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## Studies on the muscid flies associated with pasturing cattle and water buffaloes in Taiwan (Diptera: Muscidae)

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### Introduction

Many species of muscid flies are observed in the pastures in Taiwan. Some of them occur from cattle and/or water buffalo dung and the adult flies attack cattle and/or water buffalo for blood sucking or licking tears or secretions from wounds. Catangui et al. (1) reported that blood sucking species, especially *Stomoxys calcitrans*, have high negative influence on average daily gain of heifers and Mullens et al. (4) reported on decreased milking value in dairy cattle being influenced by the fly. Some kind of *Musca*-species, *M. hervei*, *M. bezzii* and *M. convexifrons*, are intermediate hosts of eye worms, *Thelazia rhodesii* and *T. scrijabini*, in China, Japan and Russia. One of the common flies, *Musca con-ducens*, is known as the vector of white nose disease of cows. Stable fly, *Stomoxys calcitrans*, is also known as a vector of many kind of pathogens, such as bacteria and nematodes. In the present survey, we collected muscid flies from cow and water buffalo bodies and dung in ten pastures in Taiwan (Fig. 1). The results of the survey, eleven genera and 26 species are recorded. All specimens are temporarily deposited in the Laboratory of Environmental Entomology, Rakuno Gakuen University.

### Records

#### 1. *Musca domestica* Linnaeus, 1758

*Material examined*: Numerous specimens from many localities of Taiwan.

*Distribution*: Cosmopolitan.

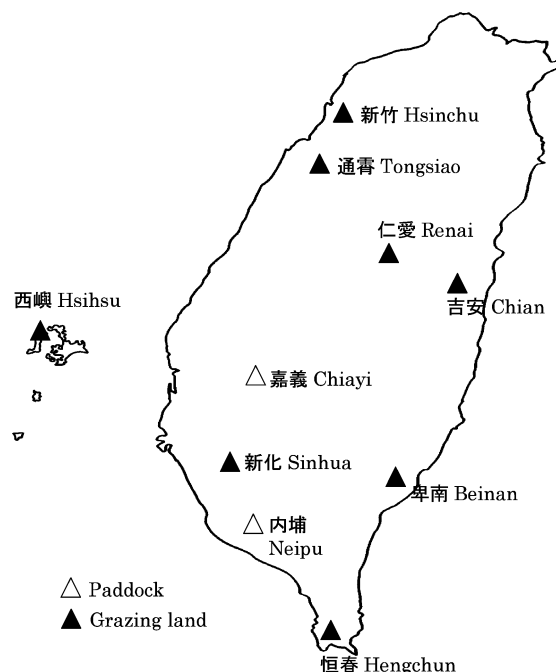


Fig. 1 Map of Taiwan, △ and ▲ show the surveyed places.  
The place shown as △ are paddock and ▲ are pasture.

#### 2. *Musca seniorwhitei* Patton, 1922

*Material examined*: 24♂♂, 49♀♀, Chian, 3 May 2004; 359♂♂, 370♀♀, Chian, 30-31 August 2004; 24♂♂, 49♀♀, Chian, 3 May 2004; 14♂♂, 26♀♀, Hengchun, 9 September 2004; 41♂♂, 28♀♀, Chian, 5 May 2005; 1♀, Hengchun, 11 May 2005; 15♂♂, 12♀♀, Chian, 10-11 August 2005; 8♂♂, 2♀♀, Chian, 16 August 2005; 1♂, 7♀♀, Chian, 29-30 August 2005; 14♂♂, 40♀♀, Chian, 17-18 November 2005; 1♂, 1♀, Hengchun, 20 November 2005; 16♂♂, 62♀♀, Chian, 3-4 March 2006.

*Distribution*: Taiwan; Burma, China, India, Indonesia (Java and Sumatra), Philippines (Luzon)

and Mindanao), Sri Lanka and Thailand.

### 3. *Musca confiscata* Speiser, 1924

*Material examined:* 1♂, 62♀, Hengchun, 17-18 May 2004; 2♀, Sinhua, 23 August 2004; 3♀, Beinan, 1 September 2004; 1♀, Neipu, 6 September 2004; 16♀, Hengchun, 9 September 2004; 1♀, Tongsiao, 21 December 2004; 6♂♂, 60♀, Hsinchu, 22-23 December 2004; 20♀, Neipu, 29-31 December 2004; 2♂♂, 50♀, Hengchun, 5 January 2005; 1♂, 50♀, Hengchun, 11 May 2005; 13♀, Hengchun, 29-30 August 2005; 2♀, Beinan, 19 November 2005; 1♂, 4♀, Hengchun, 20 November 2005; 4♂♂, 12♀, Hsihsu, 7 March 2006.

*Distribution:* Taiwan; Burma, China, India, Malaya, Philippines, Ryukyu Islands, Sri Lanka.

### 4. *Musca ventrosa* Wiedemann, 1830

*Material examined:* 1♀, Hsinchu, 6 May 2004; 1♂, Hengchun, 18 May 2004; 10♀, Chiayi, 22 August 2004; 1♂, 3♀, Sinhua, 23-24 August 2004; 2♂♂, 6♀, Tongsiao, 26-28 August 2004; 3♀, Chian, 30-31 August 2004; 1♀, Hengchun, 9 September 2004; 3♂♂, 7♀, Tongsiao, 20-21 December 2004; 1♀, Hsinchu, 23 December 2004; 1♂, Chian, 28 December 2004; 3♀, Sinhua, 3-4 January 2005; 1♂, Chian, 5 May 2005; 1♀, Tongsiao, 18 August 2005; 1♀, Chian, 18 November 2005; 1♀, Sinhua, 21 November 2005; 1♂, 3♀, Tongsiao, 24 November 2005.

*Distribution:* Taiwan; Widely distribute in Oriental, Australasian and Afrotropical Regions.

### 5. *Musca inferior* Stein, 1903

*Material examined:* 1♂, 1♀, Hengchun, 8 August 2002; 2♂♂, Chian, 3 May 2004; 1♀, Hengchun, 17 May 2004; 75♂♂, 79♀, Chian, 30-31 August 2004; 1♂, 1♀, Neipu, 6 September 2004; 11♂♂, 25♀, Hengchun, 9 September 2004; 12♂♂, 27♀, Chian, 27-28 December 2004; 2♂♂, 5♀, Chian, 5 May 2005; 12♂♂, 14♀, Chian, 10, 11, 16, 29-30 August 2005; 14♂♂, 19♀, Chian, 17-18 November 2005; 1♂, 1♀, Hengchun, 20 November 2005; 1♀, Chian, 3 March 2006.

*Distribution:* Taiwan; Borneo, Burma, Chian, India, Indonesia, Malaya, Nepal, Philippines, Sri

Lanka and Thailand.

### 6. *Musca crassirostris* Stein, 1903

*Material examined:* 1♂, Hengchun, 8 August 2002; 1♀, Beinan, 13 May 2004; 2♂♂, 6♀, Hengchun, 17-18 May 2004; 1♀, Beinan, 1 September 2004; 289♂♂, 435♀, Hengchun, 9 September 2004; 1♂, 4♀, Beinan, 29-31 December 2004; 7♂♂, 5♀, Hengchun, 5 January 2005; 1♂, Beinan, 10 May 2005; 6♀, Hengchun, 11 May 2005; 2♂♂, 7♀, Hengchun, 29-30 August 2005; 12♀, Beinan, 19 November 2005; 5♂♂, 23♀, Hengchun, 20 November 2005.

*Distribution:* Taiwan; Borneo, Burma, China, India, Indonesia, Sri Lanka and Thailand. Afrotropical and S. Palaearctic Regions.

### 7. *Musca sorbens* Wiedemann, 1830

*Material examined:* 1♂, Hengchun, 22 December 2003; 3♀, Beinan, 15 May 2004; 13♂♂, 26♀, Hengchun, 17-18 May 2004; 2♂♂, 5♀, Chian, 30-31 August 2004; 3♀, Neipu, 6 September 2004; 1♂, 1♀, Hengchun, 11 May 2005.

*Distribution:* Taiwan; Widely distribute in Oriental and Afrotropical Regions. Hawaii, Micronesia and Southern Palaearctic Region.

### 8. *Musca conducens* Walker, 1860

*Material examined:* 4♂♂, 4♀, Taidong, 20 December 2003; 54♂♂, 116♀, Chiayi, 26-28 December 2003; 11♂♂, 29♀, Chiayi, 28 February 2004; 4♂♂, 76♀, Chian, 3 May 2004; 74♂♂, 231♀, Hsinchu, 6 May 2004; 27♂♂, 171♀, Sinhua, 11-12 May 2004; 4♂♂, 113♀, Beinan, 13-15 May 2004; 10♂♂, 25♀, Hengchun, 17-18 May 2004; 14♀, Chiayi, 22 August 2004; 1♂, 9♀, Sinhu, 23-24 August 2004; 34♂♂, 195♀, Tongsiao, 26-28 August 2004; 1♂, 17♀, Hsinchu, 28-29 August 2004; 8♀, Chian, 30-31 August 2004; 11♂♂, 63♀, Beinan, 1 September 2004; 2♂♂, 7♀, Neipu, 6 September 2004; 1♂, 3♀, Hengchun, 9 September 2004; 13♂♂, 50♀, Tongsiao, 20-21 December 2004; 33♂♂, 73♀, Hsinchu, 22-23 December 2004; 4♂♂, 16♀, Chian, 27-28 December 2004; 6♂♂, 8♀, Neipu, 29-30 December 2004; 16♂♂, 60♀, Sinhua, 3-4 January 2005; 1♀, Hengchun, 5 January 2005; 4♂

♂, 5 ♀, Sinhua, 28 April 2005; 1 ♀, Hsinchu, 2 May 2005; 8 ♂♂, 15 ♀♀, Chian, 5 May 2005; 1 ♂, 2 ♀♀, Beinan, 10 May 2005; 1 ♂, Hengchun, 11 May 2005; 2 ♂♂, 2 ♀♀, Chian, 11-16 August 2005; 1 ♂, Tongsiao, 18 August 2005; 1 ♂, 2 ♀♀, Hengchun, 29-30 August 2005; 1 ♀, Chian, 17 November 2005; 7 ♂♂, 19 ♀♀, Beinan, 19 November 2005; 1 ♂, 2 ♀♀, Hengchun, 20 November 2005; 4 ♂♂, 27 ♀♀, Sinhua, 21 November 2005; 10 ♂♂, 35 ♀♀, Tongsiao, 24 November 2005; 1 ♂, 5 ♀♀, Sinhua, 23 February 2006; 10 ♂♂, 5 ♀♀, Tongsiao, 24 February 2006; 5 ♂♂, 2 ♀♀, Beinan, 4-5 March 2006.

*Distribution:* Taiwan; Throughout Oriental Region. New Guinea, Egypt, Afrotropical and Australian Regions, China, Japan.

9. *Musca formosana* Malloch, 1925

*Material examined:* 3 ♀♀, Tongsiao, 20-21 December 2004; 3 ♀♀, Hsinchu, 22-23 December 2004; 1 ♀, Sinhua, 6 March 2006.

*Distribution:* Taiwan; China, India, Malaya, Nepal, Sri Lanka and Thailand.

10. *Stomoxys calcitrans* (Linnaeus, 1758)

*Material examined:* Numerous specimens examined.

*Distribution:* Cosmopolitan.

11. *Stomoxys sitiens* Rondani, 1873

*Material examined:* 1 ♂, 12 ♀♀, Hengchun, 8, 11-12 August 2002; 2 ♂♂, 5 ♀♀, Hengchun, 13 October 2002; 1 ♀, Beinan, 16 October 2002; 11 ♂♂, 5 ♀♀, Neipu, 18-20 October 2002; 1 ♂, 1 ♀, Chiayi, 22 October 2002; 1 ♀, Chian, 16 August 2005.

*Distribution:* Taiwan; Burma, China, India, Laos, Malaya, Philippines, Sri Lanka, Thailand.

12. *Stomoxys indicus* Picard, 1908

*Material examined:* 15 ♂♂, 17 ♀♀, Hengchun, 8-11 August 2002; 4 ♂♂, 3 ♀♀, Hengchun, 12-13 October 2002; 1 ♀, Chian, 18 November 2005; 1 ♀, Chian, 3 March 2006; 1 ♀, Hengchun, 5 March 2006.

*Distribution:* Taiwan; Burma, China, India, Indonesia, Japan, Micronesia, Philippines, Ryukyu Islands, Sri Lanka, Vietnam.

13. *Stomoxys uruma* Shinonaga et Kano, 1966

*Material examined:* 1 ♀, Sinhua, 23 February 2006; 26 ♂♂, 21 ♀♀, Sinhua, 6 March 2006.

*Distribution:* Taiwan; Ryukyu Islands, Thailand, Vietnam.

14. *Haematobosca sanguinolenta* (Austen, 1909)

*Material examined:* 1 ♀, Chian, 17 June 2002; 1 ♂, Beinan, 16 October 2002.

*Distribution:* Taiwan; Burma, Cambodia, China, India, Indonesia, Laos, Micronesia, Nepal, Philippines, Ryukyu Islands, Sri Lanka, Thailand, Vietnam.

15. *Haematobia irritans exigua* de Meijere, 1903

*Material examined:* 1 ♂, Chian, 17 June 2002; 1 ♀, Hengchun, 12 October 2002; 3 ♂♂, 7 ♀♀, Chian, 10-11, 29 August 2005; 1 ♂, Hengchun, 30 August 2005; 1 ♀, Beinan, 19 November 2005; 26 ♂♂, 25 ♀♀, Sinhua, 21 November 2005; 7 ♂♂, 11 ♀♀, Chian, 3-4 March 2006.

*Distribution:* Taiwan; Burma, China, Pakistan, India, Indonesia, Japan, Malaya, Nepal, New Guinea, Solomon Islands, Sri Lanka, Thailand, Vietnam.

16. *Hydrotaea jacobsoni* (Stein, 1919)

*Material examined:* 1 ♀, Hengchun, 23 December 2003; 16 ♂♂, 215 ♀♀, Sinhua, 23-24 August 2004; 16 ♀♀, Tongsiao, 20-21 December 2004; 4 ♀♀, Hsinchu, 22-23 December 2004; 6 ♀♀, Chian, 27-28 December 2004; 4 ♂♂, Sinhua, 3 January 2005; 1 ♀, Tongsiao, 3 May 2005; 2 ♀♀, Renai, 4 May 2005; 1 ♀, Renai, 17 August 2005; 1 ♂, Chian, 18 November 2005; 2 ♀♀, Hsinchu, 24 February 2006; 1 ♀, Tongsiao, 24 February 2006; 1 ♀, Chian, 4 March 2006; 1 ♂, Beinan, 5 March 2006; 1 ♂, Sinhua, 6 March 2006.

*Distribution:* Taiwan; Indonesia (Java), Malaya, Philippines, Sri Lanka.

17. *Morellia hortensia* (Wiedemann, 1824)

*Material examined:* 1 ♂, Sinhua, 12 May 2004; 4 ♂♂, 8 ♀♀, Sinhua, 23-24 August 2004; 1 ♂, Tongsiao, 26 August 2004; 7 ♂♂, 7 ♀♀, Sinhua, 3-4 January 2005.

*Distribution:* Taiwan; Borneo, China, India, In-

donesia (Java and Sumatra), Malaya, Nepal, Philippines, Ryukyu Islands, Sri Lanka.

18. *Neomyia indica* (Robineau-Desvoidy, 1830)

*Material examined:* 13♂♂, 45♀♀, Beinan, 13-15 May 2004; 8♂♂, 8♀♀, Hsihsu, 7 March 2006.

*Distribution:* Taiwan; Borneo, Burma, India, Indonesia, Laos, Malaya, Philippines, Ryukyu Islands, Sri Lanka, Thailand.

19. *Neomyia timorensis* (Robineau-Desvoidy, 1830)

*Material examined:* 3♀♀, Tongsiao, 3 May 2005; 10♀♀, Renai, 17 August 2005; 2♂♂, 3♀♀, Tongsiao, 24 February 2006.

*Distribution:* Taiwan; Widely distribute in Oriental Region and Papuan subregion of Australian Region, Japan, Korea.

20. *Brontaea flexa* (Wiedemann, 1830)

*Material examined:* 6♂♂, 25♀♀, Hengchun, 17-18 May 2004; 4♀♀, Hengchun, 11 May 2005.

*Distribution:* Taiwan; India, Ryukyu Islands, Afrotropical Region.

21. *Brontaea lasiopa* (Emden, 1965)

*Material examined:* 6♀♀, Renai, 4 May 2005; 17♀♀, Renai, 17 August 2005 (Huang); 1♀, Hsihsu, 7 March 2006.

*Distribution:* Taiwan; China, India, Japan, Nepal.

22. *Brontaea distincta* (Stein, 1909)

*Material examined:* 1♀, Chian, 3 May 2004; 2♀♀, Sinhua, 12 May 2004; 3♀♀, Hengchun, 17-18 May 2004; 1♀, Chian, 30 August 2004; 1♀, Hengchun, 9 September 2004; 1♀, Tongsiao, 20 December 2004; 9♂♂, 17♀♀, Chian, 27-28 December 2004; 7♀♀, Sinhua, 3-4 January 2005; 3♀♀, Hengchun, 11 May 2005; 1♂, 4♀♀, Hengchun, 20 November 2005; 3♀♀, Chian, 4 March 2006; 5♀♀, Sinhua, 6 March 2006.

*Distribution:* Taiwan; Burma, India, Indonesia (Java), Nepal, Sri Lanka.

23. *Brontaea ascendens* (Stein, 1915)

*Material examined:* 1♀, Hengchun, 22 December 2003; 5♂♂, 24♀♀, Beinan, 13-15 May 2004; 3

♀♀, Chian, 31 August 2004; 1♂, 2♀♀, Tongsiao, 20-21 December 2004; 52♀♀, Sinhua, 28 April 2005; 27♀♀, Tongsiao, 3 May 2005; 2♀♀, Renai, 17 August 2005; 2♀♀, Sinhua, 22-29 August 2005; 29♀♀, Sinhua, 23 February 2006; 2♂♂, 14♀♀, Tongsiao, 24 February 2006; 1♀, Chian, 4 March 2006; 4♀♀, Beinan, 4-5 March 2006; 19♂♂, 47♀♀, Sinhua, 6 March 2006; 10♂♂, 20♀♀, Hsihsu, 7 March 2006.

*Distribution:* Taiwan; Burma, China, India, Indonesia, Japan, Sri Lanka.

24. *Myospila pudica* (Stein, 1915)

*Material examined:* 2♀♀, Sinhua, 24 August 2004; 1♂, Hengchun, 9 September 2004; 3♀♀, Renai, 17 August 2005; 1♂, 3♀♀, Sinhua, 23 February 2006; 1♀, Chian, 4 March 2006; 5♀♀, Sinhua, 6 March 2006.

*Distribution:* Taiwan; Ryukyu Islands.

25. *Pygophora confusa* Stein, 1915

*Material examined:* 1♀, Hengchun, 18 May 2004; 2♂♂, 3♀♀, Hengchun, 5 March 2006.

*Distribution:* Taiwan; China, Japan.

26. *Graphomyia rufitibia* Stein, 1918

*Material examined:* 1♀, Hsihsu, 7 March 2006.

*Distribution:* Taiwan (Penghu Island); almost cosmopolitan but absent from many remote island groups.

## Discussion

Twenty-six species of muscid flies were collected from ten pastures in Taiwan. Among the pastures, 9 were of cattle and one was from a water buffalo farm. Nine species belonging to the genus *Musca* were collected. Among them, the larvae of *M. seniorwhitei*, *M. confiscata*, *M. inferior*, *M. crassirostris*, *M. conducens* and *M. formosana* were mainly breed in cattle and water buffalo dungs. The adults of these species gather on animal bodies and suck blood or secretion from wounds (Fig. 2). The female of *M. crassirostris* lays large mass of eggs under the surface of the fresh dungs. Adults of this species possess well developed proboscis and prestomal teeth which serve to open wounds of cattle to

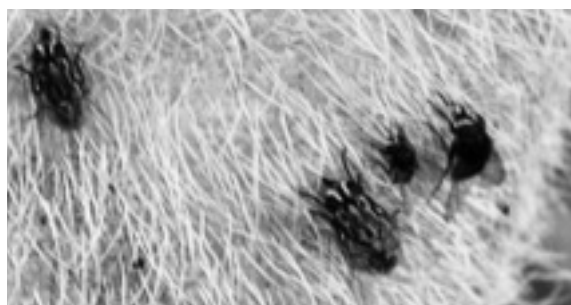


Fig. 2 Flies gathering on buffalo's bodies and suck blood or secretion.

facilitate sucking blood or secretion. The adults of *M. conducens* also possess developed prestomal teeth and crawled around wound. This species is most common in pastures of Taiwan and carrier of the pathogen of white nose disease of cattle. *M. inferior* is a larviparous species. The adults of this species are blood feeders and they swarm around the cattle and water buffalo to take blood from wound. They are collected on dungs and grasses in and around pastures and on bodies of cattle and water buffaloes. *Musca sorbens* is the most common species in and around human dwellings. The larvae of this species are coprophagous and develop mainly in human or dog feces but also breed in cattle and swine dung and chicken feces. Adults are commonly found in and around garbage dump, latrines, market places or farm houses in the rural and urban areas. They gather on human and animal bodies and suck blood or secretion from open wounds.

Four species belonging to the genus *Stomoxys* were obtained. *S. calcitrans* is the most common blood sucking fly in Taiwan. Breeding sources are livestock dungs or compost heaps. According to Greenberg (2, 3), the adults are the vector of many pathogens such as *Trypanosoma*, Streptococci, Spirochaeti, *Bacillus anthrax* and *Habronema*-species, however, those are not reported in Taiwan. The other *Stomoxys*-species are not important. Another blood-sucking fly, *Haematobia irritans exigua*, is also common in Taiwan. Adults attack cattle or water buffalo bodies and live upon them as ectoparasites (Fig. 3). Adult flies are great nuisance to cattle and water buffaloes and they only leave their host briefly to oviposit.



Fig. 3 Flies infesting buffalo's face.

The larvae of *Neomyia timorensis* and *N. indica* were found from cow or water buffalo dungs and adults gather same medium, but never on animal bodies. Four *Brontaea*-species were also breed in cattle or water buffalo dungs. Eggs are laid on fresh dung and the larvae hatch in the second stage. Third stage larvae are predaceous, it regarded that they prey upon larvae of other flies reared from same manure (5). The larvae of *Myospila pudica* occur from cattle or water buffalo dungs and the adults were also collected from dungs in pasture. The bionomics of the flies are summarized in Table.

The adults of *Pygophora confusa* and *Graphomyia rufitibia* were collected in pastures, however, they are harmless species.

### Abstract

Muscid flies inhabiting the pasture of cattle and water buffaloes were surveyed at 10 localities in Taiwan. From the results of this survey, 26 species of 11 genera were recorded. Among them, 10 non-biting species belonging to 2 genera, and 6 biting species belonging to 3 genera were recorded as ectoparasites of cattle and water

**Table** Bionomics of muscid flies collected in this survey.

Species	Medium of larvae			Feeding habits of adult					
	dung	garbage dump	manure	collected on cow dung	blood-sucking	gather on wounds or sores	suck secretion sweat, tear	disease carrying	Unknown
<i>Hydrotaea jacobsoni</i>									○
<i>Musca domestica</i>	○	○				○	○	○	
<i>Musca seniorwhitei</i>	○					○			
<i>Musca confiscata</i>	○					○	○		
<i>Musca ventrosa</i>	○	○				○	○	○	
<i>Musca inferior</i>	○					○		○	
<i>Musca crassirostris</i>	○					○	○	○	
<i>Musca sorbens</i>	○	○				○	○	○	
<i>Musca conducens</i>	○					○	○	○	
<i>Musca formosana</i>	○					○			
<i>Morellia hortensia</i>	○					○			
<i>Neomyia indica</i>	○			○					
<i>Neomyia timorensis</i>	○			○					
<i>Stomoxys calcitrans</i>			○		○			○	
<i>Stomoxys sitiens</i>	○		○		○				
<i>Stomoxys indicus</i>	○	○			○				
<i>Stomoxys uruma</i>	○				○				
<i>Haematobosca sanguinolenta</i>	○				○				
<i>Haematobia irritans exigua</i>	○				○			○	
<i>Brontaea ascendens</i>	○			○					
<i>Brontaea flexa</i>	○			○					
<i>Brontaea lasiopa</i>	○			○					
<i>Brontaea distincta</i>	○			○					
<i>Myospila pudica</i>	○			○					
<i>Pygophora confusa</i>									○
<i>Graphomya rufitibia</i>	○	○		○					

buffaloes. Six species of 2 genera were recorded to be coprophagous and remain 2 species of 2 genera were unknown in their bionomics.

### 摘 要

台湾において放牧地に生息するイエバエ科ハエ類を10ヶ所の牧場で調査し、11属26種の分布を明らかにした。その中には放牧中の牛や水牛を加害する種として非刺咬種が2属10種、刺咬性種が3属6種が含まれていた。その他の種は食糞性の種が2属6種、生態不明種が2属2種であった。

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Chong Lin, for their kind arrangement for this survey.

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