A morphometric study of *Altica oleracea* (Linnaeus, 1758) and *A. deserticola* (Weise, 1889) (Coleoptera: Chrysomelidae: Alticinae)

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Altica oleracea and *Altica deserticola* are different flea beetles (Coleoptera: Chrysomelidae: Alticinae) feeding on different host plants. Morphological variation was studied within both males and females of ten populations of *A. oleracea* and *A. deserticola*. 12 out of 15 variables were found to be significant in the model to discriminate between two species. Morphological differences were detected between the sexes, species and populations collected from different localities.

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1. Introduction

Altica Fabricius, 1775 is a large genus (ca. 250 species) distributed throughout the world; at least 50 species are represented in the Palearctic region, and 14 are known in Kazakhstan and Central Asia (Lopatin 1984). Eighteen species of this genus are known in Turkey (Aslan 1997, Aslan *et al.* 1999, Aslan & Özbek 2000, Aslan & Warchalowski 2001). Some *Altica* species damage wood and shrub plantations. All species of *Altica* are morphologically similar. In general, they have large- or moderate-sized bodies that are oval or ovate, dorsally moderately swollen, glabrous, color metallic green, blue, or violet. Frons are with large tubercles, usually distinctly demarcated by furrows, and tubercles occur more rarely on top separated by weak transverse depression (Lopatin 1984). Antennae are 11-segmented, filiform, moderately thick, pronotum transverse, anterior angles thickened, with aristate pores, elytra with humeral tubercles, coalescents punctation, and sometimes vestiges of oblong costae (Aslan 1997). These species are generally identified by studying male aedeagus, and males are reliably identified only on the basis of genital characteristics. Consequently, systematic studies based on morphological and genetic data do not always agree, and the use of multivariate statistics on biometrical data has in many cases proven to be helpful in a better characterization of sibling species and subspecies, even of different forms or populations of insect species, and has provided important systematic information (Verdyck *et al.*

Table 1. Groups and numbers of specimens studied.

Species/Sex	Locality	Code	Number
Altica oleracea			
Males	Iğdir	MAOIG	8
	Bayburt	MAOB	9
	Atrvin	MAOAR	9
	Kars	MAOKA	11
	Trabzon	MAOTR	8
	Erzurum	MAOER	9
	Muş	MAOMU	8
	Konya	MAOKO	11
	Balıkesir	MAOBA	9
	Diyarbakır	MAODI	8
Females	Iğdir	FAOIG	9
	Bayburt	FAOB	9
	Atrvin	FAOAR	10
	Kars	FAOKA	12
	Trabzon	FAOTR	8
	Erzurum	FAOER	10
	Muş	FAOMU	7
	Konya	FAOKO	9
	Balıkesir	FAOBA	7
	Diyarbakır	FAODI	9
Altica deserticola			
Males	Iğdir	MADIG	8
	Bayburt	MADB	6
	Atrvin	MADAR	7
	Kars	MADKA	8
	Trabzon	MADTR	6
	Erzurum	MADER	5
	Muş	MADMU	7
	Konya	MADKO	6
	Balıkesir	MADBA	3
	Diyarbakır	MADDI	4
Females	Iğdir	FADIG	8
	Bayburt	FADB	7
	Atrvin	FADAR	8
	Kars	FADKA	7
	Trabzon	FADTR	6
	Erzurum	FADER	7
	Muş	FADMU	5
	Konya	FADKO	4
	Balıkesir	FADBA	3
	Diyarbakır	FADDI	5

1996, 1997, 1998, Verdyck 2001). In many organisms, morphological variation is a result of phenotypic variation, and can be determined by genetic and environmental factors (Blackman & Spence 1994, Skulason & Smith 1995, Verdyck *et al.* 1996).

In the present paper, morphological variation between *Altica oleracea* (Linnaeus, 1758) and *A. deserticola* (Weise, 1889) is studied in terms of morphometric parameters.

Table 2. Morphological characters measured for biometric analyses. Abbr. = abbreviation (used in the text). Accuracy = rate of sensitivity used in microscopic observation.

Abbr.	Character description	Accuracy
A1	length antennomere 1	0.02
A2	length antennomere 2	0.02
A3	length antennomere 3	0.02
A4	length antennomere 4	0.02
A5	length antennomere 5	0.02
IO	distance between the eyes	0.02
OD	diameter of the eye	0.02
IA	distance between the bases of antennae	0.02
PB	maximum width of the pronotum	0.05
EB	maximum width of both elytra	0.05
PL	maximum length of the pronotum	0.05
EL	maximum length of the elytra	0.05
TL	total length	0.05
TI	length of the hind tibia	0.01
TA	length of the hind first tarsal segment	0.01

2. Material and methods

A total of 300 samples (150 females and 150 males) including 180 *Altica oleracea* (Linnaeus, 1758) (90 males and 90 females) and 120 *A. deserticola* (Weise, 1889) (60 males and 60 females), collected from 10 different localities, have been used in this study. All further analyses were done on males and females separately to avoid effects of sexual dimorphism interfering in the discrimination of the groups. The list of the samples collected from different localities is shown in Table 1. For study, each specimen was mounted on a small cardboard platelet in such a way that all characters used for the morphometric study were clearly visible. These cardboard platelets were mounted on insect pins that, once pinned in a small amount of Plasticine, allowed manipulation of the specimen in all directions, making study from all angles possible. Measurements were made by means of a Censor of Leitz (G 12.5×, interval 1/20 mm) measuring device attached to a Zeiss binocular stereoscope, allowing an accuracy of up to 0.02 mm.

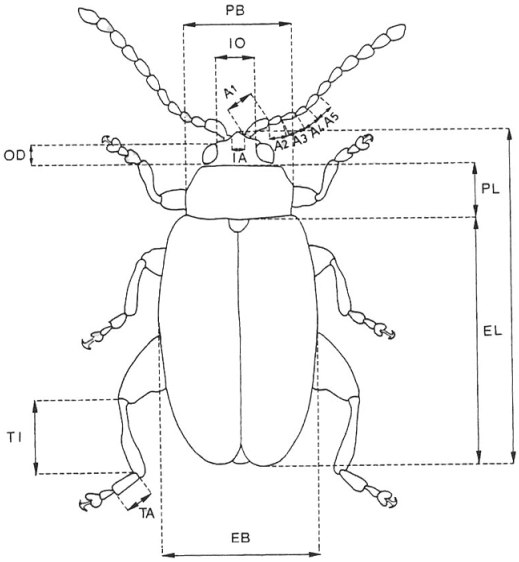

Fig. 1. Illustration of the 15 measurements taken (redrawn from Verdyck *et al.* 1998).

For further analysis, the samples were subdivided according to sex, species and locality. To describe morphological variation, the same selection of 15 measurements was used as for biometrical works. The characters evaluated in the study are listed in Table 2 and indicated on Fig. 1.

Multivariate techniques, providing a simultaneous examination of inter-relationships among more than one variable, were used to study morphological aspects of the species. In order to investigate patterns of discrimination between the species, and sexes in each species, stepwise discriminate analysis (Johnson & Wichern 1998) was used by using Statistica software (Statsoft 1995). The data from different sexes were analysed separately to avoid size and shape differences between sexes (Verdyck *et al.* 1996). To reveal morphological relationships between the different populations by drawing two dendograms for the male and the female specimens, the unweighted pair-group method using averages (UPGMA) was employed.

3. Results

The 300 samples, composed of 180 *Altica oleracea* and 120 *A. deserticola* from 10 localities, were examined. *A. oleracea* samples were collected from *Polygonum* and *Oenothera*, and *Sangiosorba minor* plants. *A. deserticola* samples were collected from *Epilobium* and *Glycyrrhiza glabra*. For the localities and detail numbers for each species, see Table 1, and for means and standard deviations for the 15 characters of each sample, see Table 2.

Twelve out of 15 variables were statistically significant in the model that discriminated between males and females of the two species (Table 3). These characters were EL, TI, EB, OD, A2, PB, TA, TL, IO, A1, A5, PL for males, and TL, TA, IO, A3, A2, TI, IA, A4, A5, EL, PL, EB for females. The variables A3, A4 and IA for males and A1, OD and PB for females were not significant in the model. Standardized coefficients for the variables in the discriminate function (the larger the standardized coefficient, the greater the contribution of the respective variable for the discrimination between groups) are given in Table 3. For the males, TA, A1 and OD contributed to the canonical root 1 more than other variables in the model, while as IO, A3 and TA worked best for females. Canonical root 1 explained 100% of the variance in both sexes (Table 3).

The UPGMA clusters (Figs. 2–3) more accurately grouped the female populations of the same

Table 3. Standardized coefficients for the variables in the discriminate function and cumulative proportion of variance explained. Cum. Prob. = Cumulative probability. For the variables, see Table 2.

Males		Females	
Variable	Root 1	Variable	Root 1
EL	0.04333	TL	–1.30754
TI	–1.14446	TA	2.14672
EB	1.10062	IO	–2.28575
OD	1.20865	A3	–2.15278
A2	0.38396	A2	0.93075
PB	0.52968	TI	0.35429
TA	–1.56733	IA	0.94246
TL	1.16874	A4	1.58257
IO	1.10942	A5	–0.67699
A1	1.25932	EL	–0.59821
A5	–0.85224	PL	1.75459
PL	–0.50764	EB	–1.09759
Cum. Prob.	1.00000		1.00000

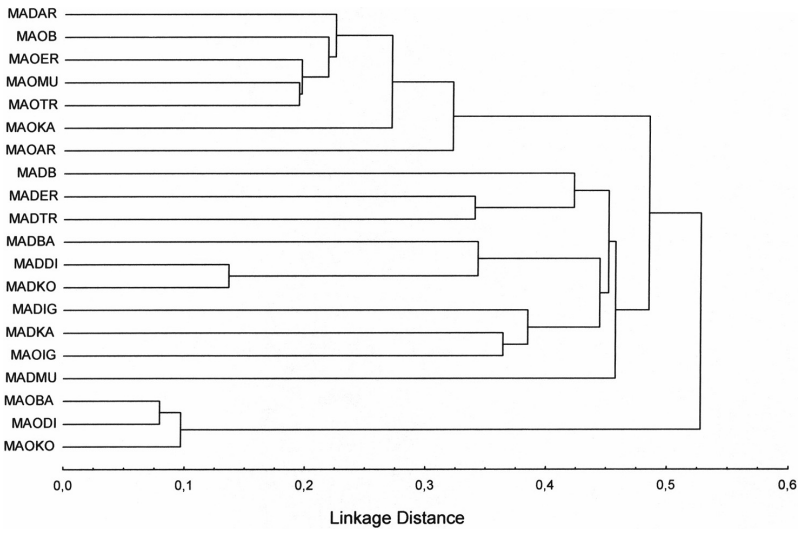

Fig. 2. UPGM cluster tree of male populations.

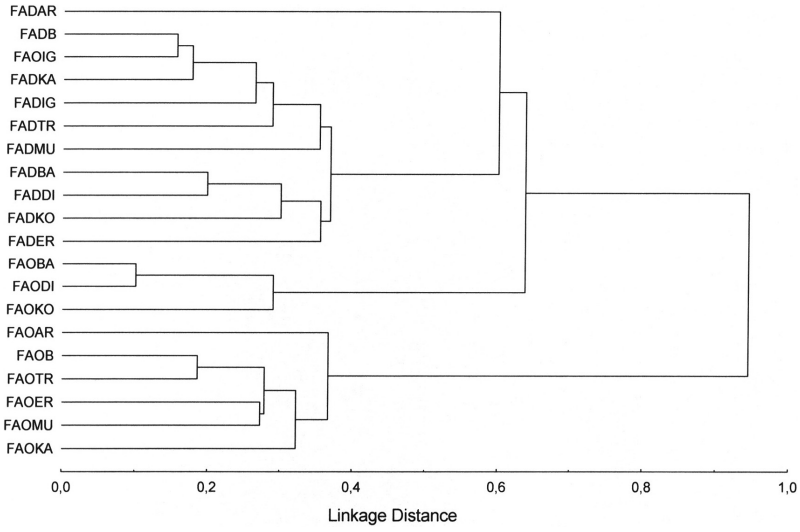

Fig. 3. UPGM cluster tree of female populations.

species than male populations although a full separation of different species was not obtained in both sexes. In females, only one of the populations was classified far from the rest of the same species, while the dendogram belonging to males was a blend of both species.

4. Discussion

Even though the two species – *Altica deseticola* and *A. oleracea* – are relatively similar to each other in terms of morphology, they can be distinguished based on the characters described below. In *A. deserticola*, the lateral bands of aedeagus are convex or slightly flat, but not in form of grooves; oblique striations are distinct and cover almost all of the apical half of lateral bands, apical part of aedeagus is distinctly isolated, sharp, basal furrow of pronotum is fairly weak, almost straight, and frontal keel is moderately narrow, rounded upward, and narrows terminally. Furthermore, frontal tubercles are swollen, angular, dorsally green, often with golden iridescence, or bluish-green. In *A. oleracea*, the apex of aedeagus is totally rounded, without vestiges of denticle, hav-

ing below a deep groove surrounded by the most adjacent keels, which diverge in apical quarter and encompass there a deep depression. The apex of elytra usually has a flat pit-like depression, green, bluish-green or blue in colour, sometimes with golden iridescence. (Lopatin 1984, Aslan 1997).

As in many other beetle genera, the females are larger than the males, and EB shows significant differences between the sexes in *Altica* genus. Moreover, some differences were found between localities (Figs. 2–3). In previous studies, there have been a few attempts to determine the morphometric parameters of the species of *Phyllotreta* Chevrolat, 1837 (Verdyck *et al.* 1996, 1997, 1998, Verdyck 2001). However, there have been no studies on *Altica* species up to now. To our knowledge, this is the first morphometric study on *A. oleracea* and *A. deserticola*. Our UPGMA clusters (Figs. 2–3) showed that individuals – in both males and females – of the same species, collected from different localities, were more similar to each other than those of the other species. Our results also suggested that *A. oleracea* and *A. deserticola* can be differentiated on the basis of the morphometric measures of the characters listed in Table 2. Furthermore, the data in the present study demonstrated that (male and female) *A. oleracea* and *A. deserticola* specimens collected from various localities were morphologically different.

References

Aslan, I. 1997: Faunistic and systematic study of the subfamily Alticinae (Coleoptera, Chrysomelidae) species collected from Erzurum province. — Ph.D. Thesis, Atatürk University, 215 pp.

Aslan, I. & Özbek, H. 2000: New Records of Leaf-Beetles, Chrysomelidae (Coleoptera) from Turkey. — J. Ent. Res. Soc. 2: 1–7.

Aslan, I. & Warchalowski, A. 2001: New records of the subfamily Alticinae (Coleoptera, Chrysomelidae) for the Turkish fauna. — J. Ent. Res. Soc. 3: 1–4.

Aslan, I., Gruev, B. & Özbek, H. 1999: A preliminary review of the subfamily Alticinae (Coleoptera, Chrysomelidae) in Turkey. — Tr. J. of Zoology 23: 373–414.

Blackman, R. L. & Spence, J. M. 1994: The effects of temperature on aphid morphology, using a multivariate approach. — Eur. J. Entomol. 91: 7–22.

Johnson, R. A. & Wichern, D. W. 1998. Applied Multivariate Statistical Analysis. 4th edition. — Prentice Hall, NJ, USA. 816 pp.

Lopatin, I. 1984: Leaf beetles (Chysomelidae) of Central Asia and Kazakhstan. — New Delhi. 415 pp.

Skulason, S. & Smith, T. B. 1995: Resource polymorphism in vertebrates. — TREE 10: 366–370. Verdyck, P., Wolf, H., De Backeljau, T. & Hulselmans, J. 1996: A morphological study of two colour forms of *Phyllotreta cruciferae* (Chrysomelidae: Alticinae). — In: Jolivet, P. & Cox, M. L. (eds.), Chrysomelidae Biology, vol. 3: General Studies: 285–191.

Verdyck, P., Timmermans, J. P. & Hulselmans, J. 1997: A morphometric study of genitalia of *Phyllotreta dilatata, P. flexuosa, P. ochripes* and *P. tetrastigma.* — Entomologie 67: 123–129.

Verdyck, P., Bruyn, L. De. & Hulselmans, J. 1998: A morphological study of *Phyllotreta tetrastigma* (Coleoptera: Chrysomelidae: Alticinae) including two colour forms. — Journal of Natural History 32: 777–783.

Verdyck, P. 2001: Morphological variation within and between four closely related *Phyllotreta* species: *P. dilatata, P. flexuosa, P. ochripes* and *P. tetrastigma* (Coleptera: Chrysomelidae). — Zoologischer Anzeiger 240: 35–46.