**DIGITAL INSECT SPECIMEN PHOTOGRAPHY OF MICROSCOPIC AND MACROSCOPIC DIAGNOSTIC FEATURES**

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**INTRODUCTION**

Previous papers have described progress in developing a photographic work station, initially for use with film cameras. Ref 1, Taylor, 2001. Ref 2. Taylor, 2004. Ref 3, Taylor, 2012. Ref 4, Taylor, 2015.

The later papers described equipment primarily designed for photographing whole specimens using a range of lenses. These lenses being used on a 45⁰ angled stage with an adapted microscope stage positioned to hold the specimen and allow small incremental changes to the specimen to camera distance, ‘Working Distance’, whilst carrying out photographic sequences for subsequent image stacking using Helicon Focus 6 software.

In 1992 I commenced research into the Diptera, Asilidae fauna of the Eastern Mediterranean islands of Chios and Lesvos, with colleagues from the Liverpool Museum and elsewhere. I had then, and still also have now, difficulty in identifying some material due to the scattered sources of keys and descriptions. Study of the Robber Fly website of Fritz Geller-Grimm yielded some patchy help via its photographs of Type Specimens, however much of the material was of poor quality after many years since collection.

I resolved to create a ‘Virtual Reference Collection’ of all the species on our Chios and Lesvos checklist. This collection being in the form of ‘Diagnostic Papers’, one for each species. Each paper would include a diagnosis text based on the best keys available, cross-referenced to high quality photographic images of whole specimens down to detail as small as 2mm. This entailed the development of the 45⁰ angled stage to accommodate a full range of high quality macro lenses and an extended focussing ‘rail’ with fine adjustment and no looseness or ‘backlash’ in operation.

I have now developed the equipment to meet these objectives and have completed 37 Diagnostic Papers of the 63 Asilid taxons on the Chios and Lesvos checklist. **See Appendix 1** for this checklist and availability of the Diagnostic Papers freely downloadable from my website miketaylornaturalist.co.uk

**EQUIPMENT USED**

The improved angled stages have been developed using the following Olympus equipment, with the current ranges of prices obtainable on e-bay.

Olympus E410 Camera £100 to £150.

Olympus E620 Camera £120 to £250.

Olympus Focussing Rail £40 to £100.

Olympus Auto Bellows £90 to £150.

Olympus Telescopic Auto Macro Tube 65-115 £130 to £160.

Olympus 20mm Macro Lens £300 to £400.

Olympus 38mm Macro Lens £350 to £400.

Olympus 50mm Macro Lens £70 to £175.

Olympus 35mm Digital Lens £100

Sets of Extension Tubes £25 to £60.

OM to OM4/3 Adaptor £10 to £20.

Remote Shutter Release £5.

There should be no difficulty in using different cameras to the Olympus used in my arrangements. In these cases a different adaptor e.g. Nikon to OM, Cannon to OM…..would be needed.

Using the Olympus equipment listed and an angled stage with the dimensions detailed later, the ranges of Fields of View ( widths for landscape and heights for portrait orientations ) with the listed lenses are as follows:-

35mm Digital 50mm-85mm

50mm Lens 9mm-60mm

38mm Lens 4mm-13mm

20mm Lens 2mm-5mm

As the 38mm and 20mm Olympus lenses are expensive, a start could be made using just the 50mm Olympus Macro lens, and further lenses purchased as needs and opportunities arise.

If a suitable camera is already available then an initial arrangement using just a 50mm lens could be completed at a cost of less than £300 if limited to the use of stacks of extension tubes. This cost excludes the overhead light source.

**SIMPLIFIED ANGLED STAGE DESIGN**

The angled stage is made of an operating surface with a prop, both supported on foot plates. The operating surface and the prop are made from 12mm thick 7 Ply wood. The 60mm high footplates raise the whole level of the equipment without excessive distances between them, this ensures maximum availability of rail extension potential within a small ‘footprint’ beneath the light source.

The operating surface is 450mm long overall and 155mm wide, with a 45⁰ angled base where it is attached to the forward footplate. The operating surface has a 60mm by 65mm cut-out at the top to allow access to the camera battery compartment during operation. The prop is 240mm long overall and 155mm wide, with a 45⁰ angled base where it is attached to the rear footplate. These footplates are best glued to the pre-assembled operating surface and prop on a true flat surface to avoid annoying wobbling during operation. See Fig A for completed configuration.

With my equipment there are two ¼ inch diameter clearance holes drilled on the centreline of the operating surface 90mm and 110mm from the base for attaching the Focussing Rail and a single ¼ inch diameter clearance hole 25mm from the top for attaching the camera. I use one inch long socket headed ¼ inch diameter one inch long UTC bolts, obtained from Amazon for £2 a pack.



Fig A Fig B Fig C

As I frequently take large numbers of images in a single session requiring changes in orientation and format ( including between landscape and portrait ) for my convenience I have two other set ups based on the same principles. Fig B shows a camera in the portrait position, and Fig C a camera with a bellows unit.

**OPERATING METHOD**

I use my equipment with the light source described in a previous paper, Ref 3.

For ease and speed of use I have calibrated my equipment and formulated an exposure table showing which shutter speeds to select depending upon choice of lens and extensions. My camera is always set to 100 ASA sensitivity and as I always use Speed Priority (S) the aperture is always manually selected at f8.

**EXPOSURE TABLE**

EXTENSION LENGTH FIELD WORKING DISTANCE SPEED at f8

mm mm mm

Olympus 35mm Digital Macro Lens

0 50/85 70/160 Auto Exp

Olympus 50mm Macro Lens

7 115 360 1/20 sec

13 70 220 1/20 sec

21 45 145 1/20 sec

31 30 100 1/15 sec 33 27.5 85 1/13 sec 38 24 83 1/10 sec 47 19.5 71 1/8 sec

52 18 66 1/6 sec 59 14.5 57 1/6 sec 78 11.5 45 1/4 sec

92 9 35 1/4 sec

Olympus 38mm Macro Lens

0 13 60 1/15 sec

7 11.5 55 1/10 sec

12 10.5 50 1/5 sec

19 9.5 50 1/4 sec

33 8 45 1/3 sec

38 7 44 1/2.5 sec

78 5 40 1/1.3 sec

109 4 39 1.3 secs

Olympus 20mm Macro Lens

0 5 25 1 sec

52 3 19 1.3 secs

95 2.2 19 6 secs

109 2 20 8 secs

**OPERATIONAL SEQUENCE**

Selection and preparation of specimens for photography is the same as described in previous papers, see References.

The end of the Focussing Rail has a knurled screw which is used for fixing the retaining plate to which the photographic grey-carded mounted specimens is slotted.

The specimen to be photographed is measured and the Field dimension selected from the list in the Exposure Table.

The indicated Lens and Extension Length is then set up and selected on the camera. The carded specimen is slotted onto the retaining plate and the Working Distance ‘WD’ read from the Exposure Table is adjusted as appropriate by moving the specimen towards or away from the camera using the Focussing Rail knob and a ruler.

Speed priority (S) is selected on the camera, the speed selected is as indicated in the Exposure Table and the sensitivity setting 100 ASA.

Using the camera display adjust the specimen position in the frame. Using the Focussing Rail knob, move the specimen so that it is just too far away from the camera to be in focus. Using the Remote Shutter Release in conjunction with sequential small rotations of the Focussing Rail knob and by observing the progression of the specimen into focus and beyond to out of focus, take the desired sequence of images.

Small shallow features will need very few exposures in the sequence,say 6 or 8. Large specimens with an oblique wing tip to wing tip aspect perhaps several dozen exposures.

Image stacking is then performed on the computer using Helicon or Zerene.

**SAMPLE IMAGES** Fig D

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E.cowinii. Sp 18mm, Lg 14mm. West Kimmeragh,IOM.9.VIII.2002.S.M..Crellin.

Fig E Fig F

 

Stichopogon albofasciatus. Sp 16mm, Lg 10mm. Neomochtherus mundus

Kalloni, Lesvos, Greece, 25.IV.2001. Sp 23mm, Lg 16.5mm,

Salagonas, Chios, Gr. 9.VII.97.

Fig G



Engelopogon naxia, Sp 32mm, Lg 18mm, Kalimassia, Chios, Greece, 8.V.2016.

Fig H

 

Machimus Species B. Sp 18.5mm Lg 11.5mm, Thimiana, Chios, Greece,30.IV.02.

**Camera Settings:-**

Fig D. 50mm lens, 52mm XT, 1/6 at f8. Fig E. 38mm lens, 78mm XT, 1/1.3 at f8

Fig F. 20mm lens, 52mm XT, 1.3’ at f8 Fig G. 20mm lens, 0mmXT, 1.0’ at f8.

Fig H. 20mm lens, 45mmXT, 1.6’ at f8. Fig I. 20mm lens, 0mmXT, 1.0’ at f8.

**APPENDIX 1**

**CHECKLIST, ROBBER FLIES (Dipt, Asilidae), OF CHIOS & LESVOS, GREECE.**

Mike Taylor, 16th October 2017.

STATUS OF

CHIOS LESVOS FIGURED

DIAGNOSIS

**LEPTOGASTRINAE**

**1.** *Leptogaster palparis* Loew. 1847. **X**Available

(*Leptogaster Species A)* Awaiting more specimens and determination.

**ASILINAE**

**2.** *Erax barbatus* Scopoli. 1763 **X** Available

**3.** *Erax tenuicornis* Loew. 1848 **X** Need specimens

**4.** *Promachus canus*

*leontochlaenus*  Loew. 1871 **X**  Available

**5.** *Promachus leoninus* Loew. 1848 **X** Available

**6.** *Polyphonius laevigatus* Loew. 1848 **X** Available

**7.** *Pamponerus choremii*

Smart, Taylor & Hull. 2007 **X X** Available

**8.** *Anripnrisson trifarius* Loew. 1849 **X X** InPrep

**9.** *Engelopogon goedli* Loew. 1864 **X**  Available

**10.** *Engelopogon**naxia*Macquart. 1838 **X** Available

**11.** *Neomochtherus mundus* Loew. 1850 **X** Available

**12.** *Cerdistus denticulatus* Loew. 1849 **X X** Available

**13.** *Dysmachus fuscipennis* Meigen 1820 **X** Available **14.** *Dysmachus stylifer* Loew. 1854 **X** Available **15.** *Eutolmus calopus* Loew. 1848 **X** In Prep

**16.** *Eutolmus fascialis* Loew. 1848 **X** Available

**17.** *Eutolmus haematoscelis* Gerst. 1861 **X X** Available

( *Eutolmus mordax* Loew. 1848 ) Provisional to be confirmed.

*( Eutolmus paricida* Loew. 1848 ) Provisional to be confirmed.

**18.** *Machimus annulipes* Brullé. 1832 **X X N**eed specimens

**19.** *Machimus caliginosus* Meigen. 1820 **X** In Prep

**20.** *Machimus gonatistes* Zeller. 1840 **X** In Prep *( Machimus mystacinus* Becker. 1923) Provisional to be confirmed.

**21.** *Machimus setibarbus* Loew. 1848 **X** Available

*(Machimus Species A)* Awaiting more specimens and determination.

*(Machimus Species B)* Awaiting more specimens and determination.

**22.** *Neoepitriptus setosolus* Loew. 1840 **X** Available

( *Tolmerus poecilogaster*Loew. 1849) Provisional to be confirmed

**23.** *Tolmerus pyragra* Zeller. 1840 **X X** Available

**LAPHRIINAE**

**24.** *Laphria aurea* Fabricius, 1794 **X**Available

**25.** *Laphria flava* Linnaeus. 1776 **X** Need specimens

**26.** *Choerades loewi* Lehr. 1992 **X** Available

**27.** *Andrenosoma cornuta* Oldroyd. 1972. **X** Available

**28.** *Pogonosoma marrocanum* Fabr. 1794 **X**  Need specimens

**DASYPOGONINAE**

**29.** *Anarolius jubatus* Loew. 1844 **X** Available

**30.** *Stenopogon junceus* Wiedemann.1820 **X** Available

**31,** *Stenopogon sabaudus*

*harpax* Loew. 1868 **X** Available

**32.** *Ancylorrhynchus glaucius* Rossi. 1790 **X** Need specimens

**33. S***cylaticus miniatus* Becker. 1915 **X** Available

34. *Holopogon nigripennis* Meigen. 1820 **X** In Prep

**35.** *Habropogon longiventris* Loew. 1847 **X** Available

**36.** *Stichopogon albofasciatus* Meigen. 1820 **X** Available

**37.** *Stichopogon scaliger* Loew. 1847 **X** Available

*(Stichopogon Species A)* Awaiting more specimens and determination

**38.** *Pycnopogon fasciculatus* Loew. 1847 **X** Available

**39.** *Pycnopogon leucostomus* Engel. 1930 **X** Available

**40.** *Pycnopogon pallidipennis* Brullé. 1836 **X** Available

**41.** *Crobilocerus megilliformis* Loew. 1847 **X** Need specimens

**42.** *Heteropogon ornatipes* Loew. 1851 **X**  In Prep

**43.** *Heteropogon scoparius* Loew. 1847 **X** Available

**ACANTHOCNEMINAE**

44. *Saropogon dasynotus* Loew. 1870 **X** Available

**45.** *Saropogon eucerus* Loew. 1847 **X** Available

**46.** *Saropogon leucocephalus* Meigen. 1820 **X** Available

**47.** *Saropogon platynotus* Loew. 1847 **X** Available

*( Saropogon Species E}* Awaiting determination

*( Saropogon Species F)* Awaiting determination

*(Saropogon Species G)* Awaiting determination

*(Saropogon Species H)* Awaiting determination

*(Saropogon Species I)* Awaiting determination

**48.** *Dasypogon octonotatus* Loew. 1869 **X** Available

**49.** *Molobratia teutonus* Linnaeus. 1767 **X** Available

**PRYTANIINAE**

**50.** *Scytomedes haemorroidalis* Fabr. 1794. **X** Available

**NOTES ON THE CHECKLIST**

**1.** 50 species are identified from the two islands.

**2.** 4 more Asilinae have been provisionally identified from poor or limited material and require confirmation.

**3.** 9further suspected taxa have been grouped and await

determination.

**AVAILABILITY OF DIAGNOSIS PAPERS**

All ‘Available’ diagnosis papers indicated above are freely downloadable

from my website www.miketaylornaturalist.co.uk

They are found in the Section ‘Insect Specimen Identification’.

**USE OF DIAGNOSIS PAPERS**

Any of the ‘ xlsx’ Diagnosis papers may be used as ‘Templates’ by workers wishing to create their own. Downloaded papers can be edited with diagnosis texts substitutedfor different taxons.

My Asilid diagnosis texts are mainly based on my translation of Engel 1930.

The Plates of Images are limited to 140mm widest ‘jpg’ images.

REEFERENCES

Ref 1 Taylor M.J. 2001 BJENH, **14**: 193-206

Ref 2 Taylor M.J. 2004 BJENH, **17**: 25-33

Ref 3 Taylor M.J. 2012 ‘ Insect Digital Work Station, 11 Feb 2012.

www.miketaylornaturalist.co.uk

Ref 4 Taylor M.J. 2015 ‘ Digital Insect Specimen Photography with ‘Helicon Focus 6’ computer stacking software and Rotating Specimen Stages. 30 June 2015

www.miketaylornaturalist.co.uk