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Distribution of the *Anoplophora* Species (Coleoptera, Cerambycidae, Lamiinae) in Okinawa Island, Southwest Japan

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Abstract Local distribution in Okinawa Island of the Ryukyus of the three cerambycid beetles belonging to the lamiine genus *Anoplophora* is analyzed on the basis of field survey and re-examination of old specimens. *Anoplophora oshimana* is the only species autochthonous to the island and is now restricted to the central part. *Anoplophora malasiaca* seems to have invaded into Okinawa from the mainland of Japan sometime in the 1970's and is now mainly found in orange orchards in the northern area, probably having been driven by *Anoplophora macularia*, which may have invaded into the southern part of the island in the 1990's.

Introduction

Although *Anoplophora oshimana* had been considered the only species of the genus *Anoplophora* occurring in Okinawa Island (BREUNING, 1961; MAKIHARA, 1976), there were some specimens identical with *A. malasiaca* in my collection as was already recorded (OHBAYASHI, 1992). Besides, I collected some specimens identical with *A. macularia* on this island in 1993. After that in 1999, I asked my friends residing in Okinawa Island for collecting as many *Anoplophora* specimens as possible. I also tried to examine old specimens of the genus *Anoplophora* collected on this island in the collections of the University of the Ryukyus, Okinawa Agricultural Experiment Station, Hokkaido University and Ehime University.

In 2000, I visited Okinawa Island and observed by myself the habitats of these species with the help of my friends. Some of the living specimens of the *Anoplophora* species collected during my survey were brought to the Entomological Laboratory of Ehime University. They were paired and placed in plastic cages with living twigs of *Melia azedarach*, and the mating behavior of these couples was observed.

I wish to dedicate this short report to the late Dr. Yoshihiko KUROSAWA for his useful advice given at times on my study of the Cerambycidae. He suggested me differences of *A. malasiaca* and *A. macularia* when the latter had been usually regarded as a synonym of the former. I would like to express my sincere gratitude to Messrs. Seiji INADA of Okinawa Prefecture and Mr. Yûsaku SUGIURA of our laboratory who accompanied me on my collecting trip to the Okinawa Island in 2000. I am also much indebted to Dr. Masako YAFUSO and Mr. Takeshi SASAKI of the University of the

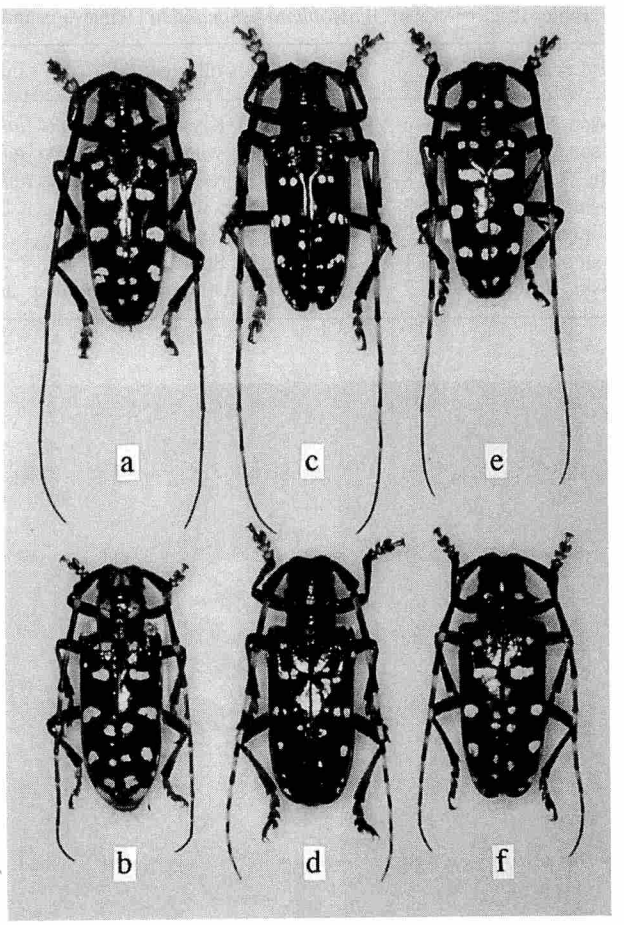


Fig. 1. Habitus of *Anoplophora* species from Okinawa Island. —— a, b, *A. oshimana*; c, d, *A. malasiaca*; e, f, *A. macularia*. —— a, c, e, males; b, d, f, females.

Ryukyus, and Messrs. Masaaki KIMURA, Tôru MATSUMURA and Masashi SUGIMOTO of Okinawa Prefecture for their invaluable help in various ways.

Distribution of the *Anoplophora* Species in Okinawa Island

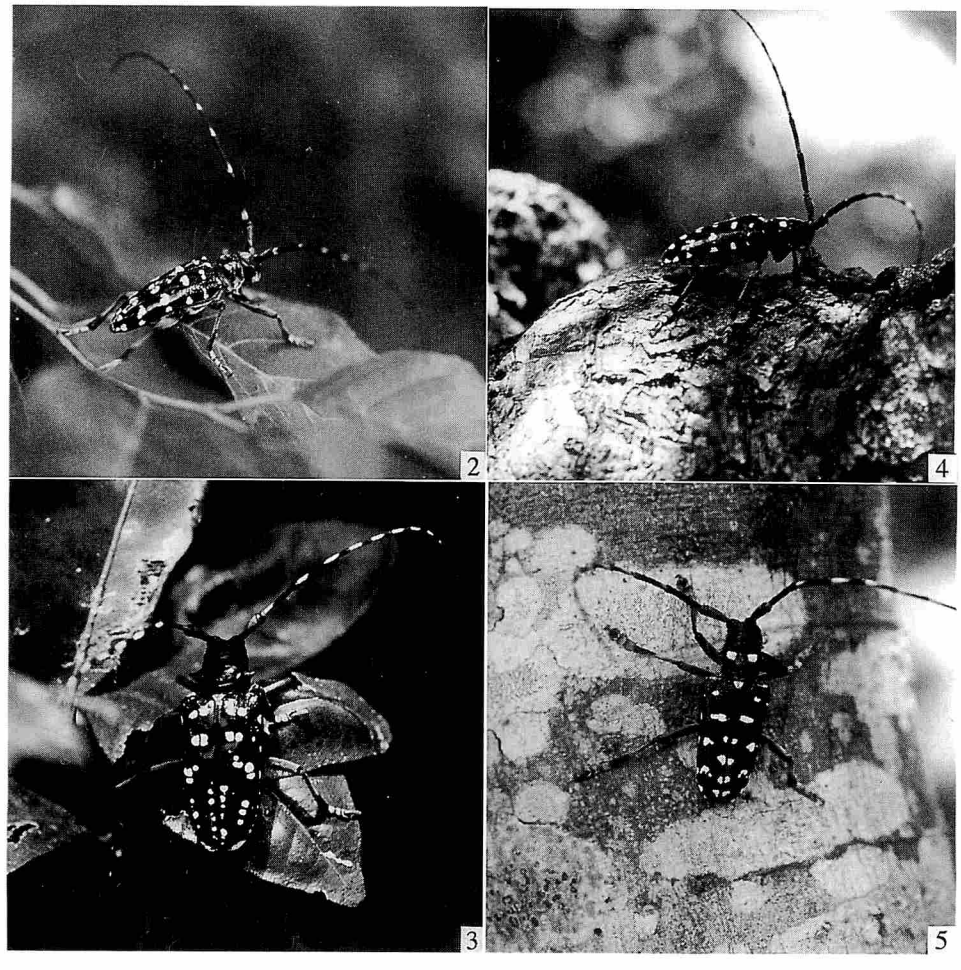
Anoplophora oshimana (FAIRMAIRE, 1895)

(Table 1, Figs. 1 a–b, 2)

This species was originally described from Amami-ôshima Island and is distributed in Amami-ôshima Is., Okinoerabu-jima Is., Ukejima Is. (new record), Tokunoshima Is. and Okinawa Is. of the Ryukyus. However, I never saw any specimens

Table 1. Records of *Anoplophora oshimana* in Okinawa Island.

Number	Locality	Date	Collector	Infested plant
3♂, 1♀	Onna-son, Yamada	6–VII–1999	M. KIMURA	*Schima liukiuensis*
3♂, 4♀	Onna-son, Yamada	1–VI–2000	N. OHBAYASHI	*Schima liukiuensis*
Many	Kin-chô, Kin	8–VI–2000	S. INADA	*Schima liukiuensis*
1♀	Nago-shi, Yofuke	3–VI–1999	S. INADA	
2♀	Nago-shi, Isagawa	27–V–1999	SAKASHITA	
1♂	Nago-shi, Kouki	1–VI–2000	M. SUGIMOTO	
Many	Nago-shi, Haneji River	2~5–VI–2000	N. OHBAYASHI	*Alnus* sp. and *Melia azedarach*



Figs. 2–5. Mode of life of *Anoplophora* species. — 2, *A. oshimana* on the leaf of *Alnus* sp.; 3, *A. malasiaca* on the leaf of *Citrus depressa*; 4–5, *A. macularia* on the trunk of *Melia azedarach*.

collected on Okinawa Island before 1999 when Messrs. Seiji INADA and Masaaki KIMURA found the true *A. oshimana* specimens there. By the survey made in 2000, I was able to observe this species infesting for maturation by feeding on stems or leaves of *Schima liukiuensis* (Theaceae), *Alnus* sp. (Betulaceae) or *Melia azedarach* (Meliaceae). I also observed holes which seemed to be the emergence holes of this species on the trunks of *Quercus* sp. As the result, it became apparent that this species now inhabited rather limited areas around Nago City in the middle of the island.

Anoplophora malasiaca (THOMSON, 1865)

(Table 2, Figs. 1 c–d, 3)

The specimens examined from Okinawa Island are identical with *A. malasiaca* distributed in the mainland of Japan. The oldest specimen which I was able to examine was collected in Naha City in 1970. In the 1970's, *A. malasiaca* was mainly collected in the area around Naha City which is mainly occupied now by *A. macularia*. We col-

Table 2. Records of *Anoplophora malasiaca* in Okinawa Island.

Number	Locality	Date	Collector	Infested plant
1♀	Naha-shi, Shuri	20–VI–1975	TSUTSUMI	
1♂	Naha-shi, Shuri	1–V–1977	T. NAKAMOTO	
1♂	Naha-shi, Shuri	27–V–1975	Y. NOTSU	
4♂, 2♀	Naha-shi, Shuri	9–V–1970	S. AZUMA	
1♂	Naha-shi, Sueyoshi	16–VI–1976	M. KINJO	
1♀	Ginowan-shi, Ooyama	17–V–1970	K. MIYAGI	
1♀	Ginowan-shi, Kakazu	30–IV–1995	T. MATSUMURA	*Citrus* sp.
1♀	Ginowan-shi, Kakazu	11–V–1971	Tukasa KOHAMA	
1♀	Gushikawa-shi, Gushikawa	1–VII–1995	T. MATSUMURA	
1♀	Gushikawa-shi, Enobi	1–VI–2000	M. SUGIMOTO	
1♀	Gushikawa-shi, Kanekadan	1–VI–2000	N. OHBAYASHI	*Melia azedarach*
1♂, 2♀	Motobu-chô, Kenken	19–VI–2000	S. INADA	*Citrus depressa*
1♂	Nakijin-son, Gogayama	9–VI–1979	M. KINJO	
1♀	Nakijin-son, Shoshi	18–VI–1995	T. MATSUMURA	
1♀	Nago-shi	13–V–1980	N. OOBA	
1♀	Nago-shi, Yaga	1–V–1999	SAKASHITA	
1♂, 2♀	Oogimi-son, Uehara	22–VI–1999	S. INADA	*Citrus* sp.
Many	Oogimi-son, Uehara	2–VI–2000	N. OHBAYASHI	*Citrus depressa*
1♂	Oogimi-son, Takasato	29–VI–1993	N. OHBAYASHI	*Melia azedarach*
3♂, 4♀	Oogimi-son, Nerome	2–VI–1995	T. MATSUMURA	*Citrus* sp.
1♂, 3♀	Oogimi-son, Nerome	18–VI–1995	T. MATSUMURA	*Citrus* sp.
Many	Oogimi-son, Nerome	2–VI–2000	N. OHBAYASHI	*Citrus depressa*
1♀	Oogimi-son, Nekumachiji	24–VII–1995	T. SASAKI	
1♀	Oogimi-son, Nekumachiji	8–VIII–1995	T. SASAKI	
1♀	Oogimi-son, Nekumachiji	14–VII–1996	T. SASAKI	
1♂	Kunigami-son, Yona	18–VII–1999	TERUYA	
1♂	Kunigami-son, Ôkuni-rindô	27–V–2000	T. ÔHASHI	

lected this species mainly in the northern area of the island where orchards of *Citrus depressa* (Rutaceae) were prevalent. Only a few specimens were found in the middle to southern areas of the island from *Melia azedarach* (Meliaceae).

Anoplophora macularia (THOMSON, 1865)

(Table 3, Figs. 1e–f, 4, 5)

This species is mainly distributed in Taiwan though its type locality is designated to North China in the original description. In 1993, I collected this species at Sueyoshi Park of Naha City which had been the territory of *A. malasiaca* in the 1970's. According to the investigations made by my friends, it is now widely found from the southen end to the middle of the island. I observed that several trees of *Melia azedarach* were damaged by heavy infestation of this species. It seemed likely that the southern areas of this island were occupied by *A. macularia*.

Table 3. Records of *Anoplophora macularia* in Okinawa Island.

Number	Locality	Date	Collector	Infested plant
1♂	Itoman-shi, Nashiro	30–VII–1999	S. INADA	
1♂, 2♀	Itoman-shi, Maehira	23–V–2000	S. INADA	
4♂, 1♀	Itoman-shi, Maehira	24–V–2000	S. INADA	
1♀	Tamagusuku-son	26–VII–1999	T. SASAKI	
Many	Chinen-son, Kudeken	5–VI–2000	N. OHBAYASHI	*Melia azedarach*
2♂	Chinen-son, Utaki	30–V–2000	S. INADA	*Melia azedarach*
1♀	Naha-shi, Furushima	29–VI–1999	TERUYA	
1♂, 1♀	Naha-shi, Tomari	3–VII–1999	M. KIMURA	
1♂, 1♀	Naha-shi, Tomari	27–VII–1999	M. KIMURA	*Melia azedarach*
4♂	Naha-shi, Sueyoshi	28–VI–1993	N. OHBAYASHI	
2♀	Naha-shi, Sueyoshi	30–VII–1999	M. KIMURA	
1♂, 2♀	Naha-shi, Maejima	VI–1999	H. NAKACHI	*Melia azedarach*
1♀	Nishihara-chô	1–VII–1999	T. SASAKI	
1♀	Nishihara-chô	27–VII–1999	TERUYA	
14♂	Nakagusuku-chô	27–VII–1999	T. SASAKI	
1♂	Kadena-chô	9–VII–1999	N. KAWAUCHI	
6♂, 2♀	Okinawa-shi, Ikehara	30–VI–1999	S. INADA	*Melia azedarach*
1♂, 1♀	Okinawa-shi, Goya	29–VI–1999	S. INADA	
1♀	Okinawa-shi, Goya	29–VI–1999	M. KIMURA	
2♂	Okinawa-shi, Yogi	30–VI–1999	M. KIMURA	*Melia azedarach*
2♂, 1♀	Okinawa-shi, Yogi	2–VII–1999	S. INADA	
3♂, 2♀	Okinawa-shi, Koja	3–VII–1999	S. INADA	*Melia azedarach*
5♂, 1♀	Gushikawa-shi, Kanekadan	30–VI–1999	S. INADA	*Melia azedarach*
Many	Gushikawa-shi, Kanekadan	1–VI–2000	N. OHBAYASHI	*Melia azedarach*
1♂	Gushikawa-shi, Miyasato	15–V–1995	T. MATSUMURA	
1♂	Ishikawa-shi, Sonan	30–V–2000	S. INADA	
1♂	Kin-chô, Okukubi	21–VII–1999	TERUYA	

Mating Trial of the *Anoplophora* spp.

The results are shown in Table 4. All the species fed on the twigs of *Melia azedarach* and males made contact with females of other species with the exception of a couple of a small male of *A. malasiaca* and a large female of *A. oshimana*. After the contact, they mounted on females and achieved mating.

Table 4. Mating trial of *Anoplophora* spp. collected from Okinawa Island (June 9–10, 2000).

	A. malasiaca ♂ (Nerome)	*A. oshimana* ♂ (Haneji River)	*A. macularia* ♂* (Chinen)
A. malasiaca ♀		Mount and mate	—
A. oshimana ♀	Mount and mate		No contact
A. macularia ♀	Mount and mate	—	

* Small specimen.

Discussion

The results delineated above show that *A. macularia* may be a new invader associated with *Melia azedarach*, which is widely distributed from Taiwan to Japan. Though

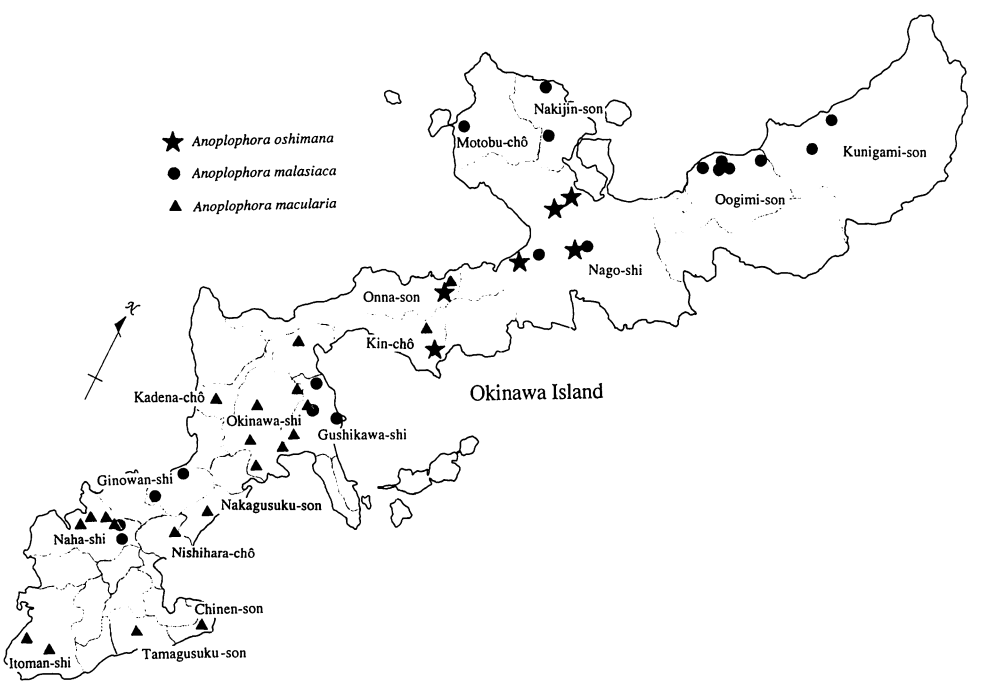


Fig. 6. Distributional map of the *Anoplophora* species in Okinawa Island.

no *Anoplophora* species was found by our survey from the northern mountainous area, in which flourishes the true natural forest, *A. oshimana* seems to be autochthonous to this island because they attack several wild trees. On the other hand, *A. malasiaca* had once been widely distributed in the island, and possibly they were also an invader before 1970's associated with introduction of Satsuma mandarin (*Citrus unshiu*), but now rather restricted its habitat to northern citrus orchard area.

The distributional map of the three species is shown in Fig. 5. They appear to share their habitats, though partly inhabiting sympatrically. No specimen possessing intermediate character states of the three had been found out, but the mating trial suggests possibility of their hybridization. I am now carrying on a DNA analysis of these *Anoplophora* species in collaboration with specialists of that field. It will clarify the origin of the invaders and also possible existence of hybrid individuals.

要　　約

大林延夫：沖縄本島におけるゴマダラカミキリ属3種の分布．—— 沖縄本島のゴマダラカミキリ属には，従来，オオシマゴマダラカミキリ1種のみが知られていたが，今回，このほかにゴマダラカミキリとタイワンゴマダラカミキリの2種が同所的に分布していることが明らかとなった．これらの分布状況について，昨年，現地での観察を行うとともに，過去の標本について調査を行った．このうち，在来種と考えられるオオシマゴマダラカミキリは，中部の名護市周辺に分布が極限されていた．一方，ゴマダラカミキリは，1970年代には那覇市周辺で採集された標本が散見されたが，現地調査では北部の柑橘栽培地帯でシークヮーサーを加害しているものが多く見られた．タイワンゴマダラカミキリは，南部の知念村から中部の名護市周辺まで広く分布し，センダンの生木に多数の生息するようすが観察された．この結果から，ゴマダラカミキリは1970年代に本土から沖縄に侵入し，さらに1990年代になってタイワンゴマダラカミキリが南から侵入してきたと考えられた．これらは，島内の各地で同所的に分布していたが，外見的に雑種と思われる個体はほとんど見いだせなかった．しかし，これらの種を相互にペアにして飼育すると，大部分の組み合わせでマウントおよび交接が観察され，野外で雑種が生じている可能性が示唆された．

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