

# Donkey's Eyes, *Junonia* spp. (Lepidoptera, Nymphalidae), in Trinidad and Tobago

Matthew J.W. Cock

CABI, Bakeham Lane, Egham TW20 9TY, UK

*m.cock@cabi.org / mjwcock@btinternet.com*

## ABSTRACT

There are two common species of *Junonia* in Trinidad and Tobago, which have been confused together under the local name 'donkey's eye': *J. zonalis* C. Felder and R. Felder and *J. genoveva genoveva* (Cramer). There is also a local, mangrove-feeding species, *J. litoralis* Brévignon, found in Trinidad but not reported from Tobago. Characters are presented to facilitate identification of adults in the field and from images.

Key words: *Junonia zonalis*, *Junonia genoveva*, *Junonia litoralis*, *Ruellia tuberosa*, *Avicennia germinans*

## INTRODUCTION

Donkey's eye is the common name used in Trinidad and Tobago (Barcant 1970) for two of the three species of *Junonia* (Lepidoptera, Nymphalidae, Nymphalinae) that occur there (Cock 2014). Barcant (1970) treated these two species as a single common species found everywhere in Trinidad and Tobago. However, there are two common species of *Junonia* in Trinidad and Tobago, which had been confused together as the donkey's eye: *J. zonalis* C. Felder and R. Felder and *J. genoveva genoveva* (Cramer). There is also local, mangrove-feeding species, *J. litoralis* Brévignon, found in Trinidad, but not reported from Tobago (Cock 2014, 2017). At least three more species of the complex are found in the Guianas (Brévignon and Brévignon 2012), but these have not been reported from Trinidad or Tobago. Further information on the history and nomenclature of the three species can be found in Cock (2014), together with an explanation of why these names are used for the Trinidad and Tobago fauna.

The molecular genetics of *Junonia* is the subject of ongoing research (e.g. Lalonde *et al.* 2018 and papers cited therein), which is slowly unravelling the complexities found in different geographical areas. DNA barcodes show two main lineages, but do not segregate the recognised species (Brévignon and Brévignon 2012, Lalonde *et al.* 2018), although ongoing research looking at genomes will throw more light on this (C. Brévignon, pers. comm. 2019). Based on recent research, it can be anticipated that the three morphological species in Trinidad are likely to be divided by their food plants, and other aspects of their ecology such as habitat preference, phenology, courtship, but that hybridisation will also occur (Gemmell *et al.* 2014). The names applied to the Trinidad and Tobago species may well be changed in this process as this complex group becomes better understood.

Because the two common species of donkey's eye are amongst the most frequently photographed species in Trinidad and Tobago, this note sets out how to distinguish them, with attention to the characters that are visible in

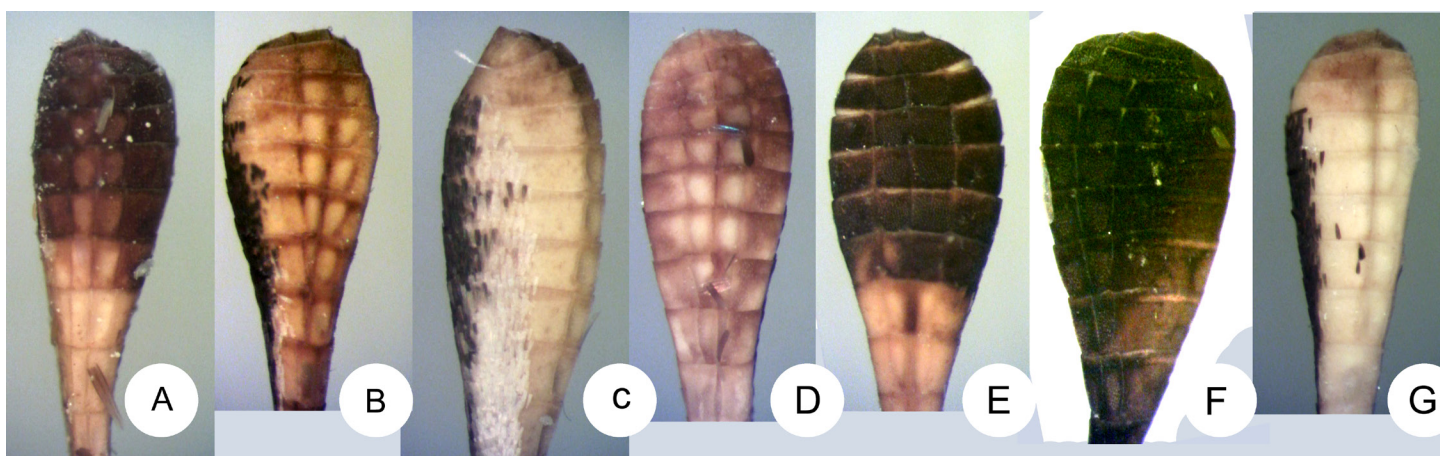
images of the living adults. Suggestions for further research are also mentioned.

## RESULTS

The caterpillars of *J. litoralis* are known to feed on black mangrove *Avicennia germinans* (L.) L. (Acanthaceae) (Brévignon and Brévignon 2012), and so far this species has only been found at Caroni Swamp south to Couva in Trinidad, although it can be expected to occur in other areas of mangrove swamp. Observations away from mangrove swamps are unlikely to be this species, but could be either of the other two species.

One of the clearest diagnostic features is the **colour of the underside of the antenna club**, which is pale in *J. zonalis* and distally dark in *J. g. genoveva* and *J. litoralis* (Brévignon and Brévignon 2012). This is not completely clear-cut; I have examined the 10-11 segmented antennal clubs of all Trinidad and Tobago specimens to hand using a binocular microscope (Fig. 1) and come to the following conclusions. My single male specimen of *J. litoralis* has the club dark brown, except the basal two segments are pale ventrally (Fig. 1A). Specimens of *J. zonalis* have the club dark above and creamy white or pale brown below, and in both sexes the distal 3-4 segments may be pale brown ventrally (Figs. 1B-D). Specimens of *J. g. genoveva* have the club dark blackish-brown ventrally, dark brown at the apex, but the basal 2-3 segments of the club may be pale ventrally (Fig. 1E-F), and with scattered white scales extending on the outside edge to about the middle of the club. However, the colour of the ventral side of the antennal club will rarely be visible in images of living adults (none of the live images included here (Figs. 15-23) show this character), so markings of the dorsal and ventral wing surfaces must be used to identify these.

Pinned specimens of all three species are shown life size as Figs. 2-14 (specimens collected by the author and in the author's collection except as indicated), and their separation with both the dorsal and ventral surface visible together is relatively straightforward. In images



**Fig. 1.** Details of antennal club of pinned specimens of *Junonia* spp., ventral view except **C** in lateral view. **A**, *J. litoralis* male (Fig. 2); **B**, *J. zonalis* male (Fig. 5); **C**, *J. zonalis* male (Fig. 6); **D**, *J. zonalis* female (Fig. 7); **E**, *J. g. genoveva* male (Fig. 11); **F**, *J. g. genoveva* female (Fig. 14); **G**, *J. zonalis* female possible hybrid (Fig. 9).



**Figs. 2-3.** *Junonia litoralis*. **2**, male, Trinidad, Caroni Swamp, track to west from Cacandee Sluice, 26.iii.2003, M.J.W. Cock. **3**, female, Trinidad, Caroni Swamp, ix.2004, S. Alston-Smith (S. Alston-Smith collection).

of live specimens, only one wing surface is available, so characters that work for just the ventral surface or just the dorsal surface are needed. *Junonia litoralis* is usually larger than the other two species, although these *Junonia* spp. can vary in size (e.g. compare Figs. 12-14). In ventral view, the hindwing of *J. litoralis* is relatively uniformly dark brown in the male (Fig. 2), paler in the female (Figs. 3, 24), with the eye spots greatly reduced; that of *J. zonalis* is also rather uniform and an intermediate chestnut-brown in the male (Figs. 4-6, 17), paler and less uniform in the female (Figs. 7-8, 20); while that of *J. g. genoveva* is relatively pale (Figs. 10-14, 23). In dorsal view, the

male of *J. litoralis* (Fig. 2) is a much darker species than *J. zonalis* (Figs. 4-6, 15, 16), the outer ring basal to the main forewing eyespot is always sullied brown, not clear orange, and the submarginal orange band of the hindwing is reduced or absent. The subapical band of the *J. litoralis* specimen illustrated (Fig. 2) is almost white, but this is not the case in the only other Trinidad specimen that I have seen which has this band distinctly tinted orange-brown, so should not be relied on as a diagnostic character. The dorsal view of female *J. litoralis* (Figs. 3, 24) could be confused with female *J. zonalis* (Figs. 7-9, 18, 19) and female *J. g. genoveva* (Figs. 12-14, 22), but the orange

colouring is duller (like *J. zonalis*), the hindwing submarginal band is broader (like *J. g. genoveva*) and the forewing pale subapical band is narrower. Fig. 9 shows a female (from the tiny patch of mangrove at the neck of the Point Gourde peninsula) identified as *J. zonalis* due to the pale club ventrally (Fig. 1F) and wing shape, but otherwise resembling *J. litoralis*; it might be a hybrid between the two.

*Junonia zonalis* is intermediate in dorsal view (Figs. 4-9, 15, 16, 18, 19) – normally darker than *J. g. genoveva* (Figs. 10-14, 21, 22) but lighter than male *J. litoralis* (Fig. 2), and comparable to female *J. litoralis* (Fig. 3): the discal hindwing and basal forewing often have a grey tone to them; the outer ring basal to the main forewing eyespot is usually at least slightly sullied brown in the male, but may be sullied or clear orange in the female; and the submarginal



**Figs. 4-6.** Male *Junonia zonalis*. **4**, Trinidad, Maracas Valley, 28.xii.1981, M.J.W. Cock. **5**, Trinidad, Cat's Hill, 16.vi.2013, J. Morrall. **6**, Trinidad, Cat's Hill, 16.vi.2013, J. Morrall (note missing hindwing spot).



**Figs. 7-9.** Female *Junonia zonalis*. **7**, Trinidad, near Centeno, 10.vi.1978, M.J.W. Cock. **8**, Trinidad, Cat's Hill, 16.vi.2013, J. Morrall. **9**, possible *J. zonalis* x *J. litoralis* hybrid, Trinidad, Point Gourde, 22.iii.2003, M.J.W. and P.J.A. Cock.

band of the hindwing is narrow or reduced, dull orange when present. *Junonia g. genoveva* (Figs. 10-14, 21, 22) is usually paler than *J. zonalis* (Figs. 4-8, 15, 16, 18, 19), and the dorsal surface does not have a grey tone. The outer ring basal to the main forewing eyespot is only rarely slightly sullied brown and is normally clear orange; this character should only be considered in combination with the other diagnostic characters discussed here. The submarginal band of the hindwing is always bright orange and relatively

broad. In addition to these characters (summarised in Table 1) it can be seen that the three species and two sexes have slightly different wing shapes (Figs. 2-14), although this may be difficult to judge in images of living adults. Most images of living adults can be identified from the relevant characters for the dorsal or ventral view, but some females are likely to be difficult to allocate between *J. zonalis* and *J. g. genoveva* on the one hand and between *J. zonalis* and *J. litoralis* on the other.



**Fig. 10-11.** Male *Junonia genoveva*. **10**, Tobago, Crown Point, 12.ix.1982, M.J.W. Cock. **11**, Trinidad, Point Gourde, 11.vi.2013, M.J.W. Cock.



**Fig. 12-14.** Female *Junonia genoveva*. **12**, Tobago, Crown Point, 12.ix.1982, M.J.W. Cock. **13**, Tobago, Crown Point, 9.i.1982, M.J.W. Cock. **14**, Trinidad, Point Gourde, 11.vi.2013, J. Morrall.

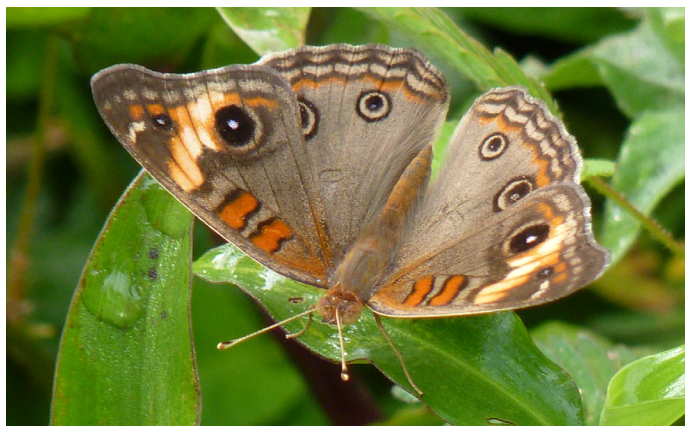
## DISCUSSION

Although *J. zonalis* and *J. g. genoveva* both seem to be common in Trinidad and Tobago, little is known about their relative distribution, flight times, seasonal variation, behaviour, food plants, early stages etc. and studies on these aspects would be worthwhile. I have the impression that *J. zonalis* is generally more common and widespread, and is usually the species found in gardens, whereas *J. g. genoveva* is more common in drier areas, particularly in Tobago, but this needs critical evaluation.

As noted above, *Junonia litoralis* is known to feed on black mangrove in French Guiana (Brévignon and Brévignon 2012) and caterpillars have also been observed on mangrove in Trinidad (S. Alston-Smith pers. comm.). Although *J. litoralis* has not been reported from Tobago, and the extent of mangrove there is very limited – a little over 200 ha compared to more than 9,000 ha in Trinidad (Junan and Ramsewek 2013) – it would be worth checking



**Fig. 15.** *Junonia zonalis* male, undated, Trinidad, Curepe, M.J.W. Cock. The submarginal orange band of the hindwing is almost absent, and the outer ring basal to the main forewing eyespot is brown.



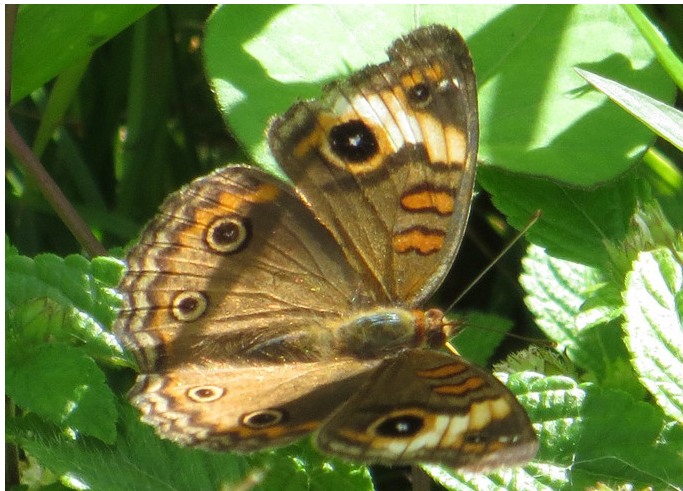
**Fig. 16.** *Junonia zonalis* male, 18 April 2010, Trinidad, Cat's Hill, K. Sookdeo. The submarginal dull orange band of the hindwing is narrow, and the outer ring basal to the main forewing eyespot is grey-brown.



**Fig. 17.** *Junonia zonalis* male, 14 September 2016, Trinidad, Fishing Pond, K. Mahabir. The relatively uniform, chestnut brown colouring of the ventral hindwing is typical of the male of *J. zonalis* (cf. Figs. 4-6).



**Fig. 18.** *Junonia zonalis* female, 29 January 2010, South Oropouche, T.P. Maharaj. The submarginal band of the hindwing is dull orange and narrow, and the outer ring basal to the main forewing eyespot is pale grey-brown.



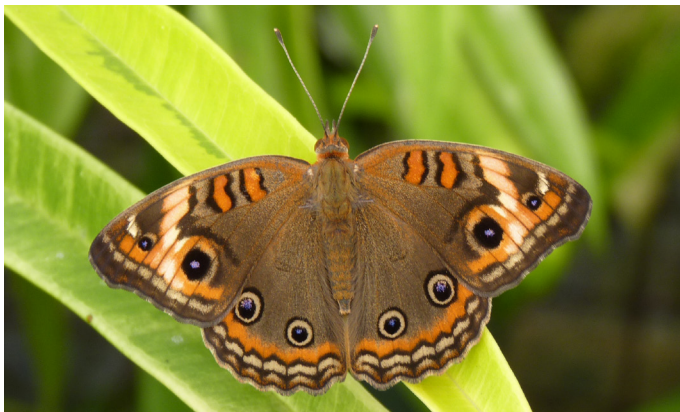
**Fig. 19.** *Junonia zonalis* female, Trinidad, Four Roads to Carmichael, 3 January 2015, Mike G. Rutherford (cropped from <https://www.inaturalist.org/observations/11317932>; Creative Commons License CC-BY-NC). The submarginal orange band of the hindwing is narrow and dull orange, and the outer ring basal to the main forewing eyespot is sullied brown.



**Fig. 20.** *Junonia zonalis* female, 14 September 2016, Trinidad, Fishing Pond, K. Mahabir. The brown colouring of the ventral hindwing is paler than in the male of *J. zonalis* (Figs. 4-6), but not as pale and uniform as that of the female of *J. g. genoveva* (Figs. 12-14).



**Fig. 21.** *Junonia genoveva genoveva* male, Trinidad, 18 March 2007, South Oropouche, T.P. Maharaj. The hindwing submarginal band is broad and orange, and the outer ring basal to the main forewing eyespot is sullied brown.



**Fig. 22.** *Junonia genoveva genoveva* female, 19 June 2010, Trinidad, K. Sookdeo. The hindwing submarginal band is broad and bright orange, and the outer ring basal to the main forewing eyespot is slightly sullied brown.



**Fig. 23.** *Junonia genoveva genoveva* mating pair, Trinidad, Aripo Savannah, 14 October 2011, M.J.W. Cock. The pale ventral colouring is obvious. Note the female (above) carries the male (below).



**Fig. 24.** *Junonia litoralis* female, 19 July 2019, Orange Valley, Couva, Davis Gunn (cropped from <https://www.inaturalist.org/observations/36174162>; Creative Commons License CC-BY-NC). The overall colouring is dull and dark, hindwing submarginal band is medium-broad and dull orange, the outer ring basal to the main forewing eyespot is sullied brown, and the forewing sub-apical band is narrow and sullied.

the larger areas of mangrove at the west end of Tobago for this species. Based on the observations of Brévignon and Brévignon (2012), it can be expected that *J. g. genoveva* feeds on *Hyptis atrorubens* Poit. and other Lamiaceae. The food plant of *J. zonalis* is not clearly known, but F.C. Urich (in Beccaloni *et al.* 2008) reared either *J. g. genoveva* or more likely *J. zonalis* from *Ruellia tuberosa*

**Table 1.** Overview comparison of the Trinidad and Tobago *Junonia* spp. These characters will need to be considered alongside the figures, as several are based on relative differences. They should be locally evaluated before applying them to populations of these species from other countries.

Character	Distribution	Ventral antennal club	Outer pale ring basal to the main forewing eyespot	Sex	Ventral hindwing colouring	Subapical forewing pale band	Overall dorsal colouring	Orange submarginal band, dorsal hindwing*
<i>J. litoralis</i>	Mangrove swamp, Trinidad only	Dark brown, except the basal two segments are pale	Always sullied brown	male	Rather uniformly dark brown	Narrow; may be white	Dark; noticeably more than other species	Narrow; dull orange, sullied dark brown
				female	Rather uniformly brown	Narrow	Dull	Medium; dull orange
<i>J. zonalis</i>	Disturbed areas, Trinidad and Tobago	Creamy white or pale brown; the distal 3-4 segments may be pale brown ventrally	Usually sullied brown	male	Rather uniformly intermediate chestnut-brown	Broad	Dull, sometimes with a green tinge to hindwing	Narrow, occasionally more or less absent; dull orange
				female	Paler than male and more contrasting markings	Broad, sometime reduced	Dull, sometimes with a green tinge to hindwing	Narrow to medium width; dull orange
<i>J. genoveva</i>	Disturbed areas, Trinidad and Tobago	Dark blackish-brown, dark brown at the apex, but the basal 2-3 segments may be pale	Usually clear orange	male	Relatively uniform pale brown	Broad	Bright	Medium width; bright orange
				female	Contrasting pale brown markings	Broad, some-time reduced	Bright	Broad; bright orange

\* The extent to which the bands are perceived as dull or bright orange is at least partially a function of the width of the band (a broader band appears brighter orange), and this may need to be taken into consideration.

L. (Acanthaceae) in Trinidad. The species of this group are recorded from a variety of other families across the Neotropics including Asteraceae (Asterales), Lentibulariaceae, Orobanchaceae, Plantaginaceae, and Verbenaceae (Lamiales) (Beccaloni *et al.* 2008, Brévignon and Brévignon 2012). Hence the food plants accepted by *Junonia* spp. in Trinidad and Tobago need investigation and documentation.

#### ACKNOWLEDGEMENTS

I thank Scott Alston-Smith, Davis Gunn, Kamal Mahabir, Tarran P. Maharaj, Mike G. Rutherford and Kris Sookdeo for letting me use their images, John Morrall for specimens and helpful comments, and Christian Brévignon and Andrew Neild for valuable feedback on a draft.

#### REFERENCES

- Barcant, M.** 1970. Butterflies of Trinidad and Tobago. London: Collins. 314 p.
- Beccaloni, G.W., Vilorio, A.L., Hall, S.K. and Robinson, G.S.** 2008. Catalogue of the hostplants of the Neotropical butterflies. Catálogo de las plantas huésped de las mariposas neotropicales. (Monografías del Tercer Milenio, Vol. 8). Zaragoza, Spain: Sociedad Entomológica Aragonesa. 536 p.
- Brévignon, L. and Brévignon, C.** 2012. Le genre *Junonia* en Guyane française - Nouvelles observations et révision systématique (Lepidoptera: Nymphalidae). *Lépidoptères de Guyane*, 7: 8-35.
- Cock, M.J.W.** 2014. An updated and annotated checklist of the larger butterflies (Papilionoidea) of Trinidad, West Indies: Papilionidae, Pieridae and Nymphalidae. *Insecta Mundi*, 0353: 41 p.
- Cock, M.J.W.** 2017. The butterflies (Papilionoidea) of Tobago, West Indies, West Indies: An updated and annotated checklist. *Insecta Mundi*, 0539: 38 p.
- Gemmell, A.P., Borchers, T.E. and Marcus, J.M.** 2014. Molecular population structure of *Junonia* butterflies from French Guiana, Guadeloupe, and Martinique. *Psyche*, 2014(897596): 21 p.
- Junan, R. and Ramsewak, D.** (2013) Status of mangrove forests in Trinidad and Tobago, West Indies. *Caribbean Journal of Science*, 47: 291-304.
- Lalonde, M.M.L., McCullagh, B.S. and Marcus, J.M.** 2018. The taxonomy and population structure of the buckeye butterflies (genus *Junonia*, Nymphalidae: Nymphalini) of Florida, USA. *Journal of the Lepidopterists' Society*, 72: 97-115.