

UC Merced

Biogeographia - The Journal of Integrative Biogeography

Title

The Orthoptera of the Trentino: ecological and biogeographic considerations

Permalink

<https://escholarship.org/uc/item/6d622344>

Journal

Biogeographia - The Journal of Integrative Biogeography, 26(1)

ISSN

1594-7629

Authors

Agapiti, Barbara
Fontana, Paolo

Publication Date

2005

DOI

10.21426/B626110583

Peer reviewed

The Orthoptera of the Trentino: ecological and biogeographic considerations

BARBARA AGABITI*, PAOLO FONTANA**

*Istituto Agrario S. Michele all'Adige
via S. Pietro 3, I-38100 Trento
e-mail: barbara.agabiti@iasma.it

**Dipartimento Agronomia Ambientale e Produzioni Vegetali Agripolis
via dell'Università 16, I-35020 Legnaro, Padova
e-mail: paolo.fontana@unipd.it

Key words: Insecta, Orthoptera, Trentino, Ecology, Red List, Biogeography.

SUMMARY

The Authors have researched into Orthoptera (Insecta, Orthoptera) of Trentino, based on data in literature and also on several collections carried out by the authors themselves in the past years; furthermore the collections of the Museums of Trento, Verona and Berlin have been examined. The Orthoptera fauna up to today counts 104 species and its numerical substance has been compared to the one of the bordering areas (Bolzano, Sondrio, Bergamo, Verona, Vicenza, Belluno and Treviso), basing the comparison also on the territorial extension and altitude excursion. The same provinces have also been compared applying the Sørensen's indexes, from which similarity matrixes of the different provinces have been obtained, elaborated afterwards by the statistics program R-win and by the CANOCO 4.0 software, in order to obtain cluster dendograms illustrating the distances between the various elements examined. This analysis has pointed out that Trentino is border area between west and east Orthoptera fauna. The same statistical analysis has been done on the altitude zones. The following species are particularly interesting in biogeography: *Barbitistes vicetinus*, *Anonconotus italoaustriacus*, *Pseudoprumna baldensis*, *Podisma pedestris nadigi*, *Glyptobothrus alticola*, *Antaxius difformis*, *Saga pedo*, *Ephippiger vicheti* e *Chorthopodisma cobellii*. From the data thus obtained it was also possible to single out the rare or threatened species and to write down a first red list for Trentino, also acknowledging the environments most sensitive to environmental modifications. The most threatened or vulnerable species in Trentino are therefore: *Ruspolia nitidula*, *Xiphidion discolor*, *Tettigonia cantans*, *Tettigonia caudata*, *Pteronemobius h. heydenii*, *Saga pedo*, *Calliptamus i. italicus*, *Anacridium aegyptium*, *Locusta migratoria cinerascens*, *Psophus stridulus*, *Oedaleus decorus*, *Oedipoda germanica*, *Sphingonotus c. caeruleans*, *Aiolopus s. strepens*, *Stethophyma grossum*, *Parapleurus alliaecus*, *Arcyptera f. fusca*.

INTRODUCTION

The study of the Orthoptera fauna of the Trentino region is particularly interesting, given its geographical position, intermediate between the Alpine

and the Pre-Alpine regions, allowing the population of fauna of different origins and characterized by various environmental needs. Trentino is also characterized by remarkable climate, fauna and flora differences in the North-South direction. The particular orology of the territory and the complex articulation of the valleys enhance these differences, allowing the presence of numerous micro-climatic situations that favour the fauna differentiation and the processes of isolation and speciating.

MATERIALS AND METHODS

The Authors have researched into Orthoptera of Trentino, based on data in litterature and also on several collections carried out by the Authors themselves in the past years; furthermore the collections of the Museums of Trento, Verona and Berlin have been examined. The Orthoptera fauna of the Trentino has been compared to the one of the bordering areas (Bolzano, Sondrio, Bergamo, Verona, Vicenza, Belluno and Treviso), basing the comparison also on the territorial extension and altitude excursion. The same provinces have also been compared applying the Sørensen's indexes, from which similarity matrixes of the different provinces have been obtained, elaborated afterwards by the statistics program R-win 7.0 (Becker, Chambers and Wilks, 2003) and by the CANOCO 4.0 (Cajo J.F. Ter Braak, 1998) software, in order to obtain cluster dendograms illustrating the distances between the various elements examined and a Canonical Corispondence Analysis to study the enviromental variables.

RESULTS

Orthoptera Check-list of Trentino

From 1800 until today the knowledge of the Orthoptera fauna in Trentino has remarkably increased: at about the end of the XIX century 78 species were known (Cobelli, 1886), between 1900 and 1950 the number went up to 92 (Galvagni, 1947), up to the 104 known today with a new quotation by the Authors for the *Barbitistes vicetinus* (Galvagni and Fontana, 1993) for the area Borghetto all'Adige (South of Trentino). The 104 species of the Trentino are listed in Tab. I (the 73 underlined species are the ones found during the 2002-2003 sampling campaigns). The area of study is shown in the Fig. 1, the points represent the sampling localities. In Italy 11 Orthoptera Families are known (Heller et al., 1998), 9 of which are represented in Trentino (Tab. II).

Tab. I - Check-list of the Orthoptera of Trentino

Superfam. TETTIGONIOIDEA	32. <i>A. difformis</i> (B. von Watt., 1861)
Fam. TETTIGONIIDAE	Gen. <i>Yersinella</i> Rammé, 1933
Subfam. Phaneropterinae	33. <i>Y. raymondi</i> (Yersin, 1850)
Gen. <i>Barbisites</i> Charp., 1825	Gen. <i>Pachytrachis</i> Uvarov, 1940
1. <i>B. serricauda</i> (Fab., 1794)	34. <i>P. gracilis</i> (Brunner, 1861)
2. <i>B. obtusus</i> Targ. & Toss., 1881	35. <i>P. striolatus</i> (Fieb., 1853)
3. <i>B. vicetinus</i> Galvagni & Fontana, 1993	Gen. <i>Roeseliana</i> Zeuner, 1941
Gen. <i>Tylopsis</i> Fieb., 1839	36. <i>R. roeseli</i> (Hangenbach, 1822)
4. <i>T. liliifolia</i> (Fab., 1793)	37. <i>R. fedtschenkoi</i> Saus., 1874
Gen. <i>Leptophyes</i> Fieb., 1853	Gen. <i>Chopardius</i> Harz, 1969
5. <i>L. albovittata</i> (Kollar, 1833)	38. <i>C. p. pedestris</i> (Fab., 1787)
6. <i>L. laticauda</i> (Fribaldsky, 1867)	Subfam. Ehippigerinae
7. <i>L. boscii</i> Brunner, 1878	Gen. <i>Ehippiger</i> Berthold, 1827
Gen. <i>Polysarcus</i> Fieb., 1853	39. <i>E. vicheti</i> Harz, 1996
8. <i>P. denticauda</i> (Charp., 1825)	40. <i>E. ehippiger</i> Fieb., 1784
Gen. <i>Poecilimon</i> Fischer, 1854	Subfam. Saginae B. von Watt, 1882
9. <i>P. ornatus</i> (Schmidt, 1850)	Gen. <i>Saga</i> Charp., 1825
Gen. <i>Isophya</i> Brunner, 1878	41. <i>S. pedo</i> (Pallas, 1771)
10. <i>I. pyrenaea</i> (Serv., 1839)	Fam. RHAPHIDOPHORINAE
11. <i>I. m. modestior</i> Brunner 1882	Subfam. Troglophilinae
Subfam. Meconematinae	Gen. <i>Troglophilus</i> Krauss, 1879
Gen. <i>Meconema</i> Serv., 1831	42. <i>T. cavicola</i> (Kollar, 1833)
12. <i>M. thalassinum</i> (De Geer, 1773)	43. <i>T. n. neglectus</i> Krauss, 1879
13. <i>M. meridionale</i> A. Costa, 1860	Fam. GRYLLOTALPIDAE
Gen. <i>Phaneroptera</i> Serv., 1839	Gen. <i>Gryllotalpa</i> Latr., 1802
14. <i>P. falcata</i> (Poda, 1761)	44. <i>G. gryllotalpa</i> (L., 1758)
15. <i>P. n. nana</i> Fieb., 1853	Fam. GRYLLOIDAE
Subfam. Conocephalinae	Subfam. Gryllinae
Gen. <i>Xiphidion</i> Serv., 1831	Gen. <i>Gryllus</i> L., 1758
16. <i>X. dorsalis</i> (Latr., 1804)	45. <i>G. campestris</i> L., 1758
17. <i>X. discolor</i> (Thunberg, 1815)	Gen. <i>Acheta</i> L., 1758
Gen. <i>Ruspolia</i> Schultess, 1898	46. <i>A. domesticus</i> L., 1758
18. <i>R. nitidula</i> (Scopoli, 1786)	Gen. <i>Melanogryllus</i> Chopard, 1961
Subfam. Tettigoniinae Otte, 1997	47. <i>M. d. desertus</i> Pallas, 1771
Gen. <i>Tettigonia</i> L., 1758	Gen. <i>Gryllomorpha</i> Fieb., 1853
19. <i>T. viridissima</i> L., 1758	48. <i>G. dalmatina</i> (Oksay, 1832)
20. <i>T. cantans</i> (Fuessly, 1775)	Gen. <i>Eumodicogryllus</i> Chopard, 1961
21. <i>T. caudata</i> (Charp., 1845)	49. <i>E. burdigalensis</i> (Latr., 1804)
Gen. <i>Anonconotus</i> Camerano, 1878	Subfam. Nemobiinae
22. <i>A. italoaustriacus</i> Nadig, 1987	Gen. <i>Nemobius</i> Serv., 1839
Subfam. Decticinae	50. <i>N. sylvestris</i> (Bosc, 1792)
Gen. <i>Decticus</i> Serv., 1831	Gen. <i>Pteronemobius</i> Jacobson & Bianchi, 1904
23. <i>D. v. verrucivorus</i> (L., 1758)	51. <i>P. h. heydenii</i> (Fisher, 1853)
Gen. <i>Metrioptera</i> Wesmael, 1838	52. <i>P. concolor</i> Walzer, 1871
24. <i>M. brachyptera</i> (L., 1761)	Fam. OECANTHIDAE
Gen. <i>Bicolorana</i> Zeuner, F.E., 1941	Subfam. Oecanthinae
25. <i>B. b. bicolor</i> (Philippi, 1830)	Gen. <i>Oecanthus</i> Serv., 1831
Gen. <i>Pholidoptera</i> Wesmael, 1838	53. <i>O. pellucens</i> (Scopoli, 1763)
26. <i>P. griseoaptera</i> (De Geer, 1773)	Superfam. ACRIDOIDEA
27. <i>P. a. aptera</i> (Fab., 1793)	Fam. TETRIGIDAE
28. <i>P. fallax</i> (Fischer, 1854)	Gen. <i>Acrida</i> L., 1758
29. <i>P. l. littoralis</i> Fieb. 1835	54. <i>A. ungarica mediterranea</i> Dirshius, 1949
Gen. <i>Platycleis</i> Fieb., 1852	Gen. <i>Tetrix</i> Latr., 1802
30. <i>P. g. grisea</i> (Fab., 1781)	55. <i>T. bipunctata</i> (L., 1758)
31. <i>P. intermedia</i> (Serv., 1839)	56. <i>T. subulata</i> (L., 1758)
Gen. <i>Antaxius</i> B. von Watt., 1882	57. <i>T. turki</i> (Krauss, 1876)

58. *T. tenuicornis* Sahlberg, 1893
Fam. TRIDACLYDAE Sauss., 1877
Subfam. Tridactlynae Sauss., 1877
Gen. *Xya* Latr., 1809
59. *X. variegata* Latr., 1809
Fam. CATANTOPIDAE
SUBFAM. Catantopinae
Gen. *Podisma* Latr., 1829
60. *P. p. pedestris* (L., 1758)
subsp. *P. p. nadigi* Harz, 1975
Gen. *Melanopus* Stål, 1873
61. *M. f. frigidus* (Boheman, 1846)
Gen. *Kisella* Harz, 1973
62. *K. alpina* (Kollar, 1833)
63. *K. irena* Fruhstrfer, 1921
Gen. *Odontopodisma* Dovnar-Zapolskii, 1932
64. *O. schmidti* Fieb. 1853
Subfam. Calliptaminae
Gen. *Calliptamus* Serv., 1831
65. *C. i. italicus* L., 1758
66. *C. siciliae* Ramme, 1927
Gen. *Pezotettix* Burmeister, 1840
67. *P. giornai* (Rossi, 1794)
Subfam. Cyrtacanthacridinae
Gen. *Anacridium* Uvarov, 1923
68. *A. aegyptium* (L., 1764)
Fam. ACRIDIDAE
Subfam. Locustinae (Oedipodinae)
Gen. *Oedipoda* Serv., 1831
69. *O. cerulescens* (L., 1758)
70. *O. germanica* (Latr., 1804)
Gen. *Sphingonotus* Fieb., 1852
71. *S. c. caeruleans* (L., 1767)
Gen. *Paracinema* Fischer, 1853
72. *P. tricolor bisignata* Charp., 1825
Gen. *Aiolopus* Fieb., 1853
73. *A. strepens* (Latr., 1804)
74. *A.t. thalassinus* Fab. 1871
Gen. *Psophus* Fieb., 1853
75. *P. stridulus* (L., 1758)
Gen. *Locusta* L., 1758
76. *L. migratoria cinerascens* Fab. 1781
Gen. *Stethophyma* Fieb., 1853
77. *S. grossum* (L., 1758)
Gen. *Parapleurus* Fischer, 1854
78. *P. alliaceus* (German, 1817)
Gen. *Oedaleus* Fieb., 1981
79. *O. decorus* (Germar, 1826)
Gen. *Acrotylus* Fieb., 1853
80. *A. patrielis* (Herrich-Schaffer, 1838)
Subfam. Gomphocerinae
Gen. *Gomphocerus* Thunberg, 1815
81. *G. rufus* (L., 1758)
Gen. *Arcyptera* Serv., 1839
82. *A. f. fusca* (Pallas, 1773)
Gen. *Aeropus* Gistel, 1850
83. *A. s. sibiricus* (L., 1767)
Gen. *Aeropedellus* Hebard, 1935
84. *A. v. variegatus* (Fischer-Waldheim, 1846)
Gen. *Chorthippus* Fieb., 1852
85. *C. d. dorsatus* (Zettersted, 1821)
86. *C. p. parallelus* (Zettersted, 1821)
Gen. *Euthystria* Fieb., 1853
87. *E. brachyptera* (Ocksay, 1826)
Gen. *Stenobothrus* Fischer, 1853
88. *S. lineatus* (Panzer, 1796)
Gen. *Stauroderus* Bolivar, 1897
89. *S. scalaris* (Fischer won Waldheim, 1846)
Gen. *Omocestus* Bolivar, 1878
90. *O. viridulus* (L., 1758)
91. *O. rufipes* (Zatterstedt, 1821)
Gen. *Euchorthippus* Tarbinskij, 1925
92. *E. pulvinatus* Fischer-Waldheim, 1846
93. *E. declivus* (Brisout, 1848)
Gen. *Pseudoprumna* Dovnar-Zapolski, 1932
94. *P. baldensis* (Krauss, 1883)
Gen. *Chorthopodisma*
95. *C. cobelli* (Krauss, 1883)
Gen. *Stenobothrodes* Tarbinskij, 1948
96. *S. rubicundulus* Kruseman & Jeekel, 1967
Gen. *Glyptobotrus* Chopard, 1951
97. *G. alticola* Ramme, 1921
98. *G. b. biguttulus* (L., 1758)
99. *G. b. brunneus* (Thunberg, 1815)
100. *G. mollis ignifer* (Ramme, 1923)
101. *G. eisentrauti* Ramme, 1931
102. *G. v. vagans* Eversmann, 1848
Gen. *Dirshius* Harz, 1975
103. *D. h. haemorroidalis* (Charp., 1825)
104. *D. petraeus* (Brisout, 1855)

Charaterization of the sampling environments

The distribution of the Orthoptera is not only dependent on the environmental characteristics but also on the micro-climatic conditions. During the sampling campaigns we have singled out some characteristic habitats, which have been difficult to classify due to the variety of vegetable associations found. According to Odasso (2002) we have schematized the main floristic group of the Trentino (Tab. III):

Tab. II - Families, genera and species of the Orthoptera of Italy and Trentino

Italy	Trentino			
	Family	Genus	Species	Genus
Tettigoniidae	44	127	24	40
Rhaphidophoridae	5	14	1	2
Gryllidae	21	31	7	8
Oecanthidae	1	1	1	1
Gryllotalpidae	1	8	1	1
Tetrigidae	4	7	2	5
Tridactylidae	1	1	1	1
Pamphagidae	4	8	0	0
Pyrgomorphidae	1	1	0	0
Catantopidae	18	43	7	9
Acrididae	36	92	26	37
Total	136	333	69	104

Tab. III - Main type of vegetation

Zone	Type of vegetation	Main tree species
Plain (0-200 m)	Woods of ilex, manna-ash, oaks, and hoarnbeam	British oak, ilex, ash-tree, hornbeam, sorb, bay oak and hazel
Sub mountainous (201-800 m)	Woods of ilex, manna-ash, oaks, and hoarnbeam	British oak, bay oak, hazel, ash-tree and hornbeam
Lower mountain (801-1300 m)	Beech-wood and mixed woods of conifers and braoadleafs	Norway spruce, beech, ilex, Scotch fir and alder
Upper mountain (1301-2000 m)	Woods of conifers and Norway spruce wood	Norway spruce, silver fir and ilex
Sub alpine (2001-2200 m)	Sub alpine Norway spruce wood	Norway spruce, ilex and Pinus cembra
Alpine (2201-3700 m)	Alpen prairie and moor	Bushes of rhododendron, juniper and bilberry

Orthopteric associations

Regarding the Orthopteric associations we referred to La Greca and Messina's pattern (1982); the 52% of the Orthoptera belong to «grassland field» association, another 13% belong to «shrub grassland» association and another 16% to the «shrub woodland» association (Fig. 2).

Altitudinal distribution

The plain zone is undoubtedly less representative of the Trentino territory, limited to narrow zones near the Adige river and Garda lake. The Orthoptera

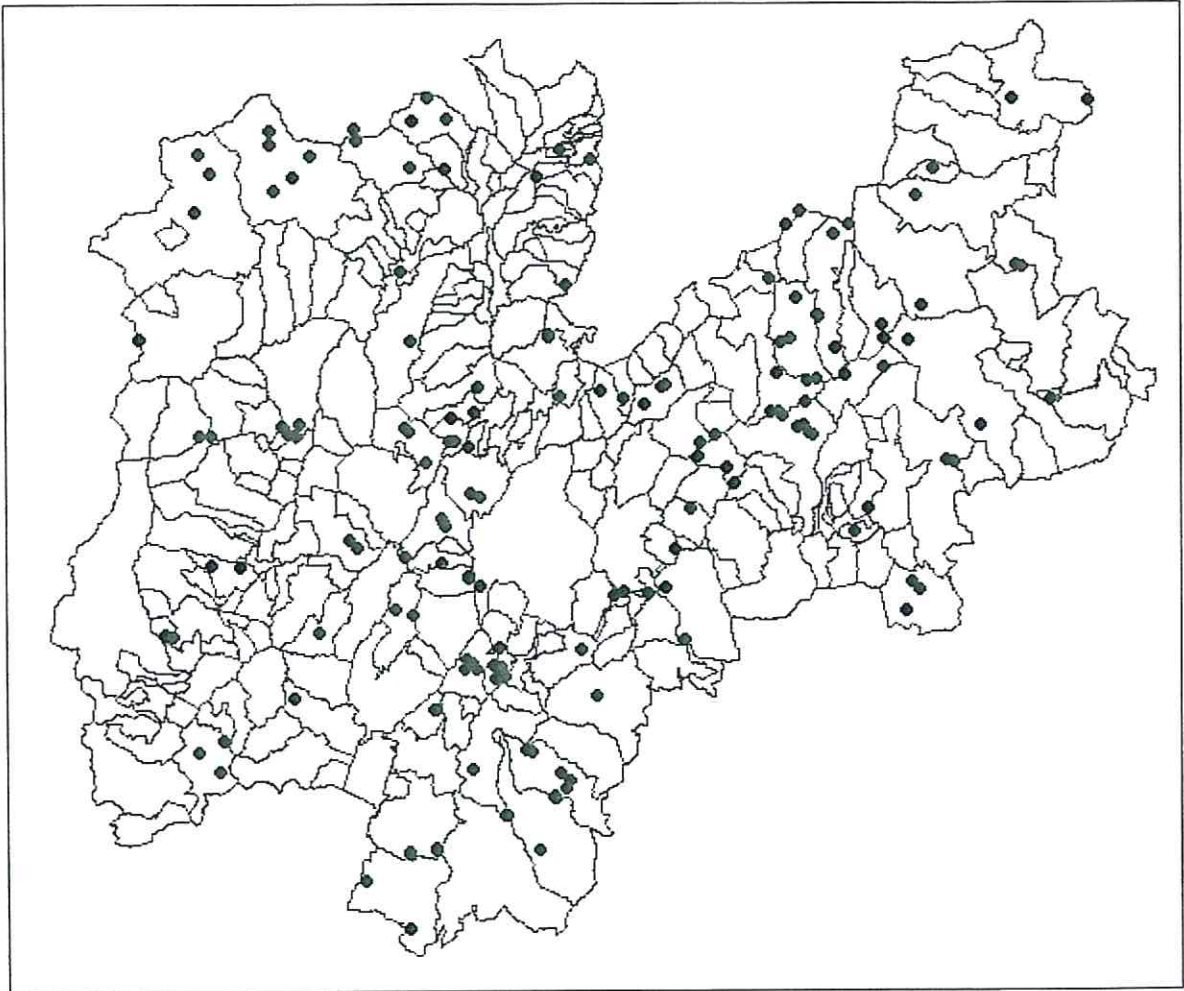


Fig.1 - Maps of the sampling localities

species are distributed in the different environments as follows, in the altitude zones; the number of species for each level is reported in brackets:

Plain 0-200 m (10 species)

Mixed woods: in bushes in the underwood: *Barbitistes vicetinus*, *Pholidoptera griseoptera*, *Pholidoptera a. aptera*, *Pholidoptera fallax*, *Ephippiger vicheti*. Dry fields: *Gryllus campestris*, *Ephippiger vicheti*. Cool fields: *Tettigonia viridissima* (in the bushes), *Gryllus campestris*, *Glyptobothrus b. biguttulus*, *Tetrix b. bipunctata*. Anthropogenic environments: *Acheta domesticus*.

Sub mountainous 201-800 m (48 species)

Dry fields: *Decticus v. verrucivorus*, *Ephippiger vicheti*, *Platycleis g. grisea*, *Ruspolia nitidula*, *Gryllus campestris*, *Anacridium aegyptium*, *Stenobothrus lineatus*, *Oedipoda caerulescens*, *Chorthippus p. parallelus*, *Chorthippus d. dorsatus*, *Dirshius b. haemorroidalis*, *Omocestus viridulus*, *Omocestus rufipens*, *Glyptobothrus b. brunneus*. Cool fields: *Tylopsis liliifolia*, *Gryllomorpha dalmatina*, *Gryllus campe-*

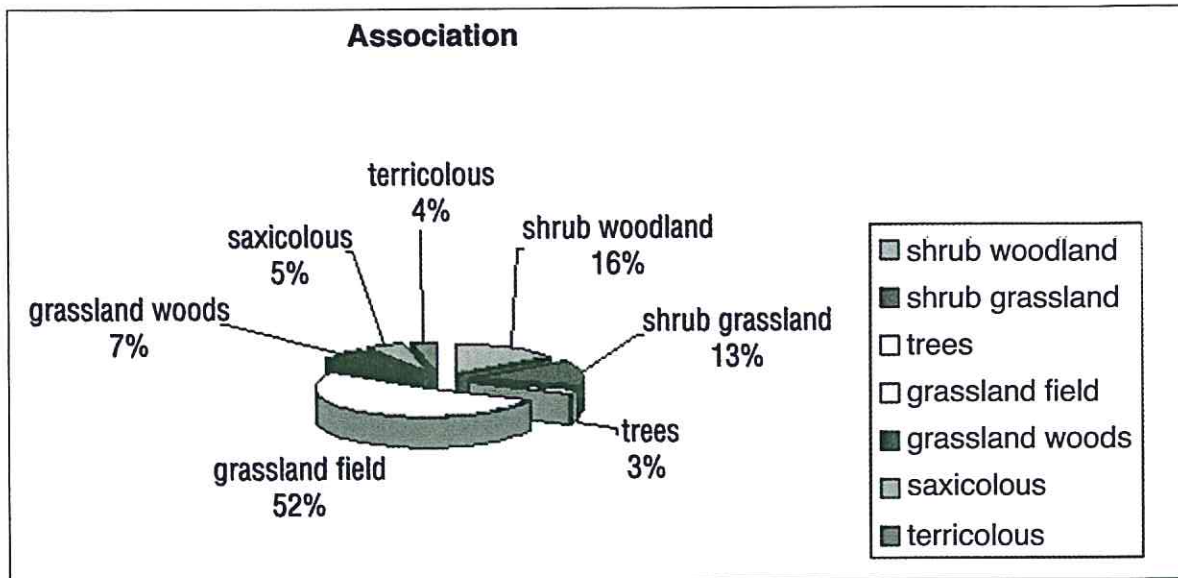


Fig. 2 - Association of Orthoptera

stris, *Kisella irena*, *Euthystira brachyptera*, *Glyptobothrus b. biguttulus*, *Glyptobothrus mollis ignifer*, *Tetrix b. bipunctata*, *Tetrix subulata*, *Chorthippus d. dorsatus*, *Euchorthippus declivus*, *Omocestus viridulus*, *Stauroderus scalaris*, *Stenobothrus lineatus*; in the bushes: *Tettigonia viridissima*, *Chopardius p. pedestris*, *Metrioptera bracypetra*, *Poecilinom ornatus*, *Roeseliana roeseli*. Wet fields: *Tetrix b. bipunctata*, *Omocestus rufipens*, *Tetrix subulata*, *Kisella irena*. Mixed woods: caves: *Troglophilus n. neglectus*, *Troglophilus cavicola*; on the trees: *Meconema meridionale*, *Phaneroptera n. nana*; in the underwood: *Barbitistes serricauda*, *Barbitistes obtusus*, *Leptophyes boscii*, *Pachytrachis striolatus*, *Phaneroptera falcata*, *Pholidoptera fallax*, *Pholidoptera a. aptera*, *Pholidoptera griseoaptera*, *Platycleis g. grisea*, *Yersinella raymondi*; clearing: *Yersinella raymondi*, *Gomphocerus rufus*, *Psophus stridulus*. Slimy sandy environments: *Gryllus campestris*, *Omocestus rufipens*, *Ruspolia nitidula*, *Sphingonotus c. caerulans*, *Psophus stridulus*. Vegetation on rocks and debris: *Calliptamus siciliae*, *Glyptobothrus v. vagans*, *Oedipoda caerulescens*, *Oedipoda germanica*. Anthropogenic environments: *Acheta domesticus*.

Lower mountain 801-1300 m (54 species)

Anthropic environments: *Acheta domesticus*. Tilled land: *Glyptobotrurus mollis ignifer*, *Tettigonia caudata*, *Euchorthippus declivus*. Broad-leaved woods: where the Oak tree prevails: over trees: *Meconema meridionale*, *Phaneroptera n. nana*; clearing: *Leptophyes boscii*, *Phaneroptera falcata*, *Pachytrachis striolatus*, *Yersinella raymondi*, *Platycleis g. grisea*, *Pholidoptera fallax*, *Pholidoptera griseoaptera*, *Pholidoptera a. aptera*, *Psophus stridulus*, *Glyptobothrus v. vagans*; on litter: *Nemobius sylvestris*, *Troglophilus cavicola*. In wetter woods with Alder predominance: *Barbitistes serricauda*, *Barbitistes obtusus*, *Barbitistes vicetinus*. Dry fields: *Decticus v. verrucivorus*,

Platycleis g. grisea, *Pholidoptera griseoptera*, *Phaneroptera n. nana*, *Chopardius p. pedestris*, *Nemobius sylvestris*, *Calliptamus i. italicus*, *Aiolopus s. strepens*, *Psophus stridulus*, *Omocestus rufipes*, *Glyptobotrus mollis ignifer*, *Glyptobotrhus v. vagans*, *Chorthippus d. dorsatus*, *Chorthippus p. parallelus*, *Dirshius h. haemorroidalis*, *Dirshius petraeus*. Wet fields: *Ruspolia nitidula*, *Platycleis g. grisea*, *Phaneroptera falcata*, *Pholidoptera griseoptera*, *Pholidoptera fallax*, *Yersinella raymondi*, *Pachytrachis gracilis*, *Pachytrachis striolatus*, *Dirshius h. haemorroidalis*, *Dirshius petraeus*, *Oedipoda caerulescens*, *Calliptamus i. italicus*, *Omocestus rufipens*, *Omocestus viridulus*, *Chorthippus d. dorsatus*, *Chorthippus p. parallelus*, *Euchorthippus declivus*, *Euthystria brachyptera*, *Tetrix b. bipunctata*, *Glyptobotrhus mollis ignifer*, *Xiphidion discolor*. In very humid and shady zones: (besides: *Chorthippus d. dorsatus*, *Chorthippus p. parallelus*, *Platycleis g. grisea*), are to be added: *Roseliana roeseli*, *Stauroderus scalaris*, *Stenobotrhus lineatus*; in the bushes: *Metryoptera brachyptera*, *Tettigonia viridissima*, *Tettigonia caudata*, *Chopardius p. pedestris*, *Poecilonom ornatus*, *Polysarcus denticauda*. Sandy environments: *Sphingonotus c. caerulans*, *Oedipoda caerulescens*, *Dirshius petraeus*. Vegetation on rocks and debris: *Glyptobotrhus v. vagans*, *Oedipoda germanica*, *Oedipoda caerulescens*.

Upper mountain 1301-2000 m (59 species)

Mixed woods: on trees: *Meconema meridionale*, *Phaneroptera n. nana*; in the bushes of the underwoods: *Barbitistes serricauda*, *Barbitistes obtusus*, *Pholidoptera fallax*, *Pholidoptera griseoptera*, *Pholidoptera a. aptera*, *Pachytrachis striolatus*, *Yersinella raymondi*, *Leptophyes boscii*, *Platycleis g. grisea*; clearing: *Bicolorana b. bicolor*, *Yersinella raymondi*, *Calliptamus siciliae*, *Psophus stridulus*, *Gomphocerus rufus*, *Glyptobotrhus v. vagans*; on litter: *Nemobius sylvestris*. Dry fields: *Platycleis g. grisea*, *Tettigonia cantans*, *Pholidoptera griseoptera*, *Chopardius p. pedestris*, *Gryllus campestris*, *Tetrix bipunctata*, *Euthystria brachyptera*, *Stenobotrhus lineatus*, *Calliptamus siciliae*; on the driest and most sun-exposed slopes: *Euchorthippus declivus*, *Dirshius h. haemorroidalis*, *Dirshius petraeus*, *Glyptobotrhus eisentrauti*, *Glyptobotrhus mollis ignifer*, *Glyptobotrhus v. vagans*, *Stenobothrodes rubicundulus*, *Stauroderus scalaris*; in dry grazing lands with surfacing rocks that increase the presence of: *Calliptamus i. italicus*, *Oedipoda caerulescens*, *Stenobothrodes rubicundulus*, *Psophus stridulus*, *Platycleis g. grisea*, *Omocestus viridulus*, *Omocestus rufipens*, *Glyptobotrhus mollis ignifer*, *Stenobotrhus lineatus*, *Stauroderus scalaris*. Cool fields: *Arcyptera f. fusca*, *Phaneroptera falcata*, *Bicolorana b. bicolor*, *Ruspolia nitidula*, *Tettigonia cantans*, *Pholidoptera a. aptera*, *Pachytrachis gracilis*, *Polisarcus denticauda*, *Tetrix subulata*, *Pseudoprumna baldensis*, *Psophus stridulus*, *Euthystria brachyptera*, *Glyptobotrhus b. biguttulus*, *Glyptobotrhus b. brunneus*, *Glyptobotrhus mollis ignifer*, *Stenobotrhus lineatus*, *Stauroderus scalaris*, *Aeropus s. sibiricus*, *Stenobothrodes rubicundulus*, *Podisma p. pedestris*, *Melanoplus f. frigidus*, *Kisella irena*; in the bushes. *Tettigonia cantans*, *Tettigonia viridissima*, *Metryoptera brachyptera*, *Chopardius p.*

pedestris, *Poecilimon ornatus*, *Roeseliana roeseli*, *Antaxius difformis*, *Bicolorana b. bicolor*, *Glyptobothrus alticola*, *Chorthopodisma cobellii*. Wet fields: *Arcyptera f. fusca*.

Sub alpine 2001-2200 m (25 species)

Coniferous woods, in bushes: *Pholidoptera griseoptera*, *Pholidoptera a. aptera*, *Barbitistes obtusus*. Cool fields: *Decticus v. verrucivorus*, *Omocestus viridulus*, *Dirshius h. haemorroidalis*, *Stenobothrus lineatus*, *Kisella irena*, *Pseudoprimumna baldensis*, *Aereopedellus v. variegatus*, *Glyptobothrus b. biguttulus*, *Glyptobothrus b. brunneus*, *Glyptobothrus mollis ignifer*; the dominant species are: *Stenobothrodes rubicundulus*, *Podisma p. pedestris*, *Aeropus s. sibiricus*, *Melanoplus f. frigidus*, *Omocestus viridulus*, *Chorthippus p. parallelus*, *Decticus v. verrucivorus*, *Pseudoprimumna baldensis*, *Stenobothrodes rubicundulus*, *Stenobothrus lineatus*, *Stauroderus scalaris*, *Glyptobothrus mollis ignifer*. In the most humid thalwegs with tall grass vegetation: *Pholidoptera a. aptera*, *Tettigonia cantans*. In the bushes: *Poecilimon ornatus*, *Tettigonia cantans*, *Metrioptera brachyptera*, *Antaxius difformis*. Dry fields: *Gryllus campestris*, *Glyptobothrus eisentrauti*.

Alpine 2201-3700 m (15 species)

Alpine praries: *Decticus v. verrucivorus*, *Aeropus s. sibiricus*, *Stenobothrus lineatus*, *Chorthippus d. dorsatus*, *Omocestus viridulus*, *Omocestus rufipens*, *Chorthippus p. parallelus*, *Glyptobothrus b. biguttulus*, *Glyptobothrus mollis ignifer*. In the most humid zones: *Metrioptera brachyptera*; higher altitudes are reached by: *Podisma p. pedestris*, *Melanoplus f. frigidus*, *Kisella irena*, *Aeropus s. sibiricus*, *Omocestus viridulus* and occasionally *Gryllus campestris*. Reach the 2650 m only *Aeropus s. sibiricus* and the 2700 m only *Aereopedellus v. variegatus*.

Most species are concentrated between the sub-mountainous and lower mountain zones, the number of species gradually decreases in the upper mountain zone and is drastically reduced in the Alpine zone where only few species can adapt to the extreme environment of the Alpine praries and high altitude moorlands (Fig. 3).

Corological Categories

Analysing the bio-geographical distribution of the species in Trentino, their Corological Categories are as follows (Fig. 4): the 22% of the species has an Euro-Sibirc distribution, the 18% a Palearctic distribution and another 16% an European distribution. The endemic species of the Alpine Arch as: *Chorthopodisma cobellii*, *Pseudoprimumna baldensis*, *Podisma pedestris nadigi*, *Glyptobothrus alticola*, *Antaxius difformis*, *Ephippiger vicheti* and *Anonconotus italoaustriacus* are also of a great biogeographic interest; *Podisma pedestris nadigi* is known only in the Alps Giudicarie (the Alps between Lombardia and Trentino), *Pseudoprimumna baldensis* in the M. Baldo (South Trentino), *Glyptobothrus alticola* in the locality

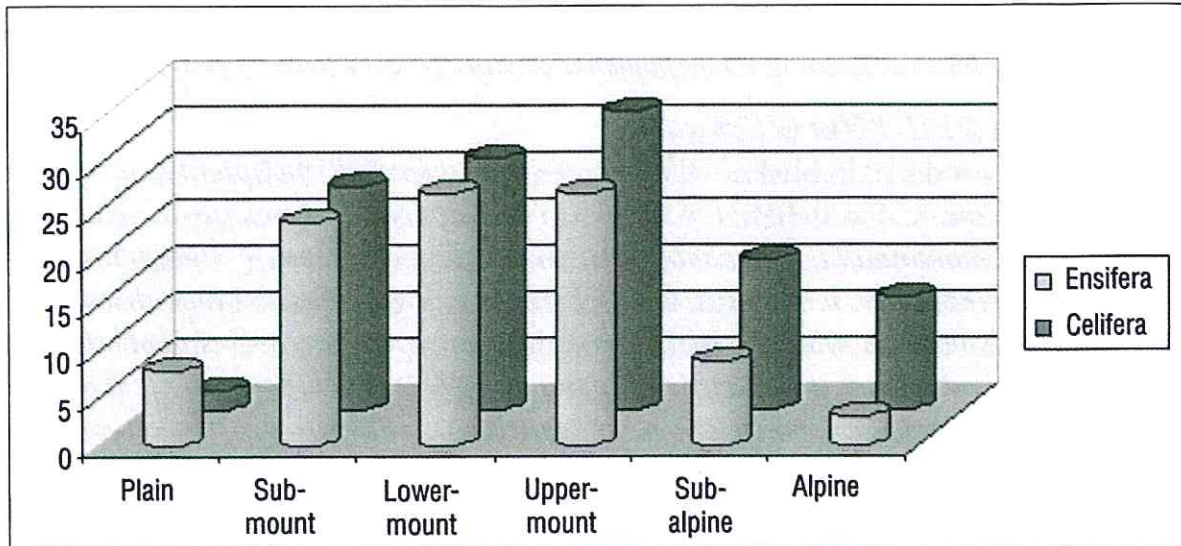


Fig. 3 - Distribution of Ensifera and Celifera in the altitudinal zones

of Dosso dei Morti in the Alps Giudicarie (West Trentino); the species *Chopardius p. pedestris* is endemic of the Center-South Europe.

Canonical Corresponding Analysis and similarity matrixes

Using the data related to the various sampling campaigns, in order to single out the environmental factors that better characterize the distribution of Orthoptera on the studied territory, we have carried out a statistical type of investigation considering as environmental variables, the altitude, the slope and the type of environment; the data has been elaborated by the CANOCO 4.0 software; from the CCA (Fig. 5) what emerges is that the main factors are altitude and humidity ratio in the environment of capture. The abscissa divides the wet-

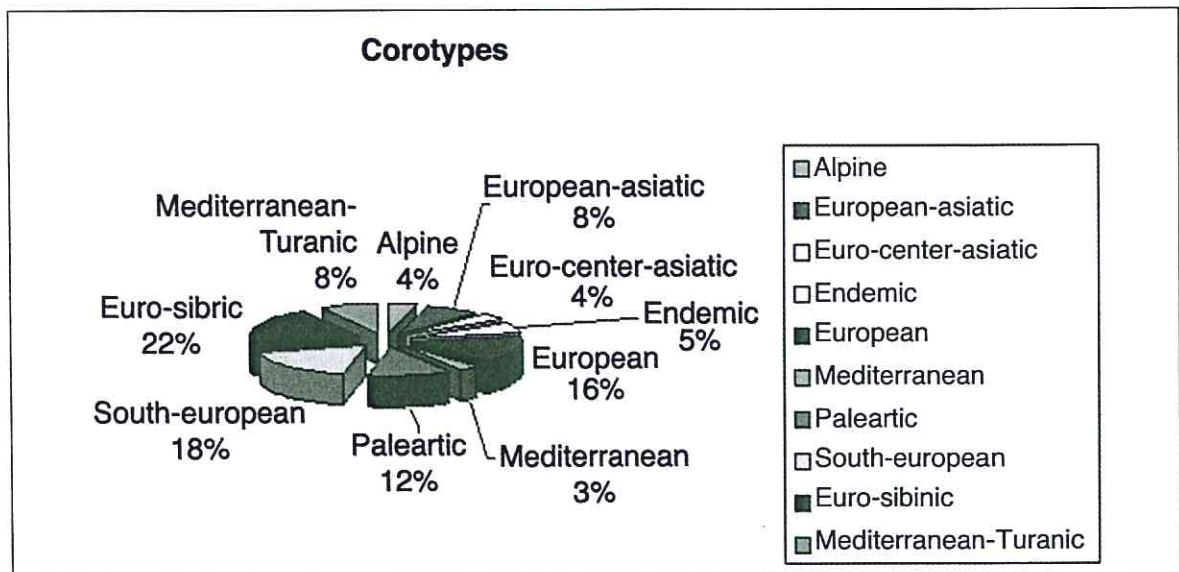


Fig. 4 - Corotypes

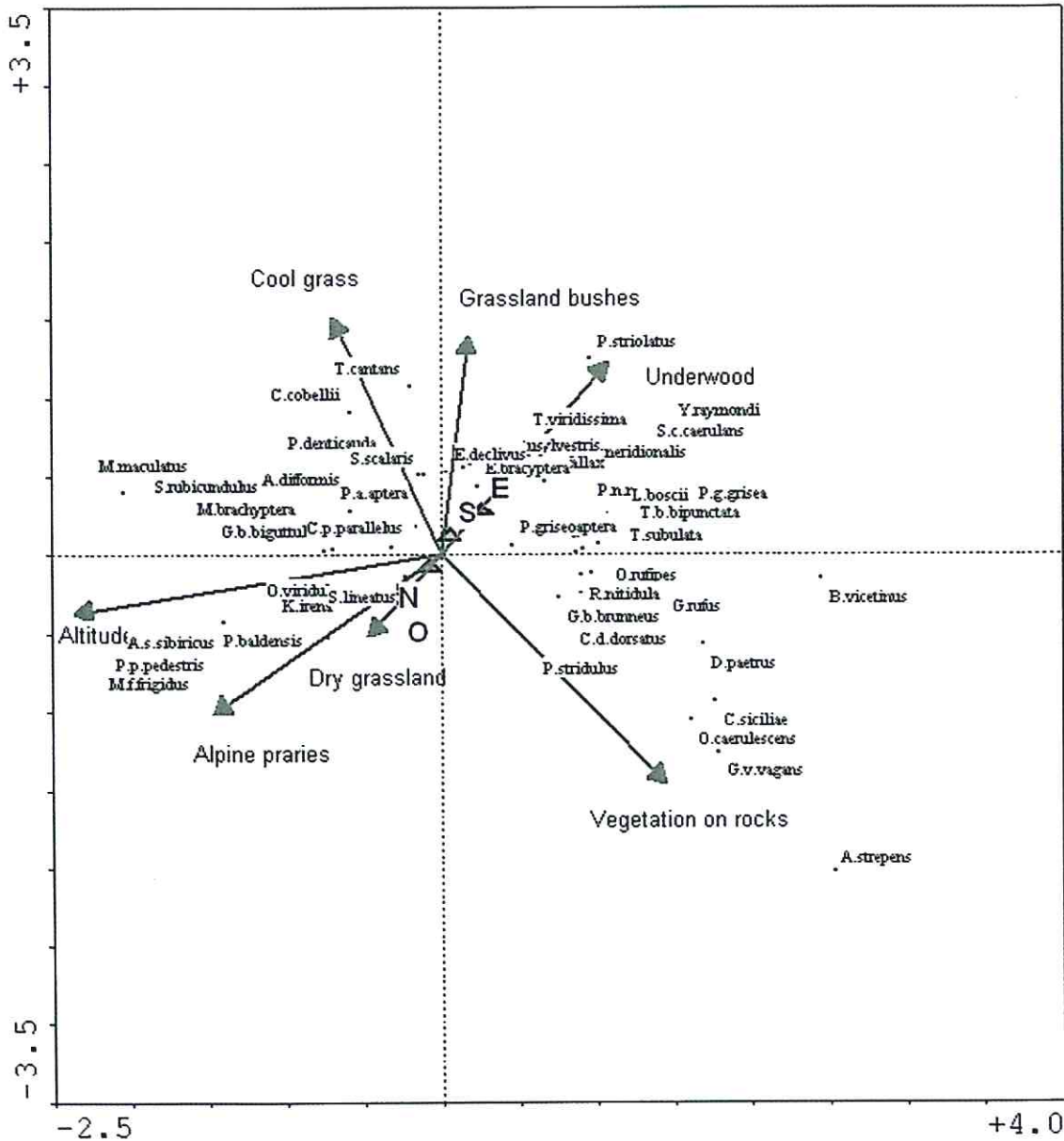


Fig. 5 - CCA performed with CANOCO 4.0

environments from the dry-environments; the ordinate divides the grassland-environments from the bushes-environments; the expositions were chosen like “dummy variables”; the environmental variables are represented like arrows which length gives some information about its correlation with the principal axes of the CCA; the species are represented by points that are the centroids of their distributions, according with the variable most important for the distribution of that species. For some species such as *Podisma p. pedestris* and *Kisella irena*, the prevailing factor is altitude, whereas for other species such as *Psophus stridulus* and *Glyptobothrus mollis ignifer* the environmental xericity and exposure are determining. Some other species like *Tettigonia cantans* and *Chorthopodisma cobellii* are strictly linked to the cool and humid grassland.

Tab. IV - Sørensen's matrix for the altitudinal zones

	Alpine	Lower mountain	Upper mountain	Sub alpine	Sub mountainous	Planiziale
Alpine	1	0.93	1	0.89	0.85	0.13
Lower mountain	0.93	1	0.94	0.54	0.86	0.21
Upper mountain	1	0.94	1	0.58	0.79	0.19
Sub alpine	0.89	0.54	0.58	1	0.78	0.21
Sub mountainous	0.85	0.86	0.79	0.78	1	0.24
Planiziale	0.13	0.21	0.19	0.21	0.24	1

We have therefore analyzed the specific composition of each altitude zone, identifying the species in common between zones, obtaining a square and simmetrical matrix to which the Sørensen's indexes have been applied (Tab. IV); thus it was possible to obtain a rate of similitude between different altitude levels. The elaboration of this matrix by the R-win software, has produced the dendrogram shown in Fig. 6. The algorithm used to calculate the distances on

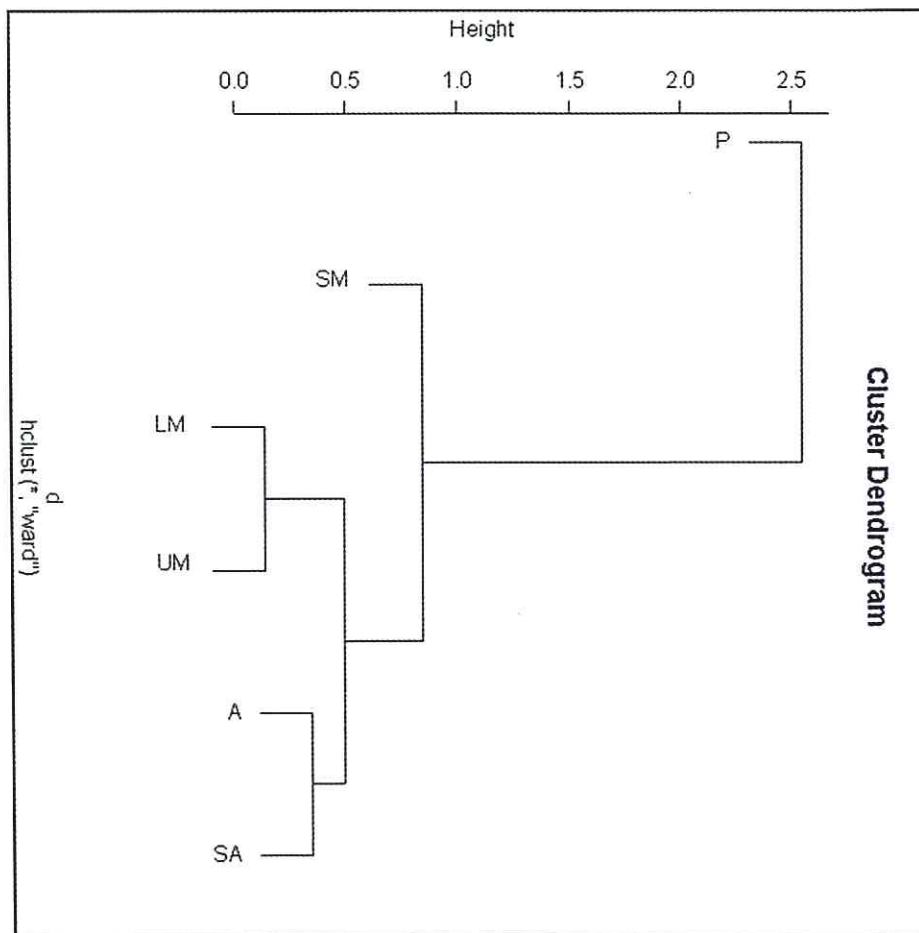


Fig. 6 - Dendrogram of the altitudinal zones (P=plain; SM= Sub mountainous; LM= Lower mountain; UM= Upper mountain; SA= Sub alpine; A= Alpine)

Tab. V - Sørensen's matrix for the Provinces near Trentino region

	Belluno	Bolzano	Brescia	Sondrio	Treviso	Trento	Udine	Vicenza	Verona
Belluno	1	0,89	0,77	0,8	0,71	1	0,85	0,82	0,85
Bolzano	0,89	1	0,73	0,77	0,60	1	0,84	0,75	0,72
Brescia	0,77	0,73	1	0,76	0,68	0,98	0,83	0,87	0,90
Sondrio	0,8	0,77	0,76	1	0,62	0,98	0,81	0,80	0,81
Treviso	0,71	0,60	0,68	0,62	1	0,93	0,88	0,91	0,90
Trento	1	1	0,98	0,98	0,93	1	0,84	0,82	0,8
Udine	0,85	0,84	0,83	0,81	0,88	0,84	1	0,82	0,80
Vicenza	0,82	0,75	0,87	0,80	0,91	0,82	0,82	1	0,89
Verona	0,85	0,72	0,9	0,81	0,90	0,8	0,80	0,89	1

the matrixes is Ward (square Euclidean distances). The sub mountain flat land and the plain present a specific composition distinctly different from the sub-alpine and alpine flat lands, whereas the lower and upper mountain flat lands are more similar to each other.

Finally we have followed the same procedure for the Provinces at the borders of Trentino (Tab. V). The dendrogram obtained is the following (Fig. 7). It is

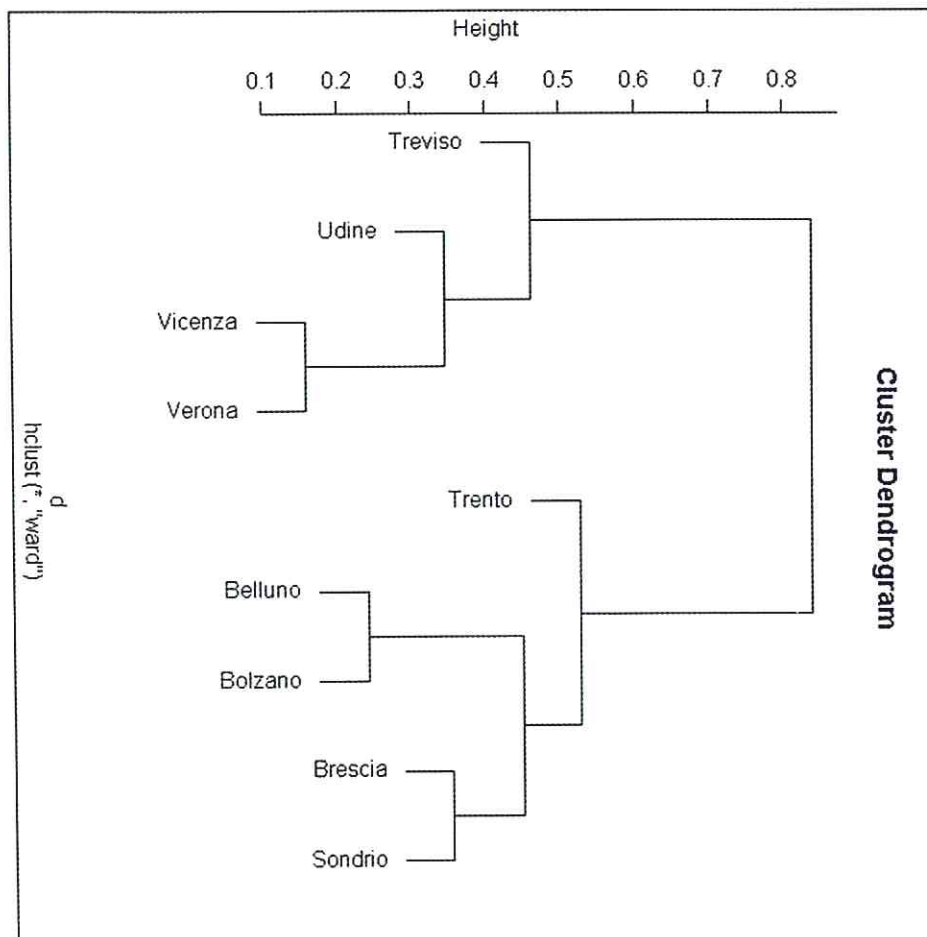


Fig. 7 - Dendrogramm of the Provinces near Trentino region

clear that Trentino, as far as specific composition is concerned, in an intermediate situation between the East and West Alp regions and the major dominance of the Provinces of Veneto and Friuli on one side and the Provinces of Bolzano and Lombardia on the other side.

Rare and threatened species

This study has underlined, as it has already been said, that the most abundant species are undoubtedly the prairie species, the typical species of prairie and grazing land environments and of wood clearings, the less abundant are present in ecotone environments in marshland, of the gravelly-sandy biotops on river banks and of the river vegetation, as well as the high levels typical of the Alpine prairies. The presence of typical species of dry and steppe zones or that live on stoney slopes is increasing. It is possible to suppose that this remarkable increase of the species adapted to drier environments is due to the gradual distribution of the humid environments. The ecotone environments and the humid zones are particularly threatened by the environmental modifications and studying the present data in literature referring to the previous century, it has been possible to notice a decrease in the findings of some species, once abundant and easily traceable, and today considered rare, and even in danger and threatened. A first list of the threatened species, or however very rare in Trentino is shown in the following chart (Tab. VI).

Tab. VI - List of the rare species of the Trentino region

Superfam. TETTIGONIOIDEA	Fam. ACRIDIDAE
Fam. TETTIGONIIDAE	Subfam. Locustinae (Oedipodinae)
Subfam. Conocephalinae	Gen. <i>Locusta</i> L., 1758
Gen. <i>Ruspolia</i> Schultess, 1898	<i>L. migratoria cinerascens</i> Fab. 1781
<i>R. nitidula</i> (Scopoli, 1786)	Gen. <i>Psophus</i> Fieb., 1853
Gen. <i>Xiphidion</i> Serv., 1831	<i>P. stridulus</i> (L., 1758)
<i>X. discolor</i> (Th., 1815)	Gen. <i>Tetrix</i> Latr., 1802
Subfam. Tettigoniinae Otte, 1997	<i>T. turki</i> (Krauss, 1876)
Gen. <i>Tettigonia</i> L., 1758	Gen. <i>Oedaleus</i> Fieb., 1981
<i>T. cantans</i> (Fuessly, 1775)	<i>O. decorus</i> (G., 1826)
<i>T. caudata</i> (Charp., 1845)	Gen. <i>Oedipoda</i> Serv., 1831
Subfam. Saginae B. von Watt, 1882	<i>O. germanica</i> (Lat., 1804)
Gen. <i>Saga</i> Charp., 1825	Gen. <i>Sphingonotus</i> Fieb., 1852
<i>S. pedo</i> (Pallas, 1771)	<i>S. c. caeruleans</i> (L., 1767)
Fam. GRYLLIDAE	Gen. <i>Aiolopus</i> Fieb., 1853
Subfam. Nemobiinae	<i>A. strepens</i> (Latr., 1804)
Gen. <i>Pteronemobius</i> J. & B., 1904	Gen. <i>Stethophyma</i> Fieb., 1853
<i>P. h. beydenii</i> (Fisher, 1853)	<i>S. grossum</i> (L., 1758)
Fam. CATANTOPIDAE	Gen. <i>Parapleurus</i> Fisch., 1854
Subfam. Calliptaminae	<i>P. alliaceus</i> (G., 1817)
Gen. <i>Calliptamus</i> Serv., 1831	Subfam. Gomphocerinae
<i>C. i. italicus</i> L., 1758	Gen. <i>Arcyptera</i> Serv., 1839
Subfam. Cyrtacanthacridinae	<i>A. f. fusca</i> (P., 1773)
Gen. <i>Anacridium</i> U., 1923	
<i>A. aegyptium</i> (L., 1764)	

CONCLUSIONS

The investigation carried out on the Orthoptera fauna of the territory of Trentino has underlined some very important ecological characteristics: the upper mountain flat land stations are those with a greater abundance of species and with the greatest diversity of environments, however a considerable number of species, basically of Euro-Siberian distribution, can also reach higher levels. As far as the threatened, or however rare species are concerned it is probable to suppose that their drastic decrease is due to the systematic disappearance of their natural habitat. In fact they are species linked to humid environments such as the peat-bogs or the marshlands and ecotone environments; the abandoning of the fields and their incipient bushing has favoured the expansion of shrub-prairie species or basically xero-thermophilic as *Chorthippus p. parallelus*, *Omocestus viridulus* and *Decticus v. verrucivorus* that are particularly abundant and present in all the gathering stations; on the other hand it is particularly relevant the presence of interesting species from a bio-geographical and eco-fauna point of view. *Polysarcus denticauda* that prefers non degraded grazing fields and indicates good environmental conditions. *Podisma p. pedestris* orophilic species of Euro-Siberian distribution, prefers environments characterized by scarce vegetation also on surfacing matrix. *Melanoplus f. frigidus* it is a boreo-alpine fauna element, present in Italy only along the Alps and is one of the most orophilic species. *Chortopodisma cobellii* endemic of the North-East Alps. *Calliptamus siciliae* species especially linked to xeric and sun exposed environments. *Sphingonotus c. caerulans* found in only one station along the Vanoi stream in Val Sugana (South-East Trentino), it prefers sandy environments of river banks, but it is very sensitive to environmental modifications. *Barbitistes obtusus* shrub species endemic of the Alps and North Appennines. *Barbitistes vicetinus* shrub species endemic of Vicentino (North-East Italy), now quoted for Trentino. *Antaxius difformis* species ecologically linked to high level bushes, where the juniper prevails, it is endemic of the East Alps. *Saga pedo* thermophilic species and linked to the xerothermic oasises, its first mention is due to Galvani and Prosser, 2004.

The statistical investigation (CCA and Cluster Analysis) have underlined how the kind of habitat and the altitude decidedly influences the distribution of Orthoptera species and the Cluster Analysis has identified Trentino as natural corridor for the diffusion of the species between the East and West Alps.

BIBLIOGRAPHY

- ANDREETTI A., OSELLA G. 2001- Blattaria, Mantodea, Orthoptera, Phasmatodea, Dermaptera dei Monti della Laga: faunistica, ecologia e zoogeografia (*Artropoda, Insecta*). Mem. Mus. Civ. Stor. Nat. Verona, II serie, 14: 3-93.
- COBELLI R. 1886 - Gli Ortoteri genuini del Trentino. Museo Civico di Rovereto vol. X, pp. 5-101.
- FONTANA P. 1999 - Attuali conoscenze sugli Ortoteri del Vicentino (Italia nord-orientale) *Insecta, Blattaria, Mantodea, Orthoptera, Phasmatodea, Dermaptera*. Quaderni del Museo Naturalistico Archeologico, 3: 5-45.

- FONTANA P., BUZZETTI F., COGO A., ODÈ B. 2002 - Cavallette, Grilli, Mantidi e insetti affini del Veneto. Guide Natura/1 Museo Naturalistico Archeologico di Vicenza.
- FOWLER C. 2002 - Statistica per ornitologi. Muzzio Ed., pp. 11-240.
- GALVAGNI A. 1950 - Contributo alla conoscenza dell'Ortottero fauna del Trentino e del Veneto. Boll. Soc. Entomol. Ital., LXXX (7-8): 57-64.
- GALVAGNI A., FONTANA P. 1992 - *Barbitistes vicentinus* sp.n, dell'Italia Nord-Orientale (*Insecta Orthoptera Tettigoniidae*). Atti Acc. Rov. Agiati, 242, (VII/II B): 199-206.
- GALVAGNI A., FONTANA P. 2004. Le specie del genere *Anonconotus* Camerano, 1878 delle Alpi orientali (*Insecta, Orthoptera, Tettigoniidae*). Atti Acc. Rov. Agiati, 254, (VIII/IV, B): 71-96.
- GALVAGNI A., PROSSER F. 2004 - Saga pedo (Pallas, 1771) rinvenuta in Trentino, Italia settentrionale (*Insecta Orthoptera Tettigoniidae Saginae*). Atti Acc. Rov. Agiati, 254, (VIII/IV, B): 97-106.
- HARZ K. 1969 - Die Orthopteren Europas. The Hague, vol I-II.
- HELLER K. ET AL. 1998 - Check-List of European Orthoptera. Articulata Beiheft 7, 1998: 1-61.
- HELLRIGL K. 1996 - Die Tierwelt Südtirols. Nat. Mus. Südtirols, pp. 305-321.
- HUGH G. 1980 - Cambridge University press. Multivariate analysis in community ecology, pp. 1-168.
- LA GRECA M. ET AL. 1995 - Blattaria, Mantodea, Isoptera, Orthoptera, Phasmatodea, Dermaptera, Embioptera. In: Minelli A., Ruffo S., La Posta S. (eds.). Checklist delle specie della fauna italiana, 36 (1994), Calderini Bologna, pp. 1-23.
- ODASSO 2002 - I tipi forestali del Trentino. Centro di Ecologia Alpina, report 25, pp. 7-125.
- REYNOLDS L. 1988 - Statistical Ecology. Wiley, pp. 205-257.