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The Odonata (Insecta) of Patagonia: A synopsis of their current status with illustrated keys for their identification

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Abstract

Patagonia is a vast landmass with a distinctive environmental and biotic heterogeneity. Its Odonata biodiversity is the best known of South America, and it is composed of 36 species, of which more than 50% are endemic. We summarize the main taxonomic, distributional and biological information including illustrated keys for adults and known larvae, and distributional maps.

Key words: Zygoptera, Anisoptera, larva, adult, southern Argentina, southern Chile, key, distribution maps

Introduction

Patagonia represents one of the main austral landmasses of the World. It is characterized by a distinctive environmental heterogeneity consisting of a narrow ecotone between two main biomes: the subantarctic forests and the arid or semiarid areas of the steppe. This ecotone runs parallel a few kilometers east of the Andes, so arid areas of Patagonia are mostly developed in Argentina, with the exception of part of Magallanes region in southern Chile which is also arid. The environmental heterogeneity is clearly reflected in almost all biotic components, which contain subantarctic and neotropical representatives.

The order Odonata is represented in Patagonia by 36 species arranged in nine families and 18 genera (Table 1. Authors' names and year of description for each species are only included in this table). Approximately 60% of the species and 40% of the genera are endemic (Muzón 1995; 1997a; 2009), the monotypic family Neopetaliidae being one of the most remarkable endemisms. We do not expect to find any as yet undescribed species here, but new records are still likely, such as *Phyllopetalia altarensis* (Carle 1996), a central Chilean species, or some subtropical species in northern Patagonia in Argentina (e.g., Colorado river basin).

Biogeographical aspects of Patagonian odonates have been treated previously (Jurzitza 1989a; Muzón 1995, 1997a, 2009; Muzón *et al.* 2005). They follow a general biodiversity pattern characterized by two main faunistic components: the subantarctic, restricted to the *Nothofagus* forest on both slopes of the Andes, and a widespread neotropical component mainly distributed in the steppe (Table 1). The subantarctic faunistic component can be tracked further north up to central Chile (Roig 1994; Roig & Flores 2001) whereas the neotropical one is represented either by widespread species, e.g., *Ischnura fluviatilis*, *Lestes undulatus*, *Rhionaeschna absoluta*, or by species more restricted in distribution, e.g., *Andinagrion peterseni*, and Patagonic endemics, e.g., *Cyanallagma interruptum*, *Erythrodiplax connata*, *Sympetrum villosum*.

The most significant biodiversity patterns observed in Patagonia are the latitudinal species richness decline, from more than 30 species in the north to only one, *Rhionaeschna variegata*, in Tierra del Fuego island, and the striking differences between the composition and richness of the forest and steppe taxocoenosis; these patterns determine two diversity gradients: north to south and west to east, resulting in highest differences among northwestern (more rich and diverse) and southeastern areas. These gradients could be partially explained by the

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uplift of the Andes, which determines the rainfall and forest patterns and creates a peninsular effect (Muzón 1997a).

Conservation status of Patagonian odonates was treated previously (IUCN 2013; Muzón & von Ellenrieder 1999). There are several natural protected areas, both in Argentina and Chile, which shelter all the species recorded. Nevertheless, this promissory circumstance does not always mean that populations are effectively under protection. In fact, the restrictive biological traits which characterize several striking endemisms, *e.g.*, the terrestrial larvae of *Phenes raptor* and the small shaded stream-dwelling larvae of *Neopetalia puntacta*, determine the need of specific action plans for their conservation, plans that are not actually being proposed or performed. All the rare and endemic species inhabit the subantarctic *Nothofagus* forest from 39º S to 45º S, and almost all of them (i.e., Petaluridae, Austropetaliidae and Neopetaliidae) are red listed (Table 1) (Paulson 2004; IUCN 2013).

Scientific knowledge of Patagonic odonates probably began, as stated by Calvert (1956: 93), during James Cook's first voyage in the HMB Endeavour (1768–1771), with the collection, done perhaps by Joseph Banks or Daniel Solander in January of 1769, of the specimen used by Fabricius (1775) for the description of *Aeshna variegata* (now *Rhionaeschna variegata*), the first Patagonian odonate described. After Fabricius work, other isolated but relevant contributions were made during the 19th century by Burmeister (1839), Rambur (1842), Selys (1858, 1876), Brauer (1864) and McLachlan (1870). Only during the 20th century were more specific contributions on Patagonian Odonata published (Ris 1904, 1928; Martin 1921; Campion 1922; Herrera *et al.*1955/1956; Fraser 1957; Böttger & Jurzitza 1967, 1989a; Muzón 1995, 1997a).

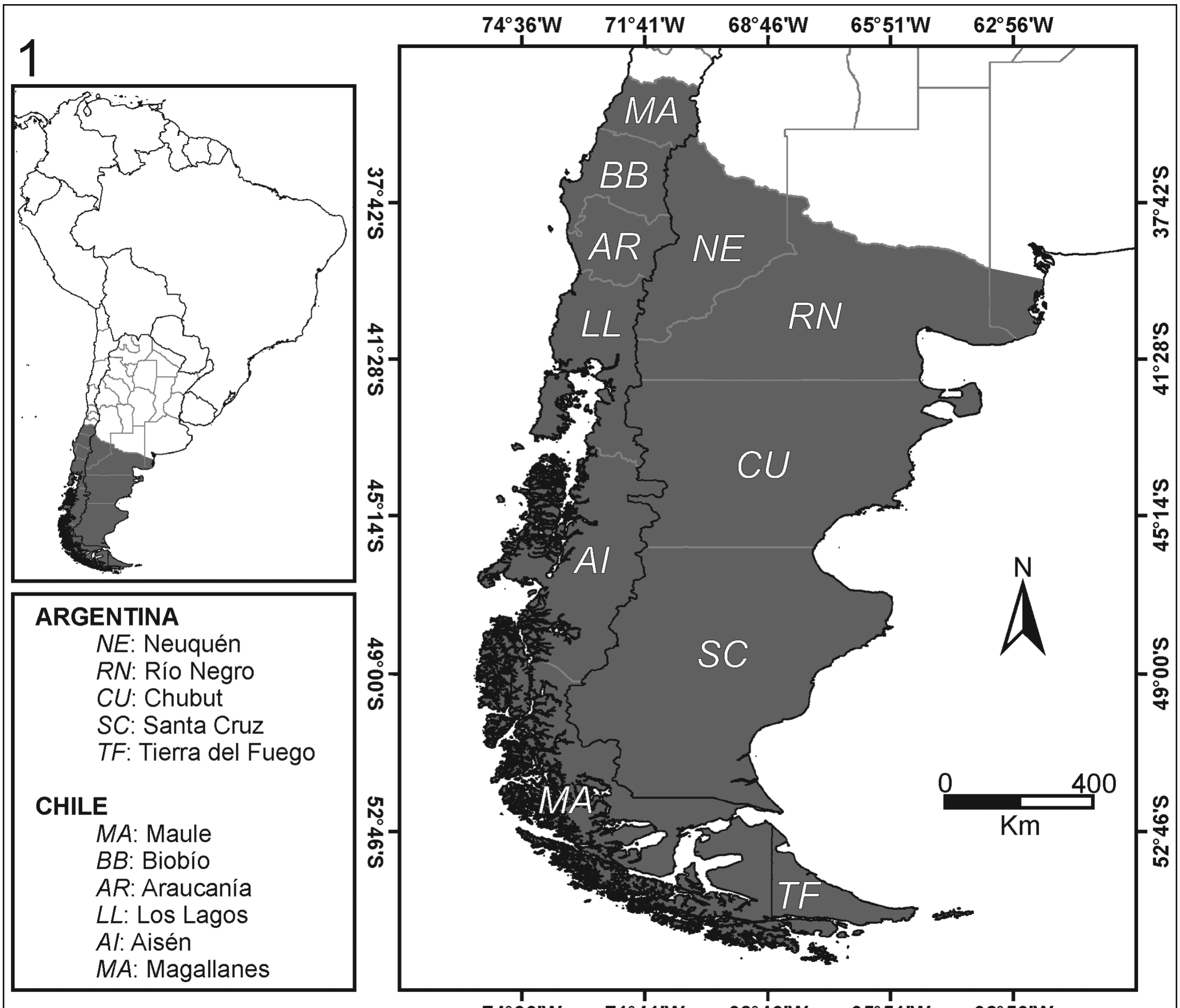

FIGURE 1. Patagonia.

TABLE 1. Record of Patagonic odonate species according to main biomes (forest and steppe) and countries.

	Forest		Steppe
	Chile	Argentina	
Lestes undulatus Say 1840 (LC)	X	X	X
Andinagrion peterseni (Ris 1908)	-	X	X
Antiagrion antigone Ris 1928	X	-	-
Antiagrion blanchardi (Selys 1876) (VU)	X	-	-
Antiagrion gayi (Selys 1876) (LC)	X	-	-
Antiagrion grinbergsi Jurzitza 1974 (LC)	X	X	-
Cyanallagma interruptum (Selys 1876) (LC)	X	X	X
Ischnura fluviatilis Selys 1876 (LC)	X	-	X
Oxyagrion rubidum (Rambur 1842)	X	-	X
Neogomphus bidens Selys 1878 (LC)	X	-	-
Neogomphus edenticulatus Carle & Cook 1984	X	X	-
Neogomphus molestus (Hagen in Selys 1854)	X	?	-
Progomphus joergenseni Ris 1908	-	-	X
Rhionaeschna absoluta (Calvert 1952)	X	X	X
Rhionaeschna bonariensis (Rambur 1842)	X	X	X
Rhionaeschna confusa (Rambur 1842) **	X	-	-
Rhionaeschna diffinis (Rambur 1842) (LC)	X	X	X
Rhionaeschna variegata (Fabricius 1775)	X	X	X
Phenes raptor Rambur 1842 (LC)	X	X	-
Hypopetalia pestilens McLachlan 1870 (LC)	X	X	-
Phyllopetalia apicalis Selys 1858 (LC)	X	-	-
Phyllopetalia apollo Selys 1878 (LC)	X	X	-
Phyllopetalia excrescens Carle 1996 (VU)	X	-	-
Phyllopetalia pudu Dunkle 1985 (LC)	X	X	-
Phyllopetalia stictica Hagen in Selys 1858 (DD)	X	X	-
Neopetalia punctata (Hagen in Selys 1854) (DD)	X	X	-
Dasythemis mincki clara Ris 1908 (LC)	-	-	X
Erythrodiplax atroterminata Ris 1911 *	-	-	X
Erythrodiplax connata (Burmeister 1839)	X	X	X
Erythrodiplax corallina (Brauer 1865)	X	-	X
Erythrodiplax nigricans (Rambur 1842)	-	-	X
Erythrodiplax ochracea (Burmeister 1839) (LC)	-	-	X
Sympetrum villosum Ris 1911	X	X	-
Gomphomacromia chilensis Martin 1921	X	-	-
Gomphomacromia paradoxa Brauer 1864	X	X	?
Rialla villosa (Rambur 1842)	X	X	-
Totals	31		16
	30	19	
		27	

Note: in the printed table, "Argentina" spans the Argentina forest column and the Steppe column. In the totals, 31 spans the two Forest columns and 27 spans the two Argentina columns.

*Recorded in Chile, north of Patagonia
** Recorded in Argentina, north of Patagonia
(LC) Least Concern, (DD) Data Deficient, (VU) Vulnerable (IUCN, 2013)

TABLE 2. Flight periods of odonate species in Patagonia (01 to 12, months).

	07	08	09	10	11	12	01	02	03	04	05	06
Lestes undulatus					■	■	■	■				
Andinagrion peterseni				■	■	■	■	■				
Antiagrion antigone						■	■	■				
Antiagrion blanchardi								■				
Antiagrion gayi							■	■				
Antiagrion grinbergsi					■	■	■	■	■			
Cyanallagma interruptum			■	■	■	■	■	■	■	■		
Ischnura fluviatilis							■	■	■			
Oxyagrion rubidum					■	■	■	■				
Neogomphus bidens						■	■	■	■			
Neogomphus edenticulatus					■	■	■	■	■			
Neogomphus molestus					■	■	■	■	■			
Progomphus joergenseni					■	■	■	■	■			
Rhionaeschna absoluta					■	■	■	■				
Rhionaeschna confusa						■	■	■				
Rhionaeschna diffinis				■	■	■	■	■	■	■		
Rhionaeschna variegata					■	■	■	■	■			*
Phenes raptor				■	■	■	■	■				
Hypopetalia pestilens				■	■	■	■	■	■			
Phyllopetalia apicalis			■	■	■	■	■	■				
Phyllopetalia apollo			■	■	■	■	■					
Phyllopetalia excrescens				■	■	■						
Phyllopetalia pudu					■	■	■	■				
Phyllopetalia stictica				■	■	■	■	■				
Neopetalia punctata				■	■	■	■					
Dasythemis mincki clara					■	■	■					
Erythrodiplax atroterminata						■	■					
Erythrodiplax connata				■	■	■	■	■	■			
Erythrodiplax corallina				■	■	■	■	■	■			
Erythrodiplax nigricans							■					
Erythrodiplax ochracea						■						
Sympetrum villosum					■	■	■	■	■			
Gomphomacromia chilensis								■				
Gomphomacromia paradoxa				■	■	■	■	■			**	
Rialla villosa					■	■	■	■	■			

* One specimen collected in Chubut province in middle June by Pessacq.
** One male collected in June, which probably represents an isolated record (von Ellenrieder & Garrison, 2005).

The purpose here is to provide an up-to-date synopsis of Patagonian odonates based on published data, as well as to provide an easy to use key with which to identify all final instar larval and adult odonate species of Patagonia in order to facilitate further research on ecological and conservation studies.

Study area. The name Patagonia generally refers to the area south of the Pampas ecoregion (the vast lowlands of Argentina), but it has been restricted by several authors to the arid area south of the Colorado river basin in Argentina. In this paper, Patagonia is used in a wider sense, encompassing a large area of 1,100,000 km^2, including both slopes of the Andes (see Fig. 1). Its northern limit is the Maule - Valdivian (35° S) area in Chile and the Colorado river basin in Argentina. The Andes determine a west – east rainfall pattern with the highest values on the west slope (from approximately 4,000 mm/year in some areas of Chile to 1,000 or less in the eastern forest areas of Argentina and less than 500 in the arid or semiarid steppe). This rainfall gradient is reflected in differentiation of ecoregions, from the Valdivian rainforest to the Patagonic steppe.

Patagonia houses several types of aquatic environments, from glacial lakes to ponds, marshes, peat bogs, large rivers, streams and small endorrheic basins (Muzón *et al.* 2005).

Material and methods

For each taxon, distribution maps and biological notes are given. In addition, keys for adults and last instar larvae are provided. Biological notes were culled from the literature or were based on personal observations. Data for flight periods (Table 2) were gathered from the literature and from material in the Museo de La Plata entomological collection and should be not considered complete, since almost all records correspond to late spring or summer field trips, undermining possible early spring, autumn or winter occurrence.

Specimens were studied with the aid of a Leica MS5 stereomicroscope in the Instituto de Limnología Dr. R. A. Ringuelet (ILPLA) and Laboratorio de Investigaciones en Ecología y Sistemática Animal (LIESA). Illustrations were made with the aid of a camera lucida and an open-source design program (Inkscape version 0.48.4 at <www.inkscape.org>) and are not to scale.

Wing venation follows Riek & Kukalová-Peck (1984) as modified by Bechly (1996). Mandibular formula of larvae follows Watson (1956). Abbreviations for structures used throughout the text are as follows: Fw: forewing; Hw: hindwing; Ac: arculus; n: nodus; pt: pterostigma; Ax: antenodals; S1–10: abdominal segments 1 to 10.

Ordinal and family level classification follows Dijkstra *et al.* (2013) recent proposal, except for the genus *Gomphomacromia*, which is treated here for convenience as Corduliidae instead of Libelluloidea *incertae sedis*.

Results

Key to adults

1 Head dioptic (eyes separated by a distance greater than distance between lateral ocelli) (Fig. 2a); Fw and Hw similar in shape and size, petiolated (Fig. 2b); male terminalia composed of a pair of dorsal cerci and a pair of ventral paraprocts (Fig. 2c); female ovipositor developed, ventral margin serrated (Fig. 2d) . . . . Zygoptera ... 2

- Head dioptic or holoptic (if dioptic, eyes separated by a distance equal or less than the space between lateral ocelli) (Figs. 3a–c); wings never petilolated, anal area of Hw enlarged (Fig. 3d); male terminalia composed of a pair of cerci and a single epiproct (Fig. 3e); female ovipositor variable . . . . Anisoptera … 10

2(1) Origin of IR_2 and RP_3 nearer to nodus than to arculus (Fig. 4a); anterior hamuli quadrangular (Fig. 4b); cerci variable, but never forcipate . . . . Coenagrionidae … 3

- Origin of IR_2 and RP_3 nearer to arculus than to nodus (Fig. 4c); anterior hamuli elongated and subtriangular (Fig. 4d), cerci forcipate (Fig. 4e) . . . . Lestidae (only *Lestes undulatus*)

3(2) Male cerci in lateral view horizontal (Fig. 5a); female lacking mesepisternal fossae (Fig. 5b) 4

- Male cerci in lateral view decumbent forming an angle of approximately 45° with posterior margin of S10 (Fig. 5c); female with mesepisternal fossae (Fig. 5d). . . . . *Oxyagrion*, only *O. rubidum*

4(3) Male paraprocts variable, but never sigmoidal in lateral view (Figs. 7a, c, 8b); interlaminar sinus of female subtriangular (Fig. 6a), posterior end variable 5

- Male paraprocts sigmoidal in lateral view (Fig. 6b); interlaminar sinus of female subrectangular, posterior end closed by a continuous ridge (Figs. 5b, 6c) . . . . *Ischnura*, only *I. fluviatilis*

5(4) Posterior margin of S10 of male slightly elevated with a mid-dorsal notch flanked by small bulging processes (Fig. 7a); female with vulvar spine on S8 (Fig. 7b) 6

- Posterior margin of S10 flat, without bulging processes (Fig. 7c); female lacking vulvar spine on S8 (Fig. 7d) . . . . *Antiagrion* ... 7

6(5) Color pattern of head and thorax including light blue areas . . . . *Cyanallagma*, only *C. interruptum*

- Color pattern of head and thorax including red areas . . . . *Andinagrion*, only *A. peterseni*

7(5) Male paraprocts in lateral view with acute tip directed posteriorly (Fig. 7c); posterior margin of posterior lobe of prothorax of female straight or slightly concave (Fig. 8a) . . . . *A. antigone*

- Male paraprocts in lateral view with acute apophysis directed dorsally (Fig. 8b); posterior margin of posterior lobe of prothorax of female W-shaped (Fig. 8c) 8

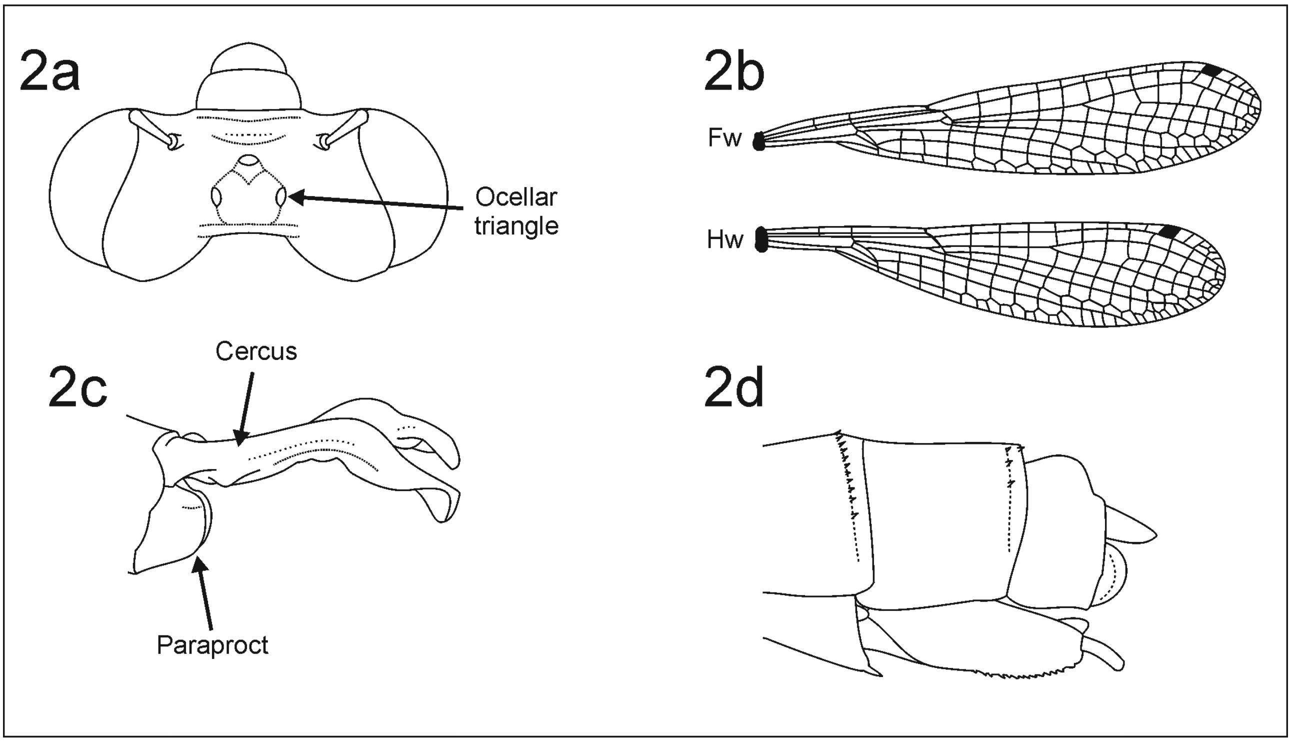

FIGURE 2. a *Antiagrion grinbergsi*, head, dorsal view; b Coenagrionidae, wings; c *Lestes undulatus*, male terminalia, lateral view; d *Cyanallagma interruptum*, female terminalia, lateral view.

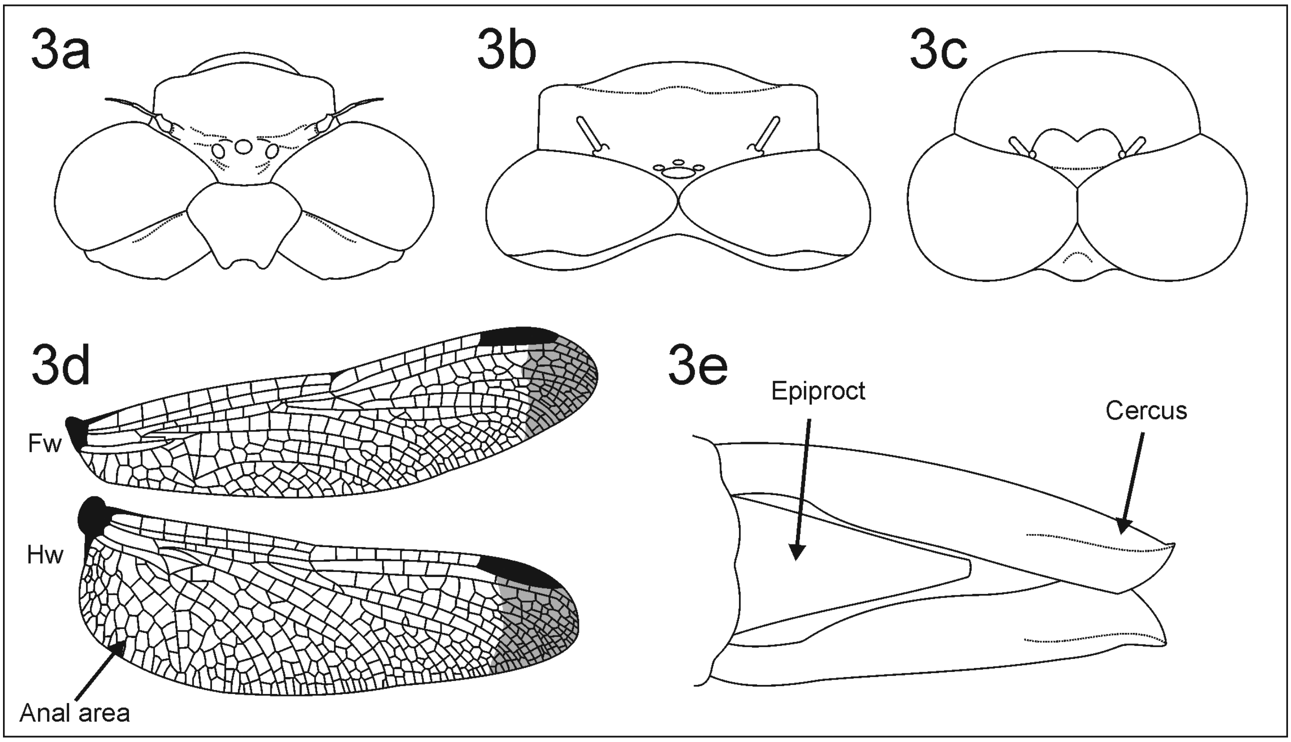

FIGURE 3. a *Phenes raptor*, head, dorsal view (modified from Garrison *et al.* 2006); b *Neopetalia punctata*, head, dorsal view (modified from Garrison *et al.* 2006); c *Rialla villosa*, head, dorsal view (modified from Garrison *et al.* 2006); d *Erythrodiplax atroterminata*, wings (modified from von Ellenrieder & Garrison, 2007); e *Rhionaeschna diffinis*, male terminalia, dorsal view (modified from von Ellenrieder, 2003).

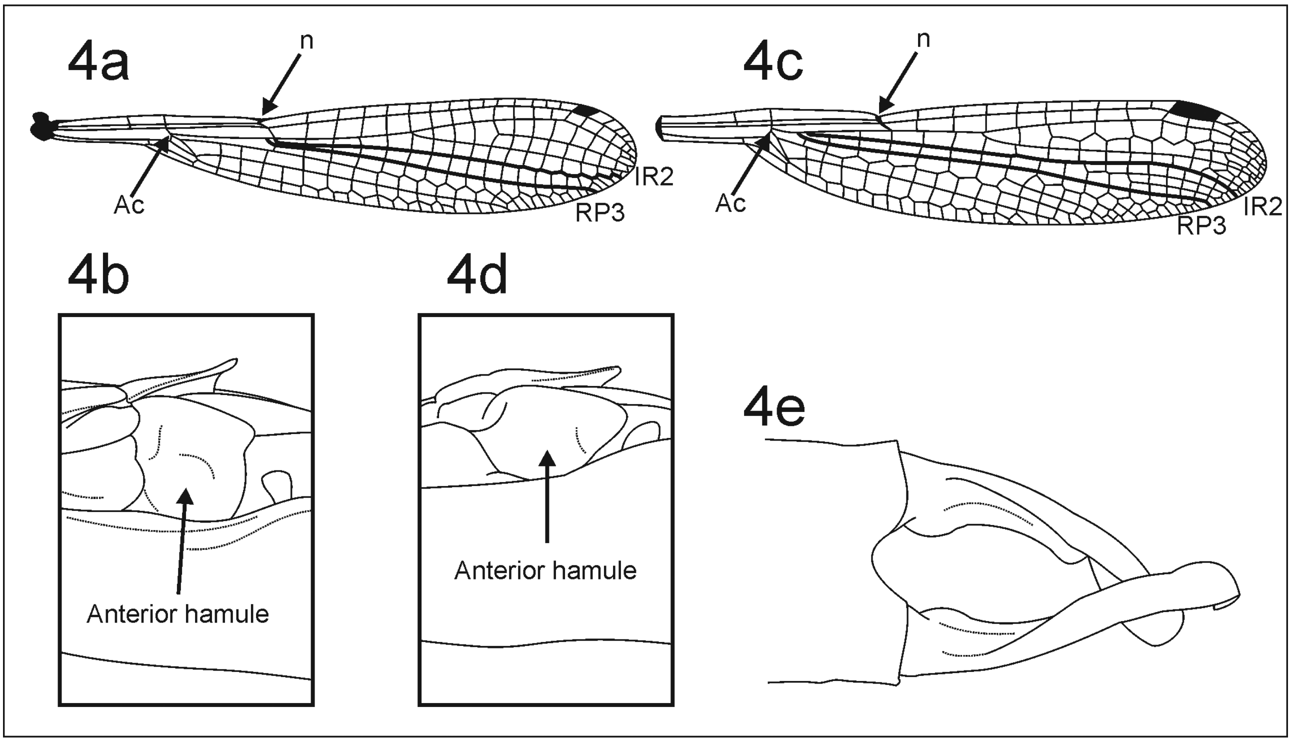

FIGURE 4. a *Cyanallagma interruptum*, Fw showing position of IR_2 and RP_3 (modified from von Ellenrieder & Garrison, 2008); b *Antiagrion grinbergsi*, male anterior hamule, lateral view; c *Lestes undulatus*, Fw showing position of IR_2 and RP_3; d *Lestes undulatus*, male anterior hamule, lateral view; e *Lestes undulatus*, male terminalia, dorsal view.

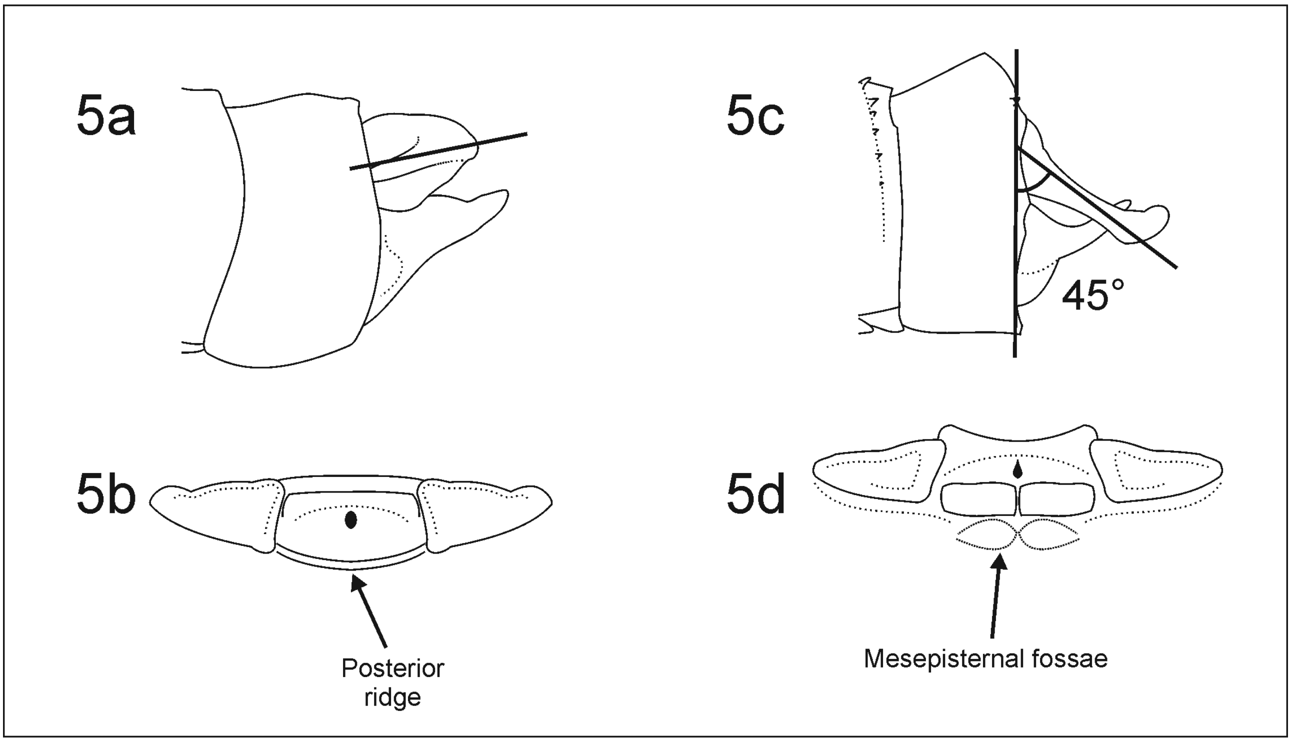

FIGURE 5. a *Antiagrion antigone*, male terminalia, lateral view; b *Ischnura fluviatilis*, female thorax, dorsal view; c *Oxyagrion rubidum*, male terminalia, lateral view; d *Oxyagrion rubidum*, female thorax, dorsal view.

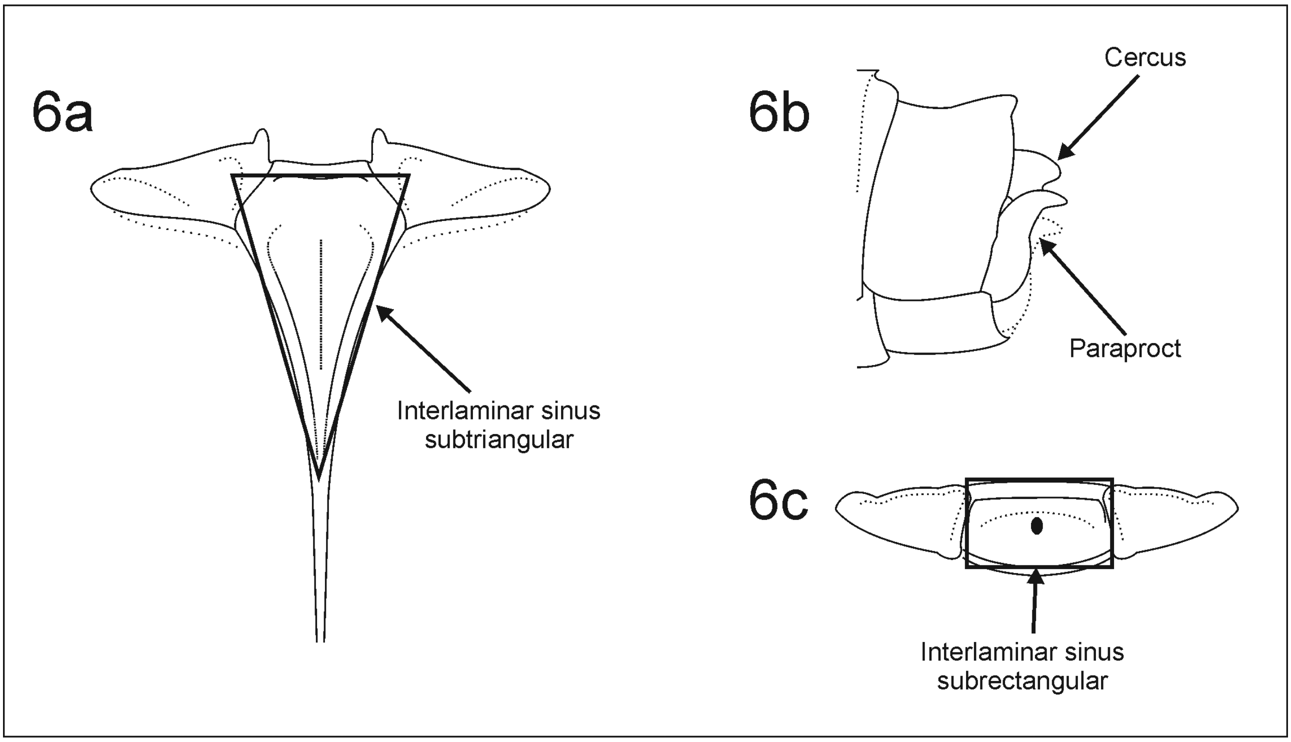

FIGURE 6. a *Antiagrion blanchardi*, female thorax, dorsal view; b *Ischnura fluviatilis*, male terminalia, lateral view; c *Ischnura fluviatilis*, female thorax, dorsal view.

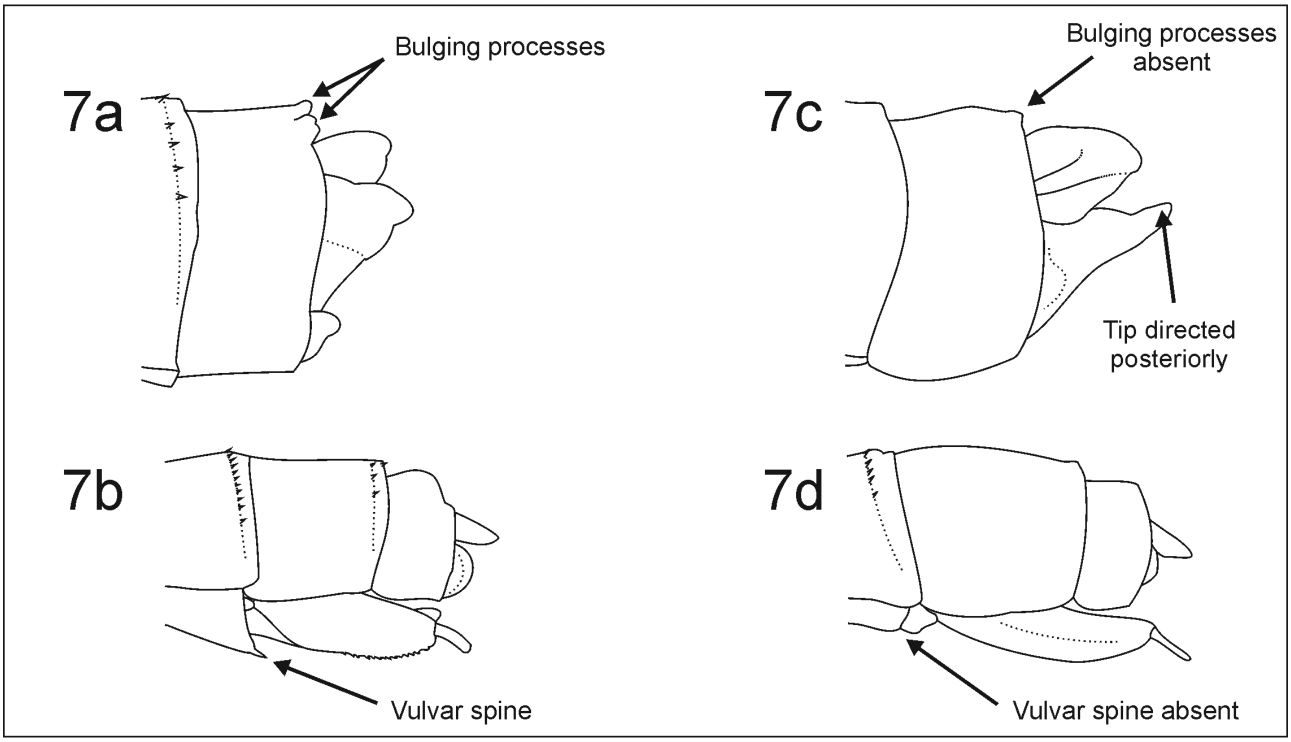

FIGURE 7. a *Cyanallagma interruptum*, male terminalia, lateral view; b *Cyanallagma interruptum*, female terminalia, lateral view; c *Antiagrion antigone*, male terminalia, lateral view; d *Antiagrion antigone*, female terminalia, lateral view.

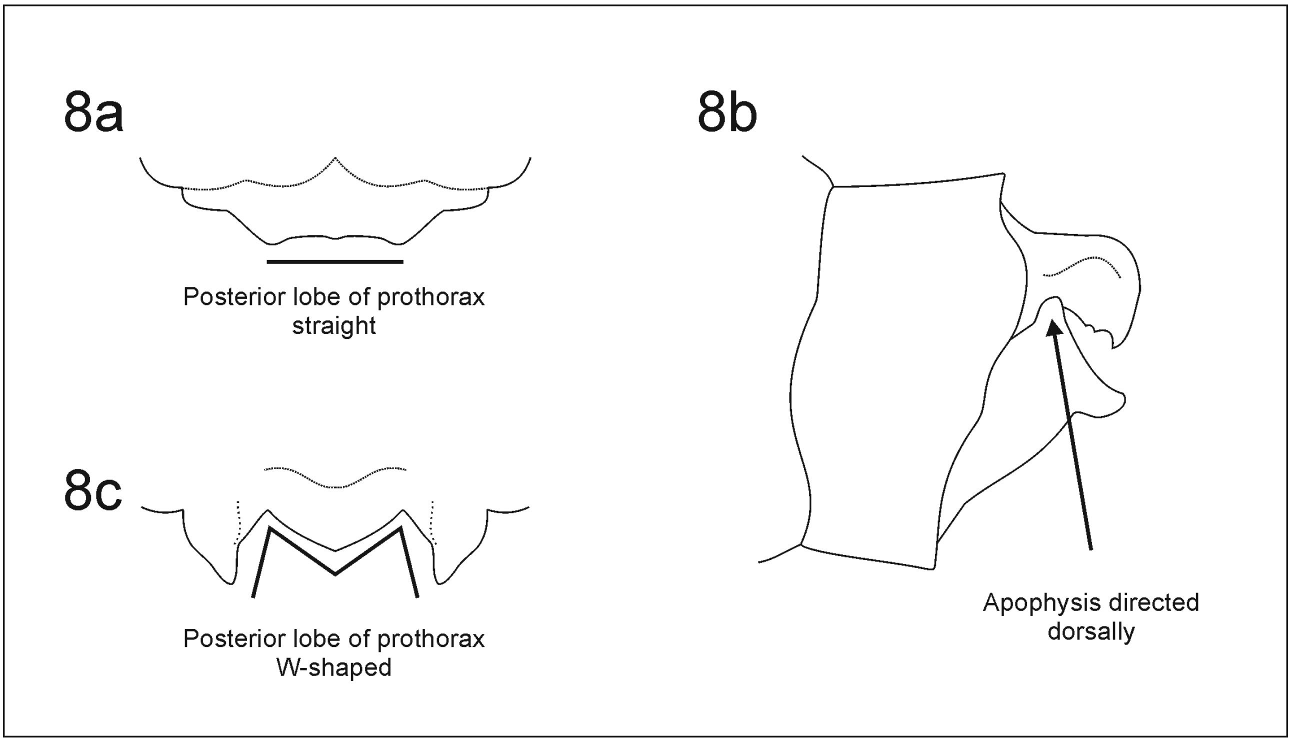

FIGURE 8. a *Antiagrion antigone*, posterior lobe of prothorax of female, dorsal view; b *Antiagrion grinbergsi*, male terminalia, lateral view; c *Antiagrion grinbergsi*, posterior lobe of prothorax of female, dorsal view.

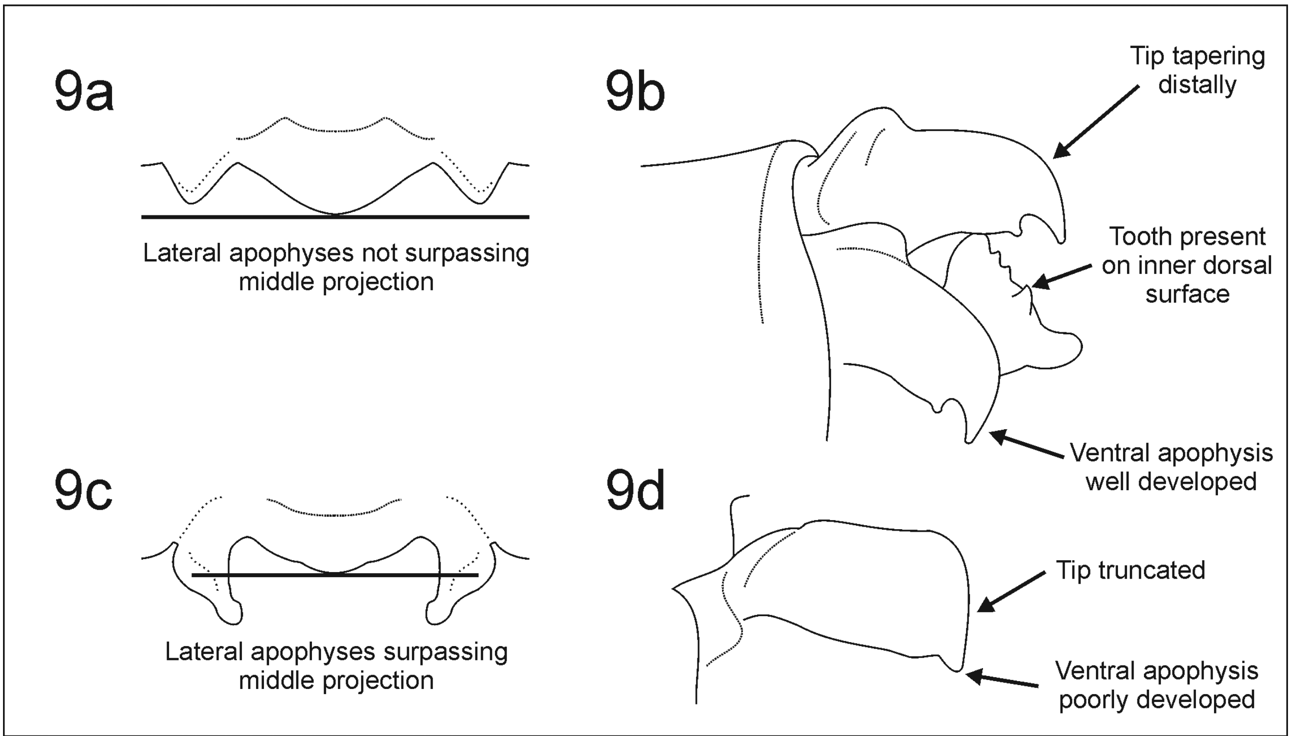

FIGURE 9. a *Antiagrion blanchardi*, posterior lobe of prothorax of female, dorsal view; b *Antiagrion gayi*, male terminalia, dorsolateral view; c *Antiagrion gayi*, posterior lobe of prothorax of female, dorsal view; d *Antiagrion grinbergsi*, male cercus, inner view.

8(7) Male paraprocts lacking teeth on inner-dorsal surface; female with lateral apophysis of posterior lobe of prothorax not surpassing middle projection (Fig. 9a) . . . . *A. blanchardi*

\- Male paraprocts with teeth on inner-dorsal surface (Fig. 9b); female with lateral apophysis of posterior lobe of prothorax surpassing middle projection (Fig. 9c). 9

9(8) Male with tip of cerci in mesal view truncated with ventral apophysis poorly developed (Fig. 9d); female with lateral apophysis of posterior lobe of prothorax rounded (Fig. 10a), color pattern of head as in Fig. 10b. . . . . *A. grinbergsi*

\- Male with tip of cerci in mesal view tapering distally with ventral apophysis well developed (Fig. 9b); female lateral apophysis of posterior lobe of prothorax acute (Fig. 10c), color pattern of head as in Fig. 10d . . . . *A. gayi*

10(1) Eyes widely separated dorsally (Fig. 3a) 11

\- Eyes close together or touching dorsally (Figs. 3b–c) 12

11(10) Pt in Hw closer to apex than nodus (Fig. 11a); labium with ligula entire (Fig. 11b); male cerci variable, never foliated, epiproct variable (Fig. 11c); female ovipositor modified as vulvar laminae (Fig. 11d) . . . . Gomphidae ... 24

\- Pt in Hw approximately half way from nodus to apex (Fig. 12a); labium with ligula cleft (Fig. 12b); male cerci foliated distally, epiproct strongly concave in lateral view (Fig. 12c); female ovipositor sawlike, reaching caudal margin of S10 (Fig. 12d) . . . . Petaluridae (only *Phenes raptor)*

12(10) Male anterior lamina with deep median cleft; posterior hamule vestigial (Fig. 13a); female ovipositor sawlike (Fig. 13b). . . 13

\- Male anterior lamina entire; posterior hamule variable, never vestigial (Fig. 13c); female ovipositor modified as vulvar lamina (Fig. 13d), if gonapophyses present then sternum S10 expanded (Fig. 16c) 14

13(12) Wings with 5–7 red spots on costal margin (Fig. 14a); eyes meeting dorsally at a single point (Fig. 14b); S7–8 with lateral expansions (Fig. 14c) . . . . .Austropetaliidae ... 27

\- Wings hyaline, lacking red spots on costal margin (Fig. 15a); eyes forming an eye seam (Fig. 15b); abdomen without lateral expansions (Fig. 15c) . . . . Aeshnidae, only genus *Rhionaeschna* ... 33

14(12) Eyes forming an eye seam (Fig. 3c); color pattern of wings variable, never with red spots on costal margin (Figs. 3d, 17a, d, 18a, c); male posterior hamule variable (Figs. 13c, 17c); female sternum S10 never expanded (Fig. 13d, 18b, d, 19b). 15

\- Eyes meeting dorsally at a single point (Fig. 3b); wings with five red spots on costal margin (Fig. 16a); male posterior hamule bilobate (Fig. 16b); female sternum S10 expanded into a large plate (Fig. 16c) . . . . Neopetaliidae, only *Neopetalia punctata*

15(14) Second crossvein between RP1, 2 and IRP2 oblique (Fig. 17a); male fore tibia lacking keel (Fig. 17b); male S2 lacking auricles (Fig. 17c) . . . . Libellulidae ... 16

\- Second crossvein between RP1, 2 and IRP2 straight, not oblique (Fig. 17d); male fore tibia with keel (Fig. 17e); male S2 with auricles (Fig. 13c) . . . . Corduliidae ... 22

16(15) Last antenodal of Fw incomplete (could be complete in reddish species), three rows of cells in discoidal field (Fig. 18a); female sternum S9 not projected distally and without a fringe of long hairs (Fig. 18b). 17

\- Last antenodal of Fw complete, two rows of cells in discoidal field (Fig. 18c); female sternum S9 projected distally and fringed with long hairs (Fig. 18d) . . . . *Dasythemis*, only *D. mincki clara* (recorded in Patagonia only in Somuncura plateau)

17(16) Black, brown or reddish species, color pattern of pterothorax variable, never with whitish spots against reddish background; male distal segment of vesica spermalis long and cylindrical, without dorsoapical flagellae (Fig. 19a); female vulvar lamina scooped (Fig. 19b). . . . . *Erythrodiplax* ... 18

\- Reddish species; pterothorax reddish brown with whitish spots or stripes; male distal segment of vesica spermalis with two dorsoapical flagellae (Fig. 19c); female vulvar lamina short and bilobated (Fig. 19d) . . . . *Sympetrum*, only *S. villosum*

18(17) Black or brown species; base of Hw hyaline or with a small brownish basal spot. 19

\- Red species; base of Hw with a yellowish brown to dark red spot reaching Ax2 to Ax4 (Fig. 17a) 21

19(18) Male cerci yellowish; females with a small black spot on anterior portion of mesepisternum . . . . *E. nigricans*

\- Not as above 20

20(19) Tips of wings brown or black (Fig. 3d) . . . .*E. atroterminata*

\- Tips of wings hyaline . . . . *E. connata*

(NOTE: some females of *E. atroterminata* with hyaline wings are almost indistinguishable from females of *E. connata*. These species are sympatric only in northern steppe areas of Patagonia, see Fig. 57a)

21(18) Abdomen reddish, Hw basal spot reaching Ax2. . . . . *E. ochracea*

\- Abdomen reddish, except S8–10 with black spots, Hw basal spot reaching Ax3 or Ax4 (Fig 17a) . . . . *E. corallina*

22(15) Hw anal loop boot-shaped, midrib of anal loop (Aspl) distinct (Fig. 20a) . . . . *Rialla*, only *R. villosa*

\- Hw anal loop polygonal, midrib of anal loop (Aspl) indistinct (Fig 20b) . . . . *Gomphomacromia* ... 23

23(22) Mesanepisternum dark; male cerci with rounded tips (Fig. 21a) . . . . *G. chilensis*

\- Mesanepisternum with yellow spots; male cerci with flattened tips (Fig. 21b) . . . . *G. paradoxa*

24(11) Wings without a nodal brown spot; postocellar ridge complete (Fig. 22a); distal segment of male vesica spermalis with 2 long flagella; vulvar lamina extending from 0.75 of S9 to beyond distal margin (Fig. 22b) . . . . *Neogomphus* ... 25

\- Wings with a nodal brown spot; postocellar ridge incomplete (Fig. 22c); distal segment of male vesica spermalis lacking flagella; vulvar lamina extending to about 0.3 of S9 (Fig. 22d) . . . . *Progomphus*, only *P. joergenseni*

25(24) Male cerci about as long as epiproct (Fig. 23a); vulvar lamina shorter than S9 (Fig. 23b) 26

\- Male cerci about twice as long as epiproct (Fig. 23c); vulvar lamina longer than S9 (Fig. 23d). . . . . *N. bidens*

26(25) Face predominantly yellow; pterothorax without brown bands along metapleural sulci; female postocellar ridge highest laterally. . . . . *N. molestus*

\- Face predominantly brown; pterothorax with brown bands along metapleural sulci; female postocellar ridge highest medially . . . . *N. edenticulatus*

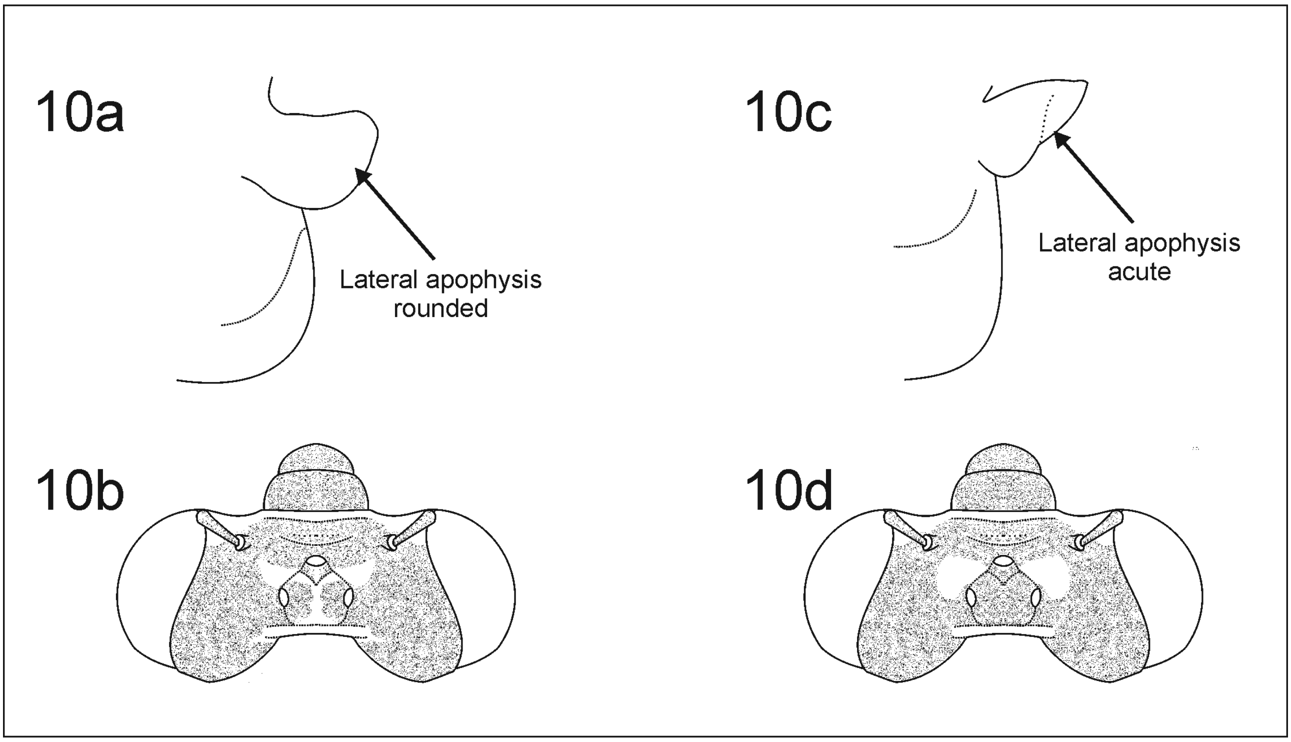

FIGURE 10. a *Antiagrion grinbergsi*, lateral apophysis of posterior lobe of prothorax of female, dorsolateral view; b *Antiagrion grinbergsi*, female head, dorsal view; c *Antiagrion gayi*, lateral apophysis of posterior lobe of prothorax of female, dorsolateral view; d *Antiagrion gayi*, female head, dorsal view.

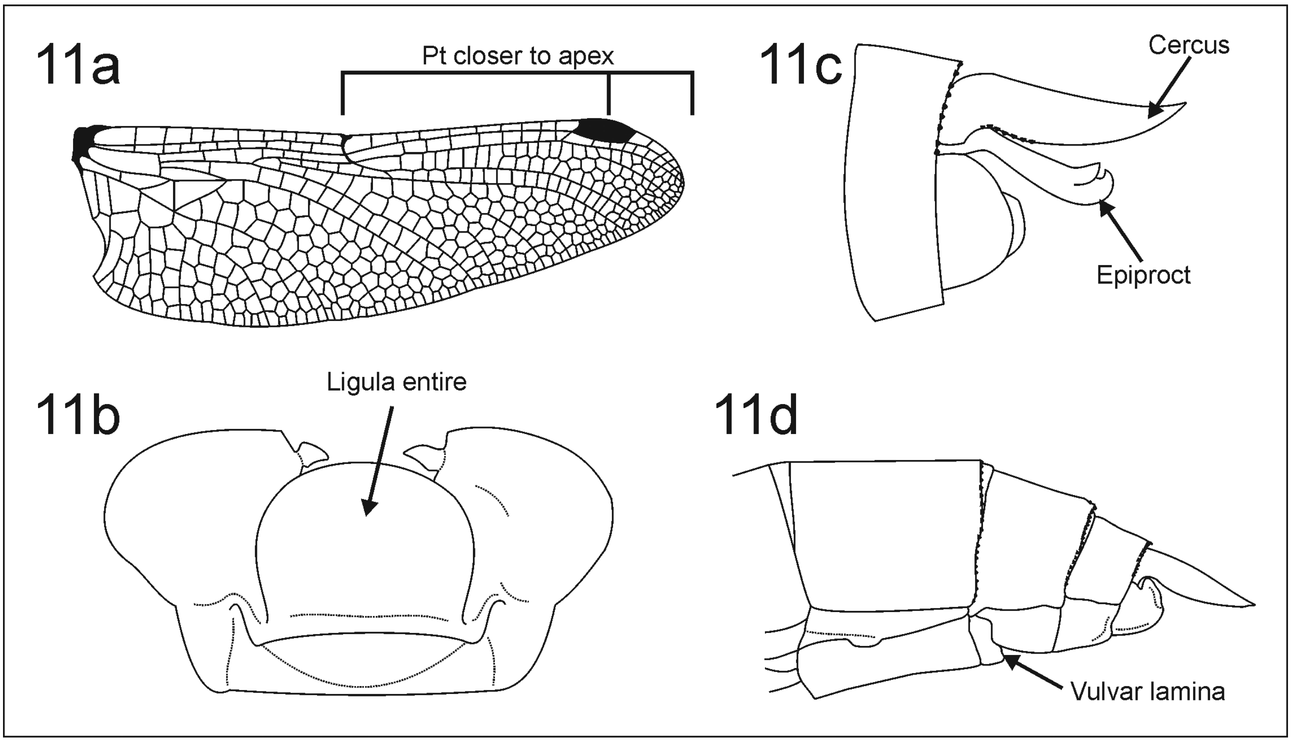

FIGURE 11. a *Neogomphus bidens*, Hw (modified from Garrison *et al.* 2006); b *Progomphus joergenseni*, labium, posterior view; c *Progomphus joergenseni*, male terminalia, lateral view (modified from von Ellenrieder & Garrison, 2007); d *Progomphus joergenseni*, female terminalia, lateral view.

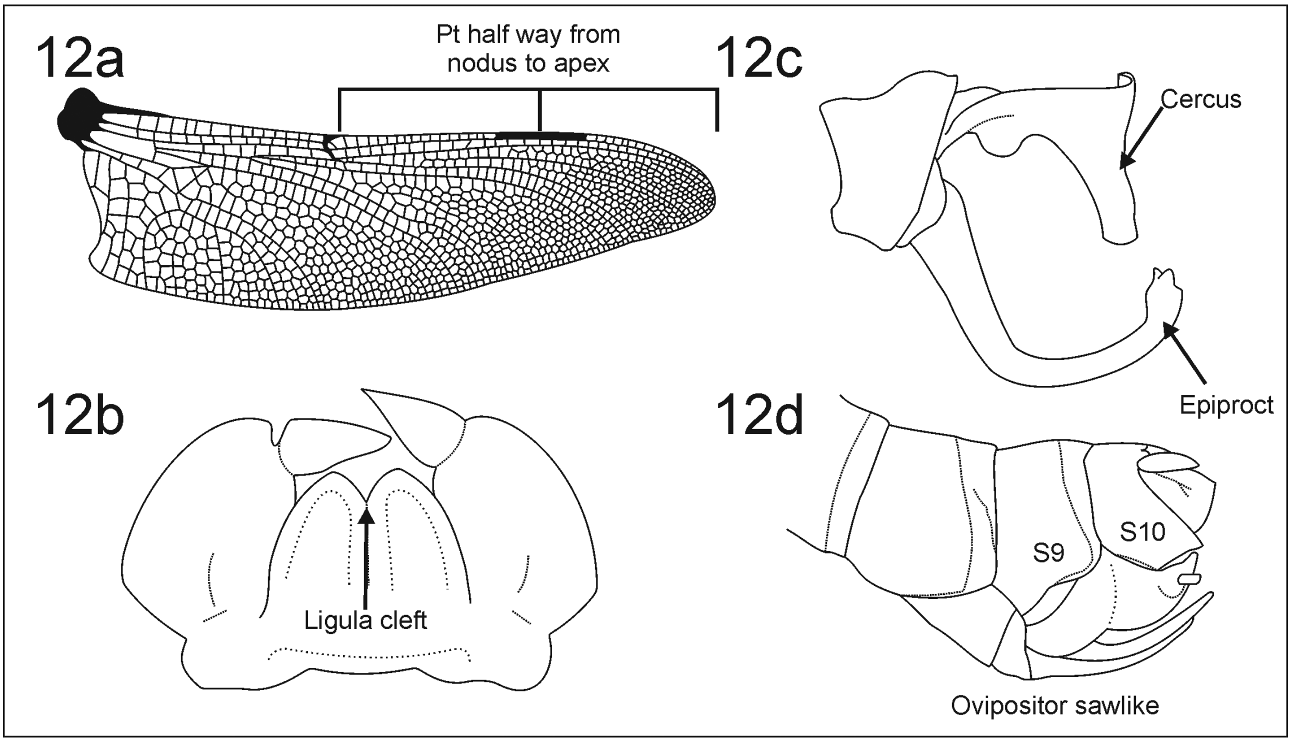

FIGURE 12. a *Phenes raptor*, Hw (modified from Garrison *et al.* 2006); b *Phenes raptor*, labium, posterior view (modified from Garrison *et al.* 2006); c *Phenes raptor*, male terminalia, lateral view (modified from Garrison *et al.* 2006); d *Phenes raptor*, female terminalia, lateral view (modified from Matushkina & Klass 2011).

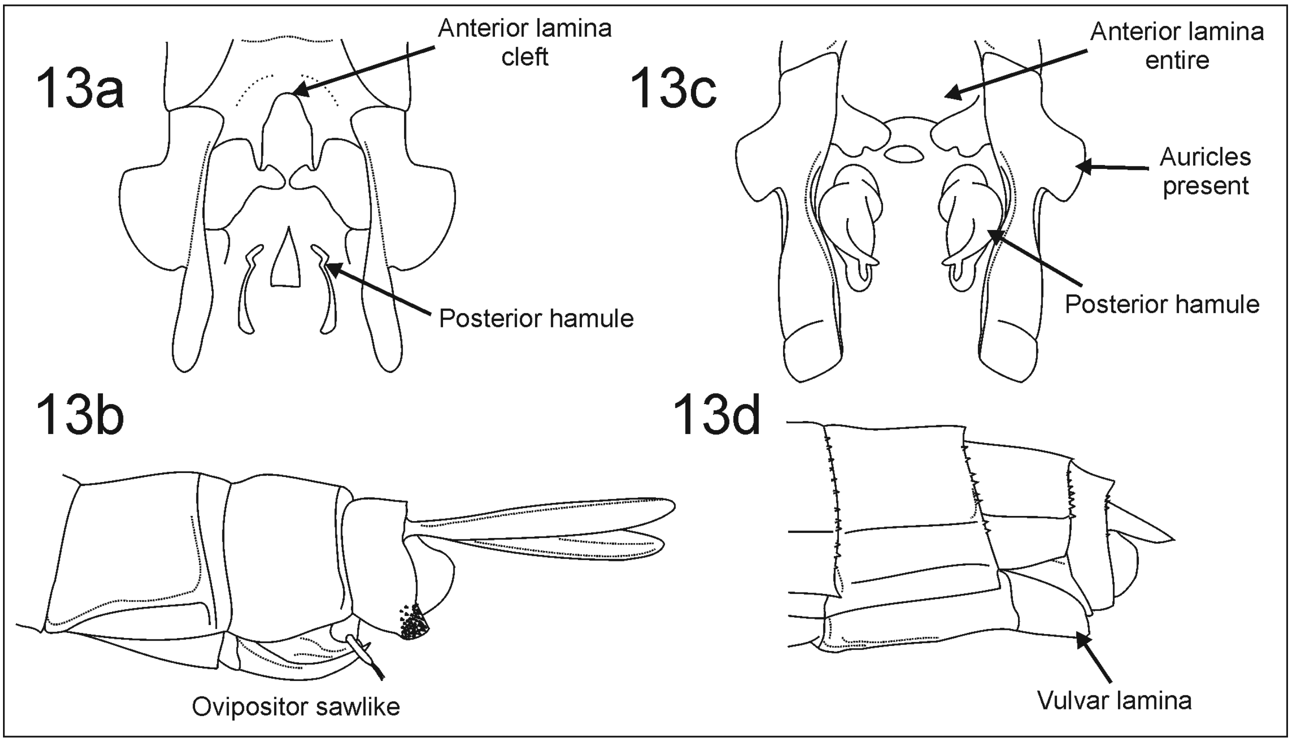

FIGURE 13. a *Phyllopetalia pudu*, male genital fossa, ventral view (modified from Garrison *et al.* 2006); b *Rhionaeschna variegata*, female terminalia, lateral view; c *Gomphomacromia paradoxa*, male genital area, ventral view (modified from von Ellenrieder & Garrison 2005); d *Erythrodiplax atroterminata*, female terminalia, lateral view.

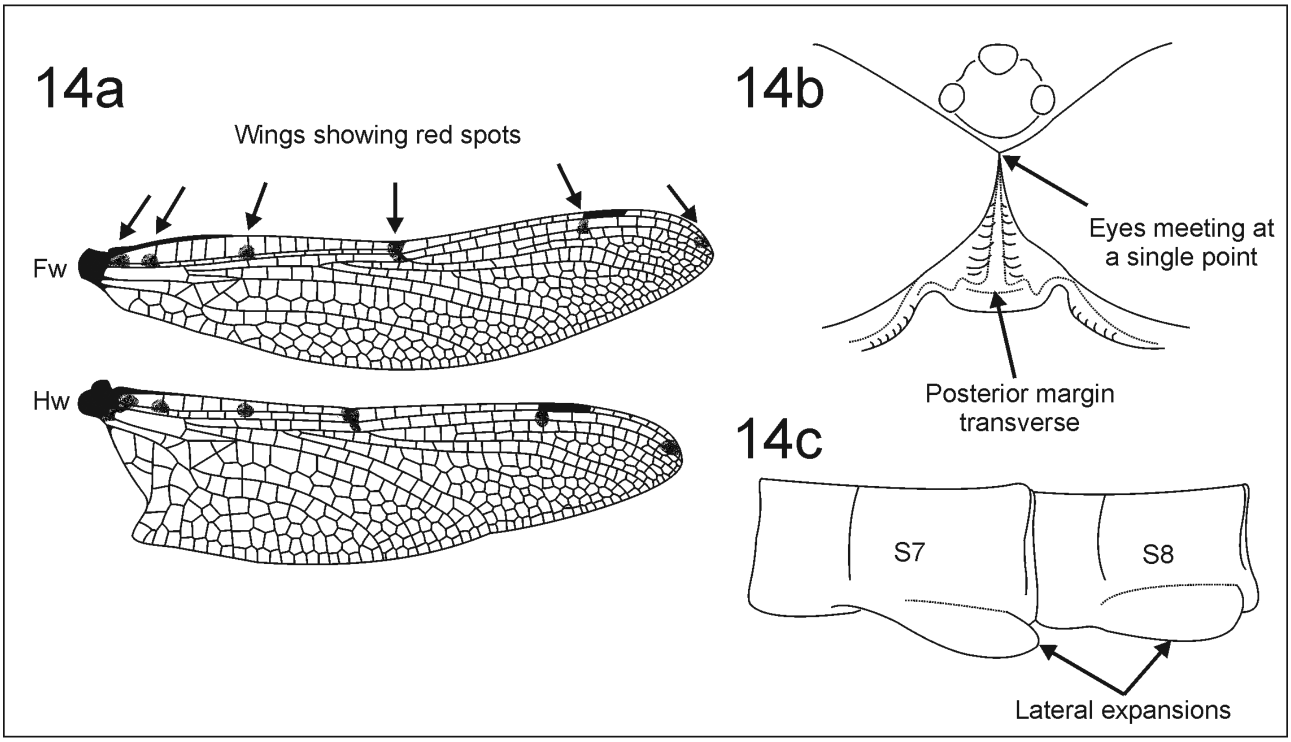

FIGURE 14. a *Phyllopetalia apicalis*, wings (modified from Garrison *et al.* 2006); b *Phyllopetalia altarensis*, head, dorsal view (modified from von Ellenrieder 2005); c *Phyllopetalia excrescens*, S7–8, lateral view (modified from von Ellenrieder 2005).

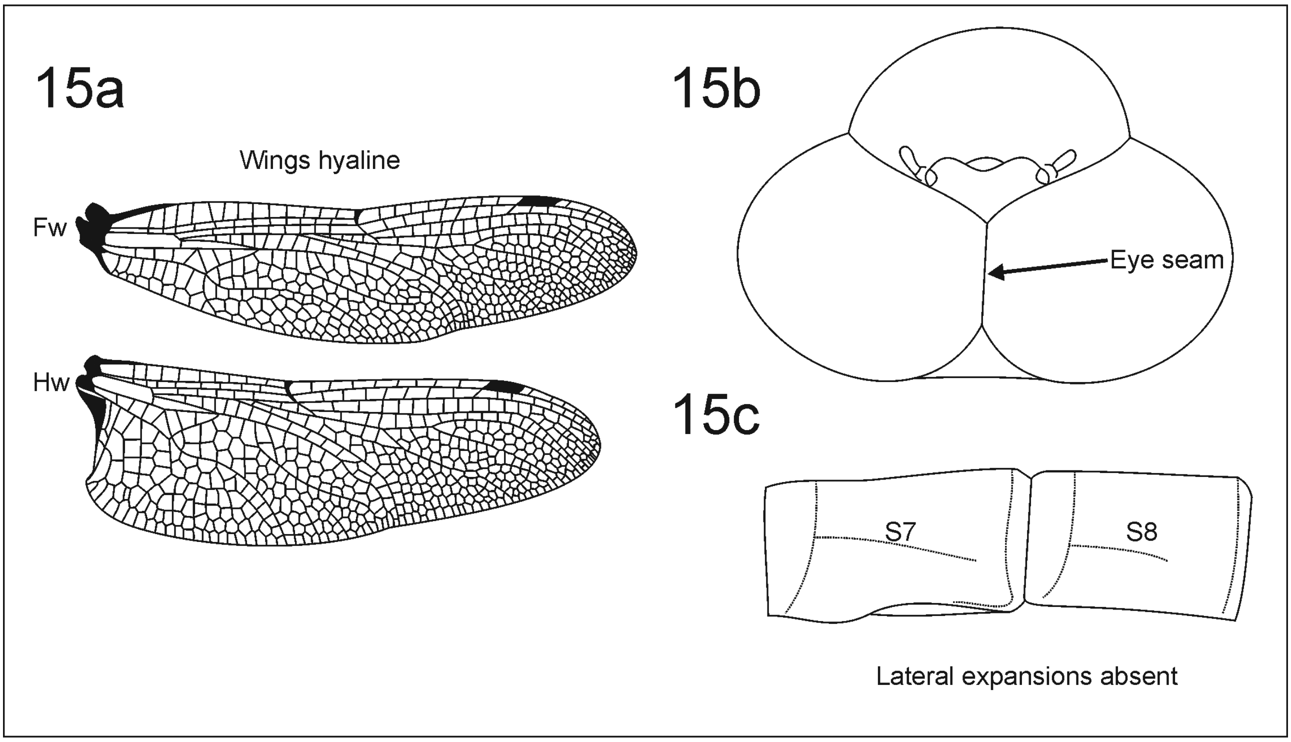

FIGURE 15. a *Rhionaeschna bonariensis*, wings (modified from von Ellenrieder 2003); b *Rhionaeschna variegata*, head, dorsal view (modified from von Ellenrieder 2003); c *Rhionaeschna absoluta*, S7–8.

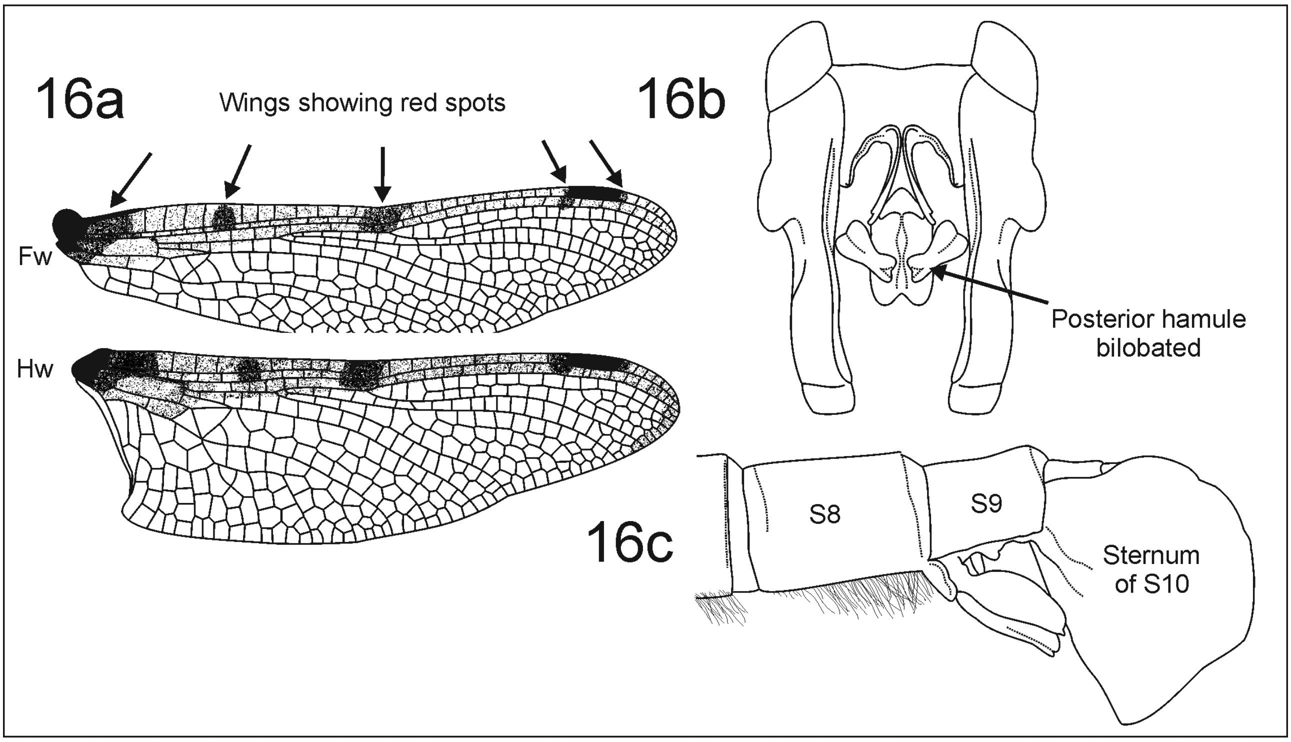

FIGURE 16. a *Neopetalia punctata*, wings (modified from Garrison *et al.* 2006); b *Neopetalia punctata*, male genital fossa, ventral view (modified from Garrison *et al.* 2006); c *Neopetalia punctata*, female terminalia, lateral view (modified from Garrison *et al.* 2006).

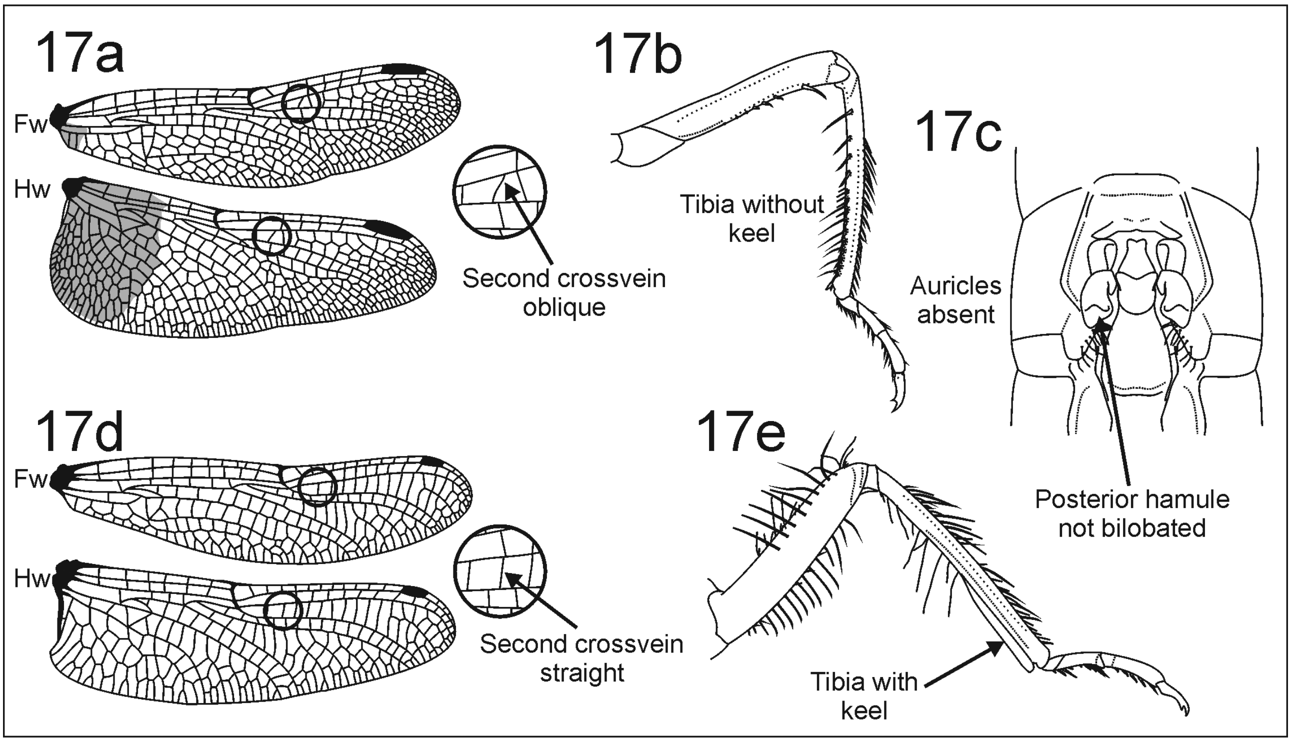

FIGURE 17. a *Erythrodiplax corallina*, wings showing second crossvein oblique (modified from von Ellenrieder & Garrison 2007); b *Dasythemis mincki clara*, fore leg, lateral view; c *Dasythemis mincki clara*, male genital fossa; d *Gomphomacromia chilensis*, wings showing second crossvein straight (modified from von Ellenrieder & Garrison 2005); e *Gomphomacromia paradoxa*, fore leg, lateral view;

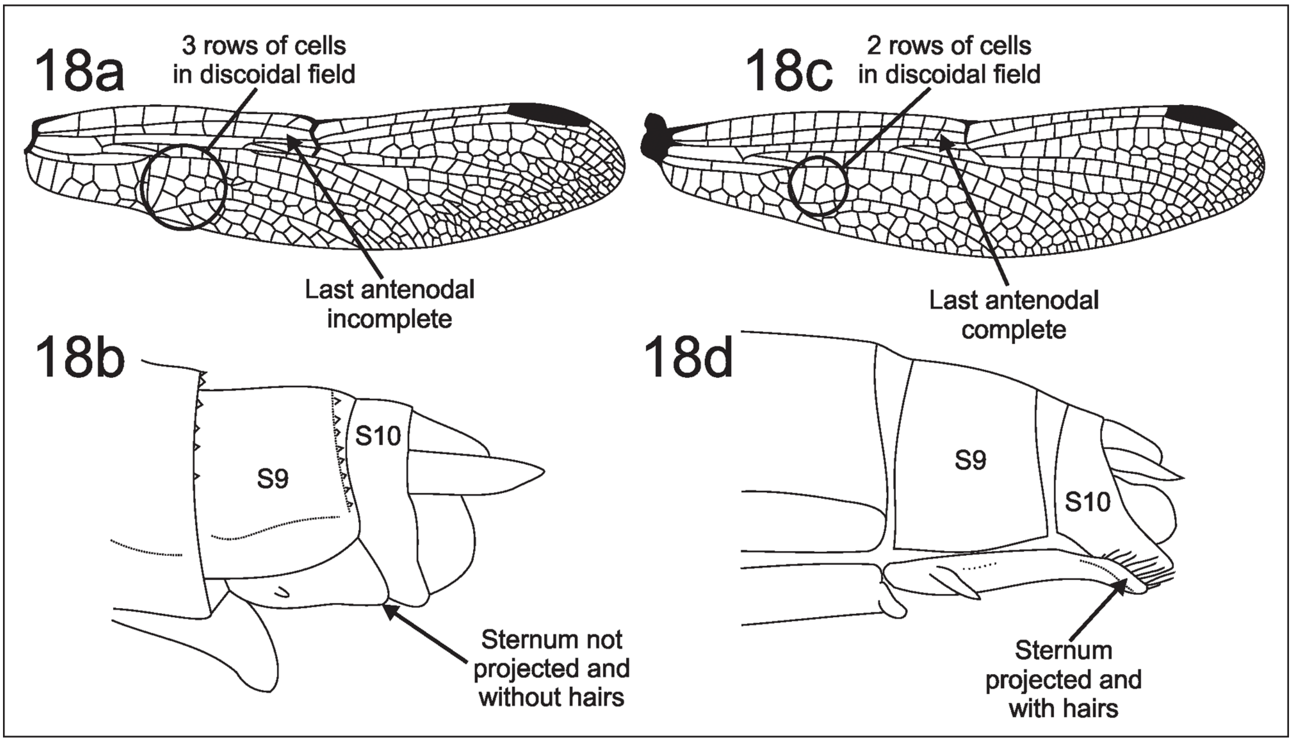

FIGURE 18. a *Sympetrum villosum*, Fw showing vein characters (modified from Garrison *et al.* 2006); b *Erythrodiplax nigricans*, female terminalia, lateral view (modified from Borror 1942); c *Dasythemis mincki clara*, Fw showing vein characters , Fw showing vein characters (modified from von Ellenrieder & Garrison 2007); d *Dasythemis mincki clara*, female terminalia, lateral view (modified from von Ellenrieder & Garrison 2007).

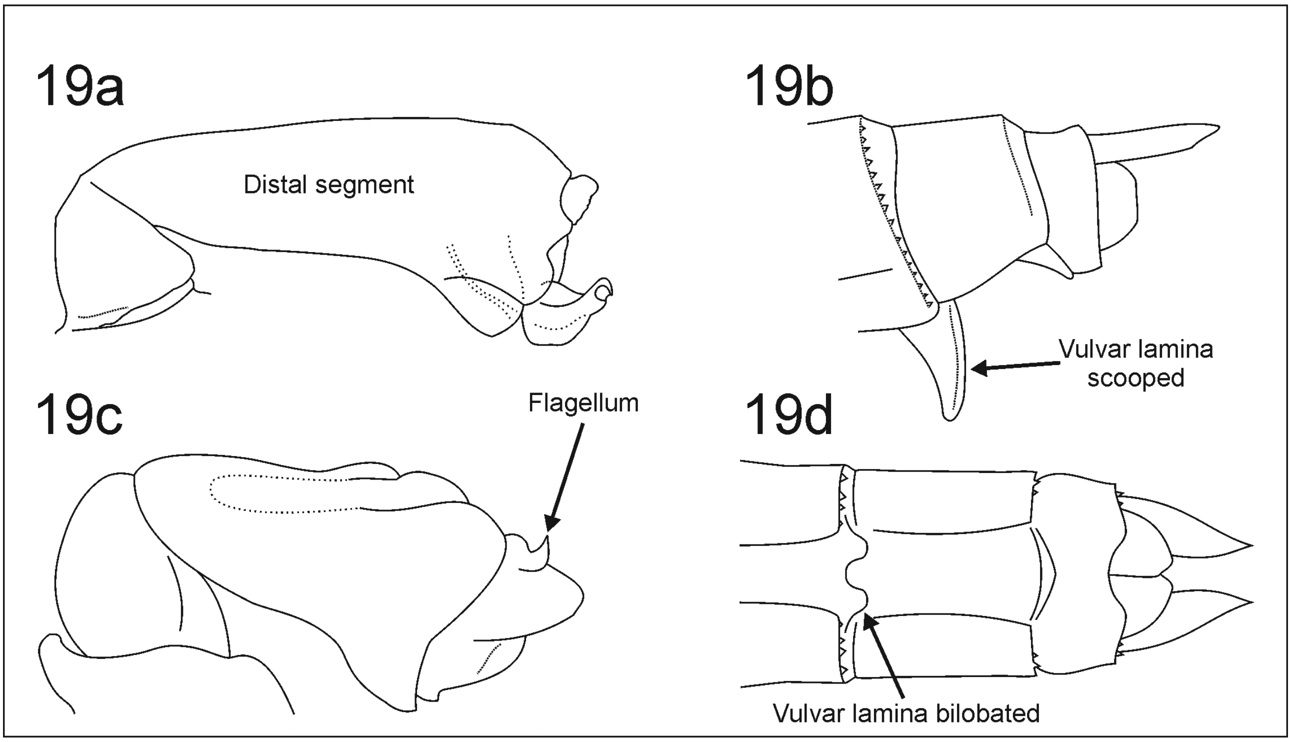

FIGURE 19. a *Erythrodiplax connata*, vesica spermalis, lateral view (modified from Garrison *et al.* 2006); b *Erythrodiplax corallina*, female terminalia, lateral view (modified from Borror 1942); c *Sympetrum villosum*, vesica spermalis, lateral view (modified from Garrison *et al.* 2006); d *Sympetrum villosum*, female terminalia, ventral view (modified from Garrison *et al.* 2006).

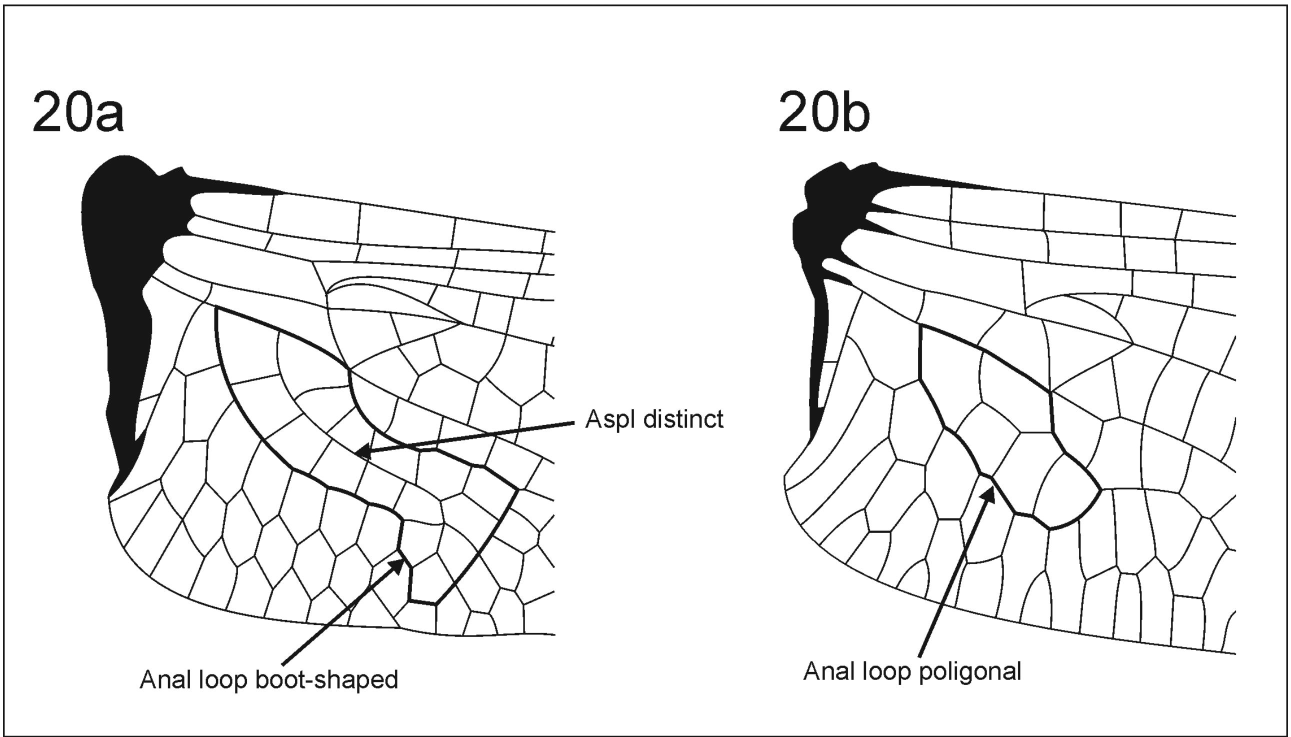

FIGURE 20. a *Rialla villosa*, base of Hw (modified from Garrison *et al.* 2006); b *Gomphomacromia chilensis*, base of Hw (modified from von Ellenrieder & Garrison 2005).

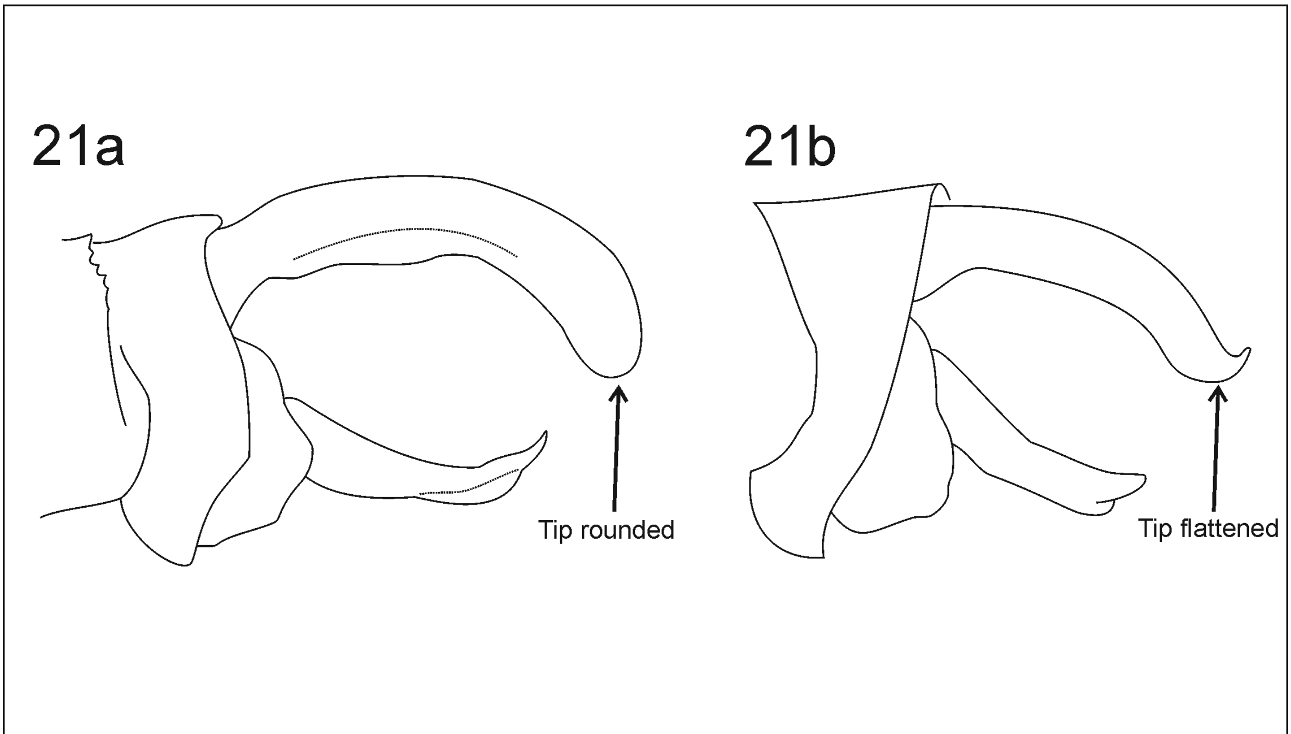

FIGURE 21. a *Gomphomacromia chilensis*, male terminalia, lateral view (modified from von Ellenrieder & Garrison, 2005); b *Gomphomacromia paradoxa*, male terminalia, lateral view (modified from von Ellenrieder & Garrison 2005).

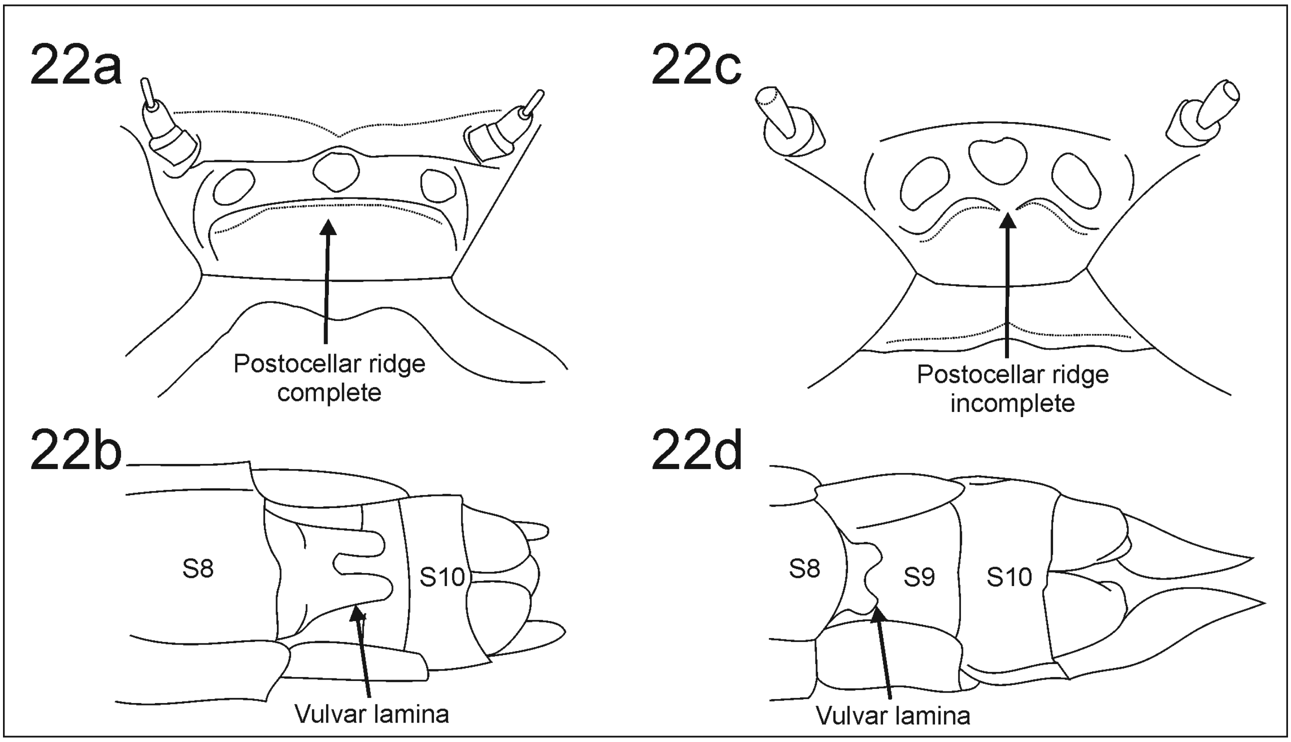

FIGURE 22. a *Neogomphus bidens*, head, dorsal view (modified from Schmidt 1941); b *Neogomphus molestus*, female terminalia, ventral view (modified from Schmidt 1941); c *Progomphus joergenseni*, head, dorsal view; d *Progomphus joergenseni*, female terminalia, ventral view.

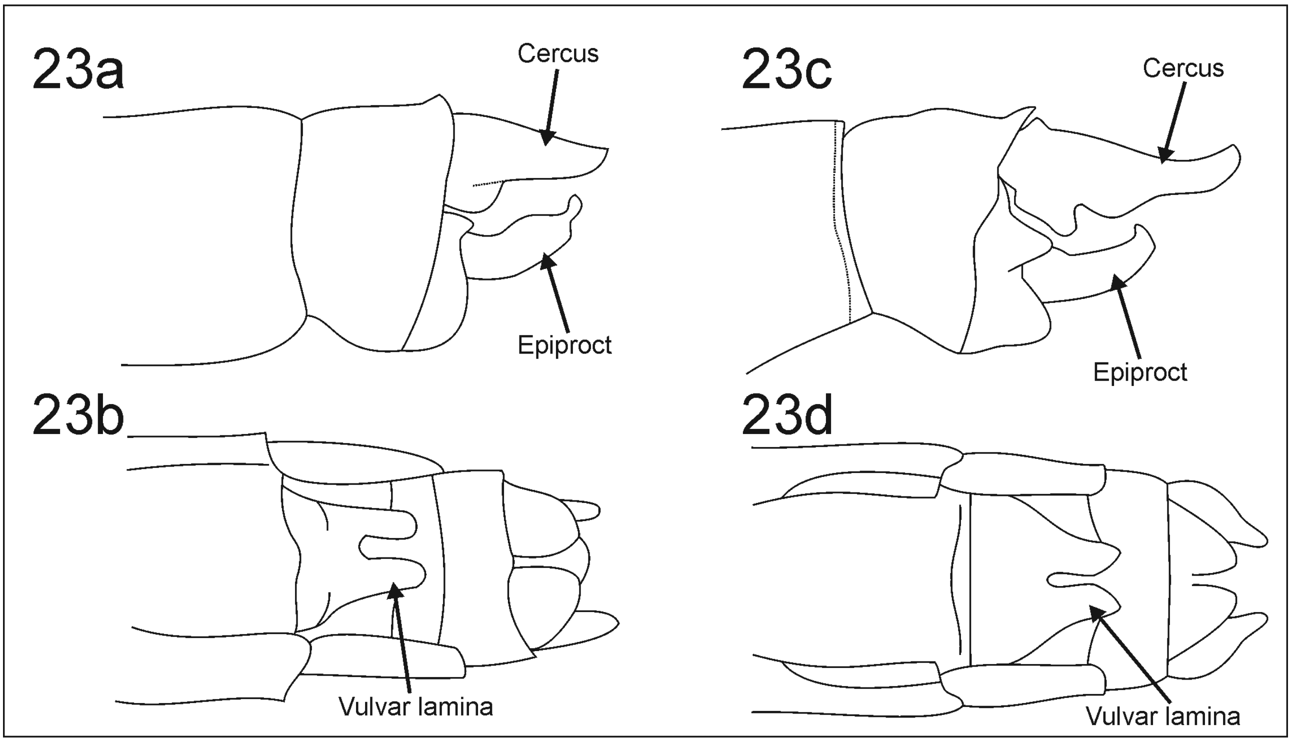

FIGURE 23. a *Neogomphus molestus*, male terminalia, lateral view (modified from Schmidt, 1941); b *Neogomphus molestus*, female terminalia, ventral view (modified from Schmidt 1941); c *Neogomphus bidens*, male terminalia, lateral view (modified from Schmidt 1941); d *Neogomphus bidens*, female terminalia, ventral view (modified from Schmidt 1941).

27(13) Fw costal area with 5–6 reddish spots (Fig. 14a); subtriangle with 1 cell (Fig. 24a); dorsum of pterothorax smooth; pterothorax with dorsal and lateral yellowish stripes; auricles 1.5–2 times as wide as long . . . . *Phyllopetalia* ... 28

\- Fw costal area with 7 reddish spots; subtriangle with 2–3 cells (Fig. 24b); dorsum of pterothorax covered with a coarse tubercle; pterothorax with 3 lateral whitish spots; auricles about as long as wide . . . . *Hypopetalia*, only *H. pestilens*

28(27) Lateral expansions of S7–8 both semicircular (Figs. 14c, 25a) 29

\- Lateral expansions of S8 semicircular, those of S7 rectangular and very narrow (Fig. 25b) . . . . *P. apicalis*

29(28) Posterior margin of occipital triangle transverse (Fig. 14b) 30

\- Posterior margin of occipital triangle projected anteriorly (Fig. 25c) 31

30(29) Ratio of height of antefrons : height of postclypeus of about 1.08–1.55 (Fig. 26a); male cerci with large medioventral branch (Fig. 26b) and strong sub-basal swelling (Fig. 26c) . . . . *P. apollo*

\- Ratio of height of antefrons : height of postclypeus of about 1.64–1.86 (Fig. 27a); male cerci lacking medioventral branch (Fig. 27b) and with weak sub-basal swelling (Fig. 27c) . . . . *P. altarensis* (currently not known from Patagonia)

31(29) Occipital triangle with anterodorsal spine (Figs. 28a, b); male cerci with sub-basal keel (Fig. 28c) 32

\- Occipital triangle lacking anterodorsal spine (Fig. 25c); male cerci with strong sub-basal swelling (Fig. 28d) . . . . *P. excrescens* (Carle, 1996)

32(31) Antefrons black with narrow yellow stripe along carina (Fig. 29a); postocciput smooth (Fig. 28a); lateral expansions of S7 slightly wider than those of S8 (Fig. 29b). . . . . *P. stictica*

\- Anterior surface of antefrons with wide dorsal yellow stripe (Fig. 29c); postocciput with a pair of horns (Fig. 28b); lateral expansions of S7 slightly narrower than those of S8 (Fig. 29d) . . . . *P. pudu*

33(13) Mesanepisternal stripe absent (Fig. 30a) 34

\- Mesanepisternal stripe present (Fig. 30b) . . . . *R. confusa*

34(33) Frontoclypeal groove with a black stripe (Fig. 30c) 35

\- Frontoclypeal groove without a black stripe (Fig. 30d) . . . . *R. bonariensis*

35(34) Supratriangles free (Fig. 31a) 36

\- Supratriangles crossed (Fig. 31b) . . . . *R. variegata*

36(35) Male ventral terga of S4 wide (ratio of length : max. width < 2.6) (Fig. 32a); dorsal surface of S2 of females without a mediolongitudinal black stripe between transverse carina and posterior margin (Fig. 32b) . . . . *R. diffinis*

\- Male ventral terga of S4 narrow (ratio of length : max. width > 4.2) (Fig. 32c); dorsal surface of S2 of females with a mediolongitudinal black stripe between transverse carina and posterior margin (Fig. 32d) . . . . *R. absoluta*

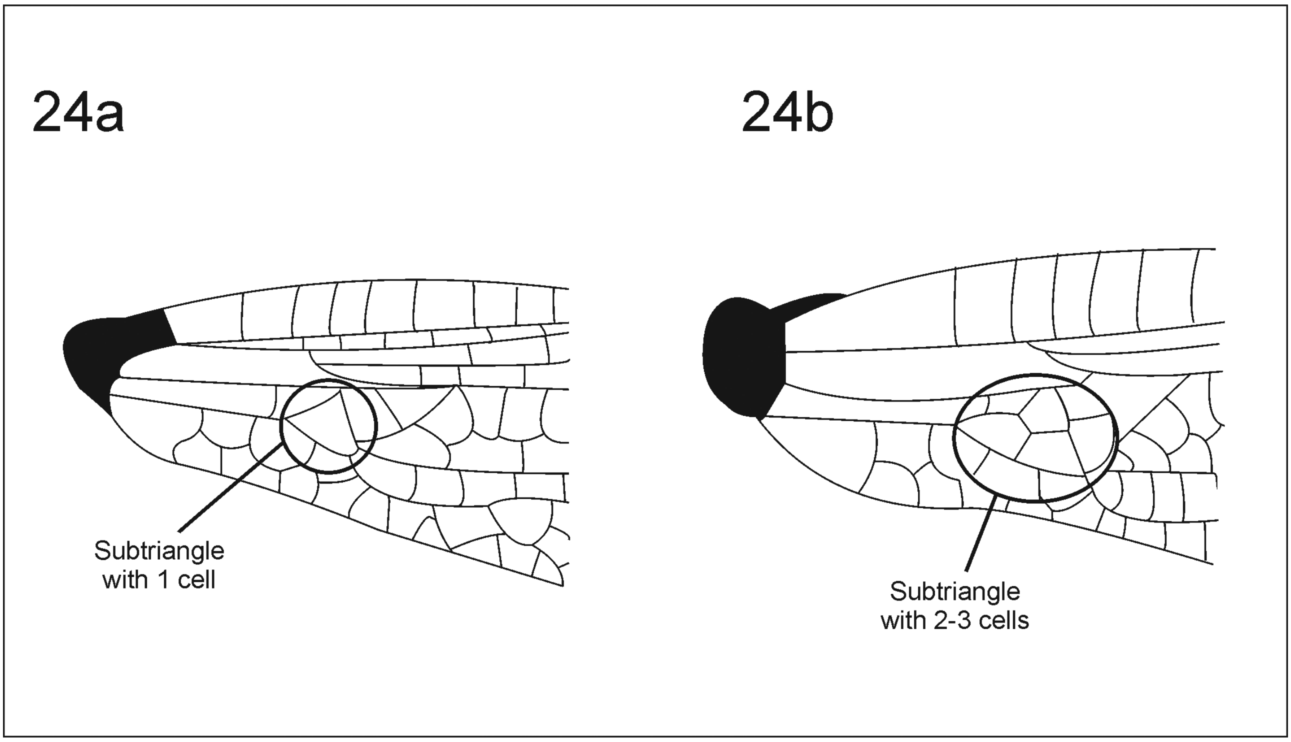

FIGURE 24. a *Phyllopetalia apollo*, base of Fw (modified from von Ellenrieder 2005); b *Hypopetalia pestilens*, base of Fw (modified from Garrison *et al.* 2006).

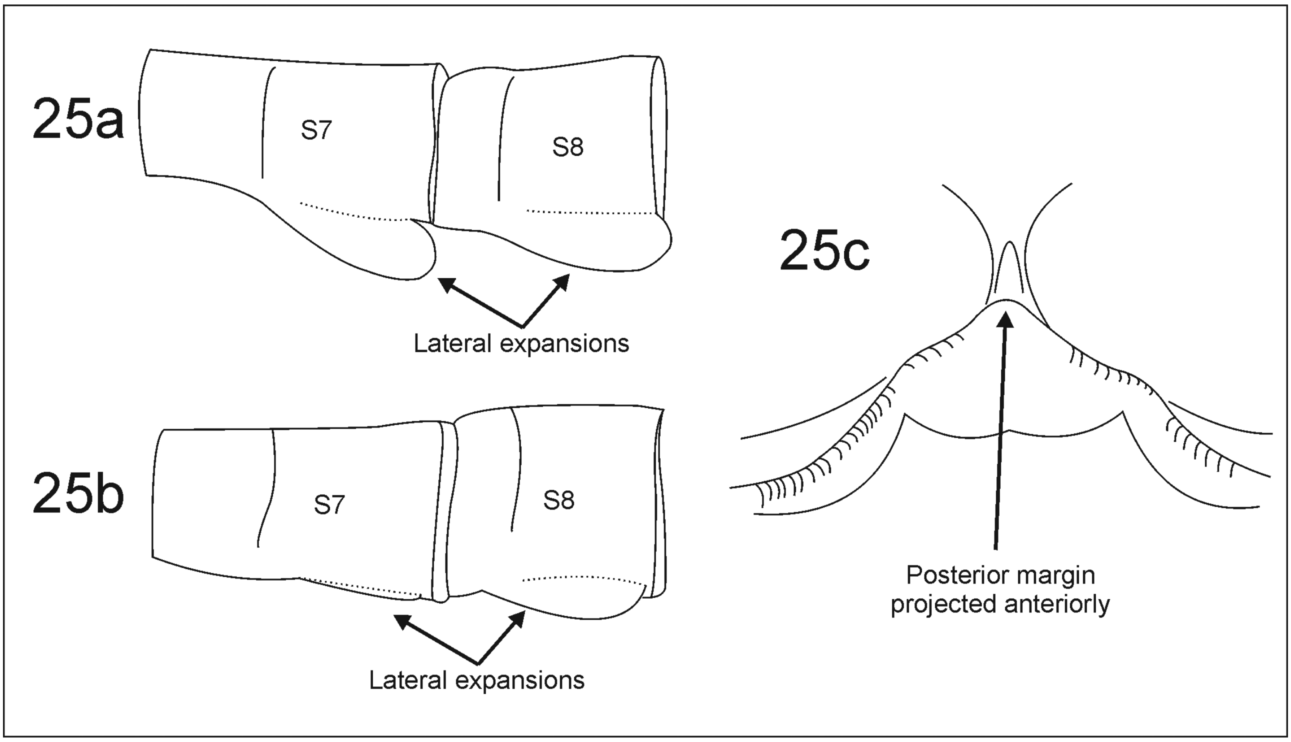

FIGURE 25. a *Phyllopetalia altarensis*, S7–8, lateral view (modified from von Ellenrieder 2005); b *Phyllopetalia apicalis*, S7–8, lateral view (modified from von Ellenrieder 2005); c *Phyllopetalia excrescens*, head, dorsal view (modified from von Ellenrieder 2005).

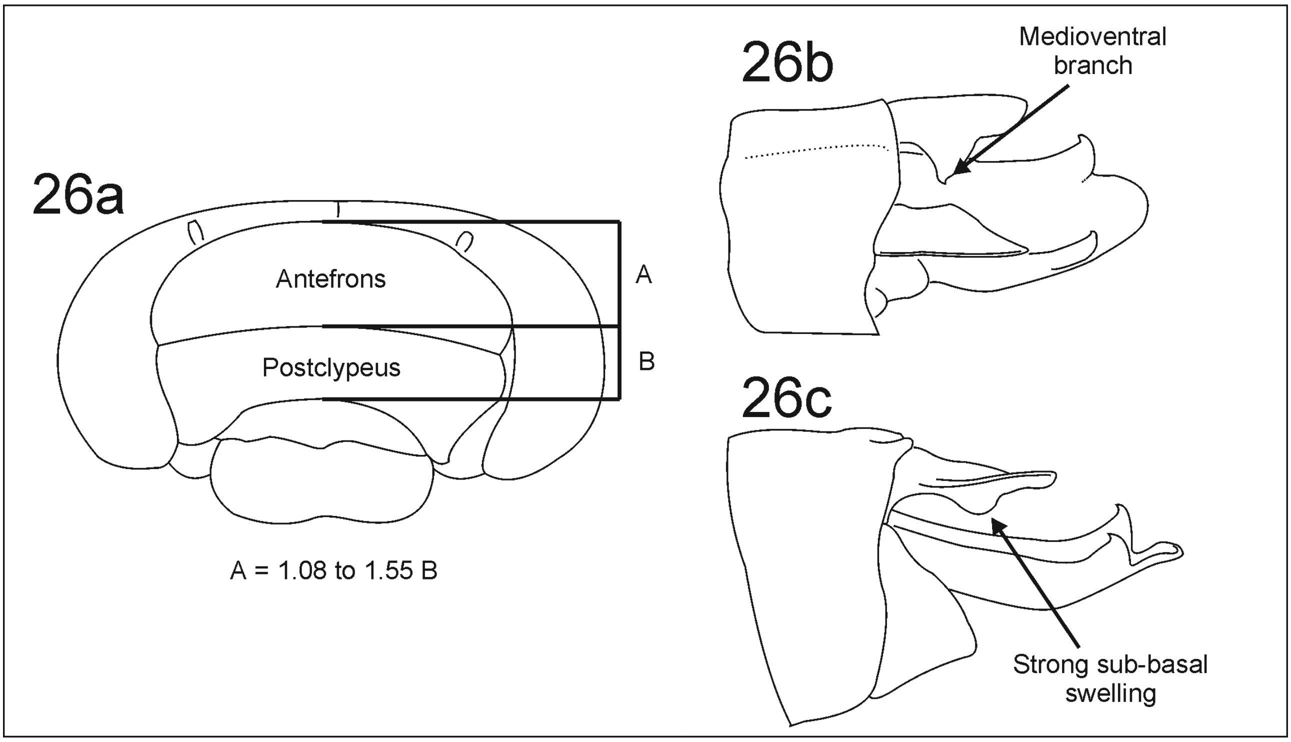

FIGURE 26. a *Phyllopetalia apollo*, head, anterior view (modified from von Ellenrieder 2005); b *Phyllopetalia apollo*, male terminalia, dorsolateral view (modified from von Ellenrieder 2005); c *Phyllopetalia apollo*, male terminalia, lateral view (modified from von Ellenrieder 2005).

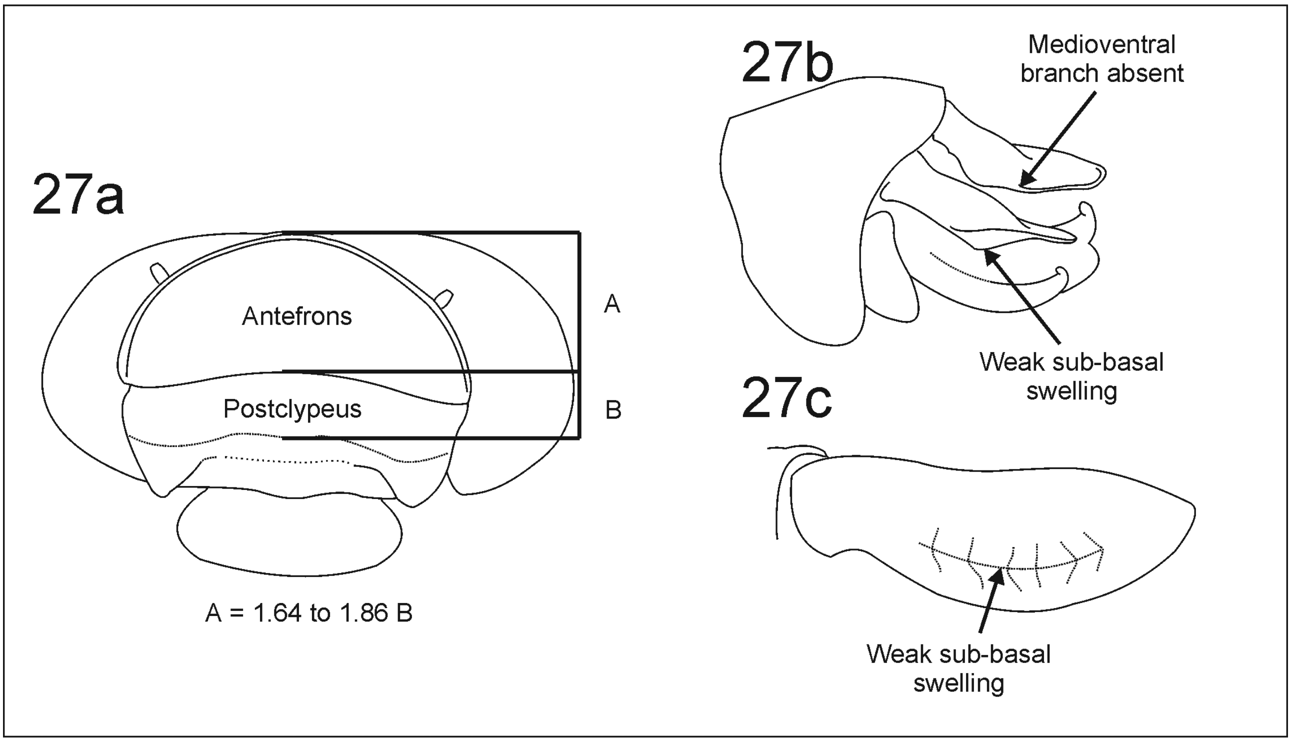

FIGURE 27. a *Phyllopetalia altarensis*, head, anterior view (modified from von Ellenrieder 2005); b *Phyllopetalia altarensis*, male terminalia, lateral view (modified from von Ellenrieder 2005); c *Phyllopetalia altarensis*, male cerci, ventral view (modified from von Ellenrieder 2005).

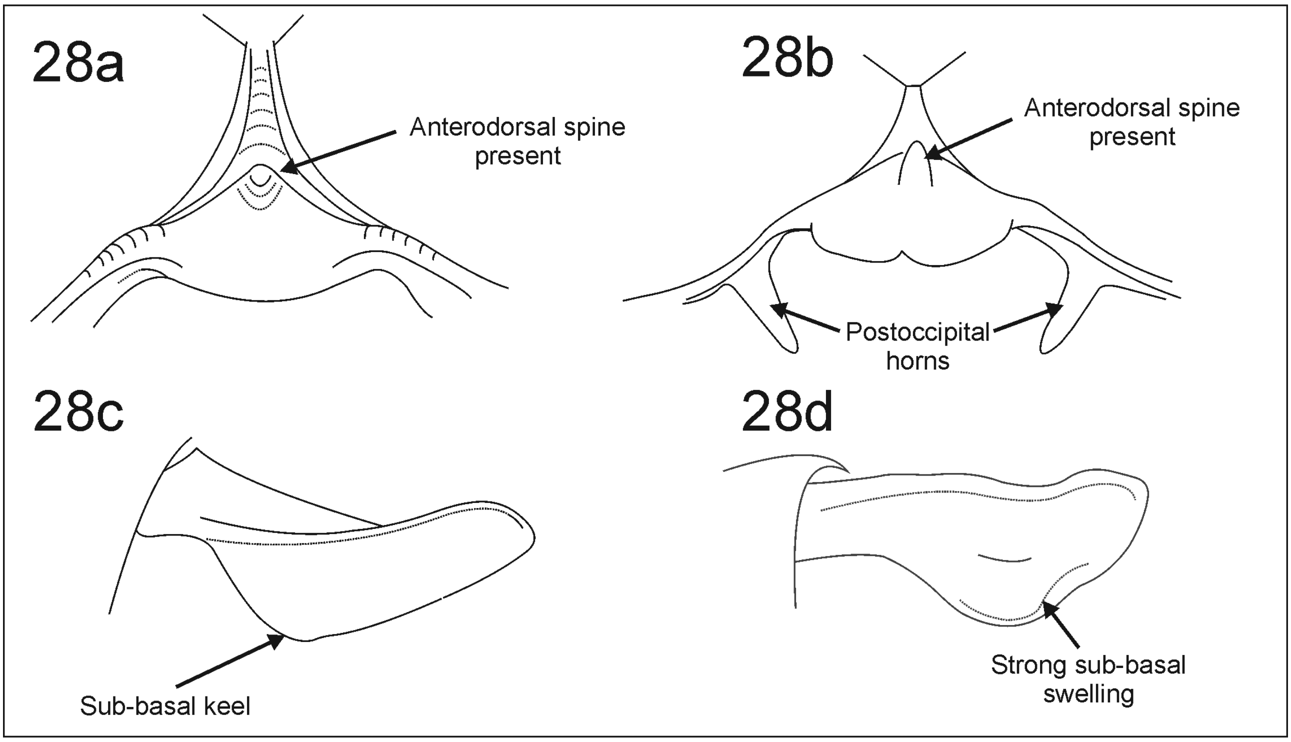

FIGURE 28. a *Phyllopetalia stictica*, head, dorsal view (modified from von Ellenrieder 2005); b *Phyllopetalia pudu*, head, dorsal view (modified from von Ellenrieder 2005); c *Phyllopetalia pudu*, male cerci, ventral view (modified from von Ellenrieder 2005); d *Phyllopetalia excrescens*, male cerci, ventral view (modified from von Ellenrieder 2005).

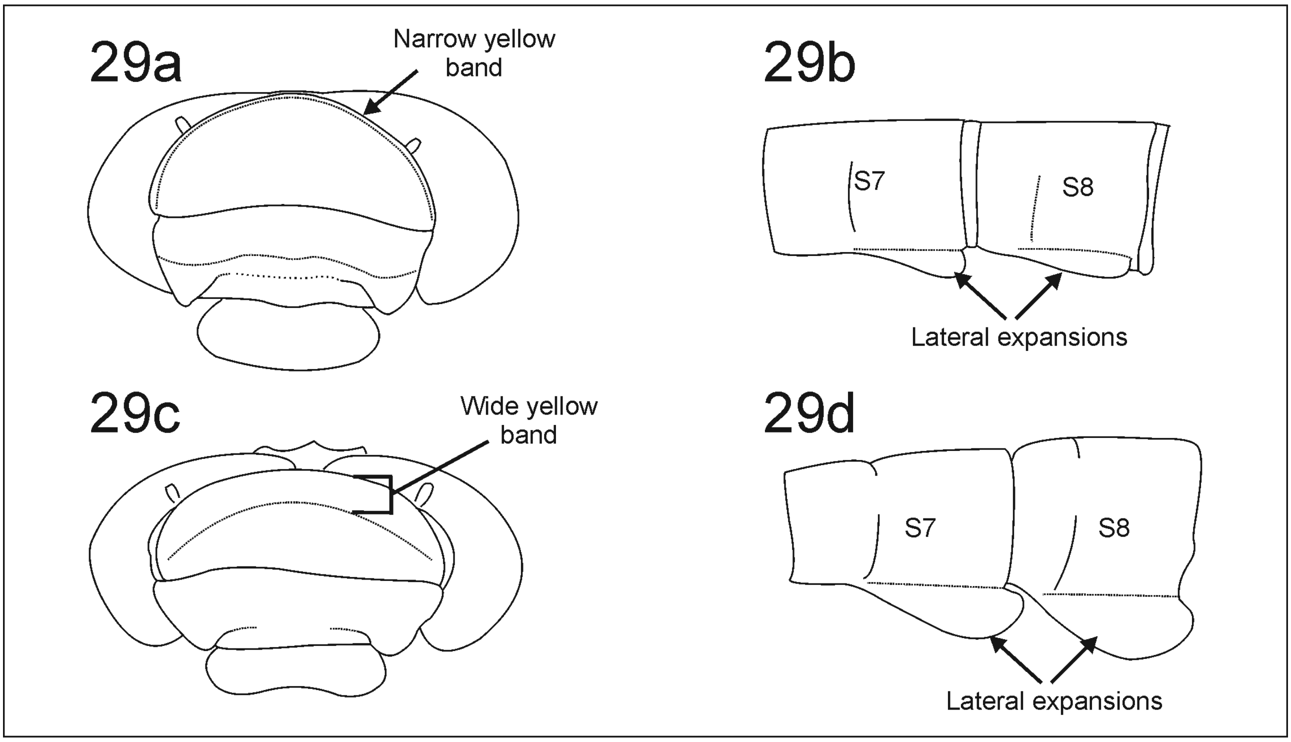

FIGURE 29. a *Phyllopetalia stictica*, head, anterior view (modified from von Ellenrieder 2005); b *Phyllopetalia stictica*, S7–8, lateral view (modified from von Ellenrieder 2005); c *Phyllopetalia pudu*, head, anterior view (modified from von Ellenrieder 2005); d *Phyllopetalia pudu*, S7–8, lateral view (modified from von Ellenrieder 2005).

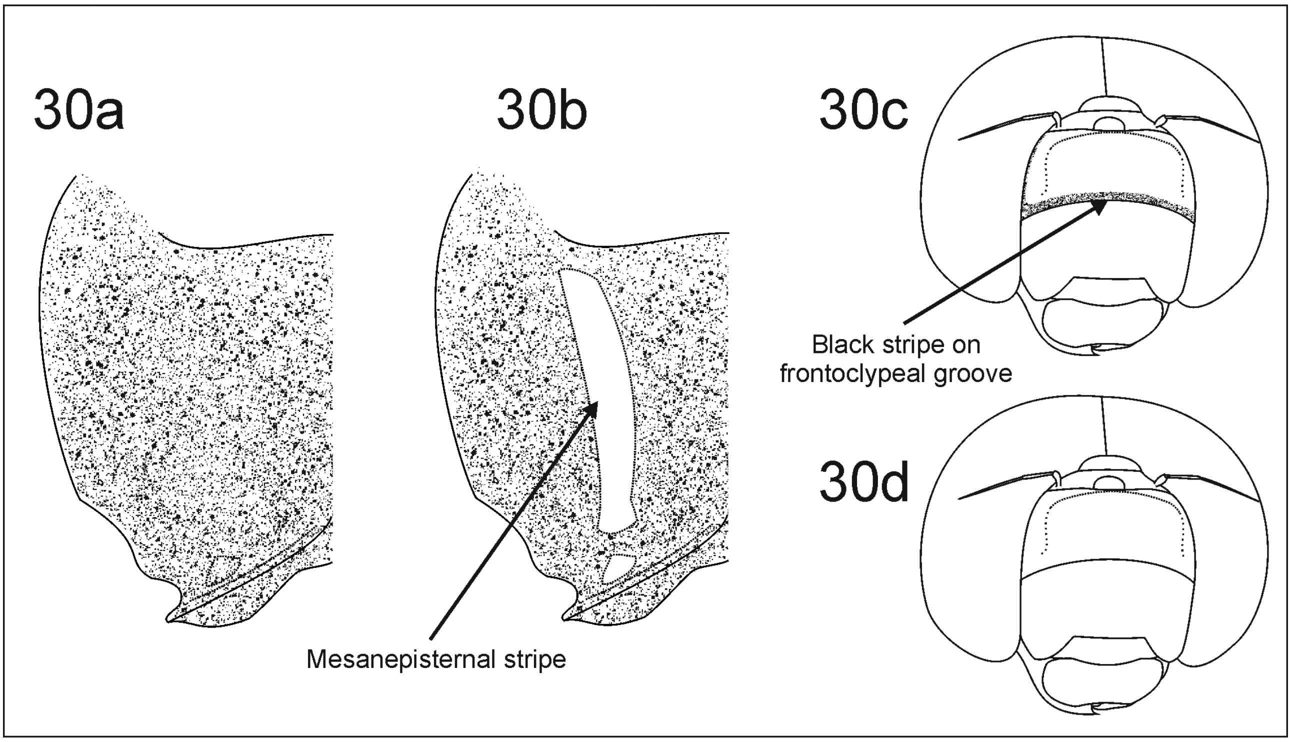

FIGURE 30. a *Rhionaeschna variegata*, left half of pterothorax, dorsal view; b *Rhionaeschna confusa*, left half of pterothorax, dorsal view; c *Rhionaeschna absoluta*, head, anterior view; d *Rhionaeschna bonariensis*, head, anterior view.

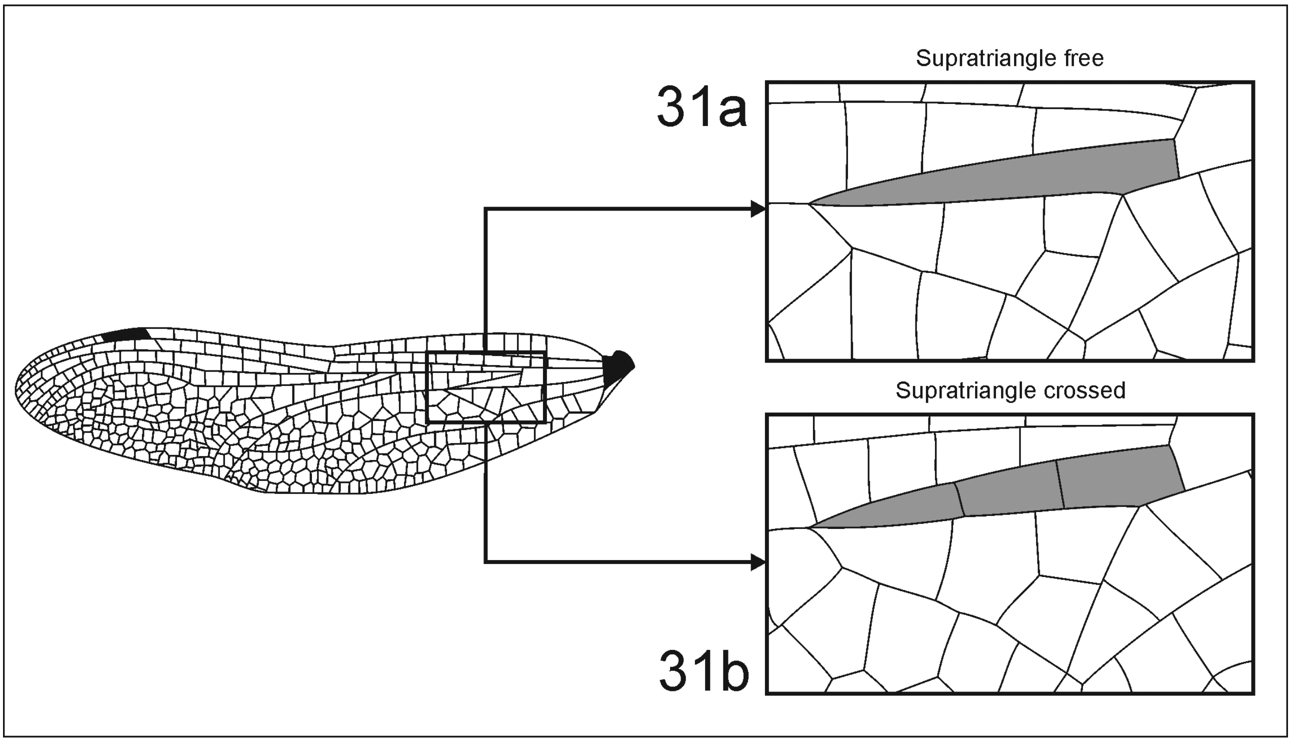

FIGURE 31. a *Rhionaeschna absoluta*, Fw supratriangle; b *Rhionaeschna variegata*, Fw supratriangle.

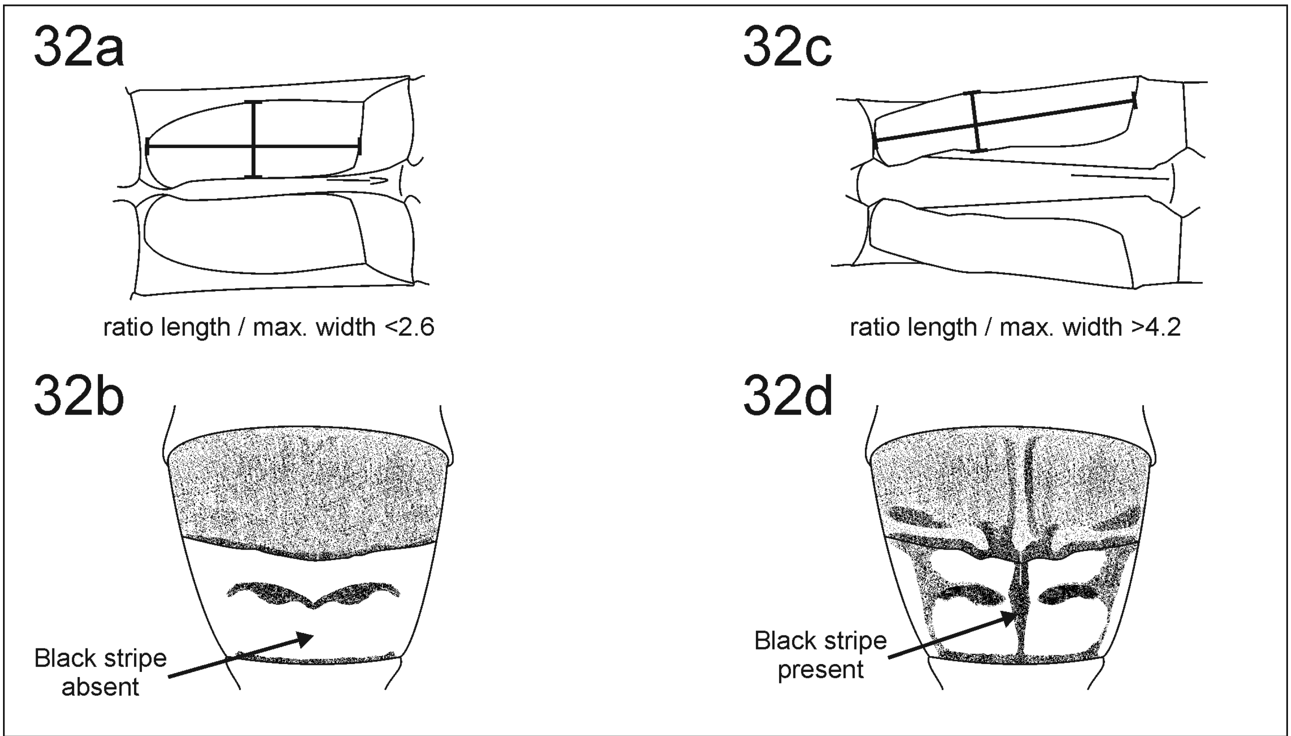

FIGURE 32. a *Rhionaeschna diffinis*, male S4, ventral view; b *Rhionaeschna diffinis*, female S2, dorsal view; c *Rhionaeschna absoluta*, male S4, ventral view; d *Rhionaeschna absoluta*, female S2, dorsal view.

Key to final instar larvae

The genus *Antiagrion* is not included in the key because none of its species has been described.

1 Abdomen robust ending in an anal pyramid (epiproct plus paraprocts) (Fig. 33a) .... Anisoptera ... 6

- Abdomen slender ending in caudal lamellae (epiproct and paraprocts flattened) (Fig. 33b) .... Zygoptera ... 2

2(1) Prementum not petiolate, triangular or subquadrate, 3–5 premental setae on each side of premental midline (Fig. 34a); movable hook of labial palp without setae (Fig. 34a) .... Coenagrionidae ... 3

- Prementum petiolate, its proximal portion slender and as long as or longer than its distal expanded portion (Fig. 34b); movable hook of labial palp with 2–3 setae (Fig. 34c) .... Lestidae, only *Lestes undulatus*

3(2) Caudal lamellae with transverse suture (Fig. 35a) 4

- Caudal lamellae without transverse suture (Fig. 35b) 5

4(3) Distal seta of labial palp with a palpal spine at base (Fig. 36a) .... *Oxyagrion,* only *O. rubidum*

- Distal seta of labial palp without a palpal spine at base (Fig. 36b) .... *Cyanallagma*, only *C. interruptum*

5(3) Posterior margin of head deeply concave (concavity surpassing posterior margin of compound eyes) (Fig. 37a); caudal lateral lamellae longer than half the length of abdomen, generally with two dark areas posterior to nodus (Fig. 37b) .... *Andinagrion*, only *A. perterseni*

- Posterior margin of head slightly concave (concavity not surpassing posterior margin of compound eyes) (Fig. 37c); caudal lateral lamellae shorter than half the length of abdomen, generally with a dark spot at nodus (Fig. 37d) .... *Ischnura*, only *I. fluviatilis*

6(1) Antennae with 6–8 segments, the third shorter than half the length of the antenna (Fig. 38a) 7

- Antennae with 3–4 segments, the third longer than half the length of the antenna (Fig. 38b) .... Gomphidae ... 11

7(6) Tibiae without robust apical spines (Fig. 38c) 8

- Tibiae with robust apical spines for digging (Fig. 38d) .... Petaluridae, only *Phenes raptor*

8(7) Prementum flat 9

- Prementum spoon shaped 10

9(8) S1–10 with lateral lobes (Fig. 39a); prementum slightly widened distally (Fig. 39b); body surface granulated .... Austropetaliidae 14

- Abdominal segments without lateral lobes, S6–9 generally with lateral spines (Fig. 39c); prementum conspicuously widened distally (Fig. 39d); body surface not granulated .... Aeshnidae, only genus *Rhionaeschna* ... 17

10(8) Labial palps with long and irregular teeth (Fig. 40a); ligula divided, with glossal and paraglossal lobes not fused (Fig. 40a) .... Neopetaliidae, only *Neopetalia punctata*

- Labial palps with short and regular teeth (Fig. 40b); ligula entire (Fig. 40b) .... Libellulidae + Corduliidae... 21

11(6) Wingpads nearly parallel (Fig. 41a) .... *Neogomphus* ... 12

- Wingpads widely divergent (Fig. 41b) .... *Progomphus*, only *P. joergenseni*

12(11) Abdomen with short triangular spines on S6 or S7–9 (Fig. 42a) .... *N. bidens*

- Abdomen with short triangular lateral spines on S8–9 (Fig. 42b) 13

13(12) Abdomen grayish brown, with no definite color pattern .... *N. molestus*

- Abdomen with two or three dorsolateral blackish spots on S5–9 .... *N. edenticulatus*

14(9) Prementum knobs adjacent to prementum mid-line (Fig. 43a), postclypeal knobs present (Fig. 43b); apex of tibia with a dense concentration of setae .... *Phyllopetalia* ... 15

- Prementum knobs well separated from prementum mid-line (Fig. 43c), postclypeal knobs absent (Fig. 43d); apex of tibia lacking a dense concentration of setae .... *Hypopetalia*, only *H. pestilens*

15(14) Body surface covered with scale-like setae with distal segment hair-like (Fig. 44a–b), lateral abdominal processes angulate 16

- Body surface covered with scale-like setae with distal segment oval (Fig. 44c), lateral abdominal processes rounded .... *P. apollo* (*Phyllopetalia apollo* is the only larva of the genus described with certainty)

16(15) Distal segment of sacle-like setae short (Fig. 44a) .... *P. stictica*?

- Distal segment of scale-like setae long (Fig. 44b) .... *P. pudu*?

17(9) One small blunt tooth on each side of prementum median cleft (Fig. 45a) 18

- Two small blunt teeth on each side of prementum median cleft (Fig. 45b) .... *R. confusa*

18(17) Angle between prothoracic apophyses acute, apices acute (Fig. 45c) 19

- Angle between prothoracic apophyses a right angle, apices blunt (Fig. 45d) .... *R. bonariensis*

19(18) Head maximum width 0.68–0.76 mm; ratio of length of inner margin of inner gonapophyses : medio-ventral length of S9 0.71–0.89 20

- Head maximum width 0.79–0.83 mm; ratio of length of inner margin of inner gonapophyses : medio-ventral length of S9 equal to 1 .... *R. variegata*

20(19) Ratio of width of prementum : length of prementum 0.91–0.97, prementum median lobe width 2.1–2.2 mm .... *R. absoluta*

- Ratio of width of prementum : length of prementum 0.88–0.91, prementum median lobe width 1.9 mm .... *R. diffinis*

21(10) Abdomen lacking dorsal hooks (Fig. 46a) 22

- Dorsal hooks on S3–9 (Fig. 46b); prementum with 10–11 setae, labial palps with 7 setae; head with two prominent tubercles (Fig. 46c) .... *Rialla*, only *R. villosa*

22(21) Labial palp with 4 long setae (Fig. 47a); abdomen lacking lateral spines .... *Dasythemis* (only *D. mincki clara*)

- Labial palp with >4 long setae (Figs. 47b–c), abdomen with or lacking lateral spines 23

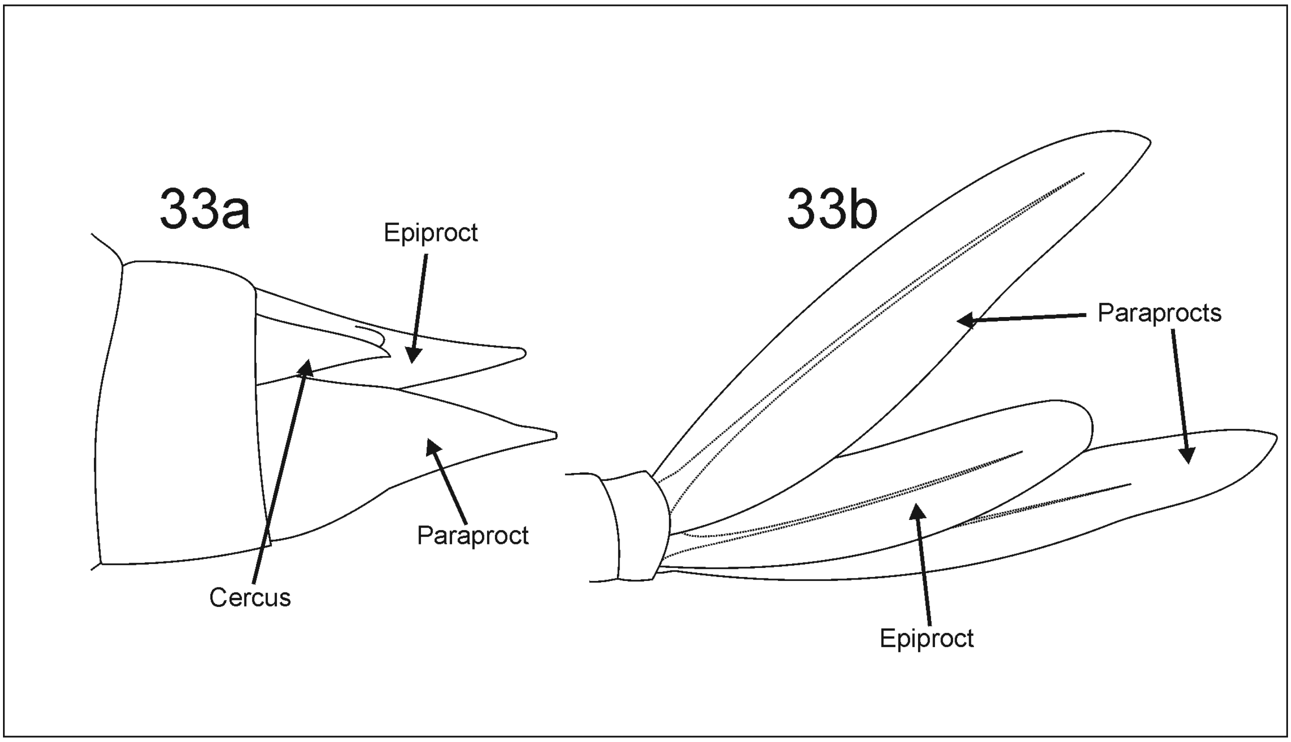

FIGURE 33. a *Progomphus joergenseni*, terminalia, lateral view; b *Lestes undulatus*, terminalia, lateral view.

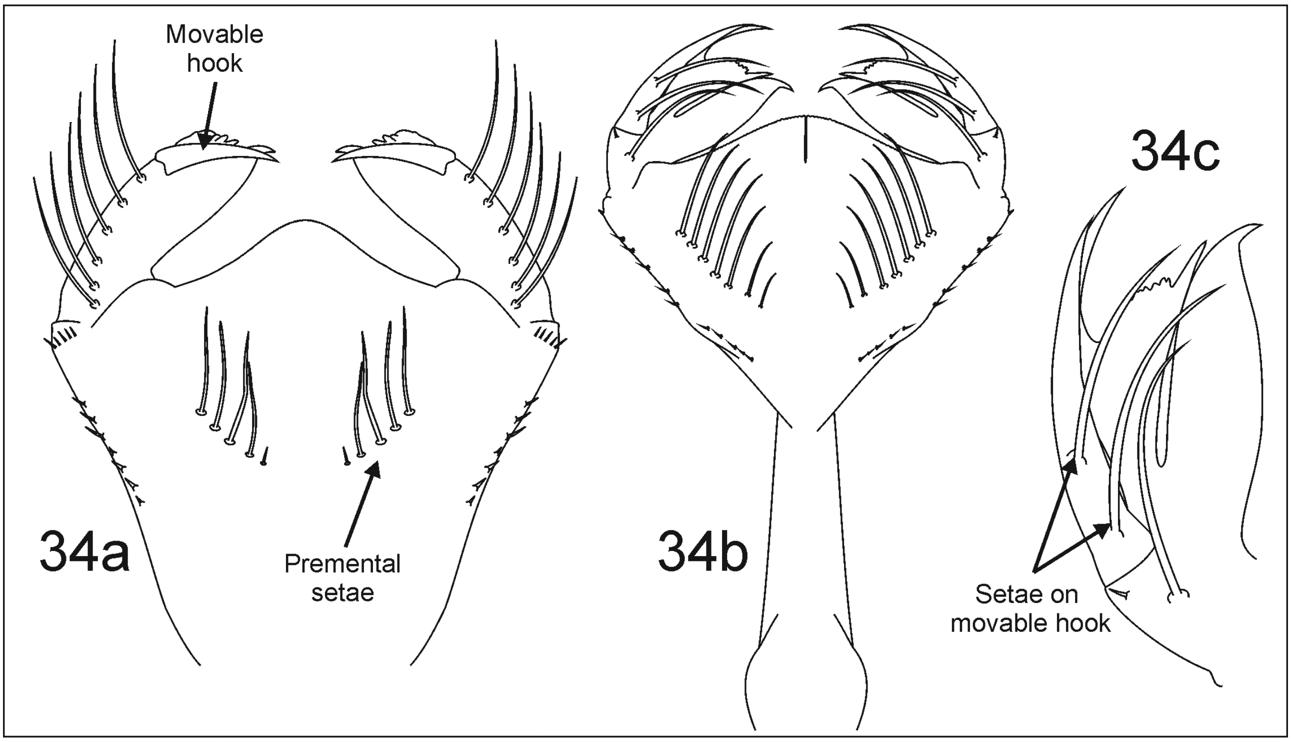

FIGURE 34. a *Ischnura fluviatilis*, prementum, dorsal view; b *Lestes undulatus*, prementum, dorsal view; c *Lestes undulatus*, labial palp.

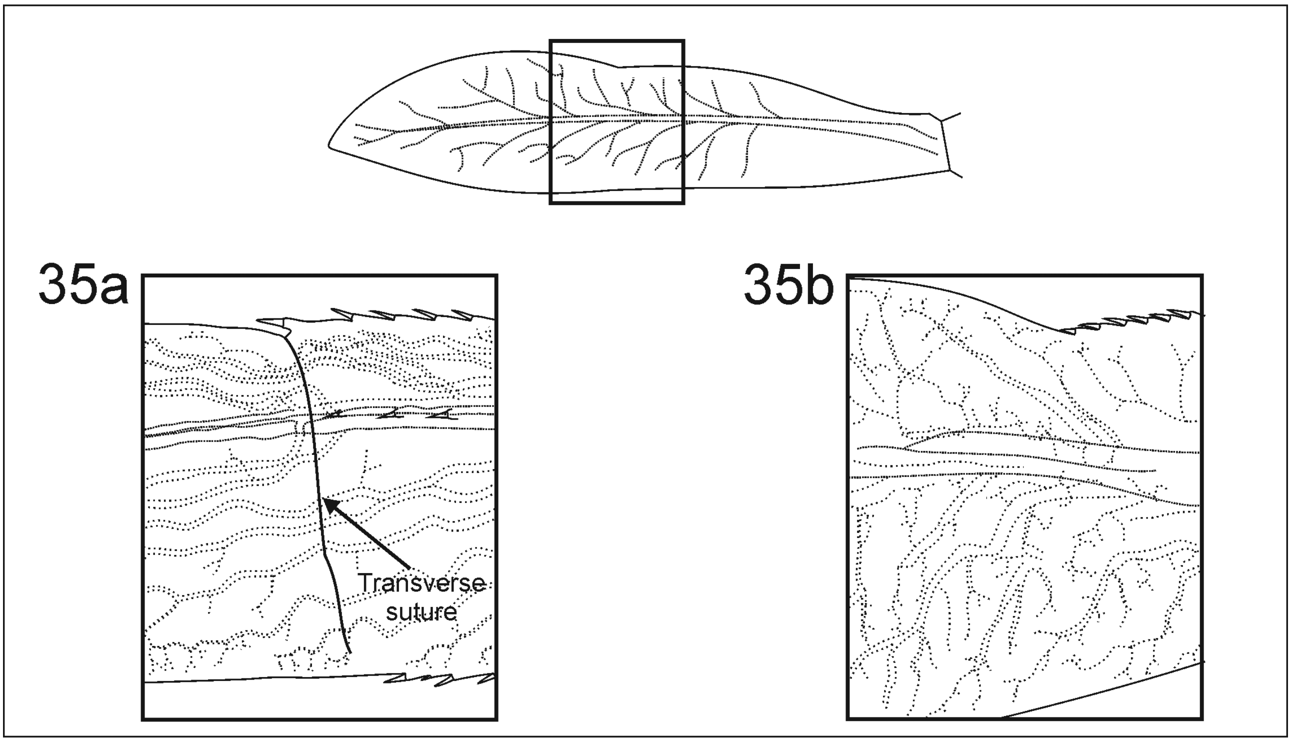

FIGURE 35. a *Oxyagrion rubidum*, nodal area of caudal lamellae; b *Ischnura fluviatilis*, nodal area of caudal lamellae.

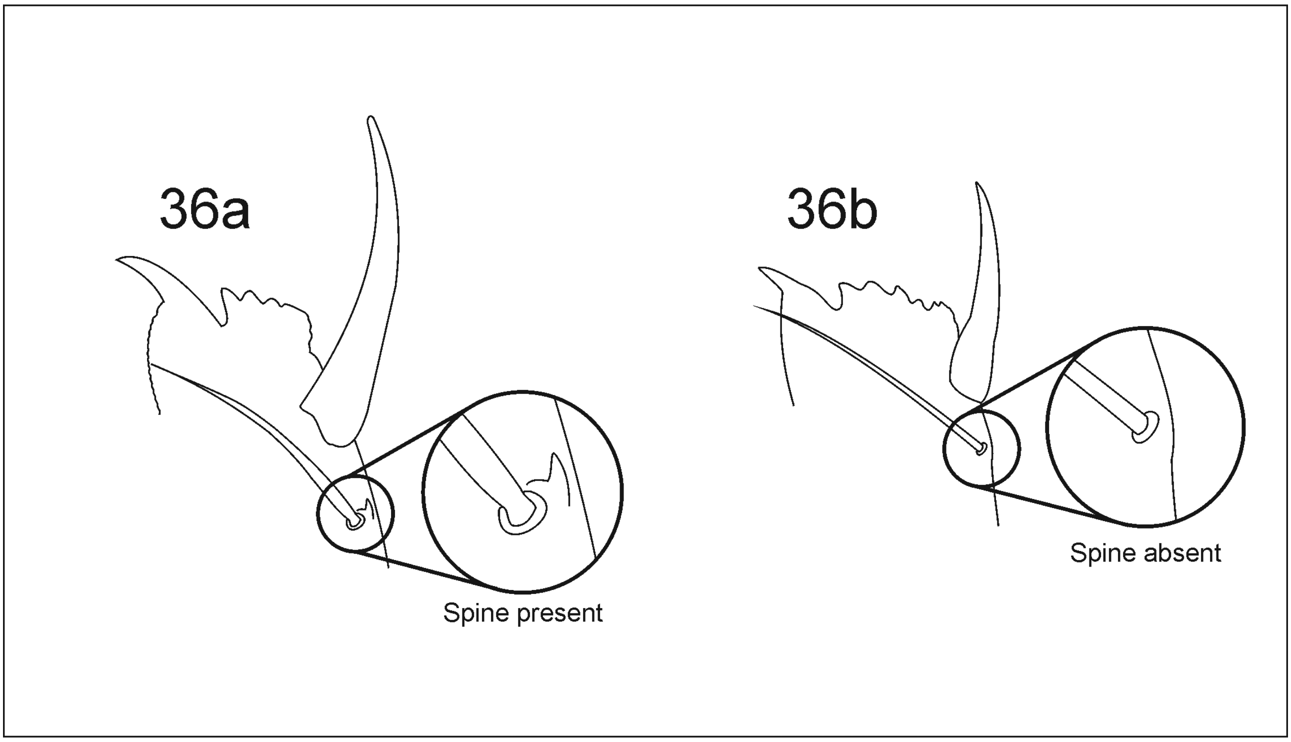

FIGURE 36. a *Oxyagrion rubidum*, labial palp showing base of distal seta; b *Cyanallagma interruptum*, labial palp showing base of distal seta.

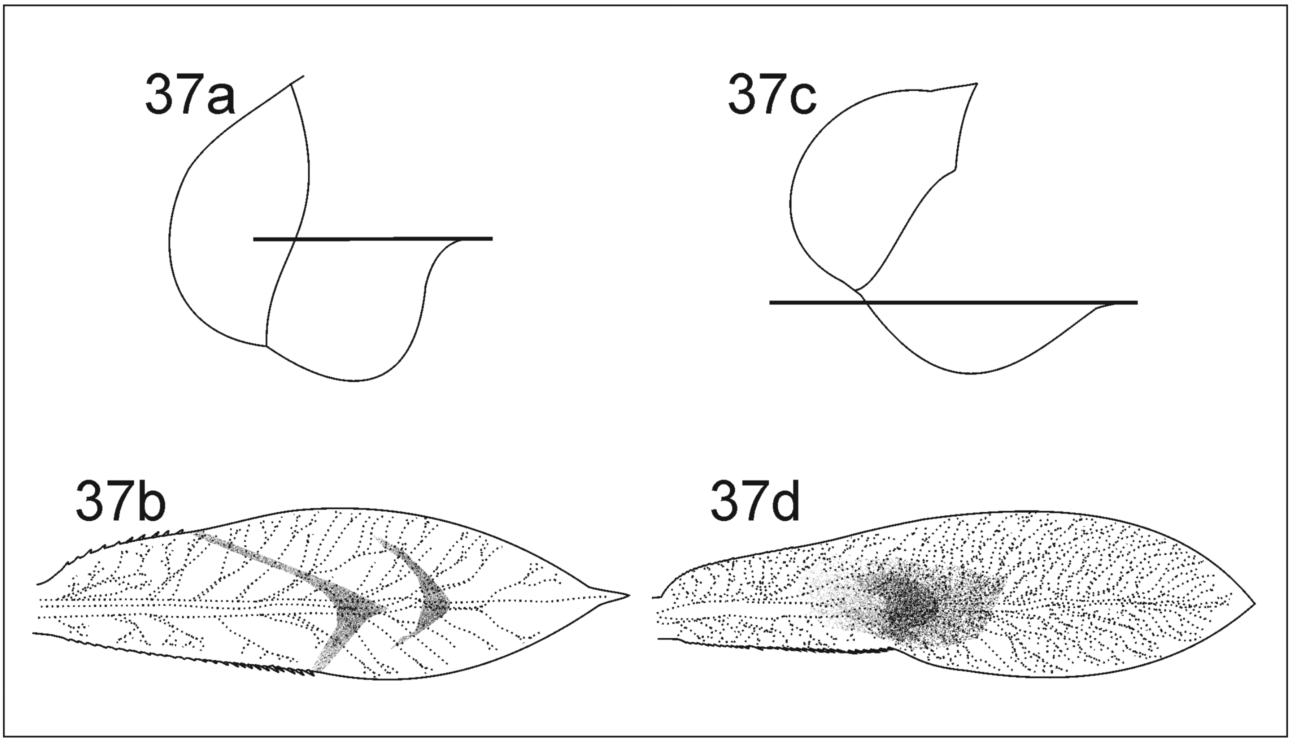

FIGURE 37. a *Andinagrion peterseni*, head showing concavity of posterior margin (modified from Bulla, 1973a); b *Andinagrion peterseni*, lateral lamella; c *Ischnura fluviatilis*, head showing concavity of posterior margin; d *Ischnura fluviatilis*, lateral lamella.

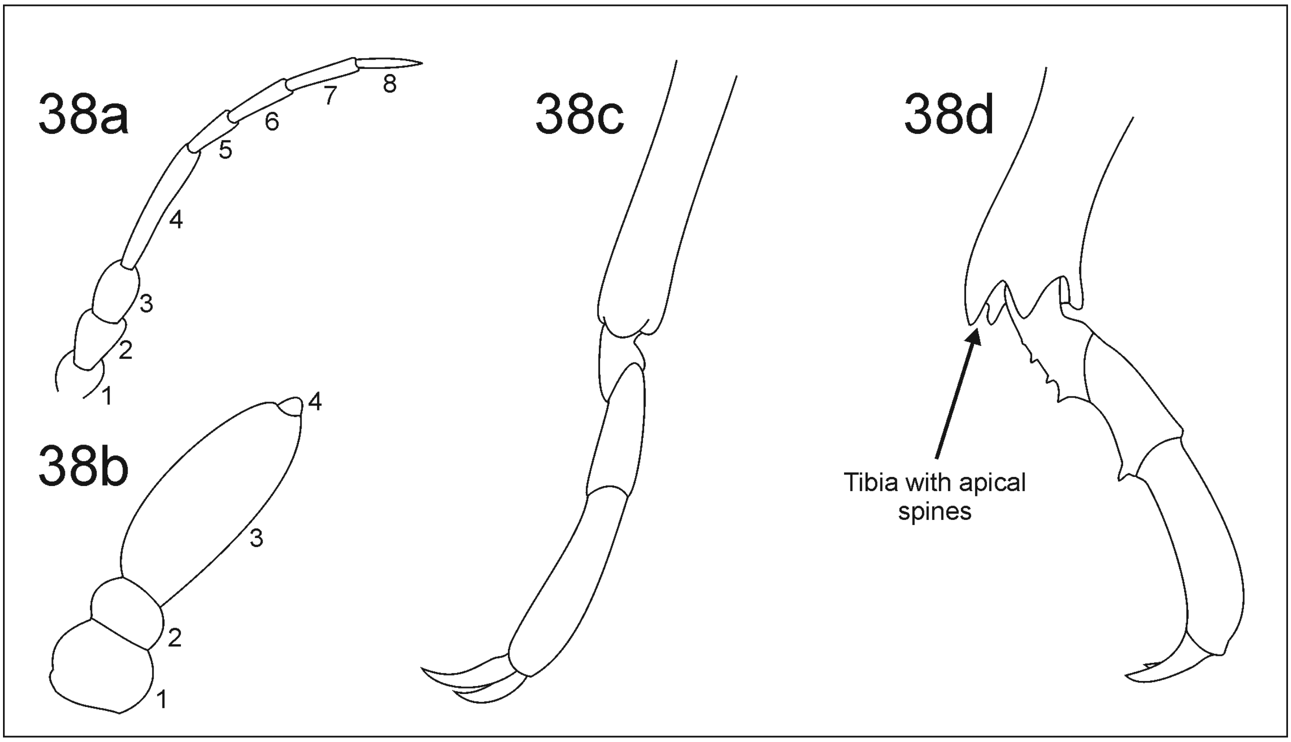

FIGURE 38. a *Rhionaeschna bonariensis*, antenna; b *Progomphus joergenseni*, antenna; c *Rhionaeschna bonariensis*; metatibia; d *Phenes raptor*, metatibia.

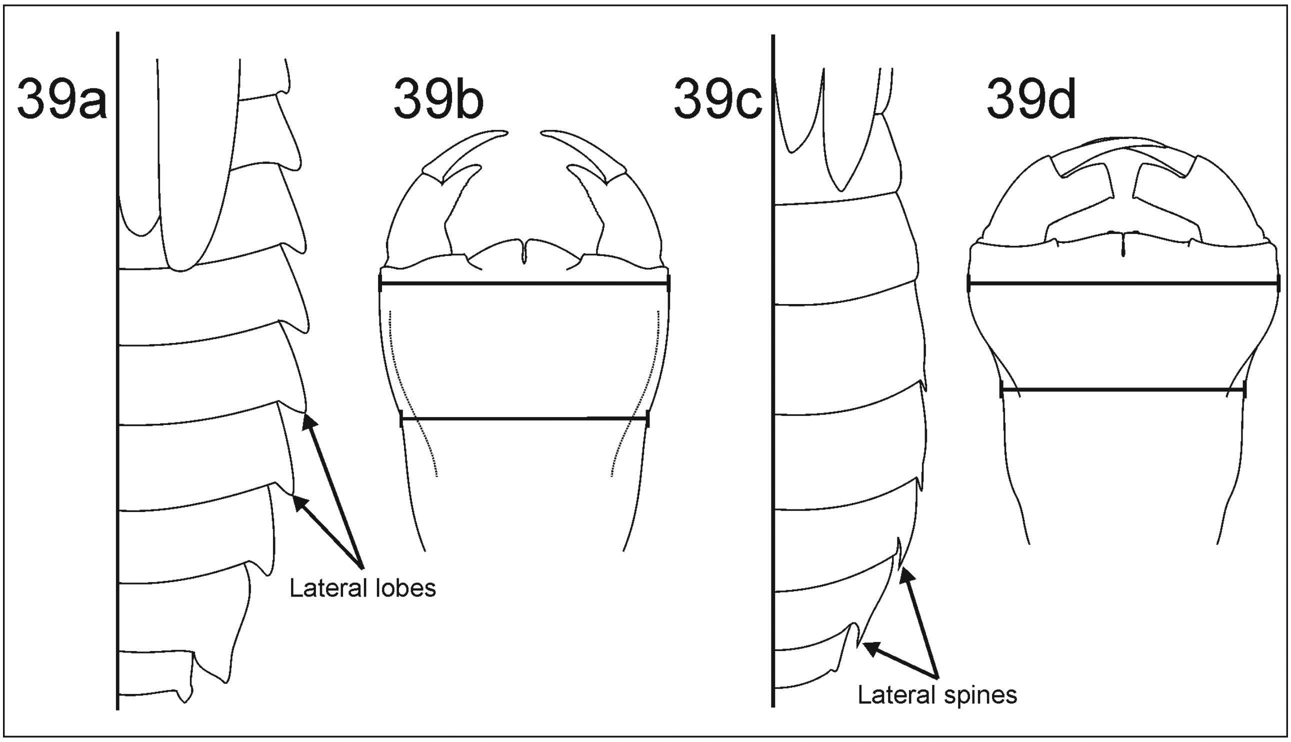

FIGURE 39. a *Phyllopetalia pudu?*, abdomen, dorsal view; b *Phyllopetalia pudu?*, prementum; c *Rhionaeschna bonariensis*, abdomen, dorsal view; d *Rhionaeschna bonariensis*, prementum.

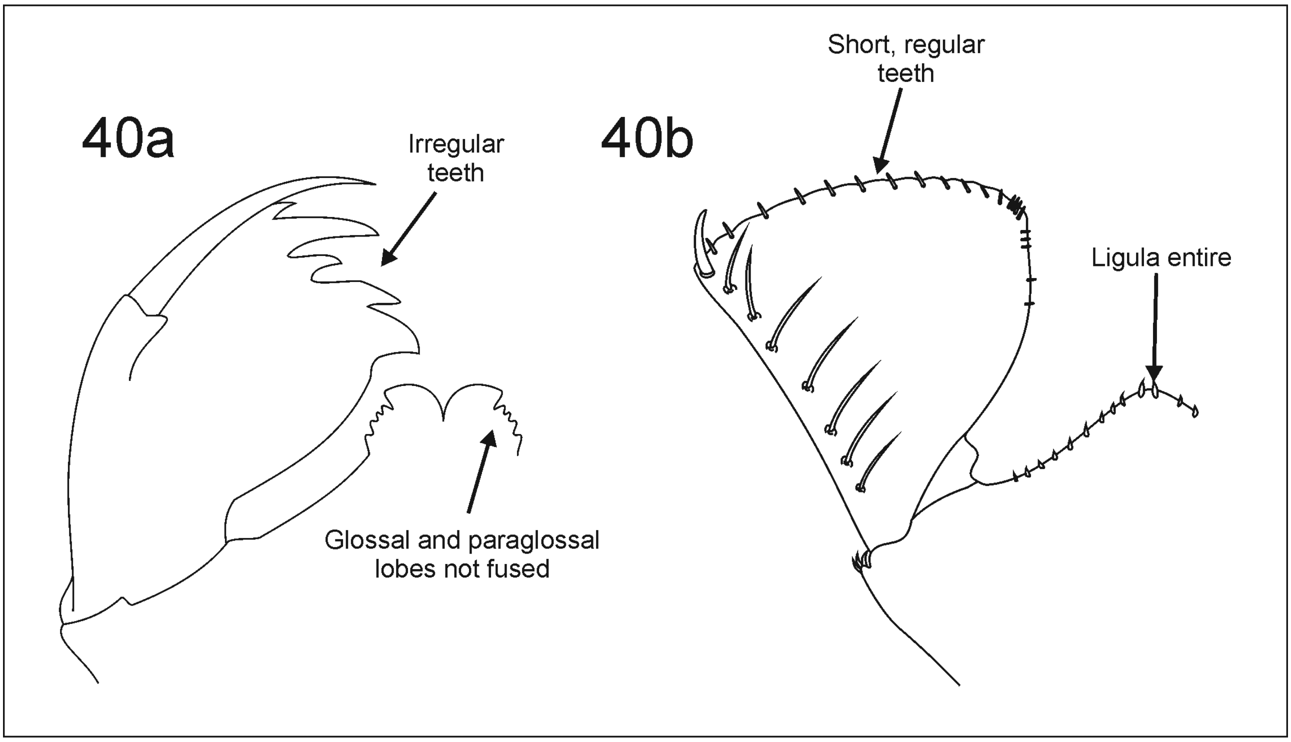

FIGURE 40. a *Neopetalia punctata*, prementum, distal portion; b *Erythrodiplax connata*, prementum, distal portion (modified from Lozano *et al.* 2011)

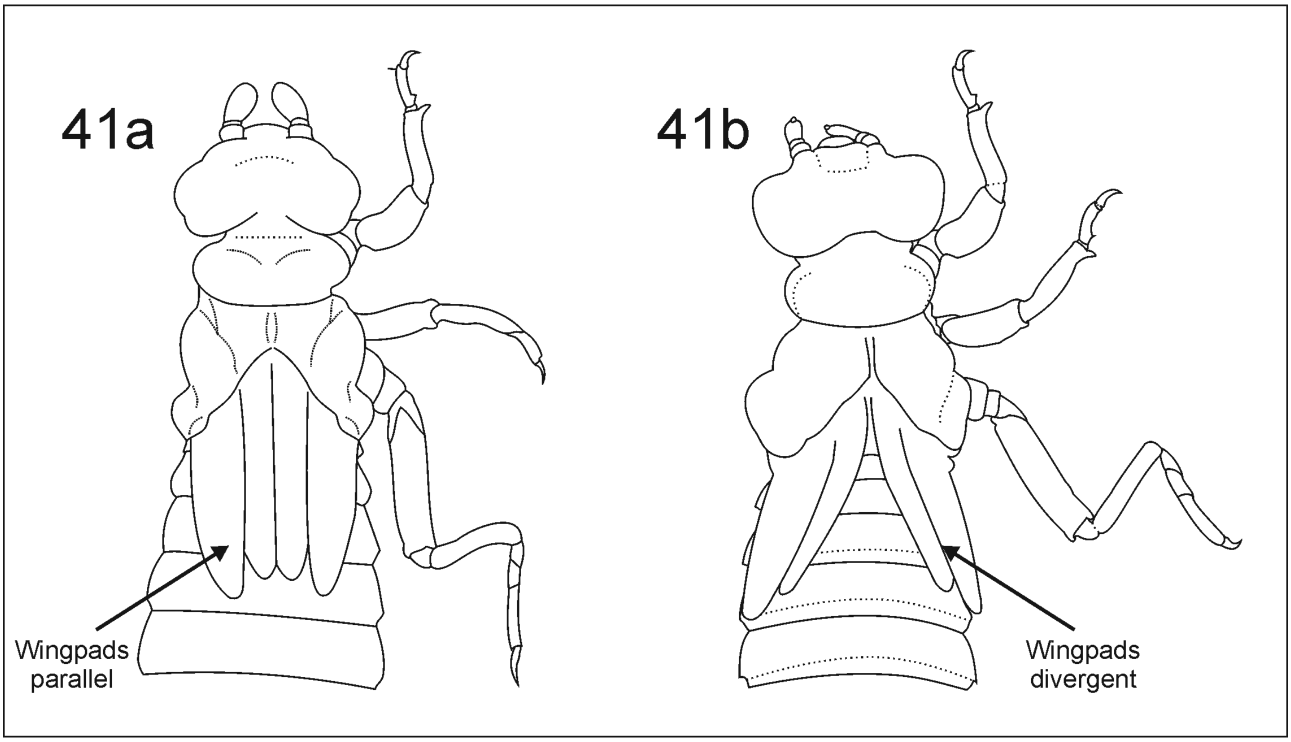

FIGURE 41. a *Neogomphus edenticulatus*, anterior half of body, dorsal view; b *Progomphus joergenseni*, anterior half of body, dorsal view.

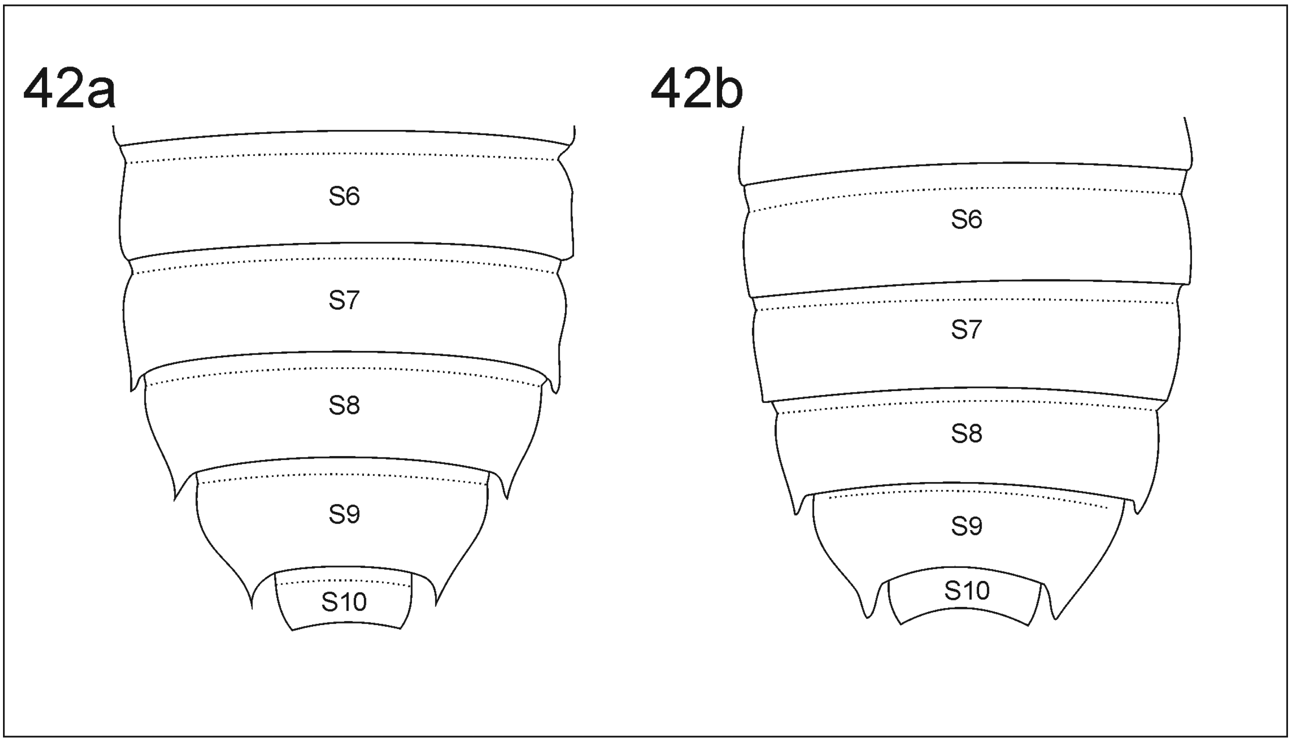

FIGURE 42. a *Neogomphus bidens*, abdomen S6–10, dorsal view; b *Neogomphus edenticulatus*, abdomen S6–10, dorsal view.

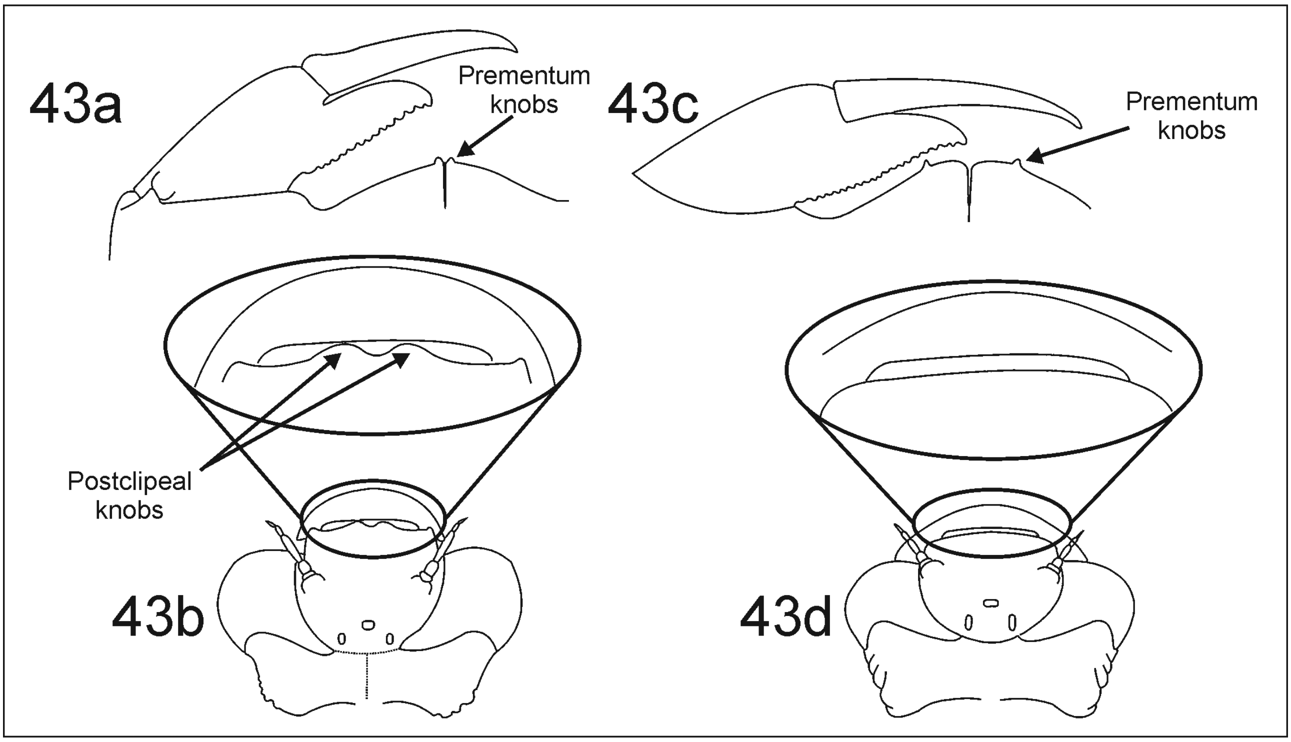

FIGURE 43. a *Phyllopetalia apollo*, prementum, anterior portion (modified from Pessacq & Brand, 2009); b *Phyllopetalia apollo*, head and detail of clypeus, dorsal view (modified from Pessacq & Brand 2009); c *Hypopetalia pestilens*, prementum, anterior portion (modified from Pessacq & Brand 2009); d *Hypopetalia pestilens*, head and detail of clypeus, dorsal view (modified from Pessacq & Brand 2009).

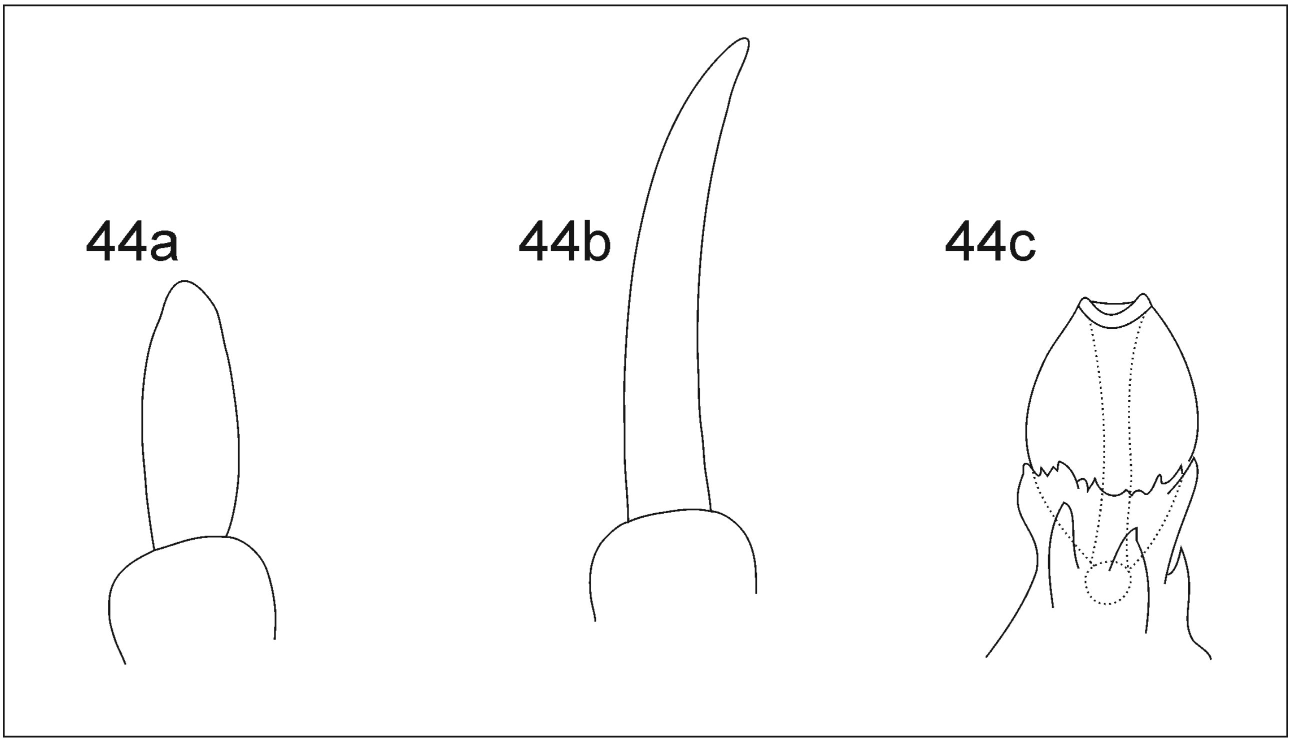

FIGURE 44. a *Phyllopetalia stictica?*, distal segment of sacle-like seta; b *Phyllopetalia pudu?*, distal segment of sacle-like seta; c *Phyllopetalia apollo*, distal segment of sacle-like seta.

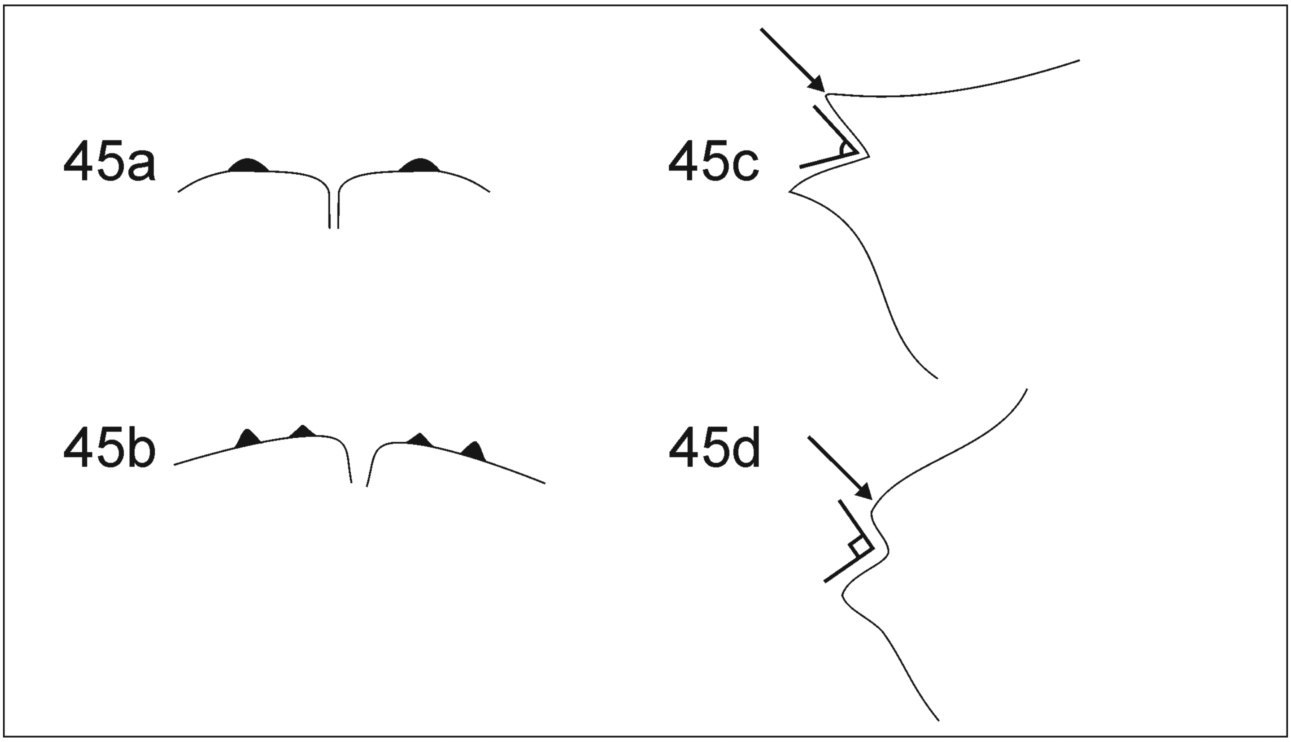

FIGURE 45. a *Rhionaeschna bonariensis*, prementum median cleft; b *Rhionaeschna confusa*, prementum median cleft; c *Rhionaeschna variegata*, prothoracic apophysis (modified from von Ellenrieder 2001c); d *Rhionaeschna bonariensis*, prothoracic apophysis (modified from von Ellenrieder 2001c).

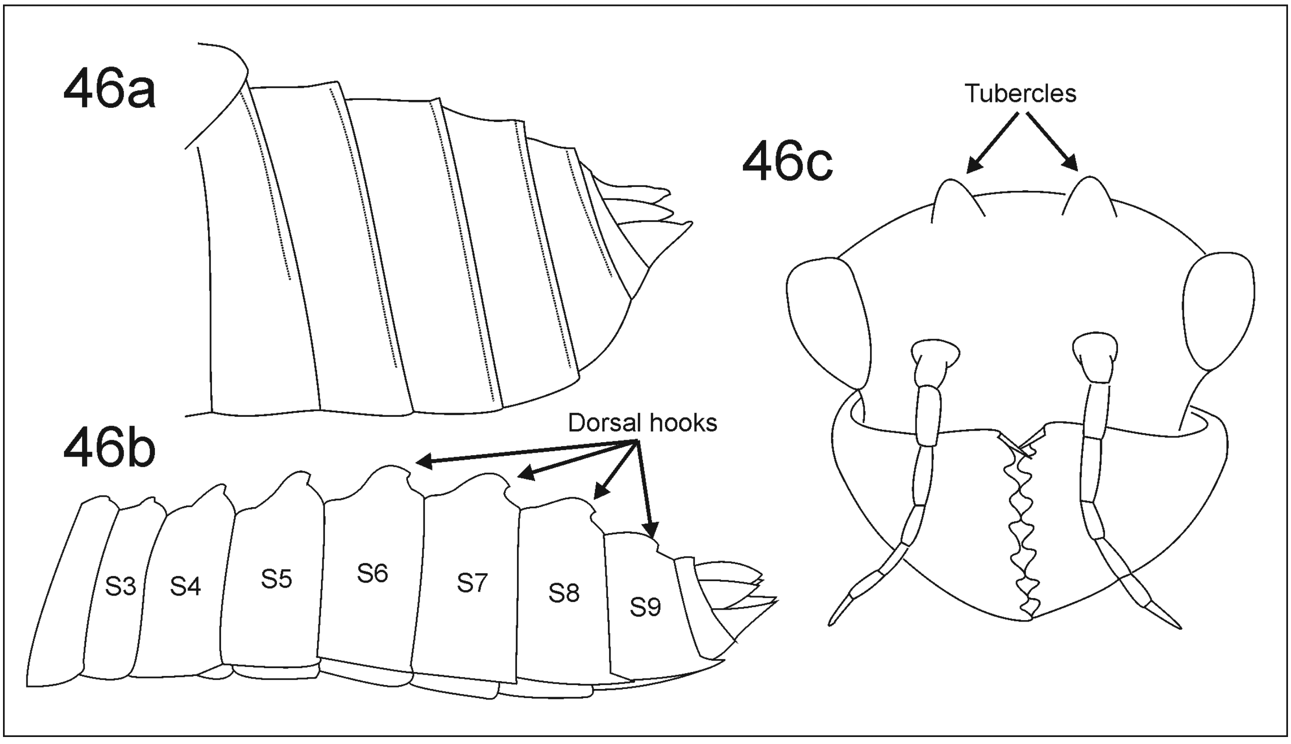

FIGURE 46. a *Erythrodiplax connata*, abdomen, lateral view; b *Rialla villosa*, abdomen, lateral view; c *Rialla villosa*, head, anterior view.

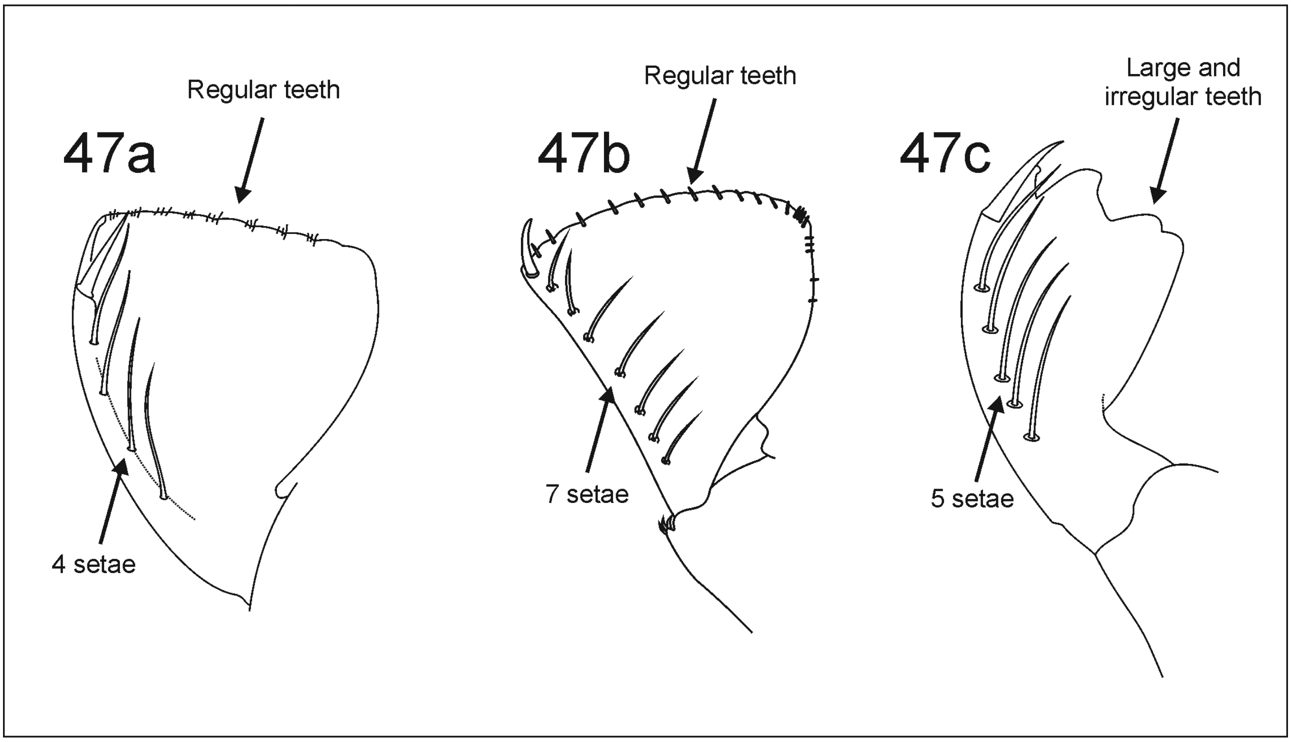

FIGURE 47. a *Dasythemis mincki clara*, labial palp; b *Erythrodiplax connata*, labial palp; c *Gomphomacromia paradoxa*, labial palp.

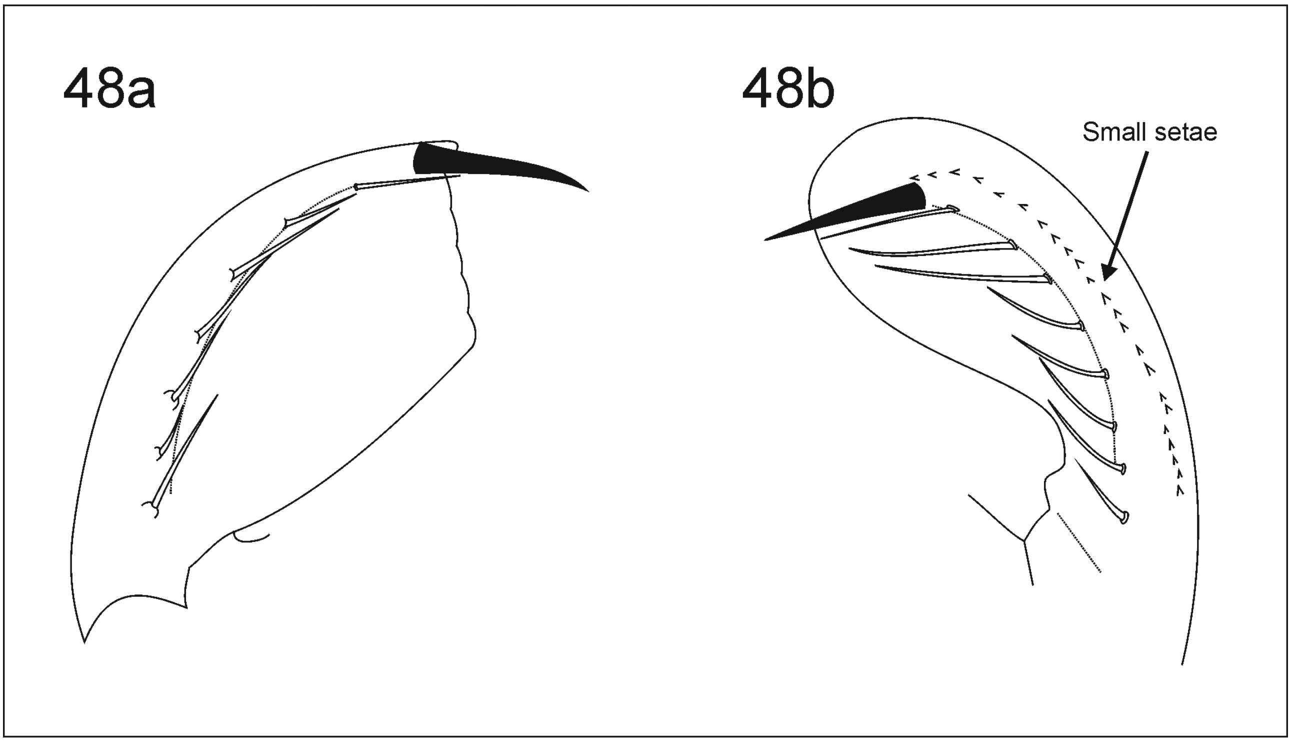

FIGURE 48. a *Erythrodiplax connata*, labial palp; b *Sympetrum villosum*, labial palp.

23(22) Labial palp with 7 or more setae (Fig. 47b); distal margin of labial palp almost entire, without large teeth (Fig. 47b); prementum with more than 10 setae 24
- Labial palp with 5–6 setae (Fig. 47c); distal margin of labial palp with large and irregular teeth (Fig. 47c); prementum with 6–7 setae .... *Gomphomacromia* (*G. paradoxa* is the only larva described for the genus)
24(23) External surface of labial palp without a row of small setae on its upper side (Fig. 48a) .... *Erythrodiplax* ... 25
- External surface of labial palp with a row of small setae on its upper side (Fig. 48b) .... *Sympetrum* (only *S. villosum*)
25(24) Abdomen with lateral spines on S8–9 (Fig. 49a) 26
- Abdomen lacking lateral spines on S8–9 (Fig. 49b) .... *E. connata*
26(25) Ratio of length of cerci : length of paraprocts less than 0.75; lateral spines on S8 and S9 different in length 27
- Ratio of length of cerci : length of paraprocts 1; lateral spines on S8 and S9 subequal (Fig. 49a) .... *E. corallina*
27(26) Lateral spines on S8 and S9 longer than 0.35 mm; anterior margin of labial palp variable; three or four molars on right mandible, always with a d molar (Fig. 49c) 28
- Lateral spines on S8 and S9 shorter than 0.25 mm; anterior margin of labial palp crenulated; three molars on right mandible: a, b and c (Fig. 49d) .... *E. atroterminata*
28(27) Ratio of lateral spines on S8 and S9 less than 0.6; anterior margin of labial palp poorly or not crenulated; three molars on right mandible: a, b and d (Fig. 49c); two molars on left mandible: a and b. .... *E .nigricans*
- Ratio of lateral spines on S8 and S9 more than 0.7; anterior margin of labial palp crenulated; four molars on right mandible: a, b, c and d; three molars on left mandible: a, b and b′ .... *E. ochracea*

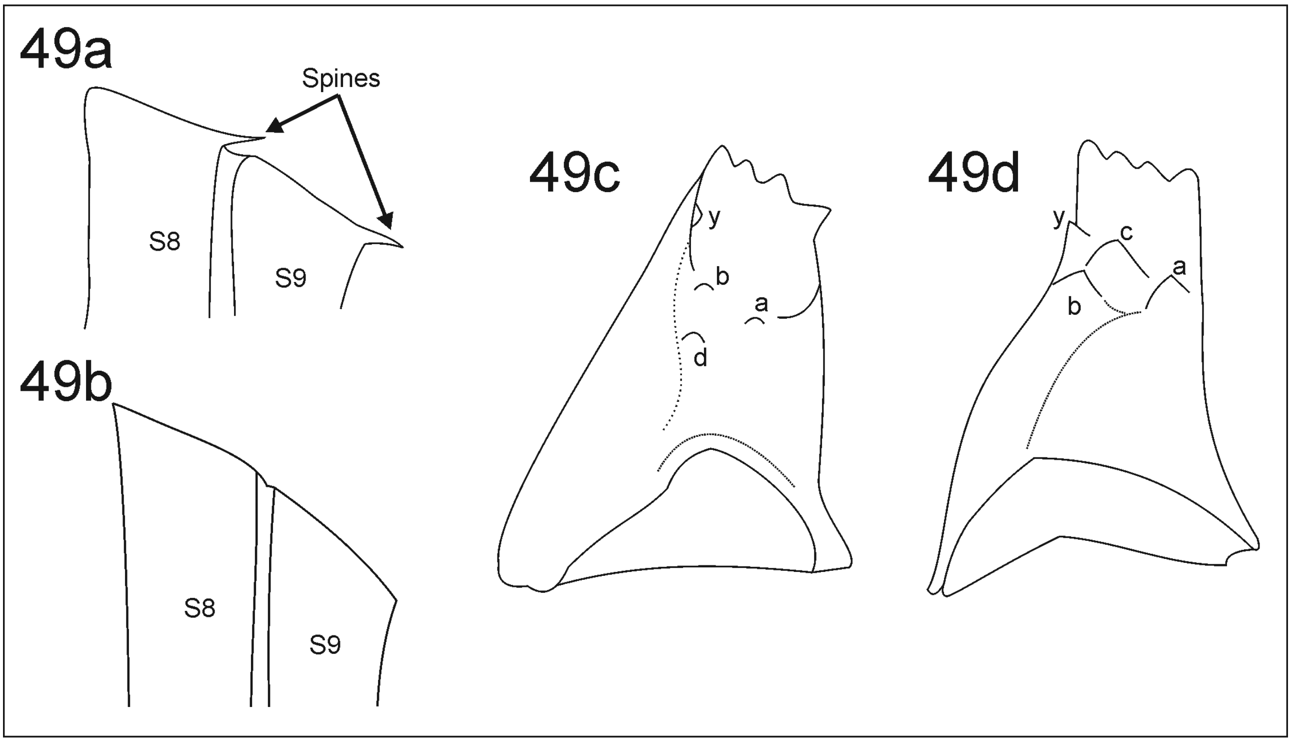

FIGURE 49. a *Erythrodiplax corallina*, S8–9, dorsal view; b *Erythrodiplax connata*, S8–9, dorsal view; c *Erythrodiplax nigricans*, right mandible; d *Erythrodiplax atroterminata*, right mandible.

Zygoptera

Lestidae (Fig. 50a)

This cosmopolitan family is represented in Patagonia only by *Lestes undulatus*, a neotropical species (recorded north to Rio Grande do Sul, Brazil).

Eight species of *Lestes* have been recorded from Argentina, and only one, *L. undulatus*, from Maule to Los Lagos regions in Chile.

Lestes undulatus is not frequent throughout Patagonia, but it can be locally abundant. It inhabits temporary ponds as marshes, bogs and small ponds both in the forest and the steppe. This species uses sedges and grasses for ovipositing and perching. Its larva was described by Muzón (1997b).

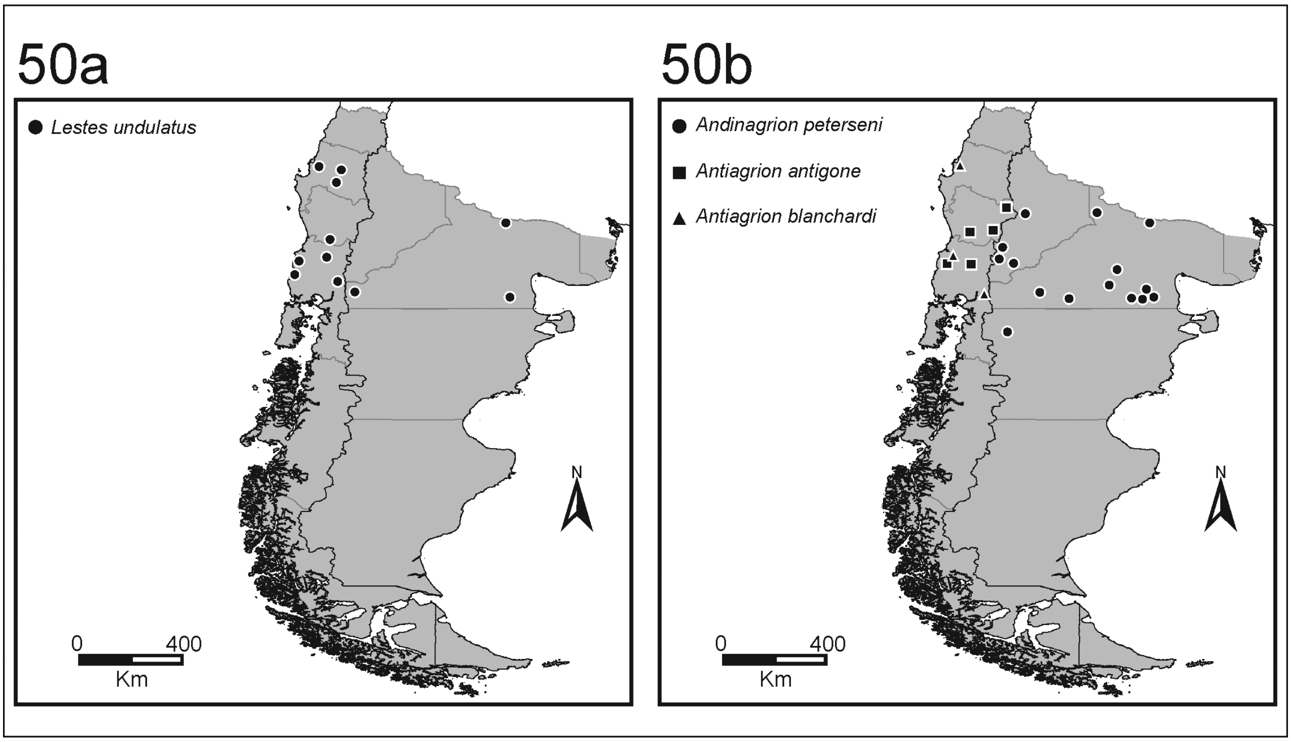

FIGURE 50. Distribution maps. a *Lestes undulatus*; b *Andinagrion peterseni*, *Antiagrion antigone*, and *A. blanchardi*.

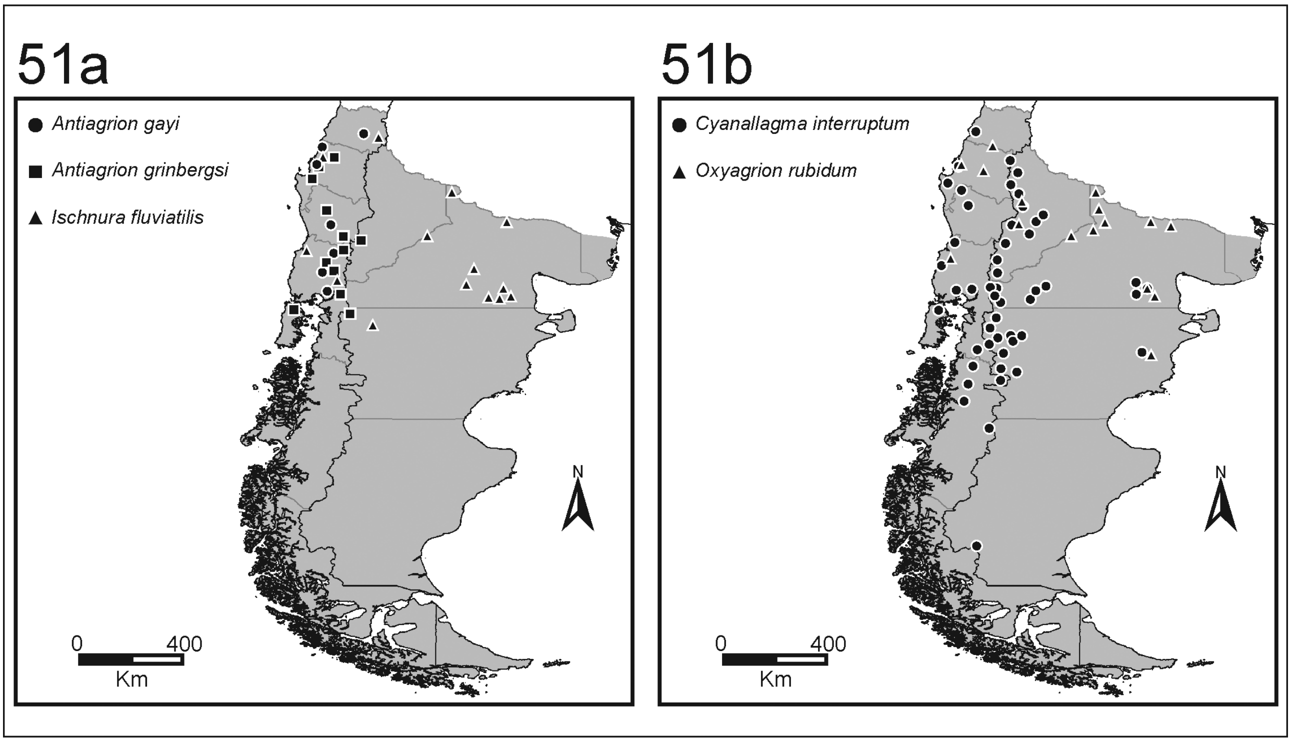

FIGURE 51. Distribution maps. a *Antiagrion gayi*, *A. grinbergsi*, and *I. fluviatilis*; b *Cyanallagma interruptum* and *Oxyagrion rubidum peterseni*.

Coenagrionidae (Figs. 50b, 51)

This family, the richest of the Zygoptera in the world, is represented in Patagonia by eight species in five genera: *Andinagrion peterseni*, *Antiagrion antigone*, *A. blanchardi*, *A. gayi*, *A. grinbergsi*, *Cyanallagma interruptum*, *Ischnura fluviatilis*, and *Oxyagrion rubidum*. Jurtzitza (1989a) recognized the subspecific division of

Oxyagrion rubidum into *O. rubidum rubidum* and *O. rubidum rufulum* Hagen, 1861. However, we do not follow that proposal here.

There are two groups of species according to their distribution: 1. Patagonian species, *i.e.*, *Antiagrion* species and *Cyanallagma interruptum*, which are mainly distributed in Patagonia; and 2. species represented in Patagonia by their southermost populations, *i.e.*, *Andinagrion peterseni*, *Ischnura fluviatilis* and *Oxyagrion rubidum*. *Andinagrion peterseni* is unique because it has not been recorded from Chile yet, although common in northern Patagonia (Muzón & von Ellenrieder 1998; von Ellenrieder & Muzón 2006, 2008). *Antiagrion antigone*, *A. blanchardi* and *A. gayi* have been recorded only from Chile, reaching the northern part of this country (Jurzitza 1974, 1989a).

Most of the Patagonian coenagrionids are common inhabitants of shallow vegetated ponds of diverse sizes, marshes, bogs and shores of great lakes. However, *Antiagrion* species were recorded also from rivers and streams. Except for *Cyanallagma*, all the species occur in low density and are only occasionally seen.

The larvae of *Andinagrion peterseni*, *Cyanallagma interruptum*, *Ischnura fluviatilis*, and *Oxyagrion rubidum* have been described (Needham & Bullock 1943; Bulla 1973a, b; Rodrigues da Fonseca & Pujol-Luz 1999; von Ellenrieder & Muzón 2003). Final instar larvae of *Antiagrion* are not known with certainty, although Needham & Bullock (1943) described a possible penultimate instar larva of this genus which they assigned to *Antiagrion* mainly by the venation pattern of the wingpads. However, this description is not thorough enough to justify its inclusion in the key. The only difference mentioned from other co-occurring coenagrionid genera is the length of the caudal lamellae (equal to the length of the abdomen, possibly longer, in *Antiagrion*; shorter than the length of the abdomen in the rest of the species). However, this character should be confirmed.

Anisoptera

Gomphidae (Fig. 52)

This family is represented in Patagonia by four species in two genera: *Neogomphus* and *Progomphus*.

The Patagonian endemic genus *Neogomphus* is composed of the Chilean endemics *N. bidens* and *N. molestus* as well as *N. edenticulatus*, recorded on both sides of the Andes; all of them inhabit *Nothofagus* forests.

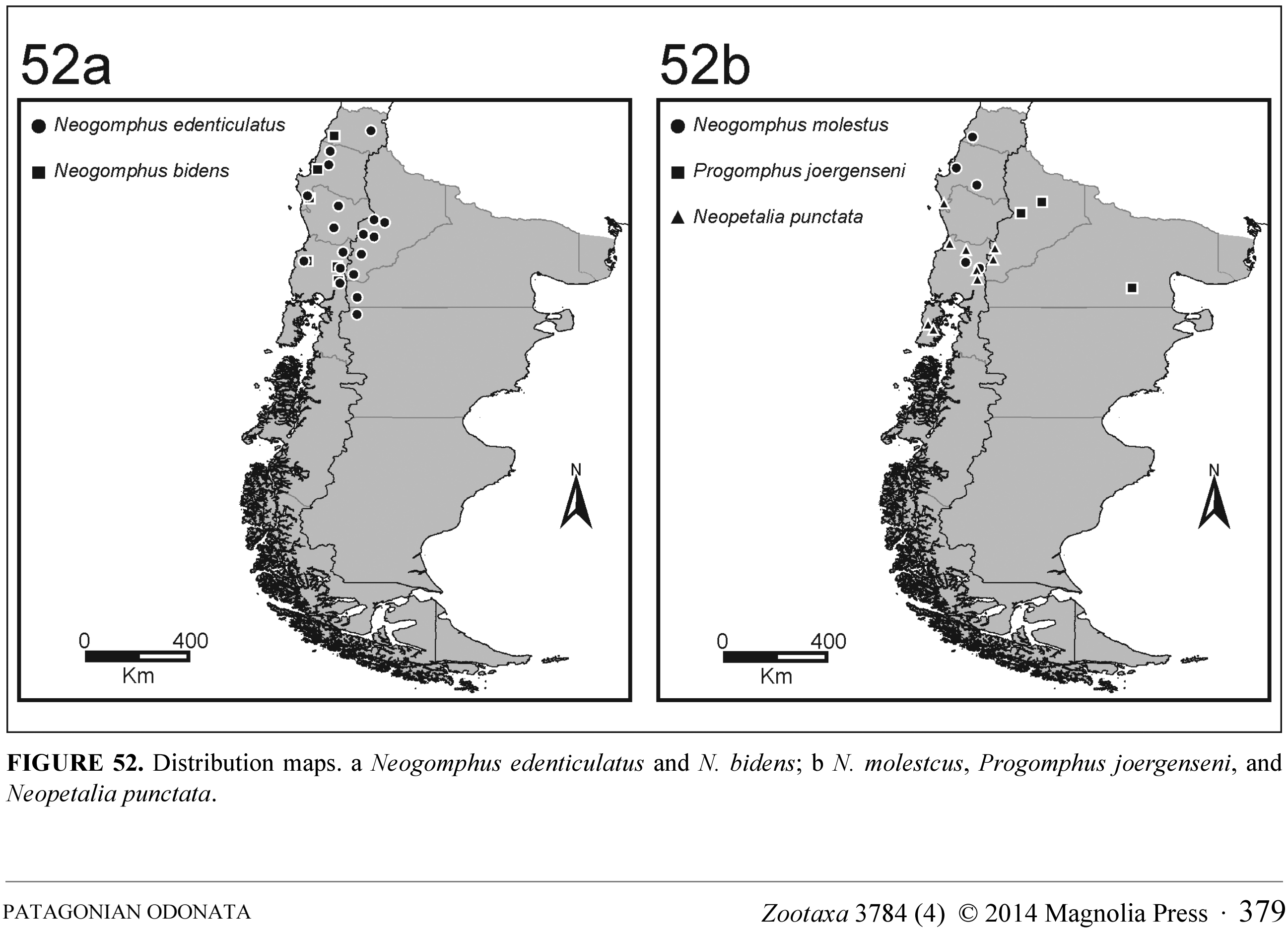

FIGURE 52. Distribution maps. a *Neogomphus edenticulatus* and *N. bidens*; b *N. molestcus*, *Progomphus joergenseni*, and *Neopetalia punctata*.

Neogomphus molestus apparently prefers rapid rivers, whereas *N. bidens* prefers large and slow ones. *Neogomphus edenticulatus* exhibits a wider habitat preference, being the only Patagonian gomphid found at lakes as well as streams and rivers (Carle & Cook 1984). *Neogomphus bidens* and *N. edenticulatus* have been recorded in sympatry (Carle & Cook 1984).

The neotropical speciose genus *Progomphus* is represented only by *P. joergenseni*, an Andean species recorded from Peru and Bolivia to Argentina and Chile; this species has a scattered distribution restricted to permanent, 1–2 m wide, sandy streams fed by spring waters, being on occasions abundant (*e.g.* Valcheta stream headings in Somuncura plateau). Described larvae were collected in sandy beds at depths of 30–40 cm. Adults fly along the stream, resting on boulders. (Muzón *et al.* 2005, 2010; Muzón & Lozano 2011).

All Patagonian gomphid larvae have been described (Needham & Bullock 1943; Belle 1992; Muzón & Lozano 2011). Both genera can be easily separated not just by their different distribution patterns (forest vs. steppe habitats), but by the orientation of the wingpads: widely divergent in *Progomphus* and parallel in *Neogomphus* (Fig. 41).

Aeshnidae (Figs. 53, 54a)

The cosmopolitan family Aeshnidae is represented in Patagonia by five species belonging to the Neotropical genus *Rhionaeschna*, including *R. absoluta*, *R. bonariensis*, *R. confusa*, *R. diffinis*, and *R. variegata* (von Ellenrieder 2001a, c, 2003).

Rhionaeschna bonariensis is a typical extra-Patagonic species, which has just one confirmed record in Argentinean Patagonia (National Park Nahuel Huapi, Rio Negro province) (von Ellenrieder 2001a, b) and some records from Araucania region in Chile (Jurzitza 1989a). According to von Ellenrieder (2001a), Patagonic records of this species are probably due to occasional dispersal events.

In Patagonia, *R. confusa* has been recorded only from Chile. This species can also be found in northern Argentina (north to Buenos Aires province), but there are no records from the Patagonic steppe (von Ellenrieder, 2001a, b).

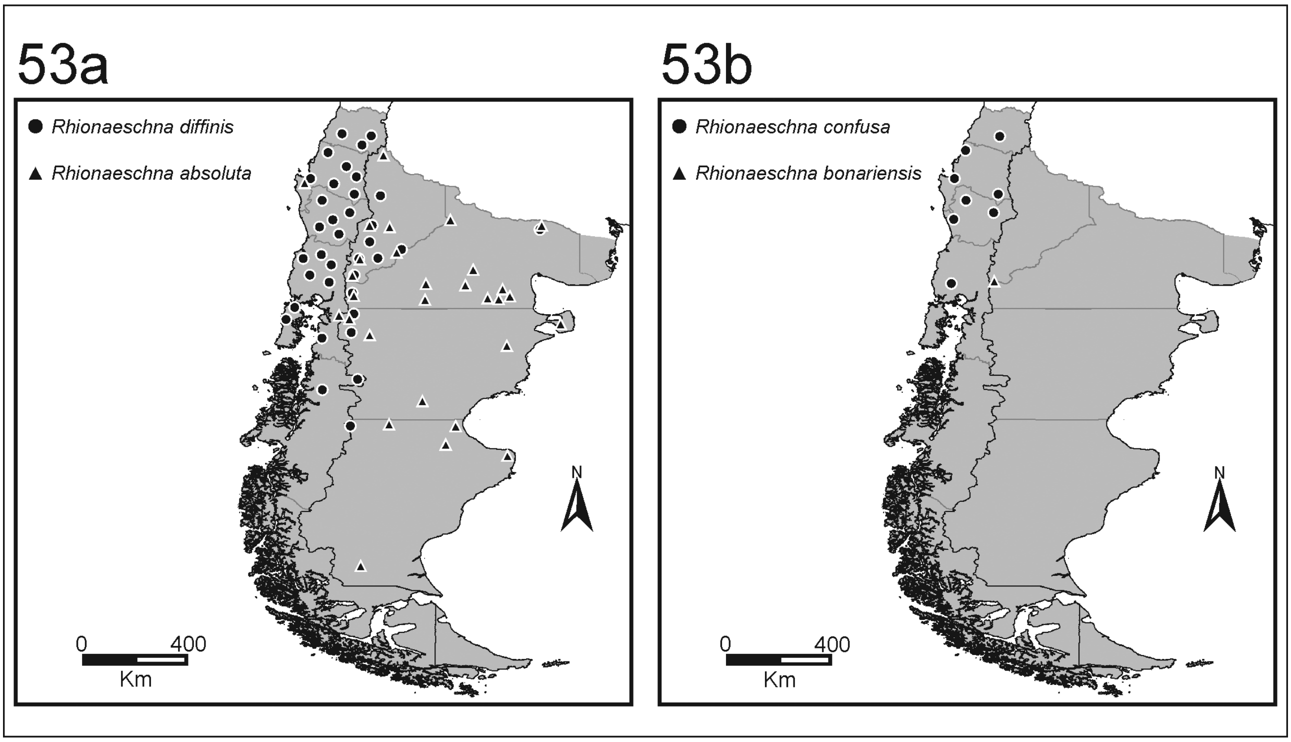

FIGURE 53. Distribution maps. a *Rhionaeschna diffinis* and *R. absoluta*; b *R. confusa* and *R. bonariensis*.

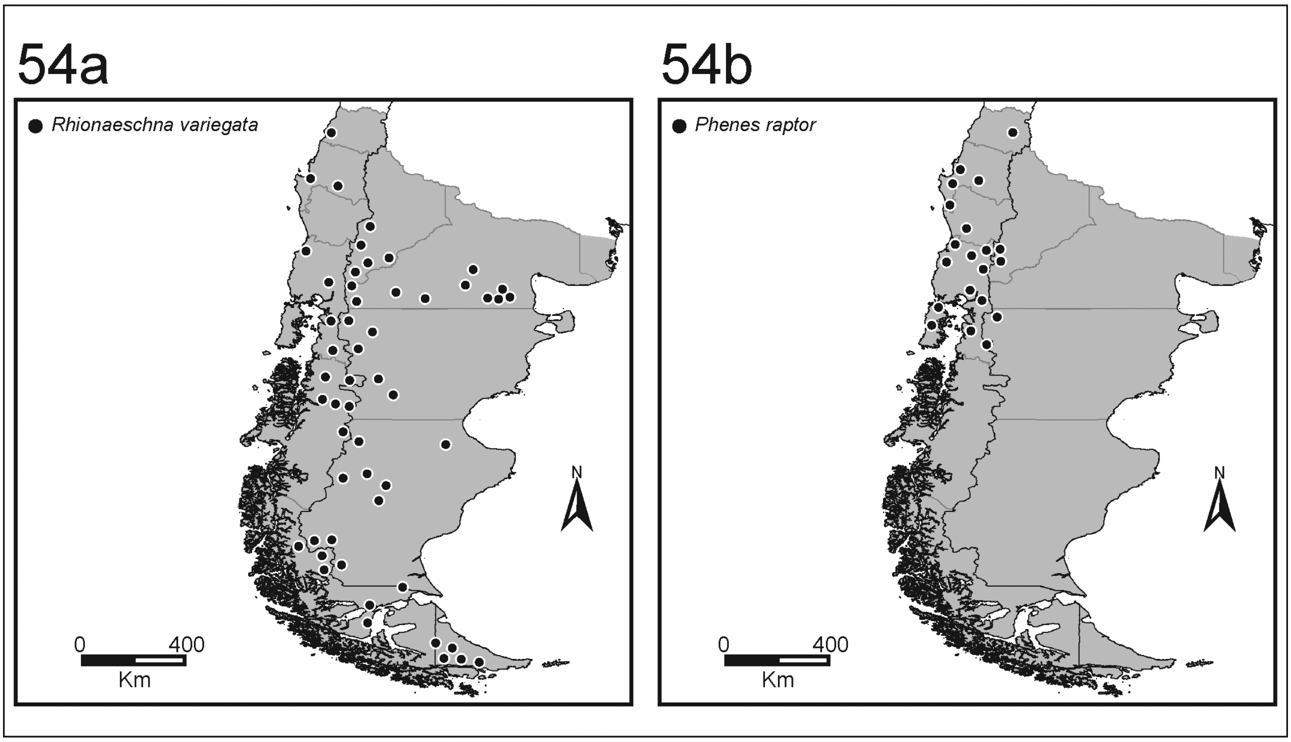

FIGURE 54. Distribution maps. a *Rhionaeschna variegata*; b *Phenes raptor*.

Rhionaeschna absoluta, *R. diffinis,* and *R. variegata* are widespread in Patagonia. *Rhionaeschna absoluta*, common in dry environments of Argentina, has been found in Chile only rarely. On the contrary, *R. diffinis* is more common in Chile than in Argentina because it is restricted to subantarctic forest environments in Patagonia (von Ellenrieder 2001a). *Rhionaeschna variegata*, the southernmost known odonate in the world and the only odonate present in Tierra del Fuego island, is the most common Patagonian species both in forest and steppe (Muzón 1995, von Ellenrieder 2001a, b).

Species of *Rhionaeschna* inhabit all types of still waters, from oligotrophic lakes to peat bogs. *Rhionaeschna variegata* and *R. absoluta* are ubiquitous and abundant, in both species larval populations show no sign of seasonal synchronization (Muzón 1995). Even though larvae of all of these *Rhionaeschna* species have been described (Calvert 1956; Rodrigues Capítulo 1980; Muzón & von Ellenrieder 1996; von Ellenrieder 2001c), their identification can be difficult as they have a similar morphology.

Petaluridae (Fig. 54b)

This family exhibits a transpacific distribution pattern; it is represented in South America only by the monotypic genus *Phenes* endemic to Patagonia. Mainly based on color differences, Jurtzitza (1989b) proposed a subspecific division for *Phenes raptor*, recognizing *P. r. raptor* as an austral form and *P. r. centralis* for the central area around Santiago city. We do not follow this proposal.

Terrestrial larvae were collected on rainforest floor and seepage areas (Garrison & Muzón 1995; Baird 2013), and terrestrial oviposition was mentioned by Muzón (2009). The larva was described by Schmidt (1941) and Needham & Bullock (1943); behavior and larval habitat preferences were recently summarized by Baird (2013).

Austropetaliidae (Figs. 55, 56a)

This small family of four genera and 10 species (Garrison *et al.* 2006) is represented also in Australia and Tasmania. In Patagonia it is represented by the genera *Hypopetalia* (monotypic: *H. pestilens*) and *Phyllopetalia*, with five species: *P. apicalis*, *P. apollo*, *P. excrescens*, *P. pudu* and *P. stictica.* All the species are present in southern Chile, but only *H. pestilens*, *P. apollo* and *P. pudu* have also been recorded in southwestern Argentina (von Ellenrieder 2005; Pessacq & Brand 2009).

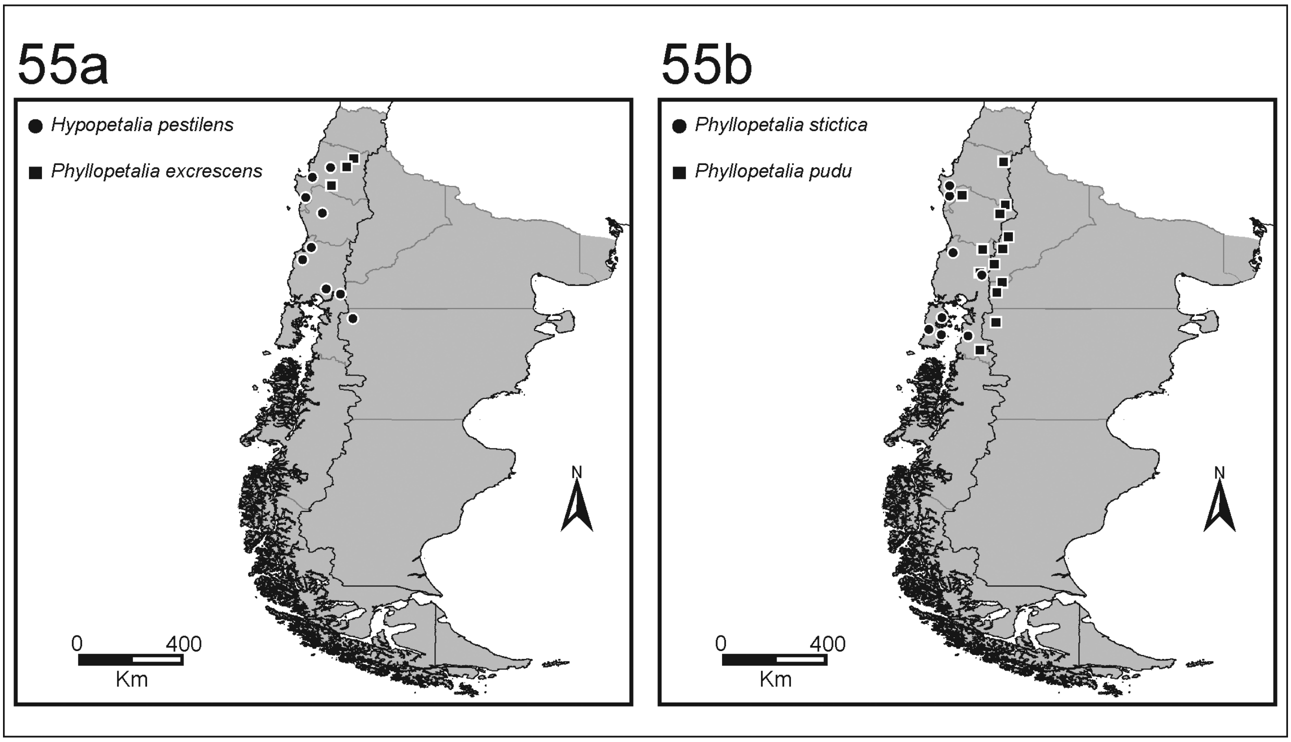

FIGURE 55. Distribution maps. a *Hypopetalia pestilens* and *Phyllopetalia excrescens*; b *P. stictica* and *P. pudu*.

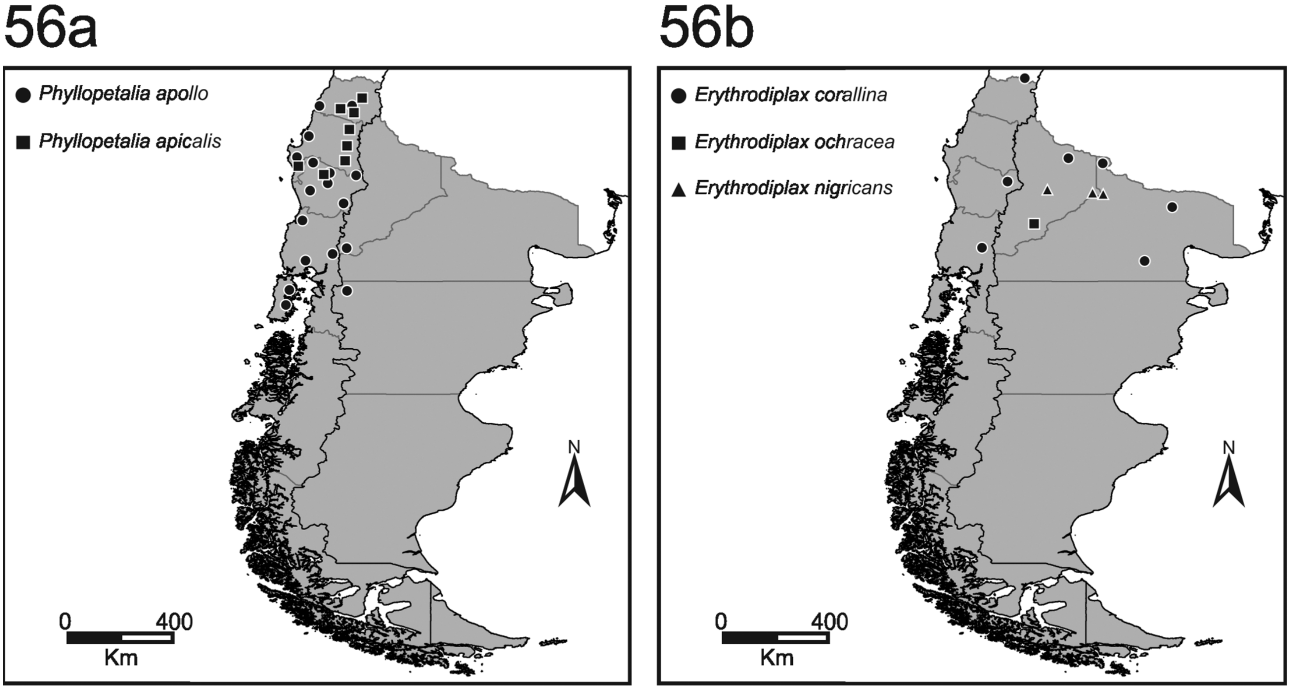

FIGURE 56. Distribution maps. a *Phyllopetalia apollo* and *P. apicalis*; b *Erythrodiplax corallina*, *E. ochracea*, and *E. nigricans*.

Phyllopetalia altarensis has been recorded from central Chile (von Ellenrieder 2005), and it is included here since its known distribution area is close to the northern limit of Patagonia.

The genus *Phyllopetalia* was revised by von Ellenrieder (2005), who synonymized four genera, four species, and one subspecies, provided keys for adults (herein reproduced) and distributional and taxonomic information.

The larval knowledge of the family is still poor, with only the larvae of *H. pestilens* and *P. apollo* known

(Schmidt 1941; Pessacq & Brand 2009) with certainty. The larva of *P. stictica* was described by supposition (Schmidt 1941), and some characters of *P. pudu* were provided by Pessacq & Brand (2009), also associated by supposition.

Austropetalids mainly inhabit shaded forests with small streams and rivulets. Carle (1996) mentions a semiterrestrial habitat for *Phyllopetalia*, Baird (2013) observed a larva that he tentatively identified as a *Phyllopetalia* sp. under a log next to a water-filled micro-depression, and Pessacq & Brand (2009 and pers. obs.) found larvae of *Hypopetalia pestilens*, *Phyllopetalia apollo* and *Phyllopetalia* sp. in small streams (1–2 m wide) within *Nothofagus* forest and on non-native Douglas-fir (*Pseudotsuga menziesii*) plantations. Larvae were found in crevices of small falls, clinging under logs or between pebbles and debris. The characteristic lateral lobes of the abdominal segments having a serrated aspect possibly mimicks *Nothofagus* leaves. Exuviae of *Phyllopetalia apollo* have been found at the top of a pine tree (*Pinus contorta*) cut at a height of about 2 m (Pessacq & Brand 2009).

Females of *Phyllopetalia apollo* have been seen flying close to the water's surface and ovipositing in the moist surface of logs protruding from water; adults of *Hypopetalia pestilens* have been seen flying close to the water's surface, but also at tree-top level, at heights of more than 10 m (Pessacq pers. obs.). On several occasions males and females have been captured with malaise traps placed across small shaded streams (Muzón & Spinelli 1995).

Neopetaliidae (Fig. 52b)

This monotypic family was established by Carle & Louton (1994) for *Neopetalia punctata*. This remarkable species has a restricted distribution from 33º S in central Chile to 43º S, being recorded in the *Nothofagus* forest of Argentina approximately between 40º S and 43º S and from sea level to 1,700 m.a.s.l. (Carle & Louton 1994; Muzón 1997a).

Larvae are shallow burrowers and were found in small muddy streams and seepages (Carle & Louton 1994); in Argentina this species has been found in small shaded streams with riparian bamboo patches within *Nothofagus* forests. Adult behavior has been described by Carle & Louton (1994).

Libellulidae (Figs. 56b, 57)

This cosmopolitan family is represented in Patagonia by seven species in three genera: *Dasythemis mincki*, *Erythrodiplax atroterminata*, *E. connata*, *E. corallina*, *E. nigricans*, *E. ochracea*, and *Sympetrum villosum*.

The biogeographical aspects of these species differ considerably. For example, *D. mincki* is recorded in Patagonia only from the Valcheta stream headings in Somuncura volcanic plateau, where it is locally abundant. The presence of this neotropical species in northern Patagonia, disjunct some 1,000 km southeast of the nearest population (Uspallata river, Mendoza province), could be explained by the thermal nature of the stream headings on this plateau (Muzón 1997a; Spinelli & Muzón 2000; Muzón *et al.* 2005). On the other hand, the cosmopolitan genus *Sympetrum* is represented only by the endemic *S. villosum*, which is a common inhabitant of ponds of the *Nothofagus* forest area between 41° S and 46° S (Muzón & von Ellenrieder 1997). Finally, the species of the neotropical genus *Erythodiplax* present in Patagonia have large distribution areas within Argentina, except for *E. connata*, a true Patagonian species, which extends slightly north to the southern portion of Mendoza province (del Palacio & Muzón 2012); all the species of *Erythrodiplax* are represented in Patagonia by their southernmost populations.

Most of the non-strict Patagonian *Erythrodiplax* are inhabitants of ponds and marshes, being rare in the northern steppe area (north to 42º S), except for *E. corallina* which is recorded both in the forest area of Chile and in the steppe areas of Argentina. *Erythrodiplax connata* is a common and locally abundant species north to 44º S.

In the northern steppe, only three libellulids have been recorded in sympatry: *Dasythemis mincki*, *Erythrodiplax atroterminata,* and *E. connata* (Muzón *et al.* 2005; Muzón *et al.* 2010). There are two other libellulids recorded in the steppe, *Erythrodiplax corallina* and *E. nigricans*, but only from isolated records; however, it is likely that all five will be found in sympatry.

All the larvae of Patagonian libellulids have been described (Carvalho *et al.* 1991; von Ellenrieder & Muzón 2000; von Ellenrieder 2007; Garré *et al.* 2008; Lozano *et al.* 2011). Those of *Sympetrum* and *Dasythemis* are easily recognized by labial palp features. Larvae of *Erythrodiplax* are harder to identify at the specific level, except for that of *E. connata*, the only one without lateral abdominal spines.

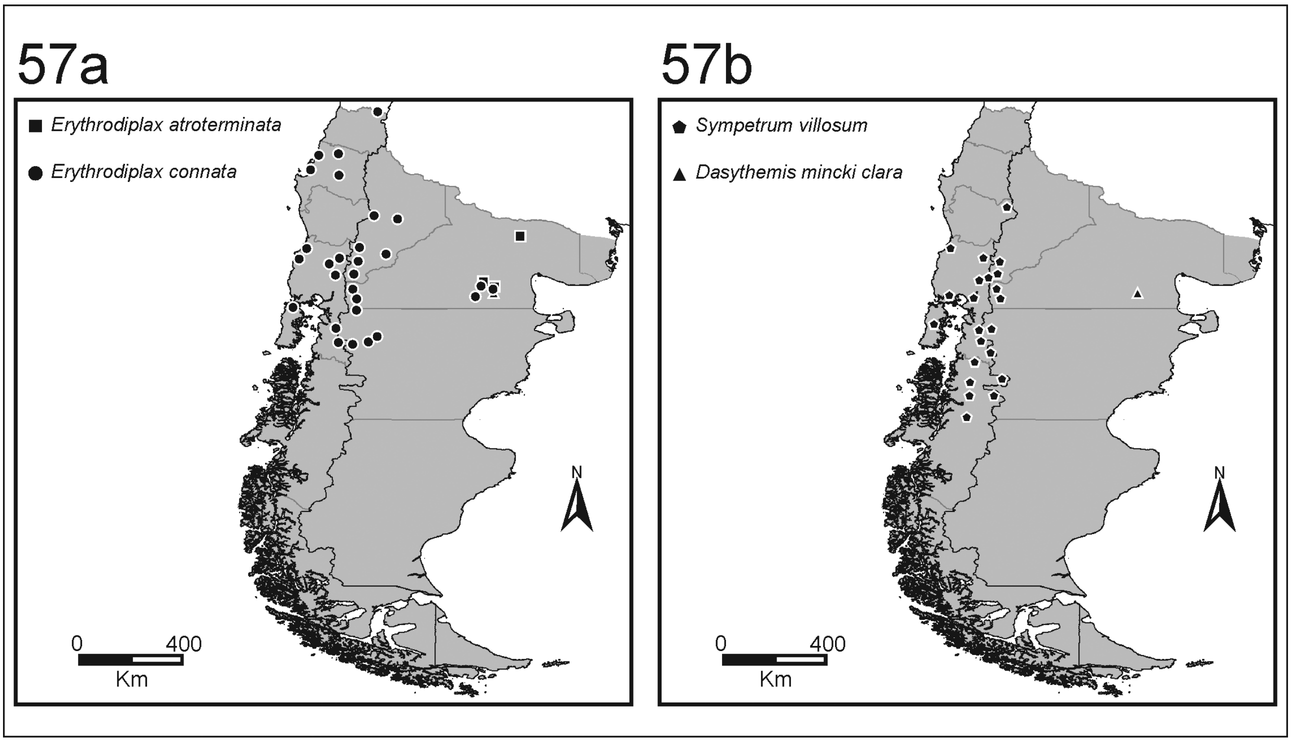

FIGURE 57. Distribution maps. a *Erythrodiplax atroterminata* and *E. connata*; b *Sympetrum villosum* and *Dasythemis mincki clara*.

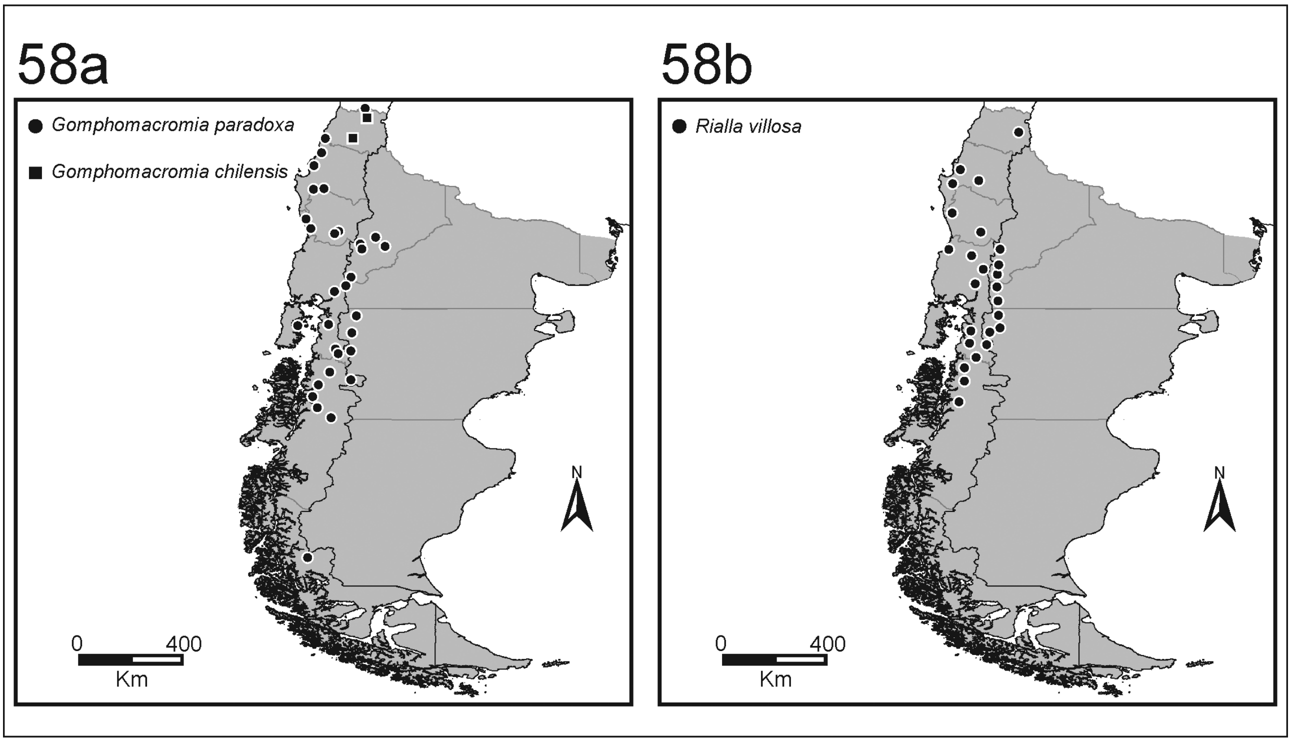

FIGURE 58. Distribution maps. a *Gomphomacromia paradoxa* and *G. chilensis*; b *Rialla villosa*.

Corduliidae (Fig. 58)

Dijkstra *et al.* (2013) proposed a restricted Corduliidae, excluding the genus *Gomphomacromia* which is left as *incertae sedis* within Libelluloidea. For practical purposes we include this genus in Corduliidae.

Corduliidae is a cosmopolitan family represented by only two genera and three species in Patagonia: *Gomphomacromia chilensis*, *G. paradoxa*, and *Rialla villosa*. The genus *Rialla* is monotypic and endemic.

The genus *Gomphomacromia* was revised by von Ellenrieder & Garrison (2005), who synonymized *G. mexicana* Needham, 1933, with *G. chilensis,* and *G. etcheverry* Fraser, 1957, with *G. paradoxa*. *Gomphomacromia chilensis* is a poorly known species endemic to central Chile, reaching Patagonia at its northern border, approximately 35° S; locality data are few. *Gomphomacromia paradoxa* occurs all along the Andean range approximately from 32° to 51° S.

The larvae of *Gomphomacromia paradoxa* and *Rialla villosa* have been described (Needham & Bullock 1943; Theischinger & Watson 1984); that of *G. chilensis* remains unknown.

Gomphomacromia paradoxa inhabits mountain streams, seepages and bogs, and it can be found in large numbers; males defend their territory and tandems land by the side of the streams (von Ellenrieder & Garrison 2005). Larvae of this species seem to be semi-terrestrial (von Ellenrieder & Garrison 2005).

Rialla villosa inhabits lakes and ponds in the *Nothofagus* forest. Adults fly straight close to the water; copulation takes place during flight; tandems perch on trees (Jurzitza 1975), adults perch occasionally on grass and bushes, usually in vertical position (Jurzitza 1989a). Larvae were collected in oligotrophic lakes with the aid of dredges from 20 m depth (Muzón 1995).

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