

สถานะการอนุรักษ์ของพืชสกุลว่านมหากาฬ (*Gynura*) ในประเทศไทยConservation Status of *Gynura* in Thailandวรรณิกา หมุนสุข<sup>1</sup> และ พิมพวดี พรพวงรุ่งเรือง<sup>1\*</sup>Wanniga Munsuk<sup>1</sup> and Pimwadee Pornpongrungrueng<sup>1\*</sup><sup>1</sup>ศูนย์วิจัยอนุกรมวิธานประยุกต์ สาขาวิชาชีววิทยา คณะวิทยาศาสตร์ มหาวิทยาลัยขอนแก่น จังหวัดขอนแก่น 40002<sup>1</sup>Applied Taxonomic Research Center, Department of Biology, Faculty of Science, Khon Kaen University, Khon Kaen, Thailand, 40002

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## บทคัดย่อ

ศึกษาสถานะการอนุรักษ์ของพืชสกุลว่านมหากาฬ (*Gynura*) วงศ์ทานตะวัน (Asteraceae) ในประเทศไทย ซึ่งพืชสกุลนี้มีจำนวน 13 แทกซา ในประเทศไทย จัดเป็นพืชเฉพาะถิ่นจำนวน 6 แทกซา การศึกษาดำเนินการโดยใช้ข้อมูลการกระจายพันธุ์พืชจากพิพิธภัณฑ์พืชและการสำรวจพันธุ์ไม้ในประเทศไทยในปี พ.ศ. 2561 นำข้อมูลการกระจายพันธุ์ที่ได้ไปประเมินสถานะการอนุรักษ์ด้วยโปรแกรม ConR โดยใช้เกณฑ์ B ตามเกณฑ์การประเมินสถานการณ์อนุรักษ์ขององค์การระหว่างประเทศเพื่อการอนุรักษ์ธรรมชาติ (IUCN) จากการศึกษาพบว่ามี 7 แทกซาที่เป็นพืชถูกคุกคาม ได้แก่ *Gynura divaricata* (L.) DC. และ *G. truncata* Kerr จัดอยู่ในสถานะเสี่ยงขั้นวิกฤตต่อการสูญพันธุ์ (CR) *G. calciphila* var. *dissecta* F.G. Davies, *G. cusimbua* (D. Don) S. Moore, *G. hmopaengensis* H. Koyama และ *G. nepalensis* DC. จัดอยู่ในสถานะใกล้สูญพันธุ์ (EN) *G. siamensis* Vanij. & Kadereit อยู่ในสถานะเกือบอยู่ในข่ายใกล้สูญพันธุ์ (VU) และอีก 6 แทกซาจัดอยู่ในกลุ่มเกือบอยู่ในข่ายเสี่ยงต่อการสูญพันธุ์ (NT) หรือมีความเสี่ยงต่ำต่อการสูญพันธุ์ (LC) โดยข้อมูลสถานะการอนุรักษ์พันธุ์พืชนี้สามารถนำไปใช้ในการวางแผนการอนุรักษ์พืชเหล่านี้ได้

## ABSTRACT

Conservation status of *Gynura* (Asteraceae) in Thailand was investigated. Thirteen taxa of *Gynura* were recorded in Thailand. Among these, six taxa are endemic to Thailand. The conservation status was analyzed based on distributional data from herbarium specimens and field surveys throughout Thailand in 2018 using ConR Program. The status was categorized under criterion B of International Union for Conservation of Nature (IUCN). The results indicated that seven taxa are threatened. *Gynura divaricata* (L.) DC. and *G. truncata* Kerr are critically endangered species (CR). *Gynura calciphila* var. *dissecta* F.G. Davies, *G. cusimbua* (D. Don) S. Moore, *G. hmopaengensis* H. Koyama and *G. nepalensis* DC. are endangered species (EN). *G. siamensis* Vanij. & Kadereit is vulnerable species (VU). The other six taxa are categorized as near threatened species (NT) or least concern (LC). This information is useful for plant conservation management.

**คำสำคัญ:** สถานการณ์อนุรักษ์ การกระจายพันธุ์ สกุลว่านมหากาฬ วงศ์ทานตะวัน

**Keywords:** Conservation Status, Distribution, *Gynura*, Compositae

## INTRODUCTION

Thailand is part of the 25 global biodiversity hotspots, defined by endemism level and degree of threat (Myers et al., 2000), and located among Indo-Burma, Indo-China and Malay peninsula regions. Approximately 15,000 taxa of plants are recorded, which is around eight percent of all plants in the world (Office of Natural Resources and Environmental Policy and Planning, 2009). The flora of Thailand has been continuously studied since 1957 (Larsen and Warncke, 1966), however, there are still many species under collected (Parnell et al., 2003). Similarly, plant diversity is globally remarkable underestimated, especially in tropical area (Corlett, 2016).

Conservation status of plant is an essential tool to protect natural habitat and prevent biodiversity loss (Dauby et al., 2017). Therefore, the estimation of conservation status has been widely investigated. Previously, the opinion of experts was used to determine conservation status. Currently, the conservation status is investigated based on the definition of International Union for Conservation of Nature (IUCN). They provide useful guideline application to evaluate conservation status that are more accurate than experiences of specialists (Rodrigues et al., 2006). IUCN aims to classify species to extinction risk categories, in both global and regional levels, as well as establish conservation priorities. Five different criteria including A.) population size reduction, B.) geographical range in the form of extent of occurrence (EOO) and/or area of occupancy (AOO), C.) small population size and decline, D.) very small or restricted population and

E.) quantitative analysis were published and used to group any organism to IUCN categories. Evaluation of five criteria assigns species to IUCN extinction risk categories; Extinct (EX), Extinct in the wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC) and Data Deficient (DD), respectively (IUCN, 2012). Around 50 percent of publication in conservation status was estimated under the criteria B (Gaston and Fuller, 2009). The criterion B is widely used to determine conservation status because this criterion only uses distributional data (Schatz, 2002). For instance, *Achillea adeniae* Aytaç & Ekici and *A. baltae* H.Duman & Aytaç, endemic plants in Turkey, were evaluated as B1a and B2a in Critically Endangered category (Aytaç et al., 2016). In spite of the fact that evaluating plant conservation status from all criteria gives better outcome, it is challenging and requiring significant amount of time to investigate (Dauby et al., 2017). The conservation status of plant can provide information for planning conservation (Chamchumroon et al., 2017) and setting management of protected areas (Corlett, 2016).

In Thailand, conservation status of plant is also considered. Preliminary checklists have been continuously published since 2005 (Pooma et al., 2005) and updated in 2017 based on the BKF's specimen databases as well as information from previous publications.

*Gynura* Cass. is a genus in the tribe Senecioneae, family Asteraceae or Compositae. There are approximately 44 species worldwide (Vanijajiva and Kadereit, 2011), mostly found in

southeast Asia, which is a center of its diversity (Davies, 1978). Common characteristics of the genus are fleshy herbs or subshrubs with tuberous root, homogamous and discoid capitula with 10 – 12-uniseriate phyllaries arranged in a single row. Florets are all bisexual, yellow to purple with very long distinctly 2-branched styles. Achenes are narrow with many ribs and white pappus (Vanijajiva, 2009; Vanijajiva and Kadereit, 2011; Koyama et al., 2016). In Thailand, 13 taxa are reported with six endemic species (Koyama et al., 2016). The preliminary checklist of threatened plants in Thailand was recorded including six taxa of *Gynura* based on herbarium data and taxonomic literature. The conservation status of some species of *Gynura* in Thailand has been categorized viz. *G. hmopengensis* H. Koyama was categorized as endangered plant and *G. calciphila* var. *dissecta* F.G. Davies as vulnerable plant. While *G. bicolor* (Roxb.) DC., *G. calciphila* Kerr var. *calciphila*, *G. cusimbua* (D. Don) S. Moore, *G. divaricata* (L.) DC., *G. nepalensis* DC. and *G. pseudochina* (L.) DC. were categorized as rare species (Chamchumroon et al., 2017). Although, *Gynura* in Thailand have been studied, however, more field works and additional data are still needed to observe and update any knowledge, especially distribution and conservation status of plant that can be changed due to global warming effects such as temperature and annual rainfall changes. Thus, this work aims to investigate the conservation status of all taxa in the genus *Gynura* in Thailand.

## RESEARCH METHODOLOGY

Distributional data of *Gynura* in Thailand were collected from herbarium specimens in the following herbaria: BK, BKF, KKU, TCD and QBG as well as field surveys throughout the country in 2018. Distribution maps and conservation status were estimated under IUCN criteria B: geographic range including, B1: extent of occurrence (EOO) and B2: area of occupancy (AOO) (IUCN, 2012) by ConR package using R and R Studio programs with default parameters. For example, population size (grid cell) was set as 2 km<sup>2</sup>, distance among sub-populations as 5 radius-km<sup>2</sup> and distance among locations as 10 km<sup>2</sup> (Dauby et al., 2017). AOO, EOO and number of sub-populations were computed by these parameters.

## RESULTS

The studied taxa were categorized into five categories, including Least Concern (LC), Near Threatened (NT), Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) (Fig. 1). Six taxa of *Gynura* including *G. bicolor* (Fig. 3A), *G. calciphila* var. *calciphila* (Figs. 2A, 2B and 3B), *G. integrifolia* Gagnep. (Figs. 2C and 4E), *G. longifolia* Kerr (Figs. 2D and 4F), *G. procumbens* (Lour.) Merr. (Fig. 5B) and *G. pseudochina* (Figs. 2E, 2F and 5C) were classified as least concern or near threatened species. While, seven taxa were categorized as threatened plants. These threatened plants were classified into three categories (IUCN, 2012). *Gynura divaricata* (Fig. 4C) and *G. truncata* (Fig. 5E) are critically endangered species. *Gynura calciphila* var.

*dissecta* (Fig. 4A), *G. cusimbua* (Fig. 4B), *G. hmopaengensis* (Fig. 4D) and *G. nepalensis* (Fig. 5A) are categorized as endangered species (EN). While, *G. siamensis* Vanij. & Kadereit (Fig. 2A–2C) is categorized as vulnerable species (VU) (5D).

Information of each species, such as number of unique occurrences, number of populations, number of locations, extent of occurrence (EOO), area of occupancy (AOO), gathering with selected criteria B category code are shown in Table 1.

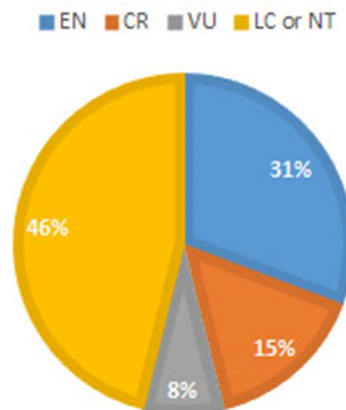


Figure 1 Summary of the conservation status of all *Gynura* taxa.

Table 1 Conservation status of plant based on IUCN criteria B from ConR package

Taxa	EOO (km <sup>2</sup> )	AOO (km <sup>2</sup> )	Number of			B1 Category (EOO)	B2 Category (AOO)	Selected criteria B category code
			unique occurrence	Sub- population	location			
<i>Gynura bicolor</i>	234832	52	13	9	11	LC or NT	LC or NT	LC or NT B1a + B2a
<i>G. calciphila</i> var. <i>calciphila</i>	39091	64	17	11	13	LC or NT	LC or NT	LC or NT B1a + B2a
<i>G. calciphila</i> var. <i>dissecta</i>	3791	12	3	3	3	EN	EN	EN B1a + B2a
<i>G. cusimbua</i>	3310	32	11	5	5	EN	EN	EN B1a + B2a
<i>G. divaricata</i>	*	4	1	1	1	*	CR	CR B2a
<i>G. hmopaengensis</i>	1735	12	3	3	3	EN	EN	EN B1a + B2a
<i>G. integrifolia</i>	176517	72	19	15	15	LC or NT	LC or NT	LC or NT B1a + B2a
<i>G. longifolia</i>	75159	68	18	16	16	LC or NT	LC or NT	LC or NT B1a + B2a
<i>G. nepalensis</i>	7039	28	7	5	5	VU	EN	EN B2a
<i>G. procumbens</i>	52596	64	16	15	15	LC or NT	LC or NT	LC or NT B1a + B2a
<i>G. pseudochina</i>	469022	296	78	62	67	LC or NT	LC or NT	LC or NT B1a + B2a
<i>G. siamensis</i>	94130	48	16	7	8	LC or NT	VU	VU B2a
<i>G. truncata</i>	*	4	1	1	1	*	CR	CR B2a

AOO = Area of occupancy

EOO = Extent of occurrence

CR = Critically Endangered; EN = Endangered; LC = Least Concern; NT = Near Threatened and

VU = Vulnerable

\*EOO parameter cannot be estimated because there are less than three records.



Figure 2 Morphology of A.) and B.) *G. calciphila* var. *calciphila*; C.) *G. integrifolia*; D.) *G. longifolia*; E.) and F.) *G. pseudochina*; G) – I.) *G. siamensis*.

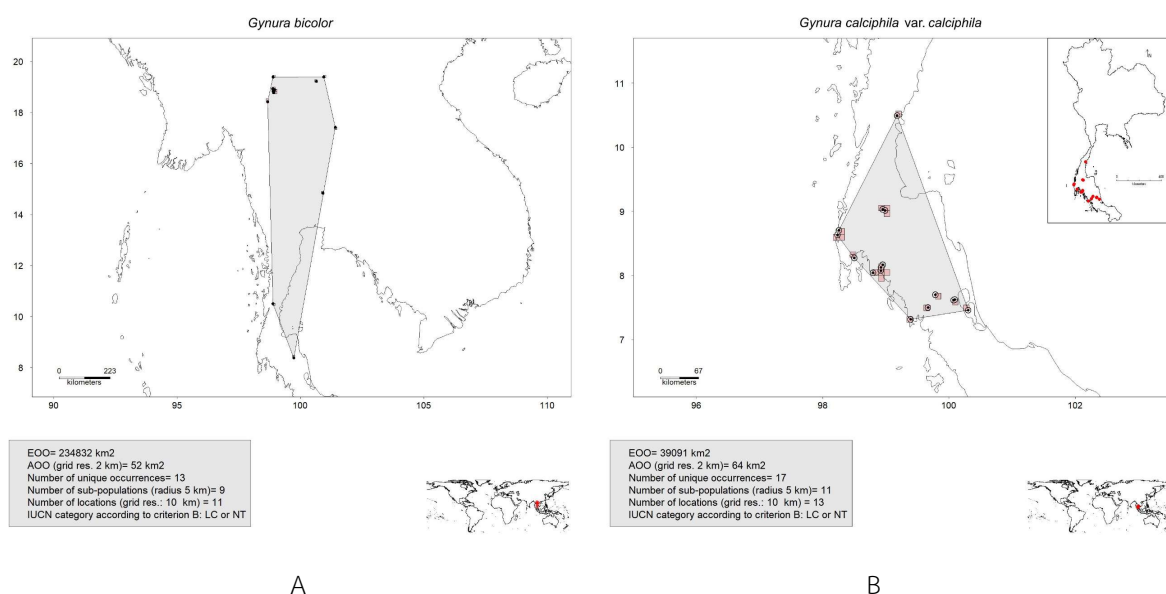


Figure 3 Distribution map of A.) *G. bicolor* and B.) *G. calciphila* var. *calciphila*.

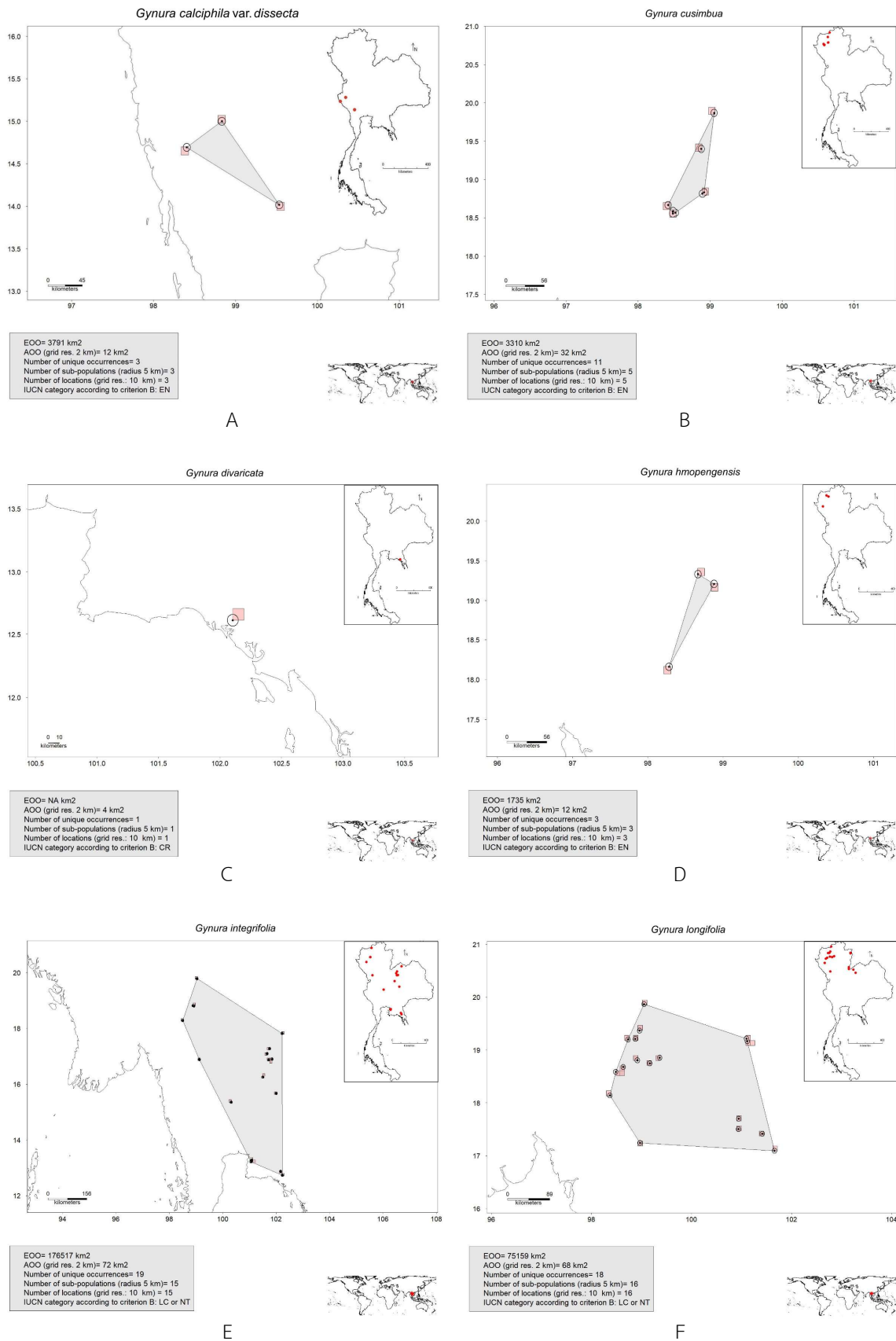


Figure 4 Distribution map of A.) *G. calciphila* var. *dissecta*; B.) *G. cusimbua*; C.) *G. divaricata*; D.) *G. hmopengensis*; E.) *G. integrifolia*; F.) *G. longifolia*.



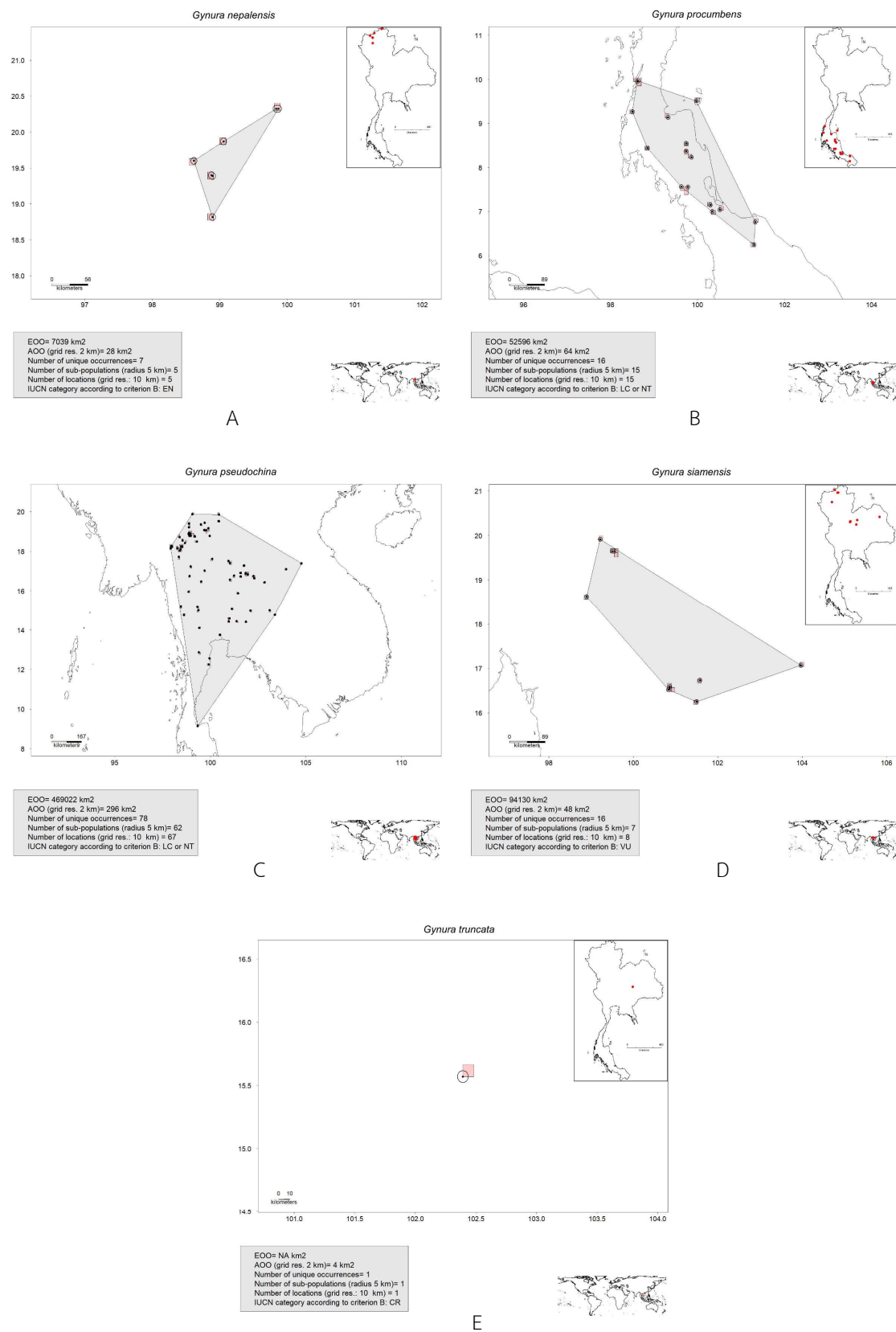


Figure 5 Distribution map of A.) *G. nepalensis*; B.) *G. procumbens*; C.) *G. pseudochina*; D.) *G. siamensis*; E.) *G. truncata*.

## DISCUSSION

Among 13 taxa of *Gynura* reported in Thailand, six taxa were endemic to Thailand including *G. calciphila* var. *calciphila*, *G. calciphila* var. *dissecta*, *G. hmopaengensis*, *G. longifolia*, *G. siamensis* and *G. truncata* (Vanijajiva and Kadereit, 2011; Koyama et al., 2016). These endemic taxa were categorized as Vulnerable, Least Concern or Near Threatened, Endangered and Critically Endangered.

*Gynura truncata* was categorized as Critically Endangered (B2a). This species has been recorded only from the type locality in Nakhon Ratchasima province since 1931 and no further specimens has been collected. Thus, the extinction risk at global level of this species should be significantly considered. While, *G. hmopaengensis* and *G. calciphila* var. *dissecta* which were previously categorized as endangered and vulnerable species, respectively by Chamchumroon et al. (2017), but here they were categorized as Endangered (B1a+B2a). *Gynura calciphila* var. *dissecta* was collected on limestone cliff in Thong Pha Phum district, Kanchanaburi province from 1971–1973, after that no more specimens have been collected. This might be caused by the habitat destruction as part of the area was turned into a Dam. For *G. hmopaengensis*, it was recorded only from the type locality near Hmo Paeng waterfall in Mae Hong Son province and Doi Suthep-Pui national park, Chiang Mai province.

*Gynura calciphila* var. *calciphila* and *G. longifolia* were categorized as Least Concern or Near Threatened (B1a+B2a). Particularly, *G. calciphila* var. *calciphila* grows on limestone mountain in the peninsular Thailand which is the

most threatened area under the demand of cement (Clements et al., 2006), while *G. longifolia* is restricted to the north of Thailand. Furthermore, invasion of invasive species also has a negative effect to native plant, especially endemic species (Forest and Plant Conservation Research Office, The Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation, 2011). It should be noted that, the extinction risk of these two species should be concerned beyond the expectation from this analysis because they are only found in Thailand (Koyama et al., 2016).

Additionally, *G. siamensis* is categorized as Least Concern (LC) or Near Threatened (NT) based on criteria B1, but Vulnerable based on criteria B2 (B2a). Therefore, this species is here categorized as vulnerable plant. Its distribution area is fragmented in the north and northeastern parts of Thailand. Distance among each population is longer than 100 km. This accelerate extinction risk of plant because the habitat fragmentation can cause reduction of population size (Mullu, 2016) and leads to decrease a possibility of recolonization (Rivers et al., 2010). Moreover, during the field survey, we found that population of *G. siamensis* in Phu Phan national park, Sakon Nakhon province is very small, no more than 500 m<sup>2</sup> and disturbed annually by wildfire. While population in Thung Salaeng Luang national park, Phitsanulok province covers more than 5 km<sup>2</sup>. Therefore, conservation planning should be intensively concerned with actual information. Because the result from criteria B estimation is limited and might be differed from full assessment IUCN criteria (Dauby et al., 2017).

The other taxa apart from the endemic one, were categorized as Critically Endangered, Endangered and Least Concern or Near Threatened.



*Gynura divaricata*, the species distributed in China (Guangdong and Hong Kong) and Thailand (Koyama et al., 2016), is categorized as critically endangered species. Even though it is not endemic species but in Thailand only a single collection has been collected from Chanthaburi province in 1999. This species was previously categorized as rare species by Chamchumroon et al. (2017). However, this species is reported as commonly used medicinal herb in China and Thailand (Vanijajiva and Kundee, 2014). Thus, conservation status of *G. divaricata* should be reconsidered due to undercollection.

*Gynura cusimbua*, the species distributed in the Himalayas, Myanmar, China and northern Thailand (Koyama et al., 2016) and *G. nepalensis*, the species distributed in Nepal, Bhutan and Thailand (Koyama, 1988; Koyama et al., 2016) are categorized as endangered species. These two species were previously categorized as rare species by Chamchumroon et al. (2017). *Gynura nepalensis* is categorized as vulnerable plant by criteria B1 (EOO) and as endangered plant by criteria B2 (AOO). Thus, it was here assigned in endangered plant because of less specimen collection and only found in high altitude in Chiang Mai province which is the highest rate of plant collection in Thailand (Parnell et al., 2003). However, their collection's sites become an attractive tourist destination such as Doi Inthanon, Doi Suteppui and Doi Ang Khang. Therefore, conservation plan should be co-operated with local natives and institutions to protect their habitats.

Finally, the rest of *Gynura* species are categorized as Least Concern or Near Threatened, including *G. bicolor*, the species distributed from India to Thailand (Koyama 1988; Koyama et al.,

2016), *G. integrifolia*, the species distributed from India (Assam), Thailand, Cambodia and Vietnam (Cochinchina), *G. procumbens*, the species widely distributed from tropical West Africa to Southeast Asia (Koyama et al., 2016) and *G. pseudochina*, the species distributed in India, China, Myanmar, Thailand and Indonesia (Java) (Koyama et al., 2016). *Gynura bicolor* and *G. pseudochina* were previously categorized as rare species by Chamchumroon et al. (2017). However, these taxa are widespread taxa or cultivated through Thailand, thus Least Concern or Near Threatened were assigned here.

## CONCLUSIONS

The conservation status of plant should be evaluated and announced to the public. This information is significant to establish important areas (IPAs) in Thailand and increasingly monitored by government. Even though, there are several IUCN assessment criteria for estimating the conservation status. The application of these criteria depends on data type and data analysis (Rodríguez et al., 2015). Based on distributional data, the criteria B is here applied for considering and attending about conservation that should be completely accelerated as soon as possible as we have no time left to protect the biological resources from reduction by global warming and climate change, resulting from human activities such as habitat destruction due to urbanization.

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