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# 生态学报

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# 生态学报

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**封面图说:** 鸳鸯——在分类上属雁形目,鸭科。英文名为 Mandarin Duck(即“中国官鸭”)。鸳指雄鸟,鸯指雌鸟,故鸳鸯属合成词。常常栖息于山地河谷、溪流、湖泊、水田等处,雌雄偶居,以植物性食物为主,也食昆虫等小动物。繁殖期 4—9 月间,雌雄配对后迁至营巢区。巢往往置于树洞中,用干草和绒羽铺垫,每窝产卵 7—12 枚。江西省婺源鸳鸯湖是亚洲最大的野生鸳鸯越冬栖息地。鸳鸯是一种美丽的禽鸟,中国传统文化又赋予它很多美好的寓意,因此,在许多文学艺术作品中经常用以表达爱情。

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刘晋仙,陶建平,何泽,王玉平,郭庆学. 海南霸王岭山地原始林与伐后林中木质藤本对支持木的选择. 生态学报, 2012, 32(12): 3834-3840.

Liu J X, Tao J P, He Z, Wang Y P, Guo Q X. Liana-host tree associations in the tropical montane primary forest and post-harvest forest of Bawangling, Hainan Island, China. Acta Ecologica Sinica, 2012, 32(12): 3834-3840.

## 海南霸王岭山地原始林与伐后林中木质藤本 对支持木的选择

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**摘要:**通过对海南霸王岭热带山地原始林与伐后林中树木及其攀附木质藤本的调查,研究原始林与伐后林中木质藤本对支持木的选择性。结果表明:1)6 科优势树木中附藤率最高的是野牡丹科(Melastomataceae),附藤率最低的科,原始林中是山矾科(Symplocaceae),伐后林中是茜草科(Rubiaceae)。2)原始林中,谷木(*Memecylon ligustrifolium*)与线枝蒲桃(*Syzygium araiocladum*)的附藤比率和每木藤本数均高于样地平均水平;三角瓣花(*Prismatomeris tetrandra*)和龟背灰木(*Symplocos andenophylla*)的附藤比率均低于样地平均水平,而每木藤本数与样地平均水平之间没有显著差异。伐后林中,谷木的附藤比率和每木藤本数高于样地平均水平;九节(*Psychotria rubra*)的附藤比率和每木藤本数低于样地平均水平。3)杜仲藤(*Parabarium micranthum*)的主要支持木是谷木,夜花藤(*Hypserpa nitida*)的主要支持木是线枝蒲桃。研究表明,木质藤本对支持木在科和种水平上都具有选择性,因此木质藤本会对树木造成不对称影响,进而影响森林的结构和动态。

**关键词:**木质藤本;支持木;原始林;伐后林;海南霸王岭

## Liana-host tree associations in the tropical montane primary forest and post-harvest forest of Bawangling, Hainan Island, China

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**Abstract:** In the present study, the associations between trees and lianas were investigated along four ridge transects in primary forest and post-harvest forest in tropical evergreen mountain rain forest in Bawangling Nature Reserve, Hainan Island. The results showed that, in primary forest, Melastomataceae had a higher proportion of trees with lianas than the other five dominant families while Symplocaceae had a lower proportion. However, the percentage of trees with lianas showed no significant overall difference among six dominant families ( $P = 0.09$ ). In post-harvest forest, Melastomataceae had a higher proportion of trees with lianas as well, but Rubiaceae had the lowest proportion. The percentage of trees with lianas showed a significant overall difference among six dominant families ( $P < 0.01$ ). At the species level, in primary forest, *Memecylon ligustrifolium* and *Syzygium araiocladum* both had a significantly higher proportion of trees with lianas, while *Prismatomeris tetrandra* and *Symplocos crassifolia* both had a lower proportion. *M. ligustrifolium*, *S. araiocladum* and *Symplocos laurina* were infected by lianas more than other host tree species, however, the number of lianas per tree were not significantly different from the average level of plots. In post-harvest forest, *M. ligustrifolium*, had a higher proportion of trees with lianas and *Psychotria rubra* had a lower proportion. *M. ligustrifolium*, *S. araiocladum* and *Acronychia*

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*pedunculata* were infected by lianas more than other host tree species, but *P. rubra* was rarely infected by lianas. In primary forest, *M. ligustrifolium* was the dominant host tree species, and four liana species selected them as their main host. *Hypserpa nitida* and *Parabarium micranthum* had obvious selectivity to the host tree species in five main liana species. In post-harvest forest, *M. ligustrifolium* and *S. araiocladum* were the dominant host tree species, and two liana species selected *M. ligustrifolium* as their main host, while two liana species selected *S. araiocladum* as their main host trees. *H. nitida*, *P. micranthum*, *Smilax amaurophlebia* and *Smilax china* had obvious selectivity to the host tree species in seven main liana species. In two forest types, *P. micranthum* and *H. nitida* infected the same host tree species. *M. ligustrifolium* was infected more by *P. micranthum* and *S. araiocladum* more by *H. nitida*. This study showed that the percentage of trees with lianas varied among families and species. Lianas affect host trees that belong to different families and different species in different ways. In conclusion, trees could suffer from asymmetric influences from the interference of lianas, which would affect forest structure and dynamics during forest succession.

**Key Words:** lianas; host tree; primary forest; post-harvest forest; Bawangling

木质藤本是一类必须依靠其他植物或其他支持物的物理支撑才能到达森林冠层的木质攀援植物<sup>[1-5]</sup>。在热带森林中木质藤本的物种丰富度通常占木本植物物种丰富度的 25% 左右<sup>[6]</sup>,对森林生物多样性和生态系统功能都有重要影响。树木是木质藤本最主要的支撑物,因此木质藤本和树木间的相互作用在很大程度上决定了木质藤本对森林的影响程度<sup>[7-8]</sup>。一些研究认为木质藤本对不同树种的影响不同,不同树种间的附藤比例<sup>[9-10]</sup>,其上攀附的木质藤本数量和物种数<sup>[11]</sup>以及树冠被木质藤本覆盖的程度<sup>[9]</sup>均存在差异。然而也有一些研究不支持这样的观点,他们认为木质藤本对支持木的攀附是一种随机过程,在一些热带森林中,不同树种被木质藤本攀附的几率几乎相同<sup>[3,12-13]</sup>,其上攀附的木质藤本数量也没有明显的差异,木质藤本和树木之间没有特殊的种间关系<sup>[8,14]</sup>。基于存在的争议,本文通过对原始林和伐后林中木质藤本与树木的调查研究来进一步证实木质藤本与支持木之间是否存在一定的选择性关系。

本研究拟通过调查海南霸王岭山地原始林与伐后林中木质藤本在树木上的分布情况来揭示木质藤本与支持木的相互关系,进一步了解促进或阻止木质藤本定居和分布的原因。在原始林和伐后林中研究并区分这种影响机制中不同的影响因子,有利于进一步了解木质藤本在热带森林中的分布,同时有利于理解木质藤本对不同树种的影响程度,从而进一步理解木质藤本改变热带森林树木群落结构的机制。

## 1 研究区概况

霸王岭国家级自然保护区位于海南岛西南部山区,地理坐标(18°52'—19°12' N, 108°53'—109°20' E),总面积约 72 000 hm<sup>2</sup>。气候属热带季风气候,年平均气温 23.6 °C,年均降水量 1 500—2 000 mm,干湿季明显,5—11 月为雨季,12 月至次年 4 月为旱季。该地区地形复杂,以山地为主,海拔 100—1 654 m,林区内土壤以砖红壤为主,随着海拔的增加,逐渐过渡为山地红壤、山地黄壤和山地草甸土<sup>[15]</sup>。本文调查的具体地点是长臂猿保护区对面山脊(海拔 700—900 m,坡度 5°—10°)的山地原始林和伐后林,土壤为山地黄壤,原始林以黄叶树(*Xanthophyllum hainanense*)、线枝蒲桃(*Syzygium araiocladum*)、海南山胡椒(*Lindera robusta*)、中华厚壳桂(*Cryptocarya chinensis*)、黄牛奶树(*Symplocos laurina*)为优势树种;伐后林以中华厚壳桂、海南白椎(*Castanopsis carlesii*)、海南山胡椒、线枝蒲桃、黄牛奶树为优势树种,样地具体概况见表 1。

## 2 研究方法

### 2.1 野外调查方法

野外调查于 2009 年 1—4 月进行。在霸王岭山地雨林区内选择原始林和自然恢复 31a 的伐后林作为调查样地。在两种林地内分别设置 10 m × 100 m 的样带各 2 条,每条样带再分为 10 m × 20 m 的小样方,共做样方 20 个,总面积 4 000 m<sup>2</sup>。记录各样方内胸径(dbh) ≥ 1 cm 树木的物种名称、胸径、高度以及所攀附木质藤本的物种名称。

表 1 样地概况  
Table 1 General situation of two stands

| 森林类型<br>Forest types          | 树木 Tree         |                       |                             |                                                            |                           |                                                            | 木质藤本 Liana      |                      |                             |                    |
|-------------------------------|-----------------|-----------------------|-----------------------------|------------------------------------------------------------|---------------------------|------------------------------------------------------------|-----------------|----------------------|-----------------------------|--------------------|
|                               | 多度<br>Abundance | 丰富度<br>Richness       | 径级<br>Diameter class<br>/cm | 个体数<br>(支持木数)<br>Individuals<br>(host tree<br>individuals) | 高度级<br>Height class<br>/m | 个体数<br>(支持木数)<br>Individuals<br>(host tree<br>individuals) | 多度<br>Abundance | 丰富度<br>Richness      | 径级<br>Diameter class<br>/cm | 个体数<br>Individuals |
| 原始林<br>Primary forest         | 1722            | 46 科<br>78 属<br>120 种 | 1—3                         | 1014 (304)                                                 | 1.5—3                     | 688 (159)                                                  | 714             | 23 科<br>31 属<br>38 种 | 0.5                         | 466                |
|                               |                 |                       | 3—5                         | 285 (151)                                                  |                           |                                                            |                 |                      | 0.5—1                       | 152                |
|                               |                 |                       | 5—10                        | 209 (120)                                                  |                           |                                                            |                 |                      | 1—2                         | 46                 |
|                               |                 |                       | 10—20                       | 130 (69)                                                   |                           |                                                            |                 |                      | 2—5                         | 36                 |
|                               |                 |                       | 20—40                       | 54 (31)                                                    |                           |                                                            |                 |                      | ≥5                          | 14                 |
|                               |                 |                       | ≥40                         | 30 (24)                                                    |                           |                                                            |                 |                      |                             |                    |
| 伐后林<br>Post-harvest<br>forest | 2710            | 49 科<br>82 属<br>133 种 | 1—3                         | 1168 (300)                                                 | 1.5—3                     | 532 (100)                                                  | 773             | 25 科<br>27 属<br>33 种 | 0.5                         | 290                |
|                               |                 |                       | 3—5                         | 737 (248)                                                  |                           |                                                            |                 |                      | 0.5—1                       | 336                |
|                               |                 |                       | 5—10                        | 494 (210)                                                  |                           |                                                            |                 |                      | 1—2                         | 108                |
|                               |                 |                       | 10—20                       | 224 (102)                                                  |                           |                                                            |                 |                      | 2—5                         | 36                 |
|                               |                 |                       | 20—40                       | 61 (35)                                                    |                           |                                                            |                 |                      | ≥5                          | 3                  |
|                               |                 |                       | ≥40                         | 26 (4)                                                     |                           |                                                            |                 |                      |                             |                    |

2.2 统计分析方法

同一林型内木质藤本在不同科树木上的分布情况采用单因素方差(One-way ANOVA)分析并用 LSD 进行多重比较。原始林与伐后林间木质藤本在相同科树木上的分布情况,优势树种附藤率和每木藤本数与样地平均水平的比较,每种木质藤本在主要支持木上的分布频率与该藤本在所有支持木上平均分布频率的比较均采用 T 检验。显著性水平差异设定为  $P < 0.05$ ,所有分析采用 SPSS 18.0 统计分析软件完成。

3 结果与分析

3.1 木质藤本在不同科树木上的分布情况

原始林中,附藤率较高的 6 科树木依次是野牡丹科(Melastomataceae) ( $49.6 \pm 4.918$ )%、壳斗科(Fagaceae) ( $48.1 \pm 9.196$ )%、桃金娘科(Myrtaceae) ( $47.9 \pm 4.634$ )%、茜草科(Rubiaceae) ( $39.6 \pm 2.977$ )%、樟科(Lauraceae) ( $33.2 \pm 3.684$ )%、山矾科(Symplocaceae) ( $32.2 \pm 5.918$ )%,但是 6 科树木的附藤率差异不显著( $F=1.97, P=0.09$ )。而在伐后林中,附藤率较高的 6 科树木依次是野牡丹科( $49.3 \pm 6.759$ )%、壳斗科( $39.4 \pm 3.848$ )%、桃金娘科( $36.1 \pm 4.069$ )%、樟科( $34.7 \pm 3.646$ )%、山矾科( $31.7 \pm 3.103$ )%、茜草科( $21.4 \pm 2.878$ )%,6 科树木附藤率之间差异显著( $F=4.65, P<0.01$ ) (图 1)。原始林与伐后林中,对应科树木附藤率存在差异的只有茜草科( $t=4.39, P<0.01$ ),其余 5 科之间没有显著差异(图 1)。

3.2 树木附藤情况

原始林中,谷木(Memecylon ligustrifolium)和线枝葡萄(Syzygium araiocladum)的附藤比率高于样地平均水平,而三角瓣花(Prismatomeris tetrandra)和龟背灰木(Symplocos andenophylla)的附藤比率低于样地平均水平;谷木、线枝葡萄和黄牛奶树(Symplocos laurina)的平均每木藤本数均高于样地平均水平。伐后林中,谷木的附藤比率高于样地平均水平,而九节(Psychotria rubra)的附藤比率低于样地平均水平;平均每木藤本数高于样地平均水平的有谷木、线枝葡萄和长柄山油柑(Acronychia pedunculata),低于样地平均水平的只有九节(表 2)。

3.3 木质藤本对支持木的选择

原始林中谷木是大多数木质藤本优先选择的支持木,其中有 4 种藤本的支持木主要是谷木。夜花藤(Hypserpa nitida)和杜仲藤(Parabarium micranthum)在主要支持木上的攀附频率,明显高于在其它支持木上的攀附频率。伐后林中有 2 种藤本的主要支持木是线枝蒲桃,2 种藤本的主要支持木是谷木。夜花藤、杜仲藤、细致菝葜(Smilax amaurophlebia)和菝葜(Smilax china)在主要支持木上的攀附频率,要高于在其它支持木上

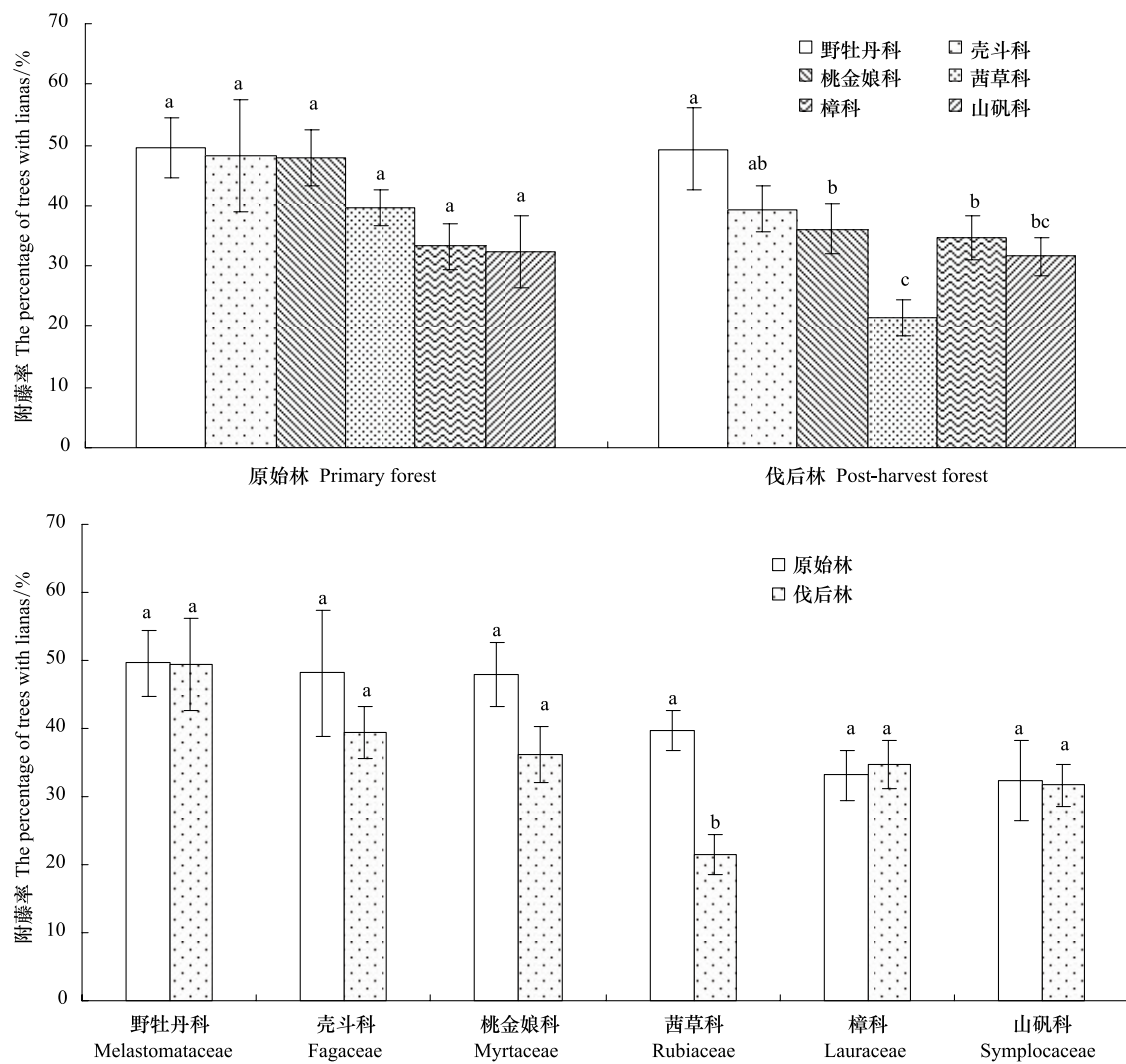


图 1 木质藤本对不同科支持木的选择

Fig. 1 The distribution of lianas-infested tree families in the tropical montane primary forest and post-harvest forest of Bawangling  
柱状图顶部字母的不同表示存在显著性差异 ( $P < 0.05$ )

表 2 树木(个体数 $\geq 50$ )( $DBH \geq 1$  cm)附藤比率及平均每木藤本数

Table 2 The percentage of tree with lianas and mean number of lianas per tree in the tropical montane primary forest and post-harvest forest of Bawangling

| 森林类型<br>Forest types          | 种名<br>Species                          | 科名<br>Family    | 个体数<br>Number<br>of individuals | 附藤比率/%<br>Percentage<br>of host<br>trees with lianas | 平均每木藤本数<br>Mean number<br>of lianas per tree |
|-------------------------------|----------------------------------------|-----------------|---------------------------------|------------------------------------------------------|----------------------------------------------|
| 原始林<br>Primary forest         | 谷木 <i>Memecylon ligustrifolium</i>     | Melastomataceae | 177                             | 57.8 $\pm$ 5.91 *                                    | 0.68 $\pm$ 0.089 **                          |
|                               | 线枝蒲桃 <i>Syzygium araiocladum</i>       | Myrtaceae       | 135                             | 59.5 $\pm$ 4.97 **                                   | 0.83 $\pm$ 0.148 **                          |
|                               | 三角瓣花 <i>Prismatomeris tetrandra</i>    | Rubiaceae       | 123                             | 31.1 $\pm$ 4.01 *                                    | 0.34 $\pm$ 0.048                             |
|                               | 九节 <i>Psychotria rubra</i>             | Rubiaceae       | 105                             | 33.0 $\pm$ 6.91                                      | 0.42 $\pm$ 0.087                             |
|                               | 乌心樟 <i>Cinnamomum tsoi</i>             | Lauraceae       | 96                              | 33.4 $\pm$ 6.39                                      | 0.43 $\pm$ 0.086                             |
|                               | 中华厚壳桂 <i>Cryptocarya chinensis</i>     | Lauraceae       | 94                              | 31.7 $\pm$ 6.26                                      | 0.43 $\pm$ 0.097                             |
|                               | 龟背灰木 <i>Symplocos andenophylla</i>     | Symplocaceae    | 81                              | 20.9 $\pm$ 5.85 **                                   | 0.25 $\pm$ 0.070                             |
|                               | 黄牛奶树 <i>Symplocos laurina</i>          | Symplocaceae    | 65                              | 50.2 $\pm$ 9.63                                      | 0.69 $\pm$ 0.128 *                           |
|                               | 厚皮香八角 <i>Illicium ternstroemioides</i> | Illiciaceae     | 54                              | 42.6 $\pm$ 10.26                                     | 0.56 $\pm$ 0.150                             |
| 伐后林<br>Post-harvest<br>forest | 黄牛奶树 <i>S. laurina</i>                 | Symplocaceae    | 211                             | 29.7 $\pm$ 4.04                                      | 0.35 $\pm$ 0.056                             |
|                               | 线枝蒲桃 <i>S. araiocladum</i>             | Myrtaceae       | 200                             | 34.9 $\pm$ 4.11                                      | 0.48 $\pm$ 0.076 *                           |
|                               | 九节 <i>P. rubra</i>                     | Rubiaceae       | 180                             | 19.5 $\pm$ 3.39 **                                   | 0.18 $\pm$ 0.036 **                          |

续表

| 森林类型<br>Forest types | 种名<br>Species                       | 科名<br>Family     | 个体数<br>Number<br>of individuals | 附藤比率/%<br>Percentage<br>of host<br>trees with lianas | 平均每木藤本数<br>Mean number<br>of lianas per tree |
|----------------------|-------------------------------------|------------------|---------------------------------|------------------------------------------------------|----------------------------------------------|
|                      | 龟背灰木 <i>S. andenophylla</i>         | Symplocaceae     | 165                             | 29.2±4.62                                            | 0.30±0.050                                   |
|                      | 丛花灰木 <i>Symplocos poilanei</i>      | Symplocaceae     | 144                             | 29.8±7.51                                            | 0.32±0.076                                   |
|                      | 谷木 <i>M. ligustrifolium</i>         | Melastomataceae  | 139                             | 56.8±7.26 **                                         | 0.82±0.162 **                                |
|                      | 海南山胡椒 <i>Lindera robusta</i>        | Lauraceae        | 136                             | 36.3±7.03                                            | 0.42±0.086                                   |
|                      | 海南栲 <i>Castanopsis hainanensis</i>  | Fagaceae         | 131                             | 38.9±6.73                                            | 0.51±0.105                                   |
|                      | 乌心樟 <i>C. tsoi</i>                  | Lauraceae        | 116                             | 36.0±5.95                                            | 0.37±0.061                                   |
|                      | 中华厚壳桂 <i>C. chinensis</i>           | Lauraceae        | 109                             | 36.2±6.85                                            | 0.45±0.119                                   |
|                      | 长柄山油柑 <i>Acronychia pedunculata</i> | Rutaceae         | 86                              | 40.1±7.12                                            | 0.47±0.076 *                                 |
|                      | 厚皮香八角 <i>I. ternstroemioides</i>    | Illiciaceae      | 85                              | 39.3±5.49                                            | 0.41±0.073                                   |
|                      | 凸脉冬青 <i>Ilex kobuskiana</i>         | Aquifoliaceae    | 56                              | 33.8±7.49                                            | 0.37±0.083                                   |
|                      | 五列木 <i>Pentaphylax euryoides</i>    | Pentaphylacaceae | 53                              | 49.6±10.92                                           | 0.46±0.103                                   |

原始林样地中树木的平均附藤率是 (41.1±2.73) % , 平均每木藤本数是 0.41±0.03; 伐后林样地中树木的平均附藤率是 (33.6±1.24) % , 平均每木藤本数是 0.29±0.01; \*  $P<0.05$ , \*\*  $P<0.01$

的攀附频率。匍匐九节 (*Psychotria serpens*) 的主要支持木是谷木, 夜花藤的主要支持木是线枝蒲桃, 这种选择在原始林与伐后林中表现一致 (表 3)。

表 3 木质藤本 (个体数≥30) 在主要支持木上的分布情况

Table 3 Mean number of lianas per dominant host tree in the tropical montane primary forest and post-harvest forest of Bawangling

| 森林类型<br>Forest types    | 科名<br>Family          | 种名 (个体数)<br>Species<br>(individuals)      | 主要支持木<br>(个体数)<br>Main host trees<br>(individuals) | 总支持木<br>个体数<br>All host<br>tree<br>individuals | 总支持木平均<br>每木藤本数<br>Mean number<br>of lianas per<br>host tree | 主要支持木<br>平均每木藤本数<br>Mean number of<br>lianas per dominant<br>host tree |
|-------------------------|-----------------------|-------------------------------------------|----------------------------------------------------|------------------------------------------------|--------------------------------------------------------------|------------------------------------------------------------------------|
| 原始林<br>Primary forest   | 茜草科<br>Rubiaceae      | 匍匐九节 (157)<br><i>Psychotria serpens</i>   | 谷木 (38)<br><i>Memecylon ligustrifolium</i>         | 166                                            | 0.97±0.013                                                   | 0.99±0.032                                                             |
|                         | 防己科<br>Menispermaceae | 夜花藤 (128)<br><i>Hypserpa nitida</i>       | 线枝蒲桃 (35)<br><i>Syzygium araiocladum</i>           | 201                                            | 0.65±0.050                                                   | 0.96±0.042 **                                                          |
|                         | 夹竹桃科<br>Apocynaceae   | 杜仲藤 (38)<br><i>Parabarium micranthum</i>  | 谷木 (13)<br><i>M. ligustrifolium</i>                | 112                                            | 0.81±0.052                                                   | 1.01±0.005 *                                                           |
|                         | 菝葜科<br>Smilacaceae    | 菝葜 (46)<br><i>Smilax china</i>            | 谷木 (12)<br><i>M. ligustrifolium</i>                | 56                                             | 0.92±0.044                                                   | 1.00±0.200                                                             |
|                         | 胡椒科<br>Piperaceae     | 华南蒟 (46)<br><i>Piper austrosinense</i>    | 谷木 (10)<br><i>M. ligustrifolium</i>                | 47                                             | 0.99±0.011                                                   | 1.00±0.120                                                             |
|                         | 防己科<br>Menispermaceae | 夜花藤 (183)<br><i>H. nitida</i>             | 线枝蒲桃 (35)<br><i>S. araiocladum</i>                 | 298                                            | 0.62±0.036                                                   | 0.99±0.085 **                                                          |
|                         | 夹竹桃科<br>Apocynaceae   | 杜仲藤 (111)<br><i>P. micranthum</i>         | 谷木 (14)<br><i>M. ligustrifolium</i>                | 138                                            | 0.70±0.045                                                   | 1.00±0.002 **                                                          |
| 伐后林 Post-harvest forest | 茜草科<br>Rubiaceae      | 匍匐九节 (98)<br><i>P. serpens</i>            | 谷木 (17)<br><i>M. ligustrifolium</i>                | 102                                            | 0.92±0.040                                                   | 0.99±0.001                                                             |
|                         | 菝葜科<br>Smilacaceae    | 细枝菝葜 (90)<br><i>Smilax amaurophlebia</i>  | 九节 (16)<br><i>Psychotria rubra</i>                 | 140                                            | 0.64±0.052                                                   | 1.00±0.001 **                                                          |
|                         | 菝葜科<br>Smilacaceae    | 菝葜 (55)<br><i>S. china</i>                | 龟背灰木 (7)<br><i>Symplocos andenophylla</i>          | 74                                             | 0.75±0.068                                                   | 0.99±0.003                                                             |
|                         |                       |                                           | 丛花灰木 (7)<br><i>Symplocos poilanei</i>              |                                                |                                                              | 1.01±0.001 *                                                           |
|                         | 茜草科<br>Rubiaceae      | 楠藤 (38)<br><i>Mussaenda erosa</i>         | 海南栲 (7)<br><i>Castanopsis hainanensis</i>          | 55                                             | 0.78±0.084                                                   | 0.85±0.002                                                             |
|                         |                       |                                           | 线枝蒲桃 (6)<br><i>S. araiocladum</i>                  |                                                |                                                              | 0.96±0.035                                                             |
|                         | 马钱科<br>Loganiaceae    | 三脉马钱 (33)<br><i>Strychnos cathayensis</i> | 黄牛奶树 (6)<br><i>Symplocos laurina</i>               | 46                                             | 0.87±0.053                                                   | 0.96±0.035                                                             |
|                         |                       |                                           |                                                    |                                                |                                                              |                                                                        |
|                         |                       |                                           |                                                    |                                                |                                                              |                                                                        |
|                         |                       |                                           |                                                    |                                                |                                                              |                                                                        |

\*  $P<0.05$ , \*\*  $P<0.01$

## 4 结论与讨论

### 4.1 原始林与伐后林中木质藤本在不同科、种树木上的分布情况

在本研究区域,木质藤本对支持木在科和种水平上都具有一定的选择性,这与之前的研究结果基本一致<sup>[4,10-11,14]</sup>。本研究中,野牡丹科具有较高的附藤率,尽管在原始林中缺乏统计学上的显著性(图1)。这是由于本科的优势种谷木(表2)属于 Mangenot 型树木,这类树木的轴是混合型的<sup>[16]</sup>,整株树木在不同高度均有分枝,这为具有不同攀援高度的木质藤本<sup>[17]</sup>提供了合适高度的支持木;同时这类树木的枝下高较短,叶片钝圆且粗糙,为木质藤本的攀附提供了有效的攀援结构附着点<sup>[18-20]</sup>。另一个重要因素是,这类树木的干常常是由不断替代的近轴端垂直部分形成,而枝则是水平的远轴端部分形成<sup>[16]</sup>,这些结构可以有效地拦截光照,即使是攀附在底层的木质藤本也能得到足够的阳光,从而利于木质藤本存活。这在树种水平的研究中也得到了进一步的证明,在原始林和伐后林中谷木的附藤比率和每木藤本数都高于样地平均水平(表2)。

但是,附藤率较低的科在原始林和伐后林中存在差异,原始林中是山矾科,伐后林中是茜草科(图1)。从树种水平来看,原始林中,山矾科的优势种龟背灰木的附藤率低于样地平均水平,伐后林中,茜草科的优势种九节的附藤率和每木藤本都低于样地平均水平(表2)。影响两物种附藤率较低的原因可能是不同的。龟背灰木属于耐阴物种一般生长在荫蔽的林下,且树皮光滑不利于木质藤本的攀附<sup>[11]</sup>,而九节是属于 Leeuwenberg 型树木的灌木,处于光照较弱的森林底层,竞争力较弱<sup>[21]</sup>,同样不利于木质藤本攀附。虽然九节在原始林中也属于茜草科的优势种,龟背灰木在伐后林中也是山矾科的优势种,但二者的附藤率却没有显著低于森林平均水平(表2)。这说明木质藤本对支持木的选择受森林环境和树木特征的双重影响<sup>[11]</sup>,森林环境和森林类型会影响木质藤本的多度和分布<sup>[22]</sup>,同时也会影响树木的多度和分布<sup>[23]</sup>(表1),从而造成木质藤本在原始林和伐后林中对支持木的选择差异。木质藤本对支持木的选择除受树木本身的特征影响之外,还与其他因素相关,如微环境的不同<sup>[11]</sup>,也可能与藤本的分布类型、树木的年龄组成等相关,但尚未被证实。本研究表明木质藤本对不同树种的影响不同,因此木质藤本可以引起树种间的不对称竞争,从而在长久的进化过程中木质藤本会改变森林中树木的物种组成<sup>[4,6]</sup>,进一步会影响整个热带雨林生态系统的结构和组成。

### 4.2 原始林与伐后林中木质藤本对支持木的选择

本研究表明,一些木质藤本与支持木之间存在明显的对应关系,木质藤本会优先选择适合其攀附的支持木,这种对应关系在原始林和伐后林内均表现明显,这与多数研究结果一致<sup>[9-11]</sup>。不论是在原始林还是在伐后林中,夜花藤和杜仲藤对支持木均具有高度的选择性,但是,在原始林与伐后林中同种木质藤本选择的支持木有所不同,如菝葜(表3)。这是因为菝葜是通过卷须来攀附树木,而卷须类木质藤本通常只能攀附小径级支持木<sup>[24]</sup>,而在原始林中小径级树木相对伐后林较少(表1),使它们更多的通过树木上已经攀附的木质藤本作为支持木<sup>[25]</sup>,从而改变了菝葜对支持木的专一选择性。同时也表明,森林微环境的不同会影响木质藤本对支持木的选择策略<sup>[3,8,26]</sup>。伐后林中三脉马钱在两种支持木上的攀附比率相同(表3),可能是因为,三脉马钱是通过主茎缠绕来攀附支持木,而主茎缠绕类木质藤本对支持木没有严格的物种选择<sup>[20]</sup>,第二个原因是由于伐后林树木群落基本接近饱和,从而会掩盖木质藤本对不同树种选择的差异<sup>[27]</sup>。

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