Redescription of *Prorhinotermes japonicus* (Isoptera: Rhinotermitidae) From Taiwan

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**ABSTRACT** The winged imago of *Prorhinotermes japonicus* (Holmgren 1912) is described herein for the first time. The soldier caste and two morphs of the neotenic caste also are redescribed. Based on the similar morphology of soldier, alate and neotenic, two Chinese species, *Prorhinotermes xishaensis* Li & Tsai 1976 and *Prorhinotermes hainanensis* Ping & Xu 1989, are reverted to junior synonyms of *P. japonicus*. The current distribution of *P. japonicus* includes tropical islands surrounding the northern part of the South China Sea. Another Chinese species, *Prorhinotermes spectabilis* Ping & Xu 1989 from Yunnan Province and two Philippines species, *Prorhinotermes tibiaeensis* (Oshima 1920) and *Prorhinotermes gracilis* Light 1921, were compared and included in discussion.

**KEY WORDS** termite, taxonomy, morphology, China, Taiwan

*Prorhinotermes* Silvestri 1909 is a small genus represented by 18 described species (Constantino 2011). The highest species diversity from this genus is known from the Papuan and Indo-Malayan regions (Emerson 1955). *Prorhinotermes* spp. are mostly found on islands or coastal areas of continents (Snyder 1949, Krishna 1970). Some species, such as *Prorhinotermes canali-frons* (Sjöstedt) and *Prorhinotermes inopinatus* Silvestri, have extensive island distribution with >5,000-km linear distance ranging over Indian Ocean and Pacific Ocean (Emerson 1955, Bess 1970). So far, only two inland species, *Prorhinotermes tibiaeensis*formis Ahmnd and *Prorhinotermes spectabilis* Ping & Xu, were described from Thailand and China, respectively, some 400 km from the seacoast (Ahmad 1965, Ping and Xu 1989).

*Prorhinotermes* is considered more primitive than other genera of Rhinotermitidae, such as *Coptotermes*, *Reticulitermes*, and *Schedorhinotermes* (Roisin 1988). The caste system of *Prorhinotermes* does not constitute a true worker that is similar to Kalotermitidae and Termopsidae (Noirot and Pasteels 1988). *Prorhinotermes* colonies usually nest and feed in stumps, tree trunks, and logs with high moisture content (Bess 1970, Roonwal 1970, Weesner 1970) much resembling the nesting habits of some kalotermitids such as *Neotermes*. Their dampwood termite-like habitation may facilitate their dispersal by floating logs to distant islands. Foraging behavior of *P. inopinatus* (Rupf and Roisin 2008) and tunneling behavior of *Prorhinotermes simplex* (Hagen) (R. H. Scheffrahn and A. Mullins, personal communication) have been observed, but no extensive tunnel systems similar to those constructed by *Coptotermes* or *Reticulitermes* (King and Spink 1969, Su et al. 1993), have been reported.

Among the six described species from China, the Philippines, and Taiwan, *Prorhinotermes japonicus* (Holmgren) 1912 was first described based on soldier and neotenic specimens collected by Sanji Hozawa at Lanyu Island, Taiwan (=Orchid Island: Botel Tobago Island) and Little Lanyu Island (=Little Orchid Island; Little Botel Tobago Island). Additional surveys were conducted by Oshima 1912 and Tu 1955 on the same islands, but no winged imagos of *P. japonicus* were ever mentioned. Hence, when Li and Tsai (1976) and Ping and Xu (1989) described another two Chinese species, *Prorhinotermes xishaensis* Li & Tsai and *Prorhinotermes hainanensis* Ping & Xu, only the soldier caste of *P. japonicus* was used for comparison. In light of recent collections at Lanyu Island (type locality), Little Lanyu Island, and the southern tip of Taiwan Island (new record), we describe the winged imago for the first time herein. In addition, we redescribe the soldier, and the brachypterous and apterous neotenics. Based on similar morphology of winged imagos, soldier and neotenic castes, *P. xishaensis* and *P. hainanensis* are considered junior synonyms to *P. japonicus*. Another Chinese species, *Prorhinotermes spectabilis* Ping & Xu 1989 and two Philippine species, *Prorhinotermes tibiaeensis* (Oshima) 1920 and *Prorhinotermes gracilis* Light 1921, also were compared.

**Materials and Methods**

Descriptions and redescriptions are based on the examination of 29 colony samples collected from 17 localities including Hengchun Peninsula, Lanyu Island...
Termites were preserved in 85% ethanol. The voucher specimens will be deposited at the National Museum of Natural Science, Taichung, Taiwan. Morphometric data were obtained by using a stereomicroscope (model SZX12, Olympus Optical Co., Ltd., Tokyo, Japan) fitted with a calibrated ocular micrometer. The color photographs of each caste taken with a digital camera (DP70, Olympus Optical Co., Ltd.) and other supplementary material can be viewed at http://frec.ifas.ufl.edu/su/hou-feng-li.shtml. Measurement protocols were mainly adopted from Roonwal (1969), and the illustration of each measurement is also available through the above URL link. Color description followed the Munsell color system (Munsell Color Company 1975). Hue, value, and chroma of each color were denoted in parenthesis such as black (2.5Y 2/0).

Prorhinotermes japonicus (Holmgren)

Paratermes canalifrons (Sjöstedt): Oshima 1912: 69–71. See plate (pl.) 1, figs. 13 and 23; pl. 2, figs. 9, 12, 22, and 27. [soldier, worker, neotenic; misidentification].

Arrhinotermes japonicus Holmgren 1912: 122–124. [soldier, worker, neotenic]; Holmgren 1913: 69. See pl. 2, figs. 28 and 29. [large soldier, small soldier, worker, neotenic]; Oshima 1913: 276; Oshima 1914: 2; Hozawa 1915: 83–91, figs. 19–21. See pl. 3, figs. 16 and 17. [soldier, worker, neotenic].

Prorhinotermes japonicus (Holmgren) Snyder 1949: 86; Ping 2000: 279–280. See fig. 118.

Prorhinotermes xishaensis Li and Tsai 1976: 94–100. See figs. 1 and 2. [soldier, worker, winged imago, apterous neotenic, brachypterous neotenic]; Ping 2000: 282–284. See fig. 120.

Prorhinotermes hainanensis Ping and Xu 1989: 30–336. See figs. 1–9. [soldier]; Ping 2000: 277–279. See fig. 117.

Imagos. In dorsal view, head capsule, antennae, notum and dorsum yellow (10YR 7/8); compound eyes black (2.5Y 2/0); costal margin of wings and radial sector vein dark yellowish brown (10YR 4/6); generally giving the winged imago a uniform yellowish appearance (Fig. 2; Table 1).

Head capsule subcircular with distinct fontanelle in center. Frons slightly concave with longitudinal rugosity on both sides of fontanelle. Postclypeus convex
with a central groove connecting to fontanelle; ante-
clypeus narrow, semitransparent; labrum linguiform,
yellow. Compound eye black (2.5Y 2/0), circular, and
protruding; ocellus elliptical, yellowish white, and
contacting an ocular sclerite. Antennae composed of
17–19 segments, first segment longest, third and fourth
segments shortest, in general, the segment length
gradually increasing from proximal to distal segments;
relative length formula usually 1 > 2 > 3 = 4 = 5 < 6+. Mandibular dentition as in Fig. 2C. Pronotum
approximately semicircular, convex at the midline and
gradually sinking toward anterior corners; anterior
and lateral margin upturned; anterior corner rounded;
posterior margin and posterior corner evenly round-
ed; 4 scattered long setae = 0.2 mm at margin, <
5 long setae on the plate. Wing membrane transparent
without hairs; costal margin and radial sector vein
sclerotized. Fore wing with no clear and continuous
median vein. In some cases, median vein separating
and uniting with cubitus once or twice to form cells.
Hind wing with unsclerotized media branching out
from radial sector at proximal end; media and cubitus
merging for 0.2–1 mm at proximal one third of wing
from suture. Fore wing scale twice as long as hind wing
scale. In resting position, the fore wing scale covering
more than two thirds the length of hind wing scale;
fore wing scale with >15 long setae = 0.2 mm; hind
wing scale with more than five long setae.

In ventral view, postmentum yellow (2.5Y 7/8),
inversely pentagonal, two anterior corners rounded
each with one long setae up to 0.2 mm, two lateral sides
paralleled each with four long setae. Gena, palpi, and
abdominal sternites yellow (2.5Y 8/8). Coxae, tro-
chanters, femora, tibiae and tarsi pale yellow (2.5YR
8/4); claws sclerotized at distal end; arolia absent.

Imago Comparison. Based on description by Li and
Tsai (1976) and our current study, the winged imago
of *P. xishaensis* resembles to that of *P. japonicus*,
although the former is slightly smaller (Table 1). Many
characteristics including head length, head width, eye
maximum diameter, ocellus diameter, pronotum
length, pronotum width, fore wing length, and the
total length of *P. xishaensis* are 1–10% less than those
of *P. japonicus*. Otherwise, no distinct difference was
found between *P. xishaensis* and *P. japonicus*. Based
on the description by Oshima (1920) and Light (1921),
the winged imago of *P. tibiaoensis* (= *P. luzonensis*)
is a larger species than *P. japonicus*. The total length with
wing of *P. tibiaoensis* is 11.0–12.0 mm, whereas in
*P. japonicus* is 10.2–11.0 mm. The wing length of *P. tibi-
aoensis* is 8.5–9.0 mm compared with 7.11–8.04 mm in
*P. japonicus*, and pronotum width is 1.44–1.5 mm and
1.20–1.38 mm for *P. tibiaoensis* and *P. japonicus*, re-
spectively. The winged imagos of *P. hainanensis*, *P.
spectabilis*, and *P. gracilis* are unknown.

Soldier. Head capsule in dorsal view (Fig. 3; Table
2), tear-drop-shaped, yellow (10YR 7/8 or 2.5Y 8/8),
anterior corners more sclerotized at mandibular articu-
lations and antennal sockets, sides broadly
rounded with less than five scattered setae of variable
length to 0.2 mm. Frons slightly rugose. Fontanelle
distinct, opening facing up, whitish and circular
0.06 mm in diameter; a faint groove is present connecting
fontanelle to the base of clypeus. Head capsule when
viewed laterally, flat, with <10 scattered setae of vari-
able length to 0.2 mm on dorsal disc. Fontanelle sit-
uated close to vertex. Frons slopes smoothly from
vertex. Antennal sockets slightly concave. Eye spots
faint, whitish contrasting with yellowish (10YR 8/8)
genae, situated a short distance behind, and at same
height as antennal fossae. Clypeus narrow, white, and
trapezoidal. Labrum yellow (10YR 7/8), linguiform,
with two 2-mm setae at distal end, pointing to anterior. Mandibles very dark brown (10YR 2/2) distally and grading to brownish yellow (10YR 6/8) at base; mandible blades smoothly curved with indistinct teeth. Left mandible faintly serrated on inner surface in basal half, with more protruding molar plate at base than the right mandible. Antennae with 16–20 segments, the proximal segments yellow (10YR 8/8) and grading to yellowish white at apical segments; first segment longest; third antennal segment shortest; relative length formula usually $2^{n+1} / 1^{n} 0^{2} 2^{2} 1^{2} 0^{5} 5$. Postmentum evenly yellow (10YR 8/8), bearing scattered long setae laterally in anterior half. In lateral view, postmentum smoothly convex, protruding from gena.

Pronotum yellow (2.5Y 8/8), with scattered setae of variable length to 0.2 mm at margins, less than four long setae on plate, median anterior margin slightly concave, anterior corners rounded; posterior margin broadly convex; posterior corners broadly rounded. Many soldiers with wing pads on meso- and metanotum, width of meso- and metanotum varied. In general, pronotum is slightly wider than meso- or metanotum, but not always. Abdominal sternites semi-transparent. Coxae, trochanters, femora, tibiae, and tarsi white (10YR 8/2); claws slightly sclerotized at distal end; arolia absent.

Pronotum yellow (2.5Y 8/8), with scattered setae of variable length to 0.2 mm at margins, less than four long setae on plate, median anterior margin slightly concave, anterior corners rounded; posterior margin broadly convex; posterior corners broadly rounded. Many soldiers with wing pads on meso- and metanotum, width of meso- and metanotum varied. In general, pronotum is slightly wider than meso- or metanotum, but not always. Abdominal sternites semi-transparent. Coxae, trochanters, femora, tibiae, and tarsi white (10YR 8/2); claws slightly sclerotized at distal end; arolia absent.

**Soldier Comparison, and Synonymization.** The morphometric data (Table 2) show *P. japonicus*, *P. xishaensis*, and *P. hainanensis* are similar species. The only diagnostic character provided by Li and Tsai (1976) to describe *P. xishaensis*, collected from Xisha Island, China (Fig. 1) was the ratio of the pronotum width to mesonotum width (*P. xishaensis*, mesonotum is wider than pronotum; *P. japonicus*, pronotum is wider than mesonotum). In the current study, 26 *P. japonicus* soldiers from 13 colonies, two specimens of each colony were measured and 17 individuals exhibited wider pronotum than mesonotum. However, four individuals from TW154, TW151, and TW59 colonies have equal width of pronotum and mesonotum, and

### Table 1. Measurement of winged imagos of *P. japonicus* and *P. xishaensis*

| Measurement (mm)                              | *P. japonicus* | *P. xishaensis* |
|----------------------------------------------|---------------|-----------------|
| No. antennal segments                        | 17–19         | 19              |
| Head length to labrum tip                    | 1.48–1.60     | 1.45–1.51       |
| Head length to medium base of postclypeus    | 1.03–1.13     | 1.06 ± 0.03     |
| Postclypeus, median length                   | 0.18–0.20     | 0.19 ± 0.01     |
| Distance from medium base of head to fontanelle | 0.65–0.78   | 0.68 ± 0.03     |
| Head width, max at eyes                      | 1.36–1.50     | 1.35–1.41       |
| Labrum width, max                           | 0.55–0.83     | 0.67 ± 0.07     |
| Eye max diam without sclerite                | 0.27–0.35     | 0.31 ± 0.02     |
| Distance from eye to lower margin of head, min | 0.14–0.20    | 0.17 ± 0.02     |
| Ocellus diam, max                            | 0.17–0.20     | 0.18 ± 0.01     |
| Pronotum, median length                      | 0.66–0.80     | 0.74 ± 0.03     |
| Pronotum, max length                         | 0.80–0.90     | 0.84 ± 0.03     |
| Pronotum, max width                          | 1.20–1.38     | 1.29 ± 0.05     |
| Fore wing scale, max length                  | 1.08–1.23     | 1.14 ± 0.05     |
| Fore wing length from suture                 | 7.11–8.04     | 7.32–7.66       |
| Fore wing, max width                         | 2.11–2.55     | 2.40 ± 0.11     |
| Hind tibia, max length                       | 1.25–1.45     | 1.33 ± 0.06     |
| Total length without wings                   | 4.55–6.52     | 5.55 ± 0.51     |
| Total length with wings                      | 10.20–11.00   | 10.50 ± 0.29    |

* Measurements based on nine males and nine females collected from six colonies in current study.  
* After Li and Tsai (1976), $n = 8$.

![Fig. 3. SEMs of *P. japonicus* soldier. Lateral (A) and dorsal (B) views of head and thorax; mandibles (C). Scale bars = 500 μm.](image-url)
five individuals from TW71, NK109, and TW151 colonies have wider mesonotum than pronotum. The data showed the ratio of pronotum and mesonotum varied between intraspecific colonies of *P. japonicus*, which supports *P. xishaensis* and *P. japonicus* are being conspecific. Another Chinese species, *P. hainanensis*, collected from Hainan Island, China (Fig. 1), is also conspecific. Another Chinese species, *P. spectabilis*, also were described with multiple colony origins, multiple castes, and a large sample size are required for further species comparison.

Based on the description of *P. tibiaoensis* (= *P. luzonensis*, Light 1921), the head width of small and large soldiers were 1.40–1.65 mm, which is larger than that of *P. japonicus*, 1.20–1.55 mm. In addition, the maximum width of the pronotum of *P. tibiaoensis* is 1.25–1.35 mm which is much wider than that of *P. japonicus* (0.90–1.20 mm). The original description of another Philippine species, *P. gracilis*, was based on only one small colony collected at the same region as *P. tibiaoensis* (Light 1921). The narrow head capsule (1.25–1.35 mm) and less sclerotized body of soldiers also indicate a young colony. Light (1921) reported that the number of antennal segments of *P. gracilis* (15–16) is less than that of *P. tibiaoensis* (18–20), and the shape and size of the antennal segments between these two species are also different, so Light (1921) stated “I have felt it impossible to avoid making this a new species,” which he described as *P. gracilis*. Our current study of *P. japonicus* showed the antennal segments could range from 16 to 20, and intraspecific variation of morphological measurement are quite high (14–36%). Hence, without examination of multiple colonies, the taxonomic status of *P. gracilis* remains uncertain. It remains possible that *P. gracilis* is a junior synonym of *P. tibiaoensis*.

**Neotenics.** Neotenics (Fig. 4; Table 3) of *P. japonicus* were mentioned by Holmgren (1912, 1913), Oshima (1912), and Hozawa (1915), and neotenics of some other *Prohiniternes* spp. also were described and listed by Snyder (1949), which indicated this

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**Table 2.** Measurement of soldiers of *P. japonicus*, *P. xishaensis*, and *P. hainanensis*

| Measurement, mm | *P. japonicus* | *P. xishaensis* | *P. hainanensis* |
|----------------|----------------|----------------|------------------|
|                | Range | Mean ± SD | Range | Mean | Range | Mean |
| No. antennal segments | 16–20 | 17.43 ± 1.24 | 17–19 | 17–20 |
| Head length to tip of mandibles | 2.34–2.95 | 2.62 ± 0.16 | 2.43–2.70 | 2.61 | 2.27–2.73 | 2.51 |
| Distance from base of head to notal line | 0.85–1.10 | 0.99 ± 0.06 | 0.91–1.08 | 1.00 | 0.50–1.13 | 0.96 |
| Head width, max | 1.20–1.55 | 1.40 ± 0.08 | 1.27–1.50 | 1.35 | 1.23–1.52 | 1.37 |
| Head ht, with postmentum | 0.75–0.93 | 0.86 ± 0.05 | 0.50–0.56 | 0.52 | 0.76–0.96 | 0.55 |
| Labrum, max width | 0.24–0.33 | 0.28 ± 0.02 | 0.27–0.30 | 0.28 | 0.25–0.34 | 0.30 |
| Left mandible length | 0.19–0.30 | 0.25 ± 0.03 | 0.25–0.28 | 0.27 | 0.24–0.32 | 0.32 |
| Postmentum, median length | 0.98–1.16 | 1.05 ± 0.06 | 0.97–1.08 | 0.99 | 0.91–1.20 | 1.04 |
| Postmentum, max width | 0.43–0.50 | 0.47 ± 0.02 | 0.42–0.54 | 0.50 | 0.37–0.48 | 0.44 |
| Postmentum, min width | 0.20–0.25 | 0.22 ± 0.02 | 0.22–0.25 | 0.24 | 0.23–0.27 | 0.25 |
| Pronotum, median length | 0.45–0.60 | 0.54 ± 0.04 | 0.47–0.54 | 0.51 | 0.46–0.68 | 0.55 |
| Pronotum, max length | 0.50–0.65 | 0.60 ± 0.04 | 0.54–0.56 | 0.55 | 0.53–0.74 | 0.63 |
| Pronotum, max width | 0.90–1.20 | 1.09 ± 0.08 | 0.98–1.13 | 1.09 | 1.00–1.35 | 1.13 |
| Mesonotum, max width | 0.80–1.23 | 1.06 ± 0.11 | 1.05–1.24 | 1.19 | 0.90–1.28 | 1.06 |
| Metanotum, max width | 0.83–1.15 | 1.05 ± 0.08 | 1.00–1.13 | 1.10 | 0.90–1.26 | 1.03 |
| Hind tibia length | 1.13–1.55 | 1.33 ± 0.10 | 1.15–1.26 | 1.21 | 1.16–1.41 | 1.26 |
| Total length | 4.90–6.95 | 5.57 ± 0.51 | 4.85–6.72 | 5.71 | 4.70–6.80 | 5.63 |

*a* Measurement based on 26 soldiers from 13 colonies in current study.

*b* After Li and Tsai (1976), n = 15.

*c* After Ping and Xu (1989), n = 35.

*d* For *P. japonicus*, left mandible length was measured in ventral view as the diagonal distance from tip of mandible to most distant visible point of ventral condyle. For *P. xishaensis* and *P. hainanensis*, left mandible length was probably measured as the distance between two parallels at tip and base of mandible in dorsal view. By testing with some *P. japonicus* individuals, using the former method results in ~10% longer measurement than adopting the latter method.
reproductive caste is frequently encountered for this genus. Hence, neotenic could be a caste for species identification for *Prorhinotermes*. Neotenics were found in ≈24% (7/29) of our colony samples, in which neotenics made up 2.0–12.9% of total individuals. Based on the development of wing pads, the neotenics were divided into two types, such as apterous neotenics without wing pad and brachypterous neotenics with wing pads (Miller 1969, Thorne 1996). For brachypterous neotenics, the shapes of wing pads of meso- and metanotum were varied (Fig. 4B and C). In general, brachypterous neotenics had more winged imago characteristics than apterous neotenics, including well developed compound eyes, wing pads, distinct fontanelle, and more sclerotized cuticle. Almost every external structure of the brachypterous neotenics was larger than that of the apterous neotenics (Table 3). The common characteristics of the two types of neotenics were described below unless stated otherwise.

In dorsal view, head capsule, notum and dorsum yellow (10YR seven-eighths) to reddish yellow (7.5YR 7/8); antennae very pale brown (10YR 8/4); eye max diam w/o sclerite 0.15–0.21 0.19 ± 0.02 0.20–0.26 0.24 ± 0.03; pronotum, max width 0.55–0.75 0.64 ± 0.06 0.73–0.88 0.80 ± 0.06.

**Table 3. Measurements of *P. japonicus* brachypterous neotenics, *n* = 6 from two colonies; apterous neotenics, *n* = 12 from seven colonies**

| Measurement, mm | Apterous neotenics | Brachypterous neotenics |
|----------------|--------------------|------------------------|
|                | Range              | Mean ± SD              | Range              | Mean ± SD              |
| No. antennal segments | 16–20              | 18.00 ± 1.33            | 17–19              | 18.00 ± 1.00            |
| Head length to labrum tip | 1.25–1.63          | 1.45 ± 0.09             | 1.43–1.58          | 1.50 ± 0.06             |
| Head length to medium base of postclypeus | 0.90–1.10          | 1.01 ± 0.05             | 1.05–1.10          | 1.08 ± 0.03             |
| Head width, max | 1.15–1.43          | 1.29 ± 0.08             | 1.30–1.50          | 1.39 ± 0.09             |
| Labrum width, max | 0.45–0.58          | 0.53 ± 0.02             | 0.53–0.58          | 0.56 ± 0.02             |
| Eye max diam w/o sclerite | 0.15–0.21          | 0.19 ± 0.02             | 0.20–0.26          | 0.24 ± 0.03             |
| Pronotum, max length | 0.55–0.75          | 0.64 ± 0.06             | 0.73–0.88          | 0.80 ± 0.06             |
| Pronotum, median length | 0.50–0.65          | 0.57 ± 0.05             | 0.65–0.78          | 0.71 ± 0.05             |
| Pronotum, max width | 0.90–1.20          | 1.05 ± 0.08             | 1.18–1.33          | 1.24 ± 0.05             |
| Mesonotum, max width | 1.03–1.33          | 1.15 ± 0.10             | 1.63–1.88          | 1.72 ± 0.09             |
| Metanotum, max width | 1.03–1.28          | 1.14 ± 0.07             | 1.50–1.65          | 1.56 ± 0.06             |
| Hind tibia length | 1.03–1.35          | 1.16 ± 0.08             | 1.25–1.35          | 1.30 ± 0.05             |
| Total length | 4.20–5.80          | 4.58 ± 0.54             | 4.73–5.71          | 5.25 ± 0.39             |

*a* Head width including eyes if present.
compound eyes reddish brown (5Y 5/3) or purple; dorsum of neotenics usually darker than that of other castes, such as imagos, workers, and soldiers, generally giving the neotenic a reddish yellow appearance.

Head capsule circular. Epicranial suture distinct, light yellowish contrast with yellow (10YR 7/8) or reddish yellow (7.5YR7/8) head capsule, with fontanelle at the center, Y-shaped branches ending with ocellus on each side. Fontanelle yellow (10YR 8/8), rounded-triangle shape, 0.12–0.16 mm in diameter, opening unapparent. Frons slightly concave, faintly rugose. Postclypeus convex with two to three long setae up to 0.15 mm at each of the two lateral sides, a faint groove at midline connecting to fontanelle. Anteclypeus narrow, subhyaline. Labrum liniform, convex, yellow (10YR seven-eighths), with hyaline ommatidia circumferentially. Ocellus elliptical, white (4.5Y 5/2) or reddish white (5Y 5/3) in brachypterous neotenics with entirely reddish brown (5Y 5/3) eyes, and apterous neotenics' eyes constructing from varied number of reddish brown ommatidia in the center and whitish ommatidia circumferentially. Ocellus elliptical, yellowish white, 0.05–0.08 mm in diameter. Antennae composed of 16–20 segments, first segment longest, first and second segments more sclerotized than the others, third to eighth segments dense and short without distinct articulation giving it a stout appearance, the segment length gradually increasing from third segment to distal end.

Pronotum with scattered short setae ~0.02 mm at margin; anterior and posterior corner rounded; anterior margin slightly concave at middle, posterior margin smoothly rounded. Pronotum of brachypterous neotenics wider and longer than that of apterous neotenics. Brachypterous neotenics usually with more than three long setae up to 0.25 mm, but less than three long setae for apterous neotenics. For apterous neotenics, meso- and metanotum is ~10% wider than pronotum. In brachypterous neotenics, meso- and metanotum is >20% wider than pronotum.

In ventral view, abdominal sternites yellow (10YR 8/8 or 10YR 7/8), paler than dorsum and notum. Most ventral structures such as postmentum and legs of neotenic are similar to that of winged imagos.

Neotenic Comparison. Morphology of apterous and brachypterous neotenics of *P. xishaensis* described by Li and Tsai (1976) fitted to that of *P. japonicus* described in this study. Some comparative measurements of neotenics between these two species are shown below. For apterous neotenics, maximum head width (*P. japonicus*, 1.13–1.33 mm; *P. xishaensis*, 1.14–1.27 mm). The mean difference of each measurement between the two species is <1.35%.

Remarks. Collections of two winged imagos (NCHU) by using pit-light traps at Lanyu Island in October 2014 provided clues of the dispersal season of *P. xishaensis* for the first time. On 19 October 2008, more alates (TW68, TW71, and TW72) were found at Hengchun Peninsula. When wood logs were opened with axes, some alates flew away during our collection, which confirms their maturity for flight. Alates (TW151 and TW154) were also collected from dead trees at Little Lanyu Island in late August 2009, but some of them were not well sclerotized. Based on these three collections, we speculated the dispersal flight of *P. japonicus* occurs in late summer and early fall.

Material Measured. TAIWAN: Taitung Co., Lanyu Island: Yeyin Village: 22.05°N, 121.56°E; 10-VI-2007; H.-F. Li and R.-L. Yang; 2 soldiers (TW42). Hongtou Village: 22.03°N, 121.55°E; 25-V-2010; N. Kanzaki, Y.-C. Lan, and S.-H. Tseng; 2 soldiers and 1 apterous neotenics (TW167). Langda Village: 22.08°N, 121.51°E; 26-V-2010; N. Kanzaki, Y.-C. Lan, and S.-H. Tseng; 2 soldiers (TW170). Langda Village: 22.07°N, 121.51°E; X-2003; P. Huang and M.-M. Yang; 1 male alate and 1 female alate (NCHU). Taitung Co., Little Lanyu Island: 21.95°N, 121.61°E; VIII-2009; Y.-T. Chung; 2 soldiers, 3 male alates, 1 female alate, and 2 apterous neotenics (TW151). Same locality: 2 soldiers (TW152); Same locality: 2 soldiers, 1 male alate, 3 female alates (one for SEM), 2 apterous neotenics (one for SEM), and 3 brachypterous neotenics (one for SEM) (TW154). Pingtung Co., Hengchun Township: Longshuei Village: 21.98°N, 120.74°E; 16-X-2008; H.-F. Li; 2 soldiers (TW58). Shuicyuan Village: 21.92°N, 120.74°E; 16-X-2008; H.-F. Li; 2 soldiers (TW59). Siangjiao Bay Ecological Reserve Area: 21.93°N, 120.83°E; 19-X-2008; N. Kanzaki, Y.-C. Lan, H.-F. Li, and J.-F. Tsai; 2 soldiers (TW66). Longkeng Ecological Reserve: 21.90°N, 120.86°E; 19-X-2008; N. Kanzaki, Y.-C. Lan, H.-F. Li, and J.-F. Tsai; 1 female alate (TW68). Same locality: 2 soldiers, 5 male alates, and 2 female alates (TW71). Same locality: 1 male alate (one for SEM) and 1 female alate (TW72). Nanwan: 21.95°N, 120.78°E; 25-VI-2009; N. Kanzaki, Y.-C. Lan, and H.-F. Li; 1 apterous neotenics (NK108). Same locality: 2 soldiers, 2 apterous neotenics (NK109). Pingtung Co., Manjhou Township; all samples collected by C.-C. Chang, W.-M. Chung, Y.-C. Lan, H.-F. Li, and S.-H. Tseng. Taiwan Forestry Research Institute, Gangkou Station: 21.99°N, 120.84°E; 23-VI-2009; 2 soldiers (one for SEM), 2 apterous neotenics (one for SEM), and 3 brachypterous neotenics (two for SEM) (TW140). Sianglín-Fude Rd.: 22.04°N, 120.83°E; 24-VI-2009; 2 soldiers (one for SEM) and 2 apterous neotenics (TW142).

Type Material. SYNTYPE of *P. japonicus*, TAIWAN: Taitung Co., Lanyu Island; 12-V-1911; 2 soldiers (American Museum of Natural History, NY) (Ping and Xu 1989). HOLOTYPE of *P. xishaensis*, CHINA:
Hainan Province, Xisha Islands; Woody Island; K.-S. Li; 21-V-1974; soldier (no. 2013) (Guangdong Entomological Institute, Guangzhou, CHINA) (Li and Tsai 1976). HOLOTYPE of P. hainanensis, CHINA: Hainan Province, Ya Xian; 18.03° N, 109.08° E; Z.-M. Ping; 15-VII-1961; soldier (I. no. E2059) (Guangdong Entomological Institute, Guangzhou, China) (Ping and Xu 1989).

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