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PO Box 3300, South Brisbane 4101, Australia
Phone 06 7 3840 7555
Fax 06 7 3846 1226
Email qmlib@qm.qld.gov.au
Website www.qm.qld.gov.au

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Revision of the land snail genus *Pallidelix* Iredale, 1933 with the description of new species from the central highlands of inland Queensland (Gastropoda: Eupulmonata: Camaenidae)

John STANISIC

Honorary Research Fellow, Biodiversity Program, Queensland Museum, PO Box 3300, South Brisbane, Qld 4101, Australia. Email: john.stanisic@qm.qld.gov.au

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ABSTRACT

Pallidelix Iredale, 1933 is revised on the basis of conchological and anatomical morphology. Nine new species *Pallidelix lonesome* sp. nov., *P. expeditiana* sp. nov., *P. potteri* sp. nov., *P. staricki* sp. nov., *P. lambkinae* sp. nov., *P. moffatt* sp. nov., *P. grandis* sp. nov., *P. minerva* sp. nov. and *P. zamia* sp. nov. are described. Penial pilaster patterns and shell sculpture were considered significant species delimiting characters. A key to species is presented. Two species are shown to have relatively widespread distributions while the majority have small circumscribed distributions in scattered and isolated patches of vine thicket. Two species placed in *Pallidelix* by Stanisic *et al.* (2010) from south-eastern Queensland, viz. *H. bennetti* Brazier 1872 and *P. chinchilla* Stanisic, 2010 are herein excluded from the genus. As part of this revision the taxonomic status of the problematic *Helix expeditionis* Cox, 1868 (considered a synonym of *P. greenhilli* by Stanisic *et al.* 2010) is also discussed. □ *Pallidelix*, *Eupulmonata*, *Camaenidae*, revision, systematics, morphology, new species, Queensland, Australia.

A mega-clade of semi-arid to arid-adapted, medium-sized to large camaenids inhabiting inland parts of Queensland, coastal and inland New South Wales and the arid areas of South Australia and the Red Centre was identified by Hugall & Stanisic (2011: Clade 3). The Queensland endemic *Pallidelix* Iredale, 1933 (type species. *Helix greenhilli* Cox, 1866) is one of these Clade 3 genera with species centred in semi-arid inland southern and mid-central Queensland in the Brigalow Lands bioregion.

Pallidelix greenhilli (Cox, 1866) was described from the 'Upper Dawson River' which has its headwaters in the Carnarvon Ranges, SCQ. Based on limited material Stanisic *et al.* (2010) considered that a single species, *P. greenhilli*, inhabited all of the Carnarvon and Expedition Ranges and nearby surrounding areas. Stanisic *et al.* (2010) also included two additional

species from south-eastern Queensland in the genus (*Helix bennetti* Brazier, 1872 and *Pallidelix chinchilla* Stanisic, 2010) on the basis of grossly similar shell sculpture but conditional on a full revision of the genus. *P. simonhudsoni* Stanisic, 2015 was subsequently described from vine thickets of Carnarvon Station Reserve and detailed morphological investigations at the time revealed the possible presence of other putative *Pallidelix* species in south and mid-central Queensland. However, the specimen base of available material was not considered sufficient in its geographic coverage to allow for a full revision of the genus.

The recent donation of a large amount of material (chiefly dead shells) to the QM from the central highlands of inland Queensland has prompted this revision. This material included many new locality records for the genus and

was critical in establishing the distribution limits of putative species based on shell characters which could be linked to species recognition changes in terminal genitalia. Although some spirit material was available and DNA extraction attempted, the resulting cladogram was inconclusive and conflicting with anatomical results in establishing the validity of species. Hence, this revision is based on shell morphology and reproductive anatomy. The two additional species placed in *Pallidelix* by Stanisic *et al.* (2010) from south-eastern Queensland, *viz.* *H. bennetti* and *P. chinchilla*, are herein excluded from the genus and will be dealt with elsewhere. As part of this revision the taxonomic status of the problematic *Helix expeditionis* Cox, 1868 (considered a synonym of *P. greenhilli* by Stanisic *et al.* 2010) is also discussed.

MATERIALS AND METHODS

Material used in this study is held in the collections of the Queensland Museum (QMMO). Studies of shell characters were carried out on specimens in the museum's dry collection (RC) and anatomical studies were based on ethanol preserved samples (SC). Age cohorts in individual lots are identified by the abbreviations A (adult) and SA (subadult). Specimens were studied using a WILD M5 stereo microscope and anatomical photographs were taken with a NIKON 4200 Coolpix camera with microscope attachment. Measurements of shell characters (height, diameter) were made using callipers with a precision of 0.01 mm. Whorl counts were made to the nearest 0.125 whorl. Where possible, at least two representatives of each species were dissected in order to confirm constancy of reproductive structures. Historic type material was loaned for the study by the Australian Museum (Sydney).

Differences in reproductive anatomy between species of *Pallidelix* relate to changes in penial pilaster configuration with other features typical of the generic base plan. Hence, most genitalic illustrations presented herein only feature the dissected penial apparatus of individual species rather than the entire genitalia.

ABBREVIATIONS

General. Ck, creek; MCQ, mid-central Queensland; Mt, Mount; Mtn, mountain; NP, National Park; Ra, range; Rd, road; SCQ, south-central Queensland; SEQ, South-East Queensland; sevt, semi-evergreen vine thicket; SF, State Forest; Stn, Station; Tbl, Tableland.

Delimitation of species in *Pallidelix*. In the absence of material for molecular analysis species were delimited on the basis of variation in shell characters generally considered useful guides to species within the family (size, shape, coiling and sculpture) and differences in the male terminal genitalia, specifically variation in the internal architecture of the penial chamber. Conchological differences such as size will often relate to functionality within local environmental regimes. Hence, care needs to be taken when assessing such differences in isolation. However, when correlated with changes in shell shape and coiling pattern (expanded body whorl), size can be a useful species-specific character. Shell sculpture in *Pallidelix* is low-relief (microridgelets and tiny pustules) and deemed to have little environmental function and so is not considered to be readily subject to external selective pressures. Hence, subtle but significant shifts in sculptural patterns are more likely to be inherited and, when correlated with other conchological characters, are likely to be significant at the species level. Shell sculpture that is considered to be species-delimiting in *Pallidelix* consists of variation in the intensity of the microridgelets *versus* pustules and also changes in their ontogenetic disposition.

Genital changes within *Pallidelix* chiefly consist of variations in penial pilaster configuration with no major fundamental shifts in basic structures from the generic pattern. Species recognition changes in genitalia in the Camaenidae normally involve changes in penial pilaster pattern and this has been shown to be the case within a wide range of taxa (Solem 1992, Köhler 2011). Greatest change occurs under conditions of congeneric sympatry. The fact that the species of *Pallidelix* are allopatric or at most parapatric, suggests that

genitalic differences will be conservative and presumably due to genetic drift following long term isolation rather than a result of species-species interactions under sympatry. And this is indeed the case. Some intraspecific variation may occur in widespread species however, these need to be interpreted in conjunction with other conchological and anatomical characters when identifying species.

In this study, a species was identified by unique set of non-correlated conchological features coinciding with a shift in the number, shape and length of penial pilasters.

SYSTEMATICS

Infraorder EUPULMONATA

Superfamily HELICOIDEA

Family CAMAENIDAE

Genus *Pallidelix* Iredale, 1933

Pallidelix Iredale, 1933: 47; Iredale, 1937: 36; Smith, 1992: 140; Stanistic *et al.*, 2010: 440 (*partim*); Stanistic, 2015: 56.

Type species. *Helix greenhilli* Cox, 1866-by original designation.

Taxonomic issues. *Pallidelix* Iredale, 1933 was introduced to accommodate a single species (*Helix greenhilli* Cox, 1866) from the rather broad type locality of 'Upper Dawson River', south central Queensland. Little attention was given over to comparative morphological detail... 'the thin shell, rounded whorls, pale unicolor shade, umbilical characters, and microscopic sculpture disagree altogether with any of the preceding, and necessitate the introduction of a new generic name' (Iredale, 1933). Fortunately three syntypes, which are the only known specimens of the original collection by a Mr Greenhill, have survived for the purpose of adequately describing the species and providing a basis for comparisons and generic diagnosis.

Diagnosis. Shell large (20-30 mm diameter) to very large (30-40 mm diameter), yellowish brown to brown often with a lighter base and frequently with a reddish brown subsutural band, occasionally with an overall pinkish tinge.

Spire weakly to moderately elevated, whorls rounded to occasionally shouldered below the periphery, body whorl in some species extremely expanded. Protoconch of 1.75 whorls sculptured with crowded, radially arranged, irregularly shaped pustules (Fig. 1A), teleoconch sculpture generally with crowded pustules on the early whorls and a variable pattern of pustules and oblique to zigzag microridgelets on the last three whorls (Fig. 1B, C), sometimes becoming obsolete on the last half of the body whorl, occasionally adorned with periostracum; curved, weak to strong radial growth lines present in most species; umbilicus narrowly open and reduced to a lateral crack, or closed. Penis elongate, with a sheath, internally with an apical smooth and tapered papillate verge with a terminal pore; walls of penial chamber with smooth, thick longitudinal pilasters apically and a variable pattern of obliquely disposed longitudinal pilasters medially and thin irregular corrugated pilasters or pustules basally; epiphallus with a very thick, ascending arm, strongly reflexed and slightly twisted at the point of reflexion before giving rise to an equally long but thinner descending arm; epiphallic caecum situated near the point of reflexion; a long, thick finger-like epiphallic flagellum present at the epiphallus-vas deferens junction. Animal with coloured (red or beige) mantle.

Range. Currently considered to extend from Gurulmundi SF, north of Miles, SEQ in the south through the Carnarvon and Expedition Ranges to Springsure, SCQ and north to the Drummond Range, west of Emerald, MCQ.

Remarks. *Pallidelix* Iredale, 1933 as herein defined is distinguished by a combination of conchological features (shell shape, coiling pattern, teleoconch sculpture) and reproductive anatomy (terminal male genitalia). Species are almost exclusively allopatric occurring mostly within isolated patches of vine thicket. Protoconch sculpture consists of irregular radial microridgelets and scattered pustules (Fig. 1A). The teleoconch sculptural features are a combination of microridgelets and tiny pustules (Fig. 1B, C) which differ in their individual intensity

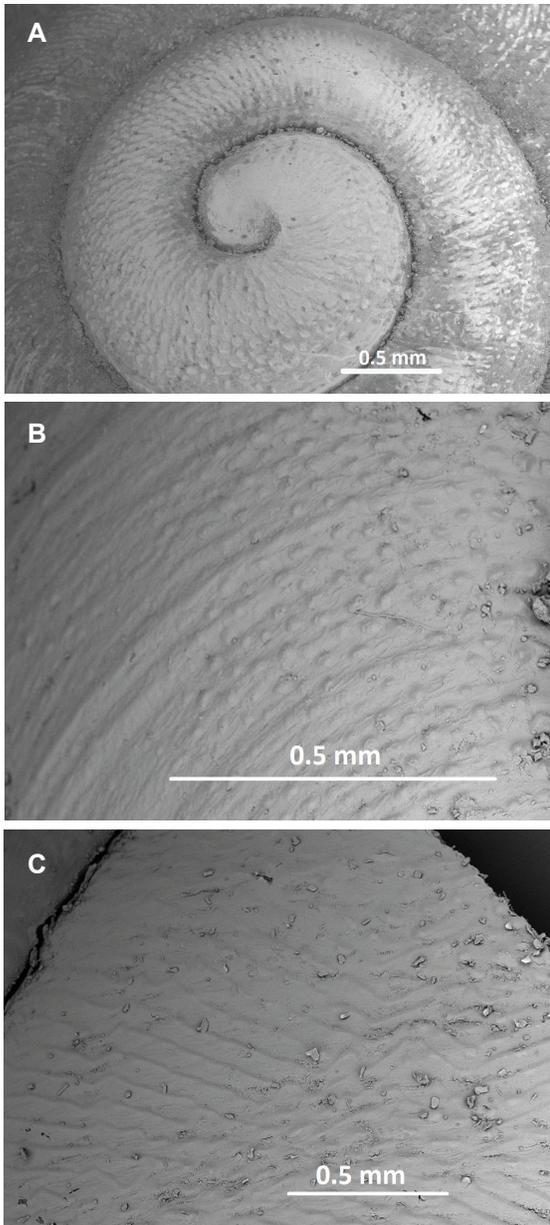


FIG. 1. Scanning electron micrographs showing aspects of *Pallidelix* sculpture. **A**, irregular microridgelets and scattered pustules on the protoconch of *P. simonhudsoni* Stanisic, 2015; **B**, crowded pustules on the teleoconch of *P. mineroa* sp. nov.; **C**, oblique and zigzag microridgelets on the teleoconch of *P. expeditiana* sp. nov.

between the various species and display a high level of local geographic consistency. Shell size, shape and coiling pattern are informative in several species but show no geographic consistency. Conchologically *Pallidelix* differs from the sometimes sympatric and similarly looking *Lynfergusonia* by having a shell sculpture that includes oblique to zigzag microridgelets which are lacking in the latter. In contrast to the former *Lynfergusonia* has a sculpture of dense pustules over the entire teleoconch. Anatomically *Pallidelix* is distinguished by having an elongate muscular penis with a series of smooth, thick, fleshy, either straight or anastomosing, longitudinal pilasters apically, and a smooth, tapering penial verge with a terminal pore. In contrast *Lynfergusonia* has a sculptured verge with the epiphallic pore located at the base of the verge and numerous irregularly shaped, small, crowded pustular pilasters; There is no caecum and the epiphallic flagellum is thin and spindly in contrast to the thick, finger-like flagellum of *Pallidelix* (Stanisic, unpublished).

Within the geographic range of *Pallidelix* there are also other yet-to-be described camaenid genera and species which possess some similar shell characters (e.g. pustules, zigzag microridgelets), but most significantly, differ in configuration of the terminal male genitalia, particularly the internal architecture of the penis.

Pallidelix greenhilli (Cox, 1866)
(Figs 2A-B, 3A-C, 12A)

Helix greenhilli Cox, 1866: 46; Cox, 1868: 40.

Pallidelix greenhilli (Cox). Iredale, 1933: 47; Iredale, 1937: 36;
Smith, 1992: 140; Stanisic *et al.*, 2010: 440, sp. 688.

Preferred common name. Dawson River Woodland Snail.

Taxonomic issues. A specimen labelled syntype (registration number AMSC.5767) and one other specimen (AMSC.101192) which may also be considered a syntype are housed in the Australian Museum, Sydney. An additional syntype (NMWZ1955.158.880) resides in the National Museum of Wales (Smith 1992). Specimen AMSC.5767 was selected as lectotype (Fig. 2A).

A major issue in the past has been the inability to associate the type series of *H.*

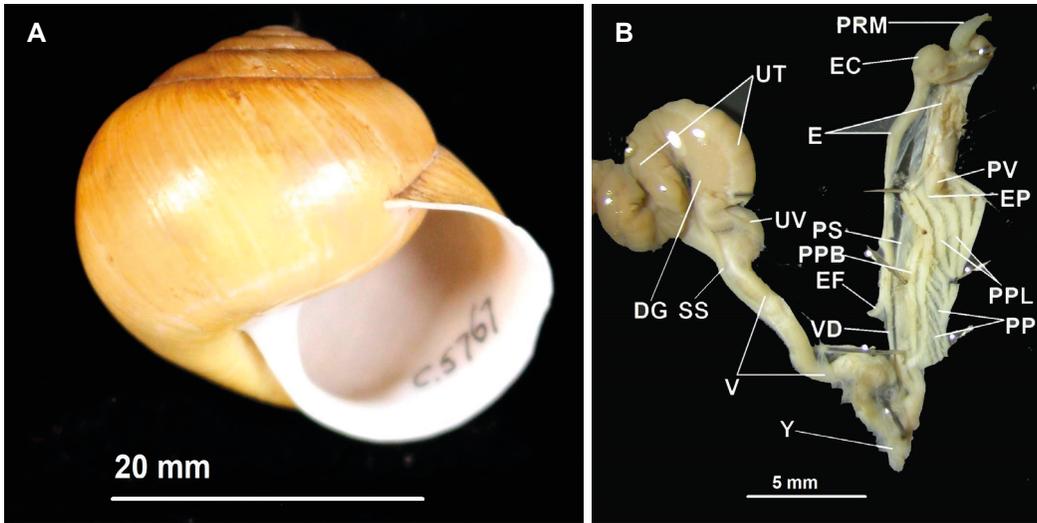


FIG. 2. *Pallidelix greenhilli* (Cox, 1866). A, lectotype, AMSC5767; B, genitalia, QMMO79091.

greenhilli from the type locality (Upper Dawson River) with any museum material from within the extensive upper Dawson River drainage. This matter was recently resolved with the donation to the Queensland Museum of a large number of specimens from the upper reaches of the Dawson River which contained material considered conchologically similar (size, shape and sculpture) to *P. greenhilli*. Stanisić *et al.* (2010) took a broad view of this species and judged it to range through a large part of the sandstone belt (Carnarvon and Expedition ranges) to the Minerva Hills near Springsure, MCQ. However, as a result of this revision *P. greenhilli* is herein restricted to the Expedition Resource Reserve area of the Expedition Range based on the shell size, shape and microsculpture of the syntypes most closely resembling those of specimens from that area.

Material examined. (All south central Queensland).

Lectotype (herein designated). AMSC.5767, Upper Dawson River (herein restricted to the Expedition Resource Reserve at the southern end of the Expedition Range), coll. Mr Greenhill, ex. Cox coll. Height of shell 23.16 mm, diameter 29.06 mm, h/d 0.797, whorls 5.875.

Paralectotypes. AMSC.101192, 1A RC; NMWZ1955.158.880 (*vide* Smith 1992), A RC; both same data as lectotype.

Other material examined. QMMO79091, 4A SC/13A RC; QMMO85256 2A, 2SA RC, Expedition Resource Reserve, adjoining “Yebna”, c.60 km NNE Injune, 25°37'18”S, 149°07'21”E, sevt, in and under logs, coll. C. Eddie, 21.vii.2009; QMMO54826, 2A,1SA RC, Taroom, W near “Yebna”, 25°41'22”S, 149°06'37”E, vine thicket, coll. P.Grimshaw, W. McDonald, 12.v.1993.

Diagnosis. Shell large, subglobose, yellowish brown to brown with a yellowish green base; teleoconch sculpture consisting of prominent, moderately crowded, oblique to zigzag microridgelets and reduced pustulation. Penial chamber apically with 5 fleshy longitudinal pilasters, medially with a prominent bifurcate longitudinal pilaster and a series of thinner fleshy obliquely oriented pilasters, basally with a series of irregularly arranged pustulose pilasters.

Description. Shell large, shiny, subglobose, yellowish brown to brown with a very weak reddish brown subsutural band and yellowish green base; spire weakly elevated, whorls 5.625-6.0 (mean 5.875), evenly rounded, the last descending rapidly in front (Fig. 2A). Height of shell 21.94-26.18 mm (mean 23.88 mm), diameter of shell 27.45-31.04 mm (mean 29.40 mm), h/d 0.747-0.874 (mean 0.812). Protoconch as for genus. Teleoconch sculpture consisting of moderately crowded and prominent, oblique

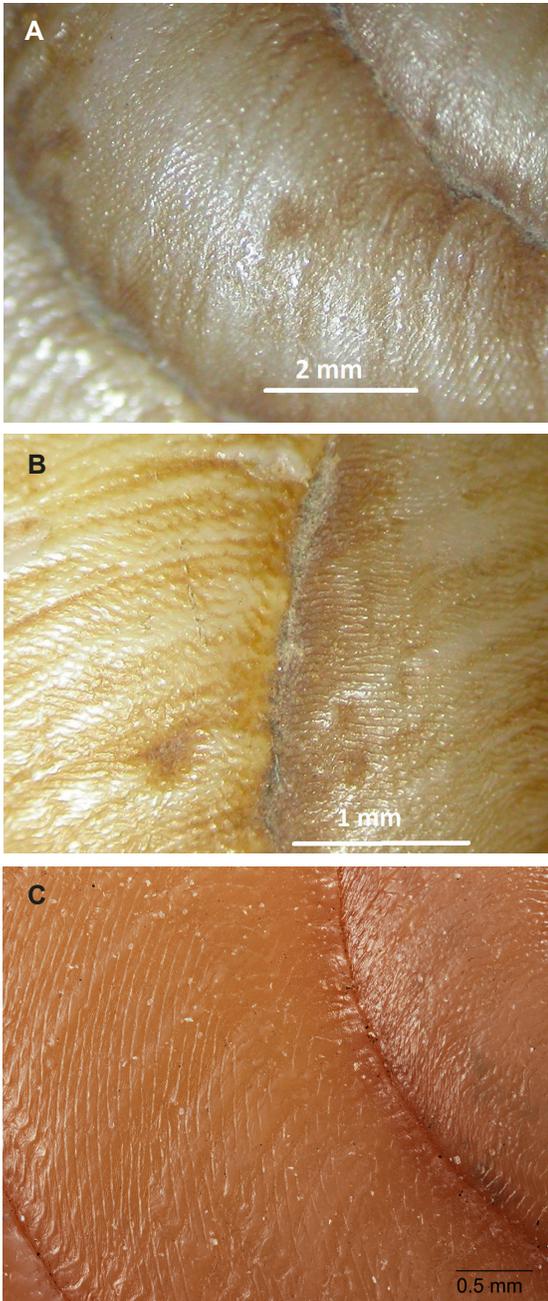


FIG. 3. Sculpture in *Pallidelix greenhilli* (Cox, 1866). **A**, lectotype, AMSC5767; **B**, Expedition Resource Reserve, QMMO79091; **C**, paralectotype, AMSC101192. Image C: Geoff Thompson, QM Digital Imaging Unit.

to zigzag microridgelets continuous on body whorl, scattered pustules near the sutures otherwise pustulation reduced; base shiny and smooth. Aperture roundly lunate, lip white, expanded and reflected; umbilicus reduced to a lateral crack. Based on 17 measured adults [QMMO79091 (13), QMMO54826 (2), QMMO85256 (2)].

Genitalia. (Fig. 2B) Penis (P) long, tapered with slightly expanded apical bulb, thin sheath (PS) present; internally with a smooth papillate verge (PV), upper walls of penial chamber with 5 straight, fleshy longitudinal pilasters (PPL), medially with a prominent bifurcate longitudinal pilaster and a series of thinner fleshy obliquely oriented pilasters (PP), basally with a series of irregular pustulose pilasters. Epiphallus (E) with relatively long, thick, muscular, curved ascending arm enveloped and partially folded within penial sheath, strongly reflexed and twisted before giving rise to a thinner, relatively short descending arm; epiphallus entering penis through a simple pore (EP) situated terminally on verge. Penial retractor muscle (PRM) inserted at the junction of the two arms of the epiphallus adjacent to an epiphallal caecum (EC). Vas deferens (VD) thin, attached to penial sheath with connective tissue; a long, thick finger-like epiphallal flagellum (EF) present at epiphallus-vas deferens junction, tightly bound to vas deferens. Vagina (V) equal to length of penis. Atrium (Y) simple. Free oviduct (UV) shorter than vagina; bursa copulatrix situated at the base of the albumen gland with a slender stalk (SS); prostate (DG), uterus (UT) and hermaphroditic duct without unusual features. Based on two dissected specimens (QMMO79091).

Distribution. Herein restricted to the Expedition Resource Reserve at the southern edge of the Expedition Range near the Dawson River, SCQ.

Habitat. Vine thicket among eucalypt woodland; living under logs and rocks (Fig. 5A).

Remarks. Conchologically *Pallidelix greenhilli* (Cox 1866) is distinguished by a combination of large shell with weakly elevated spire, sculpture

of prominent oblique to zigzag microridgelets which persist onto the last part of the body whorl and reduced pustulation (Fig. 3A-C). Anatomically the penial pilaster pattern, particularly the prominent medial bifurcate longitudinal pilaster is a structure which readily separates *P. greenhilli* from its congeners all of which lack this feature (Fig. 12A). *P. expeditiana* sp. nov. has a shell with increased pustulation and longitudinal penial pilasters which may anastomose and become obliquely disposed medially before straightening basally.

***Pallidelix lonesome* sp. nov.**
(Figs 4, 6A-C, 12B, 19A)

Etymology. For Lonesome National Park.

Preferred common name. Lonesome Woodland Snail.

Material examined. (All south central Queensland).

Holotype. QMMO85326, Lonesome NP, 25°29'41"S, 148°49'42"E, brigalow woodland/vine thicket, under rocks on ground, coll. C. Eddie, W. McDonald, W. McDonald, 10.vi.1999. Height of shell 30.31mm, diameter 31.19mm, h/d 0.972, whorls 6.375.

Paratypes. QMMO65168, 1A,3SA SC/10A RC, same data as holotype; QMMO79360, 4A RC, NE Injune, Lonesome Holding at south end of Battleship, 25°29'48"S, 148°52'32"E, sevt/*Brachychiton/Ficus*, under sandstone rocks, coll. C. Eddie, W. McDonald, 26.iv.2004; QMMO85467, 13A RC, Injune, 51.8 km NE at Lonesome Holding, Popes Nose scrub, Arcadia Valley, 25°29'37"S, 148°54'31"E, sevt on sandstone ridge slope under logs and dead on ground, coll. C. Eddie, 18.x.2011; QMMO85469, 12A RC, Injune, 46.1 km NE Expediton NP (Lonesome Section), WSW of The Candlesticks, 25°31'01"S, 148°51'12"E, sevt with emergent *Brachychiton /Acacia harpophylla*, gully on slope of sandstone ridge, under and inside logs and dead on ground, coll. C. Eddie, W. McDonald, 26.iv.2004.

Other material examined. QMMO65167, 2A,1SA SC/10A RC, Lonesome NP, Arcadia Valley Rd, 1.6km ME lookout turnoff, 25°29'26"S, 148°48'58"E, brigalow woodland/vine thicket, under rocks, coll. C. Eddie, 27.v.1999; QMMO65337, 6A,2SA RC, Lonesome NP, Arcadia Valley Rd, 1.6km ME lookout turnoff, 25°29'26"S, 148°48'58"E, brigalow woodland/vine thicket, under rocks, coll. C. Eddie, 3.iv.1997; QMMO73014, 3A SC/8A,2SA RC, Injune, NE on hill adjacent to NW corner of Expedition NP, Lonesome Section, 25°28'47"S, 148°49'30"E, sevt/*Brachychiton*, coll. C. Eddie, 20.i.2004; QMMO80651, 3A RC, Injune, 50.3 km NE at Lonesome Holding, Arcadia Valley, 25°30'03.5"S, 148°53'53.3"E, brigalow, under logs and dead on ground, coll.

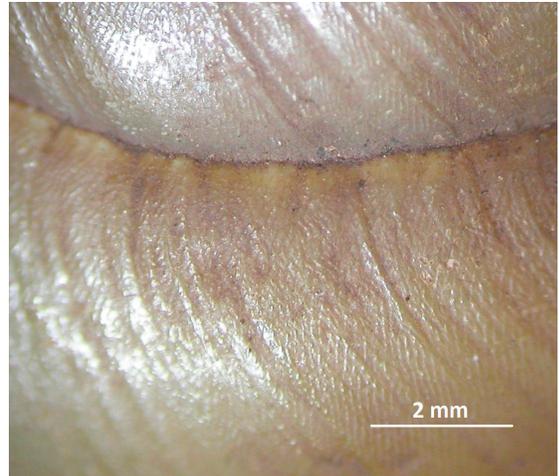


FIG. 4. Teleoconch sculpture in *Pallidelix lonesome* sp. nov., QMMO85326.

C. Eddie, 27.x.2011; QMMO79361, 1A RC, NE Injune, Lonesome Holding at Candlesticks Gully, 25°31'07"S, 148°51'08"E, sevt, under rocks and logs, coll. C. Eddie, W. McDonald, 26.iv.2004; QMMO85260, 2A RC, Injune, 52.1 km NE at Lonesome Holding, Arcadia Valley, 25°28'29"S, 148°53'25"E, brigalow regrowth, under logs, coll. C. Eddie, 29.x.2011; QMMO85263, 6A RC, NE Injune, Lonesome Holding at Candlesticks Gully, 25°31'19"S, 148°50'35.5"E, sevt in gully below sandstone ridge, under rocks and logs, coll. C. Eddie, 22.vii.2009; QMMO85261, 16A,1SA RC, NE Injune, Lonesome Holding at south end of Mt Jiman (=Battleship), 25°29'23"S, 148°52'47"E, sevt with emergent *Flindersia australis* at base of sandstone cliff, under logs and among rocks, coll. C. Eddie, 16.xii.2003; QMMO85472, 8A RC, Injune, 49.5 km NE at Lonesome Holding at south end of The Battleship, Arcadia Valley, 25°29'43"S, 148°52'36"E, sevt/*Brachychiton/Ficus*, steep slope of sandstone ridge, in leaf litter under logs and under/among rocks, coll. C. Eddie, W. McDonald, 26.iv.2004.

Diagnosis. Shell large to very large, globose with an expanded body whorl, yellowish brown to brown, occasionally with a lighter coloured base and generally with a reddish brown subsutural band; teleoconch sculpture consisting of low, crowded, oblique to zigzag microridgelets and weak scattered pustules, reduced on last part of body whorl. Penis with 5-6 fleshy longitudinal pilasters apically becoming thin and corrugated toward the atrium.



FIG. 5. *Pallidelix* habitats. **A**, *P. greenhilli* (Cox, 1866): Expedition Resource Reserve, SCQ; **B**, *P. lonesome* sp. nov.: Lonesome Holdings, SCQ; **C-F**, *P. expeditiana* sp. nov.: **C**, Sunnyholt Stn, SCQ; **D**, Moonah Stn, SCQ; **E**, Nugga Nugga Stn, SCQ; **F**, Fairview Stn, SCQ. Images: C. Eddie.

Description. Shell large to very large, globose, yellowish brown to brown, occasionally with a yellowish base, generally with a reddish brown subsutural colour band; spire moderately elevated, whorls 6.0-6.250 (mean 6.125), evenly rounded to slightly angled below the periphery in some, body whorl expanded, descending rapidly in front (Fig. 6A-C). Height of shell 27.17-31.02 mm (mean 28.80 mm), diameter of shell 29.67-35.53 mm (mean 31.71 mm), h/d 0.804-0.978 (mean 0.907). Protoconch as for genus. Teleoconch sculpture consisting of low, crowded oblique to zigzag microridgelets and weak scattered pustules, reduced on last part of body whorl which sometimes appears smooth; base shiny and smooth. Aperture roundly lunate, lip white, expanded and reflected; umbilicus reduced to a lateral crack. Based on 25 measured adults [QMMO79361 (1), QMMO79360 (4), QMMO65168 (12), QMMO73014 (8)].

Genitalia. Penis (P) long, tapered with slightly expanded apical bulb; thin sheath (PS) present; internally with a smooth papillate verge (PV), upper walls of penial chamber with 5-6 fleshy, relatively thin longitudinal pilasters (PPL), basally with corrugated, thin and straight pilasters (PP) toward the atrium. Epiphallus (E) with relatively long, thick muscular curved ascending arm enveloped and partially folded within penial sheath, strongly reflexed before giving rise to a thinner, relatively short arm; epiphallus entering penis through a simple pore (EP) situated terminally on verge. Penial retractor muscle (PRM) inserted at the junction of the two arms of the epiphallus adjacent to an epiphallal caecum (EC). Vas deferens (VD) thin, attached to penial sheath with connective tissue; a long, thick, finger-like epiphallal flagellum (EF) present at epiphallus-vas deferens junction, weakly bound to vas deferens. Other structures as for genus and without unusual features. Based on three dissected specimens (QMMO65167, QMMO65168, QMMO73014).

Distribution. Lonesome Section, Expedition NP and environs, SCQ.

Habitat. Vine thicket; living under logs and rocks (Fig. 5B).

Remarks. *Pallidelix lonesome* sp. nov. is distinguished by the combination of very large shell with moderately elevated spire and greatly expanded body whorl, teleoconch sculpture of weak, very crowded zigzag microridgelets and scattered pustules on the early whorls, body whorl with reduced sculpture and prominent growth lines (Fig. 4). *P. grandis* sp. nov. has an even more expanded body whorl with an almost smooth last half body whorl. Anatomically *P. lonesome* is distinguished by having 5-6 fleshy, relatively thin, longitudinal penial pilasters apically that become weakly, obliquely disposed medially before giving rise to thin corrugated pilasters basally (Fig. 12B). The simple pilaster arrangement in *P. lonesome* is in contrast to the more complex pattern seen in *P. greenhilli* and *P. expeditiana*. Animal with red mantle.

Pallidelix expeditiana sp. nov.
(Figs 6D-F, 7A, 8, 9A-F, 19B,E,H)

Etymology. For the Expedition Range.

Preferred common name. Expedition Range Woodland Snail.

Material examined. (All south central Queensland).

Holotype. QMMO85324, Expedition Range, summit, 24°38'S, 149°02'E, dense vine thicket, in logs, coll. J. Stanisic, D. Potter, 21.vi.1992. Height of shell 25.46 mm, diameter 29.89mm, h/d 0.852, whorls 5.625.

Paratypes. QMMO44125, 3SC/23A,1SA RC, same data as holotype; QMMO23503, 23SC/33A,16 fragments RC, locality as for holotype, coll. J. Stanisic, D. Potter, J. Chaseling, 23.vi.1989; QMMO85001, 2A SC/ 8A RC, Expedition Range NP, summit on Bauhinia-Rolleston road, 24°37.849'S, 148°00.668'E, sevt, in soil under logs/on ground, coll. J. Stanisic, L. Holcroft, 3.vii.2015.

Other material examined. QMMO85052, 1A SC/1A RC, Nuga Nuga NP, Arcadia valley, north side of Lake Nuga Nuga, 25°17.523'S, 148°56.630'E, sevt, in soil under logs/on ground, coll. J. Stanisic, L. Holcroft, 3.vii.2015; QMMO86512, 1A,1SA RC, Bauhinia, 66.3 km SW at Nugga Nugga Stn, Expedition Ra., 25°05'10"S, 148°56'51"E, brigalow open forest, dead on ground, coll. C. Eddie, A. Harris, 18.viii.2010; QMMO73523, 2A SC/2A RC, Taroom, NW at Mt Aldis, off Mapala-Bauhinia Downs Rd, 24°53'40"S, 149°07'02"E, sevt/*Brachychiton* on basalt, on underside of rocks, coll. C. Eddie, W. McDonald, 1.v.2004; QMMO56193, 3A,2SA RC, NW at Presho SF50, 25°10'38"S, 149°03'25"E, brigalow open forest

- with vine thicket understorey, under logs, coll. C. Eddie, C. James, F. Carter, 10.ix.1995; QMMO56198, 2A RC, NW at Presho SF50, at Zamia Ck, 25°10'23"S, 149°03'20"E, open eucalypt forest, under logs, coll. C. Eddie, C. James, F. Carter, 9.ix.1995; QMMO86503, 8A,1SA RC, Expedition NP, Amphitheatre Section, SE of Cannondale Mtn, 25°14'00"S, 148°59'49"E, sevt, under rocks and logs, coll. C. Eddie, 25.ix.2002; QMMO65308, 1A SC/15A RC, Taroom, NW at Expedition NP, Amphitheatre Section, 25°12'29"S, 148°59'25"E, sevt, in soil under log, coll. C. Eddie, R. Campbell, 26.v.1998; QMMO66566, Taroom, NW at Expedition NP, Amphitheatre Section, 25°11'44"S, 148°02'41"E, open woodland, coll. C. Eddie, S. Peck, 18.iii.1999; QMMO65322, 5A RC, Taroom, NW at Expedition NP, Amphitheatre Section, 25°12'26"S, 148°59'33"E, sevt, dead on ground, coll. C. Eddie, R. Campbell, 28.v.1998; QMMO79362, 9A RC, NW Taroom, Palmgrove NP, at Bakers Gully, 24°58'37"S, 149°17'23"E, sevt, in soil under logs, coll. C. Eddie, W. Mc Donald, 18.viii.2004; QMMO86527, 9A RC, NW Taroom, Palmgrove NP, at Bakers Gully, 24°58'31"S, 149°17'27"E, sevt/*Brachychiton*, among leaf litter/under and inside logs, coll. C. Eddie, W. Mc Donald, 18.viii.2004; QMMO73019, 3A SC/2A RC, NW Taroom, Palmgrove NP, at Middle Ck, 24°59'05"S, 149°13'28"E, sevt/*Brachychiton*, in soil under fallen bark and logs, coll. C. Eddie, 13.xii.2000; QMMO80672, 2A RC, Injune, c. 71.8 km NE at Sunnyholt Stn, Expedition Range, 25°17'31.3"S, 148°56'37.4"E, eucalypt woodland on sandstone plateau, under logs, coll. C. Eddie, D. Chemello, 13.x.2012; QMMO86508, 2A RC, Injune, c. 72.2 km NE at Sunnyholt Stn, Expedition Range, 25°17'11"S, 148°56'39"E, sevt on slope of sandstone ridge, dead on ground, coll. C. Eddie, 12.x.2012; QMMO60870, 4A,2SA RC, Robinson Ck, opp. Lake Murphy, NW Taroom, 25°29'16"S, 149°39'45"E, eucalypt/*Livistona*, under logs, coll. J. Stanisic, G. Ingram, 6.ii.1997; QMMO60868 9A RC, NW Taroom, on Expedition Range Rd, 25°29'37"S, 149°43'30"E, palm/coolabah swamp, under logs, coll. J. Stanisic, G. Ingram, 6.ii.1997; QMMO60796, 2A SC/2A,4SA RC, Taroom, ENE, Cabbage Tree Ck, 25°27'00"S, 150°10'10"E, *Livistona*/eucalypts/*Ficus*, on creek bank under logs, coll. J. Stanisic, G. Ingram, H. Janetzki, 20.vi.1996; QMMO85268, 1A RC, QMMO85269, 1A RC, Taroom, 86.5 km NW at Expedition NP, track on ridgeline W of Old Bore Rd, 25°12'48"S, 149°04'42"E, Ironbark/budgeroo shrubby woodland on sandstone, in soil under log, coll. C. Eddie, F. Carter, 23.ix.2002; QMMO85267, 2A RC, Taroom, 71 km NW at Expedition NP, Shepherds Peak trail, 25°18'46"S, 149°11'31"E, eucalypt woodland, on ground under logs, coll. C. Eddie, F. Carter, 25.ix.2001; QMMO60884, 1A,1SA SC/3A,5SA RC, Taroom, NW on Expedition Range Rd at Glenleigh Stn, sevt, under logs, 25°24'13"S, 149°27'49"E, coll. J. Stanisic, G. Ingram, 5.ii.1997; QMMO44154, 4A SC/6A,7SA RC, c. 58 km NW Taroom, on Glenhaughton Rd, 25°24.49"S, 149°29.17"E, sevt/*Brachychiton*, under logs, coll. J. Stanisic, D. Potter, 23.vi.1992; QMMO79423, 1A SC, NW Taroom, Comely Holding, via Glenhaughton-Mapala Rd, 24°06'51"S, 149°04'00"E, sevt along watercourse, inside log, coll. C. Eddie, W. McDonald, 19.viii.2004; QMMO80667, 8A,3SA RC, Injune, 42.9 km NE at Kentucky Stn, 25°34'20.8"S, 148°52'29.7"E, sevt/steep sandstone ridge slope, dead on ground and in cavities among boulders, coll. C. Eddie, A Harris, 12.v.2010; QMMO80668, 3A,1SA RC, Injune, 46.3 km NE at Kentucky Stn, 25°32'01.9"S, 148°52'39.4"E, sevt/ sandstone ridge slope in narrow valley, dead on ground and in cavities among boulders, coll. C. Eddie, A Harris, 13.v.2010; QMMO80648, 1A,1SA RC, Injune, 42.4 km NE at Kentucky Stn, 25°34'13.7"S, 148°51'52.8"E, eucalypt woodland with sevt understorey, on ground, coll. C. Eddie, A. Harris, 12.v.2010; QMMO73025, 1SA SC, Expedition NP, Beilba Section, 25°35'00"S, 148°58'38"E, under rock, coll. C. Eddie, 12.ix.2001; QMMO80666, 1A SC/1A RC, Injune, 41 km NE at Waddy Brae Stn, 25°38'32.4"S, 148°54'53.7"E, sevt/ sandstone ridge slope, live under rock, coll. C. Eddie, R. Johnson, R. Aisthorpe, E. Mulholland, 31.iii.2015; QMMO65355, 1A SC, NE at Waddy Brae Stn, 25°38'55"S, 148°55'40"E, sevt/edge of cliff above Bottle Tree Gully, coll. C. Eddie, D Johnson, 3.ix.1997; QMMO85446, 2A RC, Injune, 43.8 km NE at Waddy Brae Stn, 25°36'07.5"S, 148°54'52.7"E, sevt/sandstone gorge, dead on ground, coll. R. Aisthorpe, A. Bendall, 14.ix.2015; QMMO80649, 2A RC, Injune, 51 km ENE at Fairview Holding, 25°40'04"S, 149°02'24"E, eucalypt woodland with sevt understorey, in litter among fig roots and boulders, coll. C. Eddie, A. Bendall, 18.xii.2013; QMMO80650, 1A RC, Injune, 50.5 km NE at Fairview Holding, 25°35'25"S, 148°59'10"E, eucalypt woodland, dead on ground beside boulders, coll. C. Eddie, 11.iv.2012; QMMO85290, 9A/1SA RC, Injune, 46.4 km NE at Fairview Holding, 25°39'10.7"S, 148°58'48.4"E, sevt on sandstone slope, dead on ground and under/among rocks, coll. C. Eddie, 19.vi.2006; QMMO85296, 4A SC/2A RC, Injune, 46.2 km NE at Fairview Holding, 25°38'45.3"S, 148°58'28.3"E, sevt on sandstone slope, inside logs and under rocks, coll. C. Eddie, A. Bendall, 14.vii.2015; QMMO80653, 16A RC, Injune, 51.4 km E at Springwater Stn, 25°40'45.7"S, 149°02'48.7"E, sevt on sandstone ridge slope, dead on ground and under rocks, coll. C. Eddie, 21.vi.2011; QMMO80652, 16A RC, Injune, 44.6 km E at Springwater Stn, 25°43'15.6"S, 148°59'32.7"E, sevt on sandstone ridge slope, dead on ground and under rocks, coll. C. Eddie, 17.v.2011; QMMO86522, 3A,2SA RC, Injune, 41.9 km E at Springwater Stn, 25°42'04.4"S, 148°57'14.6"E, sevt on sandstone ridge slope, dead on ground and under rocks/on top of fallen tree, coll. C. Eddie, 12.v.2011; QMMO86519, 8A,3SA RC, Injune c. 31.1 km WNW at Oakwells Stn, 25°44'58"S, 148°16'35"E, sevt on scree/steep basalt ridge slope, under and among rocks, coll. C. Eddie, B. Cosh, 5.iv.2001; QMMO86520, 7A,4SA RC, Injune c. 29.9 km WNW at Oakwells Stn, 25°45'04"S, 148°17'12"E,

sevt with emergent *Brachychiton* on scree/basalt ridge slope, under and among rocks, coll. C. Eddie, B. Cosh, 5.iv.2001; QMMO86521, 3A,1SA RC, Injune c. 30.2 km WNW at at Oakwells Stn, 25°44'56"S, 148°17'02"E, sevt /basalt ridge slope, under and among rocks, coll. C. Eddie, B. Cosh, 5.iv.2001; QMMO71473, 1A RC, Injune c. 29.9 km WNW at at Oakwells Stn, 25°45'S, 148°17'E, sevt, alt. 800 m, coll. G. Monteith, D. Cook, 7.iii.2002; QMMO73521, 1A RC, Injune at Crowman Stn, 25°51'21"S, 148°16'22"E, sevt with *Brachychiton* on basalt scree, on underside of rock. Coll. C. Eddie, W McDonald, 25.iv.2004; QMMO85473, 5A,1SA RC, Injune c. 29.5 km W at Crowman Stn, 25°50'15.5"S, 148°16'25.9"E, sevt with emergent *Casuarina* /NE facing basalt ridge slope, in leaf litter among rocks, coll. C. Eddie, W. McDonald, 25.iv.2004; QMMO80669, 4A,1SA RC, Injune c. 25.5 km W at Cobbadah Stn, 25°50'28"S, 148°18'50"E, sevt on basalt scree slope, in leaf litter around fig roots and among rocks, coll. C. Eddie, 10.ix.2009; QMMO80658, 4A,1SA RC, Injune c. 25.5 km W at Cobbadah Stn in Mt Hutton Range, 25°50'12"S, 148°19'53"E, eucalypt woodland with sevt understorey/steep basalt ridge slope, coll. C. Eddie, 11.ix.2009.

Other material. Mt Aldis: QMMO85484, 1A RC; QMMO79421, 1A RC. NW Taroom, beside Robinson Ck: QMMO65431, 3A SC/2A RC; QMMO65441, 2A,1SA SC/1A RC; QMMO65445, 1A SC/1A RC; QMMO65435, 4A,1SA RC. NW Taroom, at Lake Murphy: QMMO60791, 1SA SC/1A,5SA RC; QMMO79446, 1SA RC. NW Taroom at Glenhaughton Stn: QMMO86539, 1A SC. NW Taroom at Palmgrove NP: QMMO85276, 2A RC; QMMO85275, 1A RC; QMMO52517, 6A RC; QMMO86529, 1A,1SA RC; QMMO85273, 3A,1SA RC; QMMO73315, 3A RC; QMMO66572, 3A RC; QMMO66565, 1A SC. Injune E at Fairview Stn: QMMO85294, 3A RC. Injune E at Springwater Stn: QMMO80665, 1A RC; QMMO85288, 4A,1SA RC; QMMO85285, 2A RC; QMMO85286, 3A,1SA RC. Expedition NP, Amphitheatre Section: QMMO73028, 1A SC; QMMO65298, 1SA SC; QMMO65308, 1SA SC; QMMO67035, 2A RC; QMMO65310, 2A SC/6A,1SA RC; QMMO86504, 5A RC; QMMO86506, 1A RC; QMMO85270, 2A RC; QMMO66570, 1A RC; QMMO85271, 1SA RC; QMMO86507, 1SA RC; QMMO65289; Injune WNW at Oakwells Stn: QMMO66508, 1A,4SA RC; Injune W at Crowman Stn: QMMO85475, 2A,1SA RC.

Diagnosis. Shell large, subglobose, brown to dark brown spire, occasionally with a pinkish tinge and generally with a reddish brown subsutural band, yellowish-brown to brown base; teleoconch sculpture consisting of oblique to zigzag irregular microridgelets and coarse scattered pustules on the early whorls, pustules becoming more pronounced on the penultimate and body whorls. Upper walls of penial chamber with 4-5

thick, simple and occasionally anastomosing, fleshy longitudinal pilasters (PPL) that become obliquely disposed medially before straightening basally.

Description. Shell large, subglobose, brown to dark brown spire, occasionally with a pinkish tinge, weak reddish brown subsutural band present, sometimes absent, yellowish-brown to brown base, spire moderately elevated; whorls 5.5-6.0 (mean 5.625), evenly rounded the last descending rapidly in front (Fig. 6D-F). Height of shell 18.31-25.20 mm (mean 21.71 mm), diameter 24.10-29.64 mm (mean 26.61 mm), h/d 0.750-0.904 (mean 0.830). Protoconch as for genus. Teleoconch sculpture consisting of oblique to zigzag irregular microridgelets and coarse scattered pustules on the early whorls, pustules becoming more pronounced on the penultimate and body whorls (Fig. 7A); base shiny and smooth. Aperture roundly lunate with a pink interior, lip white, expanded and reflected; umbilicus reduced to a lateral crack. Based on 56 measured adults [QMMO86527 (9), QMMO85052 (1), QMMO79362 (9), QMMO65308 (14), QMMO44125 (23)].

Genitalia. (Fig. 8) Penis (P) long, tapered with slightly expanded apical bulb; thin sheath (PS) present; internally with a smooth papillate verge (PV), upper walls of penial chamber with 4-5 thick, simple and anastomosing, fleshy longitudinal pilasters (PPL) that become thinner, obliquely disposed medially before straightening basally (PP) (Fig. 9A). Epiphallus (E) with relatively long, thick muscular curved ascending arm enveloped and partially folded within penial sheath, strongly reflexed and slightly twisted before giving rise to a thinner, relatively short arm; epiphallus entering penis through a simple pore (EP) situated terminally on verge. Penial retractor muscle (PRM) inserted at the fold of the two arms of the epiphallus adjacent to an epiphallallic caecum (EC). Vas deferens (VD) thin, attached to penial sheath with connective tissue; a relatively long, thick, finger-like epiphallallic flagellum (EF) present at epiphallus-vas deferens junction, bound to vas deferens. Vagina (V) equal to length of penis. Atrium (Y) simple. Free oviduct (UV) shorter than vagina; bursa copulatrix (S) simple, situated

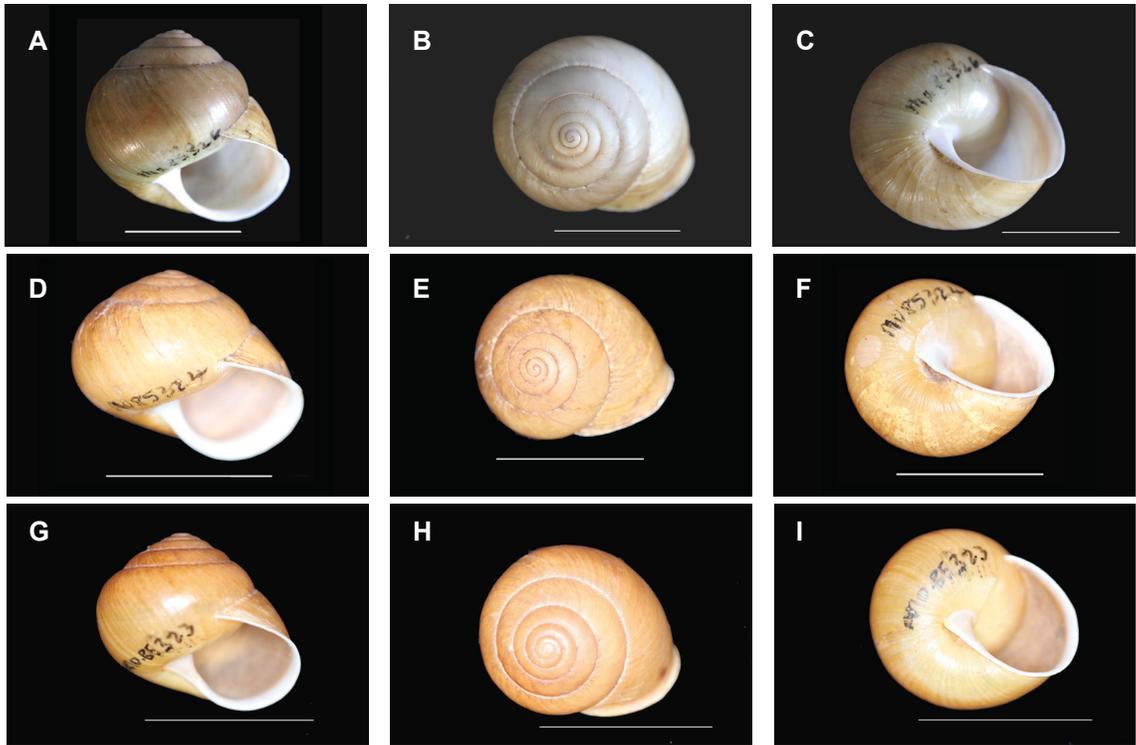


FIG.6. *Pallidelix* holotypes. A-C, *P. lonesome* sp. nov., QMMO85326; D-F, *P. expeditiana* sp. nov., QMMO85324; G-I, *P. potteri* sp. nov., QMMO85323. Scale bars = 20 mm.

at the base of the albumen gland (GG) with a slender stalk (SS); prostate (DG), uterus (UT) and hermaphroditic duct (GD) without unusual features. Based on five dissected specimens (QMMO44125, QMMO79417, QMMO66566, QMMO60796, QMMO80666).

Distribution. Expedition Range NP, including Palmgrove NP and Nuga Nuga NP but excluding the Lonesome Section and Expedition Resource Reserve, SCQ. Possible outliers in the Great Dividing Range, west of Injune, SCQ.

Habitat. Vine thickets; living under and inside logs (Fig. 5C-F).

Remarks. *Pallidelix expeditiana* sp. nov. is the most widespread of the species covered in this revision and inhabits a large area of the Expedition Range from east of Injune and north-west of Taroom to the summit of the range on

the Dawson Highway (Bauhinia-Rolleston Road). The penial pilaster configuration of 4-5 thick, apical, fleshy longitudinal pilasters that sometimes anastomose and become thin and slightly oblique medially before straightening toward the atrium, coupled with the pattern of zigzag irregular microridgelets and coarse scattered pustules on the early whorls with pustules becoming more pronounced on the penultimate and body whorls are considered key distinguishing features (FIGS 7A, 9A). Molecular studies may yet prove otherwise. *P. expeditiana* is distinguished from *P. greenhilli* (Cox, 1866) by the coarser telecoconch sculpture and less complex penial pilaster pattern.

The populations of *P. expeditiana* occur in scattered patches of vine thicket of variable quality ranging from relatively dense bottle tree scrubs to drier vine dominated scrub. Rainfall in the Expedition Range is locally variable

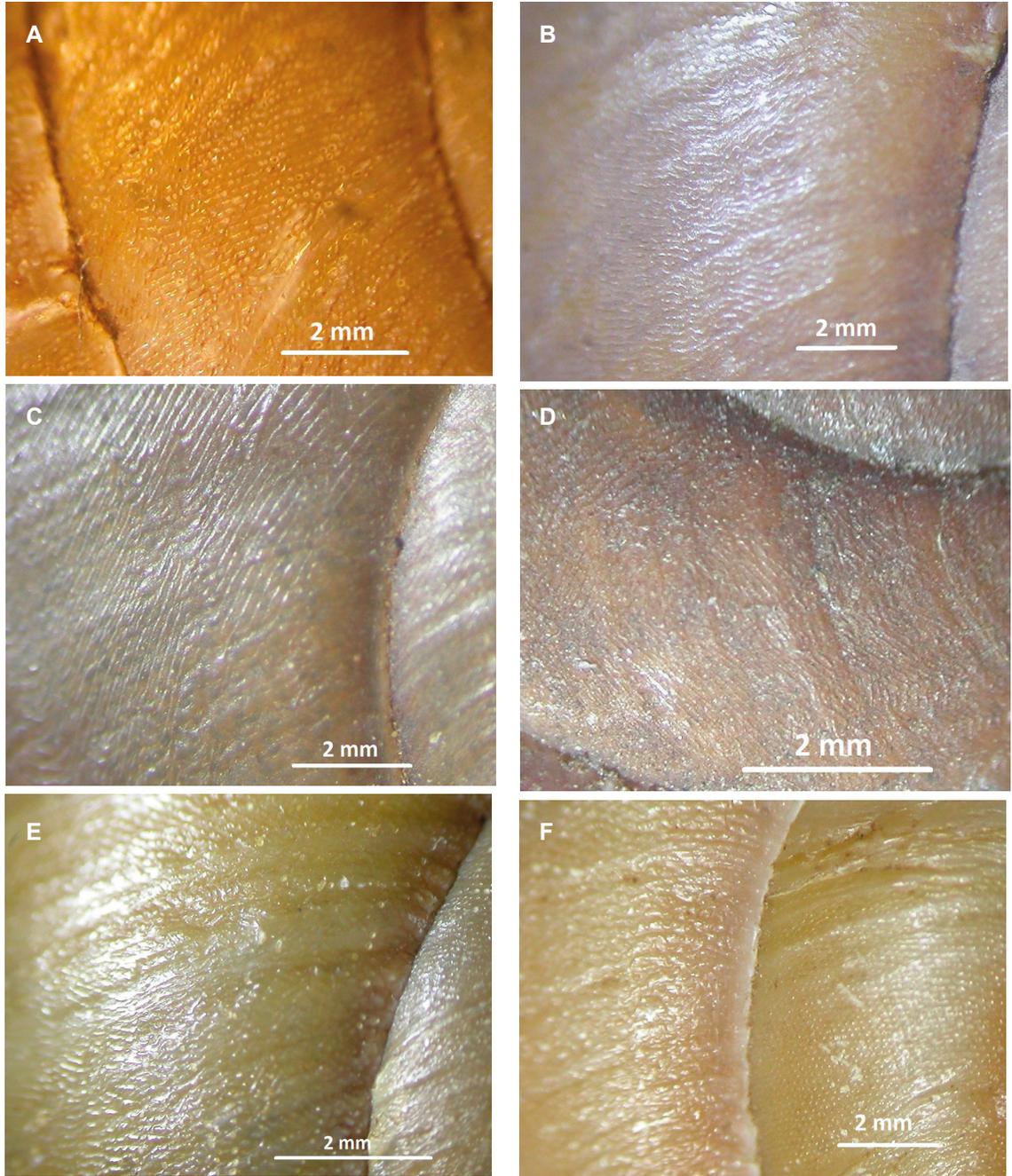


FIG. 7. *Pallidelix* shell sculpture. **A**, *P. expeditana* sp. nov., QMMO44125; **B**, *P. potteri* sp. nov., QMMO46301; **C**, *P. staricki* sp. nov., QMMO79085; **D**, *P. lambkinae* sp. nov., QMMO73020; **E**, *P. moffatt* sp. nov., QMMO85048; **F**, *P. minerva* sp. nov., QMMO56625.

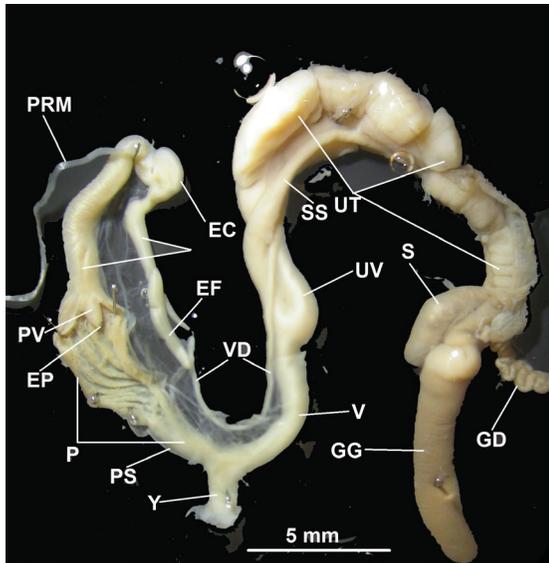


FIG. 8. Genitalia, *Pallidelix expeditiana* sp. nov., Palmgrove NP, SCQ, QMMO79147.

reflecting topography and not surprisingly the shells exhibit significant size differences across the species' range. Largest specimens come from the northern part of the range (summit) with the smallest being the more southwestern Amphitheatre populations. Dissection of limited adult material across the species' range showed some variability in penial pilaster pattern that may indicate incipient speciation in isolated and distant populations (Fig. 9B-F). Molecular studies based on a wider range of material may be needed to fully resolve the integrity of this species. Animal with red mantle.

Specimens from Oakwells, Crowman and Cobbadah Stations (localities in the Great Dividing Range and to the west of the Expedition Range) are included in *P. expeditiana* on the basis of shared conchological features (teleoconch with oblique to zigzag microridgelets and prominent pustules) in the absence of spirit material for study of reproductive structures.

Pallidelix potteri sp. nov.
(Figs 6G-I, 7B, 12C, 19C)

Etymology. For Darryl Potter, Collection Manager for Molluscs, Queensland Museum.

Preferred common name. Potter's Woodland Snail.

Material examined. (All mid-central Queensland).

Holotype. QMMO85323, banks of Charlevue Ck, on Blackdown Tableland Rd, 23°39.5'S, 149°09.4'E, vine thicket, inside logs and trees, coll. J. Stanisic, D. Potter, 20.vi.1992. Height of shell 25.27 mm, diameter 28.13 mm, h/d 0.898, whorls 6.125.

Paratypes. QMMO44111, 7SC/2RC, same data as holotype; QMMO46301, 3SC/2RC, Charlevue Ck, on Blackdown Tblnd Rd, 23°39.5'S, 149°09.4'E, riverine thicket, in logs, coll. J. Stanisic, D. Potter, 17.v.1993.

Other material examined. QMMO64443, 1SA RC, Blackdown Tblnd NP, Rainbow Falls walk, 23°49'S, 149°05'E, C. Hoskins, 11.i.1998; QMMO23486 3A/3SA RC, 1SA SC, c.3.9 km along loop road from southern turnoff, Blackdown Tblnd NP, 23°48'S, 149°01'E, tall moist eucalypt forest, on ground, coll. J. Stanisic, D. Potter, J. Chaseling, 24.vi.1989; QMMO23496 1SA RC/1A 11SA SC, Blackdown Tblnd Rd, c.11.4 km SW Capricorn Hwy, 23°39'S, 149°09'E, remnant thicket, under and in logs, coll. J. Stanisic, D. Potter, J. Chaseling, 24.vi.1989; QMMO9974, 1SA SC/1A RC, Blackdown Tblnd, ca 150 km W of Rockhampton, 23°39'S, 149°09'E, open forest on sandstone, coll. R Raven, G. Monteith, 6.ii.1981; QMMO44102, 2A/5SA RC, slopes of peak, c.11.7 km E of Comet, Comet-Blackwater Rd, 23°36'S, 148°39.5'E, vine thicket, under logs in soil, coll. J. Stanisic, D. Potter, 20.vi.1992.

Diagnosis. Shell medium-sized to large, subglobose, dark brown spire with shiny, demarcated yellowish green base; upper surface of teleoconch with very fine and dense pustules on early whorls, prominent oblique to zigzag microridgelets and reduced pustules on the latter whorls, microridgelets becoming more pronounced on the body whorl. Upper walls of penial chamber with 6-7 thick, simple and straight, fleshy longitudinal pilasters (PPL) becoming obliquely disposed medially and thinner basally.

Description. Shell medium-sized to large, subglobose, dull, dark brown spire with shiny, demarcated yellowish green base; spire moderately elevated, whorls 5.125-5.875 mm (mean 5.500 mm), evenly rounded, the last descending rapidly in front (Fig. 6G-I). Height of shell 17.59-23.52 mm (mean 20.22 mm), diameter 21.18-26.10 mm (mean 24.51 mm), h/d 0.770-0.903 (mean 0.824). Protoconch as for genus. Teleoconch with very fine and dense pustules on early whorls, prominent oblique to zigzag

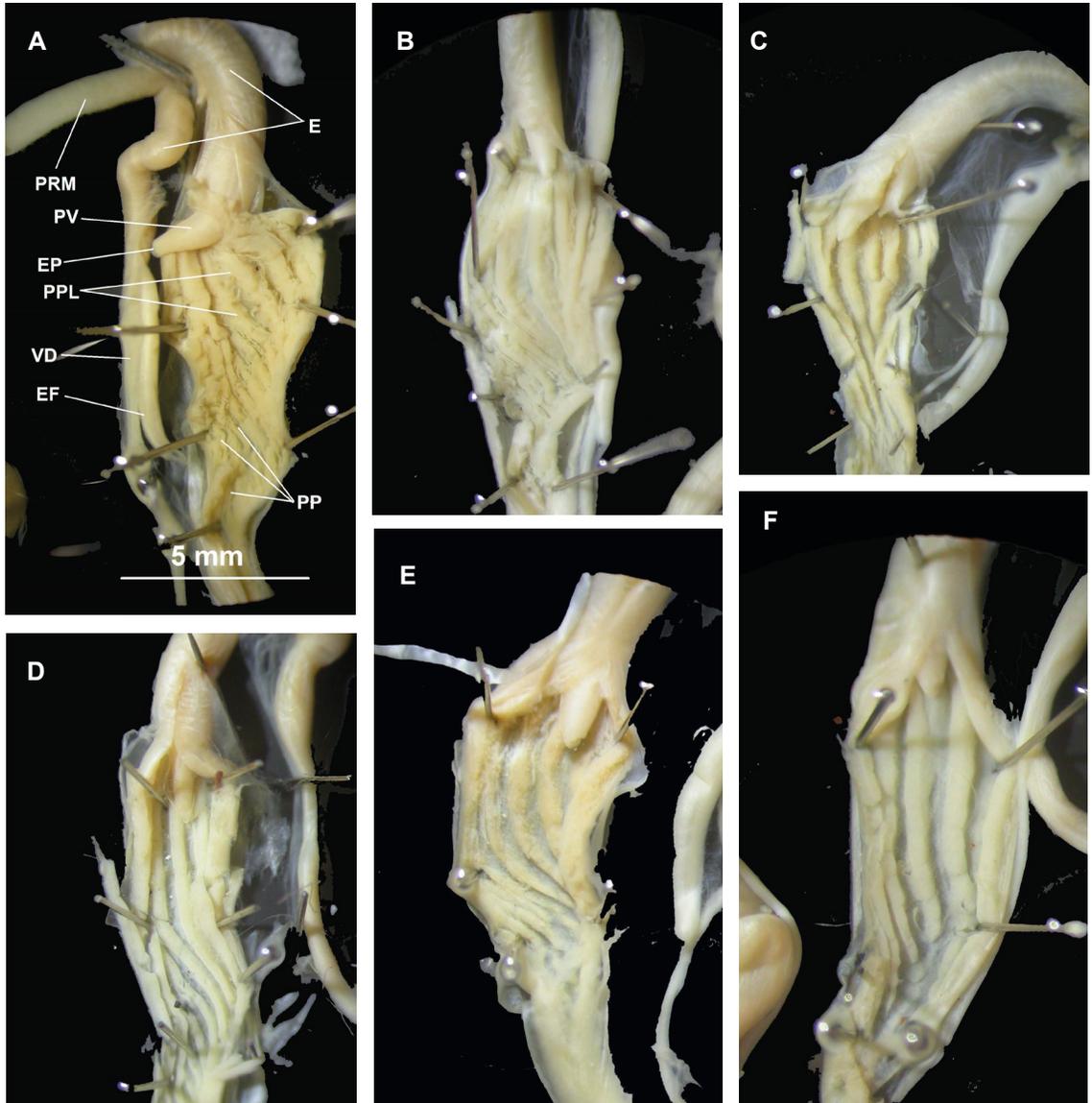


FIG. 9. Penial pilaster patterns in populations of *Pallidelix expeditana* sp. nov. **A**, Summit, Expedition Ra., QMMO44125; **B**, Waddy Brae Stn, QMMO80666; **C**, Cabbage Tree Ck, QMMO60796; **D**, Amphitheatre, QMMO66566; **E**, Palmgrove NP, QMMO79147; **F**, Fairview Stn, QMMO85181. All SCQ. Scale of images B-F as for A.

microridgelets and reduced pustules on the latter whorls, microridgelets becoming more pronounced on the penultimate and body whorls (Fig. 12C); base shiny and smooth. Aperture roundly lunate, lip white, expanded and reflected;

umbilicus reduced to a lateral crack. Based on 8 measured adults [QMMO44111 (2), QMMO46301 (2), QMMO9974 (1), QMMO23486 (3)].

Genitalia. Penis (P) long, tapered with slightly expanded apical bulb; thin sheath (PS) present;

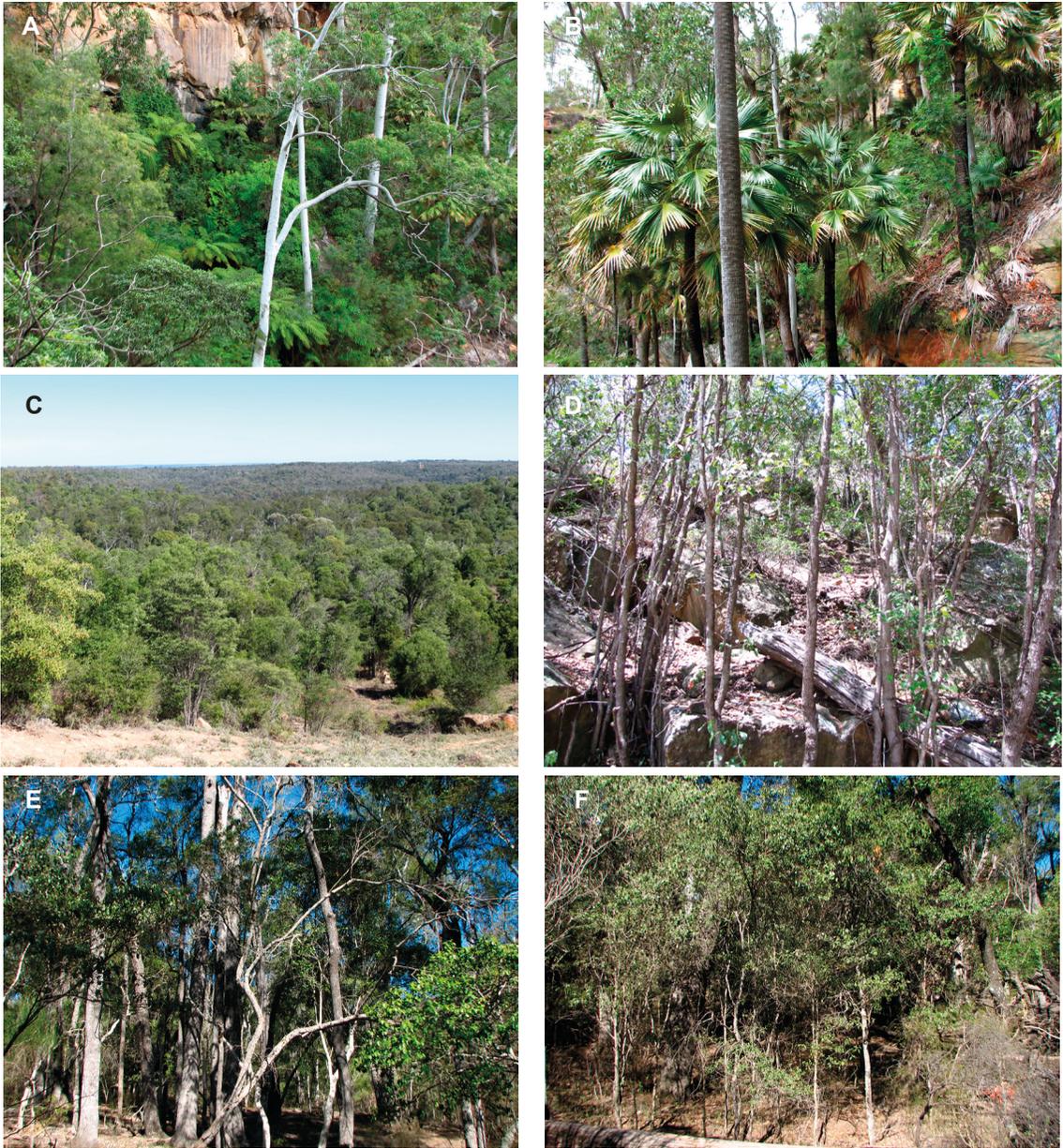


FIG. 10. *Pallidelix* habitats. **A-B**, *P. potteri* sp. nov: Blackdown Tableland, MCQ; **C-D**, *P. staricki* sp. nov: Nuggett Hills, SCQ; **E-F**, *P. lambkinae* sp. nov: Stones Country Resource Reserve, SCQ. Images: C. Eddie.

internally with a smooth papillate verge (PV), upper walls of penial chamber with 6-7 thick, simple and straight, fleshy longitudinal pilasters (PPL) that become obliquely disposed medially and thinner basally (PP) (Fig. 7B). Epiphallus (E) with relatively long, thick muscular curved ascending arm enveloped and partially folded within penial sheath, strongly reflexed and slightly coiled before giving rise to a thinner, relatively short arm; epiphallus entering penis through a simple pore (EP) situated terminally on verge. Penial retractor muscle inserted at the fold of the two arms of the epiphallus adjacent to an epiphallallic caecum (EC). Vas deferens (VD) thin, attached to penial sheath with connective tissue; a relatively long, thick epiphallallic flagellum (EF) present at epiphallus-vas deferens junction, bound to vas deferens. Other structures as for genus and without unusual features. Based on two dissected specimens [(QMMO46301 (1), QMMO23496 (1))].

Distribution. Blackdown Tableland and surrounding areas to the north, MCQ.

Habitat. Moist eucalypt/palm forest and vine thicket; living under and inside logs (Fig. 10A, B).

Remarks. *Pallidelix potteri* sp. nov. differs from *P. expeditiana* sp. nov. by the combination of teleoconch with fine pustulations and very prominent microridgelets (Fig. 7B) and penial chamber with 6-7 well defined, thick, straight and simple, apical longitudinal pilasters (Fig. 12C). In contrast *P. expeditiana* has a teleoconch with much coarser microridgelets and pustulation (Fig. 7A), and a penial chamber with 4-5, sometimes anastomosing, apical pilasters (Fig. 9A).

Pallidelix potteri sp. nov. occurs at the convergence of three sandstone ranges that form Blackdown Tableland, and the adjacent plains to the north. Much of the landscape on the plains has been transformed into farming and grazing land that has reduced areas of natural vegetation significantly. In spite of this *P. potteri* has managed to survive in thicket long drainage lines such as Charlevue Creek and in other remnant patches of vine thicket (peak E

of Comet). However, the relatively untouched Blackdown Tableland remains the core area for the species where it lives in wet eucalypt and palm forest. Animal with reddish mantle.

Pallidelix staricki sp. nov.
(Figs 7C, 11A-C, 12D, 19G)

Etymology. For entomologist Noel Starick.

Preferred common name. Starick's Woodland Snail.

Material examined. (All south central Queensland).

Holotype. QMMO86538, Roma, c. 75 km NE at Spring Gully Stn, 25°56'08"S, 149°03'23"E, sevt in sandstone gully, under logs and rocks, coll. C. Eddie, 15.v.2009. Height of shell 17.83 mm, diameter 23.91 mm, h/d 0.746, whorls 5.375.

Paratypes. QMMO86516, 5A,1SA RC, same data as holotype; QMMO79085, 1A SC/5A,4SA RC, Spring Gully, c. 76.1 km NE of Roma, 25°56'07"S, 149°03'23"E, woodland, under rocks and logs, coll. C. Eddie, 15.v.2009.

Other material examined. QMMO85465, 11A,12SA RC, Injune, 55.7 km E at Nuggett Hills Stn, 25°56'53.7"S, 149°06'40.1"E, sevt/sandstone ridge slope, in leaf litter among rocks/under logs, coll. C. Eddie, 5.viii.2016; QMMO80670, 26A,6SA RC, Injune, 55 km E at Nuggett Hills Stn, 25°57'21.1"S, 149°06'15.5"E, sevt in gully between sandstone ridge, dead on ground and under rocks/logs, coll. C. Eddie, A. Bendall, 16.i.2014; QMMO85257, 2A RC, 60.3 km E at Nuggett Hills Stn, beside Eurombah Ck, 25°59'03"S, 149°08'55"E, eucalypt woodland with sevt understorey/sandstone, in leaf litter among rocks/boulders, coll. C. Eddie, 2.i.2017; QMMO80664, 1A,4SA RC, Injune 43.7 km ESE at Scotts Creek Stn, 25°53'37"S, 149°00'01"E, sevt in gully/sandstone, under rocks and at bases of trees, coll. C. Eddie, 26.v.2009; QMMO86518, 2A,3SA RC, Injune c. 64.4 km ESE at Strathblane Stn, Knob Paddock, 25°54'39"S, 149°12'23"E, sevt at head of gully along sandstone range, in leaf litter among rocks and logs. Coll. C. Eddie, 4.vii.2008.

Diagnosis. Shell large, subglobose, dark brown spire with yellowish green base and a weak reddish brown subsutural band; teleoconch with prominent, crowded, oblique to zigzag microridgelets, persisting on the last part of the body whorl and very weak pustulation. Upper walls of penial chamber with 4 thick, fleshy longitudinal pilasters extending to the atrium.

Description. Shell large, subglobose, dark brown spire with a yellowish green base and a reddish brown subsutural band, spire moderately

elevated, whorls 5.125-6.0 mm (mean 5.500) evenly rounded the last descending rapidly in front (Fig. 11A-C). Height of shell 16.19-23.89 mm (mean 19.01 mm), diameter 22.34-28.52 mm (mean 24.55 mm), h/d 0.725-0.840 (mean 0.773). Protoconch as for genus. Teleoconch with prominent and crowded, oblique to zigzag microridgelets persisting on the last part of the body whorl, pustules barely visible (Fig. 7C); base shiny and smooth. Aperture roundly lunate, lip white, expanded and reflected; umbilicus reduced to a lateral crack. Based on 35 measured adults [QMMO86516 (5), QMMO79085 (4), QMMO80670 (26)].

Genitalia. Penis (P) tapered with thin sheath (PS); internally with a smooth papillate verge (PV), upper walls of penial chamber with 4 thick, fleshy longitudinal pilasters (PPL) extending to the atrium (Fig. 12D). Epiphallus (E) with relatively long, thick muscular curved ascending arm enveloped and partially folded within penial sheath, strongly reflexed and slightly twisted before giving rise to a thinner, relatively short arm; epiphallus entering penis through a simple pore (EP) situated terminally on verge. Penial retractor muscle inserted at the fold of the two arms of the epiphallus adjacent to an epiphallal caecum. Vas deferens (VD) thin, attached to penial sheath with connective tissue; a relatively short, thick finger-like epiphallal flagellum (EF) present at epiphallus-vas deferens junction, bound to vas deferens. Other structures as for genus and without unusual features. Based on one dissected specimen (QMMO79085).

Distribution. Spring Gully and Nuggett Hills Stations and environs, SCQ.

Habitat. Vine thicket; living under rocks and logs (Fig. 10C, D).

Remarks. *Pallidelix staricki* sp. nov. differs from *P. expeditiana* sp. nov. in having a teleoconch with very prominent, oblique to zigzag microridgelets and very reduced pustulation (Fig. 7C), and a penial chamber that has fewer straight longitudinal pilasters extending to the atrium (Fig. 12D). In contrast, the shell of *P. expeditiana* has scattered fine to coarse pustulation with

weaker microridgelets (Fig. 7A) and a penis with 4-5 apical longitudinal penial pilasters that become obliquely disposed medially before straightening basally (Fig. 9A). In the absence of material for dissection, specimens other than those from Spring Gully Stn are included here on the basis of general conchological similarity and geographic proximity. Their status will need to be confirmed either by reproductive morphology or molecular studies. Animal with bright red mantle.

Pallidelix lambkinae sp. nov.
(Figs 7D, 11D-F, 12E, 13, 19F)

Etymology. For Queensland Museum entomologist Christine Lambkin.

Preferred common name. Lambkin's Woodland Snail.

Material examined. (All south central Queensland).

Holotype. QMMO86523, Miles, 42.5km NW at Stones Country Resource Reserve, 26°23'23"S, 149°52'47"E, sevt, inside log, coll. C. Eddie, 22.x.2016. Height of shell 20.48 mm, diameter 26.75 mm, h/d 0.898, whorls 5.625. [animal SC].

Paratypes. QMMO79086, 3A SC/5A, 1SA RC, at Stones Country Resource Reserve via Gurulmundi Rd, c.42.5km NW of Miles, 26°23'21"S, 149°52'56"E, sevt/ooline/figs, inside log, coll. C. Eddie, 28.viii.2009; QMMO73020, 2A SC/1A RC, Miles, NW at Stones Country Resource Reserve, 26°23'24"S, 149°52'50"E, sevt, under logs, coll. C. Eddie, 30.vi.2003; QMMO79453, 2A RC, Stones Country Resource Reserve, Gurulmundi, 26°23'24"S, 149°52'50"E, sevt/ooline, under logs, coll. C. Eddie, 30.vi.2003; QMMO56194, 3A, 1SA RC, Miles, NW at Gurulmundi SF, 26°23'35"S, 149°53'18"E, sevt, on ground, coll. C. Eddie, 11.ix.1995; QMMO79123, 8A, 8SA RC, Gurulmundi SF, c. 40.4 km NW of Miles, 26°23'49"S, 149°54'25"E, sevt, coll. S. Bell, 13.ix.2009.

Other material examined. QMMO79147, 1A SC/6SA RC, Miles, c.44.7 km NW, 26°23'34"S, 149°54'25"E, woodland, under logs, coll. G. Jones, 27.viii.2009; QMMO79220, 3A SC/1A, 3SA RC, Miles, c.44.3 km NW, 26°23'56"S, 149°50'25"E, woodland, under logs, coll. G. Jones, 27.viii.2009; QMMO79080, 2A, 5SA SC/1A, 1SA RC, Miles, c.43.9 km NW, 26°23'42"S, 149°51'15"E, , under logs, coll. G. Jones, 27.viii.2009; QMMO79213, 1A SC/3SA RC, Miles, c.42.5 km NW, 26°24'30"S, 149°51'19"E, , ironbark woodland, under logs, coll. G. Jones, 25.viii.2009

Diagnosis. Shell medium-sized (10-20 mm) to large, subglobose, dark brown spire with yellowish green base and a weak reddish brown subsutural band, teleoconch with prominent

crowded, oblique to zigzag microridgelets persisting on the last part of the body whorl with very reduced pustulation. Penis with 4-5 thick, fleshy longitudinal pilasters apically becoming thin near the atrium.

Description. Shell medium sized to large, subglobose, dark brown spire with yellowish green base and a weak reddish brown subsutural band, spire moderately elevated, whorls 5.375-5.750 (mean 5.500) evenly rounded the last descending rapidly in front (Fig. 11D-F). Height of shell 18.22-21.89 mm (mean 20.05 mm), diameter 23.93-29.18 mm (mean 26.40 mm), h/d 0.717-0.785 (mean 0.759). Protoconch as for genus. Teleoconch with prominent, crowded oblique to zigzag microridgelets persisting on the last part of the body whorl, pustules barely visible (Fig. 7D); base shiny and smooth. Aperture roundly lunate, lip white, expanded and reflected; umbilicus reduced to a lateral crack. Based on 15 measured adults [QMMO73020 (1), QMMO79086 (1), QMMO79453 (2), QMMO56194 (3), QMMO79123 (8)].

Genitalia. (Fig. 13) Penis (P) long, tapered with thin sheath (PS); internally with a smooth papillate verge (PV), upper walls of penial chamber with 5-6 thick, longitudinal pilasters (PPL) occupying top half of the penial chamber, becoming thin near the atrium (PP), background pattern of fine pustules (Fig. 12E). Epiphallus (E) with relatively long, thick muscular curved ascending arm enveloped and partially folded within penial sheath, strongly reflexed and slightly coiled before giving rise to a thinner, relatively short arm; epiphallus entering penis through a simple pore (EP) situated terminally on verge. Penial retractor muscle inserted at the fold of the two arms of the epiphallus adjacent to an epiphallic caecum. Vas deferens (VD) thin, attached to penial sheath with connective tissue; a relatively short, thick finger-like epiphallic flagellum (EF) present at epiphallus-vas deferens junction, bound to vas deferens. Vagina (V) equal to length of penis. Atrium (Y) simple. Free oviduct (UV) shorter than vagina; bursa copulatrix (S) simple, situated at the base of the albumen gland (GG) with a slender stalk (SS); prostate (DG), uterus (UT) and hermaphroditic duct (GD) without unusual

features. Based on two dissected specimens (QMMO73020, QMMO86523).

Distribution. Gurulmundi State Forest and environs, SCQ.

Habitat. Vine thicket; living under logs (Fig. 10E-F).

Remarks. *Pallidelix lambkinae* sp. nov. is most similar to *P. staricki* sp. nov. in having a teleoconch with very prominent oblique to zigzag microridgelets and very reduced pustulation (Fig. 7D). However, the pattern of microridgelet sculpture in *P. lambkinae* is coarser than that of *P. staricki* (Fig. 7C). Internally the penis has a greater number of straight longitudinal pilasters and a pustular background (cf. Fig. 12D, E). *P. lambkinae* is only known from the vine thickets of the Gurulmundi SF and is the most southerly species of the genus. Animal with bright red mantle.

Pallidelix moffatt sp. nov.
(Figs 7E, 11G-I, 12F)

Preferred common name. Mt Moffatt Woodland Snail.

Material examined. (All south central Queensland).

Holotype. QMMO86537, Carnarvon NP, Mt Moffatt Section, Top Shelter Shed, 24°54'50.6"S, 148°01'32.4"E, burnt eucalypt woodland, under rocks and logs, coll. J. Stanisic, L. Holcroft, 24.ix.2012. Height of shell 22.61 mm, diameter 26.80 mm, h/d 0.844, whorls 5.5.

Paratypes. QMMO80702, 7A RC, Carnarvon NP, Mt Moffatt Section, Top Shelter Shed, 24°54'50.6"S, 148°01'32.4"E, burnt eucalypt woodland, under rocks and logs, coll. J. Stanisic, L. Holcroft, 24.ix.2012; QMMO85048, 1A, 1SA SC/22A, 1SA RC, Carnarvon NP, Mt Moffatt Section, Rotary Shelter Shed, 24°54'36.6"S, 148°02'28.6"E, burnt eucalypt woodland, under rocks and logs, coll. J. Stanisic, L. Holcroft, 24.ix.2012.

Other material examined. QMMO66455, 1A RC, Carnarvon NP, Mt Moffatt Section, Racecourse Spring, 24°56'00"S, 148°05'43"E, remnant vine thicket on basalt scree, dead among rocks and under logs, coll. C. Eddie, 22.i.2004; QMMO66499, 1A RC, Carnarvon NP, Mt Moffatt Section, E slope of Mt Moffatt below summit, 25°03'30"S, 148°02'47"E, semi-evergreen vine thicket on basalt, coll. C. Eddie, 4.ix.1999; QMMO85483, 5A RC, Carnarvon NP, Mt Moffatt Section, NE Marlong Plain, 24°55'47"S, 147°58'25"E, sev't/*Brachychiton* in sandstone gully, dead among rocks and under logs, coll. C. Eddie, 22.vii.2004; QMMO23542,

1A,15SA, SC/ 3SA RC, Carnarvon NP, Mt Moffatt Section, head of Carnarvon Ck, 24°57'S, 148°05'E, open woodland, under timber, coll. J. Stanisic, D. Potter, J. Chaseling, 29.vi.1989; QMMO23532, 20SA SC/1A,1SA RC, Carnarvon NP, top of Peawaddy Gorge, 24°55'S, 148°04'E, open eucalypt woodland/ cycads, under timber and rocks, coll. J. Stanisic, D. Potter, J. Chaseling, 29.vi.1989; QMMO85476, 6A,1SA RC, Carnarvon NP, Mt Moffatt Section, on N side of Moffatt Peak, 25°03'24"S, 148°02'41"E, sevt on basalt scree, dead among rocks, coll. C. Eddie, 13.x.2002; QMMO85455, 2A RC, Carnarvon NP, Mt Moffatt Section, headwaters of gully on ridge NW of Lot's Wife, 24°57'24"S, 147°57'00"E, sevt/*Brachychiton*/*Ficus*, dead on ground, coll. C. Eddie, 4.ii.2000; QMMO80700, 1SA SC/3A RC, Carnarvon NP, Mt Moffatt Section, Mahogany Forest Rd, 24°54'42.3"S, 148°03'04.8"E, burnt eucalypt woodland, under rock in litter, coll. J. Stanisic, L. Holcroft, 24.ix.2012; QMMO85278, 2A RC, Carnarvon NP, Mt Moffatt Section, E side Mt Moffatt Peak, 25°03'31"S, 148°02'47"E, sevt on steep basalt hill slope, dead on ground, coll. C. Eddie, W. Mc Donald, 25.iv.2003; QMMO85451, 1A RC; QMMO85452, 2A RC, Carnarvon NP, Mt Moffatt Section, gully on W side of Gee Gee Gap Rd, 24°56'55"S, 147°54'10"E, sevt with emergent *Brachychiton* spp. in sheltered gully on sandstone between basalt-capped ridges, dead on ground, coll. C. Eddie, W. McDonald, 23.iv.2003; QMMO66491, 1A,1SA RC, Carnarvon NP, Mt Moffatt Section, Kenniffs Cave Rd, 24°53'04"S, 148°00'23"E, woodland, coll. C. Eddie, 20.i.1999; QMMO54026, 1A RC, Carnarvon NP, Mt Moffatt Section, edge of Marlong Plain, 24°56'33"S, 147°57'52"E, tussock grassland, on ground, coll. C. Eddie, 6.x.1995; QMMO85481, 3A,1SA RC, Carnarvon NP, Mt Moffatt Section, NE Marlong Plain, 24°55'37"S, 147°58'25"E, sevt/*Brachychiton* in sandstone gully, dead among rocks and under logs, coll. C. Eddie, 22.vii.2004; QMMO65340, Carnarvon NP, Mt Moffatt Section, between Top and Rotary Shelter Sheds, 24°54'03.1S, 148°02'11"E, open woodland, dead on ground, coll. C. Eddie, 6.x.1995; QMMO80655, 1A RC, Carnarvon NP, Mt Moffatt Section, Consuelo Tbl'd at head of Carnarvon Ck, 24°56'24"S, 148°04'14"E, open eucalypt woodland, dead on ground, coll. C. Eddie, 15.xii.2002; QMMO80661, 1A RC, Carnarvon NP, Mt Moffatt Section, Consuelo Tbl'd, near Foley's Spring, 24°56'49"S, 148°07'55"E, tall eucalypt woodland/basalt tbl'd, dead on ground, coll. C. Eddie, R. Perry, 9-18.xii.2002; QMMO73104, 1A RC, Carnarvon NP, Mt Moffatt Section, Consuelo Tbl'd, near Bobindi Spring, 24°53'03"S, 148°12'11"E, grassy woodland, dead on ground, coll. C. Eddie, 17.xii.2002; QMMO73103, 1A SC/1A RC, Carnarvon NP, Mt Moffatt Section, Consuelo Tbl'd, c. 3.4 km E Racecourse Spring, 24°55'56"S, 148°05'51"E, open woodland, coll. C. Eddie, 14.ii.2002; QMMO73102, 1A SC/1A RC, Carnarvon NP, Mt Moffatt Section, Consuelo Tbl'd, near Foley's Spring, 24°56'49"S, 148°07'55"E, grassy

woodland/ coll. C. Eddie, 13.ii.2002; AMSC143691, 1SA, Carnarvon Gorge area, 24°46'S, 147°46'E, open forest in basalt country, under log, coll. P.H. Colman, 1.x.1984; QMMO85280, 1SA RC, Carnarvon NP, Mt Moffatt Section, Meteor Ck below Kenniffs Cave, 24°52'02"S, 148°01'17"E, eucalypt woodland, dead on ground, coll. C. Eddie, 21.i.1992; QMMO80662, 2A RC, Carnarvon NP, Carnarvon Gorge Section, at Nature Trail, 25°03'30"S, 148°14'17"E, open forest/*Casuarina*/*Livistona*, dead on ground, coll. C. Eddie, 25.xi.1995; QMMO80663, 1A RC, Carnarvon NP, Carnarvon Gorge Section, at Carnarvon Ck, 25°02'42"S, 148°11'00"E, *Livistona* understorey/sandstone gorge, dead on ground, coll. C. Eddie, 25.xi.1995; QMMO73024, 1A SC/1A RC, Carnarvon NP, Carnarvon Gorge Section, along Nature Trail, 25°03'30"S, 148°14'07"E, woodland, dead on ground, coll. C. Eddie, 18.xii.1996; QMMO56635, 3A,1SA RC, Carnarvon NP, Carnarvon Gorge Section, beginning of gorge walk, 25°03'25"S, 148°13'30"E, *Livistona*/*Cyathea*, under logs and rocks, coll. J. Stanisic, D. Potter, C. Eddie, 20.xi.1995; QMMO56650, 1A SC/12A,4SA RC, Moolayember Section, Carnarvon NP, Rolleston-Injune Rd, 25°13'55"S, 148°37'25"E, sevt/ooline, under logs/dead on ground, coll. J. Stanisic, D. Potter, C. Eddie, 21.ix.1995; QMMO85450, 1A RC, Carnarvon Highway, Injune-Rolleston, in vicinity of Moolayember Ck, 25°10'44.2"S, 148°34'09"E, eucalypt woodland/open forest around sandstone rock outcrops, among leaf litter around rocks, coll. C. Eddie, 13.viii.2014.

Other material. Injune NW at Saddler's Springs Stn: QMMO80659, 1 SA RC. Carnarvon NP, Mt Moffatt Section, Rotary Shelter Shed: QMMO23529, 10SA SC/1A,3SA RC. Carnarvon NP, Mt Moffatt Section, Peawaddy Gorge: QMMO16565, 3A,8SA RC; QMMO65341, 1A SC; QMMO76308, 2SA SC. Carnarvon NP, Mt Moffatt Section, Mt Rugged: QMMO85277, 3SA RC. Carnarvon NP, Mt Moffatt Section, Consuelo Tbl'd: QMMO80654, 1SA SC.

Diagnosis. Shell large, subglobose, all-over yellowish brown to light brown with a slightly greenish tinge, occasionally with a reddish brown subsutural band; teleoconch with very fine, dense pustules and widely spaced oblique to zigzag microridgelets, body whorl with prominent curved growth lines. Apical walls of penial chamber with 6-7 occasionally anastomosing, fleshy longitudinal pilasters that become obliquely disposed medially and toward the atrium.

Description. Shell large, subglobose, all-over yellowish brown to light brown with a slightly greenish tinge, occasionally with a reddish brown subsutural band, spire weakly to

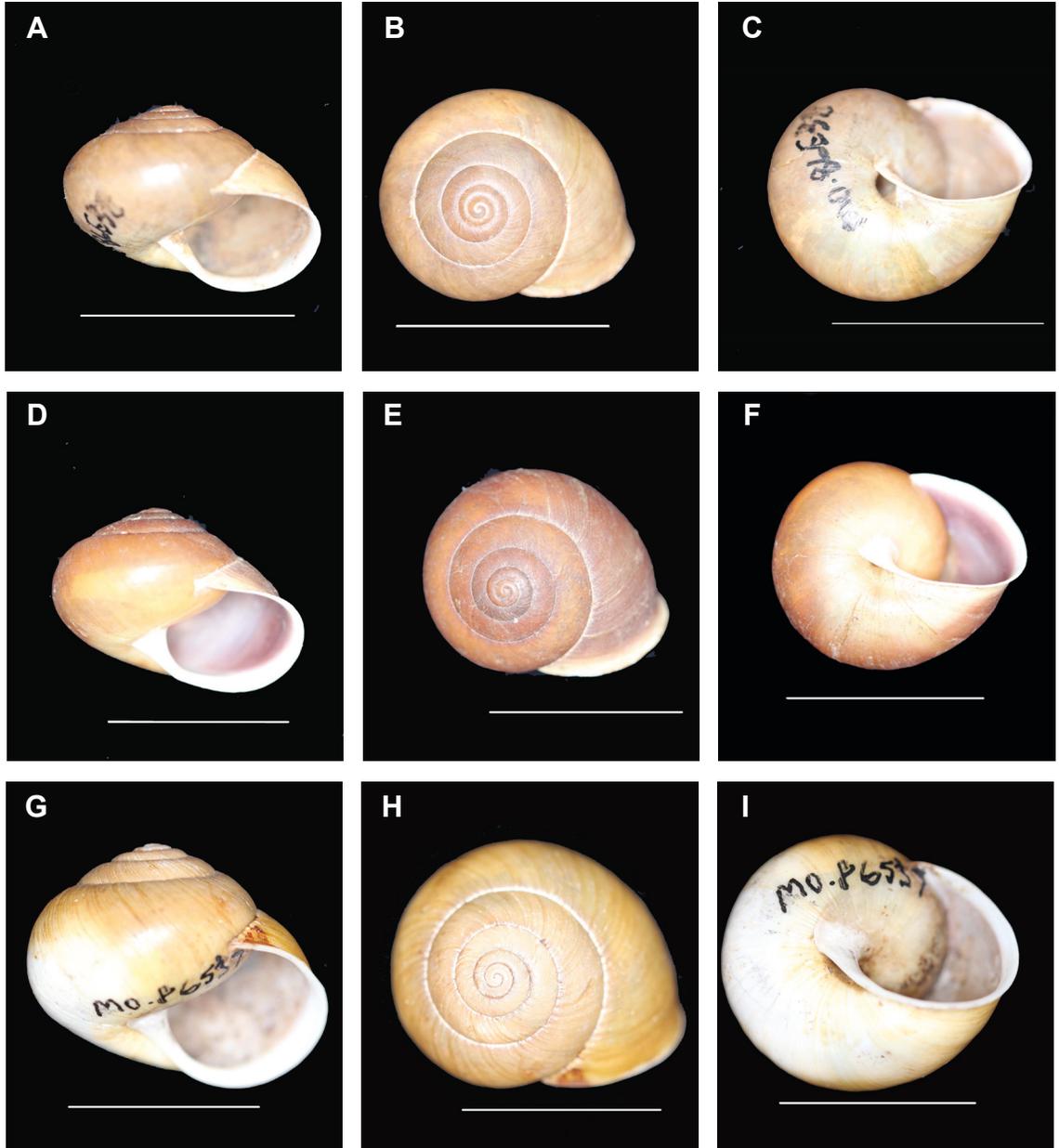


FIG. 11. *Pallidelix* holotypes. A-C, *P. staricki* sp. nov., QMMO86538; D-F, *P. lambkinae* sp. nov., QMMO86523; G-I, *P. moffatt* sp. nov., QMMO86537. Scale bars = 20 mm.

moderately elevated, whorls 5.125-6.0 (mean 5.500), evenly rounded the last descending in front (Fig. 11G-I). Height of shell 17.09-23.97 mm (mean 20.84 mm), diameter 23.15-28.58 mm (mean 25.97 mm), h/d 0.738-0.908 (mean

0.814). Protoconch as for genus. Teleoconch with very fine, crowded pustules and widely spaced oblique to zigzag microridgelets, sculpture persisting onto last half of body whorl, body whorl with prominent curved

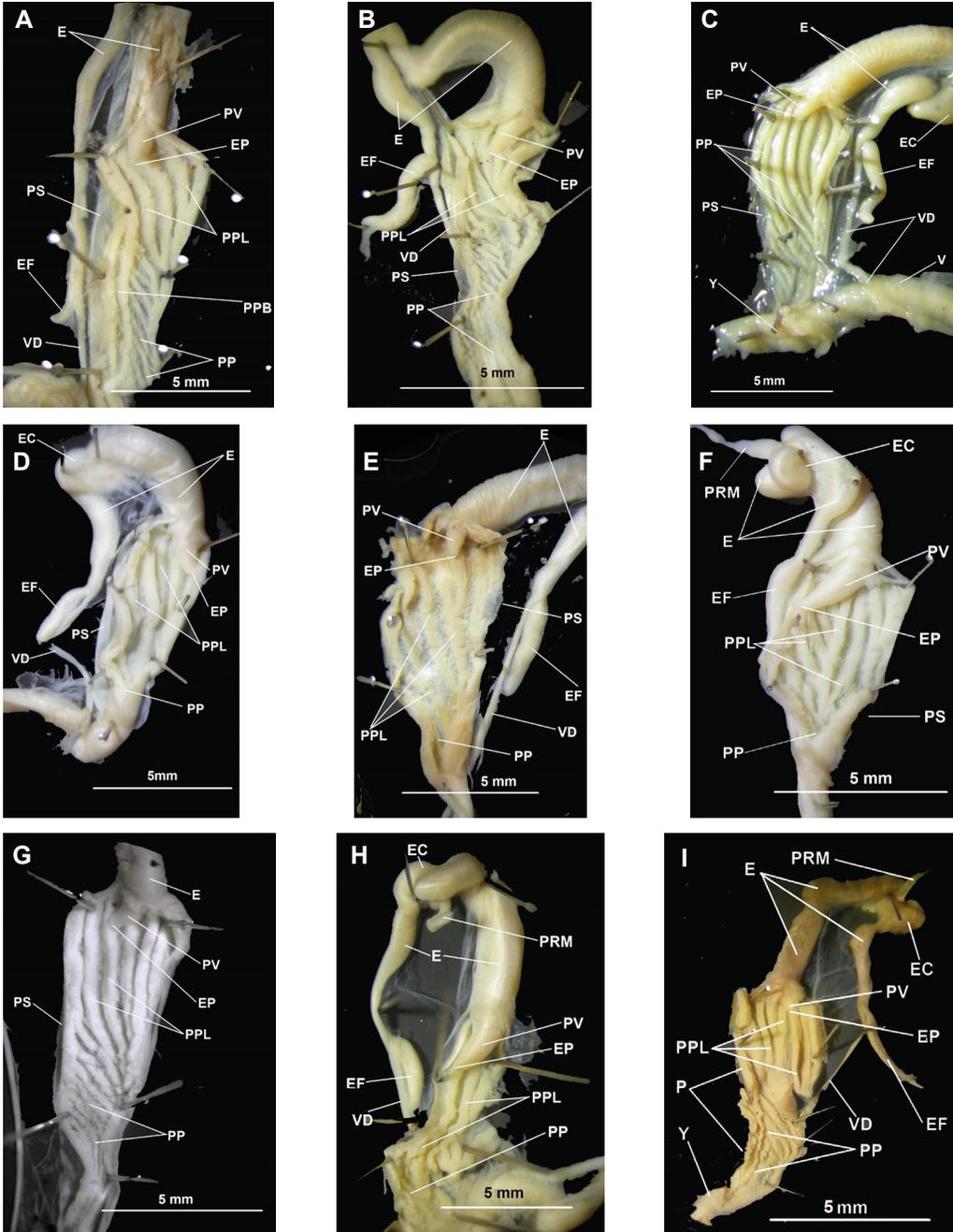


FIG. 12. Penial pilaster patterns in *Pallidelix*. **A**, *P. greenhilli* (Cox, 1866), QMMO79091; **B**, *P. lonesome* sp. nov., QMMO65168; **C**, *P. potteri* sp. nov., QMMO46301; **D**, *P. staricki* sp. nov., QMMO79085; **E**, *P. lambkinae* sp. nov., QMMO73020; **F**, *P. moffatt* sp. nov., QMMO85048; **G**, *P. simonhudsoni* Stanisic, 2015, QMMO80124; **H**, *P. minerva* sp. nov., QMMO56625; **I**, *P. zamia* sp. nov., QMMO68764.

growth lines (Fig. 7E); base shiny and smooth. Aperture roundly lunate, lip white, expanded and reflected; umbilicus reduced to a lateral crack. Based on 43 measured adults [QMMO85048 (22), QMMO80702 (8), QMMO80662 (2), QMMO85483 (5), QMMO73024 (1), QMMO80663 (1), QMMO56635 (4)].

Genitalia. Penis (P) long, tapered with slightly expanded apical bulb; thin sheath (PS) present; internally with a smooth papillate verge (PV), upper walls of penial chamber with 6-7 thick, fleshy, longitudinal pilasters (PPL) that occasionally anastomose and become obliquely disposed medially (PP) (Fig. 12F). Epiphallus (E) with relatively long, thick muscular curved ascending arm enveloped and partially folded within penial sheath, strongly reflexed and slightly twisted before giving rise to a thinner, relatively short arm; epiphallus entering penis through a simple pore (EP) situated terminally on verge. Penial retractor muscle (PRM) inserted at the fold of the two arms of the epiphallus adjacent to an epiphallic caecum (EC). Vas deferens (VD) thin, attached to penial sheath with connective tissue; a relatively long, thick finger-like epiphallic flagellum (EF) present at epiphallus-vas deferens junction, bound to vas deferens. Other structures as for genus and without unusual features. Based on four dissected specimens (QMMO73024, QMMO73095, QMMO73103, QMMO23542).

Distribution. Mt Moffatt, Carnarvon and Moolayember Sections, Carnarvon NP, SCQ.

Habitat. Eucalypt/palm and eucalypt woodland on sandstone; living under rocks and logs (Fig. 14A, B).

Remarks. *Pallidelix moffatt* sp. nov. is distinguished from the geographically adjacent *P. simonhudsoni* Stanisc, 2015 by a combination of shell with weakly to moderately elevated spire, teleoconch with scattered pustules and more widely spaced and more prominent microridgelets (Fig. 7E). *P. simonhudsoni* has a more elevated spire and more dense pustulation on the teleoconch with reduced microridgelets (Fig. 16A, B). Anatomically *P. moffatt* differs from *P. simonhudsoni* in having

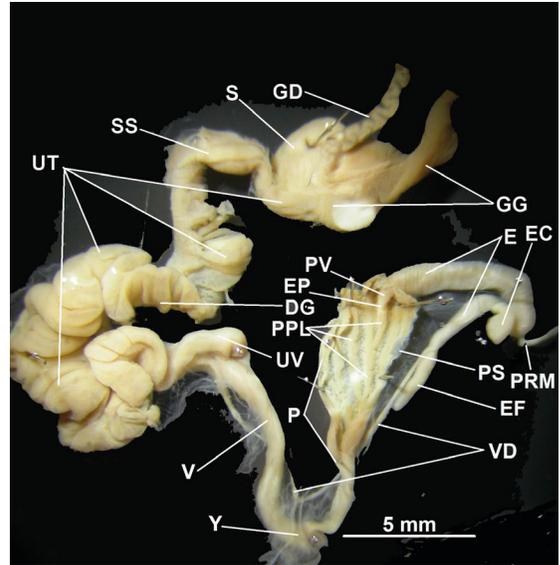


FIG. 13. Genitalia, *Pallidelix lambkinae* sp. nov., QMMO73020.

fewer penial pilasters that anastomose rather than simple and straight apical penial pilasters of the latter (cf. Fig. 12F, 12G)

P. moffatt occurs over a large area of the topographically complex Carnarvon NP and as such is subject to the vagaries of local environmental conditions. Consequently specimens show a considerable size variation throughout the species' range. Average sized specimens occur in the central sandstone areas of the Mt Moffatt and Carnarvon Gorge Sections, however those from the more elevated, basalt capped, high rainfall Consuelo Tableland are considerably larger. Alternatively, those from the drier, more isolated dry vine thickets of the Moolayember Section are very much smaller. Ecologically *P. moffatt* differs from other *Pallidelix* species in showing a preference for woodland habitat on sandstone. Animal with reddish mantle.

***Pallidelix simonhudsoni* Stanisc, 2015**
(Figs 12G, 16A-B)

Pallidelix simonhudsoni Stanisc, 2015: 56.

Preferred common name. Hudson's Woodland Snail.

Material examined. (All south central Queensland).

Holotype. QMMO80282, Fig Tree Spring, (24° 47.813'S, 147° 41.593'E), semi-evergreen vine thicket on basalt scree, under rocks, coll. J. Stanisic, 10.x.2014. Height of shell 28.02 mm, diameter 31.89 mm, h/d 0.879, whorls 5.875.

Other material examined. QMMO85328, 1A RC; QMMO56610, 2A SC/6A, 17SA RC, Carnarvon NP, Ka Ka Mundi Section, SW Springsure, SCQ, 24°51'50"S, 147°26'35"E, eucalypt woodland with remnant vine thicket/sandstone, on ground, coll. J. Stanisic, D. Potter, C. Eddie, 19.ix.1995; QMMO54833, 1SA RC, Carnarvon NP, Ka Ka Mundi Section, at Bottle Tree Flat, 24°48'27"S, 147°35'44"E, coll. W. McDonald, P. Grimshaw, 7.v.1993; QMMO54825, 2A RC, Carnarvon NP, Ka Ka Mundi Section, at Broad Gully Scrub, 24°47'54"S, 147°22'33"E, softwood scrub, coll. W. McDonald, R. Melzer, 6.v.1993; QMMO56616, 5A RC, Carnarvon NP, Ka Ka Mundi Section, 24°45'30"S, 147°20'37"E, sevt/basalt scree, in litter, coll. J. Stanisic, D. Potter, C. Eddie, 19.ix.1995; QMMO66031, 1A, 1SA RC, Carnarvon NP, Ka Ka Mundi Section, 24°49'55"S, 147°33'40"E, coll. T. Vincent, 19.vi.1999; QMMO56200, 3A, 1SA RC, Carnarvon NP, Ka Ka Mundi Section, around cattle yards below Fig Tree Spring, 24°48'35"S, 147°35'35"E, low brigalow woodland, on ground, coll. C. Eddie, 2.ii.1995; QMMO56612, 9A, 2SA RC, Carnarvon NP, Ka Ka Mundi Section, 24°49'40"S, 147°24'47"E, sevt/*Brachychiton*, under and in logs, coll. J. Stanisic, D. Potter, C. Eddie, 19.ix.1995.

Other material. All from Carnarvon Station Reserve as listed in Stanisic (2015).

Diagnosis. Shell large with a moderately to strongly elevated spire and rounded whorls, dark to yellowish brown, occasionally with a thin reddish brown subsutural band; teleoconch sculpture of relatively fine, crowded pustules and scattered oblique to zigzag microridgelets. Penis internally with 4-5 straight, smooth, thick longitudinal pilasters apically becoming obliquely disposed medially and thinner, straight and corrugated toward the atrium. Epiphallallic flagellum and caecum present. Modified from Stanisic (2015).

Distribution. Carnarvon Station Reserve and part of Ka Ka Mundi Section, Carnarvon NP, SCQ.

Habitat. Vine thicket on basalt and sandstone; living under rocks and logs (Stanisic 2015).

Remarks. Conchologically *Pallidelix simonhudsoni* Stanisic, 2015 is distinguished from *P. moffatt* sp. nov. by a combination of strongly elevated spire and predominantly fine pustules on the

teleoconch (Fig. 12 A, B). Anatomically the simple apical penial pilasters of *P. simonhudsoni* contrast with the more numerous anastomosing pilasters of *P. moffatt* sp. nov. (cf. Fig. 12F & Fig. 12G). Previously recorded from Carnarvon Station the range of the species is extended to include the immediately adjacent parts of Ka Ka Mundi Section, Carnarvon NP, SCQ. Animal with reddish mantle.

The modified diagnosis now includes the presence of an epiphallallic caecum which was previously mistaken for a simple distension of the epiphallus (Stanisic 2015).

Pallidelix grandis sp. nov.
(Figs 15A-C, 17A)

Etymology. From the Latin *grandis* = large, referring to the large size.

Preferred common name. Giant Woodland Snail.

Material examined. (All mid-central Queensland).

Holotype. QMMO85327, Springsure, W at upper Vandyke Ck, 24°38'45"S, 147°51'13"E, vine thicket/softwood scrub, on ground, coll. W. McDonald, P. Grimshaw, 9.v.1993. Height of shell 35.81 mm, diameter 35.48mm, h/d 1.009, whorls 6.125.

Paratypes. QMMO54832, 11A RC, same data as holotype; QMMO79359, 4A RC, Carnarvon NP, Ka Ka Mundi section, at Dry Creek, 24°41'55"S, 147°39'53"E, sevt on creek terrace, under rocks, coll. C. Eddie, W. McDonald, 10.viii.2004; QMMO85459, 17A, 6SA RC, Springsure, 74 km SW at Tanderra Stn, 24°37'51"S, 147°43'04"E, sevt, dead on ground/ among leaf litter under/inside logs, coll. C. Eddie, W. McDonald, 12.viii.2004; QMMO79355, 10A RC, Carnarvon NP, via Tanderra Stn, 24°42'27"S, 147°45'48"E, sevt on basalt beside creek, coll. C. Eddie, W. McDonald, 11.viii.2004; QMMO85460, 1A RC, Springsure, 74 km SW at Tanderra Stn, 24°42'06"S, 147°44'22"E, sevt on basalt ridge, dead on ground/ among leaf litter under rocks and logs, coll. C. Eddie, W. McDonald, 11.viii.2004.

Other material examined. QMMO55443, 4A RC, Carnarvon NP, 24°35'30"S, 147°43'05"E, on ground, coll. C. Eddie, 2.ii.1995; QMMO85461, 5A/5SA RC, Carnarvon NP, Ka Ka Mundi section, above Dry Creek, 24°41'40"S, 147°40'53"E, sevt/gully on basalt ridge, dead on ground/ among leaf litter under logs and rocks, coll. C. Eddie, W. McDonald, 10.viii.2004; QMMO85457, 1A RC, Carnarvon NP, via Tanderra Stn, 24°42'22"S, 147°45'52"E, sevt on creek terrace/basalt, dead on ground, coll. C. Eddie, W. McDonald, 11.viii.2004.

Diagnosis. Shell very large, globose with an elevated spire and expanded body whorl; teleoconch sculpture of very weak, low and fine, oblique to zigzag microridgelets and scattered fine pustules on early whorls, reduced to obsolete on last half of body whorl; umbilicus closed by reflexion of the columella. Anatomy unknown.

Description. Shell very large, globose with an elevated spire and expanded body whorl, yellowish brown to brown, shiny; whorls 5.750-6.500 (mean 6.125), evenly rounded above and slightly shouldered below the periphery, the last descending rapidly in front (Fig. 15A-C). Height of shell 29.09-36.40 mm (mean 32.22 mm), diameter 30.51-36.65 mm (mean 33.33 mm), h/d 0.851-0.1.060 (mean 0.903). Protoconch as for genus. Teleoconch sculpture of very weak, low and fine, oblique to zigzag microridgelets and scattered pustules on early whorls, reduced to obsolete on last half of body whorl (Fig. 17A); base shiny and smooth. Aperture roundly lunate, lip white, expanded and reflected; umbilicus closed by reflexion of columella. Based on 30 measured adults [QMMO79355 (10), QMMO79359 (4), QMMO55443 (4), QMMO54832 (12)].

Anatomy unknown.

Distribution. Northern Ka Ka Mundi and Welcome Sections, Carnarvon NP, north to Tanderra Stn, south of Springsure and environs, MCQ.

Habitat. Vine thicket on basalt; living under rocks and logs (Fig. 14C-D).

Remarks. *Pallidelix grandis* sp. nov. is readily distinguished from congeners by the very large shell with expanded body whorl having weak to obsolete sculpture and a closed umbilicus (FIGS 15C, 17A). The somewhat similar *P. lonesome* sp. nov. from the Arcadia Valley has a smaller shell with very weak sculpture persisting on the last part of the body whorl and a slightly open umbilicus (Figs 4, 6C). Although the existing specimens of *P. grandis* chiefly come from the vicinity of Tanderra Station, the locality of the holotype (upper Van Dyke Creek) suggests that the species may be more widely spread along that extensive drainage system.

Pallidelix minerva sp. nov.
(Figs 7E, 12H, 15D-F, 19D)

Etymology. For the Minerva Hills, Springsure.

Preferred common name. Minerva Hills Woodland Snail.

Material examined. (All mid-central Queensland).

Holotype. QMMO85325, Springsure, NW at Mt Zamia, Minerva Hills, 24°05'55"S, 148°05'00"E, sevt, under rocks and logs, coll. J. Stanistic, D. Potter, C. Eddie, 20.ix.1995. Height of shell 23.42 mm, diameter 29.97mm, h/d 0.781, whorls 5.625.

Paratypes. QMMO56625, 1A, 1SA SC/5A, 10SA RC, same data as holotype; QMMO35822, 4A RC, Virgin Rock, 2 km N Springsure, 24°05'50"S, 148°05'15"E, under rock in vine thicket, coll. V. Kessner, 5.iii.1992; QMMO73307, 3A, 3SA RC, Minerva Hills NP, NNW Springsure, 24°05'47"S, 148°04'52"E, sevt, under rocks at base of fig, coll. C. Eddie, 21.iii.2001.

Other material examined. QMMO54813, 3A, 1SA RC, Springsure, N at Mt Hope, 24°06'07"S, 148°06'56"E, sevt, coll. W. Mc Donald, P. Grimshaw, 14.v.1993; QMMO44089, 1SA RC, adjacent to Mt Wills, on Mt Helmet-Springsure Rd, 24°59.5'S, 147°55.5'E, vine thicket on basalt, under rocks, coll. J. Stanistic, D. Potter, 20.vi.1992; QMMO68762, 1A RC, Springsure, NW, 0.6 km SSW of Mt Zamia. 24°06'S, 148°05'E, alt. 360 m, vine thicket, coll. D. Cook, 17.xii.2000.

Diagnosis. Shell large, depressedly globose, yellowish brown to brown with thin reddish brown subsutural band and lighter coloured base; teleoconch sculpture of densely crowded pustules on the early whorls and oblique to zigzag microridgelets and pustules on the body whorl. Upper walls of penial chamber with 3-4 fleshy longitudinal pilasters, irregular corrugated pilasters basally.

Description. Shell large, depressedly globose, yellowish brown to brown with thin reddish brown subsutural band and lighter coloured base; spire weakly elevated; whorls 5.375-5.825 (mean 5.625), evenly rounded, the last descending in front (Fig. 15D-F). Height of shell 19.17-23.87 mm (mean 20.68 mm), diameter of shell 25.96-28.64 mm (mean 27.55 mm), h/d 0.700-0.844 (mean 0.751). Protoconch as for genus. Teleoconch sculpture of densely crowded pustules on the early whorls and oblique to zigzag microridgelets and pustules on the body whorl (Fig. 7E); base shiny and smooth. Aperture roundly lunate, lip white, expanded and reflected; umbilicus

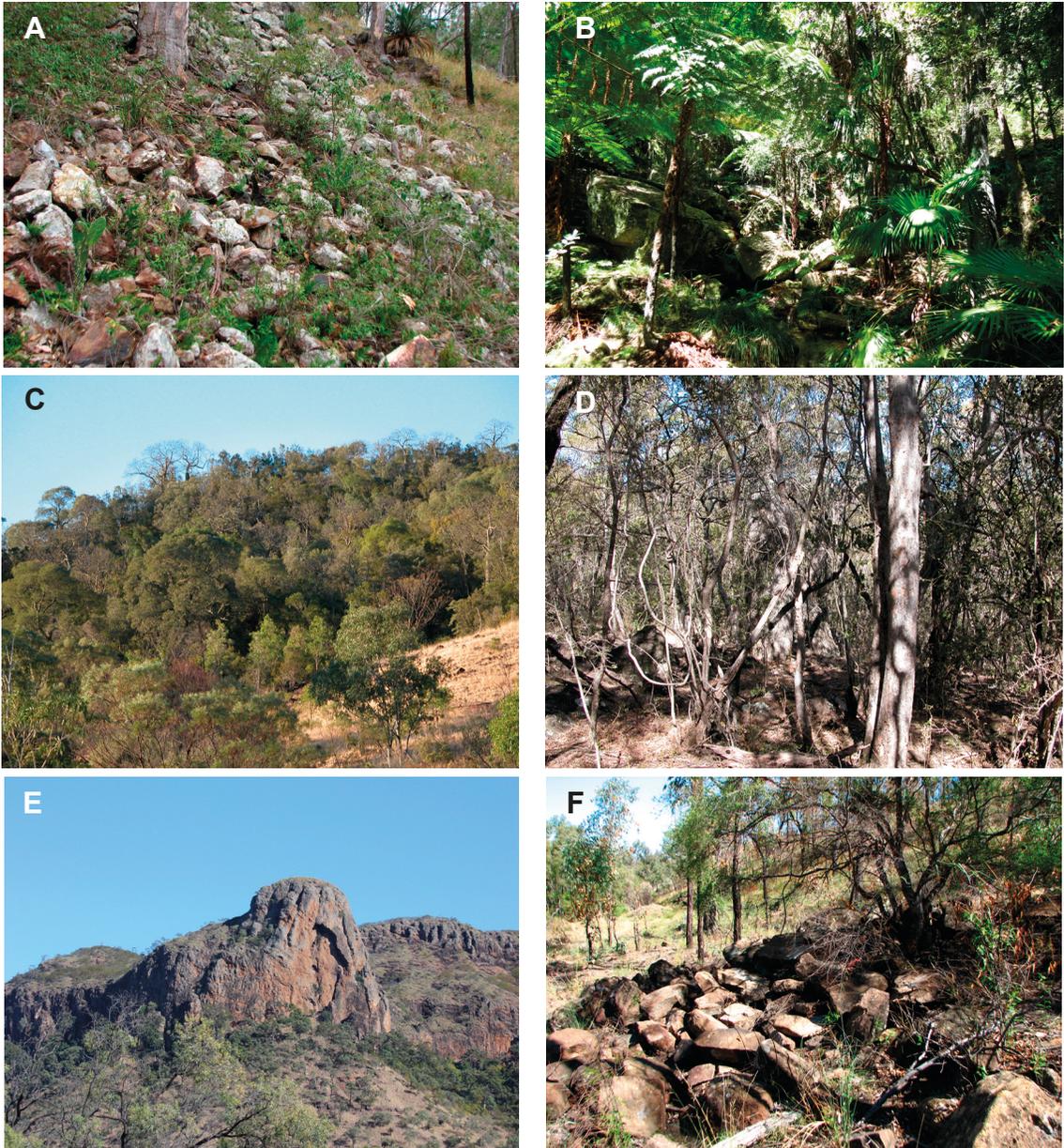


FIG. 14. *Pallidelix* habitats. **A-B**, *P. moffatt* sp. nov.: **A**, Marlong Plain, Mt Moffatt, SCQ; **B**, Carnarvon Gorge, SCQ. **C-D**, *P. grandis* sp. nov.: Tanderra Stn, MCQ; **E**, *P. mineroa* sp. nov.: Minerva Hills, MCQ; **F**, *P. zamia* sp. nov.: Drummond Range, MCQ. Images: A-D & F, C. Eddie.

reduced to a lateral crack. Based on 16 measured adults [QMMO68762 (1), QMMO73307 (3), QMMO35822 (4), QMMO54813 (2), QMMO56625 (6)].

Genitalia. Penis (P) long, tapered with slightly expanded apical bulb; thin sheath (PS) present; internally with a smooth papillate verge (PV), upper walls of penial chamber with 3-4 fleshy longitudinal pilasters (PPL) and irregular corrugated pilasters basally (PP) (Fig. 12I). Epiphallus (E) with relatively long, thick muscular, curved ascending arm enveloped and partially folded within penial sheath, strongly reflexed and slightly twisted before giving rise to a thinner, relatively short arm; epiphallus entering penis through a simple pore (EP) situated terminally on verge. Penial retractor muscle (PRM) inserted at the fold of the two arms of the epiphallus adjacent to an epiphallal caecum (EC). Vas deferens (VD) thin, attached to penial sheath with connective tissue; a relatively short, thick, finger-like epiphallal flagellum (EF) present at epiphallus-vas deferens junction, bound to vas deferens. Other structures as for genus and without unusual features. Based on one dissected specimen (QMMO78764).

Distribution. Minerva Hills, via Springsure, MCQ.

Habitat. Vine thicket and adjacent ironbark woodland; living under logs and rocks (Fig. 14E).

Remarks. *Pallidelix minerva* sp. nov. is distinguished by a combination of shell with prominent pustulation on the teleoconch whorls (Fig. 7E) and penis with 3-4 apical longitudinal pilasters (Fig. 12H). *P. zamia* sp. nov. from the Drummond Range has less pustulose shell sculpture and a greater number of apical longitudinal penial pilasters (FIGS 12I, 17B). Animal with beige-coloured mantle.

Pallidelix zamia sp. nov.
(Figs 12I, 15G-I)

Etymology. For Mt Zamia, Drummond Range.

Preferred common name. Drummond Range Woodland Snail

Material examined. (All mid-central Queensland).

Holotype. QMMO68563, Emerald, W at Drummond Ra., 13km N Bogantungan, 23°32'08"S, 147°19'21"E, alt. 680 m, rocky gully, near fig trees, coll. D. Cook, 8.x.2000. Height of shell 25.45 mm, diameter 29.52 mm, h/d 0.862, whorls 5.625.

Paratype. QMMO68764, 1A, 1SA SC/1A RC, summit of Drummond Ra., W of Emerald, 23°32'S, 147°18'E, coll. D. Cook, 25.x.2000.

Other material examined. QMMO76389, 1SA RC, Emerald, W, c. 13.5km N of Bogantungan, 23°32'S, 147°18'E, alt. 880m, open forest, coll. D. Cook, G. Monteith, 27.iii.2001; QMMO76685, 4SA RC, Emerald, W at Mt Drummond Ra., summit, 23°32'S, 147°18'E, alt. 920 m, open forest, coll. QM party, 26.x.2000.

Diagnosis. Shell large, subglobose, yellowish brown to brown with a weak reddish brown subsutural band; teleoconch sculpture of fine, crowded pustules and weak oblique microridgelets on the early whorls and crowded, prominent, oblique to zigzag microridgelets and reduced pustules on the latter whorls. Upper penial chamber with 7-8 thick, fleshy longitudinal pilasters becoming thin and corrugated basally.

Description. Shell large, subglobose, yellowish brown to brown with a weak reddish brown subsutural band; spire weakly elevated; whorls 5.625-5.750 (mean 5.625), evenly rounded, the last descending in front (Fig. 15D-F). Height of shell 24.36-25.45 mm (mean 24.90 mm), diameter of shell 28.59-29.52 mm (mean 29.05 mm), h/d 0.852-0.862 (mean 0.857). Protoconch as for genus. Teleoconch sculpture of fine, crowded pustules and weak oblique ridges on the early whorls and fine crowded, prominent, oblique to zigzag microridgelets and reduced pustules on the latter whorls (Fig. 17B); base shiny and smooth. Aperture roundly lunate, lip white, expanded and reflected; umbilicus reduced to a chink. Based on 2 measured adults [QMMO68563 (1), QMMO68764 (1)].

Genitalia. Penis (P) long, tapered with slightly expanded apical bulb; thin sheath (PS) present; internally with a smooth papillate verge (PV), upper walls of penial chamber with 7-8 fleshy longitudinal pilasters (PPL), becoming thin and corrugated basally (PP) (Fig. 12I). Epiphallus (E) with relatively long, thick muscular curved ascending arm enveloped and partially folded within penial sheath, strongly reflexed and slightly twisted before giving rise to a thinner,

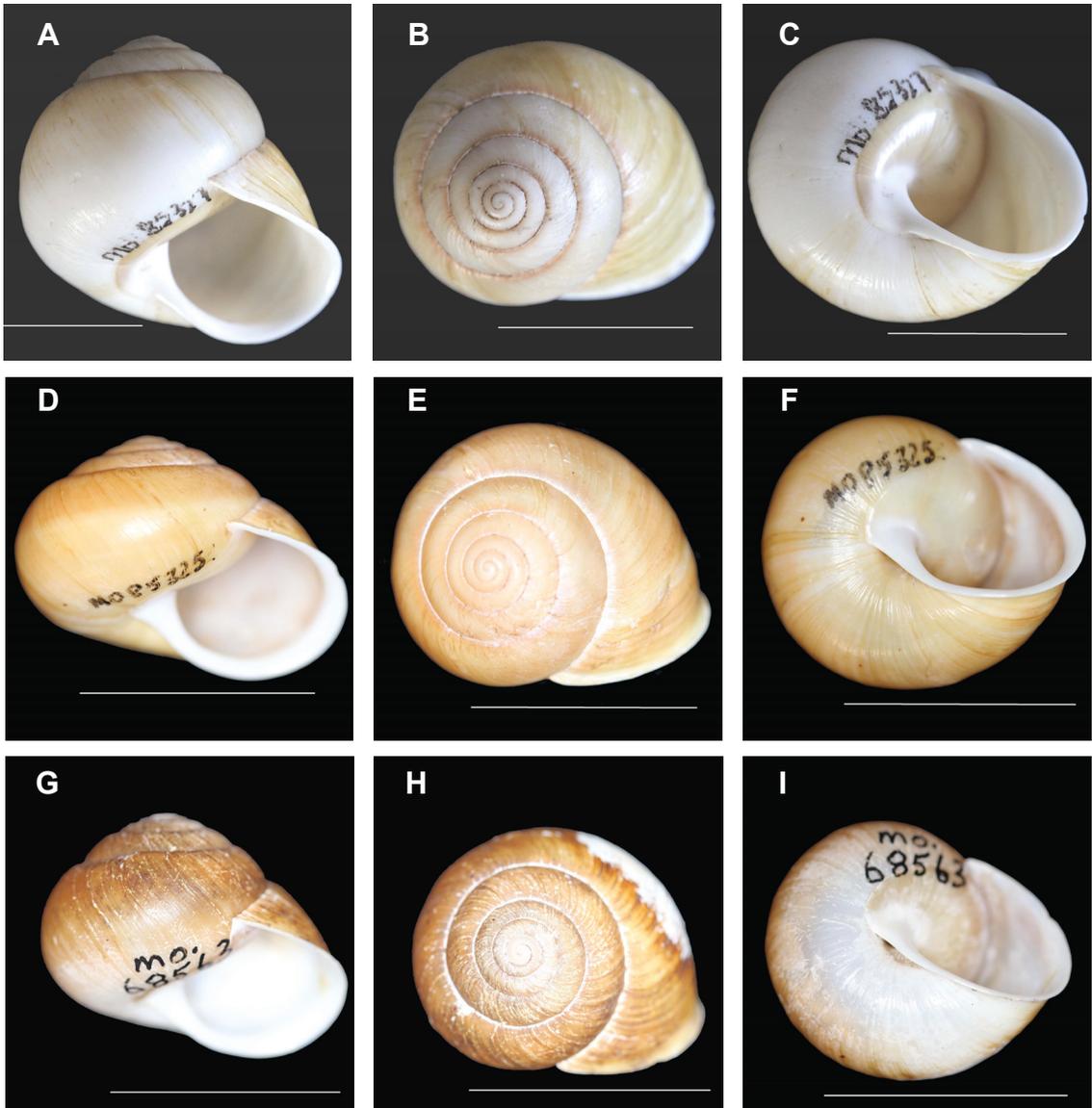


FIG.15. *Pallidelix* holotypes. A-C, *P. grandis* sp. nov., QMMO85327; D-F, *P. minerva* sp. nov., QMMO85325; G-I, *P. zamia* sp. nov., QMMO68563. Scale bars = 20 mm.

relatively short arm; epiphallus entering penis through a simple pore (EP) situated terminally on verge. Penial retractor muscle inserted at the fold of the two arms of the epiphallus adjacent to an epiphallic caecum (EC). Vas deferens (VD) thin, attached to penial sheath with connective tissue; a long, thick,

finger-like epiphallic flagellum (EF) present at epiphallus-vas deferens junction, bound to vas deferens. Other structures as for genus and without unusual features. Based on one dissected specimen (QMMO78764).

Distribution. Drummond Range, W of Emerald, MCQ.

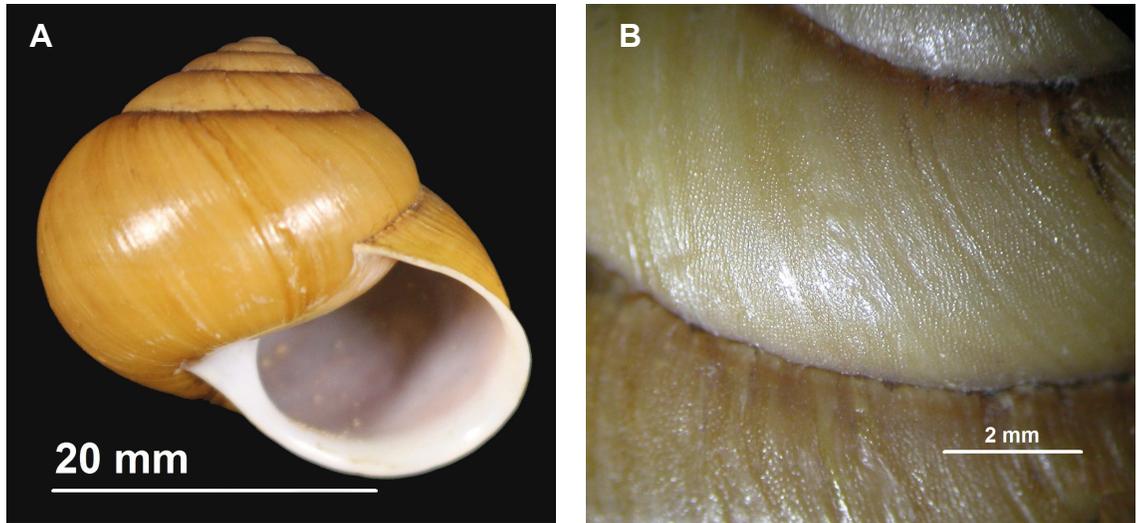


FIG. 16. Holotype of *Pallidelix simonhudsoni* Stanisc, 2015, QMMO 80282, Carnarvon Stn Reserve, SCQ. **A**, Shell; **B**, Teleoconch sculpture.

Habitat. Remnant thicket and adjacent open forest; among rocks and logs (Fig. 14F).

Remarks. *Pallidelix zamia* sp. nov. differs from *P. minerva* sp. nov. by the shell sculpture of prominent oblique to zigzag microridgelets and reduced pustulation on the latter teleoconch whorls (Fig. 17B) in contrast to the prominent pustulation and reduced microridgelets on the

latter part of the teleoconch of the latter (Fig. 7E). Anatomically *P. zamia* differs from *P. minerva* by having more numerous apical longitudinal penial pilasters (cf. Fig. 12H, 12I).

Collecting to the north of the Drummond Range has not produced any additional specimens of *Pallidelix* indicating that *P. zamia* is the most northerly species of the genus.

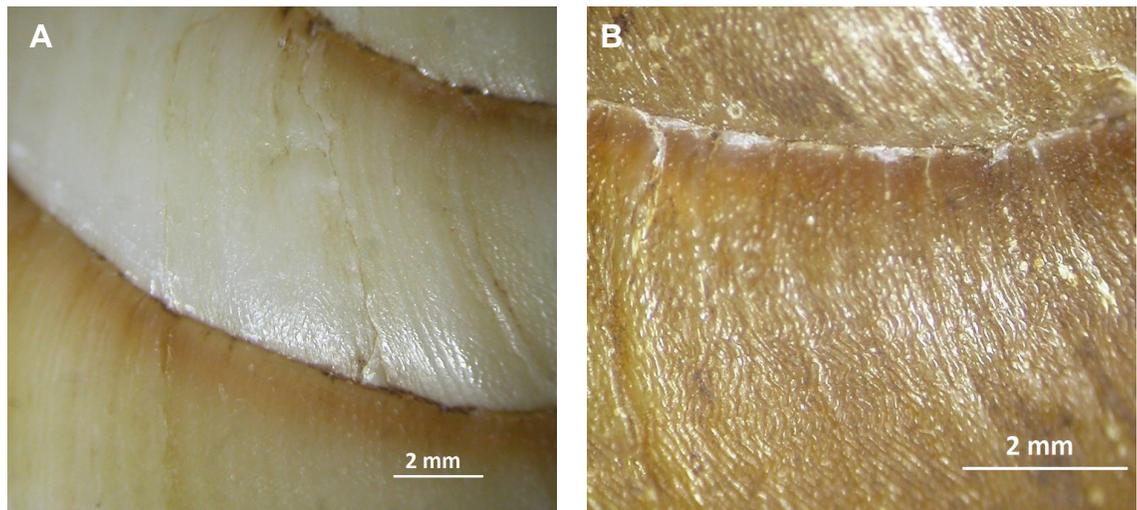


FIG. 17. Teleoconch sculpture. **A**, *Pallidelix grandis* sp. nov., QMMO85327; **B**, *Pallidelix zamia* sp. nov., QMMO68563.

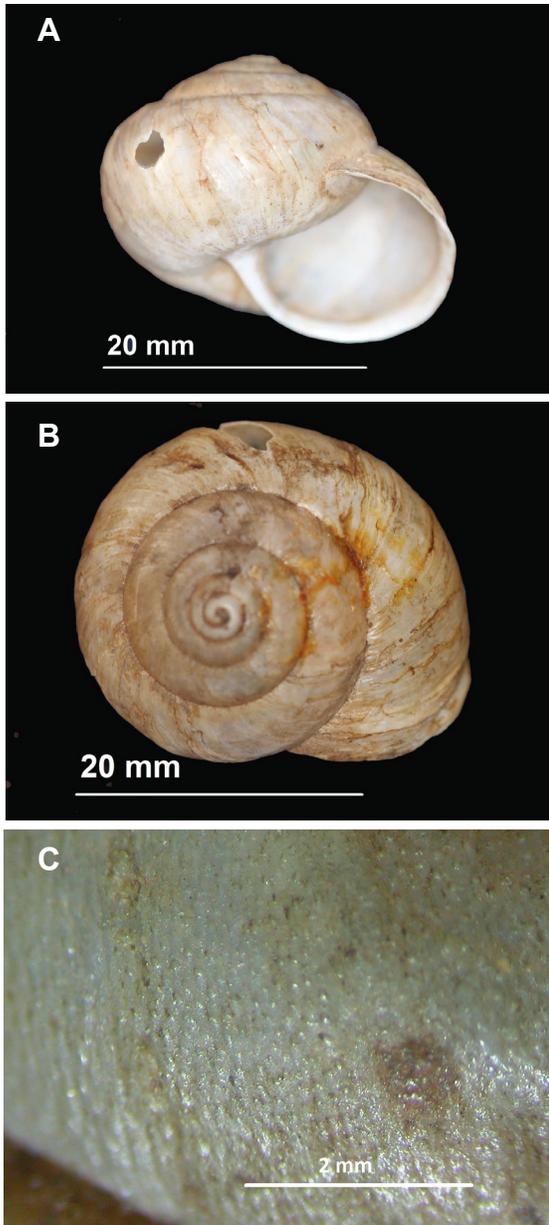


FIG. 18. *Helix expeditionis* Cox, 1868. Lectotype, AMSC33232. **A**, apertural view; **B**, dorsal view; **C**, shell sculpture showing pustules and no microridgelets.

Incertae sedis
Helix expeditionis Cox, 1868
 (Fig. 18A-C)

Helix expeditionis Cox, 1868: 37; Stanisic *et al.*, 2010: 541 (in synonymy).

Meridolum expeditionis (Cox). Iredale, 1938: 84.

Galadistes expeditionis (Cox). Smith, 1992: 126.

Lectotype (herein designated (Fig. 18A, B). AMSC33232, Tropical Australia. Pres. Sir Thomas Mitchell. Height of shell 21.70 mm, diameter 27.17 mm, h/d whorls 0.797, whorls 5.375.

Paralectotype. AMSC559601, 1 damaged SA RC, same data as lectotype.

Remarks. Stanisic *et al.* (2010) placed *Helix expeditionis* Cox, 1868 in the synonymy of *Pallidelix greenhilli sensu lato* based on the vague type locality and Iredale's (1938) annotation 'north of the preceding' referring to a species from the Darling Downs, SEQ. However, a more detailed examination of the shell sculpture and comparison with the large amount of shell material made available for this revision, has led to a reappraisal of its status.

The syntype specimens of *Helix expeditionis* were putatively presented to the Australian Museum, Sydney by explorer Sir Thomas Mitchell. The type locality on the labels associated with the specimens is given as 'Tropical Australia' presumably alluding to his fourth expedition into inland Queensland. The expedition recorded as the 'Expedition into Tropical Australia', encompassed the Central Highlands of central inland Queensland but largely west of the *Pallidelix* distribution. This expedition was recorded in one of his many journals together with a list of specimens (animals and plants) collected on the trip (Mitchell, 1848). No snails were listed in the species inventory or mentioned in the expedition narrative. It may be possible that the specimens came from one of Mitchell's other expeditions or bear no relevance to these at all.

The lectotype of *H. expeditionis* Cox, 1868 is a grey coloured, worn and damaged shell (Fig. 18A, B). The teleoconch features curved growth lines and a sculpture of very fine but worn, crowded pustules which become less noticeable on the last half of the body whorl. The sub-adult paralectotype (5.125 whorls) has similar but more defined pustulation on the teleoconch. Although there

are traces of periostracum on both shells there are no microridgelets present. The protoconchs of the two specimens exhibit sparse pustules and irregular rugose ridges (Fig. 18C). This is not the pattern seen in *Pallidelix* spp. The lack of any microridgelets on the teleoconch indicates that these specimens do not belong to *Pallidelix*.

The two shells in question most closely resemble some camaenids (many undescribed) from the southern Brigalow Lands bioregion in the vicinity of Dalby and Miles, SEQ. However, at present it is not possible to definitively associate the specimens of *H. expeditionis* with any extant species from that area. Hence, *Helix expeditionis* must be considered *incertae sedis* for the foreseeable future or at least until a full revision of the southern brigalow camaenids is completed and when a reassessment can be undertaken.

DISCUSSION

Pallidelix is one of the most dominant and widespread camaenid genera in the central highlands of inland Queensland (Stanisic, pers. obs.). Main areas of distribution are the Expedition and Carnarvon ranges with several outlier species occurring both to the north and south. The *Pallidelix* distribution chiefly comprises the Queensland Sandstone Belt which covers an area of approximately 82,000 square kilometres in south central Queensland. Consisting mainly of sandstone cliffs and deeply incised gorges the region's west also features basalt crested mountains and plateaux. The area occupied by the genus encompasses the various sections of the largely sandstone Carnarvon NP (*P. moffatt* sp. nov., *P. simonhudsoni* Stanisic, 1915 and *P. grandis* sp. nov.) and Expedition Range NP (*P. greenhilli* (Cox, 1866), *P. expeditiana* sp. nov.). One species occurs in the Arcadia Valley (*P. lonesome* sp. nov.). In addition the range of the genus also extends to the sandstone plateau of the Blackdown Tableland to the north of the Expedition Range at the junction of the Shotover and Dawson Ranges (*P. potteri* sp. nov.) and the volcanics of the Minerva Hills (*P. minerva* sp. nov.) and Drummond Range (*P. zamia* sp. nov.) in the north-west central

highlands. To the south of the Expedition Range species also occur in the Nuggett Hill/Pony Hills area east of Injune (*P. staricki* sp. nov.) and in the Gurulmundi SF, north of Miles (*P. lambkinae* sp. nov.) (Fig. 20).

The majority of species appear to have relied on scattered vine thickets for their existence in a landscape dominated by brigalow/woodland, and in many cases, lithoreugia (sandstone and basalt outcrops) have provided the microhabitats for their survival. While most species of *Pallidelix* now inhabit scattered patches of vine thicket and moist palm forest, one occurs primarily in the drier woodland communities of the Carnarvon NP (*P. moffatt*).

Size of species distributions range from the widespread (*P. moffatt*, *P. expeditiana*) to the very circumscribed and narrow (*P. greenhilli*). Most species occur in vine thicket patches isolated by the scattered nature of lithologies on which they occur. These patches are both climatically and topographically isolated in a semi-arid landscape and in many cases the isolation has been long term presumably dating from the climatic induced contractions of mesic communities in the Plio-Pleistocene.

A sizeable part of the area occupied by *Pallidelix* species is now mainly used for farming and agriculture and is largely devoid of natural vegetation, as is the case with a major proportion of the Brigalow Lands bioregion (Fensham 1996). Fortunately, a large percentage of the remaining but often fragmented natural vegetation within the *Pallidelix* distribution range (including the vitally important vine thickets) is secured in national parks and conservation reserves. However, a small but nonetheless significant number of vine thickets exist outside these conservation jurisdictions and these are open to exploitation. In more recent times mining development (coal and gas) has contributed to additional habitat fragmentation through the construction of service roads, open cut pits and gas well pads. The large scale habitat loss (historical and recent) has made collecting live snails very difficult and has contributed greatly to the somewhat constrained nature of this revision. *Pallidelix* highlights the importance of the vine thicket archipelago embedded within

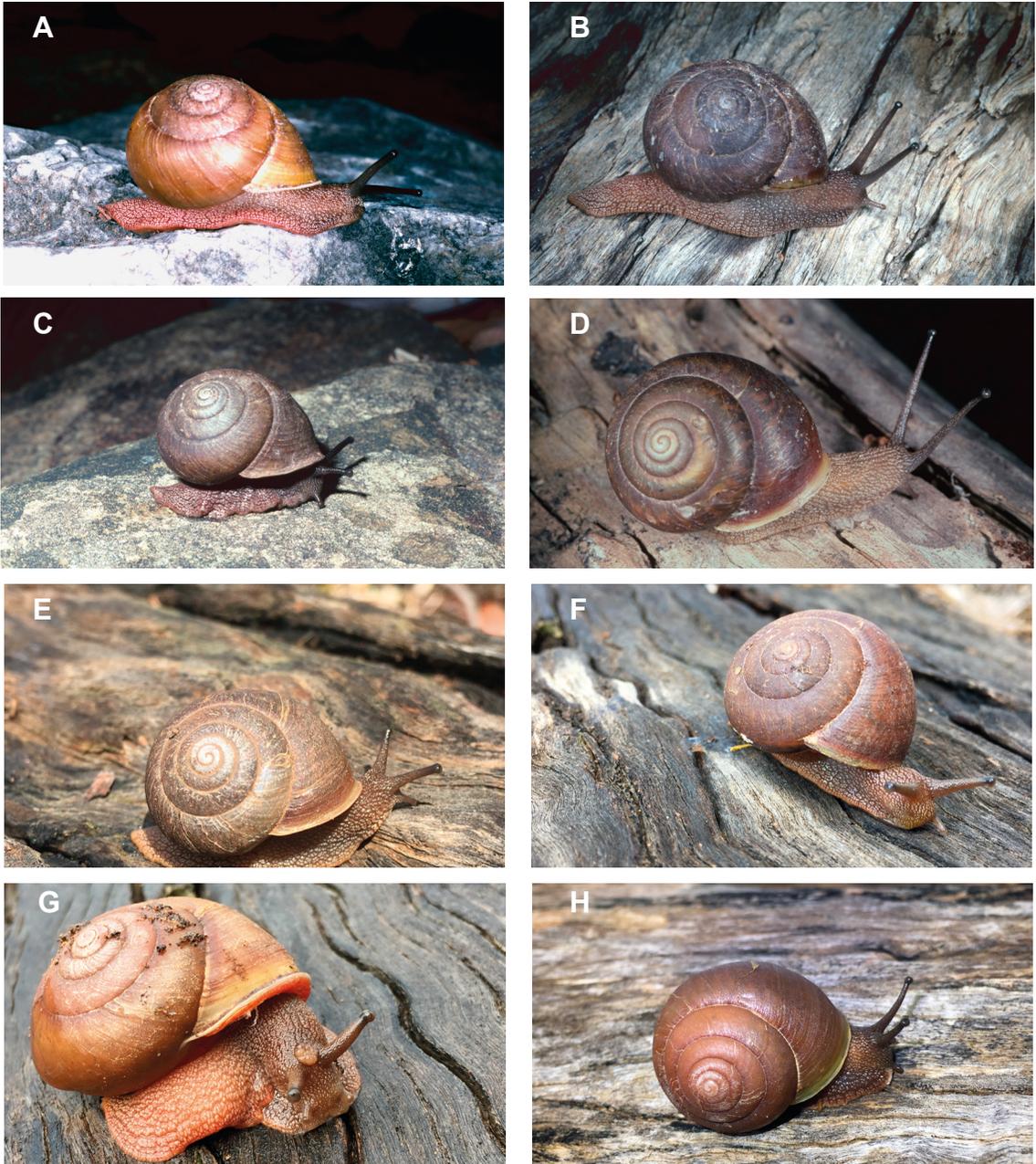


FIG. 19. **A**, *Pallidelix lonesome* sp. nov., QMMO65168, Lonesome NP, SCQ; **B**, *P. expeditiana* sp. nov., QMMO56544, NW of Taroom, SCQ; **C**, *P. potteri* sp. nov., QMMO44111, Charlevue Ck, SCQ; **D**, *P. mineroa* sp. nov., QMMO56625, Mt Zamia, Minerva Hills, SCQ; **E**, *P. expeditiana* sp. nov., Wallaroo Stn, SCQ; **F**, *P. lambkinae* sp. nov., QMMO86523, Stones Country Resource Reserve, SCQ; **G**, *P. staricki* sp. nov., QMMO86518, Strathblane Stn, SCQ. **H**, *P. expeditiana* sp. nov., QMMO85296, Fairview Holding, SCQ; Images: E-H, Craig Eddie.

the brigalow woodland communities. These vine thickets are vitally important not only for *Pallidelix* spp. and many other land snails but also for a range of other invertebrates. Their destruction has undoubtedly led to species' extinctions in the past and will continue to do so in the future unless the remaining patches (no matter how small) outside of conservation jurisdictions are provided with some formal protection.

This revision of *Pallidelix* should not be regarded as definitive. The study is based on many but mostly small, conchological datasets chiefly collected as dead shells and hence of variable quality for the study of sculptural features. Similarly animal datasets were scarce and in several cases the detail of reproductive anatomy is based on one or two specimens. The absence of sufficient and competent (fresh) material for molecular studies is considered a drawback that can and needs to be addressed in the future through additional field work if these proposed species are to be confirmed. This process will be difficult in what is now a fragmented landscape. The magnitude of this task is poignantly highlighted by the recent donation of 548 specimens of camaenids from the central highlands of which only seven represented live snails in spite of intensive searching by an expert field malacologist. However, this revision provides a roadmap for the collection of suitable animal material for genetic studies in the future by identifying species-level trends in the genus and the location of habitats in which these occur.

KEY TO THE GENUS *PALLIDELIX*

(Sculptural detail refers to the last three whorls of the teleoconch only)

1. Umbilicus closed, shell very large with greatly expanded body whorl, reduced sculpture to smooth on body whorl; Tanderra Stn, south of Springsure and environs *Pallidelix grandis* sp. nov.
 - Umbilicus a lateral crack, sculpture variable. 2
2. Body whorl greatly expanded, shell large, reduced sculpture on body whorl; Lonesome Section and environs, Expedition Range NP *Pallidelix lonesome* sp. nov.
 - Body whorl evenly expanded, shell

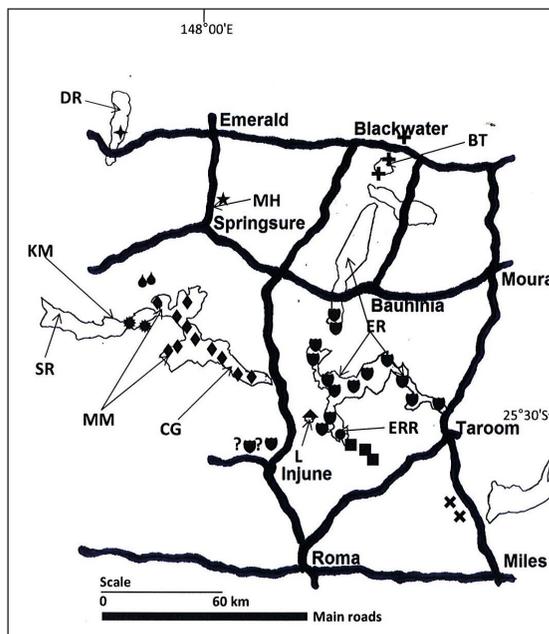


FIG. 20. Diagrammatic representation of *Pallidelix* distribution. ●, *P. greenhilli* (Cox, 1866); ▲, *P. lonesome* sp. nov.; ♥, *P. expeditiana* sp. nov. (?♥ = Crowman, Oakwells populations); +, *P. potteri* sp. nov.; ■, *P. staricki* sp. nov.; ×, *P. lambkinae* sp. nov.; ◆, *P. moffatt* sp. nov.; ★, *P. simonhudsoni* Stanisic, 2015; ◆, *P. grandis* sp. nov.; ★, *P. minerva* sp. nov.; ★, *P. zamia* sp. nov. [Locations: BT, Blackdown Tableland NP; CG, Carnarvon Gorge Section; DR, Drummond Range; ER, Expedition Range NP; ERR, Expedition Resource Reserve; KM, Ka Ka Mundi Section; L, Lonesome NP; MH, Minerva Hills; MM, Mount Moffatt Section; SR, Salvator Rosa Section].

- medium-sized to large 3
- 3. Spire moderately to strongly elevated, with prominent pustulation and reduced microridgelets; Carnarvon Station Reserve and Ka Ka Mundi Section, Carnarvon NP *Pallidelix simonhudsoni* Stanisic, 2015
 - Spire weakly to moderately elevated. 4
- 4. Spire weakly elevated, with prominent, crowded microridgelets and reduced pustulation; ESE of Injune to NE Miles 5
 - Spire moderately elevated 6
- 5. Prominent crowded microridgelets; ESE Injune: Spring Gully Stn, Nuggett Hills Stn, Pony Hills. *Pallidelix staricki* sp. nov.
 - Prominent crowded microridgelets;

- NE Miles: Gurulmundi SF
 *Pallidelix lambkinae* sp. nov.
6. Body whorl large, shell shiny with moderately spaced, prominent zigzag microridgelets and reduced pustulation; Expedition Resource Reserve and environs
 *Pallidelix greenhilli* (Cox, 1866)
 – Body whorl medium-sized with crowded microridgelets and variable pustulation .. 7
7. Pustulation and microridgelets equally prominent..... 8
 – Pustulation and microridgelets variable intensity 9
8. Weak microridgelets and coarse pustulation; Expedition Range NP
 *Pallidelix expeditiana* sp. nov.
 – Pustulation and microridgelets equally prominent; Carnarvon NP
 *Pallidelix moffatt* sp. nov.
9. Very prominent pustulation and reduced microridgelets; Minerva Hills
 *Pallidelix mineroa* sp. nov.
 – Reduced pustulation and very prominent microridgelets 10
10. Crowded oblique to zigzag microridgelets and scattered pustules; Blackdown Tableland NP and environs
 *Pallidelix potteri* sp. nov.
 – Crowded microridgelets and obsolete pustulation; Drummond Range
 *Pallidelix zamia* sp. nov.

ACKNOWLEDGEMENTS

This study could not have been successfully undertaken without the help of Roma-based environmental consultant and malacologist, Craig Eddie. His collecting efforts in the Roma-Injune-Carnarvon Range-Expedition Range area have contributed greatly to a more comprehensive understanding of the diversity and distribution of camaenids in the Queensland Central Highlands. I am extremely grateful to him for donating his material for study and for providing images of habitats and live snails. Thanks are also due to Darryl Potter (Collection Manager, Queensland Museum) and Lorelle Holcroft (Volunteer, Queensland Museum) for assistance with curation and databasing of specimens; to Alison Miller

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