

**Life history traits of cockroaches
in sugar-cane fields in La Réunion
(Blattodeae : Blattellidae and Blaberidae)**

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ABSTRACT

As there are no descriptions of immature stages and of the life history traits of the seven cockroach species found in sugar-cane fields in La Réunion, their development was followed from egg to adult under laboratory conditions. Six Blattellidae species: *Blattella lituricollis* (Walker), *Blattella biligata* (Walker), *Balta longicercata* (Bolivar), *Scalida latiusvittata* (Brunner), *Margattea nimbata nimbata* Shelford, *Lobopterella dimidiatipes* (Bolivar) and one Blaberidae species: *Pycnoscelus surinamensis* (L.) are described.

Key words: Cockroaches, Description, Life history traits, La Réunion.

INTRODUCTION

In La Réunion, large populations of cockroaches are found in sugar-cane fields, which is the main cultivated crop. La Réunion is an oceanic island situated in the Indian ocean, approximately 700 km east of Madagascar (21°06 S, 55°36 E) and has a tropical climate. Sugar-cane is cultivated at low altitudes all around the island. The absence of insecticide treatments in sugar-cane fields allows many arthropods, including cockroaches to develop. Cockroaches do not affect the development and productivity of sugar-cane. These cockroaches are omnivorous, they eat animal remains and decaying vegetation and occupy an important place in the food web as they are preyed on by many spiders and ants. Their presence can be related to water resources as most of the fields are irrigated and to the presence of abundant layers of leaf litter.

Seven species of cockroaches were collected in sugar-cane fields in La Réunion (Roth & Rivault 2002, Boyer & Rivault 2003). Six of the species collected: *Blattella lituricollis* (Walker), *Blattella biligata* (Walker), *Balta longicercata* (Bolivar), *Scalida latiusvittata* (Brunner), *Margattea nimbata nimbata* Shelford, and *Lobopterella dimidiatipes* (Bolivar) belong to the Blattellidae family. The seventh species: *Pycnoscelus surinamensis* (L.) belongs to the Blaberidae family. Although these species are widely distributed in Asia, in Oceania and on Pacific and Indian Ocean islands (Roth 1985, 1989, 1990, 1991, 1996, 1999, 2000, Roth & Rivault 2002), the description of all their developmental stages, their life history traits and their ecology are lacking. Species descriptions are based on adult males, and they generally represent the only features known. In a population most of the individuals are immature, and they have not yet been described.

As there are no descriptions of immature stages and life history traits of the seven cockroach species found in sugar-cane fields in La Réunion, their development was followed from egg to adult under laboratory conditions for further ecological studies. Descriptions of the habitus of adults and of immatures are given for each species.

MATERIALS AND METHODS

Specimens were collected from different sugar-cane fields on La Réunion (Saint Benoît, Savannah): *Blattella lituricollis* and *Blattella biligata* were collected in May 2000; *Balta longicercata*, *Scalida latiusvittata*, *Margattea nimbata nimbata*, *Lobopterella dimidiatipes* and *Pycnoscelus surinamensis* were collected in October 2002.

Collected individuals were reared in the laboratory in plastic boxes. These breeding containers included cardboard shelters, a damp sponge and dog food pellets *ad libitum*.

Pycnoscelus surinamensis, a burrowing species, were provided a layer of wood shavings covering the bottom of the container. The containers were placed in a climatized chamber, with an average temperature of 28°C and an artificial 12 h light - 12 h dark photoperiod (LD: 12-12).

The oothecae produced by females belonging to species that deposit their oothecae were collected regularly and placed in smaller containers. As soon as they hatched, all the larvae from a given ootheca were placed in a new breeding container and were kept together until they became adult.

All the females belonging to species that carry oothecae were placed individually in breeding containers as soon as they became gravid and were kept there until their ootheca hatched. Females were then removed and the sibling larvae were left there together until they became adult.

All the containers were observed three times a week and the following parameters were recorded:

- The date of extrusion of each ootheca.
- The deposition site of oothecae: 1) on the sponge; 2) on the floor of the container; or 3) stuck onto the container or onto the cardboard shelter.
- The number of eggs inside each ootheca.
- The ootheca hatching date.
- The number of larvae from each ootheca.
- The dates of each successive moult of each individual.
- The dates of emergence of adults.
- The numbers of male and female adults per ootheca.
- The date any cockroach died.
- The size of adult males: pronotum width and body length (from head to the tip of the wings or the tip of the abdomen) were measured.
- The size of oothecae (width and length) was measured.

From these data the following parameters were calculated:

- The duration between the imaginal moult and the production of the first ootheca.
- The duration of the interval between the production of two successive oothecae.
- The duration of the carrying period.
- The duration of incubation of deposited oothecae.
- The oothecal hatching rates calculated as the number of oothecae that hatched divided by the number of oothecae produced.
- The larval hatching rates, calculated as the number of larvae that hatched divided by the number of eggs in an ootheca.
- The duration of each larval instar.
- The duration of larval development from hatching until the imaginal moult.
- The survival rates of larvae, calculated as the number of adults divided by the number of larvae that hatched.
- The sex-ratio of adults.
- The life expectancy of adults.

table 1: Life history parameters for adults and larvae of seven cockroach species bred under laboratory conditions. Legend: B.li. = *Blattella lituricollis*; B.bi. = *Blattella biligata*; B.lo. = *Balta longicercata*; S.la. = *Scalida latiusvittata*; M.ni.ni. = *Margattea nimbata nimbata*; L.di. = *Lobopterella dimidiatipes*; P.su. = *Pycnoscelus surinamensis*.

Duration (in days)		B.li.	B.bi.	B.lo.	M.ni.ni.	S.la.	L.di.	P.su.
Larval development	Mean	40.12	76.09	81.30	79.35	100.31	63.83	139.75
	SE	0.25	0.46	0.74	1.39	1.53	0.77	2.19
	Range	55-36	96-58	60-130	62-133	78-129	52-92	129-160
	n	212	323	240	130	55	206	16
1st instar	Mean	4.72	9.75	10.85	14.70	12.91	10.58	19.74
	SE	0.13	0.14	0.12	0.31	0.28	0.17	0.64
	Range	4-6	8-12	8-15	5-26	8-22	5-15	17-34
	n	32	32	139	149	127	179	50
2nd instar	Mean	5.27	10.30	12.21	14.52	12.78	9.74	23.56
	SE	0.09	0.16	0.23	0.43	0.42	0.18	1.24
	Range	4-6	9-13	8-18	5-26	17-27	7-15	15-31
	n	30	30	86	98	40	160	18
3rd instar	Mean	5.72	10.73	13.58	13.41	15.15	9.03	17.20
	SE	0.18	0.16	0.38	0.48	0.57	0.09	0.32
	Range	5-9	10-13	10-22	6-25	10-25	8-13	13-22
	n	29	30	67	75	47	168	60
4th instar	Mean	5.88	11.67	15.82	13.33	19.49	11.08	19.35
	SE	0.15	0.24	0.30	0.39	0.98	0.24	0.45
	Range	5-7	9-13	12-19	8-26	10-36	8-18	15-25
	n	24	27	55	86	49	122	95
5th instar	Mean	6.08	11.40	14.81	15.62	15.63	11.53	19.86
	SE	0.15	0.22	0.24	0.63	0.61	0.16	0.40
	Range	5-8	9-13	9-20	7-25	10-27	8-18	13-22
	n	25	25	93	65	49	126	63
6th instar	Mean	6.77	11.89	15.15	15.37	14.45	12.55	39.64
	SE	0.17	0.17	0.31	0.35	1.12	0.27	1.76
	Range	5-9	10-13	11-21	8-26	11-24	10-18	29-45
	n	22	18	67	130	11	71	11
7th instar	Mean	-	12.00	-	-	-	-	-
	SE	-	0.18	-	-	-	-	-
	Range	-	10-13	-	-	-	-	-
	n	-	13	-	-	-	-	-
Adult life	Mean	191.38	186.60	98.40	158.75	108.18	106.57	-
	SE	7.69	4.32	7.11	3.93	4.83	18.45	-
	Range	140-220	164-203	57-129	140-178	88-127	42-156	-
	n	13	10	16	12	11	7	-
Survival rate of larvae (n = number of oothecae)	Mean	0.61	0.56	0.43	0.42	0.32	0.71	1.00
	SE	0.04	0.07	0.06	0.07	0.06	0.06	0.00
	Range	0.44-0.86	0.19-0.86	0.12-0.80	0.12-0.83	0.17-0.68	0.35-1.00	1.00
	n	12	10	13	11	9	12	6
Adult Sex Ratio	Males	177	119	47	53	22	89	0
	Females	161	110	46	62	20	86	37
	Ratio	1.1	1.1	1.0	0.9	1.1	1.0	0.0

RESULTS

The collected specimens of the seven species survived and reproduced under our laboratory conditions. All these species reproduce sexually, except *Pycnoscelus surinamensis*, which reproduce through thelytokous parthenogenesis (Cornwell, 1968). Under laboratory conditions, sex-ratios of all species were close to 1:1, except for *Pycnoscelus surinamensis*, which produced only females (table 1).

1. *Blattella lituricollis* (Walker) (Blaberoidea: Blattellidae: Blattellinae)

Blattella lituricollis has been reported from Africa, South Asia and many islands of the Pacific and Indian Oceans (Roth 1985, 2000, Roth & Rivault 2002).

Habitus: Their bodies are 10.6 ± 0.013 mm long and their pronotums are 2.9 ± 0.03 mm wide. Adults are generally pale yellowish brown, with two distinct dark parallel bands running the length of the pronotum. Both sexes are fully winged. Their legs are yellowish and translucent. Their antennae are yellowish brown and reach the tip of the abdomen (Fig. 1a).

Larvae are black with a large yellowish spot on the pronotum continuing posteriorly onto the meso- and meta-nota. The coloured spot is limited to the thorax of the three first instar larvae. The colour pattern on the thorax of 4th, 5th and 6th instar larvae is similar but these larvae have, in addition, a pale yellowish margin and each abdominal segment presents two small yellowish dots each side of the medial line (Figs. 2a, 3a).

Oothecae ($4.9 \pm 0.16 \times 2.3 \pm 0.05$ mm) are large compared to the bodies of the females. Oothecae are light reddish brown, lightly sclerotized and thinner at the anterior ends. They are rather flattened and slightly curved (Fig. 4a).

Life history traits: *Blattella lituricollis* has six larval instars before the imaginal moult, total larval development lasts approximately 40 days (table 1), this is the shortest development duration of all the species studied here. Larval survival rate from hatching to the imaginal moult was 61% under our experimental conditions. Females do not deposit their oothecae as soon as they are formed, but they carry them externally until, or shortly before, the eggs hatch. This corresponds to Cornwell's type 3 oviparity (1968). The first oothecae appear 10 days after the imaginal moult, then the interval between successive oothecae is about 25 days (table 2). Oothecae are carried for 15 days, vertically at first then horizontally for the duration of incubation. On average 28 larvae hatched from one ootheca and larval survival rate at hatching was 90%.

Habitat: In sugar cane fields, adults and larvae are found in the leaf litter. The larvae escape by running on the ground and the adults have functional wings and can fly away. This species is present on patches with important differences in humidity, which can vary from very wet to very dry.

2. *Blattella biligata* (Walker) (Blaberoidea: Blattellidae: Blattellinae)

Blattella biligata has been found in Africa, India, South Asia, and Indian Ocean Islands (Roth 1985, Roth and Rivault 2002).

Habitus: Adults (pronotum width: 3.9 ± 0.07 mm ; body length: 14.2 ± 0.22 mm), are yellowish brown, with no bands on the pronotum. Males and females are fully winged. Their legs are yellowish and translucent. Their antennae are yellowish brown and reach the tip of the abdomen (Fig. 1b).

table 2: Oothecae production and parameters of seven cockroach species bred under laboratory conditions. Legend: see table 1. *: Interval between imaginal moult and hatching of the first ootheca.

		B.li.	B.bi.	B.lo.	M.ni.ni.	S.la.	L.di.	P.su.
Eggs per ootheca	Mean	31.66	42.64	26.00	23.28	29.36	20.18	36
	SE	0.49	0.40	0.63	0.65	0.44	0.17	-
	Range	24-38	36-50	22-30	10-30	20-34	17-22	36
	n	50	50	50	50	50	50	1
Larval hatching rate	Mean	28.37	34.39	25.00	21.29	23.14	16.48	25.30
	SE	0.84	1.63	0.49	0.45	1.30	0.31	2.33
	Range	19-38	18-47	20-30	17-26	18-32	12-20	16-39
	n	35	23	32	24	14	48	10
Oothecal hatching rate	rate	0.90	0.81	0.96	0.91	0.79	0.82	0.70
	Oothecae	12	12	140	42	100	200	12
	Hatch rate	0.83	0.83	0.23	0.57	0.14	0.24	0.83
Carrying period (in days)	Mean	15.69	22.00	1.46	1.33	1.19	1.05	-
	SE	0.41	0.57	0.13	0.13	0.11	0.08	-
	Range	12-17	19-24	1-2	1-2	0.5-2	0.5-2	-
	n	13	8	13	15	18	21	-
Incubation of deposited oothecae (in days)	Mean	-	-	24.45	21.53	29.88	33.36	-
	SE	-	-	0.42	0.89	0.71	0.36	-
	Range	-	-	20-27	17-29	26-36	29-37	-
	n	-	-	20	17	16	34	-
Oothecae deposition site	Sponge	-	-	5	61	147	114	-
	Floor	-	-	1	230	15	10	-
	Stucked	-	-	242	0	0	0	-
	n	-	-	248	291	162	124	-
Interval between imaginal moult and extrusion of 1st Ootheca (in days)	Mean	10.58	10.06	15.35	17.33	13.62	9.65	47.25*
	SE	0.80	0.37	0.81	0.98	1.59	0.57	0.80
	Range	6-18	8-13	11-20	11-30	8-25	6-18	42-52
	n	12	16	17	24	13	26	12
Interval between two oothecae (in days)	Mean	24.78	30.67	10.75	9.14	7.25	5.15	50.00
	SE	0.40	0.95	0.38	0.40	0.41	0.19	6.00
	Range	21-28	29-35	9-12	7-10	6-9	4-8	44-56
	n	18	6	7	7	8	21	2

During the first four instars, larvae are dark brown with a large yellowish spot covering the pro-, meso- and metanota leaving a dark margin around the whole thorax. 5th, 6th and 7th instar larvae are yellowish with dark brown markings. They have two dark bands each side of the thorax and a large median band with blurred outlines on the abdominal segments. Seventh instar larvae have an important droplet of glue on each cerca (Figs. 2b, 3b).

Oothecae measure 6.8 ± 0.07 mm x 3.0 ± 0.06 mm and are light reddish brown and slightly sclerotized (Fig. 4b).

Life history traits: *Blattella biligata* has seven larval instars (table 1). A slower development and the presence of a seventh instar induce a total duration of larval development of 76 days. Larval survival rate was 56% under our experimental conditions. The first ootheca appears 10 days after the imaginal moult, then the interval between successive oothecae is about 30 days (table 2). Females carry their oothecae vertically at first then horizontally for all the duration of incubation (22 days). This corresponds to Cornwell's type 3 oviparity (1968). The number of larvae per ootheca was approximately 34 and hatching success was 81%.

Habitat: In sugar cane fields, adults and larvae are found in and on the leaf litter. Larvae escape by running away, whereas adults fly away if the environment is open enough and find shelter further away in the leaf litter and the vegetation. This species is often found on dry grounds with an abundant litter.

3. *Balta longicercata* (Bolivar) (Blaberoidea: Blattellidae: Pseudophyllodromiinae)

Balta longicercata has been reported only from Indian Ocean islands (Bolivar 1924, Roth 1991a, 1996, Roth and Rivault 2002).

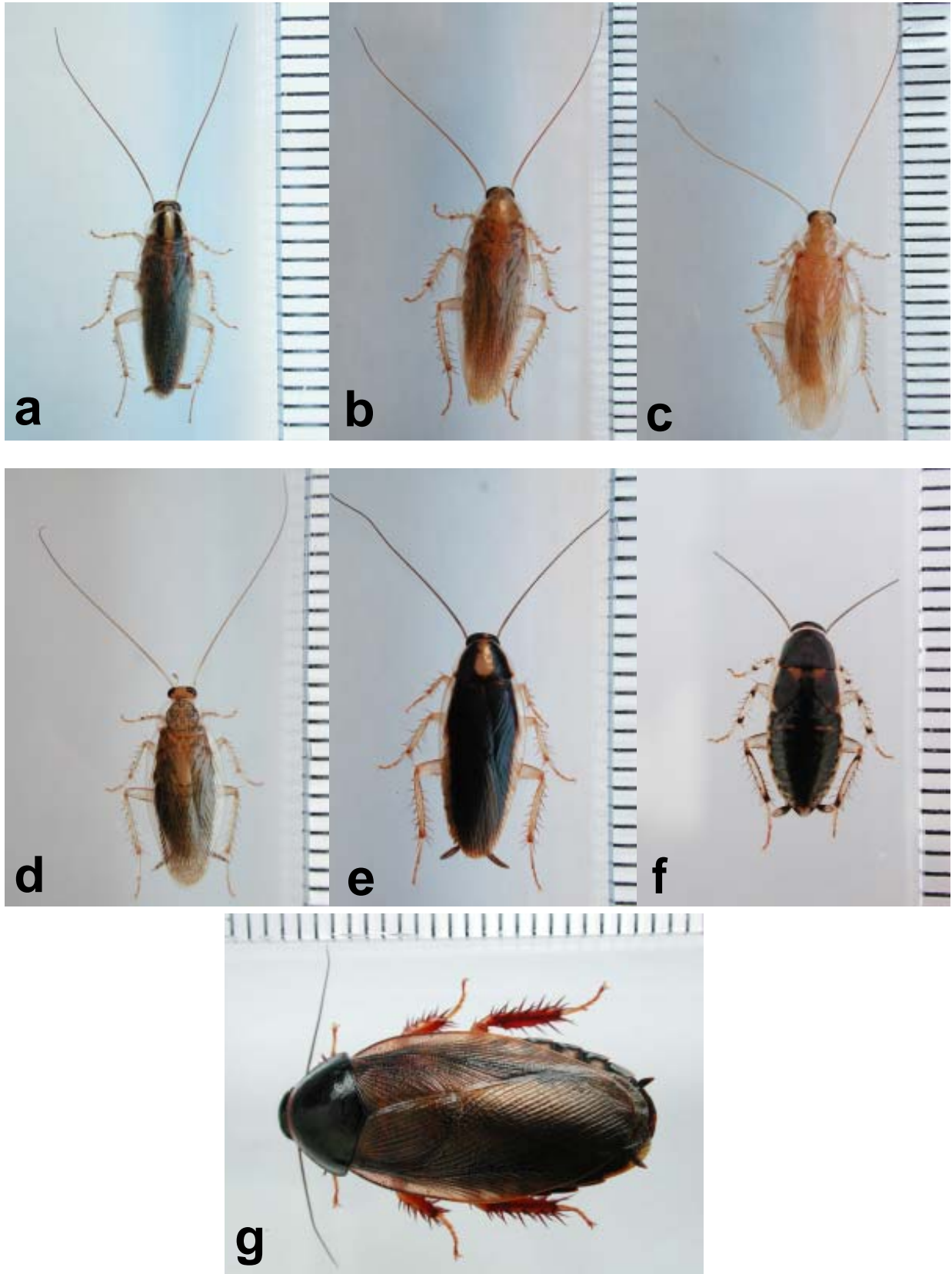
Habitus: This species measures 3.7 ± 0.09 mm x 13.5 ± 0.26 mm. Adults are pale yellow without any markings, their bodies and their legs are nearly translucent. Their antennae are pale yellow and reach beyond the tip of the abdomen. Adults of both sexes are fully winged (Figs. 1c). Larvae have pale yellow nearly translucent bodies, the posterior margin of each abdominal segment is dotted with little brown dots. Their legs and their antennae are nearly translucent (Figs. 2c, 3c).

Oothecae are rigid slightly curved (5.4 ± 0.12 mm x 2.2 ± 0.05 mm). They vary from pale green at the beginning of their formation to reddish dark brown when hatching (Fig. 4c).

Life history traits: Larval development of this species includes six instars (table 1). Average larval development lasts 81 days. Survival rate of larvae was 43%. On average 25 larvae hatched from one ootheca (table 2). The interval between imaginal moult and formation of the first ootheca was 15 days. The interval between the formation of two successive oothecae was 11 days. Oothecae are carried for 1 or 2 days, vertically at first then horizontally and then they are deposited long before the eggs hatch. The oothecae contain sufficient water for the entire embryological development and external incubation lasts approximately 24 days. This corresponds to Cornwell's type 1 oviparity (1968). The formation of the embryos is well advanced when the oothecae are deposited and stuck onto the substrate. Under laboratory conditions, *Balta longicercata* stuck their oothecae strongly in a corner of the container or on the cardboard shelter (table 2).

Habitat: In the sugar-cane fields, females stick their oothecae on leaves still on the plant. Adults are generally found above ground, hidden in the petioles of dry leaves that have remained attached to the plant. They escape mainly by flying away. Larvae may be found in the petioles of green leaves or among dry leaves in the litter. Larvae escape by short jumps a few centimetres long and search for refuge in sugar-cane leaves. This species is present in all the sugar-cane fields where dry leaves are abundant.

Fig. 1. Habitus of adult male: (a) *Blattella lituricollis*; (b) *Blattella biligata*; (c) *Balta longicercata*; (d) *Margattea nimbata nimbata*; (e) *Scalida latiusvittata*; (f) *Lobopterella dimidiatipes*; (g) *Pycnoscelus surinamensis*. One interval between two graduations equals 1 mm.



4. *Margattea nimbata nimbata* Shelford (Blaberoidea: Blattellidae: Pseudophyllodromiinae)

Margattea nimbata nimbata has been recorded from India and from Pacific Ocean islands and Indian Ocean islands (Roth 1989, 1990, 1991a, 1999, 2000, Roth and Rivault 2002).

Habitus: Adults measure 2.9 ± 0.03 mm x 10.7 ± 0.19 mm. They are yellowish or light brown, with a complex arabesque pattern on the centre of their pronotums. The lateral edges of their pronotums are translucent. Adults of both sexes are winged, their wings are translucent and checkered with many dots. The legs of adults are translucent without any markings. Their antennae are pale yellow and reach beyond the tip of the abdomen (Fig. 1d).

Larvae are lighter than adults, with lines and dots on their mesotums, metanotums and their abdomens are mottled ventrally. Their pronotums resemble those of adults, their legs and their cercae are translucent and checkered with dark dots (Figs. 2d, 3d).

Oothecae measure 3.7 ± 0.28 mm x 1.9 ± 0.03 mm. They are dark reddish brown, curved and very rigid (Fig. 4d).

Life history traits: Larval development includes six instars and lasts 80 days on average (table 1). Larval survival rate was 42%. The interval between imaginal moult and formation of the first ootheca was about 17 days, intervals between successive oothecae approximated 9 days (table 2). Oothecae are carried for 1 or 2 days vertically at first then horizontally. External incubation lasted approximately 21 days and an average of 21.29 larvae hatched from one ootheca. The formation of the embryos is well advanced when oothecae are deposited and stuck onto the substrate. This corresponds to Cornwell's type 1 oviparity (1968). Under our rearing conditions females deposited their oothecae on the damp sponges (table 2). In the field, some oothecae were found buried in damp soil. The presence of abundant water appears to be an important factor for the development of oothecae.

Habitat: In sugar cane fields, *Margattea nimbata nimbata* was found on relatively damp, not very granulous soils. The adults are winged and can escape by flying away. The larvae run away over the ground and shelter among the dry leaves in the litter or in a hole in the ground. They can freeze in the litter without attempting to hide or escape, their colours give them an efficient camouflage.

5. *Scalida latiusvittata* (Brunner) (Blaberoidea: Blattellidae: Blattellinae)

Scalida latiusvittata has been reported from India, South Asia and Indian Ocean islands (Roth 1991b, 1999, 2000, Roth & Rivault 2002).

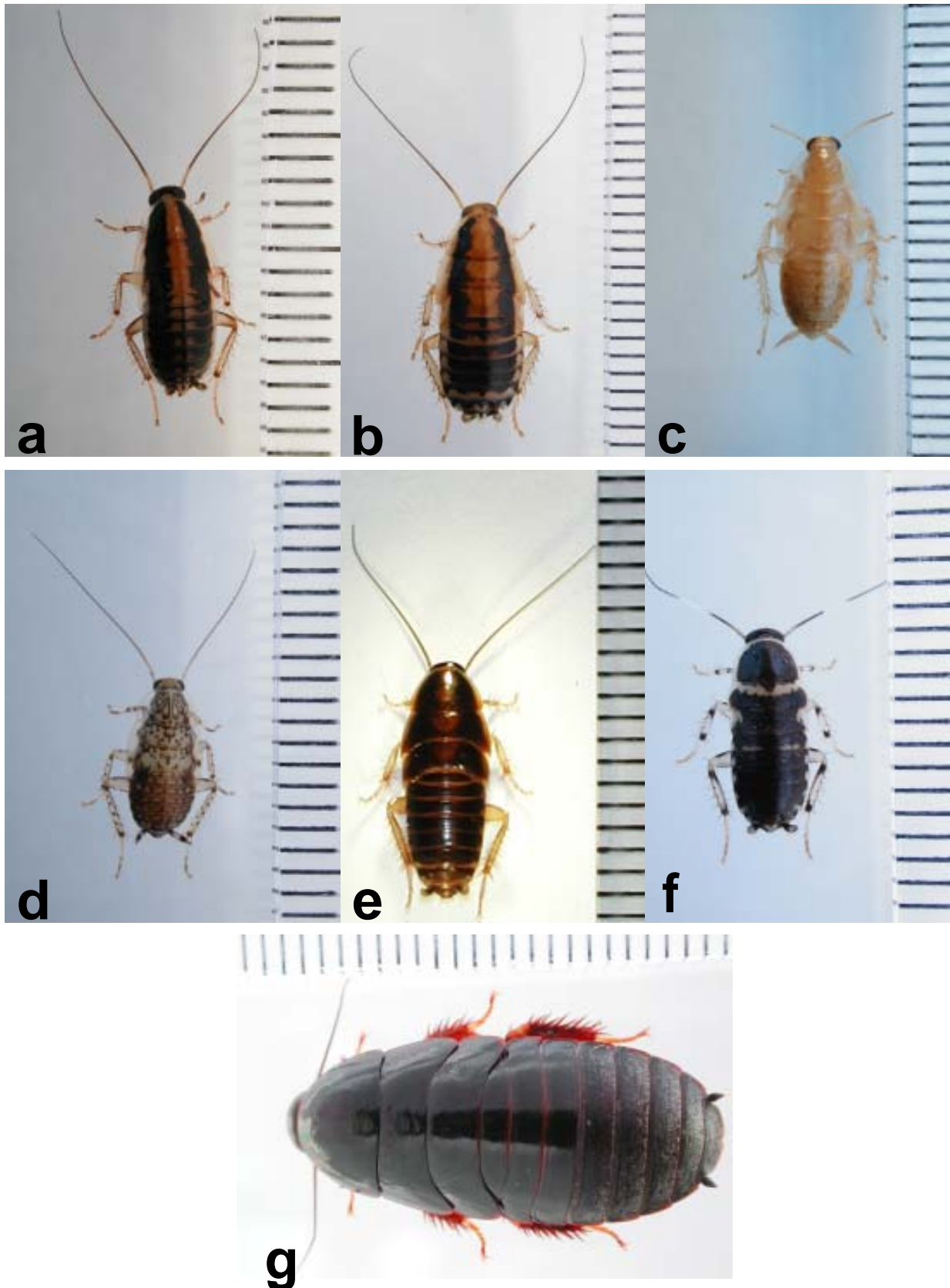
Habitus: This cockroach is shining dark brown (3.4 ± 0.08 mm x 12.2 ± 0.21 mm) with a paler margin around the whole body. Both sexes are winged. Adults have yellowish brown pronotums with a large dark brown U-shaped macula. Their legs are light brown. Their antennae are dark brown and reach the tip of their abdomens (Fig. 1e).

First and second instar larvae have two white bands on their bodies, across the anterior margin of the mesonotum segments, and one white band on the tips of their antennae. Older larvae are dark brown with two lighter brown spots on the mesonotum. Their antennae do not have any white bands (Figs. 2e, 3e).

Oothecae (5.8 ± 0.09 mm x 2.1 ± 0.03 mm) are reddish brown and curved. When deposited on the substrate, they are very flat with longitudinal grooves on the cuticular envelope of the oothecae (Fig. 4e).

Life history traits: Larval development includes six instars and lasts 100 days on average (table 1). Thirty two percent of the larvae that hatched became adult. Rearing this species is delicate because of its strong dependence on humidity. The production of oothecae was rapid, the first ootheca was formed 14 days after the imaginal moult, and then the

Fig. 2. Habitus of old larvae: (a) *Blattella lituricollis* 6th instar; (b) *Blattella biligata* 7th instar; (c) *Balta longicercata* 6th instar; (d) *Margattea nimbata nimbata* 6th instar; (e) *Scalida latiusvittata* 6th instar; (f) *Lobopterella dimidiatipes* 6th instar; (g) *Pycnoscelus surinamensis* 6th instar. One interval between two graduations equals 1 mm.



successive oothecae appeared at weekly intervals (table 2). The oothecae are carried only for 1 day, vertically at first and then horizontally. As they are deposited 30 days before the eggs hatch, this corresponds to Cornwell's type 1 oviparity (1968). Under our rearing conditions, the oothecae were deposited on the damp sponge (table 2). The presence of water appears to be important, not only for the survival of larvae and of adults, but also for the oothecae to develop normally. Oothecae, quite flat when deposited, absorb water from the substrate and swell very rapidly. The longitudinal grooves, close together in recently deposited oothecae, became part and disappeared as the oothecae absorb water (Fig. 4e). The number of larvae per ootheca was 23 on average and larval hatching success is 79%.

Habitat: In sugar cane fields, adults as well as larvae are found on relatively wet, not very granulous soils. In the field a few oothecae were found buried in damp soil. Adults and larvae are found on the ground, under the leaf litter. Although the adults are winged, they fly only very rarely and prefer to escape by running away or by hiding in a hole in the ground.

6. *Lobopterella dimidiatipes* (Bolivar) (Blaberoidea: Blattellidae: Blattellinae)

Lobopterella dimidiatipes is present on Indian Ocean islands (Roth 2000, Roth & Rivault 2002).

Habitus: Their bodies are shining black with a pale margin around their whole bodies. Males and females have micropterous wings that cover their mesonotums. Each wing has a light brown dot on the anterior margin. They measure 9.8 ± 0.24 mm from head to the tip of the abdomen and their pronotums are 3.3 ± 0.07 mm wide. Adults have a pair of rectangular pale maculae on the second abdominal segment. Their legs are translucent and checkered with dark dots. Their antennae are dark brown and do not reach the tip of their abdomens (Fig. 1f).

Larvae are shining black with a white band across the anterior margin of the mesonotum, and a pair of rectangular pale maculae on the second abdominal segment. A white band is present in the middle of their antennae (Figs. 2f, 3f).

They produce light reddish brown ovoid, rigid oothecae (4.9 ± 0.12 mm x 2.3 ± 0.05 mm) with a thin translucent envelope that becomes yellow and peels off during incubation (Roth 1967) (Fig. 4f).

Life history traits: Larval development includes six instars and lasts 64 days on average (table 1). The first oothecae were produced 9 to 10 days after the imaginal moult (table 2). The subsequent oothecae were deposited at 5 day intervals. The oothecae are carried for one day, vertically at first then horizontally. They are then deposited, 33 days before the eggs hatch. Oothecae include 16 larvae and larval survival rate was 71% (table 1). Oothecae do not require additional water from the substrate to reach maturity. Under laboratory conditions females deposited their oothecae on the floor of the container (table 2). In the field, a few oothecae were observed either buried in the ground or deposited on dry soil.

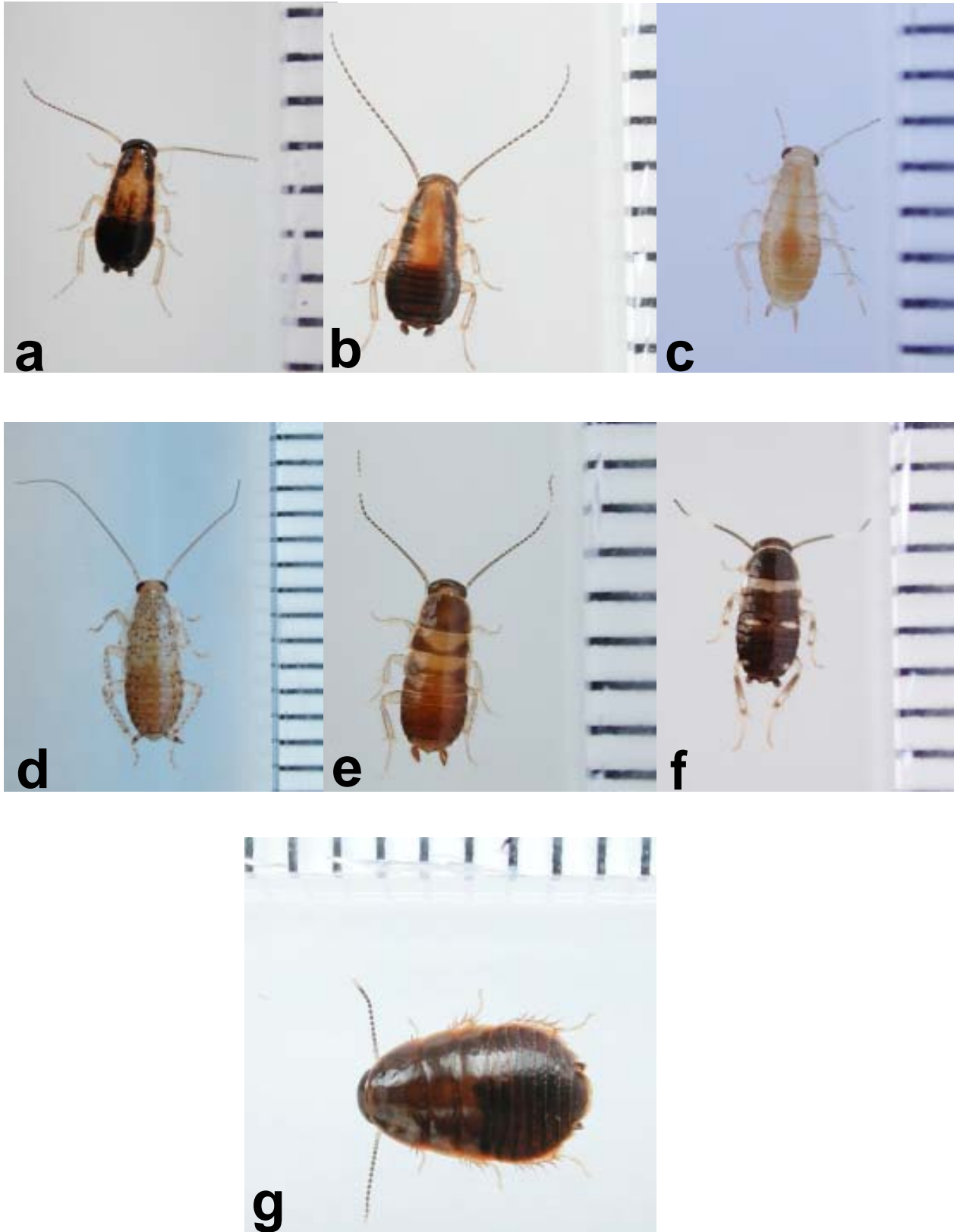
Habitat: In sugar cane fields, *Lobopterella dimidiatipes* are found on rather damp and not very granulous grounds. The adults and larvae move about mainly on the ground under the leaf litter. Their only escape modality is fleeing, as adults are micropterous. First and second instar larvae move very slowly, whereas the adults run very quickly.

7. *Pycnoscelus surinamensis* (Linnaeus) (Blaberidae: Pycnoscelinae)

Pycnoscelus surinamensis is a peridomestic species distributed world wide (Roth 1998, Parker *et al.* 1977, Parker & Niklasson 1995).

Habitus: These cockroaches are large (7.8 ± 0.11 mm x 25.3 ± 0.37 mm) with yellowish wings that reach the tip of their abdomens. Their black pronotums have a sinuate posterior margin and a yellowish band on the anterior margin. Their legs are dark reddish brown with

Fig. 3. Habitus of young larvae: (a) *Blattella lituricollis* 2nd instar; (b) *Blattella biligata* 2nd instar; (c) *Balta longicercata* 2nd instar; (d) *Margattea nimbata nimbata* 3rd instar; (e) *Scalida latiusvittata* 2nd instar; (f) *Lobopterella dimidiatipes* 2nd instar; (g) *Pycnoscelus surinamensis* 2nd instar. One interval between two graduations equals 1 mm.



strong spines and are adapted for burrowing. Their antennae are dark brown and only reach the middle of their bodies (Fig. 1g).

Larvae are blackish brown. Their heads, pronotums, mesonotums and first three abdominal terga are shiny black, the remaining abdominal terga are dull black (Figs. 2g, 3g).

Their oothecae are retained within the abdomen (3.9 ± 0.04 mm x 12.1 ± 0.07 mm), the eggs are milky white and enclosed in a fine and flexible transparent membrane (Fig. 4g).

Life history traits: Larval development includes six instars and lasts 140 days (table 1). Zappe's (1918) biological data concerning *Pycnoscelus surinamensis* gave a larval development of over 200 days for individuals raised under uncontrolled temperature conditions, compared to 140 days under our rearing conditions, at 28° C. This species is ovoviviparous. The oothecae are visible only when females extrude and then retract them into the brood sac for incubation where they remain until the eggs hatch (Cornwell 1968). The first ootheca hatched 47 days after the imaginal moult, and successive oothecae hatch every 50 days (table 2). Each ootheca included 36 eggs and all the larvae that hatched in the laboratory became adult. Our experimental breeding conditions appear to be optimal for this species.

All the adults were females. A whole year of prospection in sugar cane fields yielded only females and all collected females subsequently bred in the laboratory produced only females. This indicates that this species is strictly parthenogenetic and is not *Pycnoscelus indicus* (Roth 1967).

Habitat: In sugar cane fields, adults and larvae are found in rather dry loose soils that enable them to bury themselves easily. When discovered, they attempt to bury deeper down. Adult females are winged but do not fly.

DISCUSSION

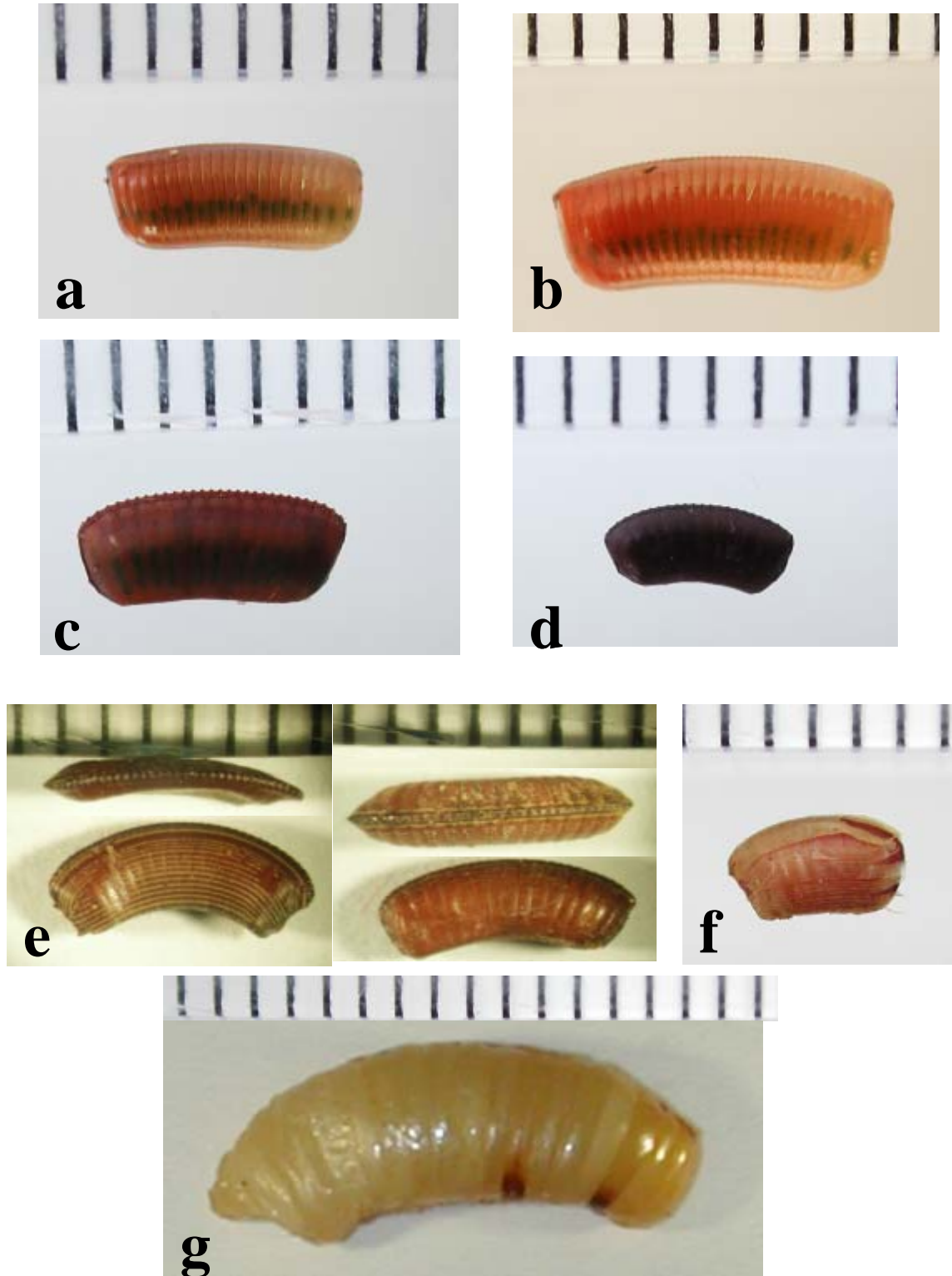
This study presents life history traits for seven cockroach species reared under controlled laboratory conditions. All these species were found in sugar-cane fields (Boyer & Rivault 2003). Although larval survival rates and oothecal hatching rates were higher for the peridomestic *Pycnoscelus surinamensis* than for the six Blattellidae species studied, all the species flourished under our laboratory conditions.

Species that deposit their oothecae long before hatching (*Balta longicercata*, *Scalida lativittata*, *Margattea nimbata nimbata* and *Lobopterella dimidiatipes*), have oothecae with relatively few eggs, low oothecae hatching rates, but short intervals between the formation of successive oothecae. Thus, females of these species invest less in each ootheca than species that carry their oothecae until hatching (*Blattella lituricollis*, *Blattella biligata* and *Pycnoscelus surinamensis*). Females that carry their oothecae until hatching have relatively more eggs per ootheca, higher hatching rates and longer intervals between the formation of successive oothecae. Thus, investment in each ootheca is important.

Females of species that deposit their oothecae, chose deposition sites where the environmental conditions are suitable for the future development and hatching of the oothecae. Oothecae deposited in a dry atmosphere contain sufficient quantities of water for the eggs to develop (*Lobopterella dimidiatipes*, *Balta longicercata*), whereas oothecae deposited in damp soil do not contain sufficient water for the eggs to develop and depend therefore on the environmental humidity (*Margattea nimbata nimbata*, *Scalida lativittata*). These two species rely on a high constant level of humidity to develop. Their establishment in sugar-cane fields might be related to irrigation that fulfill these requirements. The other species can survive longer periods of drought more easily.

Adult lifespans of the four species that deposit their oothecae long before hatching are shorter than those of the three species that carry their oothecae until hatching (table 2).

Fig. 4. Oothecae: (a) *Blattella lituricollis*; (b) *Blattella biligata*; (c) *Balta longicercata*; (d) *Margathea nimbata nimbata*; (e) *Scalida latiusvittata* left: recently deposited ootheca, right: older ootheca distended with water ; (f) *Lobopterella dimidiatipes*; (g) *Pycnoscelus surinamensis*. One interval between two graduations equals 1 mm.



Here, we stressed important differences in the life history traits of these seven species that live in the same habitat. These biological parameters, obtained from descendants of wild populations, can be readily used in population development models that are useful to understand the structure of the populations in sugar-cane fields and to assess the invasive capacity of the different species.

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