

Arrival of Tawny Coster butterflies on the East Australian Coast coinciding with the winds of Tropical Cyclone Debbie

Ashley Raymond Field^{A,B,C}

^AAustralian Tropical Herbarium, POBox 6811, Cairns Qld 4870, Australia

^BQueensland Herbarium, Mt Coot-tha Botanic Gardens, Mt Coot-tha Road, Toowong Qld 4066, Australia

^CCollege of Marine and Environmental Sciences, James Cook University, Smithfield Qld 4878, Australia.

Email: ashley.field@jcu.edu.au

Abstract

Acraea terpsicore, the Tawny Coster butterfly was first observed on the east coast of Australia in Cairns on the 27th March, 2017. It arrived in large numbers as scattered southwesterly to southeasterly migration over Trinity Bay on hot prevailing winds drawn by Tropical Cyclone Debbie. Migration rates were concentrated on the first day of arrival and decreased as the butterflies dispersed or continued migrating. The expansion of *A. terpsicore* from near Darwin to Cairns yields a revised estimate of their rate of expansion at 334 km year⁻¹.

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Handling editor: Peter Valentine

Citation: Field AR. 2017. Arrival of Tawny Coster butterflies on the East Australian Coast coinciding with the winds of Tropical Cyclone Debbie. *North Queensland Naturalist* 47: 28-31.

Introduction

Acraea terpsicore (Linnaeus, 1758), the Tawny Coster butterfly, is a well-documented recent addition to the Australian butterfly fauna (Sanderson *et al.* 2012; Braby *et al.* 2014ab; Wilson 2016; Franklin *et al.* 2017). Originally indigenous to Sri Lanka and India, it has spread through Asia in the 1990s, through the Malesian Archipelago in the 2000s and into Australia in the 2010s (Braby *et al.* 2014a). Based on climatic niche modelling and the availability of its larval food plants it was predicted *A. terpsicore* will eventually occupy a large area of the monsoonal tropics of Australia and the humid northeastern coastal tropics of Queensland (Braby *et al.* 2014a).

Although the expanding range of *A. terpsicore* in Australia has already been well documented (Sanderson *et al.* 2012; Braby *et al.* 2014ab; Wilson 2016; Franklin *et al.* 2017), the remoteness of its occurrence and episodic access means most observations probably post-date its arrival. The

first mass arrival of a migration of *A. terpsicore* on the east coast of Australia at Cairns in March 2017 offers a unique opportunity to observe the characteristics and rate of its migration as there is a) a large population of naturalist observers who are able to establish a record of absence prior to its arrival and b) the arrival coincided with a severe tropical cyclone which likely acted as a transport vector.

Acraea terpsicore were first observed in Cairns on Monday the 27th of March as an individual female flying around a *Passiflora* in a suburban garden in Smithfield. On the morning of 28th of March a large and scattered over-water migration of *A. terpsicore* estimated in the hundreds of butterflies was observed at the Cairns Esplanade and Half-Moon Bay to be flying in from NW to NNE over Trinity Bay. Their flight path appeared to be aided by the hot prevailing northwesterly to northeasterly wind. Their migration over water was reminiscent of that

observed in Blue Tiger butterflies *Tiramula hamata*. It was decided to try and count the Tawny Coster arriving in Cairns.

Methods

To estimate the number of *A. terpiscore* arriving, a 50 m line-intercept survey roughly perpendicular to their perceived line of flight was monitored at three locations. The first location was the urban sea-wall of the Cairns Esplanade (16°55'07.24"S, 145°46'46.54"E, 2 m alt, 50 m @ 241°) which is bordered on one side by open estuarine bay and the other by cultivated parkland. The second location was the fence-line of a suburban garden in Smithfield (16°49'08.55"S, 145°41'51.36"E, 12 m alt, 50 m @ 238°) that is planted with larval host plants. The third location was adjacent to Half-Moon Creek (16°48'02.28"S, 145°42'42.43"E, 5 m alt, 50 m at 253°) in slashed open eucalypt woodland bordering an estuary. Eight non-consecutive ten-minute periods were monitored on each of the 28th and 29th of March and six periods were monitored on the 31st of March. The number of *A. terpiscore* to cross the line and their direction as well as prevailing wind conditions were recorded.

Results

During the initial wave of migration on the 28th of March there were an average across all sites of 26.3 southbound crossings per hour (average of 10 minute observations x 6) with no northbound crossings observed (Fig. 1, Table 1). In contrast on the 29th and 31st there were an average of 2.1 crossings per hour southbound and 1.7 crossing per hour northbound (Fig. 1). Observation of flying individuals indicated a prevalence of females over males and examination of 18 haphazardly netted individuals at the Smithfield and Half-Moon Creek sites recovered a female:male sex ratio of 13:5.

Acraea terpiscore were observed to be abundant in the Cairns northern beaches region flying southwards on the 28th of March but were not observed in any inland suburbs. Markedly fewer *A. terpiscore* were observed in general on the 29th, 30th and 31st and those observed appeared to be foraging at flowers or searching for larval food plants low to the ground and were localised in paddocks where food plants occurred. The absence of reported observations of *A. terpiscore* in a highly populated area prior to the 27th of March, and the

apparent absence of post-egg life stages on likely host plants suggests that *A. terpiscore* had not arrived in Cairns earlier than the last week of March 2017 and arrived as a mass wave. The reduced observations after the 28th suggests they either dispersed locally or moved onwards.

Discussion

The arrival of *A. terpiscore* in the Wet Tropics coincides with the unusual hot and strong westerly to northerly winds drawn off Cape York Peninsula and the Einasleigh Uplands by Severe Tropical Cyclone Debbie. It is proposed that these winds carried *A. terpiscore* in a south-easterly direction possibly drawing large number of individuals out to sea and accounting for the over-sea arrival observed on the Cairns Esplanade on the morning of the 28th of March. Meteorological events have previously been proposed as a mode of transoceanic dispersal of butterflies into Australia. Monarch butterflies *Danaus plexippus* have been hypothesised to have arrived in Australia on storm winds over the coral sea from Oceanian Islands (Clarke & Zalucki 2004). The expansion of *A. terpiscore* down the Malesian archipelago and into Australia (Braby *et al.* 2014a) will have necessitated multiple transoceanic flights.

The coastal Wet Tropics of Queensland falls within the present-climate distribution envelope predicted by Braby *et al.* (2014a) as suitable for *A. terpiscore*. Three likely host plants are common within this region; *Adenia heterophylla*, *Hybanthus enneaspermus* and the weed *Passiflora foetida*. *Hybanthus enneaspermus* appears to be the larval food plant predominantly used by *A. terpiscore* in Australia (Braby *et al.* 2014ab; Wilson 2016; Franklin *et al.* 2017) and is common throughout the wet and dry tropics of the northeastern coast of Queensland. Multiple clusters of eggs presumed to be *A. terpiscore* were observed at Kuranda and Smithfield on *Adenia heterophylla*. Egg-laying by *A. terpiscore* on *A. heterophylla* in the Wet Tropics region heralds an interesting new era for interaction with other butterflies as it is also the larval food plant of *Acraea andromacha*, *Cethosya cydippe* and *Vindula arsinoe*. Four species using the same larval food plant in the Wet Tropics may result in a competitive interaction.

The precisely dated arrival of *Acraea terpiscore* in Cairns enables a revised estimate of their rate of range expansion using the method and records

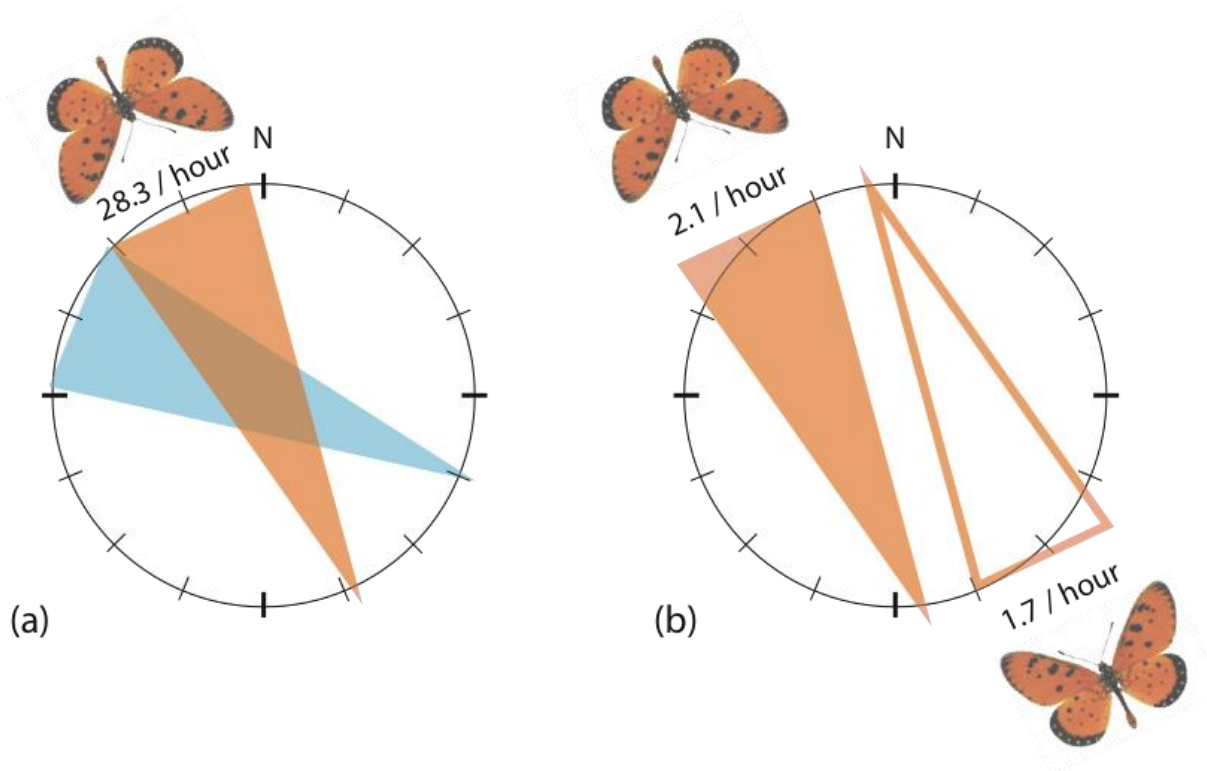


Figure 1. Hourly intercept rate and estimated flight direction of *Acraea terpsicore* crossing a 50 m line observed at three sites in Cairns, Queensland on (a) the 28/03/2017 and (b) 29-31/03/2017.

The estimated prevailing wind direction is shown in blue. *Acraea terpsicore* image modified from Braby *et al.* (2014a).

presented in Braby *et al.* (2014a&b). The rapidity with which they have reached the east coast increases their estimated rate of expansion from 315 km year⁻¹ to approximately 334 km year⁻¹. An interesting observation is that the rate of expansion appears to have increased over time. Estimates from 1984 to 1992 are 170 km year⁻¹, from 1992 to 2012 are 230 km year⁻¹ (Braby *et al.* 2014a) from 2012 to 2014 are 315 km year⁻¹ (Braby *et al.* 2014b) and the most recent expansion to Cairns on the east coast of Australia in March 2017 equals an expansion rate of 334 km year⁻¹.

The advance of *Acraea terpsicore* into Queensland has been well observed. They were recorded in February at Talaroo (Franklin *et al.* 2017) and one was sighted on 16th of March during a BushBlitz biodiversity survey of the Quincan Sandstones near Laura (Chris Burwell pers. comm.). It is possible the final distance to the east coast was covered in a single mass flight on westerly and northwesterly winds. Two additional observations in the same week support the notion of a Cyclone Debbie push for the Tawny Coster. John Young collected an adult female at Mission Beach on the 29th March

(Peter Valentine pers.comm.). Ian Montgomery recorded adults on the 30th March at Forestry Road, Bluewater just NW of Townsville (19°12'59.56"S 146°30'22.30"E.). This was at 12.20 pm and he noted dozens of them feeding on flowers (Peter Valentine, personal communication). Should this be part of the same recruitment (most likely) then that suggests in these meteorological conditions the rate of migration might be more than 300 km per week.

Acknowledgements

I thank Ross McLaren, David Cassat, Chris Burwell and Peter Valentine for additional observations and Peter Valentine for providing advice and methods on estimating the arrival rate and expansion rate.

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Table 1. Observations of *Acraea terpsicore* crossing a 50 m line per 10 minute observations and estimated prevailing conditions at three sites in Cairns, Queensland in March 2017.

kn = knots

Location	Date	Time start	Estimated wind bearing	Crossings per 10 minutes	
				NW to SE	SE to NW
Cairns Esplanade	28 Mar. 2017	c. 9:30 am	NW-N <10 kn	8	0
Cairns Esplanade	28 Mar. 2017	c. 9:45:00	NW-N <10 kn	7	0
Smithfield	28 Mar. 2017	c. 10:30 am	NW-N <10 kn	2	0
Smithfield	28 Mar. 2017	c. 10:45 am	NW-N <10 kn	6	0
Smithfield	28 Mar. 2017	c. 11:00 am	NW <10 kn	6	0
Smithfield	28 Mar. 2017	c. 11:15 am	NW <10 kn	0	0
Half-moon Creek	28 Mar. 2017	c. 11: 40 am	NW-N <10 kn	5	0
Half-moon Creek	28 Mar. 2017	c. 12:00 noon	NW-N <10 kn	1	0
Smithfield	29 Mar. 2017	c. 7:00 am	NW <10 kn	0	0
Smithfield	29 Mar. 2017	c. 7:15 am	NW <10 kn	1	0
Cairns Esplanade	29 Mar. 2017	c. 9:30 am	NW-N <10 kn	0	0
Cairns Esplanade	29 Mar. 2017	c. 9:50 am	NW-N <10 kn	0	0
Smithfield	29 Mar. 2017	c. 10:30 am	NW <10 kn	0	1
Smithfield	29 Mar. 2017	c. 11:00 am	NW <10 kn	0	0
Half-moon Creek	29 Mar. 2017	c. 11:30 am	NW-N <10 kn	0	0
Half-moon Creek	29 Mar. 2017	c. 11:46 am	NW-N <10 kn	0	0
Smithfield	31 Mar. 2017	c. 7:00 am	SE <10 kn	0	0
Smithfield	31 Mar. 2017	c. 7:30 am	SE <10 kn	0	0
Half-moon Creek	31 Mar. 2017	c. 8:10 am	SE <10 kn	3	1
Half-moon Creek	31 Mar. 2017	c. 8:28 am	SE <10 kn	0	0
Half-moon Creek	31 Mar. 2017	c. 9:10 am	SE <10 kn	0	1
Half-moon Creek	31 Mar. 2017	c. 9:47 am	SE <10 kn	1	1

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