fruit per day. The amount might be insufficient to fill the civets' stomachs. Therefore, the influences of seasonal variance in the food intake rate appeared to be low in this study.

2. Effects of flesh hardness on SI and application to wild civets

The hardness of kaki fruits presented to each civet did not affect significantly the SI. Even the hard fruits in this study was relatively soft compared to salable fruits. The range of hardness was too small to affect the SI. The ingestion pattern and SI will differ in fruits with very high hardness during the early ripening period, as in a study of frugivorous bats (Dumont 1999). More factors are needed to examine the applicable situation (e.g. hardness) of SI of this study to wild civets. Nevertheless, this is the first study to provide an index to estimate the intake rate of kaki fruits by civets. It is more robust to use the duration of all ingestion behaviors to calculate intake rate than to use bite size/rate for discarded kaki fruits, which are on the ground and relatively soft compared to salable fruits. In addition, we used non-astringent kaki fruits in this study. Japanese monkey, wild boar (*Sus scrofa*) and sika deer (*Cervus nippon*) eat astringent kaki fruits during the early ripening period (H. Ueda personal observation). It is well known that the Asian (common) palm civets (*Paradoxurus hermaphroditus*) eat coffee fruits (Marcone 2004), which contain high level of tannin (Farah and Donangelo 2006). Also, a species of the order Carnivora produced tannin-binding salivary (Robbins et al. 1991). Therefore, wild masked palm civets will eat astringent kaki fruits at least after fully ripening.

We can calculate intake rate of wild civets by multiplying the representative values of SI of captive civets by the duration of ingestion behaviors of wild animals observed from remote cameras. The minimum ingestion time (TDI) was 56 seconds in this study (Table 2). In an extremely shorter observation period than this, for example, when civets bite only two or three times for a few seconds, the estimation would not be accurate. Furthermore, we recommend to use the representative values (i.e., the range between the top 25 th percentile and the bottom 25 th percentile) of SI in estimation of wild civet's intake rate. The reason is that internal factors of animals, such as body size and appetite, also affect feeding efficiency and SI. For example, body weight variety within a species (and sex for species with greater sexual dimorphism) affects intake rate (Wilmers et al. 2002). We usually cannot determine the body weight and sex of animals from the videos of remote cameras in the field. The sex difference in body weight of civets is little (Table 1 and Ohdachi et al. 2015). Thus, we did not test the effect of body weight and sex on SI in this study. But the wild civets have great individual differences with various state affecting feeding behaviors and SI. The representative values of SI include some differences among individuals in ingestion behaviors of kaki fruits, allowing more realistic application than using the mean value.

3. Energy intake rate for captive civets

The SI was calculated while eating a whole or most of kaki fruit. For the captive civets, even the individual with the lowest SI (M4) could obtain 14.4% of the daily requirement in just about six minutes. Therefore, it is clear that even "one" cultivated fruit can be excellent food resource for civets. Regardless of whether the cultivated fruit is salable or not, we need to limit the access of invasive mammals to fruits, and consequently, to decrease crop damage and the animal populations.

V. Summary

We evaluated energy value of kaki fruits (*Diospyros kaki*), a large-sized cultivated fruit, on masked palm civets (*Paguma larvata*), an invasive species in Japan. We determined the standard values of intake rate (SI) for kaki fruits by captive civets to apply to wild civets. We conducted feeding experiments over a total of 4 days with different flesh hardness (i.e., hard and soft conditions) using 11 captive civets. We divided gross fruit intake by duration of ingestion behaviors (biting, nibbling, gnawing, lapping, and licking actions) to obtain the SI (g/s). From linear mixed-effects model analyses, the experimental day and fruit hardness presented to each

individual had no significant effect on the SI. We defined the representative values of SI as ranging from 0 . 91 to 1 . 37 g/s. The captive civet with the greatest efficiency obtained 22 . 3 % of the daily requirement in 1 minuet of ingestion time and even the civet with the lowest efficiency could obtain 14.4% of the daily requirement in just six minutes. This is the first study providing an index to estimate the intake rate of invasive medium-sized Carnivora on large-sized cultivated fruits. It is clear that cultivated fruit is an excellent food resource for civets and efforts are needed to limit the access of invasive species to cultivated fruits, and consequently, to decrease crop damage and the animal populations.

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