

THE TEPHRITIDAE (DIPTERA) OF THE MADEIRAN ARCHIPELAGO, PORTUGAL

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The Tephritidae (Diptera) of the Madeiran Archipelago, Portugal. - The tephritid fauna of the Madeiran Archipelago is reviewed. The following taxonomic changes are proposed: *Acinia valida* Wollaston, 1858 is reinstated and transferred to the genus *Campiglossa* comb. n. *Campiglossa multimaculosa* (Dirlbek & Dirlbek, 1969) is a junior synonym of *C. valida* (Wollaston, 1858), syn. n. *Acinia insularis* Wollaston, 1858 is a junior synonym of *C. producta* (Loew, 1844), syn. n. *Acanthophilus helianthi* (Rossi, 1794), *Bactrocera oleae* (Gmelin, 1790) and *Euleia heraclei* (Linnaeus, 1758) are recorded for the first time. *Campiglossa reticulata* (Becker, 1908) and *Trupanea cosmia* (Schiner, 1868) are removed from the Madeiran species list. A checklist is provided for the 16 species of Tephritidae reliably recorded. Eleven new fruit fly – host plant relations are recorded.

Keywords: Tephritidae – Madeira – T. V. Wollaston – faunistics – new synonyms – new host plants.

INTRODUCTION

The fauna of Madeira has been studied extensively and over 1000 papers have been published on different aspects (Báez, 1993). Wollaston (1858) was the first to record fruit fly species from Madeira and described 7 species from the island. The first comprehensive study of the Diptera of Madeira listed 12 fruit fly species (Becker, 1908). This number was increased to 15 by Frey (1949) and Merz (1992).

A five-month fieldtrip to Madeira provided the opportunity to gather both biological and ecological data on the fruit flies occurring on the island. For the first time extensive plant sampling has been carried out. New host plant relationships are presented here. In addition, all collections present at Madeira have been examined, as is the collection of T. V. Wollaston, deposited in the Natural History Museum in London. Most of the species he described from Madeira have been synonymized since. In this present study the nomenclature of the Madeiran fruit fly fauna is revised and new records are added.

GEOGRAPHY

The Madeiran Archipelago is situated in the Atlantic ocean, about 560 km off the west coast of Morocco, between 33°10'-32°20' N latitudes and 16°10'-17°20' W longitudes (Fig. 1). Madeira is the main island and covers an area of approximately 730

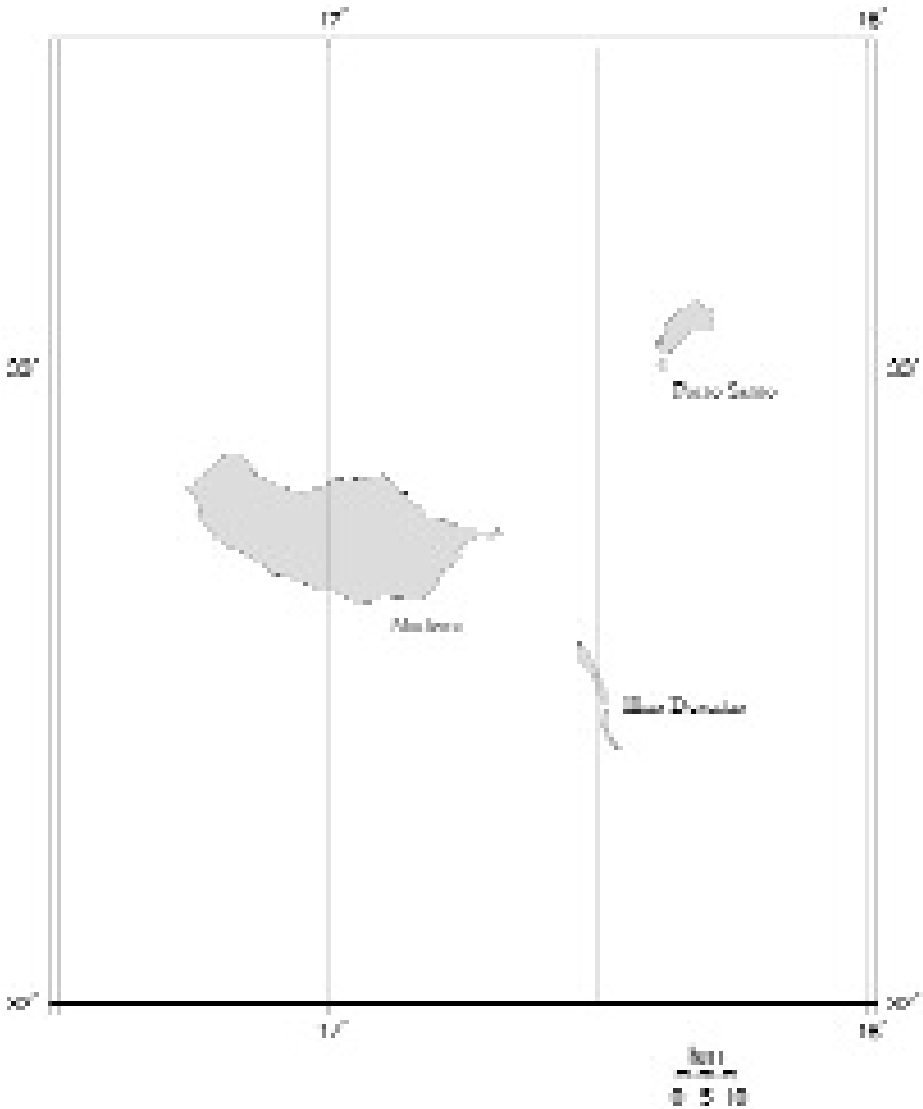


FIG. 1

The Madeira Archipelago with indication of the longitude and latitude.

km². Its highest point is at Pico Ruivo (1861m). The second largest island Porto Santo, also inhabited, situated some 60 km to the north, with an area of approximately 50 km². Its highest point is Pico do Facho (517m). To the southeast of Madeira there are three small rocky islands, the Ilhas Desertas, with a total area of less than 15 km² and the highest point at 442 m. The islands are of volcanic origin of which the age has been given various estimates ranging from 2–70 million years (Stock, 1995). Unlike the Azores and the Canary Islands there has been no recent volcanic activity.

CLIMATE AND VEGETATION

The landscape of Madeira is generally rugged (Stauder, 1990; Press & Short, 1994). A mountainous spine runs east to west across the island and is split almost at its central point by the pass of Encumeada. The eastern half contains the highest peaks. The area is very steep, with numerous rock ledges and gorges. The western half contains the high plateau of Paúl da Serra (1350m) from which descend a number of steep gorges. The north side of the island is generally much steeper than the south side. The climate is strongly influenced by the Azores anticyclone and the trade winds which, in Madeira, are principally from north and north-east (Stauder, 1990). Over 1/3 of the island lies above 1000m and dense coastal fogs develop over its mountainous terrain. Water droplets condense from these fogs and are collected in the numerous streams and rivers. In addition to the natural water resources a vast system of so called levadas, man-made aquifers used for irrigation of the cultivated land, extends across the island except for the highest parts. The total length of this irrigation system is over 3000 km long. The climate is very mild, the temperature is more or less constant throughout the year and frost is virtually unknown (Stauder, 1990).

Seven plant communities are recognised at Madeira (Tab. 1) (Press & Short, 1994; Sjörgen, 1972). Due to the climatic effects there are marked differences in the respective altitudinal limits for the same vegetation in the northern and southern halves of the island. The different associations of the shrub community (*Aeonio-Lytanthion* Alliance) are rarely fully developed above 300m in the south and 100m in the north (Press & Short, 1994). The semi-arid *Hyparrhenietum hirtae* community is found on coastal grasslands throughout the island. The very arid *Euphorbietum piscatoriae* community is found on steep sea-cliffs throughout the islands, though it is rarely found in the northern half. The arid *Biserrulae-Scorpiurietum* community is confined to the peninsula of Ponta de São Lorenço in the extreme east of Maderia. The dominant native species of this alliance like *Globularia salicina*, *Euphorbia piscatoria* and *Echium nervosum* have to a great extent been replaced by introduced species such as *Opuntia tuna*, *Ulex europaeus* and *Cytisus scoparius* (Press & Short, 1994).

TAB. 1

The different plant communities recognized on Madeira (after Sjörgen, 1972; Press & Short, 1994).

Alliance: Aeonio-Lytanthion	
Association	<i>Hyparrhenietum hirtae</i> (semi-arid, coastal grassland throughout island)
Association	<i>Euphorbietum piscatoriae</i> (arid, sea-cliffs throughout island)
Association	<i>Biserrulae-Scorpiurietum</i> (arid, coastal grassland confined to Ponta de São Lorenço)
Alliance: Clethro-Laurion	
Association	<i>Deschampsietum argenteae</i> (exposed ravines habitats with permanent water supply)
Association	<i>Vaccinio-Sibthorpietum</i> (widespread)
Association	<i>Campylopo-Airetum</i> (grazed areas above the cloud zone)
Association	<i>Ericetum cinereae</i> (high peaks)

The humid evergreen forest (*Clethro-Laurion* Alliance) covered large areas between 300-1300m in the north and 700-1200m in the south (Press & Short, 1994). Nowadays it is more or less confined to the north, having been reduced from originally some 60% to about 16% (Smit *et al.*, 2004). The very wet *Deschampsietum argenteae* community is the lower belt of actual evergreen forest with dominant trees like *Laurus azorica*, *Ocotea foetans*, *Persea indica* and the endemic *Clethra arborea*. This community is replaced by the somewhat less wet *Vaccinio-Sibthorpietum* community, or 'heath-forest' in the upper layer of the cloud-zone. Above this zone and above the cloud-zone these vegetations are replaced by the *Campylopo-Arietum* shrub community, which is generally wetter than the coastal grasslands and which is used for grazing livestock. This zone is again replaced by the semi-arid community *Ericetum cinereae* on the highest peaks.

The altitudinal zone between the coastal grasslands and the evergreen forest, between 100-300m in the north and 300-700m in the south, was probably originally covered by the dry type of evergreen forest, nowadays exclusive to the Canaries (Press & Short, 1994; Sjögren, 1972). These areas were the first to be changed by exploitation and agriculture and are now occupied by a transitional vegetation, cultivated land and exotic forest of *Pinus* or *Eucalyptus*, mixed with *Acacia* species.

The original vegetation of Porto Santo appears to have had *Juniperus phoenicea* as a dominant species, together with *Dracaena draco* and a thermophilous type of evergreen forest with *Apollonias barbujana* (Press & Short, 1994). None of this vegetation remains and the few trees that now grow on the island are exotic conifers and other introduced species like *Tamarix gallica*. For the most part the island supports a dry type of grassland of Mediterranean appearance.

MATERIAL AND METHODS

This study includes all data from the following collections, introducing the abbreviations used in this paper:

- AMFA private collection of António M. Franquinho Aguiar, Camacha, Madeira.
- BMNH Natural History Museum, London, England.
- BvA private collection of Bob van Aartsen, 't Harde, the Netherlands.
- ICLAM Insect collection of Laboratório Agrícola da Madeira, at Camacha, Madeira.
- IS private collection of Isamberto Silva, Funchal, Madeira.
- JTS private collection of the author.
- MMF Museu Municipal do Funchal, Madeira.

All the specimens from "ICLAM" were collected by A.M. Franquinho Aguiar, unless stated otherwise. Some of the records contain a number, mentioned between brackets, which refers to the catalogue of the concerning collection. The author has visited Madeira twice; 7 to 21 July 1997 and 2 February to 18 June 1998. B. Roels and the author have visited Porto Santo from 18 to 20 April 1998. The Ilhas Desertas have not been visited. The specimens collected are deposited in the collection of the author, unless stated otherwise. If no legator is given the author collected the specimens. Altogether a total of 2449 specimens of Tephritidae have been examined.

THE TEPHRITIDAE OF MADEIRA

T. V. Wollaston was the first to carry out an extensive survey of Madeiras insect fauna (for details on his life and achievements see Salmon & Wakeham-Dawson,

1999). In 1858 he described seven fruit flies from Madeira. These descriptions are very succinct and insufficient, therefore the status of the species has been subject to various interpretations. In order to resolve this problem the types have been studied and lecto-types are designated for some of his species.

Until now, a total of 15 tephritid species has been recorded for the Madeiran Archipelago (Frey, 1949; Merz, 1992). The current study has revealed that the actual number of species reliably recorded from the Madeiran Archipelago is 16. This includes four species endemic to Madeira and the Canary Islands. One previously recorded species, *Trupanea cosmia* (Schiner, 1868), was until recently only known from the series of five syntypes (Merz, 2002). Schiner (1868) described this species from Madeira, based on specimens reared from an unidentified plant collected, as stated, from Madeira during his world trip aboard the Austrian ship the "Fregatte Novara". Despite several extensive surveys it has never been found at Madeira again. On the other hand Kapoor *et al.* (1980) recorded it from India. It seems likely that the plant from which the syntypes were reared was not collected at Madeira, but rather in India, where the "Fregatte Novara" was too. It is therefore concluded here that the specimens were mislabelled and this species is not maintained on the Madeiran species list.

In the following list the species are presented in alphabetic order by subfamily. Taxonomic arrangement follows Norrbom *et al.* (1999). For each species, the previous records in the literature, the material examined, whenever necessary some taxonomical remarks, the host plant records for Madeira, the plant communities in which the species has been observed and the general distribution are given. The hostplants were identified using Press & Short (1994). The distributional information is taken from the World Catalogue (Norrbom *et al.*, 1999), where possible updated with new data of which the references are given in the text. Records of species from the Azores and the Canary Islands are based on Frey (1945) and Merz (1992) respectively. Carles-Tolrá (2002), Dirlbek & Ohm (1982) and Osten-Sacken (1884) are omitted from the references because they refer to published records only.

RESULTS

Subfamily TRYPETINAE

Tribe DACINI

Bactrocera oleae (Gmelin, 1790)

MATERIAL. **Madeira:** Caniçal, 31.viii.1995, 4♀ (ICLAM (230)). **Porto Santo:** Vila Baleira, 12.x.1994, 1♂ (leg. AMFA, JTS).

HOST PLANTS. This species has not been reared at Madeira, but it was swept from *Olea europaea*. It is known to attack *Olea europaea* and can be a severe pest in cultivated olives (White & Elson-Harris, 1992).

ECOLOGY. This species has only been found on a few imported Olive trees near the town of Caniçal. It has been collected with a bait-trap at Porto Santo.

DISTRIBUTION. Africa, into the Mediterranean part of Europe, the Middle East, Northern India and Pakistan in the Oriental region. Also known from the Canary Islands. This species is here recorded for the first time from Madeira and Porto Santo.

Ceratitis capitata (Wiedemann, 1824)

Ceratitis capitata (Wiedemann, 1824): Becker (1908), Frey (1949). This species was first recorded from Madeira by Osten-Sacken (1884) who refers to Loew (1862). However, there is no reference in Loew regarding its presence on these islands.

MATERIAL. **Madeira:** Funchal, 11.viii.1988, 2♂, 1♀ (AMFA (93–94)); 25.v.1998, 1♀; Funchal, Jardim Botânico, 14.vii.1997, 3♀; 11.iv.1998, 1♂; 22.v.1998, 32♂, 5♀; Funchal, Lombo da Boa Vista, 18.viii.1988, 2♂ (AMFA (100)); 13.ii.1989, 1♀ (AMFA (316)); viii.1989, 1♂, 3♀ (ICLAM (077–080)); Funchal, Pico do Santo Antonio, 31.v.1998, 1♂, 1♀; Ponta do Pargo, 19.v.1998, 1♂; Ribeira de Baixa, 4.v.1995, 1♂, 1♀ (ICLAM (221)); Soccoridos Valley, 3.iv.1998, 1♀; 7.vi.1998, 1♂.

HOST PLANTS. Reared at Madeira from *Coffea arabica* (n = 4), *Fragaria vesca* (n = 2) and *Passiflora edulis* (n = 2). Swept from *Citrus sinensis*. This species is known to attack a wide range of host plants and is regarded a major pest in cultivated fruit (White & Elson-Harris, 1992).

NOTE. At Madeira the ministry of Agriculture is pursuing a research program trying to control this species by the release of sterile males (Pereira *et al.*, 1996).

ECOLOGY. Found in orange plantations and gardens.

DISTRIBUTION. Originally Afrotropical, nowadays established in the greater part of the tropics and subtropics of the World. Accidentally introduced to the other parts of the World, but not able to survive in temperate climate.

Tribe TRYPETINI

Euleia heraclei (Linnaeus, 1758)

MATERIAL. **Madeira:** Funchal, Monte, 22.iv.2004, 2♂, 2♀ (AMFA).

HOST PLANTS. This species has not been reared at Madeira, elsewhere known to be a leafminer in Umbellifers.

ECOLOGY. This species is found in open shrub communities.

DISTRIBUTION. The entire Palaearctic region. This is the first record for Madeira. From the Canary Islands only the endemic *E. separata* (Becker, 1908) is known, which is very similar to this species but can be distinguished by the wing venation and the head profile.

Subfamily TEPHRITINAE

Tribe DITHRYCINI

Proceidochares utilis Stone, 1947

Proceidochares utilis Stone, 1947: White & Elson-Harris (1992).

MATERIAL. **Madeira:** Calheta, 7.iv.1998, 1♂; Campanario, 250m, 23.v.1998, 2♂; Chão de Ribeira, 450m, 15.iv.1998, 2♀; Fajã da Nogueira, 10.iii.1998, 1♂; Funchal, Corujeira, 24.v.1998, 3♂; Funchal, Pico dos Barcelos, 350m, 5.iii.1998, 1♂; 7.iii.1998, 2♂, 2♀; 10.iii.1998, 1 specimen; Funchal, Pico do Santo Antonio, 400m, 21.ii.–1.iv.1998, 24♂, 17♀, 17 specimens; Garajau, 8.vi.1998, 1♀; Loreto, 1.v.1998, 1♂; Palheiro Ferreiro, 550m, 6.v.1998, 1♂; Ribeira Brava, 3.iii.1998, 1♀; 4.iii.1998, 3♂; 5.iii.1998, 4♂, 1♀; 6.iii.1998, 5♂, 4♀; 7.iii.1998, 5♂, 9♀; 8–22.iii.1998, 506 specimens; Ribeira Brava, Boa Morte, 400m, 11.iii.1998, 18♂, 20♀; 13.iii.1998, 6♂, 6♀; 14.iii.1998, 16♂, 19♀; Soccoridos Valley, 11.ii.–3.iv.1998, 7♂, 9♀.

HOST PLANTS. Reared from stem galls on *Ageratina adenophora* (n = 715).

ECOLOGY. Confined to its host plant, which has spread over great parts of Madeira, up to an altitude of 1000m. It can be found in most plant communities, the *Hyparrhenietum hirtae*, *Deschampsietum argenteae*, *Vaccinio-Sibthorpietum* and *Campylopo-Arietum* communities.

DISTRIBUTION. Originally from Mexico, Central America, introduced in various parts of the world for biocontrol of its host plant; Australia, China, Hawaii, India, Nepal, South Africa and New Zealand (Freidberg & Mansell, 1995; Kapoor, 1993; White & Elson-Harris, 1992). White & Elson-Harris (1992) state this species has been introduced at Madeira before 1971 for control of *Ageratina adenophora* but give no reference. There is no reference in the other examined entomological literature.

Tribe NOEETINI

Ensina decisa Wollaston, 1858

Ensina decisa Wollaston, 1858: Becker (1908), Frey (1949).

MATERIAL. Syntypes *Ensina decisa* Wollaston, 1858: 1 ♂ “cotype”, “Madeira / T.V. Wollaston / B.M. 1855-7”, “*Ensina / decisa* W.” (handwritten label); 1 ♀, “cotype”, “Madeira / T.V. Wollaston / B.M. 1855-7”, “*Ensina / decisa* Woll. / det. B.H. Cogan 1970”; 1 specimen without abdomen “Madeira / T.V. Wollaston / B.M. 1855-7”, “*Ensina / decisa* Wollaston, 1858 / det. J.T. Smit 2004” (all BMNH).

Other material: **Madeira**: Caniçal, 2.v.1998, 20♂, 15♀; Chão de Ribeira, 450m, 15.iv–23.v.1998, 5♂, 9♀; Fontes, 1100m, 16.vii.1997, 2♀; Funchal, Corujeira, 24.v.1998, 1♂; Funchal, Jardim Botânico, 210m, 11.iv.1998, 4♂, 2♀; Funchal, Pico dos Barcelos, 350m, 22.ii–3.v.1998, 61♂, 41♀; Funchal, Pico Santo Antonio, 400m, 22.iv–7.iii.1998, 4♂, 5♀; Garajau, 8.vi.1998, 1♂; Montado do Barreiro, 20.v.1998, 3♂, 1♀; Machico, Pico do Facho, 2.v.1998, 4♂, 4♀; Palheiro Ferreiro, 550m, 2.v.1998, 3♂; Pico dos Cidroa, 1550m, 20.vii.1995, 1♀ (IS); Poço de Neve, 1600m, 11.vii.1997, 1♂; Ponta de São Lorenzo, 100m, 25.iii–7.v.1998, 60♂, 46♀; Ponta do Pargo, 200m, 5.v.1998, 9♂, 6♀; 19.v.1998, 3♂, 3♀; Ribeira Brava, Boa Morte, 400m, 5.v.1998, 1♂, 1♀; Caniço, Reis Magos, 6.vi.1998, 3♂; São Jorge, 4.v.1998, 1♂, 1♀; Soccoridos Valley, 3.iv.1998, 3♂; Terreiro da Luta, 6.v.1998, 8♂, 2♀. **Porto Santo**: Vila Baleira, 19.iv.1998, 14♂, 8♀.

HOST PLANTS. Reared from *Hypochoeris glabra* (n = 311) (new host plant record). Swept from *Carduus pycnocephalus* and *Galactites tomentosa*.

ECOLOGY. This species can mainly be found in disturbed areas on dry soil, up to an altitude of 1600 m. Mainly found in the *Hyparrhenietum hirtae* and *Biserrulae-Scorpiurietum* communities and to a lesser extent in the *Campylopo-Arietum* community.

DISTRIBUTION. Endemic to Madeira and the Canary Islands.

Tribe TEPHRELLINI

Oxyaciura tibialis (Robineau-Desvoidy, 1830)

Aciura tibialis Robineau-Desvoidy, 1830: Becker (1908).

Oxyaciura tibialis (Robineau-Desvoidy, 1830): Frey (1949).

MATERIAL. No material seen. This species has been recorded only by Becker (1908), all subsequent authors refer to his record.

HOST PLANTS. There are no records of reared specimens. Elsewhere known to attack flowers of *Lavandula*.

DISTRIBUTION. Mediterranean and the Middle East, also known from the Canary Islands.

Tribe TEPHRITINI

Acanthiophilus helianthi (Rossi, 1794)

MATERIAL. **Madeira:** Barreira, 800m, 13.vii.1997, 1♂, 1♀; Funchal, Jardim Botânico, 210m, 9.vii.1997, 1♂; Poço de Neve, 1600m, 11.vii.1997, 1♀; Ponta de São Lorenço, 100m, 25.iii.1998, 1♂. **Deserta Grande:** 350m, 15.iv.1998, 1♀ (IS).

HOST PLANTS. This species has not been reared at Madeira. It was swept from *Carduus pycnocephalus*, *Cynara cardunculus* and *Galactites tomentosa* (Asteraceae, Cardueae). Elsewhere known to attack a wide range of Cardueae.

ECOLOGY. This species is found in different open shrub communities, *Biserrulae-Scorpiugetum* and *Campylopo-Arietum* communities as well as cultivated areas.

DISTRIBUTION. Palaearctic region and the eastern part of Africa, also known from Thailand and the Canary Islands. This is the first record for Madeira.

Acanthiophilus walkeri (Wollaston, 1858)

Tetanocera? walkeri Wollaston, 1858.

Acanthiophilus walkeri (Wollaston, 1858): Frey (1949).

MATERIAL. Lectotype ♀, *Tetanocera walkeri* Wollaston, 1858, designated by Merz (1992): “cotype”, “Madeira / T.V. Wollaston / B.M. 1855-7”, “*Tetanocera? Walkeri* W.” (hand-written label), “Lectotype ♀ / *Tetanocera / walkeri* Wollaston / det. B. Merz 1991” (BMNH).

Other material: **Madeira:** Barreira, 800m, 11.vii.1997, 1♂, 7♀; 13.vii.1997, 19♂, 17♀; Caniçal, 2.v.1998, 1♂; Chão de Ribeira, 450m, 19.v.1998, 1♀; Fontes, 1100m, 16.vii.1997, 11♂, 5♀; Funchal, 17-23.ii.1977, 1♂ (leg. A.E. Stubbs, BMNH); Funchal, Corujeira, 24.v.1998, 1♂, 2♀; Funchal, Jardim Botânico, 210m, 9.vii.1997, 5♂, 2♀; Funchal, Lomho de Boa Vista, no date, 1♀ (AMFA (88)); Funchal, Pico dos Barcelos, 350m, 21.ii.–25.iv.1998, 21♂, 12♀; Funchal, Pico do Santo Antonio, 400m, 14.iv.1998, 1♂; Funchal, São Martinho, 13.ii.1997, 1♀ (AMFA (943)); 20.vii.1997, 1♀ (AMFA (944)); João Frino, 800m, 19.vii.1997, 1♀; Machico, Pico do Facho, 2.v.1998, 1♂; Palheiro Ferreiro, 550m, 19.vii.1997, 1♀; Poço de Neve, 1600m, 11.vii.1997, 6♂, 3♀; Ponta de São Lorenço, 100m, 25.iii.1998, 1♂, 1♀; 2.v.1998, 3♂; Ponta do Pargo, 200m, 5.v.1998, 3♂, 3♀; 19.v.1998, 3♂, 4♀; Soccoridos Valley, 10.v.1998, 2♂, 2♀.

TAXONOMIC REMARKS. As already mentioned by Merz (1992), there is a second female syntype under the name *Tetanocera walkeri* in the Wollaston collection (BMNH). It had no identification label but it was labelled ‘cotype’. This specimen clearly belongs to *Trupanea insularum* (Becker, 1908). It is here labelled as paralectotype of *Tetanocera walkeri*: “cotype”, “stood as a / co-type of / *Tet. walkeri* Woll.”, “Madeira / T.V. Wollaston / B.M. 1855-7”, “Paralectotype ♀ / *Tetanocera / walkeri* Wollaston / det. J.T. Smit 2004”, “*Trupanea* ♀ / *insularum* (Becker, 1908) / det. J.T. Smit 2004”.

HOST PLANTS. Reared from flowerheads of *Carduus squarrosus* (n = 4) (new host plant record). Swept from *Carduus pycnocephalus*, *Cynara cardunculus*, *Galactites tomentosa* and *Silybum marianum*.

ECOLOGY. This species can be found in *Hypparrhenietum hirtae*, *Campyloporietum* and to a lesser extent in *Biserrulae-Scorpiurietum* communities.

DISTRIBUTION. Endemic to Madeira and the Canary Islands.

Campiglossa producta (Loew, 1844)

Acinia insularis Wollaston, 1858 (syn. n., see below).

Oxyta tessellata (Loew, 1844): Becker (1908) (misidentification).

Paroxyta tessellata (Loew, 1844): Frey (1939; 1949) (misidentification).

Tephritis insularis (Wollaston, 1858) [*Acinia*]: Becker (1908) (synonym).

MATERIAL. Lectotype ♀, *Acinia insularis* Wollaston, 1858, designated here: “cotype”, “Madeira / T.V. Wollaston / B.M. 1855-7”, “*Acinia insularis* W.”, “Lectotype ♀ / *Acinia / insularis* Wollaston / det. B. Merz 1991”, “Synonym of / *Campiglossa / producta* (Loew) / det. B. Merz 1991”, “Lectotype ♀ / *Acinia / insularis* Wollaston / det. J.T. Smit 2004”, “*Campiglossa* ♀ / *producta* (Loew, 1844) / det. J.T. Smit 2004” (BMNH).

Other material: **Madeira**: Barreira, 800m, 13.vii.1997, 3♀; Caniçal, 2.v.1998, 5♂, 2♀; Chão de Ribeira, 450m, 19.v.1998, 4♂; Fontes, 1100m, 16.vii.1997, 1♀; Funchal, v.1913, 1♂ (leg. H.S.A. Junod, BMNH); xi.1960, 1♀ (leg. N.L.H. Krauss, BMNH); 17-23.ii.1977, 1♂ (leg. A.E. Stubbs, BMNH); Funchal, Corujeira, 24.v.1998, 1♂, 1♀; Funchal, Jardim Botânico, 210m, 11.iv.1998, 2♂, 1♀; Garajau, 8.vi.1998, 1♀; Loreto, 5.v.1998, 1♀; Funchal, Pico dos Barcelos, 350m, 7.ii-25.iv.1998, 98♂, 49♀; Funchal, Pico Santo Antonio, 400m, 21.ii-7.iii.1998, 11♂, 3♀; Montado do Bareiro, 15.v.1998, 2♂; Machico, Pico do Facho, 2.v.1998, 2♂, 1♀; Pico Ariero, 1600m, 19.vii.1997, 1♀; Poço de Neve, 1600m, 11.vii.1997, 1♂, 1♀; Ponta de São Lorenzo, 100m, 27.ii-7.v.1998, 60♂, 36♀; Ponta do Pargo, 200m, 5.v.1998, 16♂, 8♀; 19.v.1998, 2♂, 2♀; Portella, 600m, 1♀; Rabaçal, 1150m, 20.vii.1997, 1♂, 1♀; Ribeira Brava, Boa Morte, 400m, 2♀; Ribeira Brava, Cruz, 5.v.1998, 1♀; Ribiev, St. Luzia, 23-24.iii.1971, 2♀ (leg. E.W. Classey, BMNH); Soccoridos Valley, 16.ii-3.iv.1998, 5♂, 5♀, Terreiro da Luta, 6.v.1998, 4♂, 2♀. **Porto Santo**: Vila Baleira, 18-20.iv.1998, 4♂, 11♀.

TAXONOMIC REMARKS. Becker (1908) assumed that Wollaston's *Acinia insularis* could be a synonym of his *Tephritis reticulata* Becker, now in the genus *Campiglossa*. Subsequent authors uncritically adopted this synonymy. In the BMNH there are two females under the name ‘*insularis*’ and they agree with *C. producta*. One has a handwritten label ‘*Acinia insularis* W.’. In order to avoid further confusion this specimen is herewith selected as lectotype and the synonymy of *A. insularis* with *C. producta* is proposed (syn. n.). As a consequence of this misidentification *C. reticulata* (Becker) is herewith removed from the list of Madeiran Tephritidae (see also below under *C. valida*). The lectotype already bears a lectotype label by Merz, but this designation has never been published and is therefore invalid. The other female has no identification label and belongs to *Tephritis praecox* (Loew). This specimen is here labelled as paralectotype: “cotype”, Madeira / T.V. Wollaston / B.M. 1855-7”, “Paralectotype ♀ / *Acinia / insularis* Wollaston / det. J.T. Smit 2004”, “*Tephritis* ♀ / *praecox* (Loew, 1844) / det. J.T. Smit 2004”.

HOST PLANTS. Reared from *Hypochoeris glabra* (n = 73) and *Leontodon taraxacoides* (n = 26) (new host plant records). Swept incidentally from *Carduus pycnocephalus* and *Galactites tomentosa*, most probably foraging specimens.

ECOLOGY. This species can be found in all open shrub communities except for the *Ericetum cinereae* community on the high peaks and only on the edge of the forested communities.

DISTRIBUTION. Palearctic, also known from the Canary Islands.

Campiglossa valida (Wollaston, 1858), comb. n.

Acinia valida Wollaston, 1858: Becker (1908).

Campiglossa multimaculosa (Dirlbek & Dirlbek, 1969): Merz (1992) (syn. n., see below).

Paroxyna reticulata (Becker, 1908): Frey (1949) (misidentification).

MATERIAL. Syntype *Acinia valida* Wollaston, 1858: ♂, "type", "Madeira / T.V. Wollaston / B.M. 1855-7", *Acinia valida* W.", "Type ♂ / *Acinia / valida* Wollaston / det. J.T. Smit 2004", "*Campiglossa* ♂ / *valida* / (Wollaston, 1858) / det. J.T. Smit 2004." (BMNH).

Other material: **Madeira**: Funchal, 17-23.ii.1977, 1♂, 1♀ (leg. A.E. Stubbs, BMNH); Funchal, Jardim Botânico, 210m, 11.iv.1998, 3♂, 1♀; 22.v.1998, 8♂; Funchal, Lombo João Boieiro, São Roque, 22.ii.-9.iv.1953, 5♂, 5♀ (leg. A. Figueira, MMF); Funchal, Pico dos Barcelos, 350m, 8.ii-12.iv.1998, 20♂, 14♀; Funchal, Pico Santo António, 400m, 7.iii-14.iv.1998, 6♂, 2♀; 'Madeira' 2♂, 1♀ (Wollaston, 1855-7, BMNH); Monte, 500m, 4.iii.1998, 13♂, 6♀; 5.iii.1998, 1♂; 20.iii.1998, 2♂, 1♀; Ponta de São Lorenço, 100m, 17.iv.1998, 7♂, 3♀; 1.v.1998, 2♂; Ponta do Pargo, 200m, 19.v.1998, 13♂, 3♀. **Porto Santo**: 3-14.iii.1975, 1♂, 2♀ (leg. A.F.E. & W.H. Gravestien, BvA); Vila Baleira, 18-20.iv.1998, 17♂, 9♀.

TAXONOMIC REMARKS. Examination of Wollaston's collection revealed that *Acinia valida* Wollaston, 1858, is a valid species of *Campiglossa* and not a junior synonym of *Dioxyna sororcula* (Wiedemann, 1830) as stated in the World Catalogue (Norrbom *et al.*, 1999). Wollaston did not mention a number of specimens in his description. In the BMNH there is only one specimen under the name 'valida'. This was presumed to be the type of *Acinia valida* by one of the curators and bears a circular red-edged label 'type'. This is here treated as a syntype specimen, and is labelled accordingly. There are three other specimens in the BMNH that were also collected by Wollaston in the same period. These agree perfectly with specimens of *Campiglossa multimaculosa* (Dirlbek & Dirlbek, 1969), both from Madeira and from the Canary Islands. Therefore the synonymy of *Paroxyna multimaculosa* Dirlbek & Dirlbek, 1969 with *Acinia valida* Wollaston, 1858 is proposed (syn. n.).

HOST PLANTS. Reared from *Argyranthemum dissectum* (n = 23), *A. pinnatifidum* ssp. *pinnatifidum* (n = 4) and *A. p.* ssp. *succulentum* (n = 2) (new host plant records). Swept from *Coleostephus myconis*.

ECOLOGY. This species can be found in *Hyparrhenietum hirtae* and *Biserrulae-Scorpiurietum* communities up to an altitude of 600m.

DISTRIBUTION. Endemic to the Madeiran Archipelago and the Canary Islands.

Dioxyna sororcula (Wiedemann, 1830)

Dioxyna sororcula (Wiedemann, 1830): Frey (1949).

Ensina vacillans Wollaston, 1858: Wollaston (1858) (synonymy by Becker, 1908; Bezzi, 1918).

Oxyna sororcula (Wiedemann, 1830): Becker (1908).

Paroxyna sororcula (Wiedemann, 1830): Frey (1939).

Paroxyna sororcula forma *madeirensis* Lindner, 1928: Lindner (1928) (synonymy by Munro, 1957).

MATERIAL. Syntypes *Ensina vacillans* Wollaston, 1858: 2 ♀ mounted on one pin: “cotype”, “Madeira / T.V. Wollaston / B.M. 1855-7”, “*Ensina vacillans* W.” (handwritten label), “Syntypes / *Ensina / vacillans* Wollaston / det. B. Merz 1991”, “Synonym of / *Dioxyna / sororcula* (Wied.) / det. B. Merz 1991”. 3 ♀ mounted separately: “cotype”, “Madeira / T.V. Wollaston / B.M. 1855-7”, “Syntypes / *Ensina / vacillans* Wollaston / det. J.T. Smit 2004”, “*Dioxyna* ♀ / *sororcula* (Wied.) / det. J.T. Smit 2004” (all BMNH).

Other material: **Madeira:** Barreira, 800m, 11.vii.1997, 1 ♀; 13.vii.1997, 3 ♂, 6 ♀; Campanario, 250m, 23.v.1998, 1 ♂, 1 ♀; Caniçal, 2.v.1998, 1 ♀; Chão de Ribeira, 450m, 19.v.1998, 8 ♂, 6 ♀; Encumeada, 1000m, 12.vii.1997, 1 ♀; Faial, 4.v.1998, 1 ♀; Funchal, v.1913, 2 ♂, 1 ♀ (leg. H.A. Junod, BMNH); vi.1962, 1 ♂, 4 ♀ (leg. N.L.H. Krauss, BMNH); xi.1960, 4 ♂, 3 ♀ (leg. N.L.H. Krauss, BMNH); Funchal, Jardim Botânico, 210m, 9.vii.1997, 1 ♀; 22.v.1998, 2 ♀; Funchal, Jardim Orquidea, 14.vii.1997, 1 ♂; Funchal, Lido Sol, 40m, 8.vi.1996, 2 ♂, 4 ♀ (IS); Funchal, Lombo do Boa Vista, viii.1988, 1 ♂ (AMFA); Funchal, Lombo João Boeiro, São Roque, 4.vi.1953, 1 ♀ (leg. A. Figueira, MMF); Funchal, Pico dos Barcelos, 350m, 7-8.vii.1997, 5 ♂, 1 ♀; 21.ii-25.vi.1998, 48 ♂, 49 ♀; Funchal, Pico Santo Antonio, 400m, 7.iii-28.v.1998, 4 ♂, 3 ♀; Garajau, 3.vi.1998, 1 ♀; 8.vi.1998, 1 ♂, 1 ♀; João Frino, 800m, 19.vii.1997, 1 ♀; Machico, Pico do Facho, 2.v.1998, 1 ♂; Montado do Barreiro, 15.v.1998, 1 ♂; Ponta de São Lorenzo, 100m, 25.iii-2.v.1998, 3 ♂, 1 ♀; Ponta do Pargo, 200m, 5.v.1998, 1 ♂; 19.v.1998, 2 ♂, 1 ♀; Ribeira Brava, 21.v.1998, 1 ♀; Ribeira Brava, Boa Morte, 400m, 5.v.1998, 1 ♀; Ribiev, St. Luzia, 21-24.iii.1971, 1 ♂, 2 ♀ (leg. E.W. Classey, BMNH); Santana, Achada do Garamacho, 23.vi-ii.1989, 1 ♀ (AMFA); São Jorge, 4.v.1998, 1 ♂.

HOST PLANTS. Not reared at Madeira, but swept in numbers from stands of *Bidens pilosa* and *Erigeron karvinskianus*. Elsewhere known to attack several species of *Bidens*.

ECOLOGY. This species can be found in all open habitats, with a preference for less arid and disturbed areas with *Bidens pilosa* or *Erigeron karvinskianus*. Mainly found in the *Hyparrhenietum hirtae* and *Campylopo-Arietum* communities and to a lesser extent in the *Biserrulae-Scorpiurietum* community.

DISTRIBUTION. Old World tropics. Also known from the Canary Islands.

Sphenella marginata (Fallén, 1814)

Sphenella marginata (Fallén, 1814): Becker (1908), Frey (1949).

Acinia miranda Wollaston, 1858: synonymy by Becker, 1908.

MATERIAL. Syntypes *Acinia miranda* Wollaston, 1858: 1 ♂, “cotype”, “Madeira / T.V. Wollaston / B.M. 1855-7”, “*Acinia / miranda* W.” (handwritten label); “Syntype / *Acinia / miranda* Wollaston, 1858 / det. J.T. Smit 2004”, “*Sphenella* ♂ / *marginata* (Fallén, 1814) / det. J.T. Smit 2004”. 2 ♀ mounted separately: “cotype”, “Madeira / T.V. Wollaston / B.M. 1855-7”, “*Acinia / miranda* W.” (handwritten label); “Syntype / *Acinia / miranda* Wollaston, 1858 / det. J.T. Smit 2004”, “*Sphenella* ♀ / *marginata* (Fallén, 1814) / det. J.T. Smit 2004”. (all BMNH).

Other material: **Madeira:** Faial, 4.v.1998, 1 ♂; Funchal, Corujeira, 24.v.1998, 3 ♂, 2 ♀; Funchal, Pico dos Barcelos, 350m, 12.iv.1998, 1 ♂; Machico, Pico do Facho, 2-28.v.1998, 87 ♂, 31 ♀; Ponta de São Lorenzo, 100m, 2-28.v.1998, 51 ♂, 23 ♀. **Porto Santo:** Vila Baleira, 19.iv.1998, 1 ♂.

HOST PLANTS. Reared from *Senecio incrassatus* (n = 74) (new host plant record) and *S. vulgaris* (n = 118).

ECOLOGY. This species is mainly found in the dryer parts of the *Hyparrhenietum hirtae* and the *Biserrulae-Scorpiurietum* community. Also found in the disturbed areas where its host plants are present.

DISTRIBUTION. Western Palaearctic. Also known from the Azores and the Canary Islands.

Tephritis praecox (Loew, 1844)

Tephritis praecox (Loew, 1844): Becker (1908), Frey (1949).

Tephritis praecox luteipes Frey, 1936: Frey (1939) (misidentification).

MATERIAL. Paralectotype of *Acinia insularis* Wollaston (see under *Campiglossa producta* Loew), 1 ♀ (Wollaston, 1855-7, BMNH).

Other material: **Madeira:** Chão de Ribeira, 450m, 15.iv.1998, 1 ♀; Corujeira, nr. Monte, 19-21.ii.1977, 1 ♀ (leg. A.E. Stubbs, BMNH); Funchal, Pico dos Barcelos, 350m, 21.ii-12.iv.1998, 4 ♂; Funchal, Pico Santo Antonio, 400m, 9-24.iii.1998, 13 ♂, 7 ♀; Ponta de São Lorenzo, 100m, 2.v.1998, 1 ♀; 17.v.1998, 1 ♂, 4 ♀; Ponta do Pargo, 200m, 5.v.1998, 2 ♀. **Porto Santo:** Vila Baleira, 18-19.iv.1998, 2 ♀.

TAXONOMIC REMARKS. Frey (1936) mentioned two forms of this species, the typical form, with dark femora, and forma *luteipes*, with yellow femora. Merz (1992) described this latter form as a valid species, giving a detailed description, and recording both *T. praecox* and *T. luteipes* from the Canary Islands. The colour of the femora proved to be variable in both species. A good character to separate the species is the colour of the katepisternal seta, which is black in *T. praecox* and white in *T. luteipes*. The Madeiran specimens have been compared with paratypes of *T. luteipes* from the Canary Islands. This revealed that only *T. praecox* is present at Madeira.

HOST PLANTS. Reared from *Calendula arvensis* (n = 23) and *C. maderensis* (n = 5) (new host plant record).

ECOLOGY. This species is rather uncommon but can be found in more or less disturbed vegetation where its host plant is present. Mainly found in *Hyparrhenietum hirtae* and to a lesser extent in the more arid *Biserrulae-Scorpiurietum* community.

DISTRIBUTION. European part of the Palaearctic region, mainly Mediterranean. Also known from the Canary Islands.

Trupanea amoena (Frauenfeld, 1857)

Tephritis amoena (Frauenfeld, 1857): Schiner (1868).

Trupanea amoena (Frauenfeld, 1857): Frey (1949).

Urellia amoena (Frauenfeld, 1857): Becker (1908).

MATERIAL. **Madeira:** Caniço, 6.vi.1998, 1 ♀; Funchal, Pico dos Barcelos, 350m, 1 ♂; Ponta do Pargo, 200m, 1 ♂.

HOST PLANTS. Not reared at Madeira, elsewhere known to attack a wide range of Asteraceae.

ECOLOGY. This species is rare at Madeira, the specimens have been collected in disturbed areas with sandy soil in the *Hyparrhenietum hirtae* and *Euphorbietum piscartoriae* communities.

DISTRIBUTION. Palaearctic, Afrotropical, Oriental and Australasian Regions.

Trupanea insularum (Becker, 1908)

Trupanea insularum (Becker, 1908): Merz (1992).

MATERIAL. Paralectotype of *Tetanocera walkeri* Wollaston (*Acanthiophilus walkeri* W.), 1 ♀ (Wollaston, 1855-7, BMNH).

Other material: **Madeira:** Chão de Ribeira, 450m, 19.v.1998, 1 ♂; Ponta de São Lorenzo, 100m, 10.v.1998, 2 ♂, 2 ♀; 7.vi.1998, 7 ♂, 7 ♀; Ponta do Pargo, 200m, 2 ♂. **Porto Santo:** Vila Baleira, 12.x.1994, 2 ♂ (leg. AMFA, JTS).

HOST PLANTS. Reared from *Andryala glandulosa* ssp. *glandulosa* (n = 18) (new host plant record).

ECOLOGY. This species is rare at Madeira and Porto Santo and seems to prefer dryer habitats. Nearly all specimens have been found in either the *Biserrulae-Scorpiurietum* or the *Euphorbietum piscatoriae* communities, although the host plant is also found on rocks and sea cliffs on the north side of the island, as is one specimen of *Trupanea insularum* (Chão de Ribeira). Perhaps specific fieldwork will reveal that this species is less rare than it appears to be. On the Canary Islands it is known from open places in the laurophyll forest (Merz, 1992).

DISTRIBUTION. Endemic to Madeira and the Canary Islands.

Trupanea stellata (Fuessly, 1775)

Trupanea stellata (Fuessly, 1775): Frey (1949).

MATERIAL. **Deserta Grande**: 350m, 15.iv.1995, 1 ♀ (IS).

HOST PLANTS. Not reared at Madeira, but swept from *Tolpis succulenta*.

ECOLOGY. Only two specimens are known from Madeira. Frey (1949) mentioned a dry habitat, "dürre Böschung". The specimen taken from Deserta Grande also indicates that this species prefers dry habitats on Madeira.

DISTRIBUTION. Palearctic and Oriental Regions.

DISCUSSION

Madeira is an oceanic island formed by volcanic activity. There has probably never been a land bridge to a continental landmass. As a result the fruit flies may have arrived as migrating adults, although immature stages probably may have been imported to the region in plant material. In some cases this is documented, for example *Procecidochares utilis*, which was introduced to control Crofton weed (*Ageratina adenophora*) (White & Elson-Harris, 1992). In others like *Bactrocera oleae* and *Ceratitis capitata*, import to the region is likely for they attack economically important plants. Since the arrival of the Portuguese in the fifteenth century the vegetation of all islands has undergone rapid and profound changes. Numerous ornamental species were introduced and are now naturalized. Tephritid species, like *Acanthiophilus helianthi*, *Trupanea amoena* and *T. stellata* attack a wide variety of Asteraceae and may have been introduced with their hosts. However, adults may also be blown unintentionally between locations. The 'Leste', a very strong wind originating in the African desert, has been shown to blow Lepidoptera (Classey, 1966) and Odonata (Smit, 1998) from Africa to Madeira. This wind probably occasionally blows flies from Africa to Madeira or from the Canary Islands to Madeira. This could explain the endemic tephritid species shared by the Canary Islands and Madeira. The Azores anticyclone is another probable factor in the migration and unintentional movement of insect species to Madeira. This anticyclone has a strong influence on the climate of Madeira (Stauder, 1990; Press & Short, 1994) and causes a predominant wind to blow from continental Western Europe (and to a lesser degree from the Mediterranean) towards Madeira, allowing insects to be blown from Europe to Madeira.

The zoogeographical affinities between the various tephritid faunas in the Macaronesian region support the view that these weather systems are influential in the movement of tephritids between mainland and the archipelagos (Tab. 2). The same can be observed in dragonflies (Odonata), hoverflies (Diptera, Syrphidae), tachinid flies (Diptera, Tachinidae) and wasps (Hymenoptera, Vespoidea) (Smit, 1998, 2000; Smit & Zeegers, 2002; Smit *et al.*, 2004). The zoogeographical affinities of these groups match those of most of the terrestrial faunistic groups present in Madeira (Báez, 1993): i.e. a strong affinity with central Europe, a weak affinity with the Mediterranean region and a very weak affinity with the Afrotropical region. In the tephritids these affinities show a slight deviation compared to the other groups, probably due to a higher proportion of species introduced with plant material.

TAB. 2

The differences in zoogeographical affinity among the tephritids of the four north-eastern Atlantic archipelagos (Macaronesian region), showing a shift from mainly Palaearctic to a more Mediterranean and Afrotropical affinity from north to south. The introduced species, given in brackets behind the total number, are left out of consideration. The species numbers are based on Frey, 1945 (Azores), Merz, 1992, 2000 (Canary Islands) and Dirlbek & Ohm, 1982 (Cape Verde Islands). Note that the Mediterranean fauna is a sub-set of the Palaearctic fauna. Similarly the endemic fauna is a sub-set of the species totals for each Archipelago. For Madeira these are not true endemics, but they are shared with the Canary Islands.

Affinity	Azores furthest north	Madeira	Canary Islands	Cape Verde furthest south
Palaearctic	4	10	20	4
(Mediterranean)	(1)	(2)	(9)	(3)
Afrotropical	2	3	8	11
(Endemic)	(1)	(4)	(13)	(1)
Total number	6 (+ 1i)	13 (+ 3i)	28 (+ 2i)	15 (+ 1i)

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