biodiversityof microorganisms and invertebrates: its role in sustainable agriculture. CAB International, Wallingford.

Holloway, J.D. 1984. The larger moths of the Gunung MuluNational Park: a preliminary assessment of their distribution, ecology and potential as environmental indicators.in Jermy, A.C. & Kavanagh, K.P. (Eds) Gunung MuluNational Park, Sarawak, Part II. Sarawak Museum Journal 30, 149–190, Special Issue 2.

Holloway, J.D. 1985b. Moths as indicator organisms for categorizing rain forest and monitoring changes and regeneration processes. pp. 235–242 in Chadwick, A.C. & Sutton, S.L. (Eds) Tropical rain forest: the Leeds Symposium, Special Publication, Leeds Philosophical and Literary Society.

Holloway, J.D. 1986. Origins of the lepidopteran faunas in high mountains of the Indo-Australian region. In F. Vuilleumier and M. Monasterio (eds), High Altitude Tropical Biogeography pp. 533-556. Oxford University Press, New York.

Holloway, J.D. 1987. Macrolepidoptera diversity in the Indo-Australian tropics: geographic, biotopic and taxonomic variations. *Biological Journal of the Linnean Society* 30: 325-341.

Holloway, J.D., Kirk-Spriggs, A.H. & Chey, V.K. (1992) The response of some rain forest insect groups to logging and conversion to plantation. Philosophical Transactions of the Royal Society of London B 335, 425–436.

Hutacharern, C. and Tubtim, N. 1995. Checklist of Forest Insects in Thailand. Integrated Promotion Technology Co., Ltd. Bangkok.

Inoue, H. 1984. The Genus *Abraxas* of Taiwan (Lepidoptera : Geometridae). *Bull. Fac. Domest. Sci. Otsuma Wom. Univ.* 20: 93-128.

Inoue, H. 1985. The genera *Ourapteryx* and *Tristrophis* of Taiwan. *Bull. Fac. Domest. Sci. Otsuma Wom. Univ.* 21: 75-124.

Inoue, H. 1986. Further new and unrecorded species of the Geometridae from Taiwan with some synonymic notes (Lepidoptera). *Bull. Otsuma Wom. Univ., Home Econ.* 22:211-267.

Inoue, H. 1987. Geometridae of Eastern Nepal based on the collection of the Lepidopterological research expedition to Nepal Himalaya by the Lepidopterological

Society of Japan in 1963, Part III. *Bull. Otsuma Wom. Univ., Home Econ*, 23:215-270.

Inoue, H. 1990. A revision of the genus *Dindica* Moore (Lepidoptera: Geometridae). *Bull. Otsuma Wom. Univ., Home Econ*, 26:121-161.

Inoue, H. 1992. Twenty-four new species, one new subspecies and two new genera of the Geometridae (Lepidoptera) from East Asia. *Bull. Otsuma Wom. Univ., Home Econ*, 28:149-188.

Inoue, H. 1993a. On *nivea*-group of *Ourapteryx* Leach and on the systematic status of *O. yerburii* Butler from Pakistan, with description of a new species from Korea (Geometridae, Ennominae). *Tyo to Ga*, 44(3): 107-116.

Inoue, H. 1993b. The genus *Ourapteryx* leach (Geometridae, Ennominae) from Thailand, with description of six new species. *Tinea* 13 (Part 26): 261-271.

Inoue, H. 1994a. The genus *Abraxas* Leach (Geometridae, Ennominae) from Thailand. *Tinea* 14(1): 20-26.

Inoue, H. 1994b. The Geometridae of the Ogasawara islands (Lepidoptera) (Moths of Ogasawara (Bonin) Islands, Part II). *Bull. Otsuma Wom. Univ., Home Econ*, 30:195-223.

Inoue, H. 1994c. Two new genera and two new species of the Geometridea from Thailand. *Tinea* 14(1): 5-9.

Inoue, H. 1999. Revision of the genus *Herochroma* Swinhoe (Geometridae, Geometrinae). *Tinea* 16: 76-105.

Luadee, P. and H. Malicky. 1999. Two new species (Polycentropodidae, Ecnomidae) from Thailand. *Braueria* 26: 6.

Luadee, P. and P. Chantaramongkol. 2000. Comparison of *Stenopsyche siamensis* Larvae Morphology Using Scanning Electron Microscopy as a Measure of Ecotoxicity. Proc. 10th Int. Symp. Tric. (In press).

Luadee, P., I. Thani and P. Chantaramongkol. 1999. Dial flight activity of caddisflies (Insecta:Trichoptera) in northern Thailand. *Songklanakarin J. Sci. Technol.* 21(3): 293-299.

Malicky, H and P. Chantaramongkol. 1991. Beschreibung von *Trichomacronema paniae* n.sp. (Trichoptera: Hydropsychidae) aus Nord-Thailand und Beobachtungen über ihre Lebensweise. Arbeiten über thailandische Köcherfliegen nr. 9. *Ent. Ber. Luzern* 25: 113-122.

Malicky, H and P. Chantaramongkol. 1989. Beschreibung von neuen KÖcherfliegen (Trichoptera) aus Thailand und Burma. Arbeiten Über thailandische KÖ cherfliegen nr. 6. *Ent. Ber. Luzern* 22: 117-126.

Malicky, H and P. Chantaramongkol. 1989. Einige Rhyacophilidae aus Thailand (Trichoptera) Studien Über thailandische KÖcherfliegen nr. 3. *Ent. Z. Essen* 99: 17-24.

Malicky, H and P. Chantaramongkol. 1990. Elf neue KÖcherfliegen (Trichoptera) aus Thailand und angrenzenden Ländern. Studien Über thailandische KÖcherfliegen nr. 7. *Ent. Z. Essen* 101: 80-89.

Malicky, H and P. Chantaramongkol. 1991. Einige Leptocerus Leach (Trichoptera:Leptoceridae) aus Thailand. Arbeiten Über thailandische KÖ cherfliegen nr. 8. *Braueria* 18: 9-12.

Malicky, H and P. Chantaramongkol. 1992. Einige Goera (Trichoptera : Goeridae) aus SÜ dasien. Studien Über thailandische KÖcherfliegen nr. 10. *Ent. Ber. Luzern* 27: 141-150.

Malicky, H and P. Chantaramongkol. 1992. Neue KÖcherfliegen (Trichoptera) aus Thailand und angrenzenden Landern. Arbeiten Über thailandische KÖcherfliegen nr. 11. *Braueria* 19: 13-23.

Malicky, H and P. Chantaramongkol. 1992b. First observation on the altitudinal distribution of caddisflies in Northern Thailand (Doi Inthanon) 7th International Symposium on Trichoptera in Umeo, Sweden.

Malicky, H and P. Chantaramongkol. 1993. Neue Trichoptera aus Thailand. *Teil I.- Linzer biologische Beiträge* 25:433-487. - Teil II. - do. 25: 1137-1187.

Malicky, H and P. Chantaramongkol. 1993. The altitudinal distribution of Trichoptera species in Mae Klang catchment on Doi Inthanon Northern Thailand: stream zonation and cool-and warm adapted groups.(studies on caddisflies of Thailand No. 16). *Rev. Hydrobiol. trop.* 26 (4) : 279-291.

Malicky, H and P.Chantaramongkol 1996. Neue KÖcherfliegen aus Thailand(Trichoptera) Arbeiten Nr. 19 Über thailandische KÖcherfliegen. *Ent. Ber. Luzern* 36: 119-128.

Malicky, H. & Chantaramongkol, P. 2000. Ein Beitrag zur Kenntnis asiatischer *Hydropsyche*-Arten (Trichoptera, Hydropsychidae) (Zugleich Arbeit Nr. 29 über thailändische Köcherfliegen). *Linzer biol. Beitr.* 32(2): 791-860.

Malicky, H. 1987. On some Rhyacophila from Doi Suthep Mountain, northern Thailand. *Trichop. Newsletter* 14: 27-29.

Malicky, H. 1989. Odontoceridae aus Thailand (Trichoptera). *Opusc. zool. flumin.* 36:1-16.

Malicky, H. 1991. Some unusual caddisflies (Trichoptera) from southeastern Asia, Proc. 6th Int. Symp. Trich. Adam Micklewicz Univ. Press, Poznan : 381-384.

Malicky, H. 1994. Ein Beitrag zur Kenntnis asiatischer Calamoceratidae (Trichoptera) Arbeiten Über thailandische KÖcherfliegen nr. 13. *Z. Arbgem. Öst. Ent.* 46:62-79.

Malicky, H. 1995. Weitere neue KÖcherfliegen (Trichoptera) aus Asien (Arbeit Nr.18 Über Thailandische KÖcherfliegen). *Braueria* 22: 11-26.

Malicky, H. and Chantaramongkol, P. 1999. A preliminary survey of the caddisflies (Trichoptera) of Thailand. 205-216. Proceedings if the 9th International Symposium on Trichoptera.

Malicky, H. and P. Chantaramongkol 1994. Neue Lepidostomatidae aus Asien (Trichoptera : Lepidostomatidae) (Arbeiten Über Thailandische nr. 14). *Ann. Naturhist. Mus. Wien* 96B: 349-368.

Malicky, H. and P. Chantaramongkol 1997. Weitera neue KÖcherfliegen (Trichoptera) aus Thailand. Arbeit Nr. 20 Über Thailandische KÖcherfliegen. *Linzer biol. Beitr.* 29/1, 203-215.

Malicky, H. and P. Chantaramongkol. 1999. A preliminary survey of the caddisflies (Trichoptera) of Thailand. Proc. 9th Int. Symp. Trich. : 205-216.

Malicky, H. and P. Chantaramongkol. 2000. Ein Beitrag zur Kenntnis asiatischer Hydropsyche-Arten (Trichoptera, Hydropsychidae). (Zugleich Arbeit Nr. 29 über thailändische Köcherfliegen). *Linzer biol. Beitr.* 32(2): 791-860.

Malicky, H. P. Chantaramongkol, P. Chaibu, T. Prommi, S. Siralom, S. Sompong & I. Thani. 2000. Neue Köcherfliegen aus Thailand (Insecta, Trichoptera) (Arbeit über thailä ndische Köcherfliegen Nr. 30). *Linzer biol. Beitr.* 32(2): 861-874.

Malicky, H., P. Chantaramongkol, P. Chaibu, P. Thamsenanupap and I. Thani. 2000. Ach neue Köcherfliegen aus Thailand. *Braueria* 27: 29-31.

Malicky, H., P. Chantaramongkol, S. Cheunbarn and N. Saengpradab. 2001. Einige neue Köcherfliegen (Trichoptera) aus Thailand (Arbeit Nr. 32 über thailändische Kö cherfliegen). *Braueria* 28: 11-14.

Myers, N., R A Mittermeier, Mittermeier, C. G., da Fonseca, G A B, Kents, J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403: 853-858.

Parnell, J.A.N., Simpson, D.A., Moat, J., Kirkup, D.W., Chantaranothai, P., Boyce, P.C., Bygrave, P. Dransfield, S. Jebb, M.H.P., Macklin, J. Meade, C., Middleton, D.J., Muasya, A.M., Prajaksood, A., Pendry, C.A., Pooma, R., Suddee, S. and Wilkin, P. 2003. Plant collection spread and densities: their potential impact on biogeography studies in Thailand. *Journal of Biogeography* 30, 193-209.

Pinratana, A. and Lampe, R.E.J. 1990. Moths of Thailand Vol. 1. Saturniidae, Bosco Offset. Bangkok.

Prommi, T. and P. Chantaramongkol. 1999. Diversity and Distribution of Trichoptera Adults from Different Altitude Streams on Doi Suthep Park, Chiang Mai Province. Research reports on biodiversity in Thailand. 310-348.

Rhodes, B.P., Blum, J. and Devine, T. 2000. Structural development of the Mid-Tertiary Doi Suthep Metamorphic Complex and Western Chiang Mai Basin, Northern Thailand. *Journal of Asian Earth Sciences* 18: 97-108.

Sato, R. 1984. Taxonomic study of the genus *Hypomecis* Hübner and its allies genera from Japan. ESSA Entomological Society, Kurokawa, Niigata.

Sato, R. 1987a. Records of the genus *Cleora* (Lepidoptera : Geometridae) from the Philippines, with descriptions of two new species. *Tinea* 12: 157-170.

Sato, R. 1987b. Taxonomic notes on *Menophra delineata* (Walker)(Geometridae : Ennominae) and its allies from Indo-Malayan region. *Tinea* 12(Suppl.): 249-258.

Sato, R. 1989a. Records of the genus *Cleora* (Lepidoptera: Geometridae) from the Philippines, with descriptions of two new species. *Tinea* 12 (Part 17): 157-170.

Sato, R. 1989b. Two Wehrli's taxa of *Arichanna* (Lepidoptera: Geometridae) raised to the species status. *Tinea* 12 (Part 18): 171-176.

Sato, R. 1990. Three new species and one new subspecies of *Hypomecis* Hübner (Geometridae) from Indonesia. *Tinea* 12 (Part 29): 256-264.

Sato, R. 1991. Records of the genera *Hypomecis*, *Cleora* and *Alcis* (Geometridae; Ennominae) from Thailand with description of three new species and one new subspecies. *Tyo to Ga* 42(4): 271-288.

Sato, R. 1992a. *Paracaliche*, a new genus of the Geometridae (Lepidoptera), with description of two new species from China and Thailand. *Jpn. J. Ent.*, 60(2): 369-375.

Sato, R. 1992b. The genus *Rikiosatoa* (Lepidoptera, Geometridae) from Thailand, with taxonomic notes on two Chinese species. *Jpn. J. Ent.*, 60(3): 559-566.

Sato, R. 1993. Further taxonomic notes on *Amraica recursaria* (Walker) (Lepidoptera: Geometridae) and its allies, with description of two new species from Southeast Asia. *Tyo to Ga*, 44(2): 68-74.

Sato, R. 1995. Records of the Boarmiini (Geometridae, Ennominae) from Thailand II. *Trans. lepid. Soc. Japan*, 46(4): 209-227.

Sato, R. 1996a. Description of a new species closely related to *Hypomecis cineracea* (Moore)(Geometridae, Ennominae) from the Philippines. *Tinea* 14(4): 256-259.

Sato, R. 1996b. Records of the Boarmiini (Geometridae; Ennominae) from Thailand III. *Trans. lepid. Soc. Japan*, 47(4): 223-236.

Sato, R. 1996c. Six new species of the genus *Psilalcis* Warren (Geometridae, Enominae) from Indo-Malayan region, with some taxonomic notes on the allied species. *Tinea* 15(1): 55-68.

Sato, R. 1997a. Additional records of the genus *Cleora* (Geometridae, Ennominae) from the Philippines, with descriptions of one new species and two new subspecies. *Trans. lepid. Soc. Japan*, 48(3): 125-132.

Sato, R. 1997b. Taxonomic notes on *Abaciscus costimacula* (Wileman) (Geometridae, Ennominae) and its allies, with descriptions of two new species from Taiwan and Vietnam. *Tinea* 15(2): 119-124.

Sato, R. 1999. Notes on sume species of the Boarmiini (Geometridae: Ennominae) from Taiwan, with description of one new species. *Tinea* 16(1): 29-40.

Scoble, M. 1999. Geometrid moths of the world: a catalogue (Lepidoptera, Geometridae). CSIRO. Collingwood.

Shunli C; Tong W; Li Y. 1994. Studies on the bionomics and control of *Hyposidra aquilaria* Walker (Lepidoptera: Geometridae). *Forest Research* 7:101-105.

Sompong, S. and P. Chantaramongkol. 1999. Studies on Phenology and Life Cycles of *Limnocentropus* species (Trichoptera: Limnocentropodidae) on Doi Inthanon Range, Northern Thailand. Proc. 9th Int. Symp. Tric.:347-348.

Stüning, D. 2000. Additional notes on the Ennominae of Nepal, with descriptions of eight new species (Geometridae) . In Haruta, T. (Ed.). Moths of Nepal, part 6. *Tinea* 16 (Suppl, 1): 94-152.

Thani, I. and P. Chantaramongkol. 1999. Life History of *Ugandatrichia maliwan* (Trichoptera: Hydroptilidae) in Mae Klang Stream, Doi Inthanon Range, Northern Thailand. Proc. 9th Int. Symp. Tric.: 411-414.

Whitmore, T.C. 1990. An introduction to tropical rain forest. Oxford University Press. Oxford.

Output จากโครงการวิจัยที่ได้รับทุนจาก สกว.

1. ผลงานตีพิมพ์
   1. ผลการศึกษาบางส่วนจากงานวิจัยนี้ได้รับตีพิมพ์หัวข้อเรื่อง Trichoptera communities along an altitude transect on Himalayan-inlier and Himalayan-outlier mountains in Chiang Mai Province, Thailand ใน Proceeding ของงานประชุม International Symposium of Trichoptera ครั้งที่ 11 ซึ่งจัดขึ้นที่ โอซากา ประเทศ ญี่ปุ่น ซึ่งเอกสารจากงานประชุมนี้เป็นที่ยอมรับในระดับนานาชาติ ซึ่งมีฐานข้อมูลอยู่ที่ Biosis
   2. ผลงานอีกฉบับหนึ่งมีชื่อว่า A first overview of the diversity and distribution of geometrid moths (Lepidoptera: Geometridae) in Thailand คาดว่าจะส่งไปตีพิมพ์ในวารสาร National History of Siam Society ปัจจุบันกำลังอยู่ในขั้นตอนการตรวจสอบขั้นตอนสุดท้ายโดยอาจารย์ที่ปรึกษาต่างประเทศ

2. การนำผลงานวิจัยไปใช้ประโยชน์
   - เชิงสาธารณะ ผลจากงานวิจัยนี้ได้รับการเผยแพร่ออกไปสู่ผู้ที่สนใจ และเครือข่ายนักวิชาการผู้ที่ศึกษาแมลงในประเทศไทยผ่าน Website www.geol.utas.edu.au/thailand/index.htm ซึ่งนักวิชาการในประเทศหลายท่านได้ติดต่อเข้ามารวมทั้งแสดงจำนงค์ขอแลกเปลี่ยนความรู้กัน
   - เชิงวิชาการ ผลงานวิจัยนี้เป็นการศึกษาความหลากหลายทางชีวภาพซึ่งเป็นพื้นฐานสำคัญสำหรับการจะพัฒนาองค์ความรู้ด้านอื่น ๆ ต่อไปในอนาคต ไม่ว่าจะเป็นองค์ความรู้ด้าน Ecology, Conservation, Biogeography หรือ Molecular Biology

3. อื่น ๆ

   มีการเสนองานวิจัยนี้ในงานประชุม
   1. นักศึกษาเสนอผลการศึกษาแบบปากเปล่าในหัวข้อเรื่อง Biodiversity of Riparian Insects and Their Conservation in Montane, Chiang Mai, Thailand ในงานประชุม RGJ Congress IV จัดขึ้นที่ พัทยา จังหวัดชลบุรี ซึ่งจัดขึ้นในช่วงขึ้น วันที่ 25-27 เมษายน 2546
   2. อาจารย์ที่ปรึกษาเสนอผลงานแบบปากเปล่าในหัวข้อเรื่อง Trichoptera communities along an altitude transect on Himalayan-inlier and Himalayan-outlier mountains in Chiang Mai Province, Thailand ในงานประชุม International Symposium of Trichoptera ครั้งที่ 11 ซึ่งจัดขึ้นที่ โอซากา ประเทศ ญี่ปุ่น ระหว่างวันที่ 13-19 มิถุนายน 2546

ภาคผนวก

1. Trichoptera communities along an altitude transect on Himalayan-inlier and Himalayan-outlier mountains in Chiang Mai Province, Thailand
2. A first overview of the diversity and distribution of geometrid moths (Lepidoptera: Geometridae) in Thailand

ภาคผนวก 1.

Trichoptera communities along an altitude transect on Himalayan-inlier and Himalayan-outlier mountains in Chiang Mai Province, Thailand

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Abstract. Doi Inthanon and Doi Suthep-Pui mountains are major contributors of natural resources to northern residents. Doi Inthanon mountain locate on the Thanon Thongchai Range, where is connected with Himalaya range. On the other hand, Doi Suthep-Pui mountain is slightly separated from the main Thanon Thongchai Range. This research monitored the Trichoptera in many sites where had not been explored on both mountains to provide more opportunity to find new species of Trichoptera. This basic knowledge on Trichoptera can contribute valuable species that have potential to be environmental indicators in the future. The monitoring used ecologically based criteria in which 3 different riparian sites were selected in the same watershed at elevations of 600, 1,000 and 1,200 m a.m.s.l. The adult Trichoptera specimens were captured from Dry UV-light trapping that was left overnight and the water qualities were measured, concurrently. The specimens were identified and enumerated. The reported data is on the early hot-dry season, March to April 2002. There were 960 individual and 72 species of Trichoptera. Both regions provide unique species of Trichoptera and each site had a different community structure. The cluster analysis showed the grouping of the sites on the same mountain. The ordination and TWINSPAN classification showed the same major grouping result *viz* one group belonged to Inthanon at 1,000 and 1,200 m and another group was the remaining sites. The ordination showed, *Kisaura surasa* (Philopotamidae) was the most highly positively correlated species with Doi Suthep-Pui at 1,000 and 1,200 m. TWINSPAN showed *Ugandatrichia maliwan* (Hydroptilidae) as an indicator species that separated the 2 main groups of sites similar to the ordination result. The research found 13 unknown specimens that might be possible new species that will be sent to Prof. Dr. Hans Malicky to confirm identification.

Introduction

Mountains and highlands cover around 75% of the area of northern Thailand. There are four mountain ranges in this area and all are a south eastern extension of the greater Himalayan range (Fig. 1). These mountains are important contributors of natural resources including fresh water for Thailand. The western-most Thanon Thongchai Range is 880 km in length, and is located on the boundary between Thailand and Burma. On this range, there are two of the most famous and important mountains of Thailand, Doi Suthep-Pui (98°47′-98°56′E, 18°47′-18°55′N; 1,685 m) and Doi Inthanon (98°27′-98°40′E, 18°19′-18°40′; 2,565 m) (Fig. 2). These elevated areas introduce an element of temperate climate to this area. On the other hand, northern Thailand contains extensive rain forests which reach up from the equator (Whitmore 1990). Moreover, this range is the only one place in Thailand, which contains structures mainly of Precambrian geology (Dunning *et al.* 1995). The combination of these unique geographical characteristics creates an ecotone between temperate and tropical conditions which has been important for the evolution of the fauna for a long time.

Although Doi Suthep-Pui and Doi Inthanon occupy the same gneral mountain range, they differ in their relationship to the main range. Doi Inthanon is located on the middle of the range, continuously connected to the higher than 1,000 m region. In contrast, the higher parts of Doi Suthep-Pui (above 1,000 m) are separated from the main range by surrounding valleys (Fig. 2). This isolation causes the upper part of Doi Suthep-Pui to be relatively insular. In this study we refer to Doi Inthanon as a Himalaya-inlier and Suthep-Pui as a Himalaya-outlier mountain.

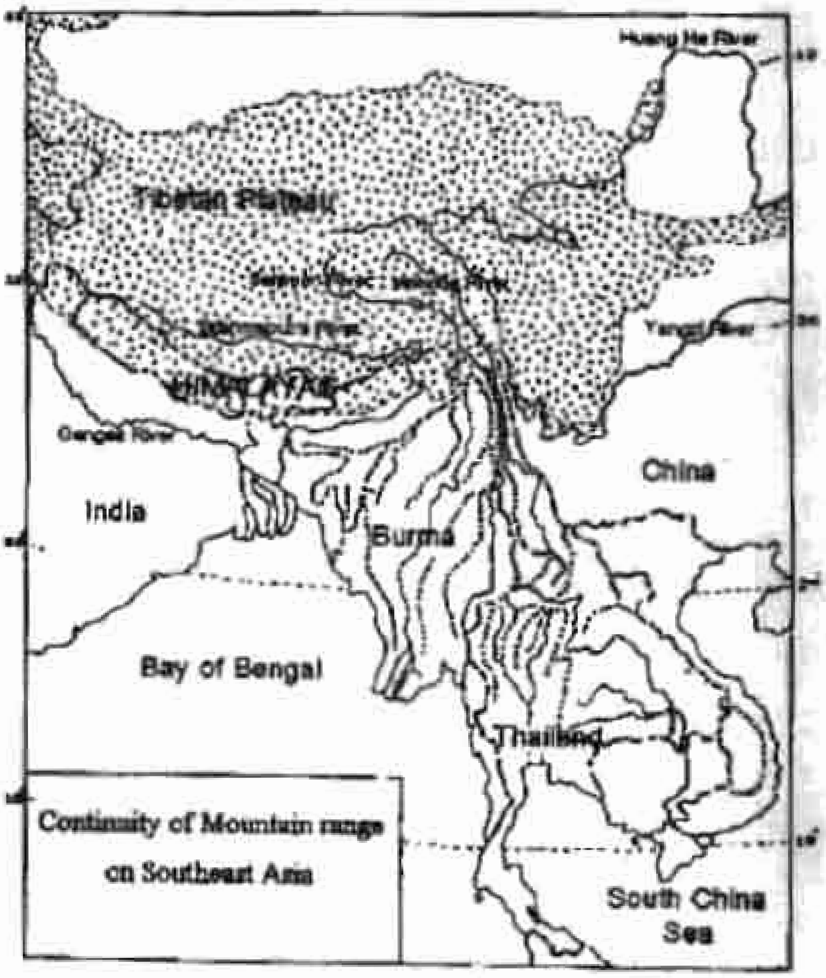


FIG. 1. Map showing the pattern of connection and continuity of mountain ranges in Southeast Asia with the Himalayan range.

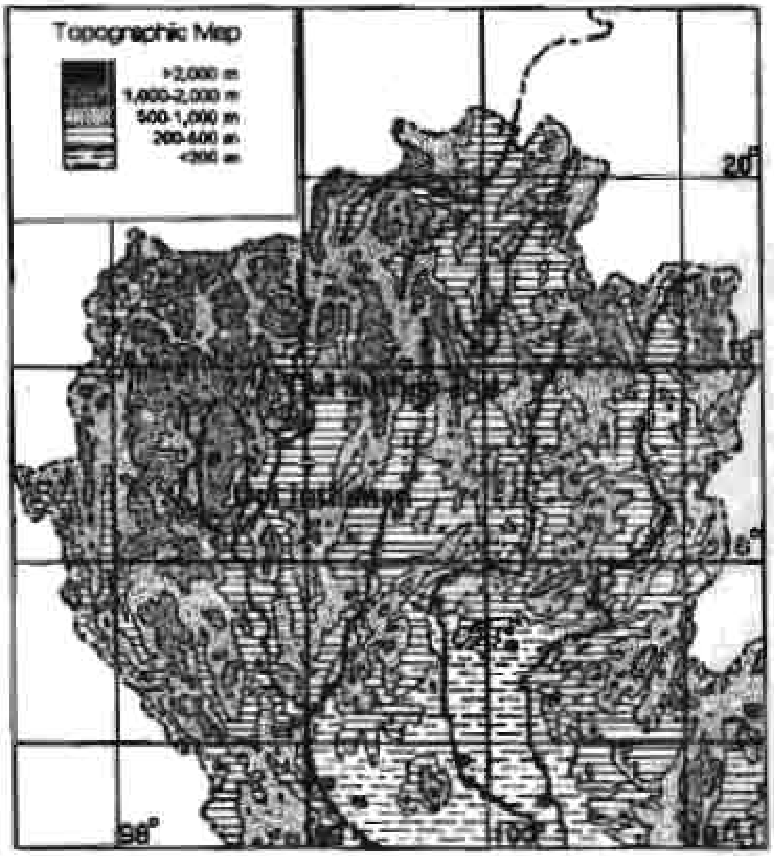


FIG. 2. Topographic map of northern Thailand showing the positions of Doi Suthep-Pui and Doi Inthanon.

Recent studies have documented Doi Suthep-Pui and Doi Inthanon as hot spots for Trichoptera in Thailand. On Doi Suthep-Pui, there are at least 131 species (Chantaramongkol and Malicky 1997) and 171 species are reported from Doi Inthanon (Malicky and Chantaramongkol 1993), but more new species and records are likely in the future. Some of them were distributed on both mountains, but some are endemic.

Nine taxa, *Himalopsyche acharai, Dolophiloides torrentis, Stenopsyche himalayana, Kambaitipsyche kykrion, Arctopsyche variabilis, Eubasilissa maclachlani, Liomnocentropus* spp., *Uenoa hiberna*, *Molannodes alticola* found on Doi Inthanon and nearby mountain ranges, are argued to represent an Himalayan connection in the Thai fauna (Malicky and Chantaramongkol 1999). Of these, only *Himalopsyche acharai* has been found on Doi Suthep-Pui (Chantaramongkol and Malicky 1997). A similar pattern occurs in the Himalayan plant genus *Rhododendron*, which grows above 1,200 m. It is widespread on Doi Inthanon and nearby ranges, but rarely found on Doi Suthep-Pui. Therefore it is hypothesised that the flora and fauna on Doi Suthep-Pui above 1,000 m may have evolved with less Himalayan influences.

This paper examines this influence by comparing the structure of Trichoptera communities along an altitude gradient using multivariate analysis, with some emphasis on the tropical-temperate interface between 1,000 to 1,200 m.

Methods

Site Description

Both Doi Suthep-Pui and Doi Inthanon have mainly a gneissic structure (Precambrian metamorphic rock), but they are locally different. Doi Suthep-Pui includes sedimentary rock on its southwest part and some granite structure at the summit area. Whereas, Doi Inthanon has only 2 types of rocks, gneiss and granites (Baum et al. 1981, Rhodes et al. 2000).

Three study sites at the elevations of 600, 1,000 and 1,200 m were selected at Doi Suthep-Pui and Doi Inthanon. Three forest types occur along the elevation gradient in this study. The first type is Lowland Forest and is located below 800 m. It mostly contains *Dipterocarpus*, Leguminoseae, Moraceae and some bamboo. The second forest type is mixed deciduous forest and is located from 800m to 1,200 m. The major tree families are Fagaceae and Dipterocarpaceae. This habitat contains the highest diversity of flora especially in the area which has not had much disturbance. Above 1200m, the vegetation is evergreen forest which does not shed its foliage and contains mostly Magnoliaceae and Theaceae.

Trapping method

In order to trap both Trichoptera and Lepidoptera for study, dry light traps (Fig. 3) were left overnight in the riparian zone of each site. Light traps consisted of a 20-watt ultra-violet lamp which was operated with a 12 volt DC battery. The lamp was suspended with transparent plastic over a funnel on a plastic bucket. In the bucket was a small bottle containing chloroform that was evaporated from a wick. The Trichoptera samples were probably fewer in species than from a wet type of trap in which the specimens are rapidly drowned before they can escape.

Identification and analysis

The specimens of Trichoptera were stored in 70% ethanol . They were enumerated and identified in the laboratory with the aid of the Preliminary Key of Trichoptera in Thailand developed by Prof. Hans Malicky. The ecological statistics program PATN was used to analyze the Trichoptera community structure. The outputs from PATN were PCC ordination, TWINSPAN and cluster analysis that showed the classification of study sites based on the local characteristics of the Trichoptera. The reported data is only for the early hot-dry season, March to April 2002.

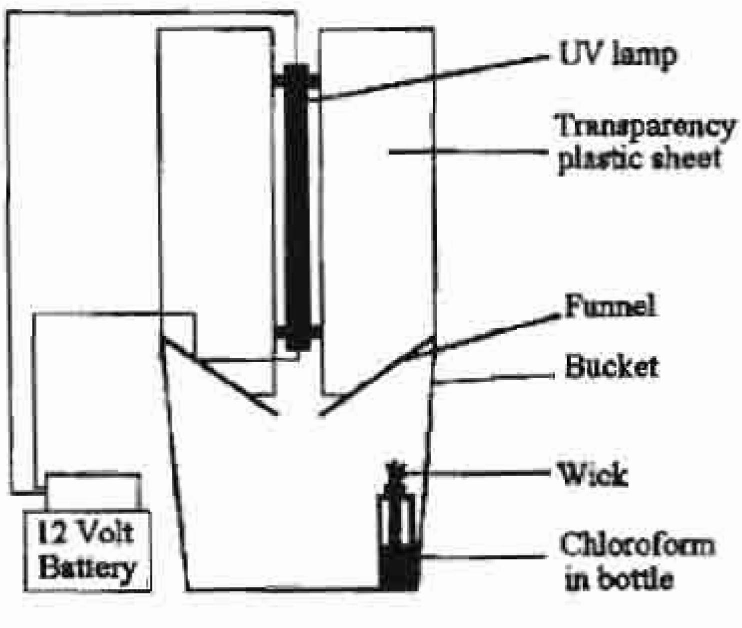


FIG. 3. Model of Dry light trap.

RESULT AND DISCUSSION

There were 960 individuals and 72 species of Trichoptera captured over the study period. Diversity was much lower on Doi Suthep-pui (10 families and 22 species) than on Doi Inthanon, (18 families and 56 species). . Both mountains provided unique species of Trichoptera and each site had a different Trichoptera community. Cluster analysis showed that the sites on each mountain were more similar in terms of their Trichoptera fauna than sites at the same elevation on different mountains (Fig. 4).

The upper levels of Doi Inthanon (1,000 and 1,200 m) were identified by ordination (Fig. 5) and TWINSPAN analysis (Fig. 6) as very different to the other sites. TWINSPAN classified the Trichoptera community from Doi Inthanon at 600 m with the Doi Suthep communities rather than with the other Doi Inthanon sites at 1,000 and 1,200 m. Population count data supported this finding and showed that all the sites on Doi suthep plus Doi Inthanon at 600 m were dominated by Hydropsychidae and Philopotamidae, whereas on Doi Inthanon at 1,000 and 1,200 m the abundant families were Hydropsychidae, Hydroptilidae and Lepidostomatidae.

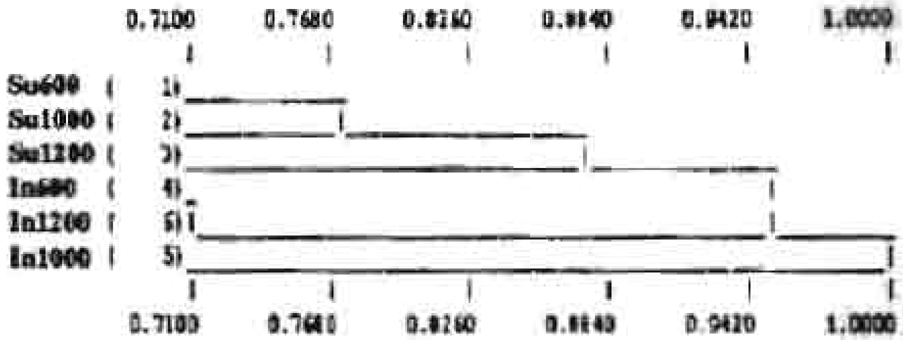


FIG. 4. Cluster analysis (UPGMA) showing the classification of study sites based on the presence-absence of Trichoptera species. Su600 is Doi Suthep-Pui at 600 m; In600 is Doi Inthanon at 600 m.

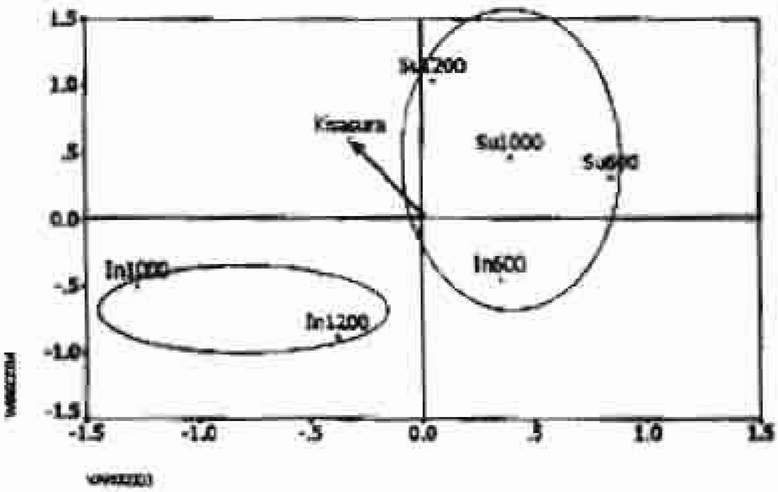


FIG. 5. Ordination (semi-strong hybrid multidimensional scaling) showing the relationship of study sites based on their Trichoptera community. *Kisaura surasa* (Philopotamidae) was identified by PCC as the most highly correlated species to the ordination.

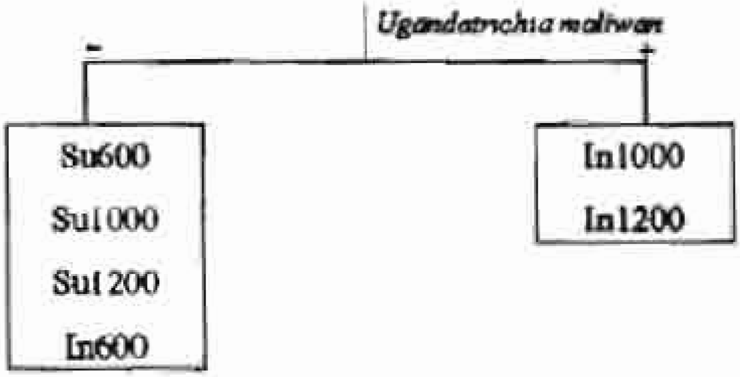


FIG. 6. TWINSPAN summary showing the classification of study sites based on their Trichoptera community. The significant indicator species is *Ugandatrichia maliwan* (Hydroptilidae).

The PCC module identified *Kisaura surasa* (Philopotamidae) as the species most strongly positively correlated with the ordination result. This species were found exclusively on Doi Suthep-Pui at 1,000 and 1,200 m. There were three other species in the samples that were not found on Doi Inthanon *viz Chimarra suthepensis* (Philopotamidae), *Anisocentropus janus* and *A. pan* (Calamoceratidae). From previous records (Malicky and Chantaramongkol 1993, Chantaramongkol and Malicky 1997) only *Kisaura surasa* and *A. pan* were recorded on Doi Suthep-Pui but not on Doi Inthanon.

Classification of the sites using TWINSPAN identified *Ugandatrichia maltwan* (Hydroptilidae) as an indicator species that separated the six sites into two major 2 groups. During this study, *Ugandatrichia maltwan* was found only on Doi Inthanon at 1,000 and 1,200 m. However this species has been found on Doi Suthep-Pui (Chantaramongkol and Malicky 1997) like *Chimarra suthepensis* and *Anisocentropus janus* that have been found on Doi Inthanon on other occasions.

There were some Trichoptera species that were found at only single sites during the monitoring period. Some of them were truly site specific but some have been reported from elsewhere (Table 1).

TABLE 1. Site specific species of Trichoptera recorded in study sites on Doi Suthep-Pui and Doi Inthanon in March to April, 2002.

Study sites	Specific species
Doi Suthep-Pui, 600m (98°55′55″E, 18°47′50″N)	*Cheumatopsyche coclès, Cheumatopsyche dubitans, Dinarthrum longipenis, Chimarra lannaensis**, *Rhyacophila petersorum**, *Rhyacophila suthepensis**
Doi Suthep-Pui, 1000m (98°55′13″E,18°48′12″N)	*Cheumatopsyche ceres, Chimarra suthepensis**, *Anisocentropus janus**
Doi Suthep-Pui, 1200m (98°54′40″E, 18°48′13″N)	*Anisocentropus pan*
Doi Inthanon, 600m (98°36′38″E, 18°32′34″N)	*Hydropsyche bacchus, Hydropsyche briareus, Chimarra toga***, *Chimarra nahesson***, *Ganonema fuscipenne*
Doi Inthanon, 1000m (98°34′56″E, 18°32′15″N)	*Hydromanicus inferior***, *Ecnomus jojachin***, *Psychomyia chomu***, *Stenopsyche hainavatika, Micrasema asuro*
Doi Inthanon, 1200m (98°31′11″E, 18°31′20″N)	*Hydromanicus truncatus, Dinarthrum fischeri***, *Dinarthrum brueckmanni, Inthanopsyche trimeresuri, Chimarra nahesson***, *Chimarra hiinorum***, *Kisaura intermidia***, *Tinodes acheron, Ganonema extensum, Arctopsyche hynacki***

Note: * species also found on Doi Inthanon, ** species also found on Doi Suthep-Pui (Malicky and Chantaramongkol 1993, Chantaramongkol and Malicky 1997).

The Trichoptera communities of the higher parts of Doi Inthanon (1,000 and 1,200 m) were distinctive and identifiably montane (Himalayan-inlier), whereas theTrichoptera communities from Doi Suthep-Pui at 1,000 and 1,200 m had closer similarities with lowland communities at 600 m. We propose that the relative isolation of Doi Suthep-Pui has reduced the faunistic influences from the high main mountain ranges (Himalayan) and reinforced the outlier status of Doi Suthep-Pui. The Trichoptera fauna of its upper levels appear to be more strongly influenced by a lowland element as a result. This inlier-outlier hypothesis will require testing using more comparative studies on other taxa.

This research found 13 unidentified specimens that might be new species that will be sent to Prof. Hans Malicky to examine further. There was also a first record of Ecnomidae on Doi Inthanon .

Acknowledgements

We would like to thank the Royal Golden Jubilee (RGJ) and the Basic Research Grant (BGJ) programme from the Thailand Research Fund (TRF) Thailand for funding, and thank Prof. Hans Malicky for taxonomic assistance on Trichoptera identification of Thailand.

Literature Cited

BAUM, F., BRAUN, E.V., HESS, A., AND KOCH, K.E., 1981. Geologic map of Northern Thailand: Fed. Institute for Geosciences and Natural Resources, Federal Republic of Germany, Scale 1:250,000.

CHANTARAMONGKOL, P. AND MALICKY, H. 1997. Trichoptera from Doi Suthep-Pui National Park, Northern Thailand. 65-67. Proceedings of the 8th International Symposium on Trichoptera. Ohio Biological Survey, Columbus.

DUNNING, G.R., MACDONALD, A.S. AND BARR, S.M. 1995. Zircon and monazite U-Pb dating of the Doi Inthanon core complex, northern Thailand: implications for extension within the Indosinian Orogen. Tectonophysics 251: 197-213.

MALICKY, H. AND CHANTARAMONGKOL, P. 1993. The altitudinal distribution of Trichoptera species in Mae Klang catchment on Doi Inthanon, northern Thailand: stream zonation and cool- and warm-adapted groups. Rev. Hydrobiol. Trop. 26 (4): 279-291.

MALICKY, H. AND CHANTARAMONGKOL, P. 1999. A preliminary survey of the caddisflies (Trichoptera) of Thailand. 205-216. Proceedings if the 9th International Symposium on Trichoptera.

RHODES, B.P., BLUM, J. AND DEVINE, T. 2000. Structural development of the Mid-Tertiary Doi Suthep Metamorphic Complex and Western Chiang Mai Basin, Northern Thailand. Journal of Asian Earth Sciences 18: 97-108.

WHITMORE, T.C. 1990. An introduction to tropical rain forest, Oxford University Press. Oxford.

ภาคผนวก 2.

A first overview of the diversity and distribution of geometrid moths (Lepidoptera: Geometridae) in Thailand.

Decha Thapanya, Porntip Chantaramongkol and Peter McQuillan

ABSTRACT

This paper lists 224 taxa of Geometridae and summarises their known distribution in Thailand. 180 species with specific distributional data contributed to a multivariate analysis of spatial and altitudinal relationships in term of localities. These distributions could be partly explained with distance, altitudinal and vegetation factors. Geographical distance between sites was found to be only a weak factor in the relationship among moth communities (Mantel test; $r = 0.188$, $P < 0.0000$). A significant correlation between altitudinal class and extracted ordination scores was found ($r = -0.6330$, $p = 0.015$). In contrast, no significant correlation between ordination scores with latitude ($r = -0.4461$, $p = 0.110$) and longitude ($r = 0.0517$, $p = 0.861$) was found. A cluster analysis classified geometrid moth communities along altitudinal distribution based on the vegetation preference as follow, 53.9% of Geometridae were found in evergreen forest, while a quarter (24.4%) preferred lowland forest and the remaining (21.7%) preferred multi-habitats.

INTRODUCTION

Thailand is located in the tropical zone of Southeast Asia and occupies around 517,000 km^2 or an area 20% larger than California, USA (Parnell *et al*, 2003). Thailand has long held a key position in Southeast Asian biogeography because of its location at the boundary of the Indochinese and Sundaic provinces, the major biogeographical regions of Southeast Asia. It is also centrally located in the Indo-Burma biodiversity hotspot which ranks sixth among the 25 such hotspots of the world and is home to 13,500 plant species (Myers *et al*, 2000).

In addition of the southernmost of Thailand is at 6°N the southern of Thailand is influenced by the tropical rain forest. On the other hands, the 75% of northernmost Thailand is the highland, which was forming from the mountain ranges continuing from the Himalayan range. These mountain ranges continuously cover on some part of western, central, northeastern and eastern of Thailand. The remaining regions are mostly planes. These geographical characteristics of Thailand cause the complex of biogeography region that support the high diversity of flora and fauna.

The complex geology, topography and strategic location of Thailand, together with its rich botanical diversity, suggests that it should have a diverse moth fauna. However, studies on the moth fauna of Thailand are in their infancy. Although occasional Lepidoptera specimens collected in Thailand ("Siam") found their way to the European collections more than a century ago, the earliest systematic study on moths in Thailand appears to be the study on Emperor moths (family Saturniidae) published by Edward J. Godfrey in 1924, reported in the National History Society of Siam Vol.VI, No.3. (Pinratana and Lampe, 1990). An Englishman, Godfrey (1877-1933) was a teacher at Suan Kularb College in Bangkok.

The family Geometridae is one of the three most diverse families of the order Lepidoptera, with around 20,000 described species worldwide (Scoble, 1999). Taxonomic knowledge about the group is proceeding at a regional level (e.g. Pitkin, 2000).

Geometrid larvae are herbivores on foliage and play a role as the nutrient transmitter to the next trophic levels. A very few geometrid moths in Thailand are significant pests in agriculture and plantations such as *Ascotis selenaria* which attacks *Casuarina equisetifolia* and *Ectropis bhurmitra* which is a pest of *Aleurites moluccana* (Hutacharern and Tubtim, 1995). However, a number of genera which have pest species elsewhere in Asia, such as *Cleora* and *Hyposidra* (Shunli *et al*. 1994), are present in Thailand also. But the vast majority of geometrid species are restricted to natural and semi-natural vegetation types forest. Geometrid moths are sufficiently diverse and widespread in Southeast Asia to be applied as bioindicators study on the ecology and biogeography (Chey *et al*, 1997; Holloway, 1984; Holloway, 1985; Holloway & Barlow, 1992; Holloway & Stork 1991; Holloway *et al*, 1992).

Introduction of geometrid localities

There are six administration regions in Thailand, related to the geography of the country; north, central, northeast, east, west and south (Fig 1). Each region contains unique geophysical characteristics and also has its own Geometridae localities show in Fig 2.

Northern Thailand is a highland area, mostly exceeding 300m elevation. The mountain ranges of northern Thailand are the south easterly extension of the Himalaya. The ridges and wide fertile valleys extend south from the borders with Burma and Laos to about 17°N. Located in this region are the head-waters of the four major tributaries of the Chao Phraya: the Ping, Wang, Yom, and Nan rivers, all of which run roughly parallel from north to south. The geometrid localities are Doi Inthanon National Park, Doi Suthep-Pui National Park and Pakia (Chiang Mai; A), Doi Phukha (Nan; B).

Central Thailand is a great fertile plain, centred on the broad valley and floodplains of the Chao Phraya river and its tributaries. Although almost all this region is developed for agriculture or urbanisation, there are a few remnants of forest suitable for geometrid moths. Geometrid records exist in this region for Khao Yai (Nakhon Nayok; H), Phuhin Rongkla and Thung Salaeng Luang National Park (Phitsanulok; D) and for Nam Nao National Park (Phetchabun, E).

To northeast rises the dry, undulating Khorat Plateau bordered to the east by the Mekong River. This is the most arid area in Thailand. Geometrid records are from Phu Luang Wildlife Reserve and Phu Rua (Loei; C), Chulabhorn Dam (Chaiyaphum; G), NamProam Dam (Khon Kaen; F).

Eastern Thailand close to the Gulf of Thailand is a major industrial area. An only remaining forest patch is in Khao Soi Dow Wildlife Reserve and nearby areas of Chanthaburi (I).

The western margin of Thailand adjacent to the Burmese border has importara stands of fertile rainforest, some with World Heritage status such as "Huai-kha-khang and Thung-yai-naresuan Wildlife Reserve" in Kanchanaburi. Records of Geometridae were available from Earawan National Park, Tum Than Lod (Kanchanaburi; J).

Southern Thailand is close to the Malaysian peninsular and the equator. The forest in this region is mostly lowland tropical rainforest with mangrove communities on the coast. There are a few high mountains in the south with records such as Khao Luang (1,786 m) (Nakhon Sri Thammarat; M) and KhaoSok (Surat Thani; L). The lowland forest patch in KhongNahka (Ranong; K) also had records. Finally, there are a few records from islands such as Nam Tok Ton Sai (Phuket; N).

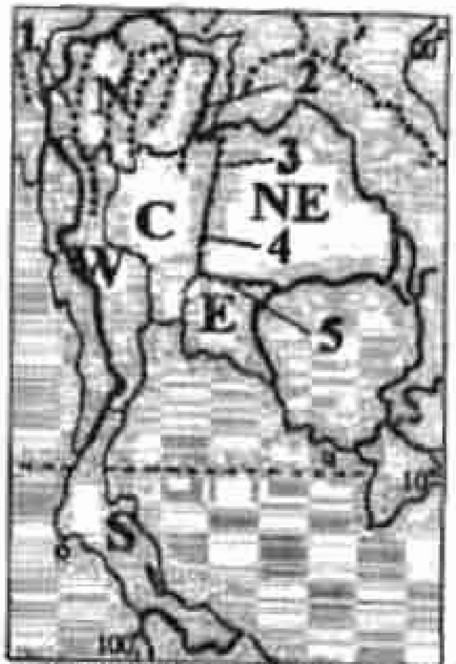


Fig 1. The administration region of Thailand, N = north, C = central, NE = northeast, W = west, E = east and S = south. The dot in map is the continuously mountain ranges from Himalayan, which are addressed as follow; 1 = Thanon Thong Chai MR, 2 = Luang Pra Bang MR, 3 = Phetchabun MR, 4 = Dong Praya Yen MR and 5 = San Kum Pank MR (MR = mountain range).

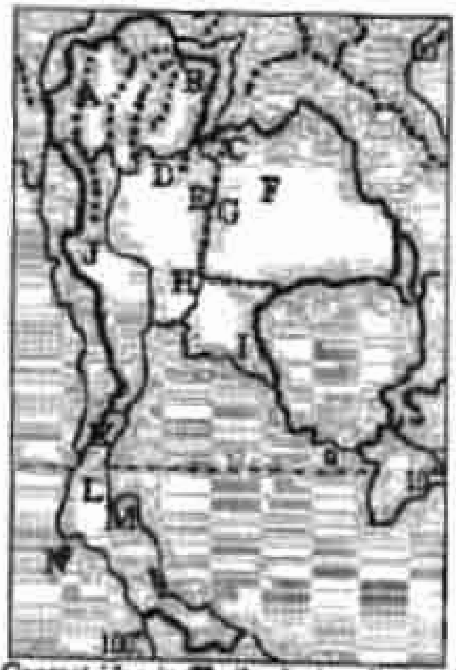


Fig 2. The locality record of Geometridae in Thailand; A = Doi Inthanon Doi Suthep-Pui and Pakia (Chiang Mai), B= Doi Phakha (Nan), C = Phu Luang and Phu Rua (Loei), D = Phuhin Rongkla and Thung Salaeng Luang (Phitsanulok), E = Nam Nao National Park (Phetchabun), F = NamProam Dam (Khon Kaen), G = Chulabhorn Dam (Chaiyaphum), H = Khao Yai (Nakhon Nayok), I = Khao Soi Dow (Chanthaburi), J = Erawan and Tum Than Lod (Kanchanaburi), K = KhongNahka (Ranong), L = KhaoSok (Surat Thani), M = Khao Luang (Nakhon Sri Thammarat) and N = Num Tok Ton Sai (Phuket).

OBJECTIVES

The main objective of this paper is to present the first overview the distribution pattern of Geometridae communities in Thailand in terms of broad spatial and altitudinal distribution. The auxiliary aim is to provide a data lists and the distribution of Geometridae for develop a database of biodiversity of Thailand and to introduce the prospective idea of biogeography study in Thailand. Then this paper was proposed as the initial number that will be as the baseline for the further studies.

METHODS

Useful distributional data was available for 180 species of the 224 taxa of Thai Geometridae. All of the scientific names conform to the recent global catalogue of Geometridae by Scoble (1999). These data were generated from the literature on Oriental geometrid moths especially by Inoue, H., Sato, R., Hashimoto, S. and Stüning, D. over the period 1980-2000 and from field trips in 2002 mostly in northern Thailand. Samples were captured with UV light traps and by mercury vapor or other light sources. It is apparent from the literature that collecting effort is uneven between localities, with a concentration of records from the Doi Suthep and Doi Inthanon area, probably reflecting their popularity and ease of access to biologists. Similarly, Parnell *et al.* (2003) noted that 20% of more than 6,500 plant collection records came from Changwat (province) Chiang Mai. However, we believe that sufficient records are available to make at least broad generalizations about the distribution of the geometrid fauna.

The 180 species and 14 relatively well collected sites were analyzed by ordination (using the program PC-ORD) and cluster analysis (SPSS) in order to evaluate the spatial distribution of geometrid moths. The input data were binary presence/absence. The extracted scores from one axis of the ordination were plotted against mean altitude, latitude and longitude and analyzed for correlation. The geometrid moth communities of each locality were compared pairwise using the Sorensen (Bray & Curtis) similarity measure, and subject to non-metric multidimensional scaling (NMS). The geographical distances in kilometers among localities were also measured. The matrices of Sorenson measures and geographical distances were then analyzed by a Mantel test to estimate the correlation between them. This gives some insight into the influence of spatial factors on the similarity of the geometrid communities.

The patterns of Geometridae communities along the vegetation zones were examined using cluster analysis. The vegetation zones of Thailand were categorized to 3 groups. The first zones is lowland Forest, generally occurring below 800m. The second forest type is mixed deciduous forest, located in a band between 800m to 1,200m. Finally, at elevations over 1,200m, the vegetation is evergreen forest.

RESULTS

Distribution of taxa across the sites was highly uneven (Table 1). More than half the taxa were reported from a single location, and only five species occurred at five or more localities. The apparent diversity of taxa at sites was also highly uneven. One site (A) possessed more than half the Geometrid taxa recorded for the country and about four times the diversity of the next most diverse site (H).

Table 1. Number of localities at which taxa occurred.

Number of localities	Taxa
Unspecified	51
One	130
Two	27
Three	6
Four	5
Five	4
Six	1

Table 2. Number of taxa present at particular localities, addressed in the Fig 2. "Z" mean Thailand recorded species, but unspecified the site.

Locality	Site	Changwat	Taxa present
A	Doi Inthanon Doi Suthep-Pui and Pakia	Chiang Mai	134
B	Doi Phukha	Nan	5
C	Phu Luang and Phu Rua	Loei	13
D	Phuhin Rongkla and Thung Salaeng Luang	Phitsanulok	4
E	Nam Nao National Park	Phetchabun	5
F	NamProam Dam	Khon Kaen	2
G	Chulabhone Dam	Chaiyaphum	6
H	Khao Yai	Nakhon Nayok	34
I	Khao Soi Dow	Chanthaburi	18
J	Erawan and Tum Than Lod	Kanchanaburi	7
K	KhongNahka	Ranong	6
L	KhaoSok	Surat Thani	2
M	Khao Luang	Nakhon Sri Thammarat	11
N	Num Tok Ton Sai	Phuket	3
Z	Unspecified	-	41
Southern Thailand	Unspecified	-	3
Northern Thailand	Unspecified	-	8

The position of localities in ordination and grouping formation on dendrogram were the results from the different member of the gemetrid moths of each locality. The proximate point in ordination or branch of cluster indicated the similarity between geometrid communities. The result from the ordination (Fig 3) was simplified for explanation by dendrogram (Fig 4). The result was shown the classification of the localities or the geometrid communities in Thailand into 3 groups.

The first group is geometrid community in the locality A, which was the Doi Suthep-Pui, Inthanon, Pakla, in northern of Thailand. In this locality contain the difference species of geometrid moths with the remaining localities. This area composed mostly of the highland Geometridae species such as; entire group of *Alcis*, *Arichanna*, *Biston*, *Catoria*, *Darisa*, *Hyposidra*, and the major of *Ourapteryx*, *Abraxas*.

The second and third groups are also exclusively composed of the geometrid moths, that not found in the first group such as, *Hypomecis separata*, *Hypomecis costaria*, *Cleora pupillata pupillata*, *Cleora determinata*. The second and third also be separated because the member of the second group are specifically with *Artchanna flavimedia*, *Arichanna peniculifera*, *Ourapteryx fulvinervis*, *Amblychia angeronaria*, *Dindica polyphaenaria*, *Dindica olivacea*. While, the third group is exclusively composed with, *Cleora contiguata brooski*, *Abraxas illuminata*, *Rikiosatoa fucatariodes*, *Biston panternaria exanthemata*.

The ordination and dendrogram reveal the clue of the factor that influence on the grouping of geometrid communities. They show the highly similarity of geometrid communities between the closely locality such as, H (Khao Yai, Nakhon Nayok) and I (Khao Soi Dow, Chanthaburi) in the second group or L (KhaoSok, Surat Thani) and N (Num Tok Ton Sai, Phuket) in the third group. This factor called "Distance factor". In contrast, the geometrid community in locality M (Khao Luang, Nakhon Sri Thammarat) was grouping with H and I rather than L and N. It was because of the geometrid community from H were mostly from higher altitude in Khao Luang mountain, whereas the communities from L and N came from the lower point. This is the effect of "altitudinal factor". In order of testing these factors and latitudinal and longitudinal factors, the correlation was done and reported next.

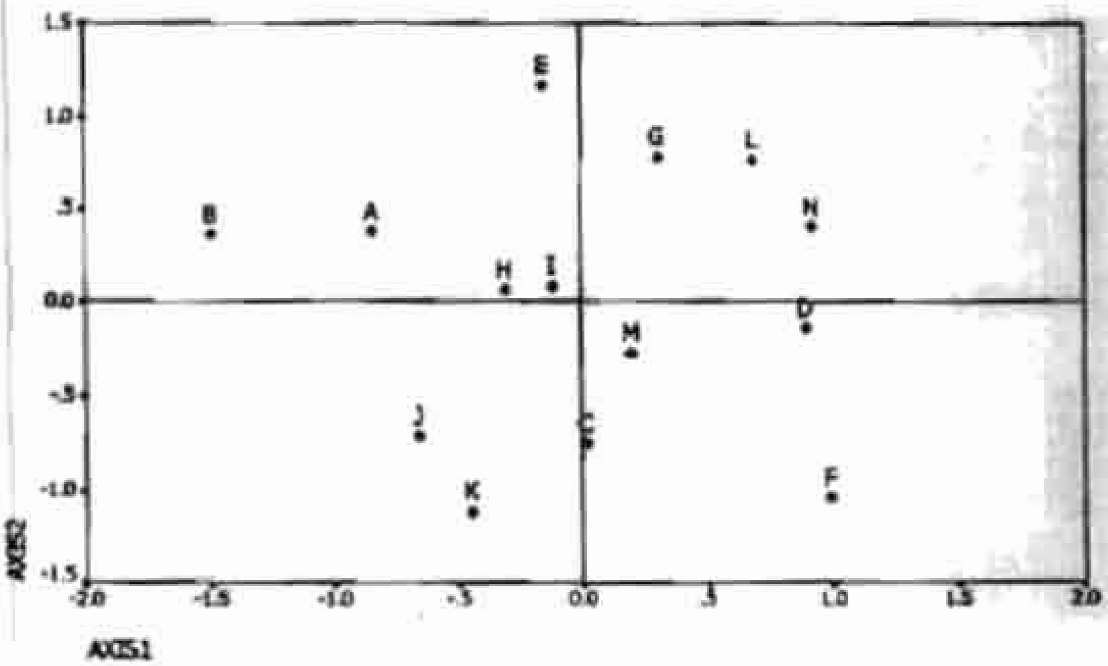


Fig 3. Ordination of localities evaluated by geometrid moths 180 species. The meaning of each locality is showed on the Fig 2.

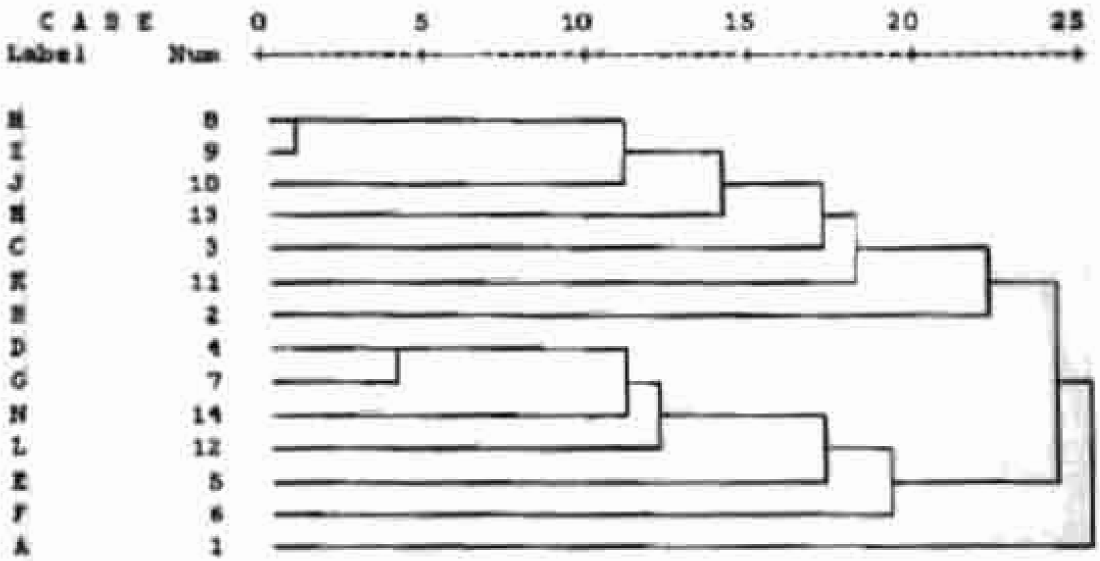


Fig 4. Dendrogram shows the classification of major localities on Geometridae in Thailand (180 species).

The influence of geographical distance between the sites

There was found to be a small but significant correlation between the geometrid communities and their geographical distance apart (Mantel test; $r = 0.188$, $P < 0.0000$). Therefore other factors must be strongly influential in explaining the observed patterns among the sites.

Altitudinal, latitudinal, longitudinal factors

The extracted ordination score from Axis1 was plotted against the altitude, latitude and longitude of localities and examined with the correlation. The significant correlation was found only between extracted ordination scores and altitude ($r = -0.6330$, $p = 0.015$)(Fig 5). Whereas, the significant correlation weren't be found between ordination scores with latitude ($r = -0.4461$, $p = 0.110$) and longitude ($r = 0.0517$, $p = 0.861$)(Fig 6). Then the Geometrid communities in Thailand can also be explained by the altitude, while the effect of latitude and longitude weren't involved.

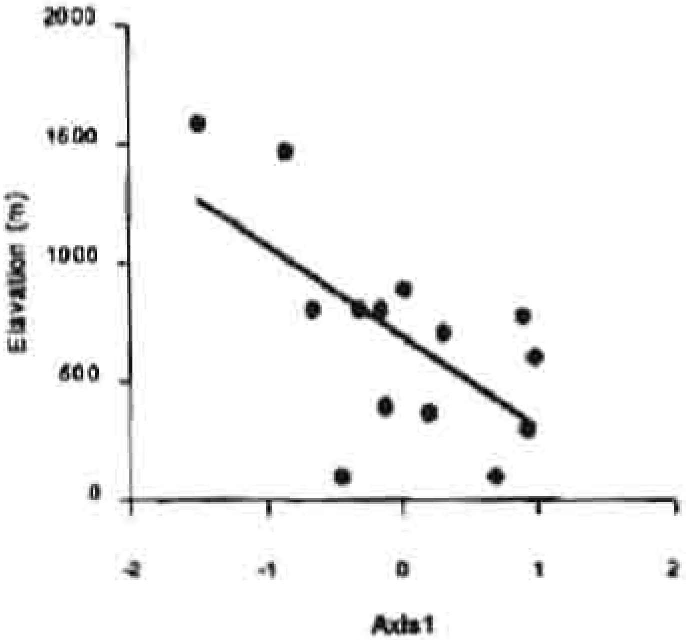


Fig 5. Scatter graph plotted between extracted ordination scores from Axis1 and altitude of localities (m). The significant correlation between these factor was found ($r = -0.6330$, $p = 0.015$).

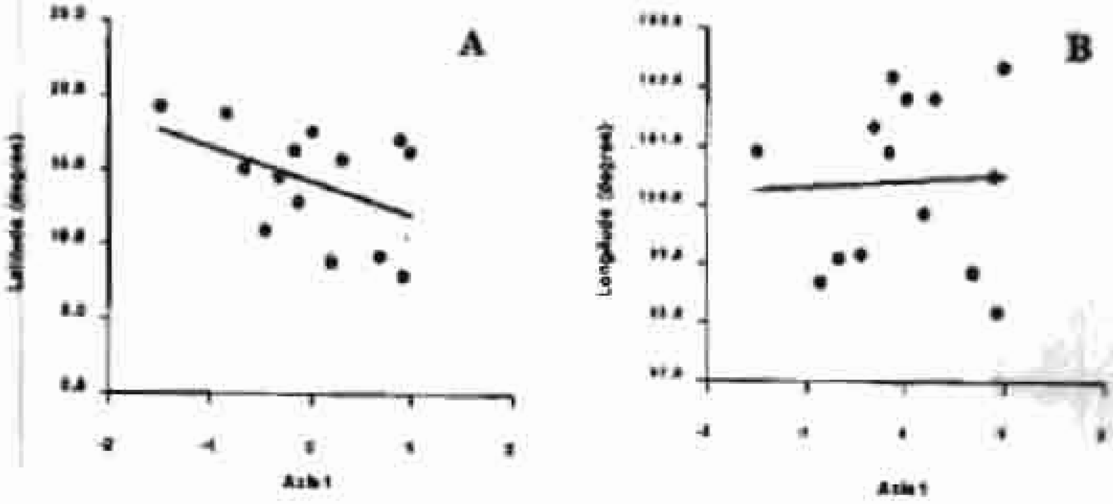


Fig 6. Graphs shows the relationship between extracted ordination scores Axis1 and latitude (A) and longitude (B) of the localities. There were not the significant correlation between the ordination scores and latitude ($r = -0.4461$, $p = 0.110$) and longitude ($r = 0.0517$, $p = 0.861$).

Pattern of Geometrid communities along the vegetation zones

The results of cluster analysis (Fig 7.) show the 6 groups of Geometridae community. The explanation of all groups show in table 3. The around half (53.9%) of Geometridae were found in evergreen forest, while a quarter (24.4%) preferred lowland forest. Whereas, the remaining (21.7%) were a multi-habitat preference. This group should include the geometrid moths that were found in the mixed deciduous forest.

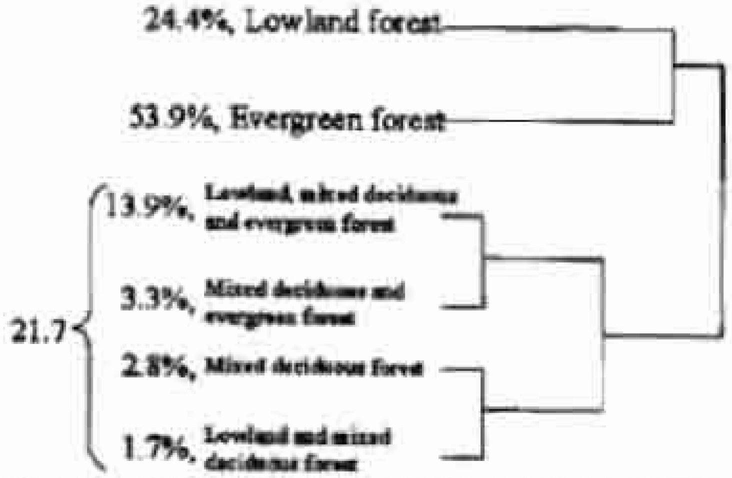


Fig 7. Dendrogram shows the classification of geometrid communities by their preference vegetation zones.

Table 3. The explanation of the dendrogram shows the classification of geometrid communities from their preference vegetation zones.

Preference vegetation zone	%	Example of Members
Lowland forest	24.4	*Amblychia* spp. Major of *Cleora* sp., some *Hypomecis* spp.
Evergreen forest	53.9	*Ultara* spp, *Trichopterigia* spp, *Ourapteryx* spp, *Arichanna* spp, Major of *Chorodna* spp. *Alcis* spp. *Abraxas* spp.
Mixed deciduous forest	13.9	*Fascellina albicordis*, *Gasterocome pannosaria*, *Alcis periphracta*, *Catoria olivescens*, *Chiasmia suthepensis*
Lowland and mixed deciduous forest	3.3	*Amraica* spp. *Psilalcis paraceptaria*
Mixed deciduous and evergreen forest	2.8	*Hyposidra talaca*, *Hyposidra aquilaria*, *Luxiaria emphatica*, *Alcis nagoustigma*, *Alcis chiangmaiensis*, *Ectropis longiscapia*
All zones	1.7	*Metabraxas atrogrisea*, *Cusiala boarmoides*, *Coremecis nigrovittata*, some *Hypomecis* spp., *Cleora* spp., *Chorodna* spp.

DISCUSSION

The pattern of spatial and altitudinal distribution of the Geometrid communities in Thailand expressed in term of localities could be explained with distance, altitudinal and vegetation factors. In this case, the role of distance factor on spatial distribution was found but the relationship not so strong (Mantel test; $r = 0.188$, $P < 0.0000$). This influence caused the geometrid communities of closely site were more similarity than the faraway sites. This phenomenon was show in some sites such as between H and I, D and G, L and N. The influence of distance factor on the altitudinal distribution was not examined, since our data were collected from the difference locations and the altitudinal criteria was roughly defined. The relationship was discovered such as the study of Brehm *et al* (2003), that they found the significant correlation between altitude distribution of geometrid communities on Andean montane forest and distance factor.

The study of altitudinal factor on living–things communities in tropical zone has been a popular topic for some time (Wolda, 1987; Holloway, 1987; Malicky and Chantaramongkol, 1993) until now (Brehm *et al*, 2003). These studies found the changing of insect communities along the altitude. Many terms of the living-things community attribute were created, such as species number, abundance, population densities, diversity indices, extracted ordination scores. These terms are usually plotted against the altitude in order to examine the correlation. In addition of the significant value of correlation, the direction (positive & negative) and the strength of the relationships (r or r^2) are usually expressed. It is accepted that the numbers of species of insects was gradually reduced, while the altitude was increased (Wolda, 1987). In this study, the geometrid communities was also changed along the altitude ($r = -0.6330$, $p = 0.015$), but it was found in opposite ways, at higher altitude had more species numbers than the lower. This event is interesting and cannot be explained by only the altitudinal factor. It is totally discussed again in the next topic, "Pattern of the altitudinal distribution of Geometrid communities in Thailand".

The vegetation factor was also influence to geometrid community, because they are the closely coevoluted organisms in the term of host and pest relationship. Brehm *et al* (2003) was reveled this relationship in term of significant correlation (Mantel test) between geometrid communities and tree diversity and vegetation structure (leaf only and all structure). In this study, this relationship was examined using cluster analysis between geometrid communities and their preference vegetation zone (Fig 7 and Table 3). We were roughly found the difference of geometrid communities between each vegetation type.

In contrast, the influences from latitudinal and longitudinal factors on geometrid communities in Thailand weren't found. There were not significant difference of geometrid communities from south to north and east to west. It is might be because of there were some species that was found widespread in Thailand such as, *Cleora alienaria*, *Hypomecis separata*, *Ruttellerona pallicostaria*. These factors were better suitable to explain the distribution of living-thing communities in the larger scale such as, the distribution in Australia continent.

These factors influencing on the distribution of Geometrid communities in Thailand is explained in the flowchart (Fig 8). The chart can be applied for study in the other organisms and also applied to the other biotic and abiotic factors e.g. temperature, pH, humidity, rainfall. We propose the important one an anthropogenic factor. If the community studies are presented their fluctuation along the time (temporal factor), the result will be more interesting.

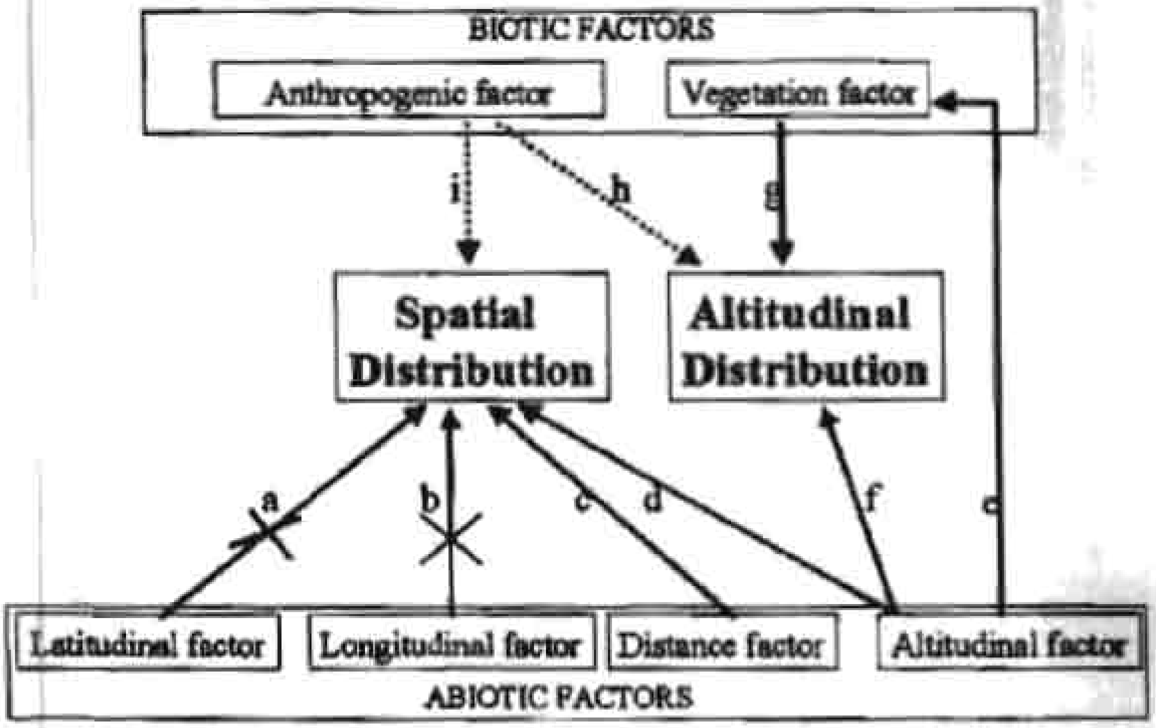


Fig 8. Flowchart shows the influence of some ecological factors on spatial and altitudinal distribution of Geometrid communities in Thailand. The altitudinal, distance and vegetation factors were revealed their influence on geometrid distribution, while the latitudinal and longitudinal influences were not found. The anthropogenic factor is the proposal factor.

Pattern of spatial distribution of geometrid communities in Thailand

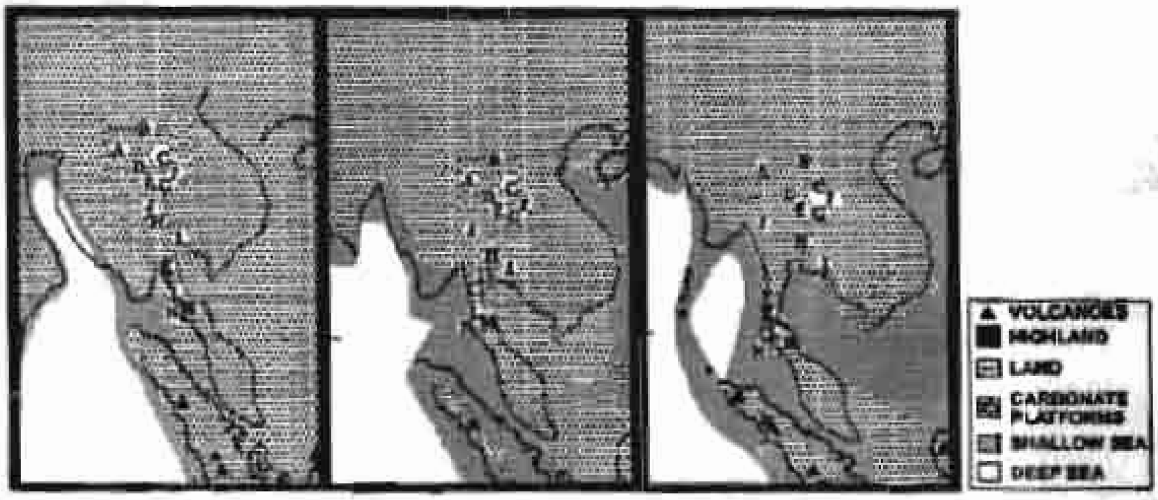
The distance and altitudinal factor were found, influencing on the spatial distribution of geometrid communities. Both factors was significantly explained the pattern of geometrid communities distribution in ordination and cluster. These pattern, with the consideration on geographical feature in Thailand, 3 groups of geometrid communities were generated.

The first group is refer to highland areas. This locality is cover mostly of northern Thailand and some part of western Thailand (upper of Kanchanaburi). These localities locate on the southernmost, Thanon Thong Chai mountain range. On this range composed with many of higher than 1,500m mountains such as, Pha Hom Pok 2,288m (Chiang Mai), Chiang Dow peak 2,225m (Chiang Mai), Suthep-Pui 1,685m (Chiang Mai), Inthanon 2,565m (the highest in Thailand, Chiang Mai) and Mon Jong 1,929m (Chiang

Mai), from upper to lower of northern Thailand. There are still more of higher peaks like this, but the remaining mountains not as famous as the addressed names. This peak continue from Himalayan range and quite high, then they have a capacity to serve the Himalayan geometrid species such as *Chorodna similis, Ultura combustaria, Ultura dierli, Dalima truncataria, Arichanna penicullifera, Arichanna flavimedia* (Stüning, 2000). This study point is usually addressed in many researches on organisms of northern Thailand. The studies on the relationships between species on these peaks along the Thanon Thong Chai range or the continuity from Himalayan are still the hot topic in the present.

The second type of locality proposed as the areas that mostly locate between 800-1,500m and mostly locate on the eastern most corridor. These corridor; Luang Pra Bang, Phetchabun, Dong Praya Yen and Sun Kura Pank mountain range (Fig 1), start from the east of northern Thailand and terminate at the top of east Thailand. This range differs from the Thanon Thong Chai range in term of geological structures (Baum *et al*, 1981). This range locate in these Changwat e.g. Nan, Uttaradit, Phitsanulok, Phetchabun, Loei, Chaiyapum, Nakhon Ratchasima, Nakhon Nayok, Sa Kaew, Prachin Buri. The localities, Phu Kha (Nan), Phu Luang (Loei), Phu Rua (Loei), Khao Yai (Nakhon Nayok), are the geometrid localities in these ranges. Moreover, the geometrid communities were similar with the communities from the other mountains e.g. Khao Soi Dow (Chanthaburi), Erawan Nation Park (Kanchanaburi), KhongNaka (Ranong), Khao Luang (Nakhon Sri Thammarat). The relationships of these geometrid communities could be explained by the history time when the Southeast Asia was a land and southern plate of Thailand was approached the central of Thailand at the time before 30 Ma (million year ago). After that time, the southern plate was gradually shifted southwest and forming into the current form. This explanation was developed by Hall (1998) and shows as Fig 9. This model could be explained the closely relative between the central and southern species. However, in the present, many localities in this group are deflagmented. Khao Yai was isolated from the corridor and the closest Khao Soi Dow was also isolated by the development in eastern Thailand. Then in this group resemble contains 3 minor groups. Firstly, the upperpart; Phu Kha, Phu Luang, Phu Rua are under the influence of Luang Pra Bang and Phetchabun corridor. Secondly, the remnant in eastern of Thailand; Khao Yai, Khao Soi Dow, are still have a previous influence from distance factor. Finally, the Thailand and Burma boundary corridor (Ta Nao Sri mountain range); Erawan, Klong Naka, Khao Luang, the forest patch between Thailand and Burma is play a role as the corridor among them. However, these localities still contain the resemblance of geometrid communities. Some of exclusive geometrid species in this group are already showed in the result. The long-term monitoring should be done, especially in the vulnerable localities.

The third group is the localities, locating in lowland or the lower than 800m forest patches. These areas support some lowland geometrid species e.g. *Abraxas illuminata, Hyposmecis transcissa, Hyposmecis separata, Xandrames latiferaria*. Some of them can be found in the second group, but never been found in the first group. The main localities are Phuhin Rongkla and Thung Salaeng Luang (Phitsanulok), Nam Nao National Park (Phetchabun), they are the remnant forest patches in upper part of central Thailand. NamProam Dam (Khon Kaen) and Chulabhone Dam (Chaiyaphum) are also the lowland forests, which are influenced under the water supply from dams. Khao Sok (Surat Thani) and Nam Tok Ton Sai (Phuket) are also the forest patches in southern Thailand. It is interesting that Phuket island shares some species of the mainland, but it still contains endemic one, *Cleora contiguata brooski*.



30 Ma **Mid Oligocene** — **15 Ma** **Middle Miocene** — **5 Ma** **Early Pliocene**

Fig 9. Model shows the simulation of the Geometrid locality positions on the plate tectonic movement of Southeast Asia since 30 Ma (Million years ago) until 5 Ma. The plate tectonic movement simulation model was created by Hall, 1998.

Pattern of the altitudinal distribution of geometrid communities in Thailand

This paper presents a distribution of geometrid communities based on the vegetation zonation of Thailand. This first group contains 53.9% of geometrid species, which prefer the evergreen forest (> 1,200m). From the original vegetation classification of Thailand in 1988 by Santisuk, the vegetation of Thailand was roughly divided to 2 groups, the lowland zone (150-1,500m) and the montane zone (> 1,000m). The montane can be sub-divided to lower and upper montane zone at 1,800m as a boundary. The significant of the 1,800m is a lower limit of cloud level (Sri-Ngernyuang *et al*, 2003). Then the geometird communities in this group could be sub-divided to 2 groups and this is required any prove from the future works. The second geometrid community (24.4%) preferred lowland forest (<800m), In Thailand, the lowland forest is mostly composed with the deciduous flora species. The final group is presented as the multi-habitat preference group. This group contains 21.7% of geometrid species that can be found in lowland, mixed deciduous and evergreen forest.

The multi-altitudinal preference species are very interesting group. Some of them are; *Biston bengaliaria*, *Biston luculentus*, *Chorodna creataria*, *Chorodna metaphaearia*, *Cleora alienaria*, *Cleora concentraria*, *Hypomecis cineracea*, *Hypomecis infixaria*, *Ourapteryx karsholti*, *Ourapteryx picticaudata*. This phenomenon was not restricted only the Geometridae. It was also reveled in the Trichoptera that was presented 171 species in Doi Inthanon. There were around 25.7% that were found between 400 to 2,300m, from lower to the upper reach such as, *Himalopsyche acharai*, *Rhyacophila petersorum*, *Trichomacronema paniae*, *Dinarthrum brueckmanni* (Malicky and Chantaramongkol, 1993).

Around a quarter of both insect orders can be stayed from foothill to the summit. This can explain by the effect of riparian zone. This zone capable to support the character of evergreen forest although it is located in the lowland deciduous forest. In this zone, the entire year humid is constantly more than 70%, and the influence of humid can control the fluctuation temperature between 15-30 °C. This factor, contributing on the high diversity in riparian zone and play a role as a gateway for both drift up and down along the altitude of organisms dispersal.

The phenomenon of inverse diversity and distribution in tropical zone, higher diversity on the higher altitude than lower, was discussed in these classical researches. Wolda (1987) explained this event was influenced from the effect of human in the lower altitudinal area. While, Holloway (1987) suggested that at the lowland forests in Southeast Asia contain deciduous species, whereas the upper elevation is an evergreen forest type. We suggest an idea about the microhabitat significant, riparian zone, as the possible factor influencing on the altitudinal distribution of fauna especially for insects.

Further studies of Geometridae in Thailand

On the evidence presented here, Thailand appears to support about 5% of Oriental geometrid moths (233 from 4,150 species (Scoble, 1999)). However this is certainly a serious underestimation of the fauna and we would expect that 800 or more species to occur in the country. Since this area has a capacity to support the species of Palaearctic origin by Himalayan corridor, Australasian pass though the Peninsular Malaysia and Oriental itself. While, the endemic species such as; *Alcis chiangmaiensis chiangmaiensis, Cleora contiguata brooski, Herochroma flavibasalis thaiensis, Perectropis siamensis, Pseudobiston pinratanai, Shangrilana paradisea*, were significantly found. The studies on the endemism or the biogeographical distribution of geometrid moths are the challenge researches in the future.

Base on these localitys, the Geometridae studies in Thailand can be further develop to 3 schemes. Firstly, the concentrated study on the altitudinal distribution. The majority of geometrid moths were captured at middle and high altitudes. However, the study should be also concentrated on the lower altitude. In case of the Author's monitoring, at the 600m *Biston, Chorodna, Hypomecis* and *Metabraxas* and many interesting geometrid moths can be found. The concentration study along the altitude might be revealed the new factors apart of the anthropogenic, vegetation and microhabitat factor.

Secondly, the study should be move to the place that never been or lack of exploration for example; at Chiang Dow and Ang Kang, the upper of Chiang Mai and also Huai-kha-khang and Thung-yai-nareasuan Wildlife Reserve. These new sites together with Doi Suthep-Pui and Doi Inthanon, all are in the same westernmost mountain range namely Thanon Thongchai range. This range plays a role as the Himalayan corridors. This way of study will be develop the knowledge on biodiversity, the ecology and biogeography in Thailand.

The finally, the study for conservation is recommended. This paper shows some localities that were isolated. Khao Yai and Khao Soi Dow are the remnant of forest patches near Thailand capital, Bangkok. Long term monitoring is recommended to put an action in order to assess the impact of deflagmentation and disturbances. These recommendations and analysis methods in this paper can be also applied in the other organisms.

The alert on biodiversity concern and biology knowledge in Thailand activates many researches, international corporations and funding agencies. In Thailand, the Biodiversity Research and Training Program; BRT was born in 1996. This program was supported from Thailand government for 12 Million US$ in 5 year shared into 120 researches which focused on field survey and taxonomic knowledge (Normile, 1998). Partially of grantees from Royal Golden Jubilee Program are also cooperate in the developing of bioscience and biodiversity knowledge. It is expected before year 2010, the biodiversity knowledge and closely related sciences; bioassessment, applied ecology, biogeography, molecular biology, in Thailand will be more presented in international publications.

REFERENCES

Baum, F., Braun, E.V., Hess, A., and Koch, K.E., 1981. Geologic map of Northern Thailand: Fed. Institute for Geosciences and Natural Resources, Federal Republic of Germany, Scale 1:250,000.

Brehm, G. Homeier, J. and Fielder, K. 2003. Beta diversity of geometrid moths (Lepidoptera: Geometridae) in an Andean montane rainforest. *Diversity and Distribution* 9, 351-366.

Chey, V.K., Holloway J.D.& Speight M.R. (1997) Diversity of moths in forest plantations and natural forests in Sabah. *Bulletin of Entomological Research* 87, 371–385.

Hall, R. 1998. The plate tectonics of Cenozoic SE Asia and the distribution of land and sea. *Biogeography and Geological Evolution of SE Asia.* (Hall, R. and Holloway, D. Eds). Backhuys Publishers, Leiden. 99-131.

Hashimito, S. 1995. New and unrecorded species of the tribe Trichopterygini (Lepidoptera, Geometridae) from Thailand. *Trans. lepid. Soc. Japan*, 46(3): 129-136.

Holloway, J.D. 1984. The larger moths of the Gunung MuluNational Park; a preliminary assessment of their distribution, ecology and potential as environmental indicators.in Jermy, A.C. & Kavanagh, K.P. (Eds) Gunung MuluNational Park, Sarawak, Part II. Sarawak Museum Journal 30, 149–190, Special Issue 2.

Holloway, J.D. 1985b. Moths as indicator organisms for categorizing rain forest and monitoring changes and regeneration processes. pp. 235–242 in Chadwick, A.C. & Sutton, S.L. (Eds) Tropical rain forest: the Leeds Symposium, Special Publication, Leeds Philosophical and Literary Society.

Holloway, J.D. 1986. Origins of the lepidopteran faunas in high mountains of the Indo-Australian region. In F. Vuilleumier and M. Monasterio (eds), High Altitude Tropical Biogeography pp. 533-556. Oxford University Press, New York.

Holloway, J.D. 1987. Macrolepidoptera diversity in the Indo-Australian tropics: geographic, biotopic and taxonomic variations. *Biological Journal of the Linnean Society* 30: 325-341.

Holloway, J. D. 1993. Moths of Borneo (Part 11), Ennominae. Southdene Sdn. Bhd., Kuala Lumpur.

Holloway, J. D. 1996. Moths of Borneo (Part 9), Oenochrominae, Desmobathrinae, Geometrinae and Orthostixinae. *Malayan Nature Journal* 49: 147-326.

Holloway, J. D. 1997. Moths of Borneo (Part 10), Sterrhinae and Larentiinae. *Malayan Nature Journal* 51: 1-242.

Holloway, J.D. 2003.An addiction to Southeast Asian biogeography. *Journal of Biogeography* 30: 2, 161-163.

Holloway, J.D. & Barlow, H.S. (1992) Potential for loss of biodiversity in Malaysia, illustrated by the moth fauna.pp. 293–311 in Aziz, A., Kadir, S.A. & Barlow, H.S. (Eds) Pest management and the environment in 2000. CAB International & Agricultural Institute of Malaysia.

Holloway, J.D. & Stork, N.E. (1991) The dimensions of biodiversity: the use of invertebrates as indicators of man's impact. pp. 37-62 in Hawksworth, D.L. (Ed.) The biodiversityof microorganisms and invertebrates: its role in sustainable agriculture. CAB International, Wallingford.

Holloway, J.D., Kirk-Spriggs, A.H. & Chey, V.K. (1992) The response of some rain forest insect groups to logging and conversion to plantation. Philosophical Transactions of the Royal Society of London B 335, 425–436.

Hutacharern, C. and Tubtim, N. 1995, Checklist of Forest Insects in Thailand. Integrated Promotion Technology Co., Ltd. Bangkok.

Inoue, H. 1984. The Genus *Abraxas* of Taiwan (Lepidoptera : Geometridae). *Bull. Fac. Domest. Sci. Otsuma Wom. Univ.* 20: 93-128.

Inoue, H. 1985. The genera *Ourapteryx* and *Tristrophis* of Taiwan. *Bull. Fac. Domest. Sci. Otsuma Wom. Univ.* 21: 75-124.

Inoue, H. 1986. Further new and unrecorded species of the Geometridae from Taiwan with some synonymic notes (Lepidoptera). *Bull. Otsuma Wom. Univ., Home Econ*, 22:211-267.

Inoue, H. 1987. Geometridae of Eastern Nepal based on the collection of the Lepidopterological research expedition to Nepal Himalaya by the Lepidopterological Society of Japan in 1963, Part III. *Bull. Otsuma Wom. Univ., Home Econ*, 23:215-270.

Inoue, H. 1990. A revision of the genus *Dindica* Moore (Lepidoptera: Geometridae). *Bull. Otsuma Wom. Univ., Home Econ*, 26:121-161.

Inoue, H. 1992. Twenty-four new species, one new subspecies and two new genera of the Geometridae (Lepidoptera) from East Asia. *Bull. Otsuma Wom. Univ., Home Econ*, 28:149-188.

Inoue, H. 1993a. On *niveo*-group of *Ourapteryx* Leach and on the systematic status of *O. yerburii* Butler from Pakistan, with description of a new species from Korea (Geometridae, Ennominae). *Tyo to Ga*, 44(3): 107-116.

Inoue, H. 1993b. The genus *Ourapteryx* leach (Geometridae, Ennominae) from Thailand, with description of six new species. *Tinea* 13 (Part 26): 261-271.

Inoue, H. 1994a. The genus *Abraxas* Leach (Geometridae, Ennominae) from Thailand. *Tinea* 14(1): 20-26.

Inoue, H. 1994b. The Geometridae of the Ogasawara islands (Lepidoptera) (Moths of Ogasawara (Bonin) Islands, Part II). *Bull. Otsuma Wom. Univ., Home Econ*, 30:195-223.

Inoue, H. 1994c. Two new genera and two new species of the Geometridea from Thailand. *Tinea* 14(1): 5-9.

Inoue, H. 1999. Revision of the genus *Herochroma* Swinhoe (Geometridae, Geometrinae). *Tinea* 16: 76-105.

Kitching, I. J. (2000). Geometrid Moths of the world: A catalogue. Edited by M. J. Scoble. CSIRO Publishing, Collingwood, Victoria. 1999. Pp. 1200 in 2 volumes plus CD-ROM. $US295.00 (hardcover), ISBN 0643 06034 8. *Systematic Entomology* 25 (2), 273-282.

Malicky, H. and Chantaramongkol, P. 1993. The altitudinal distribution of Trichoptera species in Mae Klang catchment on Doi Inthanon, northern Thailand: stream zonation and cool- and warm-adapted groups. *Rev. Hydrobiol. Trop.* 26 (4): 279-291.

Myers, N., R A Mittermeier, Mittermeier, C. G., da Fonseca, G A B, Kents, J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403: 853-858.

Normile, D. 1998. Securing a niche for basic biology. *Science* 279, 1482.

Parnell, J.A.N., Simpson, D.A., Moat, J., Kirkup, D.W., Chantaranothai, P., Boyce, P.C., Bygrave, P. Dransfield, S. Jebb, M.H.P., Macklin, J. Meade, C., Middleton, D.J., Muasya, A.M., Prajaksood, A., Pendry, C.A., Pooma, R., Suddee, S. and Wilkin, P. 2003. Plant collection spread and densities: their potential impact on biogeography studies in Thailand. *Journal of Biogeography* 30, 193-209.

Pinratana, A. and Lampe, R.E.J. 1990. Moths of Thailand Vol. 1. Saturniidae, Bosco Offset. Bangkok.

Pitkin, L.M. 2002. Neotropical ennomine moths: a review of the genera (Lepidoptera: Geometridae). *Zoological Journal of the Linnean Society*, 135:121-401.

Sato, R. 1984. Taxonomic study of the genus *Hypomecis* Hübner and its allies genera from Japan. BSSA Entomological Society, Kurokawa, Niigata.

Sato, R. 1987a. Records of the genus *Cleora* (Lepidoptera : Geometridae) from the Philippines, with descriptions of two new species. *Tinea* 12: 157-170.

Sato, R. 1987b. Taxonomic notes on *Menophra delineata* (Walker)(Geometridae : Ennominae) and its allies from Indo-Malayan region. *Tinea* 12(Suppl.): 249-258.

Sato, R. 1989a. Records of the genus *Cleora* (Lepidoptera: Geometridae) from the Philippines, with descriptions of two new species. *Tinea* 12 (Part 17): 157-170.

Sato, R. 1989b. Two Wehrli's taxa of *Arichanna* (Lepidoptera: Geometridae) raised to the species status. *Tinea* 12 (Part 18): 171-176.

Sato, R. 1990. Three new species and one new subspecies of *Hypomecis* Hübner (Geometridae) from Indonesia. *Tinea* 12 (Part 29): 256-264.

Sato, R. 1991. Records of the genera *Hypomecis*, *Cleora* and *Alcis* (Geometridae; Ennominae) from Thailand with description of three new species and one new subspecies. *Tyo to Ga* 42(4): 271-288.

Sato, R. 1992a. *Paracalicha*, a new genus of the Geometridae (Lepidoptera), with description of two new species from China and Thailand. *Jpn. J. Ent.*, 60(2): 369-375.

Sato, R. 1992b. The genus *Riklosatoa* (Lepidoptera, Geometridae) from Thailand, with taxonomic notes on two Chinese species. *Jpn. J. Ent.*, 60(3): 559-566.

Sato, R. 1993. Further taxonomic notes on *Amraica recursaria* (Walker) (Lepidoptera: Geometridae) and its allies, with description of two new species from Southeast Asia. *Tyo to Ga*, 44(2): 68-74.

Sato, R. 1995. Records of the Boarmiini (Geometridae; Ennominae) from Thailand II. *Trans. lepid. Soc. Japan*, 46(4): 209-227.

Sato, R. 1996a. Description of a new species closely related to *Hypomecis cineracea* (Moore)(Geometridae, Ennominae) from the Philippines. *Tinea* 14(4): 256-259.

Sato, R. 1996b. Records of the Boarmiini (Geometridae; Ennominae) from Thailand III. *Trans. lepid. Soc. Japan*, 47(4): 223-236.

Sato, R. 1996c. Six new species of the genus *Psilalcis* Warren (Geometridae, Ennominae) from Indo-Malayan region, with some taxonomic notes on the allied species. *Tinea* 15(1): 55-68.

Sato, R. 1997a. Additional records of the genus *Cleora* (Geometridae, Ennominae) from the Philippines, with descriptions of one new species and two new subspecies. *Trans. lepid. Soc. Japan*, 48(3): 125-132.

Sato, R. 1997b. Taxonomic notes on *Abaciscus costimacula* (Wileman) (Geometridae, Ennominae) and its allies, with descriptions of two new species from Taiwan and Vietnam. *Tinea* 15(2): 119-124.

Sato, R. 1999. Notes on some species of the Boarmiini (Geometridae: Ennominae) from Taiwan, with description of one new species. *Tinea* 16(1): 29-40.

Scoble, M. 1999. Geometrid moths of the world: a catalogue (Lepidoptera, Geometridae). CSIRO. Collingwood.

Shanli C; Tong W; Li Y. 1994. Studies on the bionomics and control of *Hyposidra aquilaria* Walker (Lepidoptera: Geometridae). *Forest Research* 7:101-105.

Sri-Ngernyuang, K., Kanzaki, M., Mizuno, T., Noguchi, H., Teejuntuk, S., Sungpalee, C., Hara, M., Yamakura, T., Sahunalu, P., Dhanmanonda, P. and Bunyavejchewin, S. 2003. Habitat differentiation of Lauraceae species in a tropical lower montane forest in northern Thailand. *Ecological Research* 18: 1-14.

Stüning, D. 2000. Additional notes on the Ennominae of Nepal, with descriptions of eight new species (Geometridae). In Haruta, T. (Ed.). Moths of Nepal, part 6. *Tinea* 16 (Suppl. 1): 94-152.

Wolda, H. 1987. Altitude, habitat and tropical insect diversity. *Biological Journal of the Linnean Society* 30: 313-323.

ACKNOWLEDGEMENTS

We gratefully thank Mrs Catherine Young for her kind help in sharing of Geometidae literatures and facilitating access to laboratory equipments in the School of Geography and Environmental Studies, University of Tasmania, Australia. We would also like to thank the Royal Golden Jubilee (RGJ) and the Basic Research Grant (BGJ) program from the Thailand Research Fund (TRF) Thailand for funding.

APPENDIX

List of 217 species (224 taxa) of Geometridae known to occur in Thailand. Locality refers to localities presented in Figure 2; Distribution records in the literature that simply refer to "Thailand" with no further resolution are annotated "Z". Reference refers to literature sources of the distribution data.

	Taxon	Locality	Reference
	Subfamily Ennominae (188)		
	Tribe Abraxini (6)		
	Abraxas Leach, [1815] 1830 (6)		
1	*Abraxas aritai* Inoue, 1994	A	Inoue, 1994a
2	*Abraxas atrolivens* Inoue, 1994	A	Inoue, 1994a
3	*Abraxas formosilluminata* Inoue, 1984	A	Inoue, 1994a
4	*Abraxas illuminata* Warren, 1894	F	Inoue, 1994a
5	*Abraxas metallica* Inoue, 1994	A	Inoue, 1994a
6	*Abraxas oblongostigma* Inoue, 1994	A	Inoue, 1994a
	Tribe Baptini (1)		
	Tasta Walker, [1863] 1862 (1)		
7	*Tasta micaceata* Walker, 1862	Southern Thailand	Holloway, 1993
	Tribe Boarmiini (142)		
	Abraciscus Butler, 1889 (2)		
8	*Abaciscus adjuncta* (Prout, 1928)	A	Sato, 1997b
9	*Abaciscus karsholti* Sato, 1996	A	Sato, 1996b
	Alcis Curtis, 1826 (16)		
10	*Alcis aagostigma* (Prout, 1927)	A	Sato, 1991
11	*Alcis albifera* (Moore, 1888)	A	Sato, 1991
12	*Alcis chiangmaiensis chiangmaiensis* Sato, 1991	A	Sato, 1991
13	*Alcis decussata* (Moore, 1868)	A	Sato, 1995
14	*Alcis hodeberti* Herbulot, 1987	A	Sato, 1995
15	*Alcis imbecilis* (Moore, 1888)	A	Sato, 1991
16	*Alcis macroclarata* Sato, 1993	A	Sato, 1995
17	*Alcis maculata* (Moore, 1867)	A	Holloway, 1993
18	*Alcis maculata prodictyota* (Wehrli, 1934)	A	Sato, 1991
19	*Alcis pammicra* (Prout, 1925)	A	Sato, 1996b
20	*Alcis paraclarata* Sato, 1993	A	Sato, 1995
21	*Alcis periphracta* (Prout, 1926)	A	Our monitoring
22	*Alcis semialba* (Moore, 1888)	A	Sato, 1991
23	*Alcis semiclarata* (Walker, 1862)	A	Sato, 1991
24	*Alcis variegata* (Moore, 1888)	A	Sato, 1991
	Amblychia Guenée, 1857 (3)		
25	*Amblychia angeronaria* Guenée, 1857	H, I	Sato, 1996b
26	*Amblychia hymenaria* (Guenée, 1857)	C, H	Sato, 1996b
27	*Amblychia praeumbrata* (Warren, 1893)	K	Sato, 1996b
	Amraica Moore, 1888 (2)		
28	*Amraica inouei* Sato, 1993	A, C, D, F, I	Sato, 1993
29	*Amraica recursaria*(Walker, 1860)	C, H, I, M	Sato, 1993
	Arichanna Moore, 1868 (6)		
30	*Arichanna flavimedia* (Hampson, 1895)	B	Stüning, 2000
31	*Arichanna furcifera* Moore, 1888	C	Sato, 1995
32	*Arichanna marginata* Warren, 1893	A	Sato, 1995

33	*Arichanna peniculifera* Stüning, 2000	B	Stüning, 2000
34	*Arichanna tramesata* Moore, 1868	A	Sato, 1995
35	*Arichanna transfasciata* Warren, 1893	A	Sato, 1995
	Ascotis Hübner, [1825] 1816 (2)		
36	*Ascotis selenaria imparata* (Walker, 1860)	A	Sato, 1996b
36a	*Ascotis selenaria selenaria* (Denis & Schiffermüller, 1775)	Z	Hutacharern and Tubtim, 1995
	Biston Leach, [1815] 1830 (10)		
37	*Biston bengaliaria* (Guenée, 1857)	A, H	Sato, 1996b
38	*Biston contectaria* Walker, [1863]	Z	Hutacharern and Tubtim, 1995
39	*Biston luculentus* Inoue, 1992	A, H, I, K	Sato, 1996b
40	*Biston panternaria abraxata* (Leech, 1889)	Z	Sato, 1996b
40a	*Biston panternaria exanthemata* (Moore, 1888)	G	Sato, 1996b
40b	*Biston panternaria lienpingensis* (Wehrli, 1939)	Z	Sato, 1996b
40c	*Biston panternaria sychnospilar* (Prout, 1930)	Z	Sato, 1996b
40d	*Biston panternaria szechuanensis* (Wehrli, 1939)	Z	Sato, 1996b
41	*Biston pustulata* (Warren, 1896)	A	Our monitoring
42	*Biston regalis* Moore, 1888	H	Sato, 1996b
	Blepharoctenucha Warren, 1895 (1)		
43	*Blepharoctenucha virescens* (Butler, 1880)	A	Sato, 1996b
	Calcyopa Stüning, 2000 (1)		
44	*Calcyopa presina* Stüning, 2000	A	Stüning, 2000
	Calichodes Warren, 1897 (1)		
45	*Calichodes ochrifasciatus* (Moore, 1888)	A	Sato, 1996b
	Catoria Moore, 1887 (2)		
46	*Catoria olivescens* Moore, 1888	A	Our monitoring
47	*Catoria sublavaria*(Guenée, 1857)	H, I	Sato, 1995
	Chorodna Walker, 1860 (9)		
48	*Chorodna complicataria* Walker, 1860	K, M	Sato, 1995
49	*Chorodna creatalia* (Guenée, 1857)	A, H	Sato, 1995
50	*Chorodna mauraria* (Guenée, 1857)	A	Sato, 1995
51	*Chorodna metaphaearia* (Walker, 1863)	A, H	Sato, 1995
52	*Chorodna pallidularia* Moore, 1868	Northern Thailand, H	Holloway, 1993
53	*Chorodna quadrinotata* (Warren, 1893)	A	Sato, 1995
54	*Chorodna similis* (Moore, 1888)	A	Our monitoring
55	*Chorodna strixaria* (Guenée, 1857)	C, H, I	Sato, 1995
56	*Chorodna testaceata* Moore, 1868	A	Sato, 1995
	Chrysoblephara Holloway, [1994] (1)		
57	*Chrysoblephara chrysoteucta* (Prout, 1926)	A	Sato, 1996b
	Cleora Curtis, 1825 (15)		
58	*Cleora alienaria* (Walker, 1860)	A, C, H, I, J, K	Sato, 1991
59	*Cleora biclavata* (Fletcher, 1953)	M	Sato, 1991
60	*Cleora concentraria* (Snellen, 1877)	A, H, I, J	Sato, 1991
61	*Cleora contiguata brooksi* (Fletcher, 1953)	N	Sato, 1991
61a	*Cleora contiguata contiguata* (Moore, 1868)	A, H, I, J	Sato, 1991
62	*Cleora cucullata fusconebulata* (Fletcher, 1953)	A, H	Sato, 1991
63	*Cleora decisaria* (Walker, 1866)	A, I	Sato, 1991
64	*Cleora determinata* (Walker, 1860)	L, M	Sato, 1991
65	*Cleora fraterna* (Moore, 1888)	A, G, I	Sato, 1991
66	*Cleora injectaria* (Walker , 1860)	I, M	Hutacharern and Tubtim, 1995

67	*Cleora inoffensa glaucata* (Fletcher, 1953)	H, M	Sato, 1991
68	*Cleora onycha onycha* (Fletcher, 1953)	H	Sato, 1991
69	*Cleora pupillata pupillara* (Walker, 1860)	H, I, N	Sato, 1991
70	*Cleora repulsaria* (Walker, 1860)	A	Sato, 1991
71	*Cleora venustaria thaiensis* Sato, 1991	A	Sato, 1991
	Coremecis Holloway, [1994] (3)		
72	*Coremecis maculata* (Warren, 1899)	H	Sato, 1995
73	*Coremecis nigrovittata* (Moore, 1868)	A, H, K	Sato, 1995
74	*Coremecis stueningi* Sato, 1995	Northern Thailand	Sato, 1995
	Cusiala Moore, [1887] 1884-7 (1)		
75	*Cusiala boarmoides* Moore, [1887]	A, C, H, I	Our monitoring
	Dalima Moore, 1868 (2)		
76	*Dalima patularia* (Walker, 1860)	Northern Thailand	Holloway, 1993
77	*Dalima truncataria* (Moore, 1868)	Z	Stüning, 2000
	Darisa Moore, 1888 (4)		
78	*Darisa lampasaria* (Hampson, 1895)	A	Sato, 1995
79	*Darisa maxima* Moore, 1888	A	Sato, 1995
80	*Darisa missionaria* (Wehrli, 1941)	A	Sato, 1995
81	*Darisa mucidaria* (Walker, 1866)	A	Sato, 1995
	Ectropis Hübner,[1825] (2)		
82	*Ectropis bhurmitra* Walker, 1860	Z	Hutacharern and Tubtim, 1995
83	*Ectropis longiscapia* Prout, 1926	A	Our monitoring
	Erebomorpha Walker, 1860 (1)		
84	*Erebomorpha fulgurita* Walker, 1860	A	Sato, 1996b
	Gasterocome Warren, 1894 (1)		
85	*Gasterocome pannosaria* (Moore, 1867)	A	Our monitoring
	Hypomecis Hübner, 1821 (13)		
86	*Hypomecis cineracea* (Moore, 1888)	A, H, I	Sato, 1991
87	*Hypomecis costaria* (Guenée, 1857)	E, H, L	Holloway, 1993
88	*Hypomecis infixaria* (Walker, 1860)	A, C, J	Sato, 1991
89	*Hypomecis ioptilaria* (Swinhoe, 1903)	A, E, G, H, I	Sato, 1991;Holloway, 1993
90	*Hypomecis moriutii* Sato, 1991	A, E	Sato, 1991
91	*Hypomecis nepalensis* (Hampson, 1902)	A	Sato, 1991
92	*Hypomecis oblivia* (Prout, 1925)	A	Sato, 1995
93	*Hypomecis procursaria* (Walker, 1860)	J	Sato, 1991
94	*Hypomecis separata* (Walker, 1860)	D, G, H, I, N	Sato, 1991
95	*Hypomecis stueningi* Sato, 1991	A	Sato, 1991
96	*Hypomecis subdetractaria subdetractaria* (Prout, 1923)	K	Holloway, 1993
97	*Hypomecis tetragonata* (Walker, 1862)	A	Our monitoring
98	*Hypomecis transcissa* (Walker, 1860)	D, G, H	Sato, 1991
	Hyposidra Guenée, [1857] (3)		
99	*Hyposidra aquilaria* (Walker, 1862)	A	Our monitoring
100	*Hyposidra talaca* Walker, 1860	A	Hutacharern and Tubtim, 1995
101	*Hyposidra violescens* Hampson, 1895	Z	Holloway, 1993
	Jankowskia Oberthür, 1884 (1)		
102	*Jankowskia fuscaria fuscaria* (Leech, 1891)	A	Sato, 1996b
	Krananda Moore, 1868 (2)		
103	*Krananda lucidaria* Leech, 1897	Northern Thailand	Holloway, 1993

104	*Krananda oliveomarginata* Swinhoe, 1894	Z	Holloway, 1993
	Lassaba Moore, 1888 (2)		
105	*Lassaba acribomena* (Prout, 1928)	M	Sato, 1995
106	*Lassaba albidaria albidaria* (Walker, 1866)	A	Sato, 1995
	Menophra Moore, [1887] 1884 (4)		
107	*Menophra lignata* (Warren, 1894)	A	Sato, 1995
108	*Menophra subpilosa* (Warren, 1894)	A	Sato, 1995
109	*Menophra subterminalis* (Prout, 1925)	C, H	Sato, 1995
110	*Menophra torridaria* (Moore, 1888)	Northern Thailand	Sato, 1995
	Microcalicha Sato, 1981 (1)		
111	*Microcalicha delika* (Swinhoe, 1902)	Southern Thailand	Holloway, 1993
	Milionia Walker, 1854 (1)		
112	*Milionia basalis pyeri* Druce, 1888	Z	Hutacharern and Tubtim, 1995
	Myrioblephara Warren, 1893 (5)		
113	*Myrioblephara conifera* (Moore, 1888)	A	Sato, 1996b
114	*Myrioblephara embolochroma* (Prout, 1927)	A	Sato, 1996b
115	*Myrioblephara idaeoides* (Moore, 1888)	A	Sato, 1996b
116	*Myrioblephara irrorata* (Moore, 1888)	A	Sato, 1996b
117	*Myrioblephara simplaria* (Swinhoe, 1894)	A, C	Sato, 1996b
	Necyopa Walker, 1861 (2)		
118	*Necyopa flatipennata* Walker, 1862	Southern Thailand	Holloway, 1993; Sato, 1996b
119	*Necyopa ioge* Prout, 1932	A	Sato, 1996b
	Ophthalmitis Fletcher, 1979 (3)		
120	*Ophthalmitis clararia* Walker, 1866	M	Sato, 1996b
121	*Ophthalmitis herbidaria* (Guenée, 1857)	A	Sato, 1996b
122	*Ophthalmitis pertusaria* (Felder&Rogenhofer, 1875)	A, C, E	Sato, 1995
	Prochasma Warren, 1897 (2)		
123	*Prochasma albimonilis* Prout, 1927	A	Sato, 1996b
124	*Prochasma dentilinea* (Warren, 1893)	A	Sato, 1996b
	Pseudalcis Warren, 1897 (1)		
125	*Pseudalcis trispinaria* (Walker,1860)	A	Sato, 1995
	Psilalcis Warren, 1893 (5)		
126	*Psilalcis bisinuata* (Hampson, 1895)	A, H	Sato, 1996b
127	*Psilalcis dignampta* (Prout, 1927),	C	Sato, 1996b
128	*Psilalcis intermidia* Warren, 1899	A, J	Sato, 1996b
129	*Psilalcis paraceptaria* Sato, 1996	A, M	Sato, 1996b
130	*Psilalcis postochrea* Sato, 1996	A, B, H	Sato, 1996b
	Rikiosatoa Inoue, 1982 (2)		
131	*Rikiosatoa euphiles* (Prout, 1916)	A	Sato, 1992b
132	*Rikiosatoa fucatariodes* Sato, 1992	E	Sato, 1992b
	Ruttellerona Swinhoe, 1894 (1)		
133	*Ruttellerona pallicostaria* (Moore, 1868)	A, H, I, J, M	Sato, 1996b
	Uliura Warren, 1904 (4)		
134	*Uliura combustaria* (Walker, 1866)	A	Sato, 1995; Stüning, 2000
135	*Uliura dierli* Stüning, 2000	A	Stüning, 2000
136	*Uliura gratiosa* Sato, 1995	Z	Sato, 1995; Stüning, 2000
137	*Uliura kurokoi* Sato, 1995	A	Sato, 1995
	Xandrames Moore, 1868 (3)		
138	*Xandrames albofasciata* Moore, 1868	A	Sato, 1996b

139	*Xandrames latiferaria* (Walker, 1860)	G, H	Sato, 1996b
140	*Xandrames xanthos* Sato, 1996	A	Sato, 1996b
	Xerodes Guenée, [1857] (1)		
141	*Xerodes ypsaria* Guenée, 1857	A	Sato, 1996b
	Zanclomenophra Holloway, [1994] (1)		
142	*Zanclomenophra robusta* (Warren, 1901)	M	Sato, 1995
	Tribe Eutoeini (2)		
	Luxiaria Walker, 1860 (2)		
143	*Luxiaria emphatica* Prout, 1925	A	Our monitoring
144	*Luxaria mitorrhaphes* Prout, 1925	A	Our monitoring
	Tribe Hypochrosini (9)		
	Fascellina Walker, 1860 (4)		
145	*Fascellina albicordis* Prout, 1932	A	Our monitoring
146	*Fascellina aurifera* Warren, 1897	Z	Holloway, 1993
147	*Fascellina inornata* Warren, 1893	Northern Thailand	Stüning, 2000
147a	*Fascellina inornata pinratanai* Inoue, 1992	A	Inoue, 1992
	Genusa Walker, 1855 (1)		
148	*Genusa bigutta* Walker, 1855	Z	Holloway, 1993
	Hypochrosis Guenée, 1857 (4)		
149	*Hypochrosis amauraspila* Yazaki, 1995	Northern Thailand	Stüning, 2000
150	*Hypochrosis abstractaria* Walker, 1862	Z	Holloway, 1993
151	*Hypochrosis binexata* (Walker, 1863)	Z	Holloway, 1993
152	*Hypochrosis hyadaria* Guenee, 1857	A	Our monitoring
	Tribe Lithinini (1)		
	Nadagara Walker, 1861 (1)		
153	*Nadagara intractata* Walker, 1862	Z	Holloway 1993
	Tribe Macarini (6)		
	Chiasmia Hübner, [1823] 1816 (6)		
154	*Chiasmia emersaria* (Walker, 1861)	Z	Holloway 1993
155	*Chiasmia lannaensis* (Bänzinger & Fletcher, 1988)	A	Scoble, 1999
156	*Chiasmia nora* (Walker, 1861)	Z	Holloway 1993
157	*Chiasmia suthepensis* (Bänzinger & Fletcher, 1988)	A	Scoble, 1999
158	*Chiasmia translineata* (Walker, 1866)	A	Holloway 1993
159	*Chiasmia triangulata* (Hampson, 1891)	Northern Thailand	Scoble, 1999
	Tribe Ourapterygini (12)		
	Ourapteryx Leach, 1814 (12)		
160	*Ourapteryx astrigera* Inoue, 1993	A	Inoue, 1993b
161	*Ourapteryx clara clara* Butler, 1880	A, H	Inoue, 1993b
162	*Ourapteryx consociata* Inoue, 1993	A	Inoue, 1993b
163	*Ourapteryx contronivea* Inoue, 1993	A	Inoue, 1993b
164	*Ourapteryx diminuta* Inoue, 1993	A	Inoue, 1993b
165	*Ourapteryx fulvinervis* Warren, 1894	D	Inoue, 1993b
166	*Ourapteryx karsholti* Inoue, 1993	C	Inoue, 1993b
167	*Ourapteryx margaritata* Moore, 1868	A, B	Inoue, 1993b
168	*Ourapteryx nivea* Butler, 1883	Z	Hutacharern and Tubtim, 1995
169	*Ourapteryx picticaudata* Walker, 1860	B, H	Inoue, 1993b
170	*Ourapteryx sciticaudaria* Walker, 1863	A	Inoue, 1993b

171	*Ourapteryx stueningi* Inoue, 1993	A	Inoue, 1993b
	Tribe Plutodini (1)		
	Plutodes Guenée, 1857 (1)		
172	*Plutodes flavescens* Butler, 1880	A	Our monitoring
	Ennominae unallocated to tribe (8)		
	Metabraxas Butler, 1881 (1)		
173	*Metabraxas atrogrisea* Inoue, 1992	A	Inoue, 1992
	Parapercnia Wehrli, 1939 (1)		
174	*Parapercnia chionopepla* Inoue, 1992	A	Inoue, 1992
	Paracalicha Sato, 1992 (1)		
175	*Paracalicha prasinaria* Sato, 1992	A	Sato, 1992
	Parectropis Sato, 1980 (1)		
176	*Parectropis siamensis* Sato, 1996	A	Sato, 1996b
	Pseudomiza Butler, 1889 (1)		
177	*Pseudomiza uniformis* Inoue, 1992	A	Sato, 1992
	Shangrilana Inoue, 1994 (1)		
178	*Shangrilana paradisea* Inoue, 1994	A	Inoue, 1994c
	Sinameda Warren, 1894 (1)		
179	*Sinameda basistrigaria*(Moore, 1868)	A	Sato, 1995
	Telletrurona Sato, 1996 (1)		
180	*Telletrurona amnicosta* Sato, 1996	A	Sato, 1996b
	Subfamily Geometrinae (22)		
	Tribe Dysphaniini (1)		
	Dysphania Hübner, [1819] 1816 (1)		
181	*Dysphania sagana*(Druce, 1882)	Z	Holloway, 1996
	Tribe Geometrini (19)		
	Aporandria Warren, 1894 (1)		
182	*Aporandria specularia* (Guenée, 1857)	Z	Hutacharern and Tumtim, 1995; Holloway, 1996
	Dindica Moore, 1888 (3)		
183	*Dindica olivacea* Inoue, 1990	H	Inoue, 1990
184	*Dindica para para* (Swinhoe, 1891)	A	Inoue, 1990
185	*Dindica polyphaenaria* (Guenée, 1857)	H	Inoue, 1990
	Eretmopus Turner, 1910 (1)		
186	*Eretmopus marinaria* (Guenée, 1857)	Z	Holloway, 1996
	Hemithea Duponchel, 1829 (1)		
187	*Hemithea evanescens* Inoue, 1992	A	Inoue, 1992
	Herochroma Swinhoe, 1893 (5)		
188	*Herochroma cristata* (Warren, 1894)	Z	Inoue, 1999
189	*Herochroma hemiticheres* Prout, 1935	Z	Inoue, 1999
190	*Herochroma thaiensis* Inoue, 1992	A	Inoue, 1999
191	*Herochroma viridaria peperata* (Herbulot, 1989)	Z	Inoue, 1999
192	*Herochroma yazakii* Inoue (Inoue, 1999)	Z	Inoue, 1999
	Ornithospila Warren, 1894 (1)		
193	*Ornithospila lineata* (Moore, 1872)	Z	Hutacharern and Tumtim, 1995
	Pelagodes Holloway, 1996 (1)		
194	*Pelagodes antiquadraria* Inoue, 1976	Z	Inoue, 1994b

	Pingasa Moore, [1887] 1884-7 (2)		
195	*Pingasa chlora* Stoll, 1782	Z	Hutacharern and Tubtim, 1995
196	*Pingasa ruginaria* (Guenée, 1857)	Z	Hutacharern and Tubtim, 1995
	Tanaorhinus Butler, 1879 (3)		
197	*Tanaorhinus kina flavinfra* Inoue, 1978	A	Inoue, 1986
198	*Tanaorhinus rafflesii* (Moore, 1860)	Z	Hutacharern and Tubtim, 1995
199	*Tanaorhinus viridiluteata* (Walker, 1861)	Z	Hutacharern and Tubtim, 1995
	Timandromorpha Inoue, 1944 (1)		
200	*Timandromorpha energes* Prout, 1933	Z	Hutacharern and Tubtim, 1995; Holloway, 1996
	Geometrinae unallocated to tribe (2)		
	Neohipparchus Inoue, 1944 (1)		
201	*Neohipparchus vallata* Butler, 1878	Z	Hutacharern and Tubtim, 1995
	Pseudobiston Inoue, 1994 (1)		
202	*Pseudobiston pinratanai* Inoue, 1994	A	Inoue, 1996c
	Subfamily Larentiinae (15)		
	Tribe Cidariini (1)		
	Ecliptopera Warren, 1894 (1)		
203	*Ecliptopera rectilinea* Warren, 1894	A	Our monitoring
	Tribe Trichopterygini (6)		
	Hypocometa Warren, 1896 (1)		
204	*Hypocometa clauda* Warren, 1896	A	Hashimoto, 1995
	Sauris Guenée, [1857] (1)		
205	*Sauris fuscomarginata* Hashimoto, 1995	A	Hashimoto, 1995
	Trichopterigia Hampson, 1895 (4)		
206	*Trichopterigia atrofasciata* Hashimoto, 1995	A	Hashimoto, 1995
207	*Trichopterigia minuta* Inoue, 1992	A	Inoue, 1992
208	*Trichopterigia sanguinipunctata* (Warren, 1893)	A	Hashimoto, 1995
209	*Trichopterigia viridilineata* Hashimoto, 1995	A	Hashimoto, 1995
	Subfamily Oenochrominae (6)		
	Abraxaphantes Warren, 1894 (1)		
210	*Abraxaphantes perampla* Swinhoe, 1890	Z	Hutacharern and Tubtim, 1995
	Sarcinodes Guenée, [1857] (5)		
211	*Sarcinodes sumatraria* (Walker, 1866)	Z	Holloway, 1996
212	*Sarcinodes carnearia* Guenée, 1857	Z	Hutacharern and Tubtim, 1995
213	*Sarcinodes debitaria* (Walker, 1863)	Z	Hutacharern and Tubtim, 1995
214	*Sarcinodes vultuaria* Guenée, 1857	Z	Holloway, 1996
215	*Sarcinodes yazakii* Inoue, 1992	A	Inoue, 1992
	Subfamily Sterrhinae (2)		

	Antitrygodes Warren, 1895 (1)		
216	*Antitrygodes cuneilinea* Walker, [1863]	Z	Hutacharern and Tubtim, 1995
	Somatina Guenée, [1857] (1)		
217	*Somatina dentifasciaria* Inoue, 1992	A	Inoue, 1992