FB 19| Geography

Department of Environmental Informatics.

Dr. Dirk Zeuss
Spaska Forteva
Madhuvanthi Venkatesh

Course Name: **Species Distribution Modelling** (SDM).

Software: **Digitize IT.**

Module: **Object Detection.**

Software Tutorial

Contents

- Aim
- User choices
- Processing Steps of DigitizeIT Software
- Image Processing (Basics)
- Template Matching Algorithm
- Outputs and Discussions
- Kickstart with DigitizeIT Software.

Aim (Overall Project)

- The main aim of the project is to develop user-friendly software that can extract the analogue information from the text books and convert the cartesian coordinates of the analogue maps to the geographical coordinates. [3]

- This information extraction could be texts, figures, tables or geographical distribution of species from the analog maps.

- This software tool box would be creating geo-referenced files (i.e. files containing geographical coordinates) of distribution ranges (of species or any other information) from the analogue input maps. [3]

[3].Dr.Dirk Zeuss , Department of Geography, University of Marburg.

User choices

- They can choose the resolution of the image. (For example, the images were down sampled for assignment through the lower resolution value input).

- They can choose the threshold at which template matching can take place.

- Similarly, the user would be easily able to adjust the toolbox according to the project specific requirements.

Input

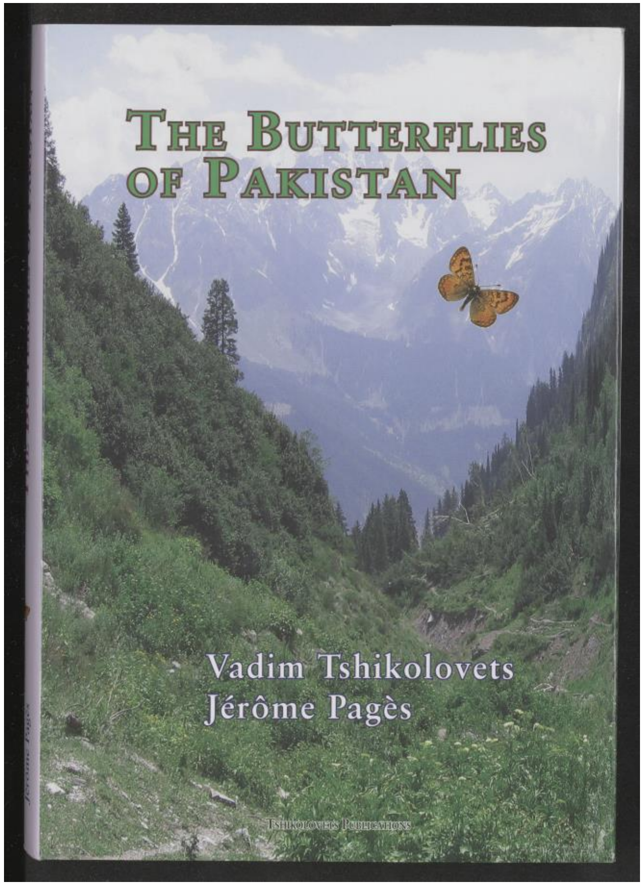
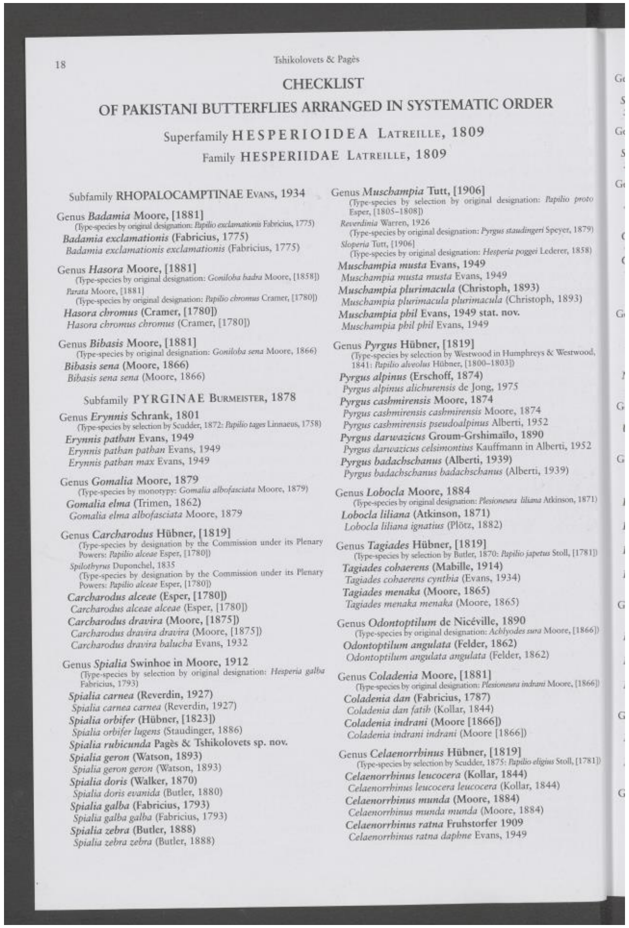


Figure 2: Front Cover [2]

- The example we use here is, "Butterflies of Pakistan".

[2]. Vadim Tshikolovets, Jerome Pages.

Input



18 Tshikolovets & Pagès

CHECKLIST

OF PAKISTANI BUTTERFLIES ARRANGED IN SYSTEMATIC ORDER

Superfamily HESPERIOIDEA LATREILLE, 1809

Family HESPERIIDAE LATREILLE, 1809

Subfamily RHOPALOCAMPTINAE EVANS, 1934

Genus *Badamia* Moore, [1881]
(Type-species by original designation: *Papilio exclamationis* Fabricius, 1775)
Badamia exclamationis **(Fabricius, 1775)**
Badamia exclamationis exclamationis (Fabricius, 1775)

Genus *Hasora* Moore, [1881]
(Type-species by original designation: *Goniloba badra* Moore, [1858])
Parata Moore, [1881]
(Type-species by original designation: *Papilio chromus* Cramer, [1780])
Hasora chromus **(Cramer, [1780])**
Hasora chromus chromus (Cramer, [1780])

Genus *Bibasis* Moore, [1881]
(Type-species by original designation: *Goniloba sena* Moore, 1866)
Bibasis sena **(Moore, 1866)**
Bibasis sena sena (Moore, 1866)

Subfamily PYRGINAE BURMEISTER, 1878

Genus *Erynnis* Schrank, 1801
(Type-species by selection by Scudder, 1872: *Papilio tages* Linnaeus, 1758)
Erynnis pathan **Evans, 1949**
Erynnis pathan pathan Evans, 1949
Erynnis pathan max Evans, 1949

Genus *Gomalia* Moore, 1879
(Type-species by monotypy: *Gomalia albofasciata* Moore, 1879)
Gomalia elma **(Trimen, 1862)**
Gomalia elma albofasciata Moore, 1879

Genus *Carcharodus* Hübner, [1819]
(Type-species by designation by the Commission under its Plenary Powers: *Papilio alceae* Esper, [1780])
Spilothyrus Duponchel, 1835
(Type-species by designation by the Commission under its Plenary Powers: *Papilio alceae* Esper, [1780])
Carcharodus alceae **(Esper, [1780])**
Carcharodus alceae alceae (Esper, [1780])
Carcharodus dravira **(Moore, [1875])**
Carcharodus dravira dravira (Moore, [1875])
Carcharodus dravira balucha Evans, 1932

Genus *Spialia* Swinhoe in Moore, 1912
(Type-species by selection by original designation: *Hesperia galba* Fabricius, 1793)
Spialia carnea **(Reverdin, 1927)**
Spialia carnea carnea (Reverdin, 1927)
Spialia orbifer **(Hübner, [1823])**
Spialia orbifer lugens (Staudinger, 1886)
Spialia rubicunda **Pagès & Tshikolovets sp. nov.**
Spialia geron **(Watson, 1893)**
Spialia geron geron (Watson, 1893)
Spialia doris **(Walker, 1870)**
Spialia doris evanida (Butler, 1880)
Spialia galba **(Fabricius, 1793)**
Spialia galba galba (Fabricius, 1793)
Spialia zebra **(Butler, 1888)**
Spialia zebra zebra (Butler, 1888)

Genus *Muschampia* Tutt, [1906]
(Type-species by selection by original designation: *Papilio proto* Esper, [1805–1808])
Reverdinia Warren, 1926
(Type-species by original designation: *Pyrgus staudingeri* Speyer, 1879)
Sloperia Tutt, [1906]
(Type-species by original designation: *Hesperia poggei* Lederer, 1858)
Muschampia musta **Evans, 1949**
Muschampia musta musta Evans, 1949
Muschampia plurimacula **(Christoph, 1893)**
Muschampia plurimacula plurimacula (Christoph, 1893)
Muschampia phil **Evans, 1949 stat. nov.**
Muschampia phil phil Evans, 1949

Genus *Pyrgus* Hübner, [1819]
(Type-species by selection by Westwood in Humphreys & Westwood, 1841: *Papilio alveolus* Hübner, [1800–1803])
Pyrgus alpinus **(Erschoff, 1874)**
Pyrgus alpinus alichurensis de Jong, 1975
Pyrgus cashmirensis **Moore, 1874**
Pyrgus cashmirensis cashmirensis Moore, 1874
Pyrgus cashmirensis pseudoalpinus Alberti, 1952
Pyrgus darwazicus **Groum-Grshimaïlo, 1890**
Pyrgus darwazicus celsimontius Kauffmann in Alberti, 1952
Pyrgus badachschanus **(Alberti, 1939)**
Pyrgus badachschanus badachschanus (Alberti, 1939)

Genus *Lobocla* Moore, 1884
(Type-species by original designation: *Plesioneura liliana* Atkinson, 1871)
Lobocla liliana **(Atkinson, 1871)**
Lobocla liliana ignatius (Plötz, 1882)

Genus *Tagiades* Hübner, [1819]
(Type-species by selection by Butler, 1870: *Papilio japetus* Stoll, [1781])
Tagiades cohaerens **(Mabille, 1914)**
Tagiades cohaerens cynthia (Evans, 1934)
Tagiades menaka **(Moore, 1865)**
Tagiades menaka menaka (Moore, 1865)

Genus *Odontoptilum* de Nicéville, 1890
(Type-species by original designation: *Achlyodes sura* Moore, [1866])
Odontoptilum angulata **(Felder, 1862)**
Odontoptilum angulata angulata (Felder, 1862)

Genus *Coladenia* Moore, [1881]
(Type-species by original designation: *Plesioneura indrani* Moore, [1866])
Coladenia dan **(Fabricius, 1787)**
Coladenia dan fatih (Kollar, 1844)
Coladenia indrani **(Moore [1866])**
Coladenia indrani indrani (Moore [1866])

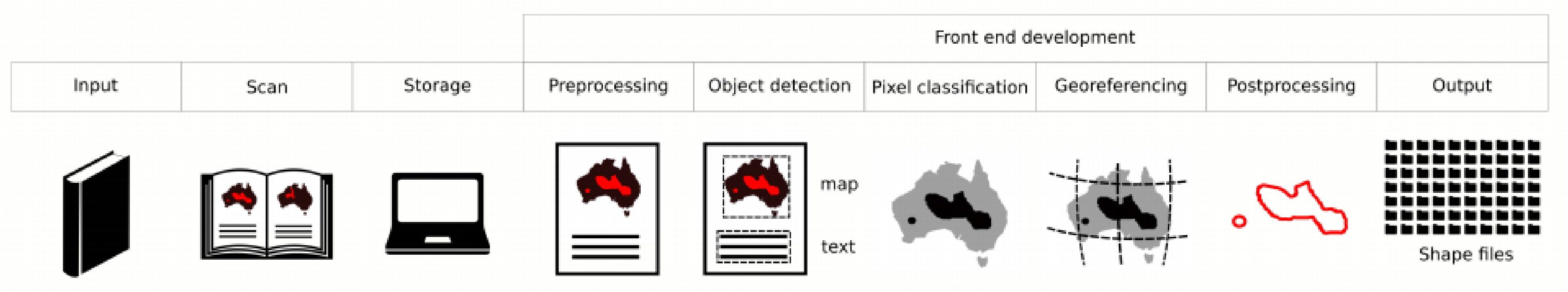
Genus *Celaenorrhinus* Hübner, [1819]
(Type-species by selection by Scudder, 1875: *Papilio eligius* Stoll, [1781])
Celaenorrhinus leucocera **(Kollar, 1844)**
Celaenorrhinus leucocera leucocera (Kollar, 1844)
Celaenorrhinus munda **(Moore, 1884)**
Celaenorrhinus munda munda (Moore, 1884)
Celaenorrhinus ratna **Fruhstorfer 1909**
Celaenorrhinus ratna daphne Evans, 1949

Figure 3: Page No 18[2]

- This book contains **(18-31), (14 pages) of species.**
- The data of the species (of about 362 pages) was scanned manually.

[2]. Vadim Tshikolovets, Jerome Pages.

Processing steps of DigitizeIT software



Front end development

Input | Scan | Storage | Preprocessing | Object detection | Pixel classification | Georeferencing | Postprocessing | Output

map

text

Shape files

Figure 3: Processing Steps [3]

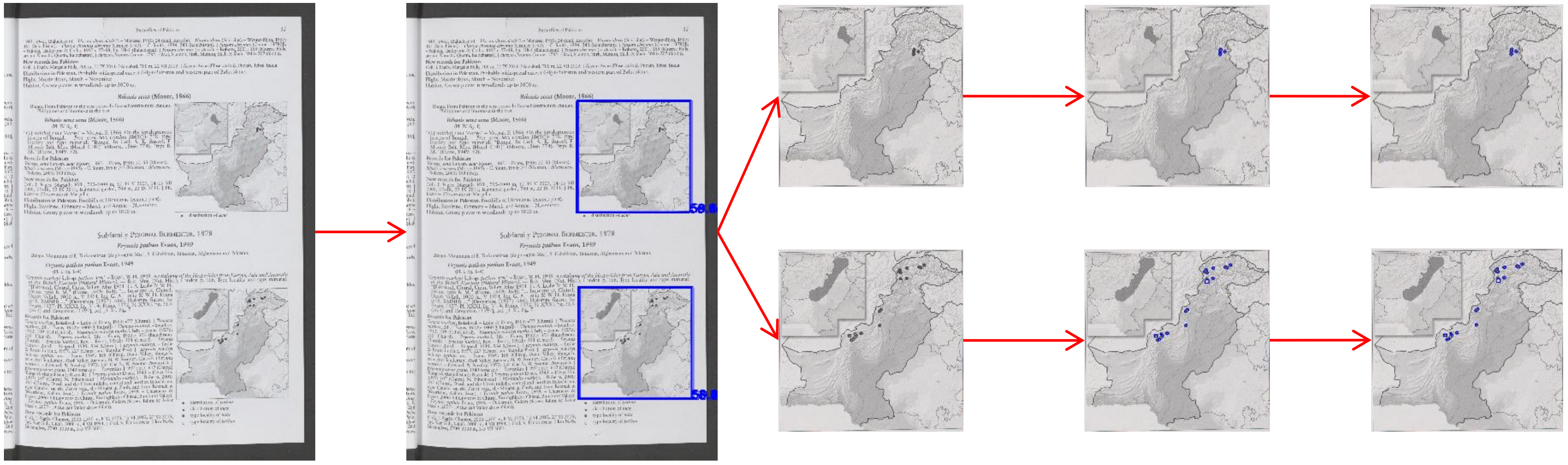
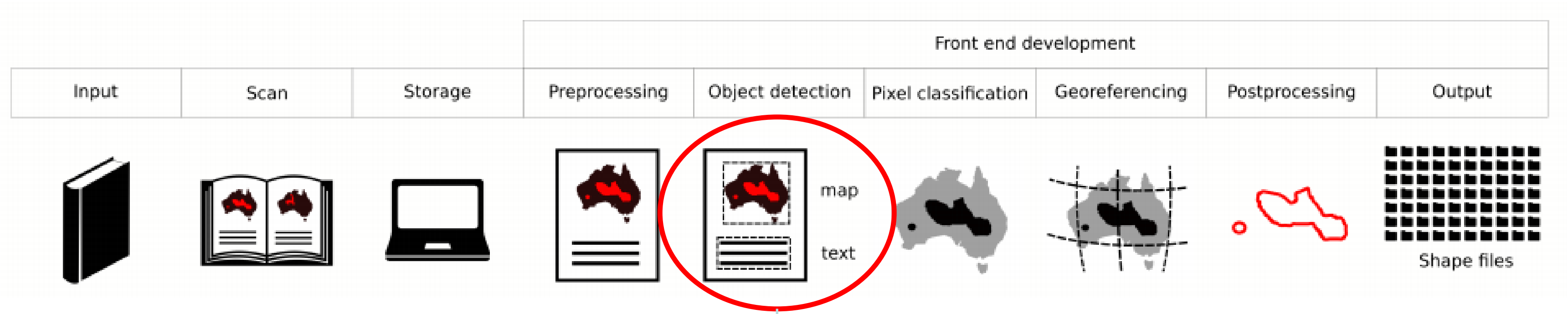


Figure 4: Processing Steps in Butterflies of Pakistan [2]

[3].Dr.Dirk Zeuss , Department of Geography, University of Marburg.

Processing steps of DigitizeIT software



			Front end development					
Input	Scan	Storage	Preprocessing	Object detection	Pixel classification	Georeferencing	Postprocessing	Output

Figure 3: Processing Steps [3]

Template Matching Algorithm (Open CV)

[3].Dr.Dirk Zeuss , Department of Geography, University of Marburg.

Pixel and Resolution

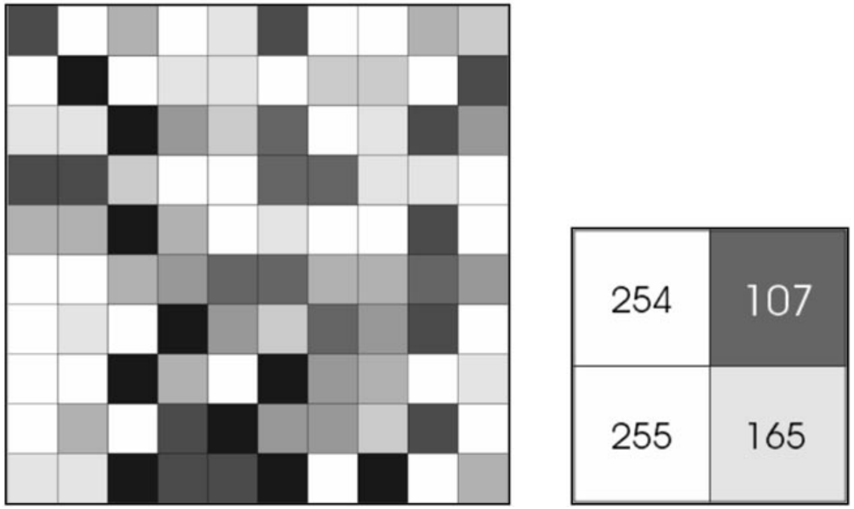


Figure 5: Image Resolution [5]

- Pix = picture, el = element.
- Pixels are smaller units or elements that comprise a digital image.
- The number of pixels in an image is called as resolution.
- The *higher the number of pixels* in an image, the *higher the resolution* it would constitute, the *higher the quality* of image would be.

Calculation of Size through Resolution

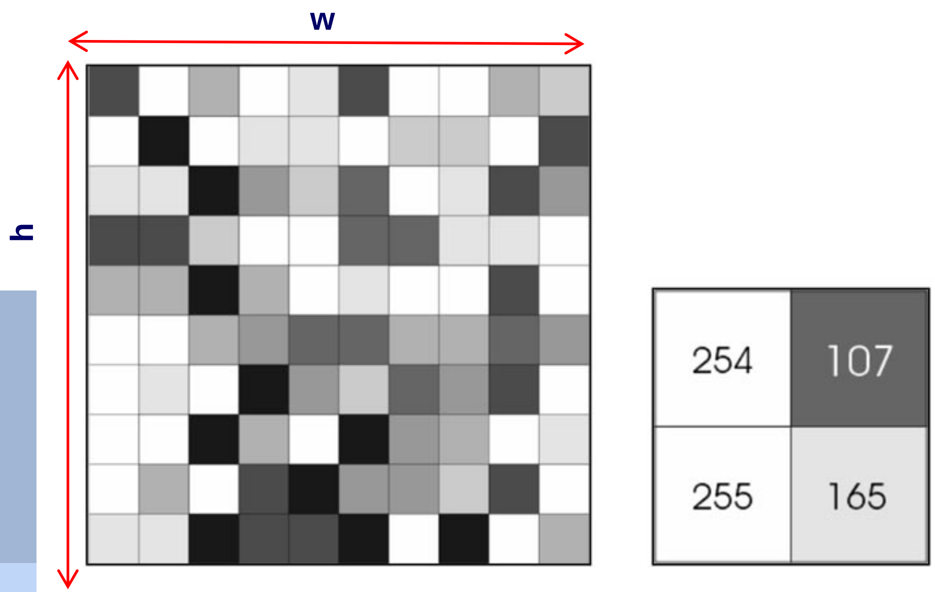


Figure 5: Image Resolution [5]

- **Size (cm) = w * h * (2.54 / no of pixels) * (2.54 / no of pixels).**

w = width of the image (in number of pixels).

h = height of the image (in number of pixels).

OpenCV (Template Matching)

Template Image

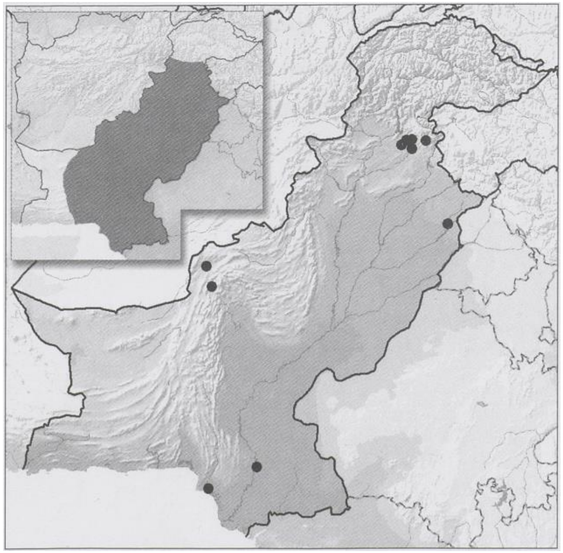
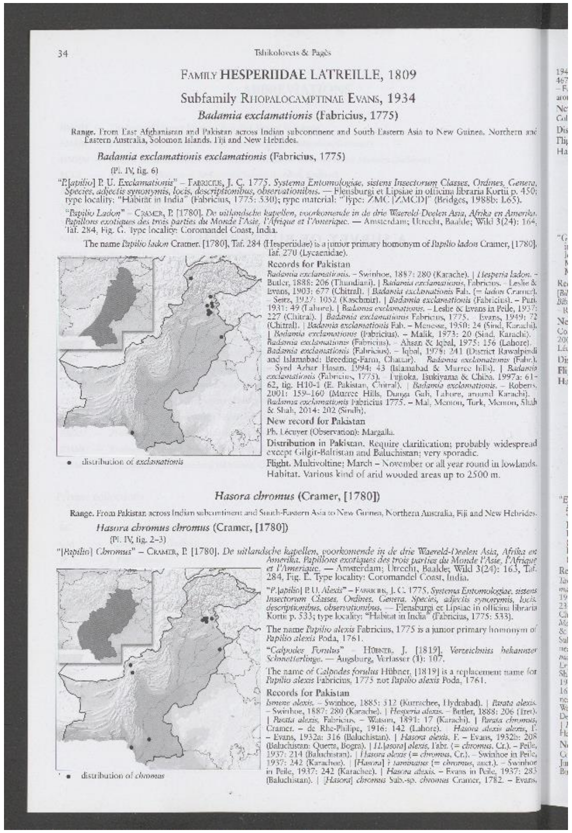


Figure 6: Template Image of page 24[2]

Input Image



34 Tshikolovets & Pagès

FAMILY **HESPERIIDAE LATREILLE**, 1809

Subfamily RHOPALOCAMPTINAE EVANS, 1934

Badamia exclamationis **(Fabricius, 1775)**

Range. From East Afghanistan and Pakistan across Indian subcontinent and South Eastern Asia to New Guinea, Northern and Eastern Australia, Solomon Islands, Fiji and New Hebrides.

Badamia exclamationis exclamationis (Fabricius, 1775)

(Pl. IV, fig. 6)

"P.[*apilio*] P. U. *Exclamationis*" – FABRICIUS, J. C. 1775. *Systema Entomologiae, sistens Insectorum Classes, Ordines, Genera, Species, adjectis synonymis, locis, descriptionibus, observationibus.* — Flensburgi et Lipsiae in officina libraria Kortii p. 450; type locality: "Habitat in India" (Fabricius, 1775: 530); type material: "Type: ZMC [ZMCD]" (Bridges, 1988b: L65).

"*Papilio Ladon*" – CRAMER, P. [1780]. *De uitlandsche kapellen, voorkomende in de drie Waereld-Deelen Asia, Afrika en Amerika. Papillons exotiques des trois parties du Monde l'Asie, l'Afrique et l'Amerique.* — Amsterdam; Utrecht, Baalde; Wild 3(24): 164, Taf. 284, Fig. G. Type locality: Coromandel Coast, India.

The name *Papilio ladon* Cramer, [1780], Taf. 284 (Hesperiidae) is a junior primary homonym of *Papilio ladon* Cramer, [1780], Taf. 270 (Lycaenidae).

Records for Pakistan

Badamia exclamationis. – Swinhoe, 1887: 280 (Karache). | *Hesperia ladon.* – Butler, 1888: 206 (Thundiani). | *Badamia exclamationis*, Fabricius. – Leslie & Evans, 1903: 677 (Chitral). | *Badamia exclamationis* Fab. (= *ladon* Cramer). – Seitz, 1927: 1052 (Kaschmir). | *Badamia exclamationis* (Fabricius). – Puri, 1931: 49 (Lahore). | *Badamia exclamationis.* – Leslie & Evans in Peile, 1937: 227 (Chitral). | *Badamia exclamationis* Fabricius, 1775. – Evans, 1949: 72 (Chitral). | *Badamia exclamationis* Fab. – Menesse, 1950: 24 (Sind, Karachi). | *Badamia exclamationis* (Fabricius). – Malik, 1973: 20 (Sind, Karachi). *Badamia exclamationis* (Fabricius). – Ahsan & Iqbal, 1975: 156 (Lahore). *Badamia exclamationis* (Fabricius). – Iqbal, 1978: 241 (District Rawalpindi and Islamabad: Breeding-Farm, Chattar). *Badamia exclamationis* (Fabr.). – Syed Azhar Hasan, 1994: 43 (Islamabad & Murree hills). | *Badamia exclamationis* (Fabricius, 1775). – Fujioka, Tsukiyama & Chiba, 1997a: 61–62, fig. H10-1 (E. Pakistan, Chitral). | *Badamia exclamationis.* – Roberts, 2001: 159–160 (Murree Hills, Dunga Gali, Lahore, around Karachi). *Badamia exclamationis* Fabricius 1775. – Mal, Menon, Turk, Menon, Shah & Shah, 2014: 202 (Sindh).

New record for Pakistan

Ph. Lécuyer (Observation): Margalla.

Distribution in Pakistan. Require clarification; probably widespread except Gilgit-Baltistan and Baluchistan; very sporadic.

Flight. Multivoltine; March – November or all year round in lowlands.

Habitat. Various kind of arid wooded areas up to 2500 m.

● distribution of *exclamationis*

Hasora chromus **(Cramer, [1780])**

Range. From Pakistan across Indian subcontinent and South-Eastern Asia to New Guinea, Northern Australia, Fiji and New Hebrides.

Hasora chromus chromus (Cramer, [1780])

(Pl. IV, fig. 2–3)

"[*Papilio*] *Chromus*" – CRAMER, P. [1780]. *De uitlandsche kapellen, voorkomende in de drie Waereld-Deelen Asia, Afrika en Amerika. Papillons exotiques des trois parties du Monde l'Asie, l'Afrique et l'Amerique.* — Amsterdam; Utrecht, Baalde; Wild 3(24): 163, Taf. 284, Fig. E. Type locality: Coromandel Coast, India.

"P.[*apilio*] P. U. *Alexis*" – FABRICIUS, J. C. 1775. *Systema Entomologiae, sistens Insectorum Classes, Ordines, Genera, Species, adjectis synonymis, locis, descriptionibus, observationibus.* — Flensburgi et Lipsiae in officina libraria Kortii p. 533; type locality: "Habitat in India" (Fabricius, 1775: 533).

The name *Papilio alexis* Fabricius, 1775 is a junior primary homonym of *Papilio alexis* Poda, 1761.

"*Calpodes Forulus*" – HÜBNER, J. [1819]. *Verzeichniss bekannter Schmetterlinge.* — Augsburg, Verfasser (1): 107.

The name of *Calpodes forulus* Hübner, [1819] is a replacement name for *Papilio alexis* Fabricius, 1775 not *Papilio alexis* Poda, 1761.

Records for Pakistan

Ismene alexis. – Swinhoe, 1885: 512 (Kurrachee, Hydrabad). | *Parata alexis.* – Swinhoe, 1887: 280 (Karache). | *Hesperia alexis.* – Butler, 1888: 206 (Iret). | *Parata alexis*, Fabricius. – Watson, 1891: 17 (Karachi). | *Parata chromus*, Cramer. – de Rhe-Philipe, 1916: 142 (Lahore). | *Hasora alexis alexis*, F. – Evans, 1932a: 316 (Baluchistan). | *Hasora alexis*, F. – Evans, 1932b: 208 (Baluchistan: Quetta, Bogra). | *H.*[*asora*] *alexis*, Fabr. (= *chromus*, Cr.). – Peile, 1937: 214 (Baluchistan). | *Hasora alexis* (= *chromus*, Cr.). – Swinhoe in Peile, 1937: 242 (Karachee). | [*Hasora*] ? *taminatus* (= *chromus*, auct.). – Swinhoe in Peile, 1937: 242 (Karachee). | *Hasora alexis.* – Evans in Peile, 1937: 283 (Baluchistan). | [*Hasora*] *chromus* Sub.-sp. *chromus* Cramer, 1782. – Evans,

● distribution of *chromus*

Figure 7: Page 24[2]

[2]. Vadim Tshikolovets, Jerome Pages.

Cross correlation

- Crosscorrelation and convolution are same, but in convolution **the kernel is flipped** (transposed value of matrix is multiplied with the original image matrix).

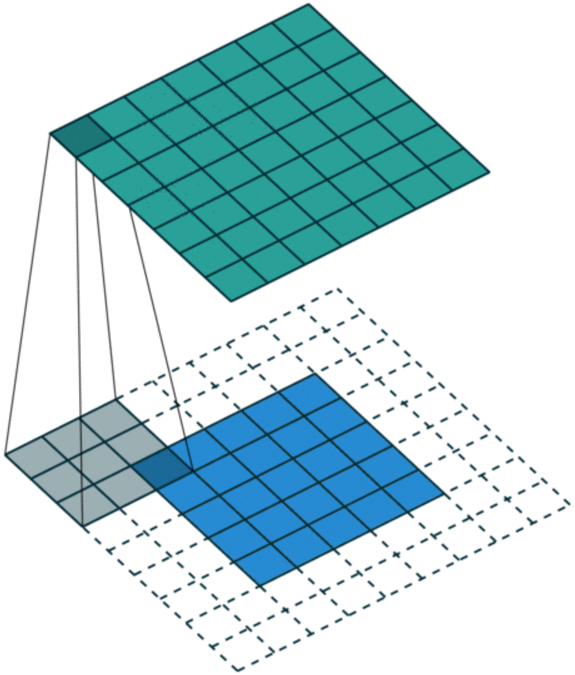


Figure 8: Cross correlation [4]

Cross correlation Output (R)	Type of Images
R > 0	For matched template and input images.
R = 0	For unmatched or different templates and input images.
R < 0	Not possible, as cross-correlation cannot have a negative output value.

Table 1: Cross correlation

OpenCV (Template Matching)

```
cv2.matchTemplate(img, tmp, cv2.TM_CCOEFF_NORMED)
```

$$R(x,y) = \frac{\sum_{x',y'} (T'(x',y') \cdot I'(x+x',y+y'))}{\sqrt{\sum_{x',y'} T'(x',y')^2 \cdot \sum_{x',y'} I'(x+x',y+y')^2}} \qquad (1)$$

>0 for the Ideal template and image.

(x,y) – Input Image.

(x´,y´)- Template Image.

[1]. OpenCV Documentation.

OpenCV (Template Matching)

Template Image

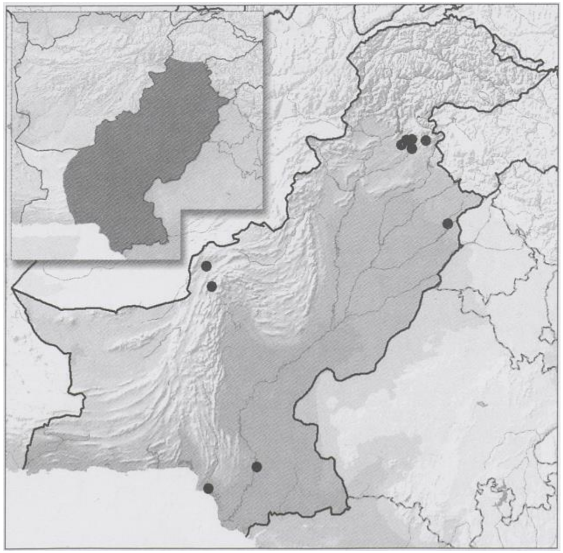
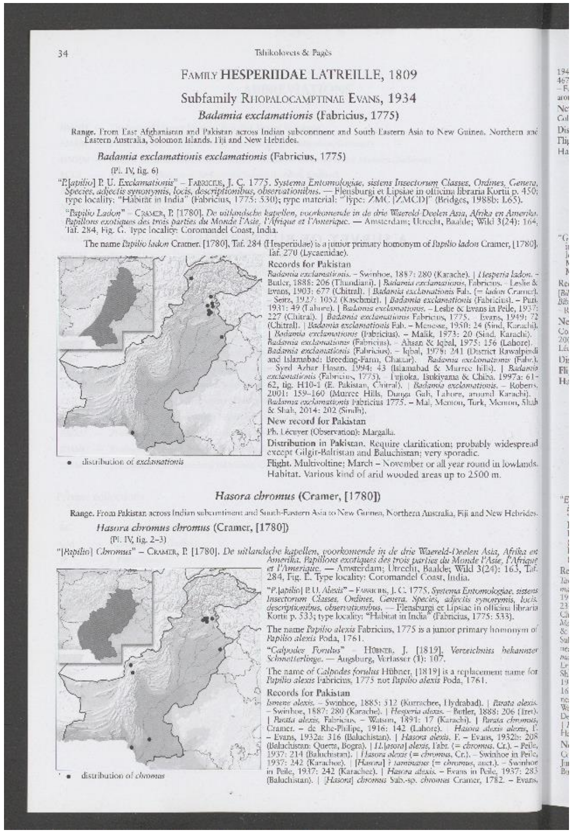


Figure 5: Template Image of page 24[2]

Input Image



>0

>0

34 Tshikolovets & Pagès

Family HESPERIIDAE LATREILLE, 1809

Subfamily Rhopalocamptinae Evans, 1934

Badamia exclamationis (Fabricius, 1775)

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Badamia exclamationis exclamationis (Fabricius, 1775)

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(Pl. IV, fig. 2–3)

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● distribution of *chromus*

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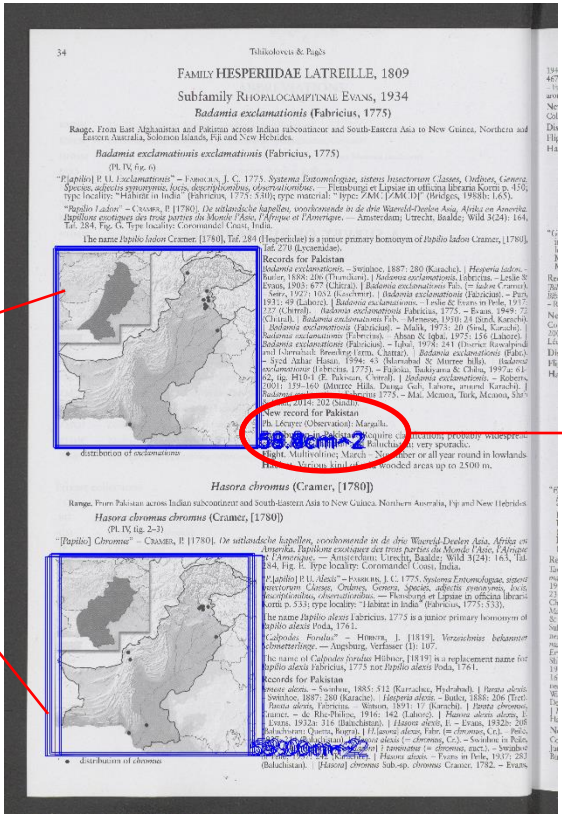
Figure 6: Page 24[2]

[2]. Vadim Tshikolovets, Jerome Pages.

OpenCV (Template Matching)



34 Tshikolovets & Pagès

FAMILY HESPERIIDAE LATREILLE, 1809

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Badamia exclamationis exclamationis (Fabricius, 1775)

(Pl. IV, fig. 6)

"P.[apilio] P. U. *Exclamationis*" – FABRICIUS, J. C. 1775. *Systema Entomologiae, sistens Insectorum Classes, Ordines, Genera, Species, adiectis synonymis, locis, descriptionibus, observationibus.* — Flensburgi et Lipsiae in officina libraria Kortii p. 450; type locality: "Habitat in India" (Fabricius, 1775: 530); type material: "Type: ZMC [ZMCD]" (Bridges, 1988b: I.65).

"*Papilio Ladon*" – CRAMER, P. [1780]. *De uitlandsche kapellen, voorkomende in de drie Waereld-Deelen Asia, Afrika en Amerika. Papillons exotiques des trois parties du Monde l'Asie, l'Afrique et l'Amerique.* — Amsterdam; Utrecht. Baalde; Wild 3(24): 164, Taf. 284, Fig. G. Type locality: Coromandel Coast, India.

The name *Papilio ladon* Cramer, [1780], Taf. 284 (Hesperiidae) is a junior primary homonym of *Papilio ladon* Cramer, [1780], Taf. 270 (Lycaenidae).

Records for Pakistan

Badamia exclamationis. – Swinhoe, 1887: 280 (Karachi). | *Hesperia ladon.* – Butler, 1888: 206 (Thundiani). | *Badamia exclamationis*, Fabricius. – Leslie & Evans, 1903: 677 (Chitral). | *Badamia exclamationis* Fab. (= *ladon* Cramer). – Seitz, 1927: 1052 (Kaschmir). | *Badamia exclamationis* (Fabricius). – Puri, 1931: 49 (Lahore). | *Badamia exclamationis.* – Leslie & Evans in Peile, 1937: 227 (Chitral). | *Badamia exclamationis* Fabricius, 1775. – Evans, 1949: 72 (Chitral). | *Badamia exclamationis* Fab. – Menesse, 1950: 24 (Sind, Karachi). | *Badamia exclamationis* (Fabricius). – Malik, 1973: 20 (Sind, Karachi). | *Badamia exclamationis* (Fabricius). – Ahsan & Iqbal, 1975: 156 (Lahore). | *Badamia exclamationis* (Fabricius). – Iqbal, 1978: 241 (District Rawalpindi and Islamabad: Breeding Farm, Chattar). | *Badamia exclamationis* (Fabr.). – Syed Azhar Hasan, 1994: 43 (Islamabad & Murree hills). | *Badamia exclamationis* (Fabricius, 1775). – Fujioka, Tsukiyama & Chiba, 1997a: 61-62, fig. H10-1 (E. Pakistan, Chitral). | *Badamia exclamationis.* – Roberts, 2001: 159–160 (Murree Hills, Dunga Gali, Lahore, around Karachi). | *Badamia* [illegible] Fabricius 1775. – Mal. Memon, Turk, Memon, Shah & [illegible], 2014: 202 (Sindh).

New record for Pakistan

Ph. Lécuyer (Observation): Margalla.

[illegible] Require clarification; probably widespread [illegible] Baluchistan: very sporadic.

Flight. Multivoltine; March – November or all year round in lowlands.

Habitat. Various kind of [illegible] wooded areas up to 2500 m.

• distribution of *exclamationis*

***Hasora chromus* (Cramer, [1780])**

Range. From Pakistan across Indian subcontinent and South-Eastern Asia to New Guinea, Northern Australia, Fiji and New Hebrides.

Hasora chromus chromus (Cramer, [1780])

(Pl. IV, fig. 2–3)

"[Papilio] *Chromus*" – CRAMER, P. [1780]. *De uitlandsche kapellen, voorkomende in de drie Waereld-Deelen Asia, Afrika en Amerika. Papillons exotiques des trois parties du Monde l'Asie, l'Afrique et l'Amerique.* — Amsterdam; Utrecht, Baalde; Wild 3(24): 163, Taf. 284, Fig. E. Type locality: Coromandel Coast, India.

"P.[apilio] P. U. *Alexis*" – FABRICIUS, J. C. 1775. *Systema Entomologiae, sistens Insectorum Classes, Ordines, Genera, Species, adiectis synonymis, locis, descriptionibus, observationibus.* — Flensburgi et Lipsiae in officina libraria Kortii p. 533; type locality: "Habitat in India" (Fabricius, 1775: 533).

The name *Papilio alexis* Fabricius, 1775 is a junior primary homonym of *Papilio alexis* Poda, 1761.

"*Calpodes Forulus*" – HÜBNER, J. [1819]. *Verzeichniss bekannter Schmetterlinge.* — Augsburg, Verfasser (1): 107.

The name of *Calpodes forulus* Hübner, [1819] is a replacement name for *Papilio alexis* Fabricius, 1775 not *Papilio alexis* Poda, 1761.

Records for Pakistan

Ismene alexis. – Swinhoe, 1885: 512 (Kurrachee, Hydrabad). | *Parata alexis.* – Swinhoe, 1887: 280 (Karachi). | *Hesperia alexis.* – Butler, 1888: 206 (Tret). | *Parata alexis*, Fabricius. – Watson, 1891: 17 (Karachi). | *Parata chromus*, Cramer. – de Rhe-Philipe, 1916: 142 (Lahore). | *Hasora alexis alexis*, F. – Evans, 1932a: 316 (Baluchistan). | *Hasora alexis*, F. – Evans, 1932b: 208 (Baluchistan: Quetta, Bugra). | *H.[asora] alexis*, Fabr. (= *chromus*, Cr.). – Peile, 1937: 21[illegible] (Baluchistan). | *Hasora alexis* (= *chromus*, Cr.). – Swinhoe in Peile, [illegible] *taminatus* (= *chromus*, auct.). – Swinhoe in Peile, 1937: 242 (Karachi). | *Hasora alexis.* – Evans in Peile, 1937: 283 (Baluchistan). | [*Hasora*] *chromus* Sub.-sp. *chromus* Cramer, 1782. – Evans,

• distribution of *chromus*

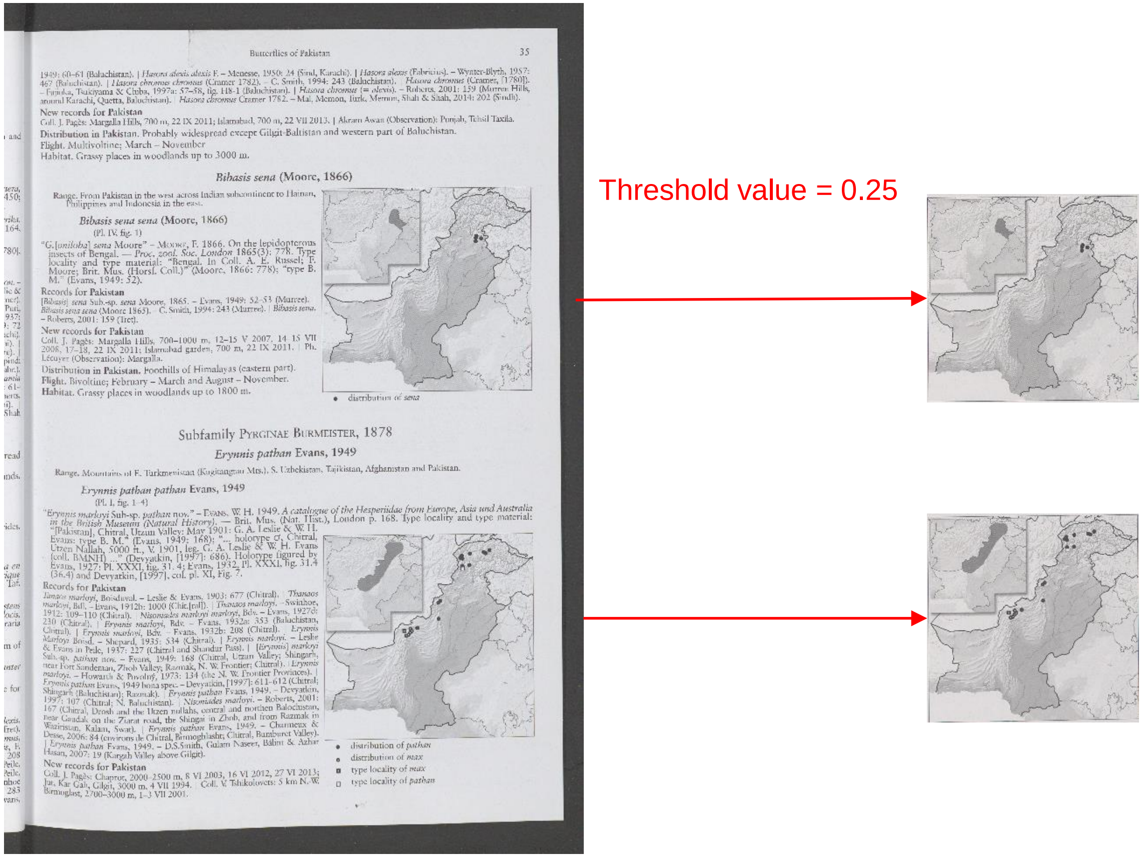
Matched Templates

Size of the rectangle

Figure 9: Output of Page 24[2]

[2]. Vadim Tshikolovets, Jerome Pages.

OpenCV (Template Matching)



Butterflies of Pakistan 35

1949: 60–61 (Baluchistan). | *Hasora alexis alexis* F. – Menesse, 1950: 24 (Sind, Karachi). | *Hasora alexis* (Fabricius). – Wynter-Blyth, 1957: 467 (Baluchistan). | *Hasora chromus chromus* (Cramer 1782). – C. Smith, 1994: 243 (Baluchistan). | *Hasora chromus* (Cramer, [1780]). – Fujioka, Tsukiyama & Chiba, 1997a: 57–58, fig. H8-1 (Baluchistan). | *Hasora chromus* (= *alexis*). – Roberts, 2001: 159 (Murree Hills, around Karachi, Quetta, Baluchistan). | *Hasora chromus* Cramer 1782. – Mal, Memon, Turk, Memon, Shah & Shah, 2014: 202 (Sindh).

New records for Pakistan
Coll. J. Pagès: Margalla Hills, 700 m, 22 IX 2011; Islamabad, 700 m, 22 VII 2013. | Akram Awan (Observation): Punjab, Tehsil Taxila.

Distribution in Pakistan. Probably widespread except Gilgit-Baltistan and western part of Baluchistan.
Flight. Multivoltine; March – November
Habitat. Grassy places in woodlands up to 3000 m.

Bibasis sena **(Moore, 1866)**

Range. From Pakistan in the west across Indian subcontinent to Hainan, Philippines and Indonesia in the east.

Bibasis sena sena **(Moore, 1866)**
(Pl. IV, fig. 1)

"G.[*uniloba*] *sena* Moore" – Moore, F. 1866. On the lepidopterous insects of Bengal. — *Proc. zool. Soc. London* 1865(3): 778. Type locality and type material: "Bengal. In Coll. A. E. Russel; F. Moore; Brit. Mus. (Horsf. Coll.)" (Moore, 1866: 778); "type B. M." (Evans, 1949: 52).

Records for Pakistan
[*Bibasis*] *sena* Sub.-sp. *sena* Moore, 1865. – Evans, 1949: 52–53 (Murree). *Bibasis sena sena* (Moore 1865). – C. Smith, 1994: 243 (Murree). | *Bibasis sena*. – Roberts, 2001: 159 (Tret).

New records for Pakistan
Coll. J. Pagès: Margalla Hills, 700–1000 m, 12–15 V 2007, 14–15 VII 2008, 17–18, 22 IX 2011; Islamabad garden, 700 m, 22 IX 2011. | Ph. Lécuyer (Observation): Margalla.

Distribution in Pakistan. Foothills of Himalayas (eastern part).
Flight. Bivoltine; February – March and August – November.
Habitat. Grassy places in woodlands up to 1800 m.

● distribution of *sena*

Subfamily Pyrginae Burmeister, 1878

Erynnis pathan **Evans, 1949**

Range. Mountains of E. Turkmenistan (Kugitangtau Mts.), S. Uzbekistan, Tajikistan, Afghanistan and Pakistan.

Erynnis pathan pathan **Evans, 1949**
(Pl. I, fig. 1–4)

"*Erynnis marloyi* Sub-sp. *pathan* nov." – Evans, W. H. 1949. *A catalogue of the Hesperiidae from Europe, Asia and Australia in the British Museum (Natural History).* — Brit. Mus. (Nat. Hist.), London p. 168. Type locality and type material: "[Pakistan], Chitral, Utzun Valley: May 1901: G. A. Leslie & W. H. Evans: type B. M." (Evans, 1949: 168); "... holotype ♂, Chitral, Utzen Nallah, 5000 ft., V. 1901, leg. G. A. Leslie & W. H. Evans (coll. BMNH) ..." (Devyatkin, [1997]: 686). Holotype figured by Evans, 1927: Pl. XXXI, fig. 31. 4; Evans, 1932, Pl. XXXI, fig. 31.4 (36.4) and Devyatkin, [1997], col. pl. XI, Fig. 7.

Records for Pakistan
Tanaos marloyi, Boisduval. – Leslie & Evans, 1903: 677 (Chitral). | *Thanaos marloyi*, Bdl. – Evans, 1912b: 1000 (Chit.[ral]). | *Thanaos marloyi*. – Swinhoe, 1912: 109–110 (Chitral). | *Nisoniades marloyi marloyi*, Bdv. – Evans, 1927d: 230 (Chitral). | *Erynnis marloyi*, Bdv. – Evans, 1932a: 353 (Baluchistan, Chitral). | *Erynnis marloyi*, Bdv. – Evans, 1932b: 208 (Chitral). | *Erynnis Marloyi* Boisd. – Shepard, 1935: 534 (Chitral). | *Erynnis marloyi*. – Leslie & Evans in Peile, 1937: 227 (Chitral and Shandur Pass). | [*Erynnis*] *marloyi* Sub.-sp. *pathan* nov. – Evans, 1949: 168 (Chitral, Utzan Valley; Shingarh, near Fort Sandeman, Zhob Valley, Razmak, N. W. Frontier; Chitral). | *Erynnis marloyi*. – Howarth & Povolný, 1973: 134 (the N. W. Frontier Provinces). | *Erynnis pathan* Evans, 1949 bona spec. – Devyatkin, [1997]: 611–612 (Chitral; Shingarh (Baluchistan); Razmak). | *Erynnis pathan* Evans, 1949. – Devyatkin, 1997: 107 (Chitral; N. Baluchistan). | *Nisoniades marloyi*. – Roberts, 2001: 167 (Chitral, Drosh and the Utzen nullahs, central and northen Balochistan, near Gandak on the Ziarat road, the Shingai in Zhob, and from Razmak in Waziristan, Kalam, Swat). | *Erynnis pathan* Evans, 1949. – Charmeux & Desse, 2006: 84 (environs de Chitral, Birmoghlasht; Chitral, Bamburet Valley). | *Erynnis pathan* Evans, 1949. – D.S.Smith, Gulam Naseer, Bálint & Azhar Hasan, 2007: 19 (Kargah Valley above Gilgit).

New records for Pakistan
Coll. J. Pagès: Chaprot, 2000–2500 m, 8 VI 2003, 16 VI 2012, 27 VI 2013; Jut, Kar Gah, Gilgit, 3000 m, 4 VII 1994. | Coll. V. Tshikolovets: 5 km N.-W. Birmoglast, 2700–3000 m, 1–3 VII 2001.

● distribution of *pathan*
○ distribution of *max*
▣ type locality of *max*
□ type locality of *pathan*

Threshold value = 0.25

Figure 10: Extraction of Maps [2]

Batch Processing of Files

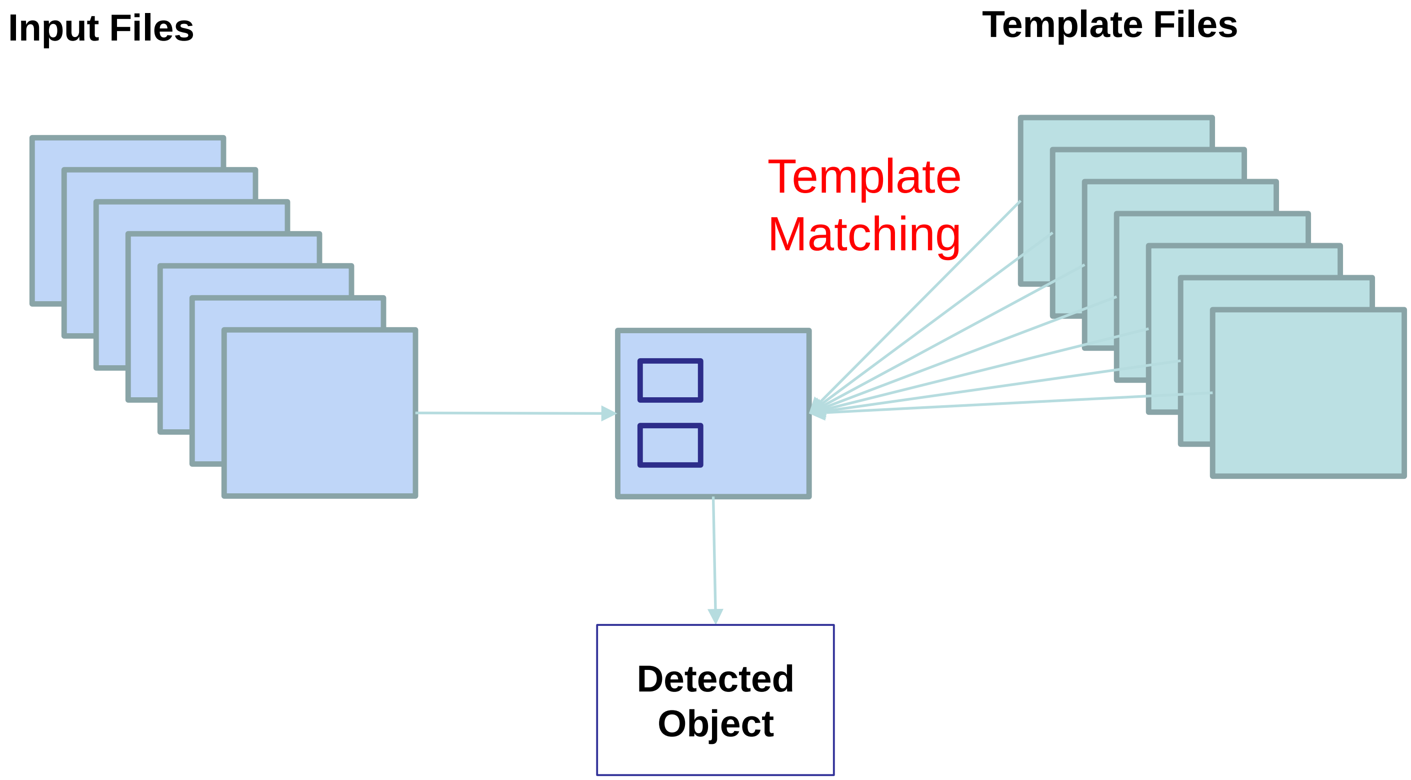


Figure 11: Batch Processing

Features of Batch Processing

- Batch processing widens the application of object detection from a single file to multiple files.

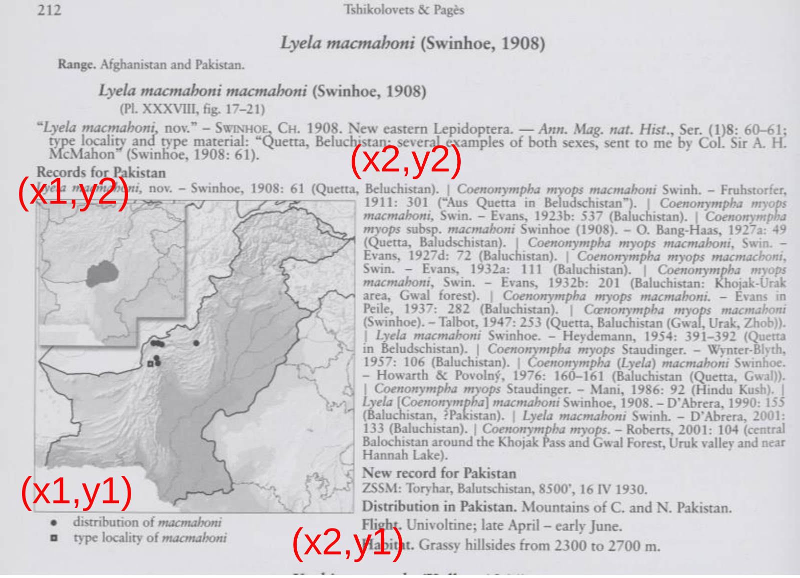
- This reduces the memory consumption by decreasing the number of template images for object detection. Since most of the maps in the text book have similar features, a template image can detect up to 10-15 maps from the input images.

- This also expands the application of the overall software tool box from books till detecting components in electrical circuits (or other applications in which object detection play a vital role).

Output

Table 2: Output of Template Matching

Filename	x1	y1	x2	y2	size	threshold	time
/content/drive/My Drive/testpakistan/0217.tif	1197	1221	4431	1502	58.9328257	0.25	18.3143082
Filename	x1	y1	x2	y2	size	threshold	time
/content/drive/My Drive/testpakistan/0217.tif	1190	1217	4427	1500	58.3962542	0.25	22.9821382


(x2,y2)
(x1,y2)
(x1,y1)
(x2,y1)
● distribution of *macmahoni*
▣ type locality of *macmahoni*

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Lyela macmahoni (Swinhoe, 1908)

Range. Afghanistan and Pakistan.

Lyela macmahoni macmahoni (Swinhoe, 1908)
(Pl. XXXVIII, fig. 17–21)

"*Lyela macmahoni*, nov." – Swinhoe, Ch. 1908. New eastern Lepidoptera. — *Ann. Mag. nat. Hist.*, Ser. (1)8: 60–61; type locality and type material: "Quetta, Beluchistan; several examples of both sexes, sent to me by Col. Sir A. H. McMahon" (Swinhoe, 1908: 61).

Records for Pakistan

Lyela macmahoni, nov. – Swinhoe, 1908: 61 (Quetta, Beluchistan). | *Coenonympha myops macmahoni* Swinh. – Fruhstorfer, 1911: 301 ("Aus Quetta in Beludschistan"). | *Coenonympha myops macmahoni*, Swin. – Evans, 1923b: 537 (Baluchistan). | *Coenonympha myops* subsp. *macmahoni* Swinhoe (1908). – O. Bang-Haas, 1927a: 49 (Quetta, Baludschistan). | *Coenonympha myops macmahoni*, Swin. – Evans, 1927d: 72 (Baluchistan). | *Coenonympha myops macmachoni*, Swin. – Evans, 1932a: 111 (Baluchistan). | *Coenonympha myops macmahoni*, Swin. – Evans, 1932b: 201 (Baluchistan: Khojak-Urak area, Gwal forest). | *Coenonympha myops macmahoni*. – Evans in Peile, 1937: 282 (Baluchistan). | *Cœnonympha myops macmahoni* (Swinhoe). – Talbot, 1947: 253 (Quetta, Baluchistan (Gwal, Urak, Zhob)). | *Lyela macmahoni* Swinhoe. – Heydemann, 1954: 391–392 (Quetta in Beludschistan). | *Coenonympha myops* Staudinger. – Wynter-Blyth, 1957: 106 (Baluchistan). | *Coenonympha* (*Lyela*) *macmahoni* Swinhoe. – Howarth & Povolný, 1976: 160–161 (Baluchistan (Quetta, Gwal)). | *Coenonympha myops* Staudinger. – Mani, 1986: 92 (Hindu Kush). | *Lyela* [*Coenonympha*] *macmahoni* Swinhoe, 1908. – D'Abrera, 1990: 155 (Baluchistan, ?Pakistan). | *Lyela macmahoni* Swinh. – D'Abrera, 2001: 133 (Baluchistan). | *Coenonympha myops*. – Roberts, 2001: 104 (central Balochistan around the Khojak Pass and Gwal Forest, Uruk valley and near Hannah Lake).

New record for Pakistan

ZSSM: Toryhar, Balutschistan, 8500', 16 IV 1930.

Distribution in Pakistan. Mountains of C. and N. Pakistan.

Flight. Univoltine; late April – early June.

Habitat. Grassy hillsides from 2300 to 2700 m.

Figure 12: Page 212 [2]

[2]. Vadim Tshikolovets, Jerome Pages.

Books

- 2020_suprascan_00030 The Butterflies of Turkmenistan
- 2020_suprascan_00031 The Butterflies of Altai, Sayans and Tuva
- 2020_suprascan_00032 The Butterflies of Russian Far East, Sakhalin, and Kuril Islands
- 2020_suprascan_00033 The Butterflies of Mongolia
- 2020_suprascan_00034 The Butterflies of Transbaikal Siberia
- 2020_suprascan_00036 The Butterflies of Tajikistan
- 2020_suprascan_00038 The Butterflies of Kazakhstan
- 2020_suprascan_00042 The Butterflies of Kyrgyzstan
- 2020_suprascan_00043 The Butterflies of Uzbekistan
- 2020_suprascan_00044 The Butterflies of Caucasus and Transcaucasia
- 2020_suprascan_00045 The Butterflies of Iran and Iraq
- 2020_suprascan_00047 The Butterflies of Ladak
- 2020_suprascan_00049 The Butterflies of Pakistan
- 2020_suprascan_00050 The Butterflies of Afghanistan

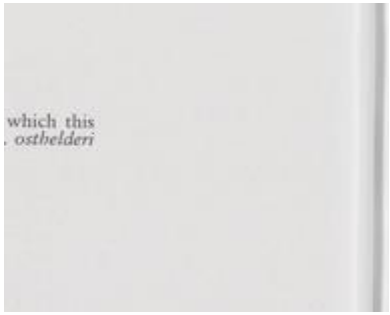
Books

- ***2020_suprascan_00030 The Butterflies of Turkmenistan***
- 2020_suprascan_00031 The Butterflies of Altai, Sayans and Tuva
- 2020_suprascan_00032 The Butterflies of Russian Far East, Sakhalin, and Kuril Islands
- 2020_suprascan_00033 The Butterflies of Mongolia
- ***2020_suprascan_00034 The Butterflies of Transbaikal Siberia***
- 2020_suprascan_00036 The Butterflies of Tajikistan
- 2020_suprascan_00038 The Butterflies of Kazakhstan
- 2020_suprascan_00042 The Butterflies of Kyrgyzstan
- 2020_suprascan_00043 The Butterflies of Uzbekistan
- 2020_suprascan_00044 The Butterflies of Caucasus and Transcaucasia
- 2020_suprascan_00045 The Butterflies of Iran and Iraq
- 2020_suprascan_00047 The Butterflies of Ladak
- 2020_suprascan_00049 The Butterflies of Pakistan
- ***2020_suprascan_00050 The Butterflies of Afghanistan***

Outputs (Threshold = 0.25)

- **2020_suprascan_00030 The Butterflies of Turkmenistan**

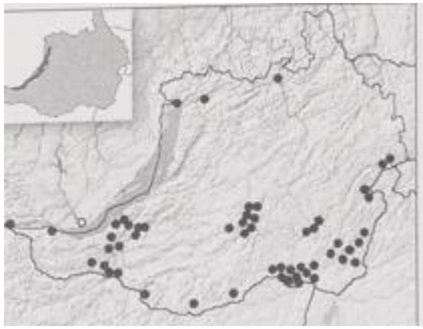
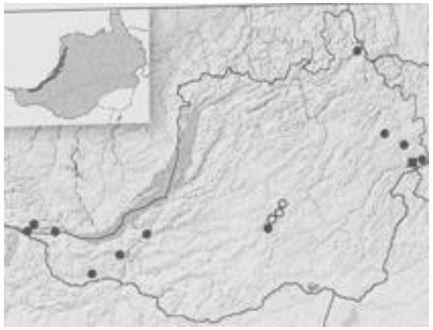
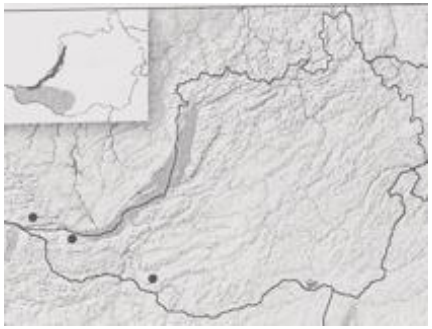
t.



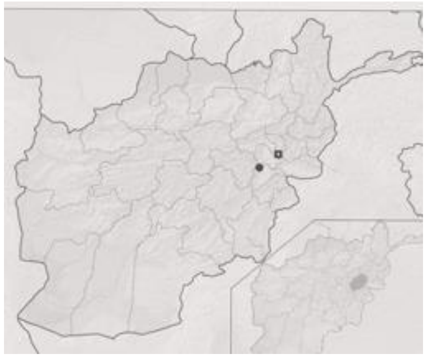
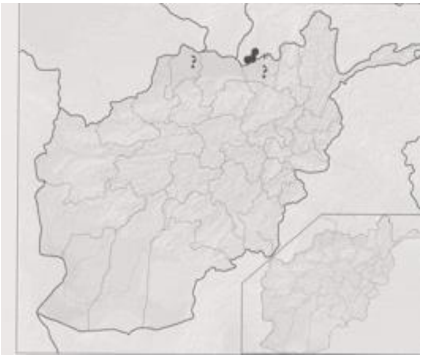
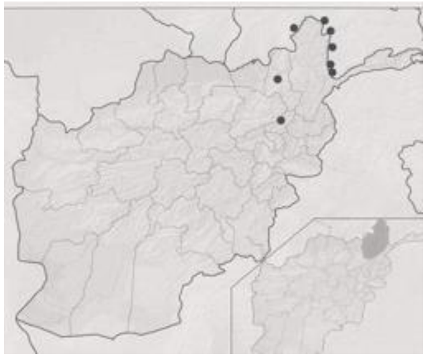
which this
. *osthelderi*

Outputs (Threshold = 0.2)

- **2020_suprascan_00034 The Butterflies of Transbaikal Siberia.**

- **2020_suprascan_00050 The Butterflies of Afghanistan.**

Coordinate Outputs

```
rows = [[tifffile, w, h , pt[1] + w, pt[0] + h, size, threshold, (time.time() - start_time)]]
```

Filename	x1	y1	x2	y2	size	threshold	time
/content/drive/MyDrive/Book 14/0124.tif	214	254	392	637	2.19176981	0.2	0.7414739132
Filename	x1	y1	x2	y2	size	threshold	time
/content/drive/MyDrive/Book 14/0123.tif	214	254	340	319	2.19176981	0.2	1.596010208

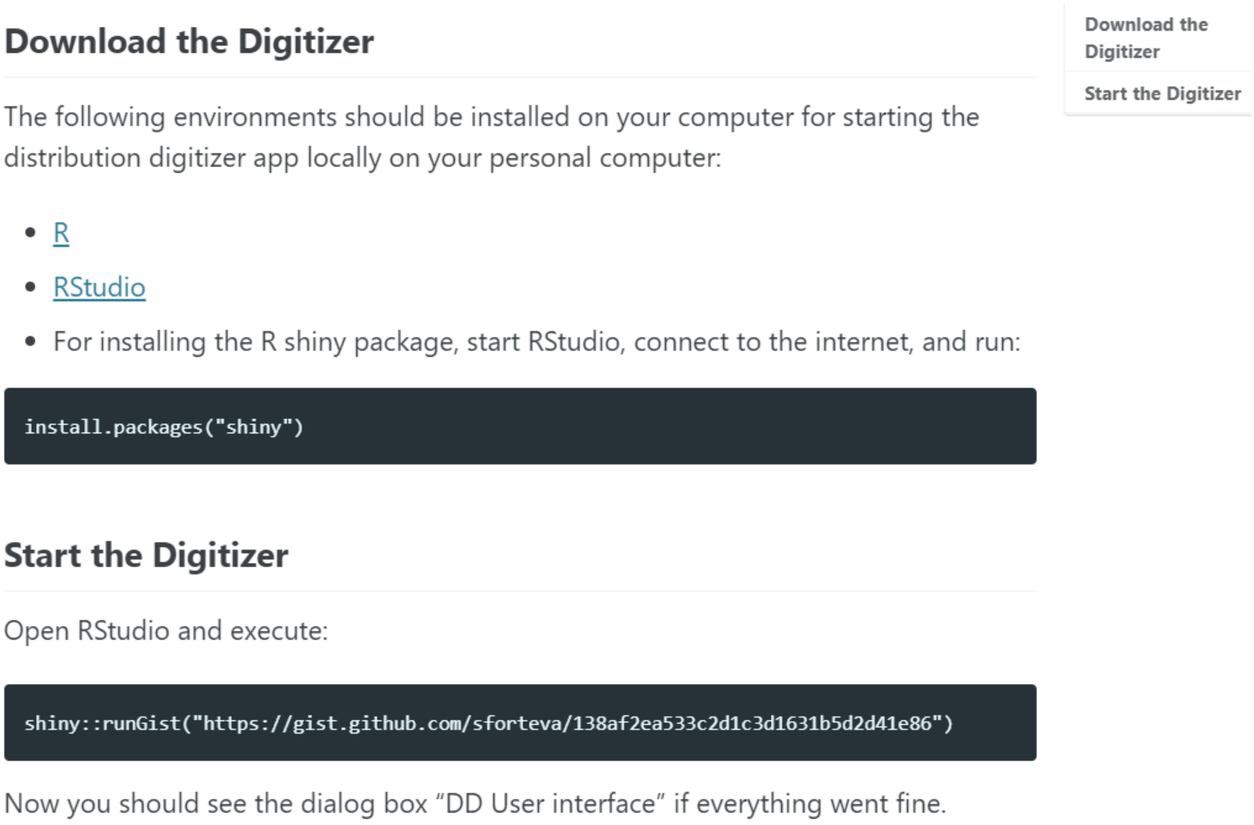
***Size of the map in the textbook =** 51.2 (8*6.4)* cm^2.

Size = w * h * (2.54 / no of pixels) * (2.54 / no of pixels)

No of Pixels ~ 250 (261-262).

DDRShiny App Installation Demo

Link : http://digitizer.umweltinformatik-marburg.de:4000/distributionDigitizer/data.html



Download the Digitizer

The following environments should be installed on your computer for starting the distribution digitizer app locally on your personal computer:

- R
- RStudio
- For installing the R shiny package, start RStudio, connect to the internet, and run:

```
install.packages("shiny")
```

Start the Digitizer

Open RStudio and execute:

```
shiny::runGist("https://gist.github.com/sforteva/138af2ea533c2d1c3d1631b5d2d41e86")
```

Now you should see the dialog box “DD User interface” if everything went fine.

Possible Errors

Error Message:

Error in library(png) : there is no package called ‘png’

Solution:

#Package Installed .

install.packages('png')

Thank you

References

[1]. OpenCV Documentation, https://docs.opencv.org/master/df/dfb/group__imgproc__object.html.

[2]. “The butterflies of pakistan“,Vadim Tshikolovets, Jerome Pages.

[3]. “DigitizeIT: An open-source toolbox for digitizing species data from analogue books”, Dr.Dirk Zeuss , Department of Environmental Informatics, University of Marburg.

[4]. Convolution vs. Cross Correlation, video from Udacity “Computational Photography” (also, all of Lesson 10, a video series with examples, animations, and formulas).

[5]. https://esahubble.org/projects/fits_liberator/improc/.