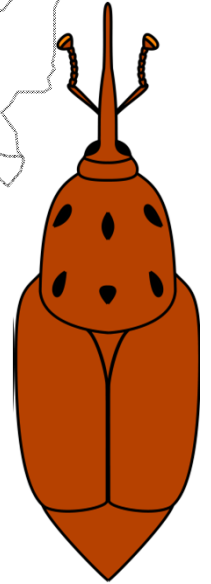


Occurrence and Damage of Red Palm Weevil in China



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2010-10-11





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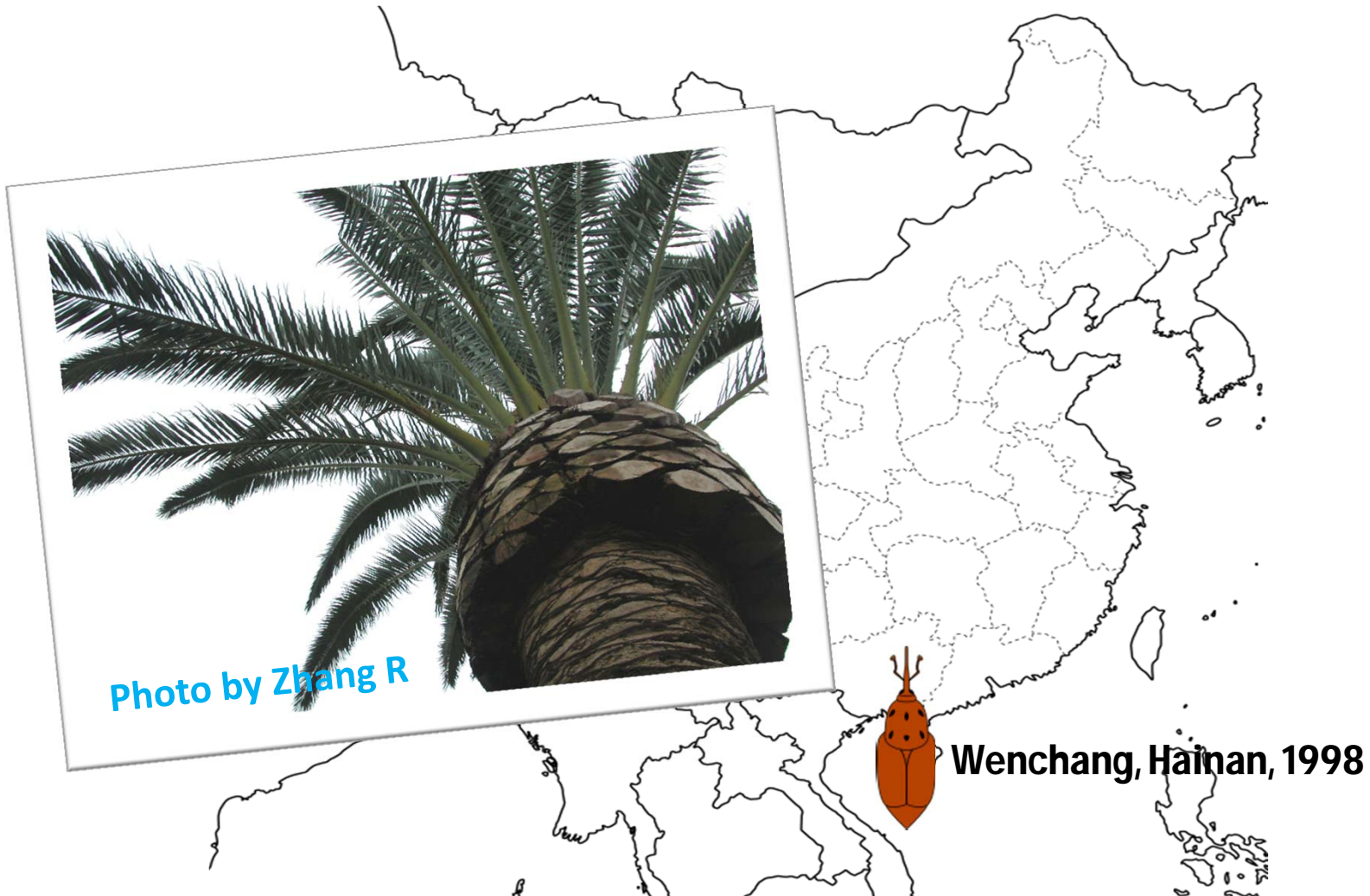




Occurrence



Earliest invasion report





Occurrence

Reported occurrence locality

1998-2010

Hainan (Wenchang, Haikou, Wanning, Qionghai, Danzhou)

Guangdong (Nanhai, Guangzhou)

Guangxi (Nanning, **Chongzuo**, Liuzhou, Beihai)

Yunnan (Honghe, Jinghong, Funing)

Guizhou (Guiyang)

Fujian (Ningde, Xiamen)

Zhejiang (Lishui, Cangnan, **Yiwu**)

Tibet (Motuo)

Jiangsu

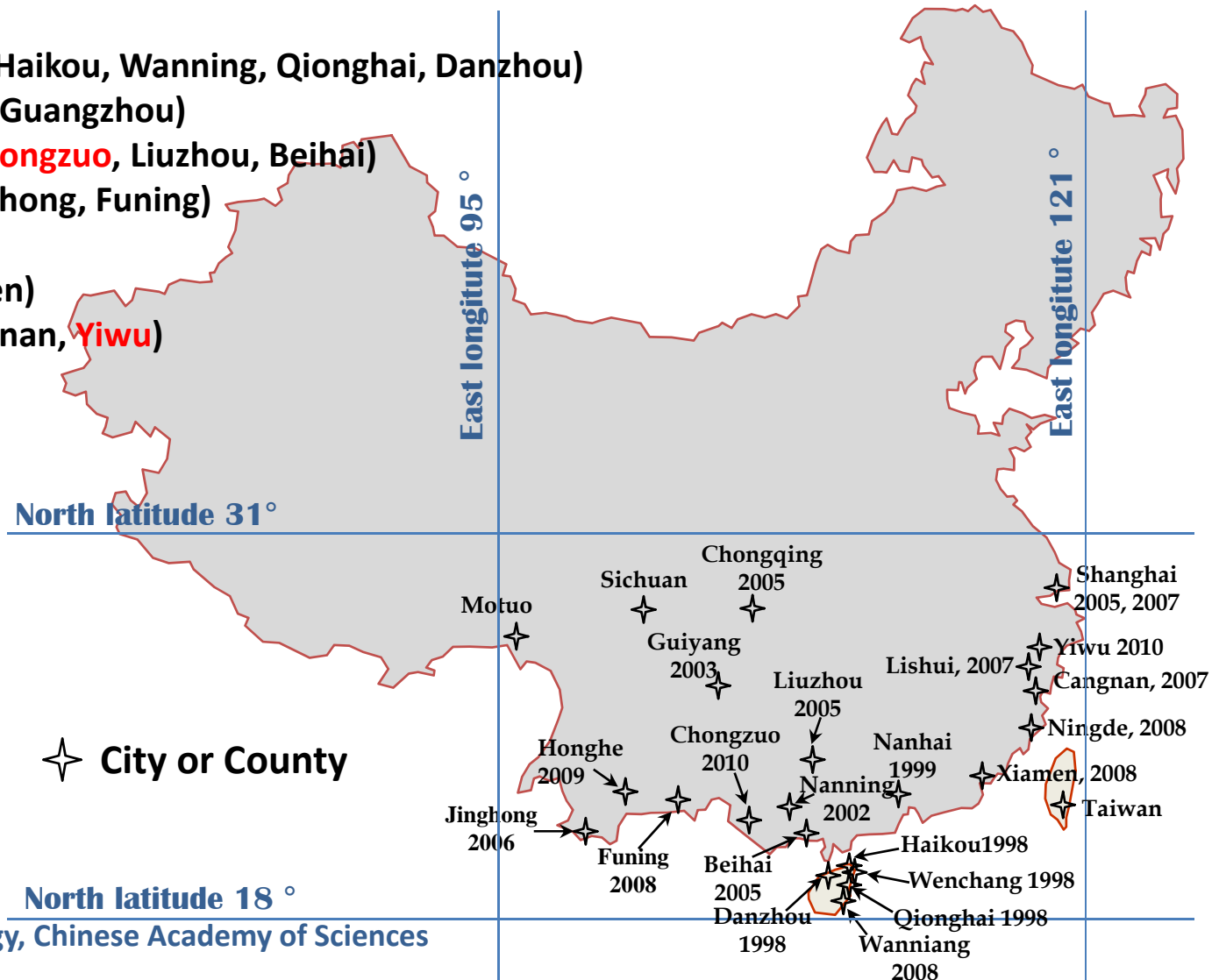
Jiangxi

Chongqing

Sichuan

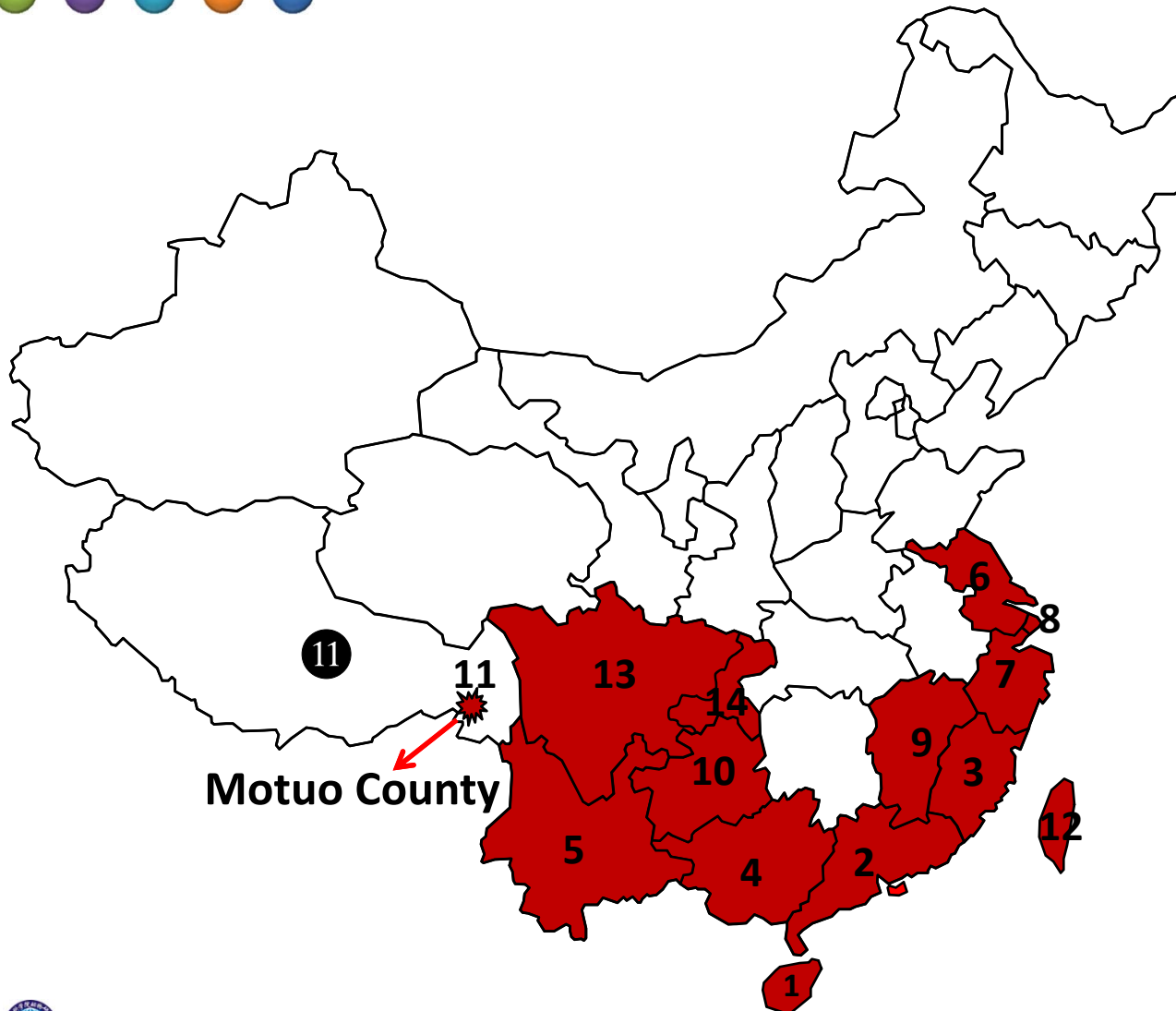
Shanghai

Taiwan





Distribution



- 1 Hainan
- 2 Guangdong
- 3 Fujian
- 4 Guangxi
- 5 Yunnan
- 6 Jiangsu
- 7 Zhejiang
- 8 Shanghai
- 9 Jiangxi
- 10 Guizhou
- 11 Tibet
- 12 Taiwan
- 13 Sichuan
- 14 Chongqing



Damage



Main Hosts in China

1. *Areca catechu*
2. *Arenga pinnata*
3. *Bismarckia nobilis*
4. *Borassus flabellifer*
5. *Caryota maxima*
6. *C. cumingii*
7. *Cocos nucifera*
8. *Corypha gebanga*
9. *C. elata*
10. *C. cumingii*
11. *C. umbraculifer*
12. *Elaeis guineensis*
13. *Livistona chinensis*
14. *Livistona cochinchinensis*
15. *Metroxylon sagu*
16. *Neodypsis decaryi*
17. *Oreodoxa regia*
18. *Phoenix canariensis*
19. *P. dactylifera*
20. *P. hamceana* var. *formosana*
21. *P. sylvestris*
22. *Saccharum sinense*
23. *Washingtonia filifera*



Damage



Economic losses

The red palm weevil caused very serious damage on coconut and areca palm plantations in China. Some other economical or ornamental palms were also involved. For example in 2007, it was reported that RPW had caused more than 150,000\$ economic losses in Guiyang, Guizhou province in China. Generally, 20-80% of palm trees in a farm can be injured based on some investigations. Therefore, it is difficult to assess the actual loss caused by this pest, but undoubtedly it affects the production of coconut palms as well as other economical palm trees in south of China.



Photo by Zhang R

Photo by Zhang R

Photo by Zhang R





2010-6-9, Yiwu, Zhejiang, 400 Canary date palms were burned.

Prof. Zhang (left) was checking infested Canary date palm in Zhejiang.

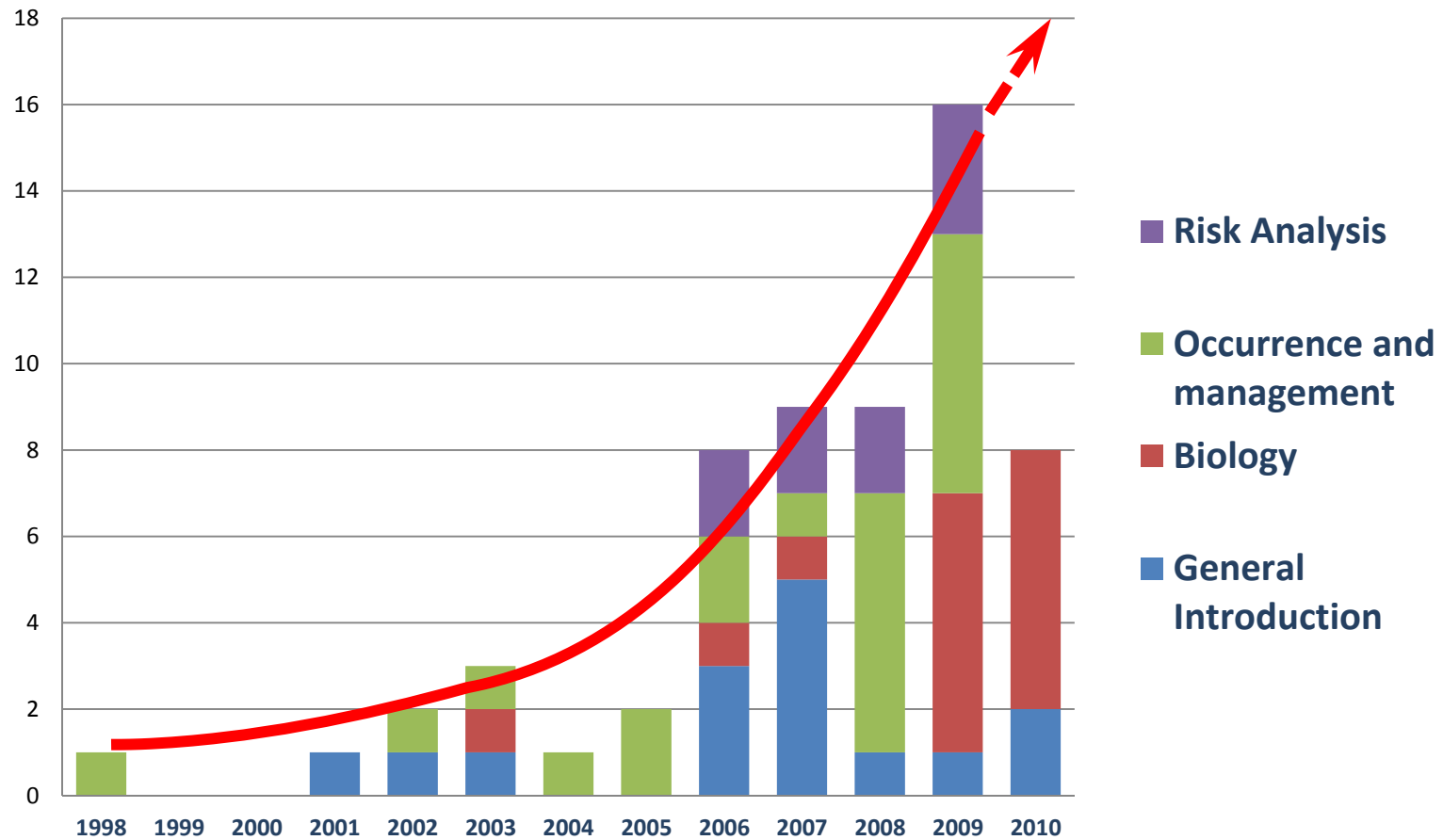


Red Palm Weevil was listed in:

- List of Forestry Quarantine Pests (2005-3-1, by State Forestry Administration) ;
- Catalogue of Quarantine Pests of Import Plants to the People 's Republic of China (The Ministry of Agriculture Bulletin No. 862 of the People's Republic of China, 2007-5-28, by Ministry of Agriculture of the People's Republic of China) .

Research Status

Papers published on RPW by Chinese Researchers (1998-2010)





椰子大害虫—锈色棕榈象及其近缘种的鉴别 (鞘翅目：象虫科)

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(1. 中国科学院动物研究所, 北京 100080; 2. 国家林业局森林保护司, 北京 100714; 3. 海南省森林病虫害防治站, 海南海口 570000)

摘要: 锈色棕榈象 *Rhynchophorus ferrugineus* (Oliver) 隶属于鞘翅目 Coleoptera 象虫科 Curculionidae, 近年在海南省严重危害椰子。文章介绍了该虫与同属近缘种美洲棕榈象 *Rhynchophorus palmarum* (L.) 等成虫、幼虫和蛹在形态特征上的区别。

关键词: 锈色棕榈象; 椰子; 种检索表

中图分类号: S763.38 **文献标识码:** A **文章编号:** 1671-0886(2003)02-0003-04

Morphological differences of the coconut pest insect, *Rhynchophorus ferrugineus* (Oliver), and its related species (Coleoptera: Curculionidae). //ZHANG Run-zhi, et al. (Institute of Zoology, Chinese Academy of Sciences, Beijing 100080, China)

Abstract: In recent years, *Rhynchophorus ferrugineus* (Oliver), which belongs to Curculionidae, Coleoptera, is getting to be a very serious pest on coconut in Hainan Province. The key to adult, larva and pupa of *R. ferrugineus* and its related species including the famous pest insect *R. palmarum* (L.) was given.

Key words: *Rhynchophorus ferrugineus* (Oliver); coconut; key to species

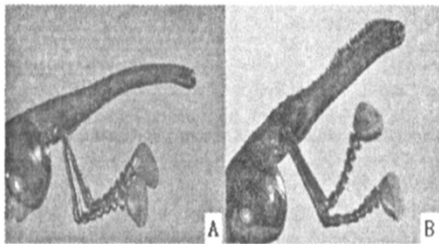


图 5 雌虫的喙与触角; 图 6 雄虫的喙与触角

图 5 红棕象甲成虫的喙与触角

Fig 5 The beak and antenna of *Rhynchonius ferrugineus*

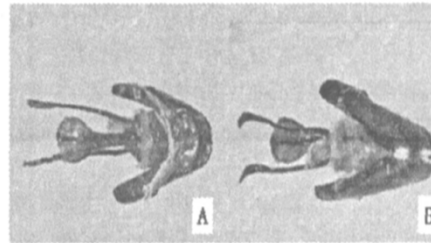


图 7 红棕象甲雄性外生殖器

图 7 红棕象甲雄性外生殖器

Fig 7 The male external genitalia of *Rhynchonius ferrugineus*

In 2003, We published a paper including a key to distinguish RPW from most of its similar congener species.

中国森林病虫 2003年3月 第22卷 第2期

· 5 ·

- 美洲棕榈象 *Rhynchophorus palmarum* (Linnaeus)
- 6. 臀板光滑; 跗节第三节底面两侧无刚毛列; 眼间距接近喙基部宽的三分之一; 前胸背板基部宽圆, 常具两条纵贯全长的红色纵带; 小盾片向后突出甚狭..... 纵纹棕榈象 *Rhynchophorus vulneratus* (Parzer)
- 寒椰棕榈象 *Rhynchophorus phoenicis* (Fabricius)
- 臀板具刻点, 跗节第3节底面两侧各具1列刚毛; 前胸背板基部卵形或者宽卵形, 常具1条宽的红色的纵带, 或者两条短小的红色纵带, 或者几个斑点; 小盾片有些向后突出..... 7
- 7. 外咽缝直到基部宽度均一; 上顎端部具4个齿; 亚颚端部截断并且中央具1个三角形凹陷; 身体黑色, 前胸背板上常具狭窄短小的红色纵带.....
- 二线棕榈象 *Rhynchophorus bilineatus* (Montrouzier)
- 二线棕榈象 *Rhynchophorus bilineatus* (Montrouzier)
- 外咽缝在基部狭缩之前长卵形扩宽; 上顎端部具3个齿; 亚颚端部截断并且弧形凹入, 具纵贯全长的狭长的中纵沟; 身体黑色或者铁锈色, 前胸背板常具1条宽的红色纵带或者斑点..... 8
- 8. 前胸背板基部宽卵形, 两侧弧形比较均匀的向前狭缩; 身体常铁锈色, 前胸背板具黑色斑点.....
- 锈色棕榈象 *Rhynchophorus ferrugineus* (Oliver)
- 前胸背板宽卵形但两侧向前强烈狭缩; 身体常黑色, 前胸背板中央具1条宽的红色纵带.....
- 纵纹棕榈象 *Rhynchophorus vulneratus* (Parzer)
- 3.1 幼虫检索表
- 1. 内唇感觉孔靠近刚毛2而远离刚毛1; 上唇侧面具16-22根刚毛..... 2
- 内唇感觉孔在刚毛1与刚毛2中间或者接近中间, 上唇侧面具24-30根刚毛..... 3
- 2. 上唇侧面具16根短刚毛; 内唇感觉孔与刚毛1间距几乎是与刚毛2间距的3倍; 腹部第8节背片前方背面无刚毛.....
- 美洲棕榈象 *Rhynchophorus palmarum* (Linnaeus)
- 端部齿钝; 下颚叶背面具二分叉的刚毛和三分叉的刚毛; 内唇刚毛1与内唇间距是内唇刚毛1与刚毛2间距的4倍.....
- 纵纹棕榈象 *Rhynchophorus vulneratus* (Parzer)
- 5. 上唇侧面具30根刚毛; 下颚叶背面具20根刚毛; 上颚大, 甚厚而粗壮; 腹部第8背片背面前方和后方各具2根刚毛.....
- 寒椰棕榈象 *Rhynchophorus phoenicis* (Fabricius)
- 上唇侧面具24根刚毛; 下颚叶背面具18根刚毛; 上颚小, 不粗壮; 腹部第8背片背面前方和后方无刚毛.....
- 二线棕榈象 *Rhynchophorus bilineatus* (Montrouzier)
- 3.1 蛹检索表
- 1. 前胸背板具两对或者3对刚毛; 中胸背板具1对刚毛..... 2
- 前胸背板和中胸背板无刚毛..... 3
- 2. 前胸背板各对刚毛间距近相等; 喙具3对着生于瘤突上的刚毛, 有的刚毛二分叉.....
- 纵纹棕榈象 *Rhynchophorus vulneratus* (Parzer)
- 前胸背板前面一对刚毛间距是后面1对刚毛间距的两倍; 喙具2到4对着生于瘤突上的刚毛.....
- 锈色棕榈象 *Rhynchophorus ferrugineus* (Oliver)
- 3. 喙背面具7对着生于瘤突上的刚毛; 后胸背板无刚毛.....
- 寒椰棕榈象 *Rhynchophorus phoenicis* (Fabricius)
- 喙背面具3对或者更少刚毛; 后胸背板常具1对刚毛.....
- 4
- 4. 喙背面具1对刚毛, 并且在触角着生处之间具隆起的瘤突.....
- 深红棕榈象 *Rhynchophorus ornatatus* (Fabricius)
- 喙背面具3对着生于瘤突上的刚毛, 2对位于喙基部的瘤突上.....
- 美洲棕榈象 *Rhynchophorus palmarum* (Linnaeus)





Research Status



Identification



Identification information can also obtain from some database of invasive species.

中国外来入侵昆虫数据库

| | | |
|---------|--------|--|
| AN00063 | 水椰八角铁甲 | Octodonta nipae (Maulik) |
| AN00064 | 四纹豆象 | Callosobruchus maculatus (Fabricius) Cowpea Weevil |
| AN00065 | 松突圆蚧 | Hemiberlesia pitysophila Takagi Pine needle scale |
| AN00066 | 苏铁白轮盾蚧 | Aulacaspis yasumatsui Takagi Asian cycad scale |
| AN00067 | 台湾乳白蚁 | Coptotermes formosanus Shiraki Formosan termite |
| AN00068 | 桃条麦蛾 | Anarsia lineatella Zeller Peach twig borer |
| AN00069 | 豌豆象 | Bruchus pisorum (Linnaeus) Pea weevil |
| AN00070 | 温室白粉虱 | Trialeurodes vaporariorum (Westwood) Greenhouse whitefly |
| AN00071 | 西花蓟马 | Frankliniella occidentalis Western flower thrips |
| AN00073 | 香蕉弄蝶 | Erionota torus Banana skipper |
| AN00074 | 香蕉象甲 | Cosmopolites sordidus Germar Banana root borer |
| AN00075 | 小楹白蚁 | Incisitermes minor (Hagen) Western drywood termite |
| AN00076 | 杏小食心虫 | Cydia prunivora Lesser apple tortrix |
| AN00077 | 锈色棕榈象 | Rhynchophorus ferrugineus (Oliver) Red palm weevil |
| AN00078 | 烟粉虱 | Bemisia tabaci (Gennadius) Cotton whitefly |
| AN00079 | 椰心叶甲 | Brontispa longissima (Gestro) Palm leaf miner |
| AN00080 | 野葛豆象 | Callosobruchus ademptus (Sharp) |

www.invasivespecies.org.cn

农业部外来入侵生物预防与控制研究中心
Center for Management of Invasive Alien Species Ministry of Agriculture, P. R. China. CMIAS

首页 | 中心简介 | 科研骨干 | 人才培养 | 科研环境 | 承担项目 | 科研成果 | 发表论文 | 学术交流 ENGLISH 2010年10月5日 星期二 4:26下午

| 通知公告 | |
|--|---|
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| 中文俗名: | <input type="text"/> |
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| 快速导航 | |
| 留言板 | |
| 种群建立情况 | |
| 中国分布 | 广东、广西、海南、云南、福建、香港、台湾。 |
| 经济和生态影响 | 如果锈色棕榈象侵入我国内陆定殖，将对我国棕榈植物造成巨大威胁，具有很大的潜在生态、经济危害性。由于棕榈植物生长周期较长，观赏价值高，所以价格也比较高。遭锈色棕榈象危害后，棕榈植株一般会迅速死亡，经济损失较大。除直接危害外，锈色棕榈象入侵后会明显破坏景观，降低景观价值，并威胁椰子产业。也可能造成在防治锈色棕榈象中滥用杀虫剂而引起潜在的环境和健康问题。由于锈色棕榈象是一种新的入侵生物，对新的生态系统的影响目前研究较少，有必要进行进一步的深入探讨。 |
| 首次发现或引入的地点及时间 | 中国广东省中山市1997年在一个棕榈苗圃发现该虫，估计是由于从1994年开始从台湾引入海枣、台湾枣和银海枣等棕榈苗木而传入。 |





Research Status



Life cycle

In general, RPW has **2-4 generations per year** in South China, with generation overlapping. Larvae are the main stage to injure the palm trees.

Example: Study on the biology of RPW in Guangxi (Ou *et al*, 2009)

Table 1 The life history of palm Rhynchophorus ferrugineus Fabricius in Nanning City of Guangxi Province

| 世代 Generation | 3月 Mar | | | 4月 Apr | | | 5月 May | | | 6月 Jun | | | 7月 Jul | | | 8月 Aug | | | 9月 Sept | | | 10月 Oct | | | 11月 ~ 翌年 2月 Nov to Feb in the next year | | | | | | | | |
|---------------------------------|------------|----------|-----------|------------|----------|-----------|------------|----------|-----------|------------|----------|-----------|------------|----------|-----------|------------|----------|-----------|------------|----------|-----------|------------|----------|-----------|--|----------|-----------|---|---|---|---|---|---|
| | 上 Early | 中 Mid | 下 Late | 上 Early | 中 Mid | 下 Late | 上 Early | 中 Mid | 下 Late | 上 Early | 中 Mid | 下 Late | 上 Early | 中 Mid | 下 Late | 上 Early | 中 Mid | 下 Late | 上 Early | 中 Mid | 下 Late | 上 Early | 中 Mid | 下 Late | 上 Early | 中 Mid | 下 Late | | | | | | |
| 越冬代 Overwintering generation | - | - | - | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | | | | | | | | | | | | | | | | - | - | - | + | + | + | ▲ | ▲ | ▲ |
| 第 1 代 The first generation | | | | | | | ● | | | | | | + | + | + | | | | | | | | | | | | | | | | | | |
| 第 2 代 The second generation | | | | | | | | | | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | | | | | | | | | |
| 第 3 代 The third generation | | | | | | | | | | | | | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | | | |

注：●卵；-幼虫；+成虫；▲蛹。

Note: ● stands for egg; - stands for larva; + stands for adult; ▲ stands for pupa





Example: Study on the effect of temperature on the population growth of RPW on sugarcane in Hainan (Li *et al*, 2010).

Table 3. Experimental population life table of *R. ferrugineus* at seven constant temperatures

| Stage | 40°C | 36°C | 32°C | 28°C | 24°C | 20°C | 16°C |
|-------------------------------------|------|--------|---------|---------|---------|--------|------|
| No. initial eggs | 150 | 150 | 150 | 150 | 150 | 150 | 150 |
| Mortality (%) | 100 | 40 | 7.33 | 6.67 | 14 | 25.33 | 100 |
| No. initial L1 | 0 | 90 | 139.01 | 140.00 | 129.00 | 112.01 | 0 |
| Mortality (%) | — | 32.22 | 33.09 | 23.57 | 28.68 | 27.43 | — |
| No. initial L2 | — | 61 | 93.01 | 107.00 | 92.00 | 81.29 | — |
| Mortality (%) | — | 37.70 | 34.41 | 37.38 | 36.96 | 42.18 | — |
| No. initial L3 | — | 38 | 61.01 | 67.00 | 58.00 | 47.00 | — |
| Mortality (%) | — | 23.68 | 19.67 | 19.40 | 20.69 | 38.30 | — |
| No. initial L4-L10 | — | 29 | 49.01 | 54.00 | 46.00 | 29.00 | — |
| Mortality (%) | — | 24.14 | 20.41 | 20.37 | 34.78 | 41.38 | — |
| No. pupae | — | 22 | 39.01 | 43.00 | 30.00 | 17.00 | — |
| Mortality (%) | — | 13.64 | 15.38 | 6.98 | 16.67 | 35.29 | — |
| No. adults | — | 19 | 33.01 | 40.00 | 25.00 | 11.00 | — |
| No. females (1.49♀: 1♂) | — | 11.37 | 19.75 | 23.94 | 14.96 | 6.58 | — |
| Eggs laid per female | — | 49.40 | 197.10 | 239.47 | 116.10 | 59.20 | — |
| Eggs of next generation expected | — | 561.68 | 3892.73 | 5732.91 | 1736.86 | 389.54 | — |
| Population trend index (<i>I</i>) | — | 3.74 | 25.95 | 38.22 | 11.58 | 2.60 | — |

Based on this study, they concluded that the most suitable temperatures for the development of RPW are **from 28 centigrade to 32 centigrade.**





Research Status



Behavior

Example: Study on the reproductive behavior of RPW in Guangxi (Qin *et al*, 2010).

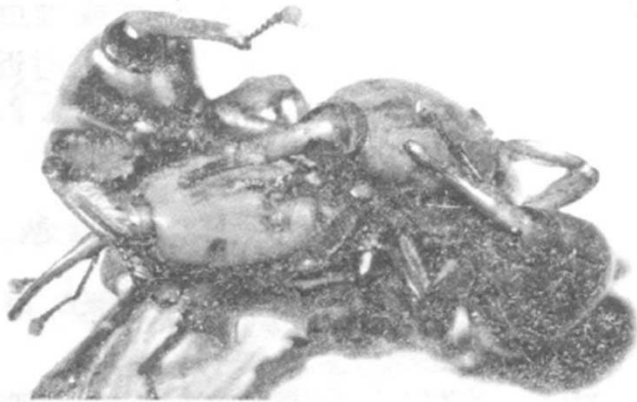


Fig.1 Competition in copulation of males

- Females are more active of oviposition at 7-10 pm during a day;
- There are two peaks of copulation during a day, 7-10 am and 4-6 pm;
- After copulation, males show protection behavior of females.

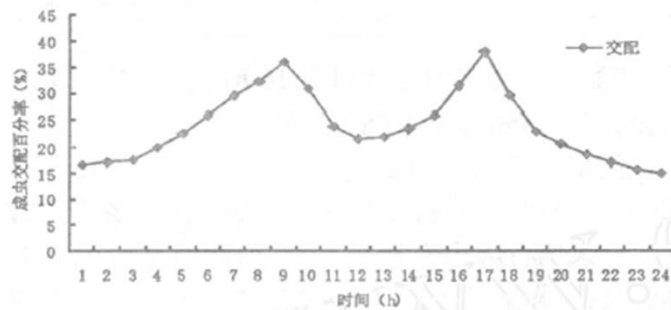


Fig.2 Circadian rhythm of copulation

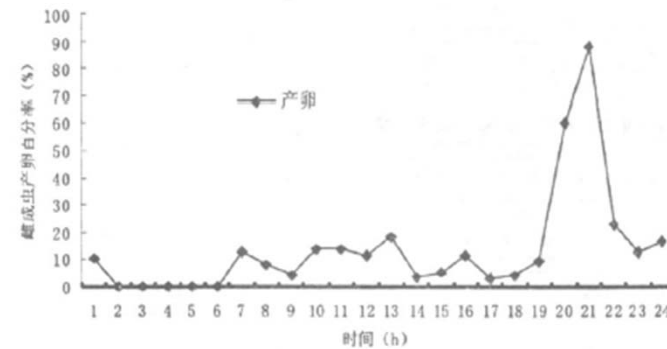


Fig.3 Circadian rhythm of oviposition



Table 6 The investigation results of harmfulness of each palm variety by palm Rhynchophorus ferrugineus Fabricius in Nanning City

| 调查品种 Investigated varieties | 被害部位 Damaged position | 平均被害株率 % Average damaged plant rate | 平均每株被害株中各虫态的数量 #头 Average number of each insect state per damaged plant | | | |
|--------------------------------|--------------------------|--|--|----------|--------|----------|
| | | | 卵 Egg | 幼虫 Larva | 蛹 Pupa | 成虫 Adult |
| 国王椰 | 叶鞘、茎秆内 | 89.56 | 109 | 37 | 16 | 19 |
| 老人葵 | 心叶、茎秆内 | 65.37 | 69 | 23 | 14 | 7 |
| 加拿利海枣 | 心叶、茎秆内 | 57.13 | 58 | 28 | 15 | 6 |
| 霸王棕 | 心叶、茎秆内 | 48.27 | 87 | 21 | 12 | 8 |
| 美丽针葵 | 心叶、茎秆内 | 27.25 | 17 | 14 | 3 | 4 |
| 大王椰 | 心叶、茎秆内 | 25.75 | 57 | 12 | 3 | 4 |
| 三角椰 | 心叶、茎秆内 | 15.25 | 51 | 11 | 8 | 0 |
| 箬叶棕 | 心叶、茎秆内 | 13.12 | 0 | 0 | 14 | 7 |
| 金山葵 | - | - | - | - | - | - |
| 棕榈 | - | - | - | - | - | - |

The field investigation on different palm were carried out in Nanning, Guangxi (Ou *et al*, 2009).

Table1 Investigation of damage caused by red palm weevil on Canary date palms

| 样点号 | 调查株数 | 受害株数 | 有虫株率 (%) | 单株枯死树平均虫口密度 (头) | | | 总数 |
|-----|------|------|----------|-----------------|-----|----|----|
| | | | | 成虫数 | 幼虫数 | 蛹 | |
| 1 | 26 | 10 | 38.5 | 11 | 39 | 4 | 54 |
| 2 | 63 | 26 | 41.2 | 6 | 13 | 2 | 21 |
| 3 | 53 | 18 | 34.0 | 25 | 46 | 10 | 81 |
| 4 | 74 | 6 | 8.3 | 0 | 33 | 3 | 36 |
| 5 | 38 | 5 | 13.2 | 8 | 21 | 0 | 29 |
| 6 | 67 | 12 | 17.9 | 30 | 12 | 7 | 49 |
| 7 | 34 | 18 | 52.9 | 32 | 13 | 2 | 47 |
| 8 | 45 | 8 | 17.8 | 16 | 31 | 10 | 57 |
| 9 | 102 | 9 | 8.8 | 2 | 57 | 8 | 67 |
| 10 | 79 | 13 | 16.5 | 26 | 35 | 10 | 71 |

The field investigation on Canary island date palm were carried out in Huidong, Guangdong (Zhong *et al*, 2007).

Research Status

Risk Analysis and Suitable Distribution Area

Example: Study on prediction of suitable distributions of RPW in China with analysis of bio-climatic matching (Ju *et al*, 2009).

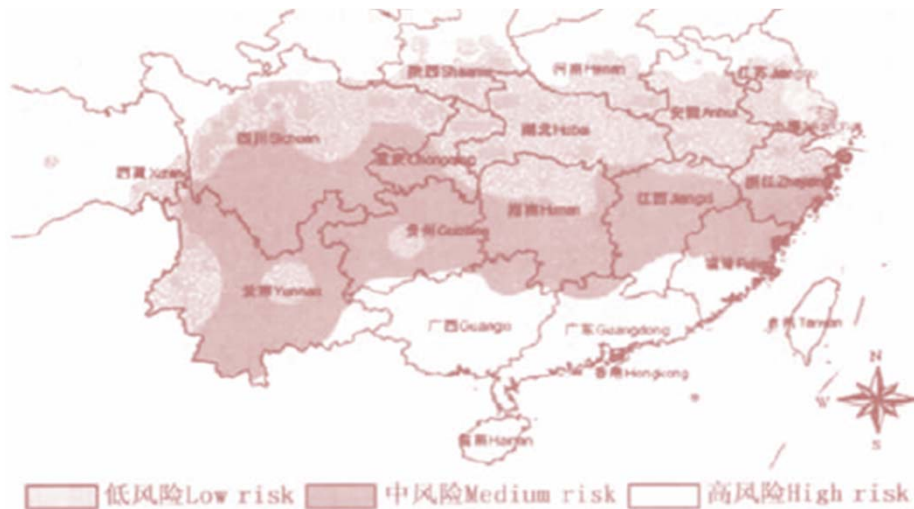


Fig.2 Prediction map of Suitable distribution area of RPW in China

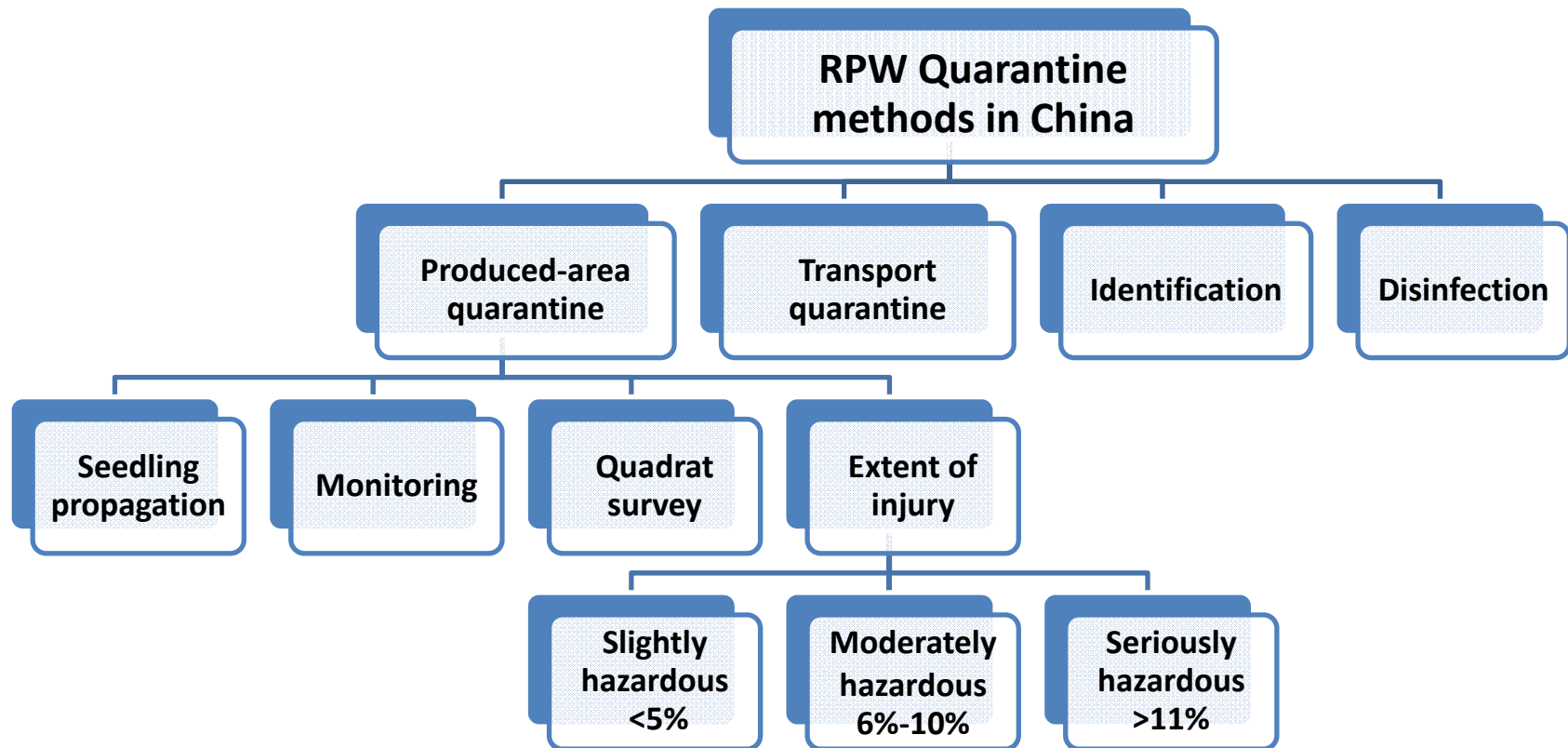
High risk area: Hainan, Guangdong, Guangxi, Hongkong, Taiwan, South of Fujian, East of Yunnan (Xishuangbanna)

Medium risk area: North of Fujian, Yunnan, Sichuan, Chongqing, Guizhou, Jiangxi, Hunan, South of Zhejiang (South of Yangtze River)

Low risk area: North of Zhejiang, Tibet (except Motuo), Shaanxi, Hubei, Henan, Anhui, Jiangsu, Shanghai



- 1 Quarantine
- 2 Field monitor
- 3 Pesticide control
- 4 Trap control
- 5 Hand picking





Management

Monitor

Example : The field monitor on different palms carried out in Hainan (Huang *et al*, 2010).



M. 红棕象甲监测点的设立; N. 红棕象甲诱捕器; O. 田间诱集的红棕象甲成虫。

Aggregation pheromone trap can catch red palm weevils all year.

Fig.4 Monitoring of Red Palm Weevil in the field

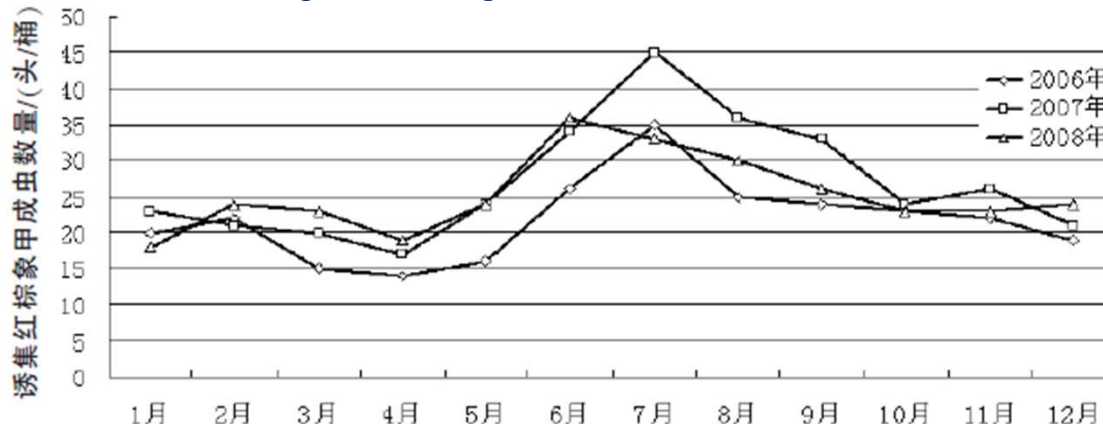


Fig.5 Monitoring results of adult activity in the field during 2006-2008

More adults are trapped from June to August in the field in Hainan.





Spraying systemic pesticide on the whole plant



Using systemic pesticide on the root



Injecting systemic pesticide in the borer hole of RPW or a 10cm deep hole bored on the top of injury part

Systemic Pesticide used in China: Flolimat; Omethoate Furadan; Phoxim; Malathion etc.



Management



Trap control

- Light trap
- Material trap
- Pheromone trap

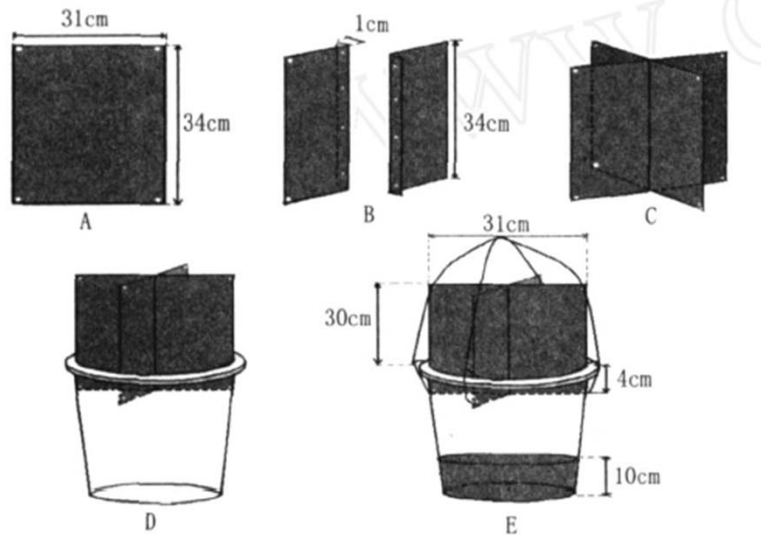


Fig.1 Procedure of making pheromone trap



What Threat ?



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Photo by Zhang R



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out me



Research interest and contact info



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- ✓ Weevil taxonomy;
- ✓ Quarantine pests, especially weevils

the end



THANK YOU !

