

## Is There Current Competition between Sympatric Siberian Weasels (*Mustela sibirica*) and Ferret Badgers (*Melogale moschata*) in a Subtropical Forest Ecosystem of Taiwan?

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**Hai-Yin Wu (1999)** Is there current competition between sympatric Siberian weasels (*Mustela sibirica*) and ferret badgers (*Melogale moschata*) in a subtropical forest ecosystem of Taiwan? *Zoological Studies* 38(4): 443-451. The Siberian weasels (*Mustela sibirica*) and ferret badgers (*Melogale moschata*) sympatric in the Guandaushi Forest are of particular interest because, with low density of rodent prey most of the time, weasels in this area perhaps adapt their diets and may compete with ferret badgers. Dietary and spatial relationships between the 2 carnivores were studied by scat analysis and capture-and-recapture rates from March 1995 to August 1998. Diets of allopatric populations reported by others are referenced for comparison. As expected, by switching to arthropod prey and shrews, weasels in Guandaushi Forest consumed food items different from weasels in alpine grasslands. Ferret badgers in Guandaushi and Fushan forests consumed similar diets. The dietary overlap between the sympatric weasels and ferret badgers was substantial; however, the occurrence frequencies of vertebrates, arthropods, and earthworms in their diets differed significantly. The major groups of arthropod prey of the 2 species differed; this might be related to their foraging behaviors. Results from preliminary trapping (March to November 1995) suggested that habitat segregation exists between weasels and ferret badgers in the 3 regions (A-C) which differ in habitat types. This pattern was confirmed in the main study period. More weasels were captured in region A than in the other regions, while a reversed pattern was observed for ferret badgers. Intensive human hunting in the spring of 1996 removed most of the marked animals. This provided an opportunity to examine the significance of current competition on the observed patterns of habitat segregation. Ferret badgers were almost eliminated after the period of hunting. The occurrence of weasels was not influenced by hunting, or by the disappearance of ferret badgers. This suggests that there is no evidence for current competition between weasels and ferret badgers, and coexistence is achieved by the differences in habitat preference, diet, and foraging behaviors of the 2 species..

**Key words:** Interspecific competition, Diet, Habitat segregation, Siberian weasel, Ferret badger.

Competition theory predicts that potential competitors coexisting in a community should exhibit niche differentiation or resource partitioning to avoid competition (Begon et al. 1986, Ricklefs 1990). Habitat, food, and time have been suggested to be the most important niche dimensions in resource partitioning between species (Pianka 1969, Schoener 1986). If the species fail to differentiate in niches, they may compete with each other directly, which, in theory, may lead to coexistence in a suboptimal state (i.e., population size less than the carrying capacity) or to the eventual exclusion of 1 species

(Volterra 1926, Lotka 1932). Empirical studies dealing with mammalian carnivores show that coexisting carnivores tend to have different diets, habitat use patterns, or activity patterns, indicating that it is a common phenomenon for coexisting species to have different niches (Maddock and Perrin 1993, Tataru and Doi 1994, Crooks and van Vuren 1995, Chuang and Lee 1997, Medina 1997). Recently, researchers have also found evidence for direct competition (in the form of interference competition) between sympatric canids as well as other mammalian predators (Thurber et al. 1992, Creel and Creel

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1996, Cohn 1998).

However, both intense and weak competition can be implied by differences in resource use between sympatric species (Pimm and Rosenzweig 1981, Begon et al. 1986). If currently competing species coexist by virtue of niche differentiation, they should retain the ability to expand their niches in the absence of competitors (e.g., Lofgren 1995, Luo and Fox 1995, Haken and Batzli 1996, Vaughan et al. 1996, Sorensen 1997). Otherwise, alternative explanations, such as "ghost of competition past" (Connell 1980) and results of independent evolutionary courses (Begon et al. 1986, Law and Watkinson 1989) should be considered.

One way to verify the importance of current competition is by experimental manipulation of 1 species (Wise 1984, Vassallo 1993, Luo and Fox 1995, Haken and Batzli 1996, Underwood 1997), or by comparing the niches of sympatric and allopatric populations (Clade and Macdonald 1995, Sorensen 1997). Experimental conditions provided by natural or anthropogenic catastrophes or events can also serve the function of removal experiments (e.g., Lofgren 1995).

Four species of Mustelidae occur in Taiwan (Chen and Yu 1984). Among them, 2 species (yellow-throated marten, *Martes flavigula*, and otter, *Lutra lutra*) are rare, while the other 2 species (Siberian weasel, *Mustela sibirica*, and ferret badger, *Melogale moschata*) are common and are frequently sympatric to each other (e.g., Lee 1994). How the latter 2 species coexist, or how they differ in terms of resource use, are the main purposes approached by this study.

Ferret badgers belong to the subfamily Melinae, members of which are thought to be omnivorous (Corbet and Hill 1992). The major food items consumed by ferret badgers in the Fushan Forest, a subtropical moist hardwood forest in north-eastern Taiwan, were earthworms and insects (Chuang and Lee 1997). Species in the genus *Mustela* are believed to be flesh-eating specialists that consume vertebrate prey (Gittleman 1989). They may also feed on invertebrates to a varying degree (King 1991, Korpimaki et al. 1991, Tatara and Doi 1994, Lode 1995, Murphy and Dowding 1995). Siberian weasels living in alpine grasslands in Taiwan mainly prey on small mammals (Ma 1990). However, unlike the high montane areas with diverse and abundant small mammals, mid-elevation forests in Taiwan, including the present study site, are depauperate of terrestrial rodents (Yu 1993 1994). Only 1 species, the spiny rat (*Niviventer coxingi*), can be found, usually at low density (Lee 1994, Yu 1994, Wu and Yu 2000). Al-

though several species of shrews (body weight less than 10 g) are also present in these forests, they may not be preferred prey for weasels (Churchfield 1990, Ray 1998). Considering the difficulties Siberian weasels have in finding mammalian prey in these forests, I hypothesize that they switch to alternative prey, and, therefore, may compete with ferret badgers. What prey items the Siberian weasels living in such habitats depend upon, and whether they compete with ferret badgers for common resources, are examined in this study.

In the spring of 1996, local hunters set traps and snares within the study area. Interviews with the hunters confirmed that they trapped some of the marked animals. Although hunting only lasted a few months, it had a devastating influence on the abundance of animals. All ferret badgers and all except 1 weasel marked before mid-1996 disappeared. After mid-1996, weasels soon established a new population in the study area. However, no ferret badger was captured during the same period except an individual captured at the last trapping session. The absence of ferret badgers after mid-1996 provided a condition of experimental removal of 1 species and made it possible to examine the competitive interactions of the 2 species. If competition exists between the 2 species, Siberian weasels would be expected to respond to the disappearance of ferret badgers.

In this paper, I address 2 questions: (1) whether the 2 carnivore species compete for food, by comparing their diets; and (2) whether the 2 species compete for space, by comparing the spatial occurrence of the 2 species and the distribution of Siberian weasels in the presence and absence of ferret badgers.

## MATERIALS AND METHODS

The study was conducted at the Guandaushi Forest (24°04'N, 121°01'E) which is within the range of the Huisun Experimental Forest Station of National Chung Hsing University. The climate is warm and humid, and is characterized by distinct rainy (May-September) and dry seasons (October-April). The average annual temperature is 21 °C, and the mean relative humidity is 83% (King and Hsia 1997).

The Guandaushi Forest is one of the 4 forest sites of the long-term ecological research (LTER) program in Taiwan (King and Hsia 1997). The forest site lies on an eastward slope extending from the Guandaushi tributary to the Xiaochushan hilltop covering an elevational gradient from 850 to 1700 m.

The natural vegetation is mainly subtropical rain forest dominated by Fagaceae and Lauraceae. However, there are also patches of coniferous stands in this area.

Siberian weasels and ferret badgers were known to be sympatric in the study area from preliminary trapping attempts (May–November 1995). The main study period was from December 1995 to August 1998. The rugged terrain and the steep slope deterred systematic trap arrangement. Therefore, traps were set on suitable sites along trails of about 5-km length. Nearly 100 traps were set at the most at any occasion. Some trap sites were abandoned due to landslides or tree falls during the course of the study.

Animals were captured with mesh-wire traps (24 x 15 x 11 cm) or Tamahawk traps baited with Pacific saury (or Sanma fish, *Cololabis saira*) from local market. Captured animals were anaesthetized with a combination of ketamine and thiazine-hydrochloride. Sedated animals were weighed, measured for body and tail lengths, and tagged with transponders for individual identification.

The study area was about 3 km<sup>2</sup> and could be divided into 3 regions (A, B, and C) by habitat types (Table 1). Traps in regions A and B were set for the entire study period as well as the preliminary trapping period. Trapping in region C was discontinued after June 1997 because of low capture rates for a year (3 animals/yr).

Traps were set for at least 4 consecutive days in a trapping session every 2 or 3 mo. Results of trapping sessions were combined on a seasonal basis (spring: March–May; summer: June–August; autumn: September–November; winter: December–February); therefore, a total of 11 seasons were defined (winter 1995–summer 1998). There were 1 or 2 trapping sessions per season. Intensive hunting occurred during the early part of the study (especially in spring 1996). In order to compare the capture-and-recapture rates of the target species in periods of different hunting pressure, the study period was divided

into 2 phases. Phase I was from winter 1995 to summer 1996 during which hunting occurred, and phase II was from autumn 1996 to spring 1998 when no hunting was known within the study area. However, hunting in the neighboring areas never stopped.

The occurrence of the 2 species in the 3 regions during the 2 phases were compared by their respective capture-and-recapture rates and numbers of individual animals captured. Capture-and-recapture rate is used as an index of the relative activity of animals in each region, while number of individual animals captured indicates the relative abundance of animals. Capture-and-recapture rate was expressed as the frequency of captures and recaptures per 100 trap-nights (TN) corrected for unavailable traps (King 1983). The significance of the interactions involving the main effects (phase, region, and species) on capture-and-recapture rates was examined by multiway analysis of variance (Sokal and Rohlf 1981).

Scat was collected for diet analysis from trapped animals. Scat samples were dried at 60 °C for 3 to 4 d and stored in paper bags. Dried scat was soaked in warm water; contents of the scat were identified by comparing with reference collections and sorted into 6 categories: mammals (including shrew, rats, and squirrels), birds, reptiles (including snakes and lizards), amphibians (frogs and toads), earthworms and arthropods (insects, millipedes, and centipedes). The occurrence of earthworms in scat was determined by the presence of earthworm chaetae or dirt nodules ingested by earthworms.

A total of 157 weasel scat and 17 ferret badger scat was collected for diet analysis. The sample size of ferret badger scat was limited for 2 reasons: (1) disappearance of ferret badgers made it impossible to collect their scat in phase II; and (2) the nesting behavior of ferret badgers in cages would mix up the feces with nesting materials, litter, and dirt the animals collected from beneath the cages.

Diets were analyzed by percentage of absolute occurrence (percentage of scat in which a food item

**Table 1.** Characteristics of the 3 trapping regions in the study area

	Region-A	Region-B	Region-C
Elevation	1400-1700 m	1150-1400 m	850-1150 m
Slope	13°	20°	37°
Vegetation	secondary forest	coniferous plantations	primary forest
Terrain	flat ridge leading to a hilltop	middle slope of the hill with a rivulet running through	slope descending to the Guandaushi tributary

occurred) and percentage of relative occurrence (percentage of the occurrence of a food item divided by the total occurrence of food items in scat samples). The latter index is considered a reasonable indication of the relative proportion of different food categories (Medina 1997). Standardized niche breadth in the diet was calculated by Levin's formula (Krebs 1989). Percentage of overlap was calculated by Pianka's adaptation of MacArthur and Levin's formula (Krebs 1989). Differences between the diets of the 2 species were examined by Chi-square test of association. Diets of Siberian weasels inhabiting alpine grasslands (ca. 3000 m in elevation) (Ma 1990) and of ferret badgers in Fushan Forest (ca. 700 m) (Chuang and Lee 1997) were included for comparison.

## RESULTS

### Diets of the two species

Arthropods and mammals were the most important components of the weasel diet, being present in 69.4% and 41.4% of scat, respectively, followed by earthworms in 28.0% of scat (Table 2). Shrews, probably *Crocidura kurodai* and *Chodsigoa sodalis*, were the most important mammalian prey for weasels. Shrews were present in about 1/3 of weasel scat.

Ferret badgers appeared to consume mostly arthropods, fragments of which occurred in 94.1%, or 16 out of 17 scat samples (Table 2). Earthworms

were the 2nd most important prey for ferret badgers, being present in 41.2% of scat (Table 2).

Diets of the 2 species in Guandaushi Forest differed significantly in the occurrence frequencies of vertebrates, arthropods, and earthworms in their scat ( $\chi^2 = 7.6$ ,  $df = 2$ ,  $p < 0.05$ ). Niche breadth in the diet for Siberian weasels was greater than that of ferret badgers (Table 2).

Compared with allopatric populations, niche breadth of the 2 carnivore species in Guandaushi were greater than that of weasels in alpine grasslands, but were less than that of ferret badgers at Fushan (Table 2). The niche overlap index of the 2 sympatric species in Guandaushi was similar to that of the 2 allopatric ferret badger populations, and was larger than the indices for all other allopatric species pairs (Table 3).

### Spatial relationships of the two species

#### Preliminary trapping period

Traps were set in regions A and B during the preliminary trapping period. Ten Siberian weasels and 4 ferret badgers were captured, marked, and released in a total of 744 TN, respectively. The 2 species have different distribution patterns in the 2 regions; weasels were present in both regions while ferret badgers were found only in region B. In region A, weasels were trapped with a capture-and-recapture rate of 2.39 per 100 TN. In region B, the capture-and-recapture rates of the 2 species were similar (weasels, 0.67 per 100 TN; ferret badgers, 0.89 per 100 TN).

**Table 2.** Diets of Siberian weasels and ferret badgers in Guandaushi Forest and 2 other areas by scat analysis

	Guandaushi				Alpine grasslands <sup>a</sup>		Fushan <sup>b</sup>	
	Siberian weasels		Ferret badgers		Siberian weasels		Ferret badgers	
	%AO <sup>c</sup>	%RO <sup>d</sup>	%AO	%RO	%AO	%RO	%AO	%RO
Mammals	41.4	26.0	5.9	3.9	97.0	92.0	0	0
Birds	3.8	2.4	5.9	3.9	4.5	4.3	0	0
Reptiles	5.1	3.2	5.9	3.9	2.5	2.4	0	0
Amphibians	11.5	7.2	0	0	0	0	39.2	16.1
Arthropods	69.4	43.6	94.1	61.5	1.0	0.9	> 95.0	38.9
Earthworms	28.0	17.6	41.2	26.9	0	0	100.0	41.0
Gastropods	0	0	0	0	0	0	1.4	0.6
NB <sup>e</sup>	0.475		0.299		0.045		0.566	
No. of scat	157		17		401		64	

<sup>a</sup>Data from Ma (1990).

<sup>b</sup>Data from Chuang and Lee (1997).

<sup>c</sup>Percentage of absolute frequency of occurrence.

<sup>d</sup>Percentage of relative occurrence.

<sup>e</sup>Niche breadth, as calculated by Levin's formula (Krebs 1989).

## Main study period

During the main study period from winter 1995 to summer 1998, 31 Siberian weasels and 15 ferret badgers were captured 183 and 62 times, respectively, out of a total of 9808 TN.

Regional differences of the 2 species observed in the preliminary trapping period recurred in the main study period. The overall capture-and-recapture rates for weasels in the 3 regions decreased from region A to C (4.34, 0.79, and 0.22 per 100 TN in regions A, B, and C, respectively). For ferret badgers, a reversed pattern was observed (capture-and-recapture rate: region A = 0, region B = 0.79, and region C = 0.14 per 100 TN).

Capture-and-recapture rates of the 2 species were affected by region and phase (hunting pressure) differently. The significance in the 3 first-order interactions in the multiway analysis of variance (Table 4) indicates that the 2 species have different regional and temporal patterns of capture-and-recapture rates. For ferret badgers in phase I, the capture-and-recapture rates increased from 0 in region A to the highest in region C (Fig. 1). In phase II, only one ferret badger was captured once in a total of 5556 TN. Hunting and the disappearance of ferret badgers did not have an obvious influence on the occurrence of weasels in the 3 regions. The regional variation in capture-and-recapture rates for weasels followed a similar pattern in both phases; the capture-and-recapture rates decreased steadily from region A to region C (Fig. 1).

Regional and temporal variations in numbers of individual animals captured are similar to the patterns in capture-and-recapture rates, especially for weasels. More weasels were recorded in region A than in regions B or C (Fig. 1). For ferret badgers in phase I, more individuals were captured in region B than in region C (Fig. 1), although the capture-and-recapture rate was higher in the latter.

## DISCUSSION

## Flexibility in diet

## Siberian weasels

Siberian weasels in the Guandaushi Forest are not exclusively flesh-eating specialists as generally believed (Gittleman 1989, King 1989). Instead, they turn to alternative prey as hypothesized and depend on invertebrates and shrews. Their diet is different from that of weasels in alpine grasslands (Ma 1990). The difference between the 2 populations is not surprising and could be related to regional differences in small mammal abundance. In high-elevation forests and grasslands of Taiwan, there are at most 4 terrestrial rodent species (*Niviventer culturatus*, *Apodemus semotus*, *Microtus kikuchii*, and *Eothenomys melanogaster*) (Yu 1993). But there is only 1 species inhabiting forests at low to middle elevations, i.e., *N. coxingi*, or spiny rat (Yu 1994). Moreover, abundances of high-mountain rodent species (e.g., Lin and Shiraishi 1992, Yu 1993, Adler 1996) are higher than that of spiny rats (Chang 1991, Lee 1994, Wu and Yu 2000). In other words, weasels at high elevations can live on the diverse and abundant small mammal fauna (Ma 1990). By contrast, weasels in forests at low to middle elevations must rely on other prey. Thus, in the Guandaushi Forest, weasels become opportunistic by turning to invertebrate prey. They even include odorous shrews, often discarded by other *Mustela* species (Churchfield 1990), in their diet. Therefore, I conclude that Siberian weasels are opportunistic predators, depending on what is locally available. In the Tsushima Islands, Japan, where there are few small mammals available, Siberian weasels are also reported to have omnivorous and opportunistic food habits (Tatara and Doi 1994).

Although weasels in Guandaushi switch to invertebrate prey, they still retain the preference for rats when available. In Guandaushi Forest, the popu-

**Table 3.** Index of niche overlap<sup>a</sup> in diets of Siberian weasels and ferret badgers in Guandaushi Forest, Fushan Forest<sup>b</sup>, and alpine grasslands<sup>c</sup>

		Guandaushi		Alpine grasslands
		Siberian weasel	Ferret badgers	Siberian weasels
Guandaushi forest	Ferret badgers	0.89		
Alpine grasslands	Siberian weasel	0.49	0.07	
Fushan forest	Ferret badgers	0.79	0.88	0.01

<sup>a</sup>Calculated by Pianka's adaptation of MacArthur and Levin's formula (Krebs 1989).

<sup>b</sup>Data from Chuang and Lee (1997).

<sup>c</sup>Data from Ma (1990).

lation density of the spiny rat is low. The capture-and-recapture rate in each trapping session was less than 2.0 per 100 TN. However, more rats were captured in the mast year of Fagaceae trees than in years of fruiting failure. There were also more spiny rats identified from weasel scat in the masting season and the following winter than in other seasons (Wu, 1999). Linked fluctuations in the amount of seed crops and numbers of rodents and weasels have been reported in high-latitude forest communities (King 1983, Pucek et al. 1993, Jedrzejewski et al. 1995, Murphy and Dowding 1995). Interactions among these 3 trophic levels in subtropical forest ecosystems deserve further attention.

#### Ferret badgers

Ferret badgers in the Gaundaushi and Fushan areas have similar diets; the major food items are arthropods (mainly insects) and earthworms (Chuang and Lee 1997). The similarity in habitats with similar available prey may explain the high diet overlap between the allopatric ferret badgers. In Gaundaushi Forest, ferret badgers were mainly captured in traps alongside rivulets. In Fushan Forest, the animals frequent stream banks and open valleys. Nevertheless, there are some differences in diets between the 2 allopatric populations, such as higher percentages of occurrence of earthworms and frogs, and lack of rat, bird, and lizard fragments in the Fushan population, which led to the 2-fold difference in their niche breadths.

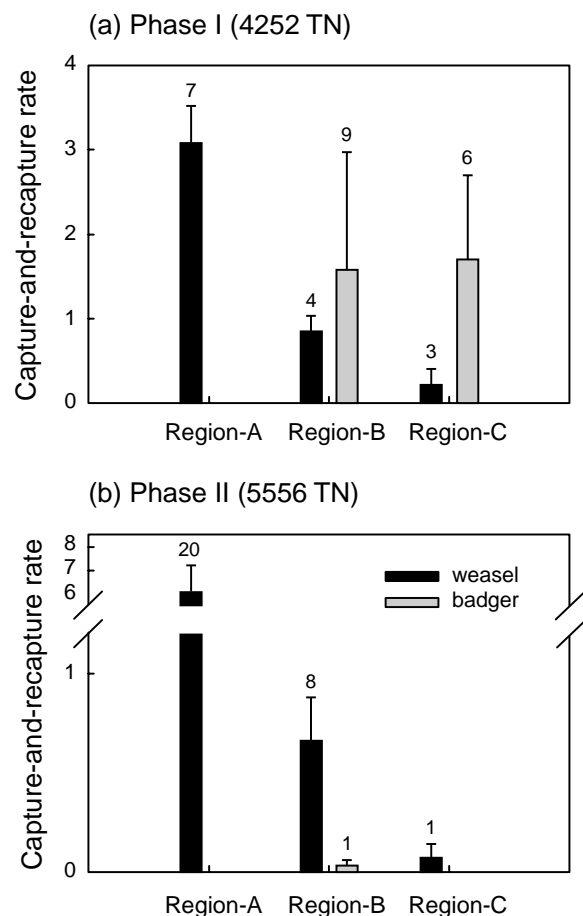
#### Competitive relationship between sympatric Siberian weasels and ferret badgers

##### Dietary relationship of the two species

Both Siberian weasels and ferret badgers in Gaundaushi consume substantial and similar portions of arthropods and earthworms (Table 2), resulting in the higher diet overlap between them in com-

parison to allopatric species pairs (Table 3). However, there are readily observed differences: more vertebrate prey (especially shrews) in weasel and more arthropods in ferret badger diets. Although differences in resource use between sympatric carnivores may permit long-term coexistence, a substantial niche overlap preserves the potential for future competition between the 2 species (Crooks and van Vuren 1995, Holbrook and Schmitt 1995).

By having overlapping yet different diets, do the 2 species in Gaundaushi compete for food directly? This is not likely for 2 reasons. First, although they both consume a large proportion of arthropods, the 2 species feed on different groups of arthropods. At



**Table 4.** Results of multiway analysis of variance on capture-and-recapture rates by species, phase, and region

Source of variation	df	F	p
Species	1	8.557	0.005
Phase	1	0.058	0.811
Region	2	6.811	0.003
Species x phase	1	5.088	0.029
Species x region	2	15.413	0
Phase x region	2	3.624	0.035
Species x phase x region	2	0.386	0.682

**Fig. 1.** Means and standard errors of seasonal capture-and-recapture rates (frequencies of captures and recaptures per 100 trap-nights, or TN) for Siberian weasels and ferret badgers in regions A, B, and C (1400-1700, 1150-1400, 850-1150 m in elevation, respectively) in phase I (winter 1995 - summer 1996) and phase II (autumn 1996 - spring 1998). Hunting by local people in the study area prevailed in spring 1996. Trapping in region C stopped after summer 1997. The number on top of each bar indicates the number of individual animals captured in each region.

the moment, it is difficult to identify the heavily chewed arthropod fragments in scat to the level of order or family. However, from the identified fragments, I found that orthopods, adults of coleopterans and centipedes were common in weasel scat, while coleopteran larvae were frequently recorded in ferret badger scat. More detailed examination of the arthropod fragments in the feces would help to differentiate the diets of the 2 species.

The 2nd reason is that the 2 species differ in their foraging behaviors. Siberian weasels seem to search in forest litter and on the ground for shrews, orthopods, adult beetles, and millipedes. It is also likely that they find these prey in caves or crevices. Ferret badgers might dig out their prey (earthworms and coleopteran larvae) from soil and rotten logs. I suggest that Siberian weasels and ferret badgers in Gaundashi do not have direct dietary competition with each other because they forage for different groups of animals in different ways.

#### Spatial relationship of the two species

In addition to food, sympatric species may compete for other resources, such as foraging grounds and nest sites (Crooks and van Vuren 1995, Dooley and Dueser 1996, Robertson 1996, Vaughan et al. 1996, Sorensen 1997). Spatial segregation due to interference competition or interspecific territoriality has been reported between sympatric carnivores (Lofgren 1995, Creel and Creel 1996, Cohn 1998) and is suggested to be a way to reduce food competition (Clade and Macdonald 1995, Cohn 1998).

Competition between Siberian weasels and ferret badgers for space in the study area was suspected by the patterns observed in the preliminary trapping period and in phase I, i.e., the higher capture-and-recapture rates of weasels in region A than in region B, and the reversed pattern for ferret badgers. In phase II when ferret badgers disappeared, the regional difference in the capture-and-recapture rates of weasels remained. In other words, in the absence of ferret badgers, weasels did not invade the region formerly occupied by ferret badgers. Interspecific competition as the driving force for niche partitioning is often refuted by the lack of niche extension or shift in 1 species in the absence of the other (Arlettaz et al. 1993 1997, Vassallo 1993). Therefore, I suggest that region A is the preferred habitat for weasels, and the spatial segregation between the 2 species may not be the result of food competition.

The conclusion that region A is the preferred habitat for Siberian weasels needs further elaboration. Some weasels were captured in regions B and

C. However, most captures in region B were in winter or were of old or weak individuals. These weasels were mainly captured in region A during their residency and were only present in region B for a short time. All 4 animals captured in region C were adult males that were captured only once. Compared with regions B and C, region A sustained a breeding population with adults of both sexes and young animals that stayed in the study area for 1-17 mo (Wu, unpubl. data). More studies are needed to determine the microhabitat features preferred by Siberian weasels.

The coexisting Siberian weasels and ferret badgers in Gaundashi Forest have overlapping yet different diets, and they prefer different habitats. The differences are not the result of niche shifting in the presence of competitors, but are more likely due to well-established individual species characters. It is these species-specific characters that make coexistence possible as suggested by studies on other animals (Arlettaz et al. 1993 1997 for bats, Vassallo 1993, Sekijima and Sone 1994 for rodents). In other words, there is no severe current competition for food or space between the 2 species where they occur sympatrically.

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## 臺灣亞熱帶森林生態系共域之華南鼬與鼬獾間之競爭關係

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擅捕鼠類的華南鼬，在小型哺乳動物相貧乏的關刀溪森林生態系中，可能會改變食性，而與共域的鼬獾相互競爭。為探討兩種食肉目動物間的競爭關係，我於1995年五月至1998年八月間，以排遺分析與捕捉標放法，分析關刀溪森林中華南鼬與鼬獾的食性與分布，並引用文獻中異域族群的食性資料進行比較。一如所期，此地區的華南鼬以節肢動物及食蟲目為主食，與高山草原區華南鼬的食性有所差異；而鼬獾的食性則與福山地區相似，皆仰賴節肢動物與蚯蚓。共域之華南鼬與鼬獾間食性的重疊度高，然兩者食性中脊椎動物、節肢動物與蚯蚓之出現頻度的分布有顯著差異。雖然兩者皆捕食節肢動物，但取用的動物類別並不相同，這可能與其覓食行為有關。1995年五月至十一月的前期捕捉資料顯示，華南鼬與鼬獾在棲地使用上有所分隔，其後的捕捉資料亦證實此一現象。在棲地類型各異的A、B與C三區中，華南鼬多見於A區，B區次之；鼬獾則在B及C區較多，從未見於A區。1996年春天，研究區的動物遭獵人捕殺，提供了檢視種間競爭與棲地分隔間關係的機會。獵捕期之後，區內鼬獾幾告絕跡，但仍可捕獲新加入的華南鼬，且其在三區的分布，並未因鼬獾的失蹤而改變。此結果顯示關刀溪森林生態系中的華南鼬與鼬獾在棲地喜好、食性與覓食行為上的差異，使兩者可共存於此，而無競爭關係。

**關鍵詞：**種間競爭，食性，棲地分隔，華南鼬，鼬獾。

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