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MORPHOMETRIC SIMILARITY AND SUMMARY OF MEASUREMENTS OF PALEARCTIC SPECIES OF THE GENUS *DIODONTUS* CURTIS (HYMENOPTERA, SPHECIDAE)

E. Budrys
Institute of Ecology

The genus *Diodontus* Curtis contains 72 described species, distributed in the grassland biomes of Eurasia, North America, and Africa. It includes several groups of closely related species. They are morphologically similar, variable, and are difficult to identify by the usual characters, like sculpture, punctuation, colour, etc.

Morphometric measurements have sometimes been used in species descriptions of *Diodontus*; mainly the relative length of flagellomeres (e.g., Beaumont, 1967; Eighme, 1989). Ratios of morphometric measurements seem to be more comparable than absolute measurements, because they do not depend on the size of specimen or the scale of measurement (Budrys, Kazenas, 1992; Budrys, 1993).

The goals of this research were 1) to determine the most informative morphometric measurements for species separation, using all available data of described and undescribed *Diodontus* species, 2) to associate some of the measurements in pairs in order to establish the most informative ratios, describing proportions of body, 3) to summarise these ratios for the described Palearctic species, and 4) to evaluate the morphometric similarity of described Palearctic species, using the methods of cluster analysis.

Methods

Measurements of wasps were made using a micrometer on a binocular microscope MBS-10, at magnification 56×. The database was managed, and summarisation of measurements was made using the computer program BORLAND PARADOX 4.5 for DOS. Discriminant and cluster analyses were done using the computer program STATSOFT STATISTICA for Windows, release 4.5.

Results

Primary selection of morphometric measurements was made intuitively, using the following principles: the measurement should be 1) informative, reflecting the characters used in verbal descriptions, like "head transverse", "face narrow", etc., 2) easy to measure, with clearly defined limits, and 3) the longest of all correlated measurements, reflecting the same character, with a smaller relative error of measurement.

The selected set of measurements for the genus *Diodontus* includes 18 measurements (Fig. 1) as follows:

COL - width of pronotal collar (distance between lateral edges of transverse carina of collar, anterodorsal aspect).

IMD - inter-mandibular distance (distance between outer margins of small swellings of genae just above the fore mandibular condyles, frontal aspect).

LCL - length of clypeus (distance between the mid point of fronto-clypeal suture and mid-point of clypeus' lower margin, frontal aspect).

LF - length of face (distance between fore margin of mid ocellus and mid point of clypeus' lower margin, frontal aspect).

LID - lower interocular distance (shortest distance between inner margins of eyes at the level of antennal sockets, frontal aspect).

LM - length of mandible (distance between outer margin of small swelling of genae just above the fore mandibular condyle and apex of mandible).

LSC - length of scape (maximum visible length of scape, usually frontal aspect).

LV - length of vertex (shortest distance between hind margin of mid ocellus and mid point of occipital carina, posterodorsal aspect).

L6F - length of sixth flagellomere (measured dorsally).

OOD - oculo-ocellar distance (shortest distance between outer margin of hind ocellus and margin of eye).

POD - post-ocellar distance (shortest distance between inner margins of hind ocelli).

PRN - width of pronotum (distance between tips of pronotal lobes, dorsal aspect).

UID - upper interocular distance (shortest distance between inner margins of eyes at the level of mid ocellus, frontal aspect).

WCA - width of clypeal apex (in *Diodontus* - the distance between the protruding ventral tips of lateral parts of clypeus' lower margin).

WH - width of head (frontal aspect).

WHO - width of hind ocellus (widest visible diameter of hind ocellus).

W6F - width of sixth flagellomere (maximum visible width, measured without the layer of trichoid sensilla).

3FL - length of three flagellomeres (maximum visible combined length of first three flagellomeres, without pedicel, usually in dorsal aspect).

Two more measurements, LHB (length of the hind basitarsus), and LBS (length of basitarsal spine, the longest of apico-lateroventral spines of the hind basitarsus), seem to be useful in separating the females of some species, but the number of measurements made is insufficient for statistically significant conclusions.

All measurements were made with the line between two limiting points forming angle of 90° with the optical axis of the microscope.

A database of measurements of 1226 females and 1438 males, representing 70 described and undescribed species of *Diodontus*, was analysed; L6F and W6F were used for males only. For simplification of the data set, the least informative measurements, established by the forward stepwise discriminant function analysis, with *F to remove* values smaller than 5, namely, LM, WHO, and WH of females, and WCA, LV, LCL, and IMD of males, were eliminated from the similarity analysis. However, the

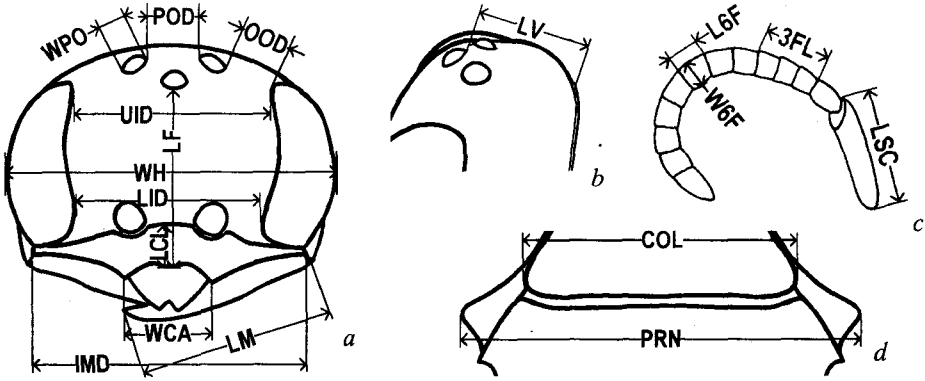

Fig. 1. Morphometric measurements of *Diodontus*. *a* - head (frontal aspect); *b* - vertex (dorsolateral aspect); *c* - antenna; *d* - pronotum (dorsal aspect). Abbreviations listed in the text

measurements WH and WHO of females were found to be useful for the ratios of the morphometric summary of species.

For evaluation of similarity, the average of each morphometric measurement of each species was calculated. Then the averages were "normalised," dividing them by the average of WH, the longest measurement, approximately reflecting the body size. Cluster analysis, using Euclidean distances and unweighted pair-group average strategy, resulted in similarity diagrams for females (Fig. 2) and males (Fig. 3).

The set of ratios for the morphometric summary of species was selected, using the forward stepwise discriminant function analysis. After each two steps of evaluation, it was assumed that the two selected measurements should build the most informative ratio for species discrimination. Then, the first of measurements was removed from the model of discrimination, and the analysis was repeated. So, step by step, the ratios WCA:IMD, 3FL:LSC, LID:LF, and IMD:LF for females, and 3FL:LSC, L6F:W6F, POD:OOD, COL:PRN, LID:UID and LID:LF for males, were chosen.

Several other ratios, tentatively useful for distinguishing of at least some species, were evaluated by comparing of their percent of the correctly predicted classifications of specimens. In this way the ratios WCA:LCL, IMD:WH, LSC:LID, LID:UID, LCL:IMD, WH:LF, LV:LF, COL:PRN, POD:OOD, and WHO:OOD for females, and ratios LID:WH, LSC:LID, WH:LF, and WHO:OOD for males were found to be more useful than their correlated alternatives.

The summary of the morphometric ratios of females (Table 1) and males (Table 2) contains minimum, maximum, average, and sample standard deviation values, and the number of measurements (N); species are listed alphabetically.

The selected ratios of morphometric measurements reflect:

- relative width of head (WH:LF),
- relative width of clypeal apex (WCA:IMD, WCA:LCL),
- relative width of face, narrowing of face ventrad (LID:LF, LID:WH, LID:UID),
- relative length (height) of clypeus (LCL:IMD),

Table 1. **Summary of morphometric ratios in females of Palearctic *Diodontus*.**

Species	Ratios of measurements (abbreviations listed in the text)						
	COL:PRN	**WH:LF**	**LID:LF**	**LID:UID**	**IMD:WH**	**IMD:LF**	**WCA:IMD**
afer	0.608 (N=1)	1.433 (N=1)	0.747 (N=1)	0.881 (N=1)	0.731 (N=1)	1.047 (N=1)	0.230 (N=1)
asiaticus	0.54-0.56 (0.552±0.011, N=2)	1.48-1.52 (1.500±0.025, N=2)	0.80-0.82 (0.807±0.017, N=2)	0.909 (N=1)	0.74-0.75 (0.747±0.010, N=2)	1.10-1.14 (1.121±0.034, N=2)	0.35 (0.347±0.001, N=2)
brevilabris	0.54-0.61 (0.577±0.020, N=24)	1.51-1.63 (1.577±0.028, N=24)	0.75-0.85 (0.810±0.028, N=22)	0.84-0.91 (0.881±0.018, N=15)	0.73-0.78 (0.759±0.014, N=24)	1.11-1.26 (1.198±0.035, N=24)	0.28-0.31 (0.293±0.008, N=24)
changaiensis	0.58-0.62 (0.599±0.021, N=3)	1.50-1.52 (1.510±0.009, N=3)	0.81-0.82 (0.816±0.008, N=3)	0.92-0.94 (0.928±0.012, N=3)	0.75-0.77 (0.761±0.010, N=3)	1.13-1.16 (1.149±0.013, N=3)	0.29-0.31 (0.300±0.007, N=3)
clarus	0.55-0.63 (0.590±0.032, N=5)	1.49-1.55 (1.521±0.020, N=5)	0.77-0.80 (0.789±0.013, N=5)	N/A	0.70-0.72 (0.715±0.009, N=5)	1.08-1.10 (1.087±0.008, N=5)	0.21-0.26 (0.228±0.018, N=5)
collaris	0.62-0.73 (0.684±0.031, N=10)	1.70-1.79 (1.748±0.028, N=10)	0.98-1.04 (1.010±0.024, N=10)	0.96-1.00 (0.980±0.019, N=3)	0.78-0.81 (0.792±0.011, N=10)	1.34-1.44 (1.384±0.031, N=10)	0.35-0.37 (0.356±0.007, N=10)
crassicornis	0.60-0.63 (0.612±0.020, N=2)	1.43-1.43 (1.434±0.001, N=2)	0.71-0.72 (0.718±0.008, N=2)	0.82-0.83 (0.824±0.007, N=2)	0.69 (0.688±0.001, N=2)	0.99 (0.987±0.002, N=2)	0.20-0.22 (0.210±0.014, N=2)
denticollis	0.708 (N=1)	1.671 (N=1)	1.025 (N=1)	1.014 (N=1)	0.790 (N=1)	1.320 (N=1)	0.319 (N=1)
dziuroo (=pygmaeus)	0.53-0.65 (0.574±0.039, N=12)	1.54-1.71 (1.619±0.043, N=13)	0.84-0.97 (0.887±0.036, N=13)	0.862 (N=1)	0.76-0.85 (0.789±0.022, N=13)	1.20-1.46 (1.279±0.065, N=13)	0.35-0.41 (0.387±0.014, N=13)
freyi	0.57-0.63 (0.596±0.020, N=18)	1.47-1.57 (1.515±0.026, N=18)	0.78-0.84 (0.810±0.017, N=18)	0.86-0.93 (0.893±0.019, N=17)	0.74-0.78 (0.753±0.010, N=18)	1.10-1.18 (1.141±0.023, N=18)	0.20-0.24 (0.219±0.014, N=17)
friesei	0.46-0.61 (0.566±0.028, N=27)	1.46-1.63 (1.552±0.044, N=29)	0.77-0.89 (0.816±0.036, N=29)	0.85-0.92 (0.876±0.021, N=21)	0.72-0.78 (0.746±0.019, N=29)	1.06-1.26 (1.159±0.058, N=29)	0.20-0.26 (0.236±0.014, N=29)
handlirschi	0.51-0.59 (0.560±0.016, N=20)	1.52-1.65 (1.571±0.033, N=21)	0.84-0.93 (0.881±0.021, N=21)	0.91-0.95 (0.924±0.017, N=8)	0.73-0.77 (0.747±0.013, N=21)	1.12-1.23 (1.174±0.027, N=21)	0.36-0.41 (0.388±0.012, N=21)
hyalipennis	0.636 (N=1)	1.479 (N=1)	0.743 (N=1)	0.823 (N=1)	0.710 (N=1)	1.050 (N=1)	0.218 (N=1)
insidiosus	0.52-0.63 (0.574±0.021, N=141)	1.29-1.55 (1.484±0.035, N=145)	0.71-0.81 (0.761±0.018, N=145)	0.82-0.93 (0.858±0.018, N=76)	0.67-0.79 (0.713±0.013, N=145)	0.93-1.14 (1.058±0.030, N=145)	0.21-0.32 (0.255±0.021, N=145)
kaszabi (=obo, monticola)	0.55-0.63 (0.589±0.022, N=23)	1.48-1.65 (1.565±0.040, N=24)	0.82-0.95 (0.887±0.034, N=24)	0.92-0.98 (0.948±0.040, N=2)	0.73-0.78 (0.756±0.013, N=24)	1.14-1.24 (1.184±0.027, N=24)	0.34-0.39 (0.364±0.012, N=24)
kohli	0.576 (N=1)	1.632 (N=1)	0.895 (N=1)	1.004 (N=1)	0.758 (N=1)	1.237 (N=1)	0.369 (N=1)
longicornis	0.56-0.61 (0.585±0.011, N=22)	1.49-1.58 (1.532±0.028, N=22)	0.77-0.84 (0.799±0.019, N=22)	0.86-0.92 (0.882±0.016, N=18)	0.72-0.75 (0.731±0.010, N=22)	1.07-1.18 (1.120±0.029, N=22)	0.27-0.32 (0.311±0.013, N=22)
luperus	0.58-0.66 (0.611±0.018, N=54)	1.41-1.51 (1.457±0.023, N=55)	0.73-0.81 (0.764±0.018, N=55)	0.84-0.90 (0.881±0.021, N=18)	0.71-0.75 (0.730±0.011, N=55)	1.03-1.13 (1.064±0.021, N=55)	0.22-0.29 (0.255±0.016, N=55)

Table 1. **(continuation).**

Species	Ratios of measurements (abbreviations listed in the text)						
	WCA:LCL	**POD:OOD**	**WHO:OOD**	**LV:LF**	**LCL:IMD**	**LSC:LID**	**3FL:LSC**
afer	0.864 (N=1)	0.764 (N=1)	0.341 (N=1)	0.544 (N=1)	0.266 (N=1)	0.559 (N=1)	1.000 (N=1)
asiaticus	1.39-1.43 (1.412±0.032, N=2)	0.72 (0.720±0.001, N=2)	0.376 (N=1)	0.48-0.52 (0.499±0.024, N=2)	0.24-0.25 (0.246±0.005, N=2)	0.51-0.53 (0.524±0.013, N=2)	1.06-1.13 (1.095±0.053, N=2)
brevilabris	1.39-1.78 (1.560±0.098, N=24)	0.55-0.69 (0.641±0.041, N=24)	0.39-0.47 (0.424±0.026, N=15)	0.49-0.54 (0.517±0.015, N=22)	0.17-0.20 (0.188±0.009, N=24)	0.54-0.60 (0.577±0.013, N=24)	0.83-0.97 (0.877±0.038, N=24)
changaiensis	1.13-1.28 (1.189±0.079, N=3)	0.85-0.96 (0.893±0.056, N=3)	0.35-0.36 (0.356±0.005, N=3)	0.55-0.56 (0.553±0.006, N=3)	0.24-0.26 (0.253±0.012, N=3)	0.49-0.51 (0.503±0.007, N=3)	0.96-1.05 (0.998±0.047, N=3)
clarus	0.91-1.22 (1.010±0.131, N=5)	0.94-1.09 (1.025±0.060, N=5)	N/A	0.53-0.57 (0.551±0.014, N=5)	0.21-0.24 (0.227±0.011, N=5)	0.51-0.53 (0.524±0.008, N=5)	0.73-0.93 (0.816±0.078, N=5)
collaris	2.00-2.50 (2.165±0.176, N=10)	0.71-0.82 (0.774±0.032, N=10)	0.36-0.40 (0.376±0.022, N=3)	0.51-0.55 (0.536±0.013, N=10)	0.14-0.18 (0.165±0.014, N=10)	0.41-0.46 (0.439±0.015, N=10)	1.04-1.15 (1.082±0.042, N=10)
crassicornis	0.76-0.84 (0.800±0.052, N=2)	0.94-1.02 (0.982±0.057, N=2)	0.37-0.39 (0.383±0.015, N=2)	0.52-0.53 (0.525±0.007, N=2)	0.26-0.26 (0.262±0.000, N=2)	0.55-0.56 (0.556±0.002, N=2)	0.85-0.89 (0.870±0.026, N=2)
denticollis	2.000 (N=1)	0.654 (N=1)	0.336 (N=1)	0.494 (N=1)	0.160 (N=1)	0.441 (N=1)	0.761 (N=1)
dziuroo (=pygmaeus)	2.00-2.55 (2.338±0.161, N=13)	0.50-0.66 (0.572±0.045, N=13)	0.385 (N=1)	0.49-0.54 (0.516±0.015, N=12)	0.15-0.18 (0.166±0.010, N=13)	0.51-0.54 (0.525±0.011, N=12)	0.96-1.12 (1.043±0.041, N=12)
freyi	0.86-1.05 (0.976±0.064, N=16)	0.77-0.98 (0.875±0.056, N=18)	0.34-0.46 (0.387±0.036, N=18)	0.53-0.59 (0.567±0.016, N=18)	0.21-0.23 (0.224±0.005, N=17)	0.52-0.57 (0.534±0.012, N=18)	0.90-1.03 (0.958±0.032, N=18)
friesei	0.92-1.25 (1.079±0.097, N=29)	0.65-0.88 (0.792±0.064, N=29)	0.35-0.45 (0.396±0.027, N=18)	0.56-0.64 (0.601±0.025, N=29)	0.20-0.25 (0.219±0.012, N=29)	0.52-0.58 (0.553±0.014, N=29)	0.80-0.95 (0.864±0.042, N=29)
handlirschi	1.58-2.09 (1.790±0.117, N=21)	0.42-0.53 (0.483±0.030, N=21)	0.31-0.36 (0.339±0.021, N=8)	0.42-0.49 (0.453±0.018, N=21)	0.19-0.24 (0.218±0.013, N=21)	0.48-0.57 (0.509±0.018, N=21)	1.06-1.32 (1.238±0.063, N=21)
hyalipennis	0.970 (N=1)	0.819 (N=1)	0.348 (N=1)	0.571 (N=1)	0.224 (N=1)	0.596 (N=1)	1.010 (N=1)
insidiosus	0.81-1.30 (1.030±0.090, N=144)	0.72-0.96 (0.820±0.045, N=145)	0.32-0.43 (0.375±0.026, N=52)	0.47-0.58 (0.526±0.021, N=140)	0.21-0.29 (0.248±0.012, N=144)	0.52-0.59 (0.554±0.014, N=141)	0.75-0.91 (0.836±0.028, N=141)
kaszabi (=obo, monticola)	1.50-2.04 (1.772±0.146, N=24)	0.68-0.86 (0.778±0.046, N=24)	0.34-0.37 (0.358±0.023, N=2)	0.40-0.49 (0.446±0.024, N=24)	0.18-0.23 (0.206±0.012, N=24)	0.44-0.49 (0.467±0.012, N=23)	0.88-1.06 (0.957±0.046, N=23)
kohli	1.711 (N=1) *	1.071 (N=1)	0.500 (N=1)	0.509 (N=1)	0.216 (N=1)	0.484 (N=1)	0.834 (N=1)
longicornis	1.17-1.48 (1.322±0.092, N=22)	0.90-1.10 (0.973±0.046, N=22)	0.37-0.46 (0.410±0.025, N=18)	0.52-0.58 (0.553±0.011, N=22)	0.21-0.26 (0.236±0.014, N=22)	0.50-0.54 (0.518±0.012, N=22)	0.94-1.06 (0.994±0.028, N=22)
luperus	0.87-1.20 (1.004±0.072, N=55)	0.58-0.80 (0.698±0.046, N=55)	0.34-0.41 (0.365±0.018, N=18)	0.45-0.56 (0.509±0.021, N=54)	0.22-0.27 (0.255±0.010, N=55)	0.52-0.60 (0.549±0.016, N=55)	0.83-1.08 (0.994±0.045, N=55)

Table 1. **(continuation).**

Species	Ratios of measurements (abbreviations listed in the text)						
	COL:PRN	**WH:LF**	**LID:LF**	**LID:UID**	**IMD:WH**	**IMD:LF**	**WCA:IMD**
major	0.56-0.60 (0.583±0.016, N=10)	1.50-1.60 (1.561±0.033, N=10)	0.79-0.88 (0.854±0.028, N=10)	0.92-0.95 (0.931±0.016, N=4)	0.71-0.80 (0.769±0.024, N=10)	1.07-1.27 (1.201±0.058, N=10)	0.25-0.28 (0.264±0.014, N=10)
medius	0.49-0.56 (0.537±0.021, N=17)	1.51-1.66 (1.591±0.041, N=17)	0.93-1.05 (0.994±0.037, N=17)	1.06-1.12 (1.093±0.024, N=5)	0.74-0.82 (0.788±0.022, N=17)	1.15-1.30 (1.253±0.045, N=17)	0.35-0.39 (0.367±0.011, N=17)
merisuoi	0.53-0.56 (0.550±0.010, N=5)	1.49-1.58 (1.525±0.033, N=5)	0.76-0.81 (0.781±0.020, N=5)	0.85-0.85 (0.847±0.000, N=1)	0.70-0.71 (0.709±0.007, N=5)	1.06-1.13 (1.082±0.028, N=5)	0.21-0.26 (0.232±0.018, N=5)
minutus	0.52-0.61 (0.565±0.016, N=300)	1.46-1.69 (1.561±0.038, N=315)	0.77-0.92 (0.833±0.024, N=315)	0.85-0.95 (0.901±0.020, N=160)	0.72-0.78 (0.753±0.013, N=316)	1.08-1.32 (1.175±0.039, N=315)	0.27-0.36 (0.308±0.014, N=316)
montanus	0.56-0.59 (0.576±0.015, N=3)	1.54-1.65 (1.599±0.057, N=3)	0.98-1.07 (1.031±0.044, N=3)	1.054 (N=1)	0.75-0.79 (0.769±0.019, N=3)	1.18-1.27 (1.229±0.043, N=3)	0.37-0.40 (0.387±0.018, N=3)
oraniensis	0.52-0.58 (0.555±0.012, N=113)	1.52-1.71 (1.582±0.034, N=118)	0.80-1.01 (0.868±0.031, N=118)	0.88-1.00 (0.929±0.021, N=75)	0.74-0.88 (0.785±0.019, N=118)	1.15-1.50 (1.243±0.051, N=118)	0.28-0.34 (0.311±0.010, N=118)
parvulus	0.53-0.58 (0.553±0.019, N=5)	1.48-1.54 (1.505±0.025, N=6)	0.73-0.76 (0.746±0.009, N=6)	0.80-0.84 (0.818±0.021, N=4)	0.66-0.68 (0.671±0.009, N=6)	0.98-1.04 (1.010±0.021, N=6)	0.27-0.31 (0.295±0.013, N=6)
puncticeps	0.61-0.65 (0.629±0.015, N=5)	1.39-1.44 (1.423±0.025, N=6)	0.67-0.74 (0.691±0.026, N=6)	0.800 (N=1)	0.68-0.70 (0.691±0.008, N=6)	0.94-1.02 (0.983±0.024, N=6)	0.21-0.27 (0.253±0.024, N=6)
punicus	0.56-0.59 (0.579±0.012, N=5)	1.69-1.73 (1.711±0.017, N=5)	0.97-1.02 (1.004±0.021, N=5)	0.94-1.01 (0.991±0.028, N=5)	0.81-0.86 (0.847±0.020, N=5)	1.37-1.49 (1.450±0.048, N=5)	0.31-0.32 (0.318±0.003, N=5)
schmiede-knechtii	0.57-0.61 (0.587±0.013, N=7)	1.60-1.65 (1.626±0.020, N=7)	0.91-0.97 (0.938±0.024, N=7)	0.92-0.97 (0.955±0.021, N=4)	0.79-0.82 (0.803±0.015, N=7)	1.28-1.34 (1.306±0.021, N=7)	0.25-0.29 (0.273±0.013, N=7)
stigma	0.60-0.63 (0.609±0.011, N=7)	1.55-1.64 (1.585±0.030, N=7)	0.81-0.84 (0.829±0.011, N=7)	0.90-0.93 (0.913±0.022, N=2)	0.77-0.81 (0.792±0.012, N=7)	1.23-1.28 (1.255±0.018, N=7)	0.28-0.30 (0.286±0.007, N=7)
temporalis	0.64-0.70 (0.669±0.014, N=31)	1.57-1.74 (1.646±0.038, N=32)	0.87-1.07 (0.940±0.040, N=32)	0.88-0.93 (0.902±0.015, N=24)	0.73-0.82 (0.789±0.020, N=32)	1.16-1.40 (1.299±0.057, N=32)	0.39-0.42 (0.409±0.008, N=32)
tobiasi	0.64-0.67 (0.655±0.013, N=3)	1.63-1.66 (1.648±0.017, N=3)	0.81-0.85 (0.829±0.023, N=3)	0.86-0.88 (0.871±0.014, N=2)	0.76-0.78 (0.765±0.013, N=3)	1.23-1.30 (1.262±0.032, N=3)	0.34-0.35 (0.343±0.005, N=3)
tristis	0.55-0.61 (0.575±0.014, N=52)	1.53-1.63 (1.582±0.025, N=53)	0.86-0.96 (0.912±0.026, N=53)	0.95-1.07 (1.015±0.028, N=51)	0.73-0.80 (0.780±0.018, N=53)	1.13-1.30 (1.233±0.037, N=53)	0.31-0.35 (0.332±0.011, N=52)
valkeilai	0.550 (N=1)	1.648 (N=1)	1.002 (N=1)	1.071 (N=1)	0.814 (N=1)	1.342 (N=1)	0.315 (N=1)
wahisi	0.551 (N=1)	1.49-1.54 (1.519±0.036, N=2)	0.81-0.84 (0.822±0.023, N=2)	N/A	0.74-0.75 (0.748±0.008, N=2)	1.13-1.15 (1.136±0.016, N=2)	0.29-0.29 (0.294±0.002, N=2)

Table 1. **(continuation).**

Species	Ratios of measurements (abbreviations listed in the text)						
	WCA:LCL	**POD:OOD**	**WHO:OOD**	**LV:LF**	**LCL:IMD**	**LSC:LID**	**3FL:LSC**
major	1.06-1.34 (1.234±0.083, N=10)	0.66-0.82 (0.723±0.047, N=10)	0.32-0.35 (0.333±0.016, N=4)	0.56-0.63 (0.593±0.022, N=10)	0.20-0.24 (0.214±0.009, N=10)	0.53-0.57 (0.550±0.012, N=10)	0.81-1.03 (0.994±0.066, N=10)
medius	1.65-2.00 (1.785±0.089, N=17)	0.64-0.84 (0.724±0.045, N=17)	0.424 (N=1)	0.49-0.57 (0.540±0.021, N=17)	0.19-0.24 (0.206±0.010, N=17)	0.43-0.51 (0.465±0.016, N=17)	0.92-1.05 (0.993±0.031, N=17)
merisuoi	0.94-1.12 (1.021±0.088, N=5)	1.05-1.16 (1.097±0.048, N=5)	0.443 (N=1)	0.54-0.56 (0.550±0.011, N=5)	0.21-0.24 (0.227±0.010, N=5)	0.50-0.53 (0.517±0.010, N=5)	0.69-0.80 (0.756±0.039, N=5)
minutus	1.18-1.73 (1.433±0.090, N=316)	0.61-0.84 (0.710±0.041, N=316)	0.32-0.46 (0.384±0.028, N=135)	0.51-0.65 (0.581±0.023, N=310)	0.18-0.25 (0.215±0.014, N=316)	0.50-0.59 (0.548±0.014, N=316)	0.75-0.91 (0.830±0.027, N=316)
montanus	1.86-2.33 (2.086±0.239, N=3)	0.57-0.65 (0.604±0.041, N=3)	0.355 (N=1)	0.53-0.57 (0.547±0.020, N=3)	0.17-0.20 (0.187±0.014, N=3)	0.42-0.44 (0.429±0.007, N=3)	1.12-1.18 (1.152±0.033, N=3)
oraniensis	1.24-1.98 (1.511±0.108, N=118)	0.60-0.88 (0.781±0.040, N=118)	0.34-0.43 (0.391±0.023, N=72)	0.54-0.64 (0.580±0.018, N=118)	0.16-0.23 (0.207±0.013, N=118)	0.49-0.56 (0.522±0.013, N=118)	0.95-1.09 (1.021±0.030, N=116)
parvulus	1.16-1.35 (1.285±0.076, N=6)	0.82-0.89 (0.844±0.028, N=5)	0.39-0.45 (0.410±0.026, N=4)	0.49-0.52 (0.506±0.011, N=5)	0.21-0.25 (0.230±0.015, N=6)	0.54-0.55 (0.547±0.005, N=6)	0.84-0.90 (0.864±0.023, N=6)
puncticeps	0.79-1.06 (0.959±0.093, N=6)	0.74-0.84 (0.801±0.040, N=6)	0.471 (N=1)	0.48-0.53 (0.510±0.017, N=6)	0.25-0.28 (0.264±0.011, N=6)	0.55-0.60 (0.571±0.023, N=6)	0.81-0.89 (0.847±0.030, N=6)
punicus	1.80-2.19 (1.982±0.144, N=5)	0.68-0.71 (0.692±0.012, N=5)	0.33-0.39 (0.365±0.021, N=5)	0.62-0.65 (0.638±0.012, N=5)	0.15-0.18 (0.161±0.011, N=5)	0.49-0.52 (0.500±0.010, N=5)	1.01-1.03 (1.020±0.012, N=4)
schmiede-knechtii	1.29-1.56 (1.440±0.104, N=7)	0.76-0.88 (0.832±0.041, N=7)	0.32-0.36 (0.345±0.018, N=4)	0.58-0.61 (0.598±0.010, N=7)	0.18-0.20 (0.190±0.007, N=7)	0.45-0.50 (0.479±0.017, N=7)	0.87-0.94 (0.906±0.035, N=7)
stigma	1.75-2.11 (1.888±0.144, N=7)	1.07-1.29 (1.185±0.068, N=7)	0.51-0.52 (0.513±0.008, N=2)	0.55-0.58 (0.563±0.013, N=7)	0.13-0.17 (0.152±0.011, N=7)	0.60-0.63 (0.617±0.013, N=7)	0.53-0.60 (0.569±0.022, N=7)
temporalis	1.66-2.19 (1.947±0.128, N=32)	0.64-0.88 (0.735±0.058, N=32)	0.32-0.40 (0.357±0.024, N=21)	0.50-0.57 (0.533±0.018, N=32)	0.18-0.24 (0.211±0.012, N=32)	0.45-0.52 (0.499±0.015, N=32)	0.89-1.01 (0.937±0.027, N=32)
tobiasi	2.37-2.78 (2.605±0.213, N=3)	1.03-1.13 (1.086±0.050, N=3)	0.47-0.49 (0.479±0.008, N=2)	0.54-0.57 (0.554±0.011, N=3)	0.12-0.15 (0.132±0.013, N=3)	0.60-0.63 (0.610±0.014, N=3)	0.56-0.60 (0.576±0.018, N=3)
tristis	1.31-1.89 (1.552±0.117, N=52)	0.78-0.94 (0.856±0.038, N=53)	0.41-0.55 (0.461±0.033, N=51)	0.53-0.59 (0.559±0.015, N=50)	0.18-0.25 (0.215±0.015, N=52)	0.48-0.53 (0.508±0.011, N=51)	0.86-1.07 (0.937±0.052, N=50)
valkeilai	1.667 (N=1)	0.655 (N=1)	0.390 (N=1)	0.590 (N=1)	0.189 (N=1)	0.489 (N=1)	1.091 (N=1)
wahisi	1.32-1.35 (1.335±0.026, N=2)	0.60-0.64 (0.616±0.029, N=2)	N/A	0.47-0.49 (0.479±0.009, N=2)	0.22-0.22 (0.220±0.003, N=2)	0.51-0.55 (0.529±0.028, N=2)	0.91-0.95 (0.930±0.026, N=2)

Table 2. **Summary of morphometric ratios in males of Palearctic *Diodontus*.**

Species	Ratios of measurements (abbreviations listed in the text)				
	COL:PRN	**WH:LF**	**LID:WH**	**LID:LF**	**LID:UID**
argentifrons	0.58-0.65 (0.613±0.022, N=14)	1.53-1.59 (1.567±0.026, N=4)	0.51-0.54 (0.526±0.008, N=13)	0.81-0.85 (0.829±0.016, N=4)	0.92-0.95 (0.937±0.013, N=5)
asiaticus	0.60-0.63 (0.608±0.012, N=5)	1.51-1.57 (1.543±0.030, N=3)	0.52-0.54 (0.533±0.009, N=5)	0.80-0.84 (0.823±0.019, N=3)	0.85-0.87 (0.860±0.012, N=3)
brevilabris	0.55-0.62 (0.586±0.017, N=26)	1.53-1.61 (1.574±0.031, N=8)	0.45-0.50 (0.473±0.012, N=26)	0.74-0.78 (0.758±0.013, N=8)	0.81-0.86 (0.828±0.018, N=8)
changaiensis	0.59-0.62 (0.607±0.010, N=8)	1.48-1.59 (1.550±0.057, N=3)	0.53-0.57 (0.550±0.011, N=8)	0.82-0.87 (0.850±0.030, N=3)	0.90-0.91 (0.906±0.008, N=3)
clarus	0.60-0.63 (0.614±0.013, N=5)	1.58 (1.578±0.004, N=2)	0.56-0.57 (0.565±0.006, N=5)	0.88-0.90 (0.893±0.011, N=2)	0.92 (0.922±0.004, N=2)
collaris	0.62-0.70 (0.656±0.027, N=19)	1.60-1.65 (1.630±0.022, N=4)	0.51-0.54 (0.521±0.009, N=19)	0.84-0.85 (0.849±0.003, N=4)	0.89-0.91 (0.901±0.012, N=4)
crassicornis	0.59-0.65 (0.615±0.032, N=3)	1.50-1.56 (1.530±0.026, N=3)	0.57 (0.571±0.002, N=3)	0.86-0.89 (0.874±0.013, N=3)	0.91-0.92 (0.917±0.009, N=3)
denticollis	0.61-0.71 (0.658±0.033, N=7)	1.60-1.65 (1.631±0.029, N=3)	0.47-0.51 (0.491±0.013, N=7)	0.78-0.81 (0.793±0.017, N=3)	0.87-0.89 (0.877±0.013, N=3)
dziuroo (=*pygmaeus*)	0.54-0.62 (0.582±0.023, N=9)	1.55-1.56 (1.554±0.005, N=2)	0.48-0.51 (0.496±0.011, N=8)	0.75-0.79 (0.772±0.031, N=2)	0.84-0.86 (0.851±0.016, N=2)
freyi	0.61-0.63 (0.618±0.011, N=3)	1.53-1.56 (1.541±0.015, N=3)	0.58 (0.577±0.002, N=3)	0.88-0.90 (0.890±0.011, N=3)	0.94 (0.942±0.003, N=3)
friesei	0.57-0.62 (0.593±0.014, N=10)	1.53-1.56 (1.544±0.009, N=8)	0.51-0.56 (0.531±0.018, N=10)	0.79-0.87 (0.827±0.025, N=8)	0.85-0.90 (0.877±0.016, N=8)
gegen	0.54-0.59 (0.564±0.018, N=6)	1.55-1.56 (1.555±0.003, N=2)	0.52-0.55 (0.536±0.008, N=6)	0.83-0.84 (0.836±0.012, N=2)	0.89-0.90 (0.897±0.008, N=2)
handlirschi	0.55-0.61 (0.588±0.016, N=26)	1.53-1.65 (1.579±0.029, N=14)	0.47-0.52 (0.495±0.011, N=28)	0.74-0.82 (0.778±0.022, N=14)	0.81-0.87 (0.840±0.015, N=14)
insidiosus	0.51-0.64 (0.578±0.023, N=117)	1.45-1.57 (1.511±0.026, N=52)	0.49-0.57 (0.533±0.015, N=115)	0.73-0.87 (0.811±0.028, N=51)	0.83-0.95 (0.898±0.024, N=50)
kaszabi (=*obo, monticola*)	0.55-0.64 (0.596±0.024, N=15)	1.561 (N=2)	0.49-0.55 (0.527±0.017, N=16)	0.79-0.86 (0.823±0.048, N=2)	0.88 (0.878±0.004, N=2)
kohli	0.57-0.62 (0.592±0.013, N=8)	1.577 (N=1)	0.50-0.53 (0.515±0.010, N=8)	0.836 (N=1)	0.926 (N=1)
longicornis	0.54-0.64 (0.585±0.024, N=22)	1.49-1.59 (1.527±0.037, N=7)	0.52-0.56 (0.542±0.011, N=22)	0.81-0.86 (0.831±0.018, N=7)	0.88-0.92 (0.900±0.014, N=7)
luperus	0.57-0.65 (0.620±0.018, N=51)	1.49-1.61 (1.549±0.030, N=26)	0.51-0.55 (0.533±0.011, N=52)	0.80-0.86 (0.829±0.016, N=26)	0.84-0.92 (0.887±0.016, N=26)
major	0.56-0.61 (0.596±0.017, N=8)	1.55-1.60 (1.578±0.026, N=3)	0.52-0.55 (0.531±0.009, N=8)	0.82-0.83 (0.827±0.005, N=3)	0.89-0.92 (0.901±0.015, N=3)
medius	0.55-0.63 (0.576±0.020, N=16)	1.547 (N=1)	0.51-0.53 (0.520±0.007, N=16)	0.820 (N=1)	0.904 (N=1)
merisuoi	0.54-0.58 (0.558±0.012, N=12)	1.563 (N=1)	0.53-0.56 (0.544±0.011, N=12)	0.856 (N=1)	0.906 (N=1)
minutus	0.51-0.64 (0.577±0.020, N=250	1.46-1.63 (1.546±0.030, N=130	0.46-0.52 (0.490±0.012, N=266	0.71-0.83 (0.759±0.022, N=130	0.81-0.89 (0.855±0.018, N=132
montanus	0.55-0.57 (0.557±0.015, N=3)	1.54-1.63 (1.585±0.065, N=2)	0.61-0.62 (0.611±0.006, N=3)	0.93-0.99 (0.963±0.045, N=2)	0.98-1.03 (1.008±0.035, N=2)
oraniensis	0.53-0.61 (0.568±0.016, N=168)	1.46-1.61 (1.538±0.030, N=120)	0.51-0.57 (0.534±0.011, N=178)	0.77-0.89 (0.819±0.022, N=120)	0.85-0.95 (0.886±0.018, N=120)

Table 2. **(continuation).**

Species	Ratios of measurements (abbreviations listed in the text)				
	POD:OOD	**WHO:OOD**	**LSC:LID**	**3FL:LSC**	**L6F:W6F**
argentifrons	1.28-1.55 (1.374±0.074, N=13)	0.59-0.69 (0.650±0.036, N=5)	0.41-0.45 (0.425±0.013, N=12)	1.34-1.49 (1.417±0.045, N=13)	1.83-2.08 (1.914±0.110, N=4)
asiaticus	0.78-0.85 (0.809±0.031, N=5)	0.39-0.43 (0.404±0.023, N=3)	0.43-0.46 (0.445±0.017, N=5)	1.35-1.51 (1.444±0.061, N=5)	1.52-1.64 (1.596±0.067, N=3)
brevilabris	0.59-0.72 (0.654±0.035, N=26)	0.45-0.49 (0.470±0.012, N=8)	0.46-0.54 (0.497±0.021, N=26)	0.98-1.14 (1.066±0.038, N=26)	1.17-1.37 (1.275±0.072, N=8)
changaiensis	0.89-1.02 (0.961±0.044, N=8)	0.39-0.44 (0.417±0.028, N=3)	0.39-0.44 (0.419±0.015, N=8)	1.09-1.29 (1.183±0.066, N=8)	1.35-1.39 (1.373±0.018, N=3)
clarus	1.13-1.25 (1.190±0.051, N=5)	0.51-0.54 (0.522±0.022, N=2)	0.38 (0.380±0.003, N=5)	1.41-1.46 (1.434±0.021, N=5)	1.01-1.02 (1.017±0.008, N=2)
collaris	0.72-0.93 (0.826±0.049, N=19)	0.41-0.48 (0.449±0.031, N=4)	0.40-0.44 (0.418±0.013, N=19)	1.18-1.41 (1.317±0.066, N=19)	1.23-1.36 (1.303±0.068, N=3)
crassicornis	0.94-1.01 (0.986±0.036, N=3)	0.43-0.46 (0.445±0.015, N=3)	0.39 (0.391±0.003, N=3)	1.45-1.52 (1.484±0.035, N=3)	0.96-1.05 (1.005±0.048, N=3)
denticollis	0.74-0.94 (0.829±0.073, N=7)	0.43-0.49 (0.467±0.032, N=3)	0.44-0.48 (0.460±0.013, N=7)	1.05-1.20 (1.125±0.054, N=7)	1.06-1.11 (1.091±0.027, N=3)
dziuroo (=*pygmaeus*)	0.59-0.72 (0.663±0.043, N=8)	0.38-0.45 (0.416±0.053, N=2)	0.43-0.49 (0.460±0.023, N=8)	1.24-1.35 (1.298±0.036, N=8)	1.16-1.36 (1.258±0.139, N=2)
freyi	0.87-1.02 (0.946±0.077, N=3)	0.42-0.45 (0.434±0.015, N=3)	0.39-0.40 (0.394±0.007, N=3)	1.37-1.44 (1.409±0.038, N=3)	0.98-1.15 (1.089±0.097, N=3)
friesei	0.88-0.94 (0.908±0.024, N=10)	0.45-0.53 (0.490±0.041, N=3)	0.42-0.51 (0.446±0.028, N=10)	1.22-1.41 (1.322±0.057, N=10)	0.99-1.16 (1.108±0.058, N=8)
gegen	0.84-0.94 (0.883±0.044, N=6)	0.45 (0.448±0.003, N=2)	0.43-0.47 (0.443±0.017, N=6)	0.93-1.05 (1.006±0.043, N=6)	1.22-1.25 (1.237±0.018, N=2)
handlirschi	0.45-0.57 (0.513±0.032, N=28)	0.33-0.43 (0.378±0.027, N=14)	0.47-0.57 (0.516±0.024, N=27)	1.21-1.59 (1.488±0.101, N=27)	1.25-1.57 (1.450±0.092, N=14)
insidiosus	0.73-1.09 (0.916±0.069, N=117)	0.39-0.56 (0.467±0.033, N=46)	0.40-0.49 (0.445±0.019, N=115)	1.13-1.44 (1.295±0.055, N=115)	0.90-1.13 (1.021±0.047, N=51)
kaszabi(=*obo, monticola*)	0.71-0.87 (0.813±0.041, N=16)	0.42-0.45 (0.437±0.025, N=2)	0.39-0.46 (0.422±0.018, N=16)	1.24-1.59 (1.404±0.094, N=16)	1.14-1.43 (1.285±0.201, N=2)
kohli	1.08-1.23 (1.139±0.051, N=8)	0.542 (N=1)	0.42-0.46 (0.444±0.012, N=8)	1.10-1.21 (1.135±0.040, N=8)	1.429 (N=1)
longicornis	0.84-1.15 (0.982±0.070, N=22)	0.41-0.49 (0.446±0.031, N=7)	0.39-0.46 (0.424±0.017, N=22)	1.32-1.55 (1.397±0.058, N=22)	1.26-1.42 (1.351±0.059, N=7)
luperus	0.59-0.80 (0.708±0.053, N=52)	0.33-0.47 (0.401±0.028, N=26)	0.43-0.49 (0.462±0.015, N=52)	1.10-1.49 (1.323±0.073, N=52)	1.12-1.50 (1.279±0.092, N=26)
major	0.79-0.92 (0.850±0.048, N=8)	0.40-0.46 (0.434±0.030, N=3)	0.44-0.47 (0.459±0.008, N=8)	1.27-1.39 (1.346±0.038, N=8)	1.13-1.25 (1.201±0.061, N=3)
medius	0.77-0.85 (0.814±0.022, N=16)	0.534 (N=1)	0.42-0.47 (0.441±0.014, N=16)	1.39-1.63 (1.543±0.072, N=16)	1.291 (N=1)
merisuoi	1.06-1.27 (1.150±0.067, N=12)	0.571 (N=1)	0.38-0.42 (0.396±0.014, N=12)	1.00-1.17 (1.072±0.046, N=12)	0.935 (N=1)
minutus	0.69-0.98 (0.823±0.057, N=266)	0.39-0.57 (0.492±0.039, N=126)	0.45-0.54 (0.491±0.015, N=265)	1.04-1.42 (1.269±0.071, N=265)	1.09-1.42 (1.254±0.071, N=130)
montanus	0.64-0.68 (0.658±0.018, N=3)	0.40-0.45 (0.424±0.034, N=2)	0.39-0.40 (0.397±0.005, N=3)	1.29-1.32 (1.300±0.014, N=3)	1.34-1.56 (1.451±0.160, N=2)
oraniensis	0.66-0.97 (0.829±0.053, N=176)	0.38-0.54 (0.466±0.031, N=117)	0.40-0.48 (0.450±0.014, N=174)	1.38-1.73 (1.536±0.064, N=176)	1.30-1.71 (1.495±0.087, N=120)

Table 2. **(continuation).**

Species	Ratios of measurements (abbreviations listed in the text)				
	COL:PRN	**WH:LF**	**LID:WH**	**LID:LF**	**LID:UID**
parvulus	0.54-0.58 (0.552±0.017, N=4)	1.51-1.56 (1.529±0.020, N=4)	0.50-0.53 (0.509±0.011, N=5)	0.77-0.80 (0.779±0.012, N=4)	0.80-0.84 (0.815±0.016, N=5)
puncticeps	0.62-0.68 (0.659±0.022, N=11)	1.50-1.54 (1.518±0.026, N=2)	0.46-0.52 (0.485±0.020, N=11)	0.71-0.72 (0.716±0.008, N=2)	0.81-0.83 (0.819±0.015, N=2)
punicus	0.57-0.61 (0.592±0.014, N=7)	1.54-1.64 (1.584±0.037, N=7)	0.54-0.56 (0.551±0.007, N=7)	0.84-0.91 (0.872±0.027, N=7)	0.88-0.94 (0.921±0.018, N=7)
schmiede-knechtii	0.56-0.64 (0.607±0.021, N=8)	1.54-1.60 (1.563±0.020, N=7)	0.55-0.58 (0.563±0.013, N=8)	0.86-0.91 (0.884±0.015, N=7)	0.92-0.94 (0.931±0.010, N=7)
stigma	0.617 (N=1)	1.557 (N=1)	0.541 (N=1)	0.842 (N=1)	0.991 (N=1)
temporalis	0.64-0.70 (0.671±0.017, N=19)	1.43-1.58 (1.509±0.035, N=14)	0.43-0.55 (0.523±0.025, N=19)	0.64-0.83 (0.790±0.046, N=14)	0.69-0.88 (0.838±0.046, N=14)
tiemudzin	0.61-0.63 (0.619±0.013, N=4)	1.54-1.59 (1.563±0.034, N=2)	0.54-0.56 (0.546±0.008, N=4)	0.83-0.88 (0.855±0.038, N=2)	0.90-0.92 (0.911±0.018, N=2)
tobiasi	0.64-0.66 (0.652±0.014, N=2)	1.548 (N=1)	0.46-0.47 (0.465±0.001, N=2)	0.720 (N=1)	0.875 (N=1)
tristis	0.55-0.63 (0.596±0.018, N=94)	1.51-1.70 (1.598±0.045, N=88)	0.46-0.52 (0.494±0.013, N=93)	0.74-0.86 (0.789±0.032, N=88)	0.80-0.89 (0.855±0.022, N=88)
valkeilai	0.59 (0.591±0.005, N=2)	1.65 (1.647±0.001, N=2)	0.50-0.51 (0.503±0.010, N=2)	0.82-0.84 (0.828±0.016, N=2)	0.88-0.89 (0.884±0.011, N=2)
wahisi	0.56-0.61 (0.588±0.017, N=8)	1.56-1.60 (1.578±0.028, N=2)	0.53-0.56 (0.544±0.007, N=8)	0.84-0.89 (0.864±0.034, N=2)	0.89-0.91 (0.901±0.010, N=2)

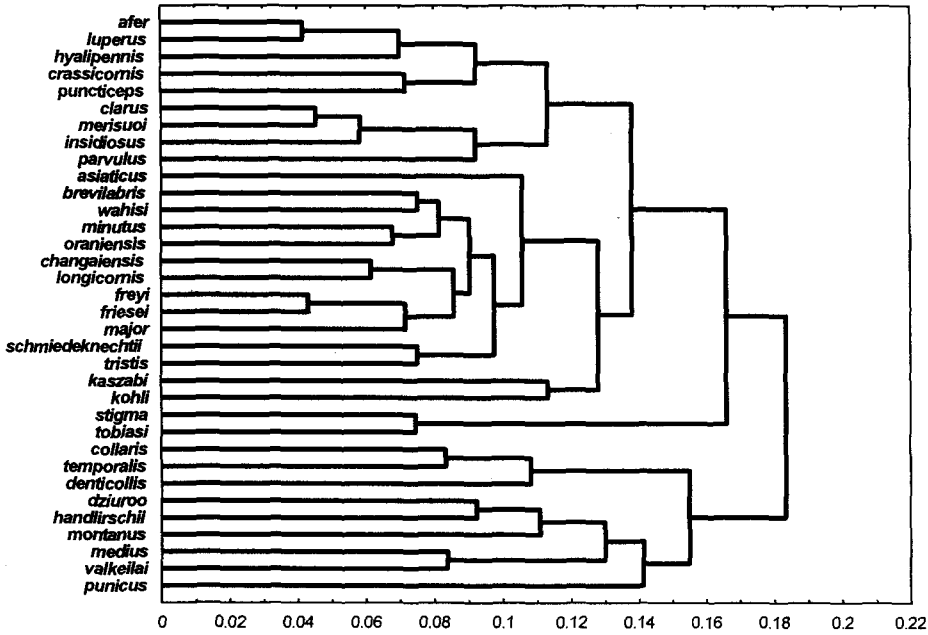

Fig. 2. Tree diagram of morphometric similarity of 34 Palearctic species of *Diodontus*, based on the measurements of females (clustering method: UPGA, Euclidean distance)

Table 2. **(continuation).**

Species	Ratios of measurements (abbreviations listed in the text)				
	POD:OOD	**WHO:OOD**	**LSC:LID**	**3FL:LSC**	**L6F:W6F**
parvulus	0.92-1.02 (0.974±0.046, N=4)	0.49-0.52 (0.502±0.013, N=4)	0.44-0.47 (0.453±0.014, N=5)	1.21-1.34 (1.278±0.053, N=5)	0.84-1.00 (0.901±0.059, N=5)
puncticeps	0.77-0.93 (0.851±0.046, N=11)	0.47-0.50 (0.482±0.021, N=2)	0.44-0.49 (0.462±0.018, N=11)	0.95-1.16 (1.079±0.065, N=11)	1.25-1.28 (1.267±0.024, N=2)
punicus	0.68-0.78 (0.727±0.033, N=7)	0.43-0.49 (0.449±0.021, N=7)	0.42-0.46 (0.447±0.014, N=7)	1.49-1.67 (1.543±0.064, N=7)	1.41-1.56 (1.491±0.059, N=7)
schmiede-knechtii	0.78-0.95 (0.879±0.057, N=8)	0.35-0.44 (0.399±0.034, N=7)	0.41-0.44 (0.421±0.013, N=8)	1.21-1.32 (1.250±0.036, N=8)	1.20-1.38 (1.287±0.061, N=7)
stigma	1.417 (N=1)	0.643 (N=1)	0.516 (N=1)	0.565 (N=1)	1.208 (N=1)
temporalis	0.73-0.96 (0.821±0.057, N=19)	0.36-0.50 (0.423±0.041, N=14)	0.43-0.58 (0.464±0.031, N=19)	1.36-1.44 (1.407±0.023, N=19)	1.06-1.27 (1.174±0.060, N=14)
tiemudzin	0.94-1.01 (0.984±0.033, N=4)	0.39-0.46 (0.427±0.048, N=2)	0.41-0.43 (0.422±0.009, N=4)	1.14-1.23 (1.192±0.045, N=4)	1.28-1.38 (1.328±0.067, N=2)
tobiasi	1.45-1.50 (1.477±0.032, N=2)	0.830 (N=1)	0.54-0.56 (0.549±0.017, N=2)	0.64-0.65 (0.642±0.008, N=2)	1.160 (N=1)
tristis	0.85-1.06 (0.950±0.047, N=94)	0.45-0.65 (0.565±0.041, N=90)	0.42-0.52 (0.472±0.018, N=89)	1.25-1.56 (1.423±0.058, N=89)	1.18-1.62 (1.371±0.087, N=85)
valkeilai	0.76-0.80 (0.779±0.023, N=2)	0.50-0.52 (0.512±0.014, N=2)	0.44-0.47 (0.457±0.017, N=2)	1.47-1.54 (1.503±0.046, N=2)	1.47-1.52 (1.493±0.033, N=2)
wahisi	0.62-0.70 (0.659±0.028, N=8)	0.39-0.40 (0.395±0.007, N=2)	0.43-0.46 (0.447±0.010, N=8)	1.20-1.36 (1.272±0.058, N=8)	1.10-1.26 (1.164±0.066, N=5)

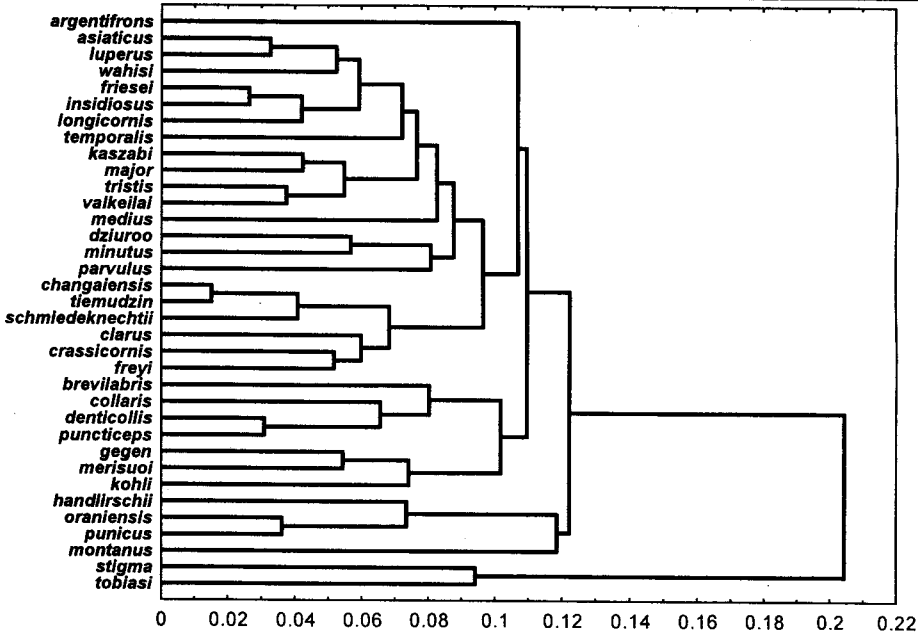

Fig. 3. Tree diagram of morphometric similarity of 35 Palearctic species of *Diodontus*, based on the measurements of male (clustering method: UPGA, Euclidean distance)

- relative width of lower head, distance between mandibles, width of clypeus (IMD:LF, IMD:WH),
- relative length of vertex, size of mandible muscles (LV:LF),
- relative distance between hindocelli (POD:OOD),
- relative size of ocelli (WHO:OOD),
- relative length of scape (LSC:LID),
- relative length of flagellum (3FL:LSC, L6F:W6F),
- relative width of pronotal collar (COL:PRN).

Discussion

The presented data show that *Diodontus* wasps are highly variable; even the range (minimum-maximum) of the most informative morphometric ratios overlaps in many species. The averages of series of conspecific specimens collected together should be more informative. From the author's experience, a discriminant function involving 2, 3 or 4 measurements is often more useful for the identification of single specimens, than just a ratio of two measurements.

Phenetic classification is sometimes useful in the taxonomy of species level, because the characters of closely related species are usually more difficult to polarise for the phylogenetic analysis than the characters of higher taxa.

Similarity analysis, based on quantitative (metric) characters, seems to be less popular than the analysis of qualitative (multistate) characters. In comparison with the latter, the advantages of morphometric measurements (or body proportions) as characters for the evaluation of species similarity are 1) their objectivity, and 2) their equivalence.

Similarity analysis of morphometric measurements in the genus *Diodontus* confirms distinctness of the species groups *tobiasi-stigma* (both sexes: Fig. 2 and Fig. 3) and *aferluperus-hyalipennis-crassicornis-puncticeps-clarus-merisuoi-insidiosus-parvulus* (females only, Fig. 2). On the other hand, e.g. the related species, *D. medius* and *D. tristis*, *D. minutus* and *D. major* (both sexes), *D. punicus* and *D. oraniensis* (females only), are distant from one other because of essential differences in their body proportions.

Obviously, morphometric similarity alone is not a sufficient basis for adequate classification, but the method may be used as a subsidiary classificatory tool in concert with others, in species taxonomy.

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Diodontus Curtis genties žiedvapsvių (Hymenoptera, Sphecidae) Palearktikos rūšių morfometrinis panašumas ir išmatavimų apibendrinimas

E. Budrys

Reziumė

Pirminis 18 morfometrinių išmatavimų atrinkimas jų statistinei analizei buvo atliktas intuityviai, remiantis tuo, kad jie turi būti: 1) informatyvūs, atspindintys rūšių aprašymuose naudojamas kūno proporcijas, 2) lengvai išmatuojami, su aiškiomis ribomis ir 3) ilgiausi iš koreliuojančių tarpusavyje, kad santykinė matavimo paklaida būtų mažesnė. Iš viso buvo išmatuota 1226 patelės ir 1438 patinai, priklausantys 70 aprašytų ir neaprašytų rūšių. Diskriminantinės analizės būdu buvo atrinkti ir atmesti 3-4 mažiausiai informatyvūs išmatavimai kiekvienai lyčiai. Likusių išmatavimų rūšių vidurkiai buvo normalizuoti, padalijant juos iš galvos pločio, rodančio absoliutų kūno dydį. Rūšių patinų ir patelių panašumas įvertintas klasterinės analizės metodu. Rūšių morfometrinių išmatavimų apibendrinimui panaudoti informatyviausi, kūno proporcijas atspindintys dviejų išmatavimų santykiai. Jie pasirinkti, etapais atliekant dviejų žingsnių diskriminantinę analizę, po kiekvieno etapo pašalinant iš modelio geriausiąjį išmatavimą. Rezultatai rodo, kad dėl didelio rūšių variabilumo individų serijų išmatavimų vidurkiai apibūdinimui yra tinkamesni už jų diapazonus, o morfometrinio panašumo analizė gali būti naudojama greta kitų rūšių klasifikacijos metodų, atsižvelgus į jos apribojimus.

Морфометрическое сходство и обобщение промеров палеарктических видов рода *Diodontus* Curtis (Hymenoptera, Sphecidae)

Э. Будрис

Резюме

Первичный отбор 18 морфометрических промеров для их статистического анализа был сделан интуитивно, с учетом того, что они должны быть: 1) информативными, отражающими используемые в описаниях видов пропорции тела, 2) легко измеряемыми, с отчетливыми границами и 3) наиболее длинными из нескольких коррелирующих, чтобы относительная ошибка измерения была меньше. Всего измерено 1226 самок и 1438 самцов, принадлежащих 70 описанным и неописанным видам. Путем дискриминантного анализа отобраны и отброшены 3-4 наименее информативных промера для каждого пола. Средние значения остальных промеров нормализованы путем их разделения на ширину головы, отражающую абсолютную величину тела. Методом кластерного анализа произведена оценка сходства видов по самцам и самкам. Для видовых морфометрических обобщений использованы наиболее информативные, отражающие пропорции тела соотношения двух промеров. Они отобраны путем поэтапного двухшагового дискриминантного анализа, после каждого этапа удаляя из модели наилучший промер. Результаты показывают, что из-за большой изменчивости видов средние значения серий особей более подходят для определения, чем диапазоны промеров, а анализ морфометрического сходства может быть использован вместе с другими методами классификации видов, с учетом его ограничений.