

# 行政院國家科學委員會補助專題研究計畫成果報告

## 霧社水庫集水區的螞蟻多樣性結構與功能研究(I)

計畫類別： 個別型計畫          整合型計畫

計畫編號：NSC89 - 2621 - Z - 002 - 075 -

執行期間：89 年 8 月 1 日至 90 年 7 月 31 日

計畫主持人：洪淑彬

共同主持人：李後晶

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國際合作研究計畫國外研究報告書一份

執行單位：國立台灣大學昆蟲學系

中 華 民 國 九 十 年 十 月 卅 一 日

# 行政院國家科學委員會專題研究計畫成果報告

## 霧社水庫集水區的螞蟻多樣性結構與功能研究(I)

### Study on the structure and function of ant community in Wushe Dam area (I)

計畫編號：NSC89 - 2621 - Z - 002 - 075 -

執行期限：89年8月1日至90年7月31日

主持人：洪淑彬

共同主持人：李後晶 國立臺灣大學昆蟲學系

#### 一、中文摘要

螞蟻分佈於廣泛的棲所中且在各種生態系中扮演不同的生態功能角色，因此螞蟻群聚常被用來作為評估不同生態系的環境狀況和管理措施的生物指標。我們假設螞蟻群聚在我們研究地區的不同生態系中，因環境因子、土壤狀況、人為干擾和管理措施而有顯著不同，且螞蟻能對廣大範圍的變動提供良好評估，因此有潛力成為不同生態系生物多樣性現況與變動的良好生物指標。為評估此種功能，我們嚐試尋找對各種生物多樣性改變敏感的螞蟻類群，建立螞蟻種豐富度、種歧異度和種組成與環境因子、植生結構和土壤動物的相關關係，並建立以螞蟻為中心的食物網，以瞭解螞蟻的生態功能。

選擇高海拔之翠峰至鳶峰一帶設一試驗區，區內選擇草生地、次生林、原始林、廢耕地等不同生態系，每月調查螞蟻相之組成，由草生地、原始林、次生林、廢耕地之螞蟻組成來比較不同生態系之生物歧異度變異；由次生林、原始林之螞蟻組成調查則可瞭解演替過程之歧異度變動；透過原始林與草生地螞蟻相比較則可釐清人為活動對螞蟻歧異度之干擾；而進行廢耕地、次生林與原始林之螞蟻相比較則可量化及評估人為操作對生物多樣性之作用，進而作為生物多樣性維護與復育之參考。

本研究探明螞蟻的種類及組成，優勢種週年數量變動，空間分佈變化及其生物歧異度之變動，並建立不同生態系、不同演替階段、不同管理措施或人為干擾之螞蟻群聚時空分佈與動態與其他植生分佈之相關性，並評估螞蟻作為生態系品質與保

育管理措施等生物指標的可行性。

**關鍵詞：**螞蟻，蟻科，生物指標，生物多樣性

#### Abstract

Ant species distributed over a wide range of habitats and played many different ecological function roles in varied ecosystems. Therefore, ant species assemblages have been used as biological indicators of environmental condition and management practices in many different ecosystems. We hypothesize that assemblages of ant species in different ecosystems of our study area will show significant differences depending on environmental factors, soil condition, human perturbations, and management practices. In addition, they are capable of providing an assessment over a wide range of stresses. So, they may have potential as a biological indicator of biodiversity condition in many different ecosystems in our study area. To assess this hypothesis, we try to find the group of ants that are sensitive to provide early warning for changes of biodiversity in the ecosystem. Associations between ant species, and environmental conditions and vegetative structure will be analyzed first. Trophic webs in different ecosystems will be constructed then, to clarify plant-ant-soil arthropod interrelationship.

One high-latitude area was chosen as research area. In this area, ant fauna will be surveyed every month in various ecosystems of grassland, secondary forest, virgin forest, and stop-cultivated land. From the

comparison of ant composition in grassland, virgin forest and secondary forest, we can understand the change patterns of biodiversity in different ecosystems. However, the biodiversity changes in succession process can be revealed by the comparison between ant composition in secondary and virgin forest. By comparing the ant fauna among virgin forest and grassland, we will understand the interference of human activity on the biodiversity. In addition, quantification and evaluation of human manipulation on the impact of biodiversity will also be obtained by comparing the ant fauna among stop-cultivated land, secondary forest and virgin forest. This result can serve as a reference for the future work on the maintenance and recovery of biodiversity.

In this study, we unveil the ant fauna, the population fluctuation of the dominant species, the changes of spatial distribution and biodiversity. In addition, we will analyze the relationships among soil types, environmental factors and ant community in various ecosystems. Furthermore, we can evaluate the suitability of using ant as a biological indicator of ecosystem quality and conservation managing tactics judging from the relationships of ant community's time and spatial distribution and plant community and established from various ecosystems, succession stages, managing tactics or human interference.

Keywords: ants, Formicidae, biological indicator, biodiversity

## 二、緣由與目的

本研究目的在探討霧社水庫集水區螞蟻群聚之組成與生態功能，以瞭解不同生態系之生物多樣性狀況，釐清人為活動對生物多樣性之干擾，及評估人為操作對生物多樣性的維護與復育之作用；並藉由不同生態系中螞蟻之生物多樣性與環境因子及植物分佈型之相關性分析，來評估以螞蟻群聚作為生物指標以評估生態系品質之可行性。

選擇高海拔之翠峰至鳶峰一帶設一試

驗區，區內選擇草生地、次生林、原始林、廢耕地等不同生態系，每月調查螞蟻相之組成，由草生地、原始林、次生林、廢耕地之螞蟻組成來比較不同生態系之生物歧異度變異；由次生林、原始林之螞蟻組成調查則可瞭解演替過程之歧異度變動；透過原始林與草生地螞蟻相比較則可釐清人為活動對螞蟻歧異度之干擾；而進行廢耕地、次生林與原始林之螞蟻相比較則可量化及評估人為操作對生物多樣性之作用，進而作為生物多樣性維護與復育之參考。

## 三、結果與討論

從 2000 年九月至 2001 年八月每月一次之採樣調查結果顯示，在本試驗區共計採集到三亞科八屬十四種的螞蟻(附錄)。其中以黃腳黃蟻(*Paratrechina flavipes*)數量最多，佔總個體數( $n=431$ )之 71%，五個不同的樣區皆有分布。而在種分布的均勻度上，全區之均勻度指數為 0.47，表示在此區中螞蟻相分布並不均勻(Fig.1)。

### (一) 不同生態系螞蟻種類及組成

各生態系全年的螞蟻種的豐度，以五年廢耕地全年所採集到的螞蟻種類數八種最多；而二年廢耕地和瑞岩溪自然保護區次之，皆為七種；二十年次生林地螞蟻的種類數少，僅有四種；原始林區有五種的採集記錄。就個體數而言，則以二十年次生林地採集到的數量最多( $n=222$ )，原始林次之，種類數較多的五年廢耕地、二年廢耕地及瑞岩溪自然保護區數量較少( $n=35, 34, 51$ ) (Fig. 2a)。

在種的均勻度上，以二年廢耕地 0.706 最高；二十年次生林地最低(0.22)；其餘五年廢耕地原始林及瑞岩溪自然保護區之均勻度分別為 0.62、0.36 及 0.48(Fig. 2b)。

以整個試驗區分布最廣、採樣數最多之黃腳黃蟻，所佔比例作為豐量指標的結果發現，的十年次生林地、原始林及二年廢耕地等三個生態系黃腳黃蟻的比例皆高於 50%，其值依序為 0.87、0.82 及 0.55。而五年廢耕地及瑞岩溪自然保護區二地黃

腳黃蟻的比例分別為 0.11 和 0.15(Fig. 2c), 並非數量最多的種類。在五年廢耕地的採集記錄中, 以荷氏黃蟻(*P. kraepelin*)所佔的比例最高(0.4, n=35), 其次為黑褐毛山蟻(*Lasiu talpa*)(0.34); 而瑞岩溪自然保護區則以擬態長腳家蟻 (*Aphaenogaster minus*)的比例最高(0.53)。

#### (二) 螞蟻種類及組成之週年動態

全年的螞蟻種的豐度變動以八月所採集到的螞蟻種類數十種最多, 而個體數則以十月最高(104); 一月及十一月皆只有黃腳黃蟻一種; 二月採集到的個體數最少, 僅有六隻、三種。就均勻度而言, 則以十月最低(0.08), 黃腳黃蟻的豐量指數以十月最高 (Fig. 3)。

#### 四、計畫成果自評

(一) 蒐集不同生態系、演替相採樣調查所得之螞蟻群聚資料, 俾便瞭解霧社水庫集水區各生態系中螞蟻群聚之組成、結構與功能。

(二) 自不同耕作方式形成之農業生態系與自然生態系中, 採樣取得螞蟻群聚資料, 以瞭解人為干擾對生物多樣性之影響。

(三) 於不同栽培作物或耕作方式之墾植區採集螞蟻群聚之資料, 以便發展與評估廢耕農地復育管理之策略。

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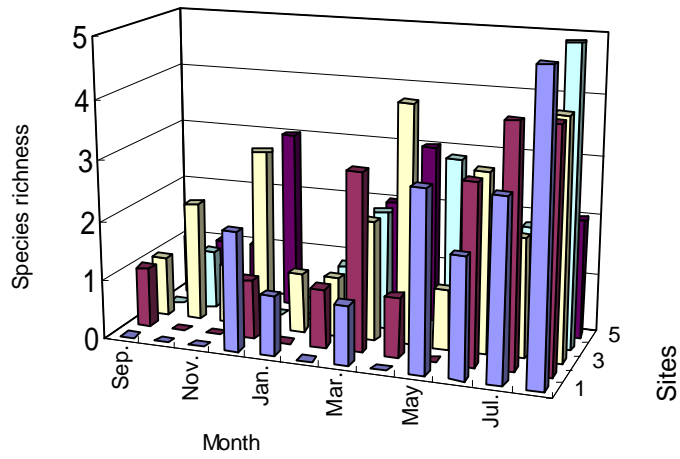
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(a)



(b)

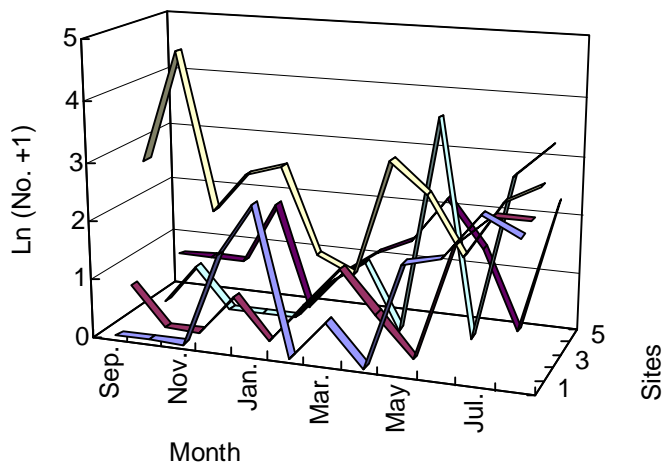
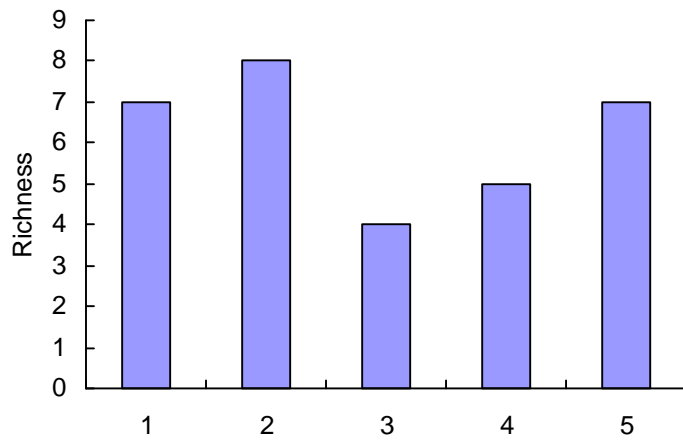
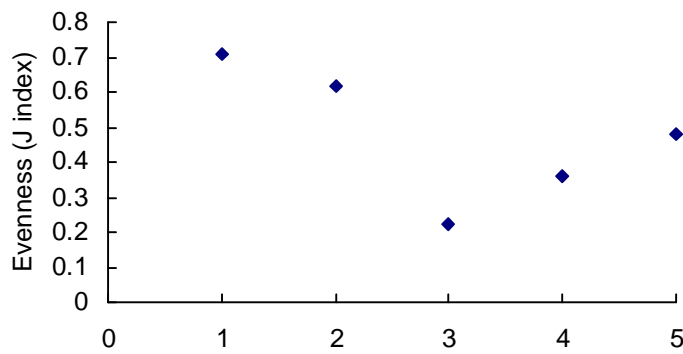


Fig. 1. Species richness and individuals of ants collected in each sampling site during Sep. 2000 to Aug. 2001. Sites 1 refer to 2 y abandoned orchard, 2 to 5 y abandoned farm, 3 to 20 y secondary forest, 4 to Primary forest, and 5 to Natural protected area, respectively.

(a)



(b)



(c)

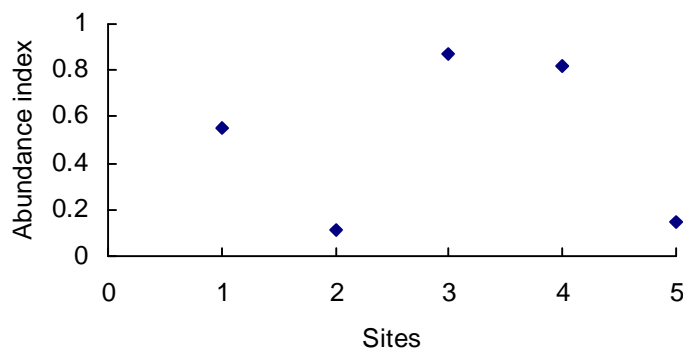
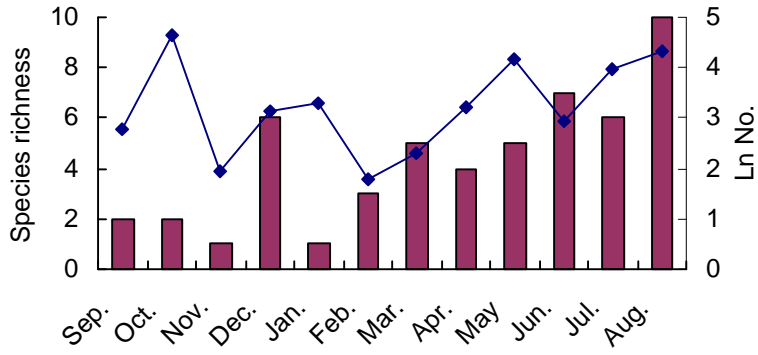
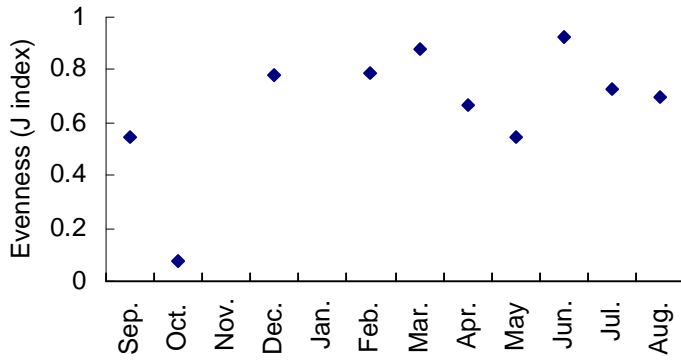


Fig. 2. Spices richness, evenness and abundance index of ants collected in each sampling site during Sep. 2000 to Aug. 2001. Sites 1 refer to 2 y abandoned orchard, 2 to 5 y abandoned farm, 3 to 20 y secondary forest, 4 to Primary forest, and 5 to Natural protected area, respectively.

(a)



(b)



(c)

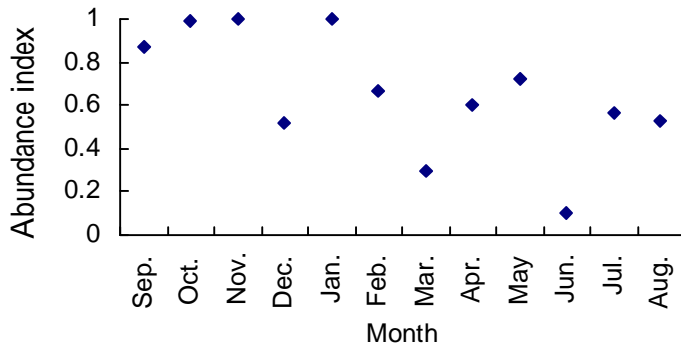


Fig. 3. Monthly fluctuations of species richness, evenness and abundance index of ants collected in each sampling site during Sep. 2000 to Aug. 2001.

Appendix. List of ant species collected in each sampling site during Sep. 2000 to Aug. 2001.

Species	2 y abandoned orchard	5 y abandoned farm	20 y secondary forest	Primary forest	Natural protected area
<b>Ponerinae</b>					
<i>Hypoponera opaciceps</i>		X	X	X	X
<i>Amblyopone silvestrii</i>	X		X	X	X
<i>Pachycondyla javanus</i>	X				
<b>Formicinae</b>					
<i>Monomorium chinense</i>	X				
<i>Lasius talpa</i>		X		X	
<i>Lasius niger</i>		X			
<i>Paratrechina flavipes</i>	X	X	X	X	X
<i>Paratrechina kraepelini</i>	X	X			X
<i>Formica japonica</i>		X			
<b>Myrmicinae</b>					
<i>Myrmica serica</i>					X
<i>Pheidole ernsti</i>	X	X	X	X	X
<i>Pheidole sauteri</i>	X				
<i>Aphaenogaster minusulus</i>					X
<i>Aphaenogaster tipuma</i>		X			