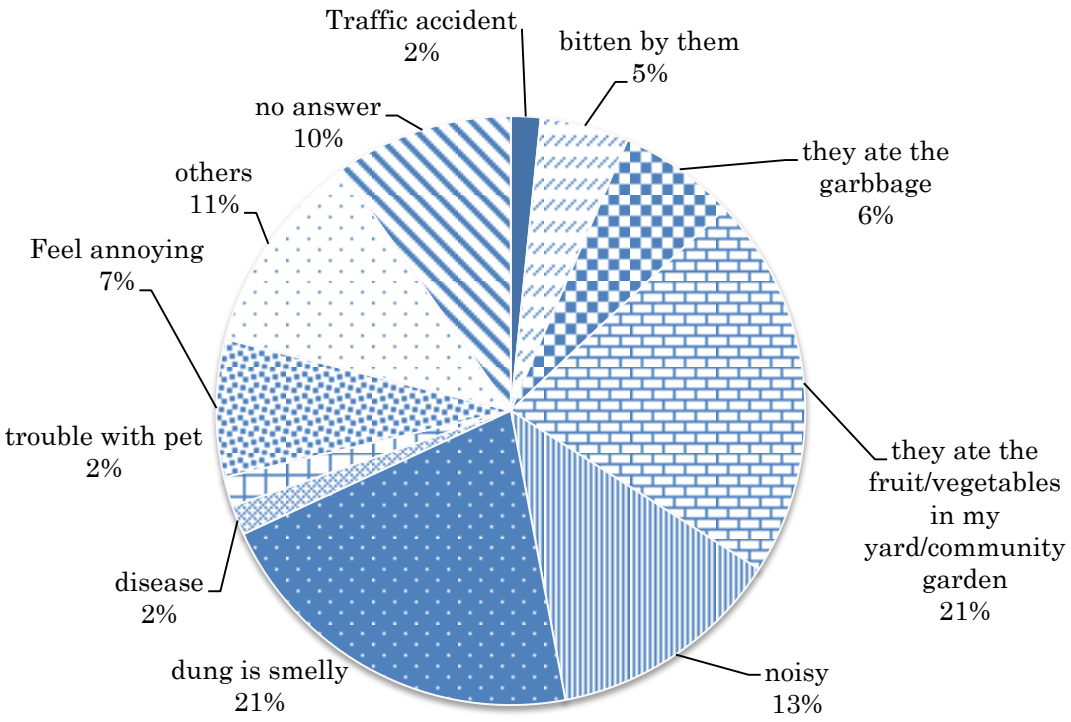


Figure 17: Types of damage caused by at least one species among raccoon dog, masked palm civet and raccoon

From the people's comments on "others" options, I found one of the most serious problem caused is "invasion to the human dwelling".

There are 16 invasion cases reported, this number including both the informants' own houses and their relatives' /friends' houses. All of these "invasion to the human dwelling" cases are caused by masked palm civet. The invasion could be also related to some other damage options such as "their dung is dirty and smelly"," made noise"," feel annoying" and "risk of getting disease" (Figure 18).

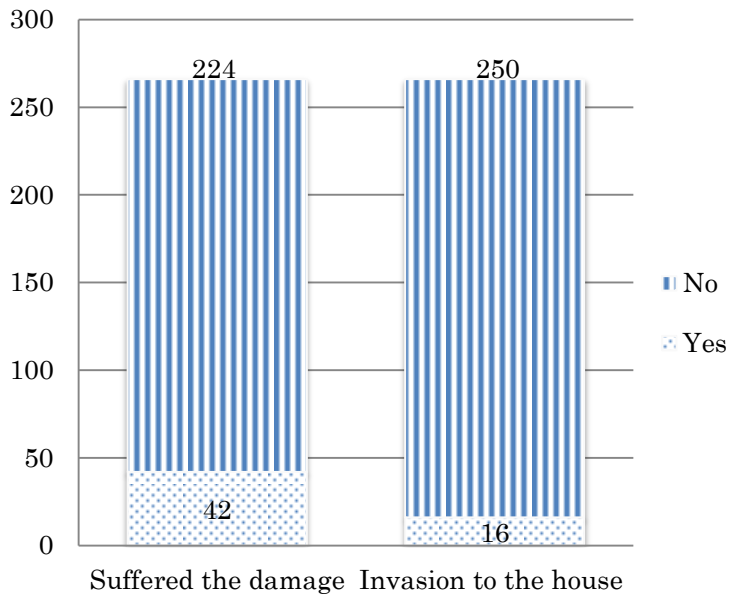


Figure 18: Human dwelling invasion conflicts reported by respondents of the mapping survey

Private pest control company C provided a list (see Appendix C) of the places where masked palm civet invaded into human's house and the company has exactly conducted the elimination business already during Jan.2010 to June 2012 (Figure 19). Due to the high cost of this elimination business (120,000 – 150,000yen), it is said that only 1/3 of the consulting calls finally conducted this business. Therefore it could be estimated the number of existing victims should be at least three times than I could get from the pest control company.

Because of the privacy protection policy, the private pest control company C could only provide a rough address (block name) of each case. I mapped all the cases by using the geographic center of the block instead of the exactly address of victim houses by using ArcMap (ArcGIS ver.10.0.0.2414).

In addition I overlapped the sighting map of target species I got from the mapping survey and the case map I got from the private pest control company C, and got a combined comprehensive map include all the sighting information and inhabitant information of target species that I could access (Figure 20).

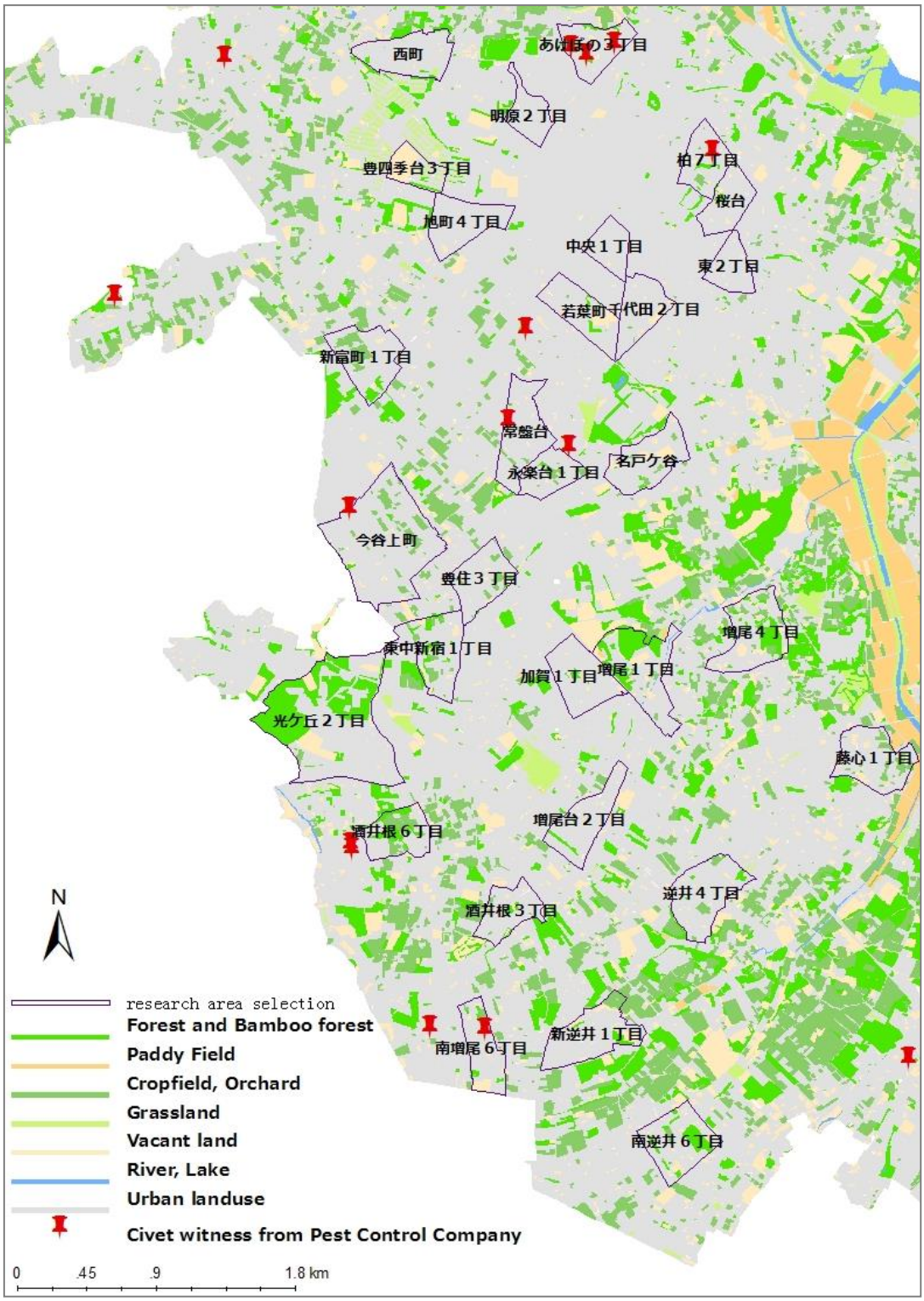


Figure 19: Human dwellings invasion cases caused by masked palm civets during Jan.2010 to June 2012, provided by the private pest control company C

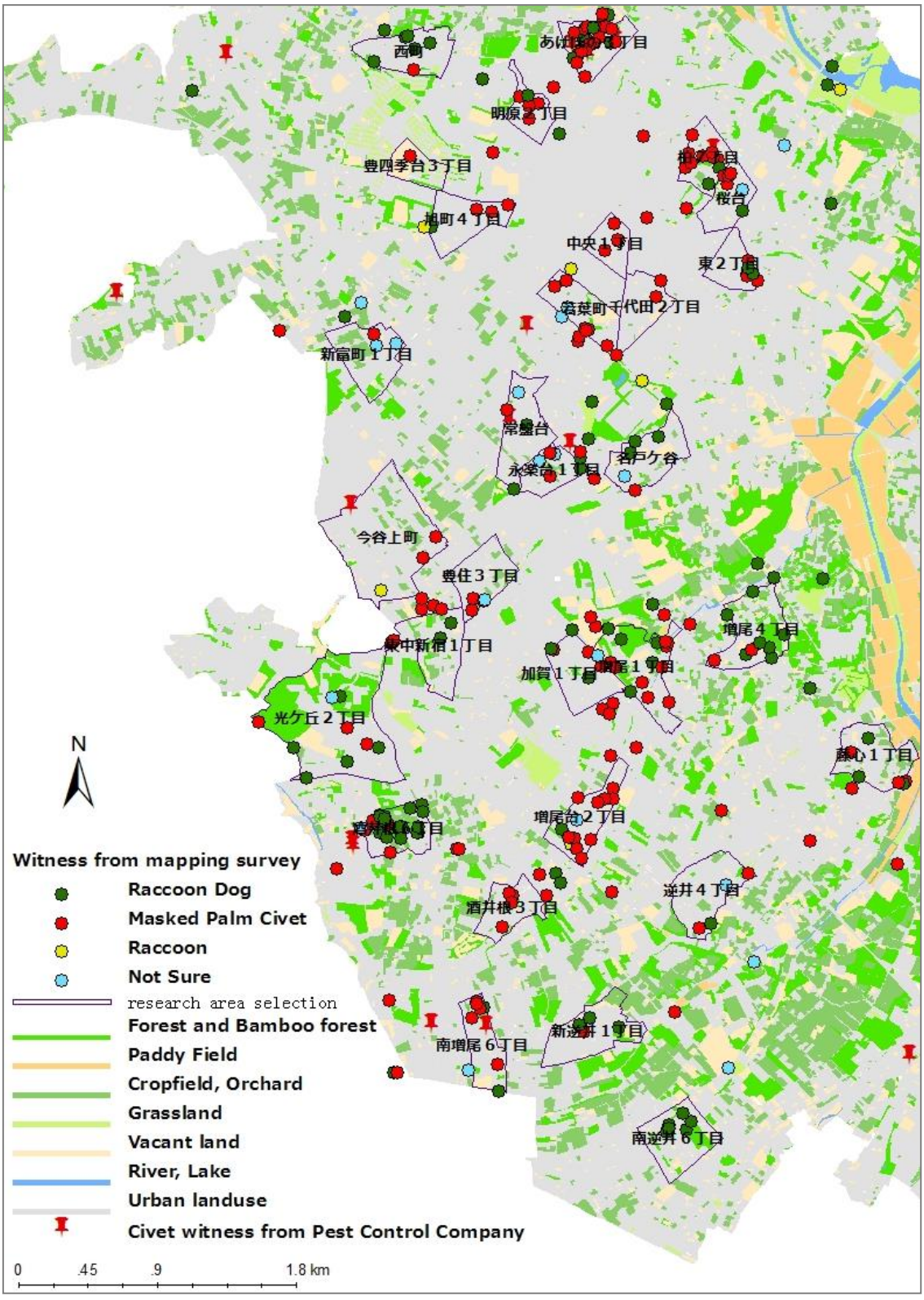


Figure 20: Distribution map of target species including sighting information and inhabitant information.

Zoonosis (infectious diseases that can be transmitted between human and nonhuman vertebrate species) (World Health Organization, 2013) can be viewed as a subset of wildlife conflict, but one that deserves special attention (Adams and Lindsey, 2010).

There are five witnesses of raccoon dogs reported that raccoon dogs infected with Sarcoptes scabiei. two of them provided pictures (Figure 21) and according to the witness location and time, there is a possibility that these two cases are actually the same individuals. And other three cases are all the dead body reports.

Figure 21: Raccoon dogs infected with Sarcoptes scabiei came into the back yard of the respondent's house, picture was took by Okimoto Mikiko.

There is no reports mentioned the diseases cause by masked palm civet. However, there are a few respondents mentioned about their worries on the possibility to get infectious diseases if the civet live in the ceiling of their house or infect to their pets.

3.6 Current Countermeasure

3.6.1 Policy

There are 3 departments of Kashiwa city office could be involved in this human-wildlife interaction and conflict issue: department of agriculture, department of environment protection, and department of urban planning.

The current situation is if someone suffered the damaged caused by wildlife, including the target species, mostly their call will be connected to the department of agriculture. However as mentioned in the previous part of this thesis, according to the current law on wildlife protection, the department of agriculture could only deal with the damage happened in rural area or directly caused the agricultural economic loss. The damage caused by masked palm civet, even it caused huge damage or have a high risk to cause new problem, if it happened in urban area and didn't cause any agricultural economic loss, according to the law department of agriculture could not take any action. The only measure they are taking now is to provide a name list and contact of private pest control companies to the victim citizens.

The department of environment protection is only in charge of the endanger species and alien species. As raccoon is the "special designated alien species" in Japan, the department of environment protection could catch and cope with it if there are any witness or damage reported caused by raccoons no matter is in urban or rural area and there is a damage or not. However in the case of raccoon dogs and masked palm civets, the department of environment protection has no right to take any actions.

For the department of urban planning, although they are in charge of the urban issues,

their main work is on planning. It seems they have no idea on how to deal with this kind of human-wildlife issue at all.

As a conclusion, there is no any specific working desk or policy from the city government level toward to solve the urban human-wildlife conflict issue, including the target species: raccoon dogs and masked palm civets.

3.6.2 Private Pest Control Companies

Private pest control companies are almost the only place who could conduct the elimination process currently. If the people who suffered the damaged caused by masked palm civets or raccoon dogs and ask for help from the company, the company will provide a series service including checking the field, accomplishing the complex procedures to get the permission on catching the animal, catching the animals, asking the veterinary to kill the animal, and finally disposing the dead body of the animal.

However, this service will charge the client around 120,000yen to 150,000yen, which could be considered as big amount of money. Therefore around 2/3 people who once consulted with the private pest control company finally gave it up due to the high cost.

3.6.3 People's Response and Behaviors toward the Damage Caused by Target Species

From the interview to local people and the comments from the questionnaire survey, people's response and behaviors towards the damage caused by target species (Figure 22) could be divided into three types: solved it anyway, do nothing, or don't take it as a damage and even feed the animal.

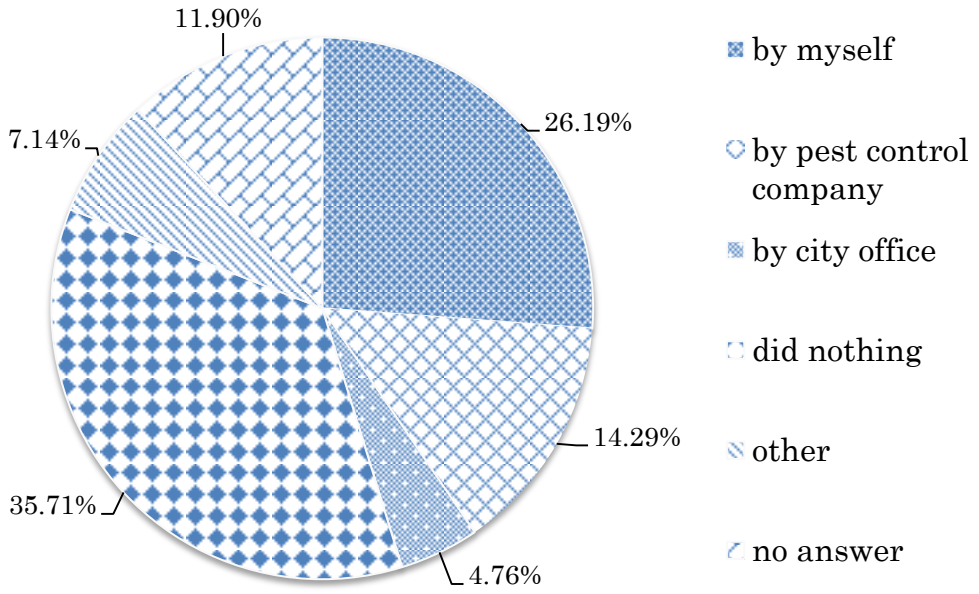


Figure 22: The answers of "How did you solve the problem" from the people who said they suffered the damage caused by target species

The result from the questionnaire survey could also be fitted into these three types.

- Solved it anyway (by myself/ by pest control companies/ by city office)

This type of people considered the damage caused by the target species as a serious trouble and they took action to eliminate the wildlife or prevent the damage happen again.

Victim, whose house has been invaded by masked palm civet, mostly took the actions such as asking help from city office, paying money to private pest control companies to eliminate it, or trying to chase it out by themselves and close all the possible entrances that civet could come in.

People who suffered other types of damage were often taking more simple actions such as building fences to protect the food trees in their yards and gardens and chasing the animal out when they see it.

Because the city office could only solve the problem related to the agricultural economic

damage, the percentage of “by city office” was only 4.76%.

Due to the high cost of the private pest control company, lots of people even once consulted with the company finally tried to solve the problem by themselves or simply gave it up.

- Don’t care, did nothing

35.71% of respondents said they did nothing on it. Mostly in these cases the damages were not much serious, didn’t cause any huge economic loss or have the risk to cause any bigger problems.

A part of people from this group even didn’t think the current damage they suffered is “damage”, and they don’t want to spend much more time and money on dealing with this issue.

- Feeding behavior

There are around 20% people responded “others” or didn’t answer the question directly. A part of people from this group were considered as the people who take the “damage” on a contrast way, which means they even have the feeding behavior and providing the foods and den sites for the animal initiatively.

One respondent said he didn’t think the current damage they suffered is “damage”, and even feel upset when the civet didn’t come to his yard anymore. Another respondent said he had fed one raccoon dog as a pet in the past.

3.6.4 Expectation to Local Government in terms of Urban Wildlife Management

There were three open questions have been asked in the questionnaire survey to ask people to write down comments or feedback. Two on the main questionnaire, one was asking for any extra comments related to urban wildlife issue, one was for any suggestion to city office. And the third one was on the mapping questionnaire and asked people's extra comments on the target species: raccoon dogs, masked palm civets and raccoons.

There are three main findings (feedbacks) from these open questions.

1) People showed their worries on the past human wildlife conflict experiences and the possible conflict might happen in future. The main worries are healthy issue and safety issue, such like "I will feel very annoy if masked palm civets invaded into my ceiling and I am worried about the disease they are carrying.", and "I am worried if masked palm civets will cause fire."

2) People have no idea on what should they do if they suffered a conflict from urban wildlife, and they are willing to know it even they didn't have any human-wildlife conflict experience before. Several respondents mentioned the same things such like "I want to know what I should do if I suffered damages caused by a raccoon dog / a masked palm civet", "I hope city hall can open some information on how to deal with those (target species) properly".

3) Besides the target species, free-ranging domestic cats and crows are also causing very serious human-wildlife conflicts in the study areas, which might be even much serious than the current conflicts caused by raccoon dogs and masked palm civets.

4. DISCUSSION

4.1 Abundance of Target Species in the Study Area

The very few number information of raccoons means the sightings of raccoons are very low. This might be caused by three reasons. 1) Raccoons could masterly stagger their active time to avoid any encounter with human being. 2) Respondents could not clearly distinguish raccoons and raccoon dogs, which mean there are amount of responses regarding to raccoon dogs were actually raccoons. 3) Abundance of raccoons in the study area might is very low.

There is no previous research could provide any evidence on raccoons' stagger skill and there were several raccoons witness reported from other researches in other cities in Japan(Miyamoto, 2008) therefore the first reason might not be the main possibility. Regarding to the respondents ability to distinguish the target species, although there is a possibility that people make mistakes, the percentage should be quite low, because the questionnaire survey was designed with a short tips for helping respondents distinguish target species and from the responses on the questionnaire people shows a high skill level on identify these three target species. Therefore the third one might be the most possible reason which means the abundance of raccoons in the study area is very low.

In consequence, following part could not discuss deeply about raccoons but will mainly focus on raccoon dogs and masked palm civets according to the sample size I got from this survey.

From the temporal analyses of the witness reports, it could be found that the witness of both raccoon dogs and masked palm civets are increasing in the recent decade, however in a different growing rate.

There are several reasons might lead to this increasing.

1) People‘s memories tend to remember the current things and people tend to report the current things therefore the witness number shows an growing trend.

2) Public knowledge level on the raccoon dog and the masked palm civet is increasing, especially because the damages caused by masked palm civets are increasing therefore they got more chances to be reported by news in recent few years.

According to the comments people wrote on the questionnaire, respondents showed a very good knowledge level on distinguishing 3 target species, and some people said they went to search for the information by themselves when they suffered the damage. Because raccoon dog is a typical native species in Japan with a long history on communication with human being and lots of traditional tales mentioned about raccoon dog, therefore it is normal that raccoon has a high degree of recognition. However masked palm civet was not such popular in Japanese traditional stories. (As mentioned in the introduction part, though raccoon dog is definitely a typical native species in Japan, there is still a discussion on whether masked palm civet is a native species or an alien species in Japan. Therefore this study will not discuss about raccoon dog and masked palm civet’s native or alien species in terms of ecological impacts.) According to the one previous research conducted on 2006 on the suburban area of Tokyo has found that the residents’ recognition level of masked palm civet was almost the lowest out of 15 mammals (Sonoda and Kuramato, 2004). Therefore the increasing of knowledge level of masked palm civet might be also a consequence of the increasing of masked palm civet’s population and the expanding of their distribution inside Kashiwa city.

For these reasons, there is a high possibility that masked palm civet population densities are both exactly increasing in the study areas, which means the abundance of masked palm civets is increasing in the study areas.

Nevertheless, for raccoon dog's case, it is still difficult to figure out their population has declined, increased or just kept in a stable level in the study areas.

4.2 Land Use Preference (Habitat Use Pattern)

As the method part has been mentioned, though the witness reported area doesn't equal with "den site" or "food resource area", the sighting from people still means where the target species have been appeared, which could be considered within their home range. Where has a high witness rate where has a high possibility to be closer to their den site and food resource area. Therefore to understand the land use pattern around the witness reported area could still be helpful to understand their habitat selection preference.

The results showed clear differences between raccoon dog and masked palm civet.

According to the previous studies on the home range of raccoon dogs and masked palm civets in Japan, it could be found that both of these two species showed a varied range depends on different habitats. A mean home range size of 125.2ha (±71.1 ha) with a 10.6 ha (±12.8 ha) core area was reported in Hokkaido (Abe et al., 2006) The average home range is around 30-120 ha according to the previous study (Torii and Ohba, 1996). However, because the previous studies showed there is a trend that urban population has a smaller home range than rural population (Adams and Lindsey, 2010).

Therefore I selected 50 m, 100 m, 200 m, 500 m, and 1000 m to set buffer zone size, which could refer to raccoon dogs' core area, raccoon dogs and masked palm civets average maximum home range, and the usual cases of raccoon dogs and masked palm civets.

The land use pattern on the 1000 m buffer zone from the witness reports of raccoon dogs shows a very similar pattern with the general land use pattern of the whole research area. On

the same time, the masked palm civets' result shows an obvious preference on urban land use.

Considering all the result of it could be found that the same species shows the similar patterns from 50 m to 1000 m, from result of 50 m to result of 1000 m, the results pattern are gradually getting closer to the general land use pattern of the whole study area.

In raccoon dogs case, the summation of "bush/ bamboo/ satoyama" and " forest in the park" land use are generally getting smaller and get closer to the general situation of whole study area (8.7%) from the result of 50 m buffer zone(14.5%) to 1000 m buffer zone(9.5%). From this result, it could be suggested that raccoon dogs are still prefer to or rely on the forests in urban area.

Meanwhile, from the result of masked palm civets, the urban land use should be focused. Even though the percentage of urban land use comes closer to the general situation (69.3%) from the result of 50 m (84.0%) to 1000 m (75.9%), it still could be suggested that masked palm civets do not depend on urban forests but even prefer the urban land use as their habitat.

There was one previous study suggested that the forest environment may not be essential or preferred for raccoon dogs and masked palm civets (Sugiura et al. 2013) because masked palm civets seem prefer habitats close to human dwellings (Ochiai et al., 2009) and raccoon dogs prefer human meal scraps (Matsuo and Ochiai, 2009), which are frequently provided in urban and agricultural fields.

However from the result of this study, I could provide a different point of view. I could suggest that masked palm civets prefer urban land use as their habitats, in contrast, though raccoon dogs could adapt to urban areas as their habitat, they still prefer the forest environment inside urban areas.

4.3 Adaptation or Adoption

No matter from the population analysis or land use pattern preference analysis, compare to masked palm civet, raccoon dog shows a lower population density or slower increasing speed, and much dependence on green space in urban area. It could be considered caused by two possible reasons: 1) there is a competition on food resources and den sites between urban raccoon dog and urban masked palm civet. And urban raccoon dog is at the disadvantage side on this competition. 2) Different natural behaviors lead to a difference on the adaptation ability. Masked palm civet is much adapts to urban environment, or even I can say masked palm civets adopt the urban environment as its habitat.

There was a previous research has reported the dietary overlap between raccoon dogs and masked palm civets in a rural area in south part of Chiba prefecture (Matsuo and Ochiai, 2009). From the interview survey with the local residents on Akebonosancyome, several people mentioned that they could see raccoon dogs several years before but recently could only see masked palm civets instead. Therefore there is a possibility that masked palm civets could occupy raccoon dog's niche and chase they out from the previous habitat. Which means even raccoon dogs adapted to urban environment and had found out their niche in urban area already, with the increasing abundance of masked palm civets and expanding home range they are using, there is still a possibility that raccoon dogs will be chased out from the urban area and have to go back to their natural habitat again.

Another reason is their different behaviors lead to a difference on the adaptation ability, which could include the amount of resources they can access to and the impact of human disturbance they affected.

It could be understood that because raccoon dogs cannot climb trees. The benefit they can get from the city could be very few, such as garbage, some short/low plants in farm land/

house yard, and there were some cases reported that they can use the small space under the house (However, the number of house which have the small space under the house is very few and even decreasing.) or some vacant houses as their den site. On the same time, several traffic accident caused by raccoon dogs were reported (Saeki and Macdonald,2004), and in most of cases, raccoon dogs were killed in the accidents.

From the questionnaire survey and interview surveys, these assumptions have been proved by the respondents. I found the people who suffered the damage from raccoon dog are mainly traffic accidents and their plants were eaten by raccoon dog. No house invasion caused by raccoon dogs, and several dead bodies of raccoon dogs were reported have been saw on the road or close to the road.

On the contrary, masked palm civets, who can climb the trees and squeeze into very small holes due to their lithe bodies, showed a much more flexible and plentiful choices on their food resources and den sites selection in urban area. For the food resources provided by human activities, they can not only eat the garbage and some short/low plants in farm land/ house yard, they can also eat the fruits and vegetables growing on the trees. For the den site, they could not only use the small space under the house or vacant houses, but even invasion into the ceiling of the houses people are living in.

In addition, because masked palm civets could their equilibrium very well, they can use the city infrastructure such as electric wire, instead of the road, as their path way, which could be much safer than sharing the path way with the automobiles.

From the questionnaire survey and field survey, I could find several existing cases to prove that masked palm civets have exactly used human’s house as their den site and got food from the food trees. Witness reports show that masked palm civets could walk on the fences or electric wires.

Although there is still a group of studies believed that masked palm civets should be

considered as native species in Japan, most of studies already took masked palm civets as the alien species in Japan. If masked palm civets were introduced into Japan through human activities, which means there is no natural environment for this species in Japan. From the current situation I collected, it could be found that masked palm civet could take the advantage from the urban area easily and the land use preference analysis shows that masked palm civet seems even prefer the urban land use better than green spaces. In this sense, it might be difficult to say that masked palm civet is getting “adapted” to urban area, but more suitable to say they discovered the urban area or they just adopted urban as one of their natural habitat in Japan.

4.4 Residents in Trouble and the Expected Role of Public Sectors

From the survey’s results, I could find many cases that citizens are suffering or suffered the damage caused by raccoon dogs and masked palm civets. It could cover almost all the common forms of conflict include damage to homes and gardens, crops, and threats to the health and safety of people and their companion animals (Adams and Lindsey, 2010).

According to the Wildlife Protection and Hunting Law and related laws , people cannot get helps from the government if there is no agricultural related damaged caused.

Ministry of Agriculture, Forestry and Fisheries in Japan published special manuals on how to deal with human-raccoon dog conflict, and human-masked palm civet conflict, the suggested solutions are mainly focus on how to build some defense construction to prevent to delight the agricultural related damage (Hayama et al., 2008).

In Yokohama city, the local government provides some basic information of how to deal with human-masked palm civet conflict, and the contact of one specific department where in charge of this issue, on their website (Yokohama city office department of environmental

creation, 2011). On the same time the local government provides the compensation for the people whose house have been invaded by masked palm civets to ask an elimination service from the pest control companies, but will not provide any support to the conflict except the invasion.

However, on the website of the study area (Kashiwa city) has almost nothing related to the target species. The only information could be found is about raccoon. Kashiwa city office designates the department of environmental protection to in charge of raccoon's issue because raccoon is the designated as the special alien species base on the Wildlife Protection and Hunting Law. According to the law, all the raccoon should be caught and killed no matter it cause conflict or not. There is no management policy even no suggestion to the citizens on how to deal with the conflict with neither raccoon dogs nor masked palm civets.

As mentioned in the result part, in Kashiwa city, if any one suffered the damage (not agricultural related) caused by raccoon dogs or masked palm civets, the public sector could provide nothing. However, the services from private pest control companies are quite expensive, most (at least 2/3 according to the interview with the pest control company) of victims decided to deal with it by themselves or keep on tolerating it. Meanwhile, the solutions suggested by the Ministry of Agriculture, Forestry and Fisheries in Japan (Hayama et al., 2008) are also costly and time consuming. Considering the money and time will be consumed, if the damaged seems not much serious, several people decided to just tolerate it instead of taking management action. However, the suboptimal or improper action might be taken as a consequence of this type of "giving up", which might lead to most dangerous risk in urban area such as zoonosis (Adams and Lindsey, 2010).

Several previous researches mentioned the importance of the policy and public sectors in urban wildlife management (Reiter et al. 1999, Knight, 2007, Sano, 2012). Public sector

(government) could be also divided into several levels.

In U.S.'s case, it includes federal, state and territorial governments, and local government. At each level one may find several different departments with varying degrees of interest in the issue at hand (Adams and Lindsey, 2010).

Japan's system was described as a "complex" system, which a number of laws overlap and several government departments, often with conflicting interests, have a role (Knight, 2007). The Key actors in wildlife management in Japan include the Ministry of the Environment, the Ministry of Agriculture, Forestry and Fisheries, Prefectures and municipalities, Politicians, and several interest groups (such as conservation NGOs and agriculture interest groups) (Sano, 2012).

As a consequence of the complex system, the strong policy bias has resulted in the adoption of suboptimal conservation policies, and there was a previous study pointed out that in many cases agricultural interests rather than environmental interests tend to dominate the policymaking process (Sano, 2012).

In the case of raccoon dogs, masked palm civets and raccoons' management, the nationwide law defined that all of these 3 species are designated as game species and could be hunted by hunter, on the same time raccoon dogs and masked palm civets could also be caught by the public sector with the permission if the animals caused any agricultural related conflict with human being.

Although masked palm civets were considered as an introduced species on most of studies, the "official" decision (law) is still ambiguous. And that is why masked palm civets still on the same category with raccoon dog as a game species, but could not come into the same category with raccoon as a special alien species.

It could be understood that it is very difficult for the policymakers to make this

classification according to the current ambiguous research data and simply ignore ecological risk. Even the Sano's research mentioned the wildlife policy in Japan shows a preference on human benefit other than ecological impact, in this case I could point out that at least on the current stage, the ecology aspect was took a bigger consideration than the human aspect.

However, avoiding the discussion on whether I should set the masked palm civet as the special alien species or not, and further, whether I should eliminate all the raccoon dog and masked palm civet who caused conflicts with human beings or not, I could still found a big gap between the residents expectation and the roles that government sectors are exactly playing.

The huge amount of claim/witness calls to the city office and the findings from the open questions of questionnaire survey showed that residents trust the local government a lot and expect the public sector could take the responsibility of this urban wildlife management issue. Several respondents mentioned about their worries on the possible conflicts might happened between themselves and raccoon dogs, masked palm civets or some other urban wildlife species and expressed their expectation to the local government if they could provide any basic education on how to deal with the human-wildlife conflict issue in urban area.

The recommendation to the local government according to most highest frequency responses mentioned by the respondents from the questionnaire survey are 1)a designated desk for human-urban wildlife conflict and urban wildlife management, 2) the basic guideline on the proper action that people should take when they have an encounter with wildlife in urban area.

4.5 The Future Trends of Human-wildlife Conflict Management in Shrinking Cities

Urbanization was once the biggest issues related to urban sustainability. According to UN's report on 2007, over 50% of the earth's human population now lives in cities. As urban populations expand, so does the urban landscape (Dearborn and Kark, 2010). The expanding urban landscape and high concentrated urban population caused several social, economic, and environmental transition of the world.

Recently, however, a lot of cities in the world are facing the phenomenon of counter urbanization, which called shrinking city. Shrinking cities are cities that are experiencing acute population loss. Deindustrialization, out-migration and aging are some of the common reasons that cities shrink. The increase in the population of growing cities is markedly higher than the losses of the shrinking cities, but the number of shrinking cities has greatly increased. Between 1950 and 2000, the number of shrinking cities has increased by 330%, while the increase in the number of cities with more than 100,000 residents has amounted to only 240% (Banzhaf et al., 2007). Thus, despite all the expectations created by the scenarios of constant growth, the number of shrinking cities has increased faster than the number of boomtowns.

City shrinkage is though generally seen as a new challenge in achieving urban sustainability due to its negative impact on economic and social sides; while, academia is starting to discuss its potential positive impact on ecological side of city shrinkage in recent years.

Rink (2009) reviewed the debate in Germany that whether should put "wilderness" as a usable concept for urban restructuring and discussed which role wilderness can play in shrinking cities, Haase(2008) argued that a perforation of built-up structure in dense cities might bring up many positive implications. A book called "Shrinking City: Effects on Urban Ecology and Challenges for Urban Development" gave an overview of urban ecology

concepts and how research in brown field is affected by urban shrinkage(Longner, 2007). The phrase “Nature abhors a vacuum” is quoted often by ecologist. For all practical purposes, life-sustaining energy comes from the sun and flows through food chains and webs consisting of millions of species. At every step and amazing array of species has evolved to fill specific niches—making use of all available energy (Adams, 1994). Thus if the urban area starts to shrinking, energies and spaces which were occupied by human being will provide new vacancies to let something else come to fill it, which means provide a chance for other species.

This potential benefit to fauna and flora in urban area should be discussed case by case. In the case of raccoon dogs, masked palm civets and raccoons, according to their behaviors and feeding habits, and current advantages they are taking from the urban area, it could be estimated that there is a big potential that shrinking cities with it associated vacant houses, vacant lands and the newly increasing agricultural activities could contribute to the abundant of urban raccoon dogs, urban masked palm civets and urban raccoons.

In Japan, shrinking has also become a big challenge for both rural and urban area. From 2010, Japan became the “top runner” of aging society in the world (Figure 23), in 2012, Japan was the only country in the world where more than 30% of population is aged over 60(HelpAge, 2013)

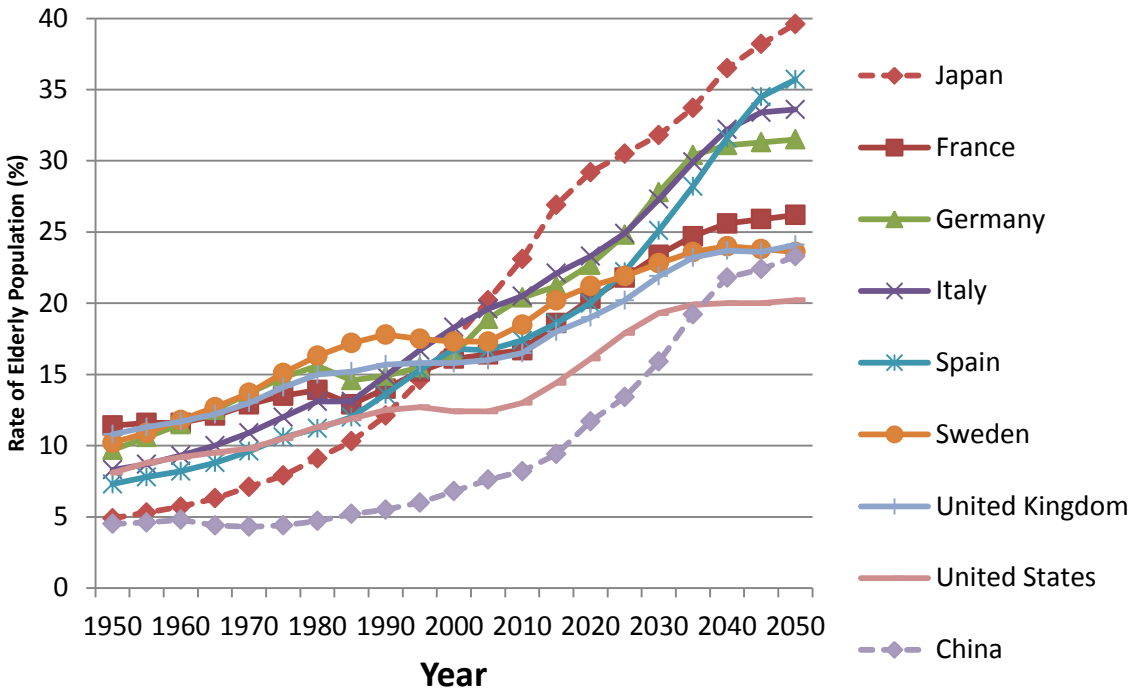


Figure 23: Trends and predictions for the global aging rate (Data: OECD Factbook 2010: Economic, Environmental and Social Statistics)

Not only is the aging issue, depopulation also happening in Japan. According to the data from the Ministry of Land, Infrastructure, Transportation and Tourism of Japan, it said that in the future 100 years, the population of Japan will turn back to the same level with 100 years ago (National Institute of Population and Social Security Research, 2012)

With the population decreasing, both the number of vacant houses and the total area of vacant lands keep on increasing. (Ministry of Land, Infrastructure, Transportation and Tourism, 2013). The increasing urban farming activities on vacant lands have been reported by one previous study. It used Kashiwa city as the study area and addressed that there are already 6.4% of vacant lands are using for urban agricultural activities and there is a big potential and motivation that people will use more vacant lands for agricultural related activities.

The shrinking city phenomenon, associated with the decreasing and aging human

population, increasing vacant houses and vacant lands, and increasing urban agricultural activities, have a potential to provide more food resources and more denning resources for some species including raccoon dogs, masked palm civets and raccoons (Figure 24). However this is still just a hypothesis and not been prove by experiment yet.

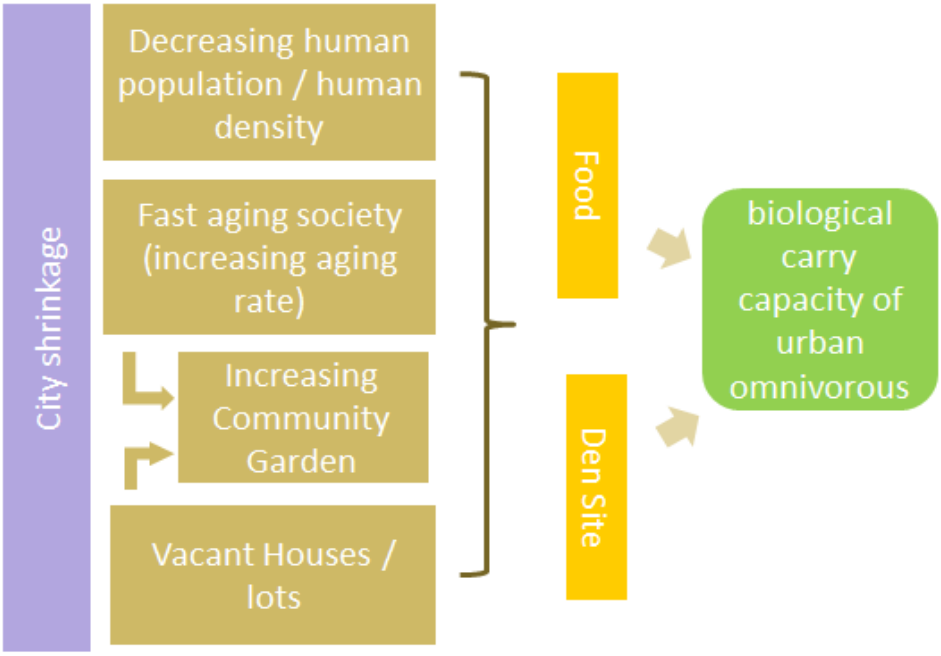


Figure 24: The framework on how shrinking cities could contribute to the urban wildlife abundance

Another possible factor is hunter. Because of the depopulation and the aging current population, legal hunters (with hunter licenses) are getting old. The total number of legal hunters declined and will keep on declining as well (Figure 25). After the extinction of Japanese wolf, including both Honshu wolf *(Canis lupus hodophilax*) and Hokkaido wolf (*Canis lupus hattai*), hunters are actually taking the top seat of the whole food net. Their hunting activities played a role in controlling the abundance or population density of several carnivorous and omnivores species, including raccoon dogs, masked palm civets and raccoons.

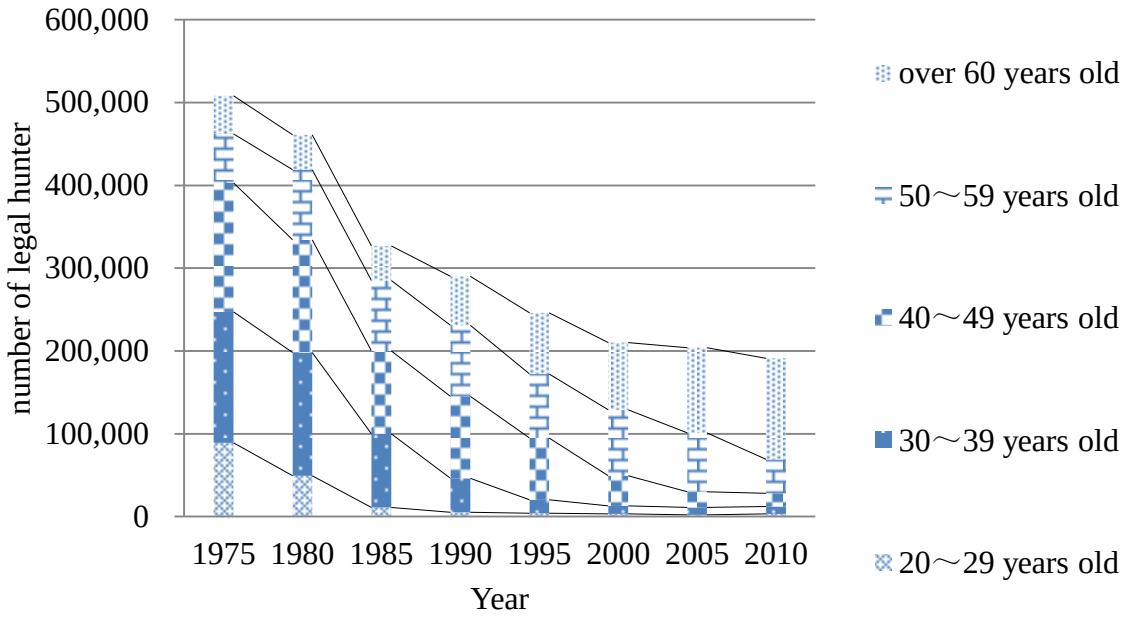


Figure 25: the number and age of legal hunters in Japan (Data: Ministry of Environment, Japan ,2013)

With the decreasing of hunters, the pressures from predator/ natural enemy are getting smaller and smaller for those carnivorous and omnivores species. In consequence the some carnivorous and omnivores species might take this advantage and get their abundance/ population density increased in cities with shrinkage.

5. CONCLUSION

Although raccoon dogs and masked palm civets are designated into the same category in terms of wildlife management policy in Japan currently, from this study, it could be addressed that raccoon dogs and masked palm civets have different land use preferences, behaviors and available food resources in urban area, which lead to a different population growth rate and different types/levels of human-wildlife conflicts in urban area.

The current Japanese wildlife management policies have concerned the human dimension already; however the focus is still only on the agricultural sectors and economic loss. The existing and potential human-wildlife happened in urban area not have not been taken into consideration yet.

Meanwhile, urban residents already experienced the impacts of increasing human-wildlife encounters in urban area. The nonagricultural damages caused by wildlife are exactly happening and the chance to have increasing human-wildlife conflicts in urban area is high due to the adaptation ability of wildlife and the dynamics of urban system.

Urban residents express their worries on the human-wildlife may occur in future, no matter they have already suffered the damage caused by wildlife or not, they are looking forward to the help from the public sectors. The gap between urban residents' expectation and the current countermeasure of public sectors could be found according to the current situation.

Hopefully, this study will help environment conservation and wildlife management related sectors and urban planners develop future wildlife management and land-use policies

which will take human-wildlife conflicts happened in urban areas into consideration as well.

In addition, for the species which stays in an ambiguous place (native or introduced species) from the ecological aspect, such as masked palm civets, I hope this study could provide a new aspect from the sociological aspect to make a the decision on policy making process.

6. LIMITATION AND FUTURE RECOMMENDATION

Because the urban human-wildlife conflict issue is still a very new field, as a startup research, this study could only provide very limited information. There are still a lot of fundamental studies are needed.

The study in urban area needs a database of private information. In this study the housing information (such as vacant houses distribution) are especially needed. However, this information is sensitive and almost unavailable due to the security concern. And I think this is the reason that why the studies of human-wildlife in urban area are very limited.

In addition, I listed the following issues and research directions that I feel important and will be greatly contribute to further develop this research field.

1) More ecological study (breeding season, behaviors, food resource, etc.) in urban area are needed.

The current studies on the target species are mainly from the rural area or zoos, except several studies on urban raccoon in U.S (Adams and Lindsey, 2010). However because of the adaptation abilities, these target species could adjust their behaviors to fit the current

environment very well. Previous studies showed that raccoons' behaviors, diet, even breeding seasons are different between in the U.S. and in Japan (Hauver et al. 2010), researches on raccoon dogs also showed that behavior patterns are different between Hokkaido raccoon dogs and Honshu raccoon dogs (Abe et al. 2006).

Therefore this is a high possibility that urban raccoon dogs, urban masked palm civets and urban raccoons have different ecological characters with rural populations (previous studies), entire and accurate understanding on their ecologies are urgently needed.

2) Continue to discuss that whether the masked palm civet is a native species or an introduced species.

It will be greatly helpful for the policy makers if the academia could get an agreement on whether the masked palm civet is an introduced species or not in Japan, which may directly affect the laws related to wildlife management policies and the current countermeasure of masked palm civets.

3) Define a human "social need" for target species (Adams, 2005).

In this study I found that people showed inconsistencies on the perceptions towards target species. In masked palm civet's case, some interviewees mentioned their attitude transformed. They felt annoying and built fences to mitigate the damage caused by masked palm civets, but after they saw the masked palm civets they felt they are cute and then the attitude changed, one even said he removed all the defense constructions and don't feel annoying anymore after he saw the cute baby masked palm civets once.

Impact of attitudinal factors on the perceptions and consequences of conflict have been discussed in several studies (Adams, 2005; Dickman, 2010). People base their perceptions and attitudes not only upon facts and personal experiences but also upon a myriad of factors such as wider societal experiences, cultural norms, expectations and beliefs (Dickman, 2010). To understand what are people's perceptions, expectations and attitudes on the target species

will be helpful to evaluate and mitigate the conflicts.

4) Conduct the survey in a bigger and continuous area.

This study could only distribute the questionnaires to 30 randomly selected areas due to the financial and other practical limitations. However, because these 30 areas are randomly selected and not adjacent, there are a lot of limitations and might include bias into this study result.

I found and possible relationship between the landform /altitude and the distribution of masked palm civets. There is a possibility that masked palm civets prefer the hilly area and the witness reports showed a concentration on high altitude areas. However, the selected areas are coincidentally mainly high altitude areas; it is a bit difficult to prove this hypothesis only by the current data. Therefore if the future research could cover the whole research area and that data might be more proper to check this hypothesis again.

In addition, the analysis and discussion on target species habitat selection and movement (such as their core habitat zone, their moving corridors, etc.) also require larger and interconnected study areas to acquire holistic information of the whole area.

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8. APPENDICES

Appendix A
Questionnaire on the Transformation of Urban Environment (and the Results)

Q1. What's the situation of the following items in the area surround your house? N= 1150

	1 None	2 Less	3 Medium	4 A few	5 Many	6 I don't know	DK/NA
Vacant lands	40.09%	30.43	13.74	7.74	1.48	4.00	2.52
Vacant houses	40.35%	25.65	10.43	9.74	1.48	10.26	2.09
Community garden	60.35%	13.57	7.57	4.35	0.78	10.09	3.30
Home garden	49.65%	23.04	9.04	3.65	0.61	10.78	3.22
Agricultural field	50.52%	20.70	8.17	10.26	3.48	4.00	2.87
Paddy field	82.17%	5.22	3.13	2.00	1.39	3.39	2.70
Bush and forest	50.61%	20.70	9.13	11.65	3.30	2.09	2.52
Park	22.61%	33.39	28.26	9.74	2.26	1.30	2.43

Q2. Do you feel any transformation of the following items in the area surround your house? N= 1150

	1 Increasing	2 No change	3 Decreasing	4 I don't know	DK/NA
Vacant lands	8.43%	34.52	41.48	12.70	2.87
Vacant houses	23.91%	39.30	6.43	27.13	3.22
Community garden	3.65%	51.74	7.83	33.30	3.48
Home garden	3.22%	51.74	8.96	32.61	3.48
Agricultural field	0.43%	49.22	26.87	20.43	3.04
Paddy field	0.53%	56.00	10.87	29.13	3.48
Bush and forest	0.61%	39.39	43.22	13.83	2.96
Park	6.09%	74.00	4.61	12.78	2.52

Q3. What's your consideration on the vacant lands in the area surround your house? N =1150

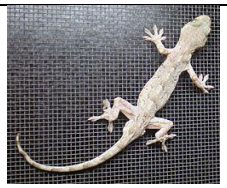
1. It's good because the fresh air and sunlight could come in	27.74%
2. A sense of freedom	25.57
3. Kids can have fun	14.00
4. Evacuation area during the disaster	19.04
5. A sense of nature	19.13
6. Connect to crimes	15.83
7. Decline of the community's vitality	11.30
8. Garbage be threw away illegally	38.96
9. Bad management and bad landscape	23.13
10.Bugs and weeds increase and the environment getting worse	34.00
11. Want to buy and use it	1.48
12. Want to rent and use it	1.91
13. Others	2.35
14. No idea/ No vacant lands around	18.09
DK/NA	1.83

Q4. What's your opinion on how to use the vacant lands in the area surround your house? N =1150

1. Community sharing garden	21.13%
2. Playground for kids	31.48
3. A public square for events	17.48
4. Parks for local community	31.13
5. Rental parking space	8.00
6. Free sharing parking lots	10.00
7. Build a community gathering hall	7.30
8. A space for solar panels	13.91
9. Evacuation space for disaster prevention	27.91
10. Neighbors of the vacant lands could use it	4.09
11. Sale it cheaply	8.61
12. Others	4.09
13. No idea/ No vacant lands around	23.83
DK/NA	2.61

Q5. What's your opinion on how to use the vacant houses in the area surround your house? N =1150

1. For local community gathering	21.65%
2. Let young people use it freely	6.61
3. Open a local cafe	17.65
4. Use as a free office	6.00
5. Open a shop	8.61
6. Others	14.35
7. No idea/ No vacant lands around	43.91
DK/NA	4.26

Swallow		kingfisher		raccoon dog		weasel	
sparrow		firefly		masked palm civet		bat	
pheasant		gecko		raccoon		hare	

Source：Wikipedia common ※ all the species have been confirmed their inhabitation in Kashiwa

Q6. Have you (and your family members) ever seen the following species with in these 10 years in the area around your house? N =1150

1. Swallow	62.17%
2. Sparrow	90.43
3. Pheasant	9.83
4. Kingfisher	8.96
5. Firefly	6.78
6. Gecko	58.52
7. Raccoon dog	13.57
8. Masked palm civet	13.22
9. Raccoon	0.87
10. Weasel	2.78
11. Bat	31.22
12. Hare	1.65
13. None of them	2.87
DK/NA	0.61

For those who have chosen 7. Raccoon dog 8. Masked palm civet Or 9. Raccoon
Please go to the Mapping survey (A3 sized paper) to answer the questions as well.

Q7. Do you have a feeling that any of the following species is increasing in recent 10 years in the area around your house ? N =1150

1. Swallow	1.83%
2. Sparrow	6.52
3. Pheasant	0.26
4. Kingfisher	0.61
5. Firefly	0.26
6. Gecko	5.22
7. Raccoon dog	1.13
8. Masked palm civet	3.65
9. Raccoon	0.26
10. Weasel	0.26
11. Bat	3.04
12. Hare	0.09
13. None of them	75.30
DK/NA	8.35

Q8. Do you have a feeling that any of the following species is increasing in recent 10 years in the area around your house ? N =1150

1. Swallow	37.48%
2. Sparrow	39.83
3. Pheasant	5.83
4. Kingfisher	4.70
5. Firefly	7.65
6. Gecko	10.61
7. Raccoon dog	5.48
8. Masked palm civet	1.57
9. Raccoon	1.13
10. Weasel	2.26
11. Bat	6.17
12. Hare	2.52
13. None of them	33.83
DK/NA	4.70

Q9. Which animal(s) do you have a positive feeling if they appear in your community? N =1150

1. Swallow	49.57%
2. Sparrow	41.47
3. Pheasant	16.25
4. Kingfisher	32.43
5. Firefly	62.26
6. Gecko	12.52
7. Raccoon dog	4.17
8. Masked palm civet	1.30
9. Raccoon	1.57
10. Weasel	2.70
11. Bat	3.91
12. Hare	10.70
13. None of them	16.35
DK/NA	3.48

Q10. Which animal(s) do you hope they will not appear in your community? N =1150

1. Swallow	2.09%
2. Sparrow	2.09
3. Pheasant	9.91
4. Kingfisher	1.91
5. Firefly	1.39
6. Gecko	24.43
7. Raccoon dog	55.04
8. Masked palm civet	70.78
9. Raccoon	68.43
10. Weasel	60.09
11. Bat	47.04
12. Hare	23.65
13. None of them	14.35
DK/NA	3.83

Q11. Please write down any comment or feedback related to the wildlife in your community.

Q12. What is your gender identity? N=1150

1. Male	40.17%
2. Female	59.30
DK/NA	0.52

Q13. What's your age? N =1150

1. 20~24	0.17%
2. 25~29	0.00
3. 30~34	5.30
4. 35~39	6.17
5. 40~44	9.39
6.45~49	8.87
7. 50~54	9.65
8. 55~59	8.61
9. 60~64	12.09
10. 65~69	13.48
11. 70~74	10.52
12. Over 75	15.39
DK/NA	0.35

Q14. What's your social status? N =1150

1. Agricultural related	0.43%
2. Freelance other than agriculture	4.78
3. White collar	27.57
4. Student	0.09
5. Housewife	40.00
6. Retired/ Jobless	21.22
7. Others	5.48
DK/NA	0.43

Q15. What type of residential structure you are living in? N =1150

1. House	78.70%	→ For those who have chosen 1. Please go to Q16.
2. Apartment complex	19.74	
3. Others	0.52	→ For those who have chosen 2 or 3. Please go to Q20.
DK/NA	1.04	

Q16. Are you growing vegetables in your own yard? N =905

1. Yes	21.99%
2. No	77.57
DK/NA	0.44

Q17. Is there any vacant house/ vacant land close to your house? N =905

1. Vacant land	15.03%
2. Vacant house	16.46
3. None	65.64
4. I don't know	1.33
DK/NA	1.55

Q18. If there is a vacant land next to your house, what do you want to do for it? (Choose one option only)

N =905

1. Renting	15.58%	
2. Buy	14.92	→ For those who have chosen 1. or 2., Please go to Q19.
3. No interest	58.34	
4. Others	4.97	→ For those who have chosen3. or 4., Please go to Q20.
DK/NA	6.19	

Q19. If you have rented/ bought a vacant land, how are you going to use it? N =276

1. Parking lot	31.16%
2. Home yard	38.77
3. Grow flowers and vegetables	60.51
4. Build new building	16.67
5. Use as a storage	7.61
6. Others	3.62
DK/NA	0.72

Q20. How many years have you been living in the current address? (choose one option only) N =1150

1. Less than 1 year	2.35%
2. 1 ~ 5 years	9.30
3. 6~ 10 years	10.52
4. 11~ 15 years	12.09
5. 16~20 years	9.04
6. Over 21 years	55.13
DK/NA	1.57

Q21. Please write down any comment or feedback to the city office

Appendix B

Questionnaire (Mapping survey) on the Distribution and Conflict Situation of Raccoon Dogs, Masked Palm Civets and Raccoons (and the Results)

Q1. Please write down the detailed information of your sighting of raccoon dogs, masked palm civets and raccoons, and map the exactly place on the map (go to the back side of this questionnaire)

Q2. Are there any raccoon dogs, masked palm civets or raccoon invade into your house? N=266

1. Yes	6.02%
2. No	88.72
DK/NA	5.26

Q3. Have you ever suffered any damage caused by raccoon dogs, masked palm civets or raccoons? N=266

1. No	77.07%	→ Mapping survey finished here.
2. Yes	15.79	→ Please continue to answer the following questions.
DK/NA	7.14	

Q4. What kind of damage have they caused? N=42

1. Traffic accident	2.38%
2. Bit people	7.14
3. Ate garbage	9.52
4. Ate fruits/vegetables in backyards/farm lands	30.95
5. Made noises	19.05
6. Smelly dungs	30.95
7. Disease/ Zoonoses	2.38
8. Fights with pets	2.38
9. Caused mental pains	11.09
10. Others	16.67
DK/NA	14.29

Q5. How did you solve the troubles? N=42

1. Solved it by myself	26.19%
2. Private pest control companies	14.29
3. City office	4.76
4. Did nothing	35.71
5. Other solutions	7.14
DK/NA	11.90

Q6. Which animal caused the damages? (If you suffered damages from over one of them, please choose the one who caused most serious problem) N=42

1. Raccoon dogs 11.90%
2. Masked palm civets 80.95
3. Raccoons 0.00
4. I am sure it was one of them, but cannot distinguish it 7.14

DK/NA 0.00


N
松ケ崎
篠籠田
市立柏幼稚園
柏
ドラッグストアスマイル
マミーマート
柏厚生クリニック
呼塚
柏保健所入口
あけぼの３丁目
あけぼの５丁目
赤城神社
あけぼの２丁目
あけぼの４丁目
柏税務署
柏５丁目
あけぼの二丁目
0 50 100 200 メートル

Appendix C

List of the Human Dwelling Invasion Cases Caused by Masked Palm Civets (Provided by Private Pest Control Company C)

Table i: List of the human dwelling invasion cases caused by masked palm civets (outside Kashiwa city)

Year	Month	city	operation	caught
2010	3	abiko	catch	3
2010	3	abiko	catch	1
2010	4	abiko	catch	0
2010	5	matsudo	catch	2
2010	5	noda	catch	1
2010	6	abiko	catch	2
2010	6	nagareyama	chase out/ close the entrance/sanitizing	0
2010	6	noda	chase out/ close the entrance/sanitizing	0
2010	6	abiko	chase out/ close the entrance/sanitizing	0
2010	10	matsudo	catch	1
2010	11	abiko	chase out/ close the entrance/sanitizing	0
2010	11	matsudo	chase out/ close the entrance/sanitizing	0
2010	12	matsudo	catch	0
2011	1	matsudo	catch	0
2011	1	kamagaya	catch	2
2011	1	abiko	catch	5
2011	2	abiko	catch	2
2011	3	abiko	catch	1
2011	3	abiko	chase out/ close the entrance/sanitizing	0
2011	4	matsudo	chase out/ close the entrance/sanitizing	0
2011	4	matsudo	catch	3
2011	5	matsudo	chase out/ close the entrance/sanitizing	0
2011	11	kamagaya	chase out/ close the entrance/sanitizing	0
2011	12	ichigawa	chase out/ close the entrance/sanitizing	0
2012	5	nagareyama	catch	2
2012	5	noda	catch	0
2012	6	matsudo	chase out/ close the entrance/sanitizing	0
2012	6	matsudo	chase out/ close the entrance/sanitizing	0

Table ii: List of the human dwelling invasion cases caused by masked palm civets (Cases in Kashiwa city)

Year	Month	city	address	operation	caught
2010	1	Kashiwa	Toyoshiki 945-X	catch	0
2010	1	Kashiwa	Nishiyama 1-9-X	catch	1
2010	2	Kashiwa	Minamimasuo 6-4-X	chase out/ close the entrance/sanitizing	0
2010	2	Kashiwa	Akebono 3-9-X	chase out/ close the entrance/sanitizing	0
2010	2	Kashiwa	Hananoi 735-X	chase out/ close the entrance/sanitizing	0
2010	3	Kashiwa	Takayanagi 1765-X	catch	1
2011	2	Kashiwa	Nishiyama 1-8-X	catch	0
2011	3	Kashiwa	Akebono 3-6-X	catch	0
2011	4	Kashiwa	Takada 1402-X	catch	5
2011	4	Kashiwa	Jyoubandai 11-X	chase out/ close the entrance/sanitizing	0
2011	5	Kashiwa	Akebono 3-7-X	chase out/ close the entrance/sanitizing	0
2011	9	Kashiwa	Ohshimada 614-X	chase out/ close the entrance/sanitizing	0
2011	11	Kashiwa	Takayanagi 587-X	catch	0
2012	1	Kashiwa	Imayakamicyo 73-X	catch	1
2012	2	Kashiwa	Shikoda 1397-X	chase out/ close the entrance/sanitizing	0
2012	4	Kashiwa	Minamimasuo 8-1-X	chase out/ close the entrance/sanitizing	0
2012	6	Kashiwa	Eirakudai 3-4-X	catch	0
2012	6	Kashiwa	Kashiwa 7-8-X	catch	0