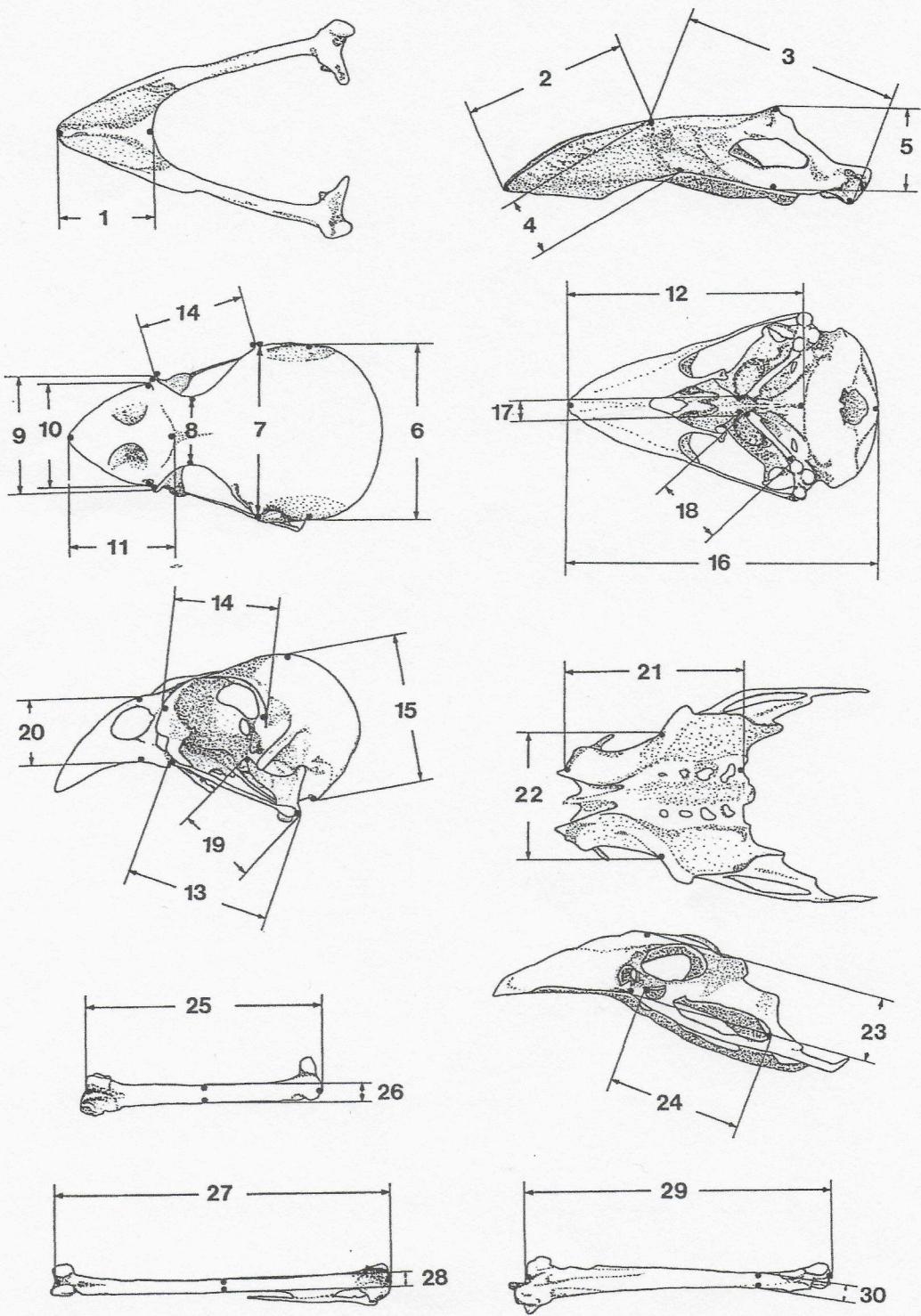
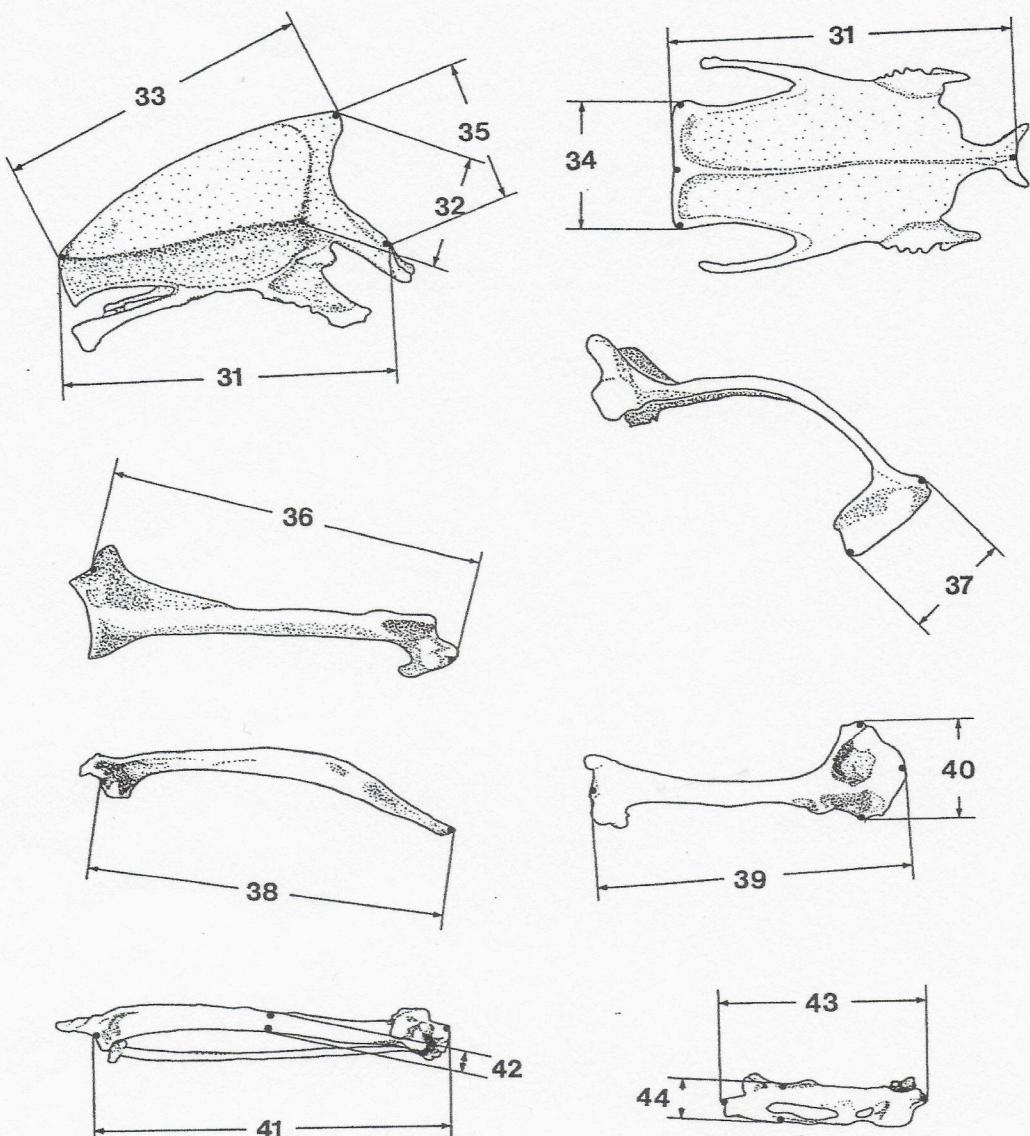


Table 1: PCA of 44 skeletal characters in 44 carduelid species. l = length, w = width, d = depth. Extreme values in bold types.

Character number and name	PC I ₁ coefficients	PC II ₁	F I ₁ squared character loadings	F II ₁
Feeding apparatus				
Head				
1 Mandible, pars symphysialis	0.15	-0.08	0.77	0.01
2 Mandible, Dentale l	0.16	-0.07	0.87	0.01
3 Mandible, pars caudalis l	0.15	-0.15	0.84	0.04
4 Mandible, Dentale d	0.15	-0.07	0.84	0.01
5 Mandible, pars caudalis d	0.16	-0.02	0.92	0.00
6 Skull, w	0.16	-0.16	0.90	0.05
7 Interorbital, max w	0.16	-0.07	0.91	0.01
8 Interorbital, min w	0.14	0.11	0.73	0.02
9 Postorbital w	0.16	-0.00	0.88	0.00
10 Internasal w	0.16	0.00	0.87	0.00
11 Premaxilla l	0.16	-0.07	0.90	0.01
12 Postorbital l	0.16	-0.11	0.92	0.02
13 Quadratojugale l	0.16	-0.13	0.87	0.03
14 Orbital w	0.16	-0.15	0.90	0.04
15 Skull d	0.16	-0.13	0.92	0.03
16 Skull l	0.16	-0.11	0.94	0.02
17 Palatinum w	0.14	0.05	0.69	0.01
18 Pterygoid l	0.15	-0.05	0.79	0.00
19 Processus orbitalis quadrati	0.16	-0.05	0.89	0.00
20 Premaxilla d	0.16	-0.00	0.91	0.00
Walking apparatus				
Pelvic girdle				
21 Synsacrum l	0.16	-0.02	0.89	0.00
22 Synsacrum w	0.15	-0.03	0.79	0.00
23 Synsacrum d	0.13	-0.19	0.61	0.06
24 Synsacrum distal l	0.15	-0.16	0.76	0.05
Leg				
25 Femur l	0.16	-0.14	0.90	0.04
26 Femur w	0.15	-0.08	0.81	0.01
27 Tibiotarsus l	0.16	-0.12	0.87	0.02
28 Tibiotarsus w	0.15	-0.09	0.79	0.01
29 Tarsometatarsus l	0.15	-0.15	0.79	0.04
30 Tarsometatarsus w	0.08	-0.06	0.25	0.01
Flying apparatus				
Pectoral girdle				
31 Sternum l	0.16	0.20	0.88	0.10
32 Keel d	0.14	0.38	0.66	0.26
33 Keel l	0.15	0.29	0.78	0.15
34 Sternum distal w	0.14	0.00	0.70	0.00
35 Sternum d	0.14	0.30	0.74	0.16
36 Coracoid l	0.16	0.10	0.92	0.02
37 Hypocleidium l	0.11	0.42	0.44	0.33
38 Scapula l	0.16	0.16	0.88	0.05
Wing				
39 Humerus l	0.16	0.01	0.90	0.00
40 Humerus distal end w	0.14	0.01	0.74	0.00
41 Ulna l	0.16	0.14	0.87	0.04
42 Ulna w	0.13	0.17	0.64	0.05
43 Carpometacarpus l	0.15	0.23	0.81	0.10
44 Carpometacarpus w	0.15	0.08	0.83	0.01
Percentage of variance explained	80.6 %	4.11 %		
Cumulative variance		84.71 %		
Eigenvalue	35.50	1.81		

Appendix. Definitions of the 44 skeletal measurements used in this study.





Material

We took 44 skeletal measurements from 208 carduelid specimens originating from most parts of the family's distributional range. Bony elements were measured with dial calipers (H. Classen and R. van den Elzen).

The characters are listed in Table 1 and figured in the Appendix. In the following we list species examined, number of specimens per species and faunal regions of species: P stands for Palaearctic region, N for Nearctic, H for Holarctic, NT for Neotropical, AT for Afrotropical region.

<i>Serinus pusillus</i>	n = 6 P	<i>Ochrospiza reichenowi</i>	n = 7 AT
<i>Serinus serinus</i>	n = 7 P	<i>Ochrospiza atrogularis</i>	n = 6 AT
<i>Serinus syriacus</i>	n = 7 P	<i>Ochrospiza leucopygia</i>	n = 5 AT
<i>Serinus citrinella</i>	n = 5 P	<i>Ochrospiza xanthopygia</i>	n = 6 AT
<i>Serinus canaria</i>	n = 1 P	<i>Ochrospiza mozambica</i>	n = 8 AT
<i>Serinus canicollis</i>	n = 8 AT	<i>Ochrospiza dorsostriata</i>	n = 6 AT
<i>Alario alario</i>	n = 17 AT	<i>Linurgus olivaceus</i>	n = 2 AT
<i>Pseudochloroptila totta</i>	n = 10 AT	<i>Chloris chloris</i>	n = 5 P
<i>Dendrospiza hyposticta</i>	n = 6 AT	<i>Chloris spinoides</i>	n = 1 P
<i>Dendrospiza scotos</i>	n = 6 AT	<i>Chloris sinica</i>	n = 1 P
<i>Dendrospiza capistrata</i>	n = 1 AT	<i>Carduelis carduelis</i>	n = 9 P
<i>Dendrospiza koliensis</i>	n = 2 AT	<i>Spinus spinus</i>	n = 4 P
<i>Crithagra gularis</i>	n = 6 AT	<i>Spinus barbatus</i>	n = 2 NT
<i>Crithagra tristriata</i>	n = 2 AT	<i>Spinus cucullatus</i>	n = 6 NT
<i>Crithagra mennelli</i>	n = 1 AT	<i>Acanthis flammea</i>	n = 6 H
<i>Crithagra leucoptera</i>	n = 1 AT	<i>Linaria cannabina</i>	n = 2 P
<i>Crithagra burtoni</i>	n = 1 AT	<i>Leucosticte arctoa</i>	n = 1 H
<i>Crithagra striolata</i>	n = 4 AT	<i>Erythrina erythrina</i>	n = 1 P
<i>Crithagra albogularis</i>	n = 7 AT	<i>Erythrina mexicana</i>	n = 1 N
<i>Crithagra sulphurata</i>	n = 7 AT	<i>Uragus sibiricus</i>	n = 1 P
<i>Crithagra donaldsoni buchanani</i>	n = 7 AT	<i>Procarduelis vinacea</i>	n = 1 P
<i>Serinops flavigularis</i>	n = 5 AT	<i>Coccothraustes coccothraustes</i>	n = 6 P

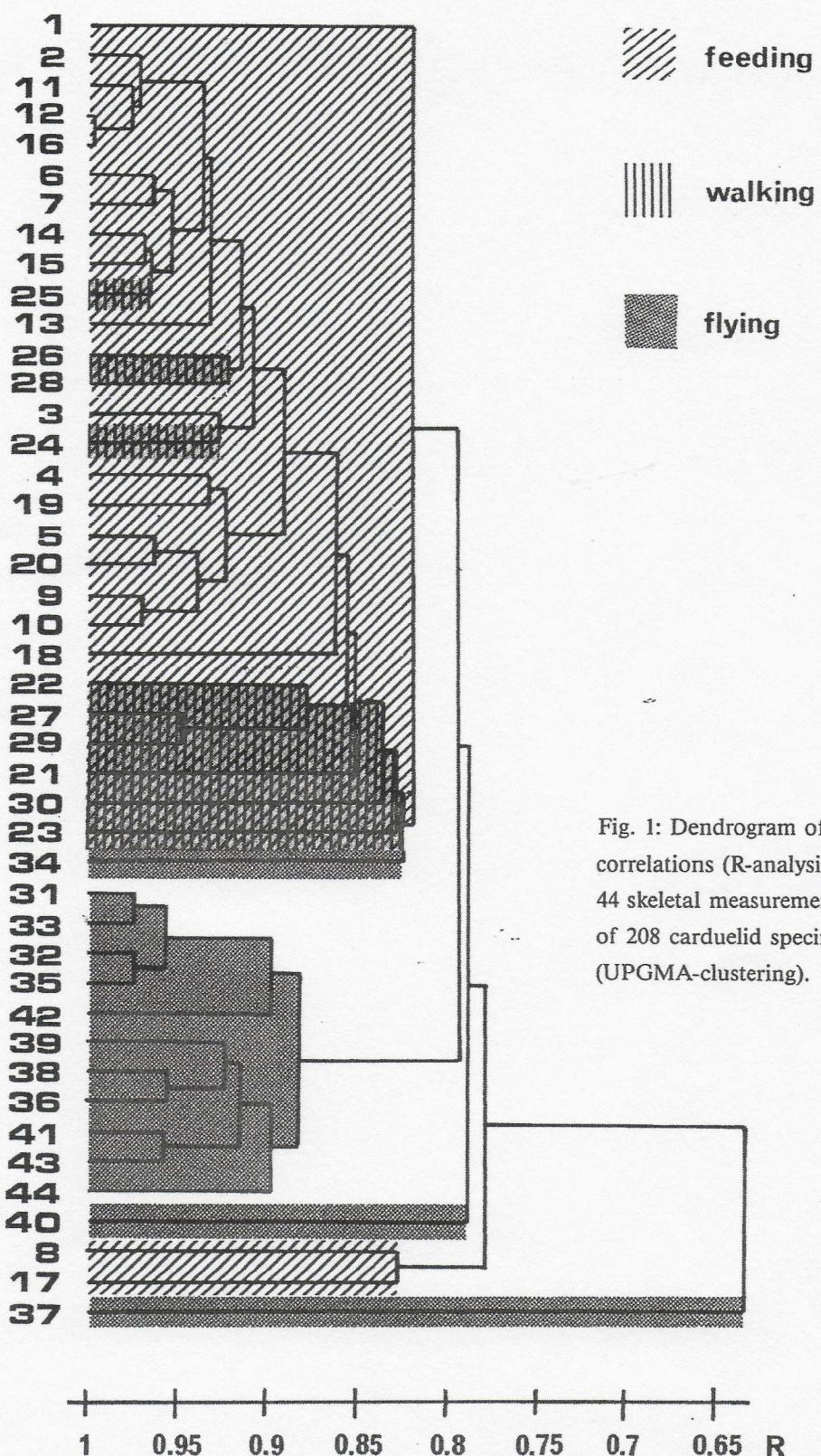


Fig. 1: Dendrogram of character correlations (R-analysis) between 44 skeletal measurements of 208 carduelid specimens (UPGMA-clustering).

ORDINATION

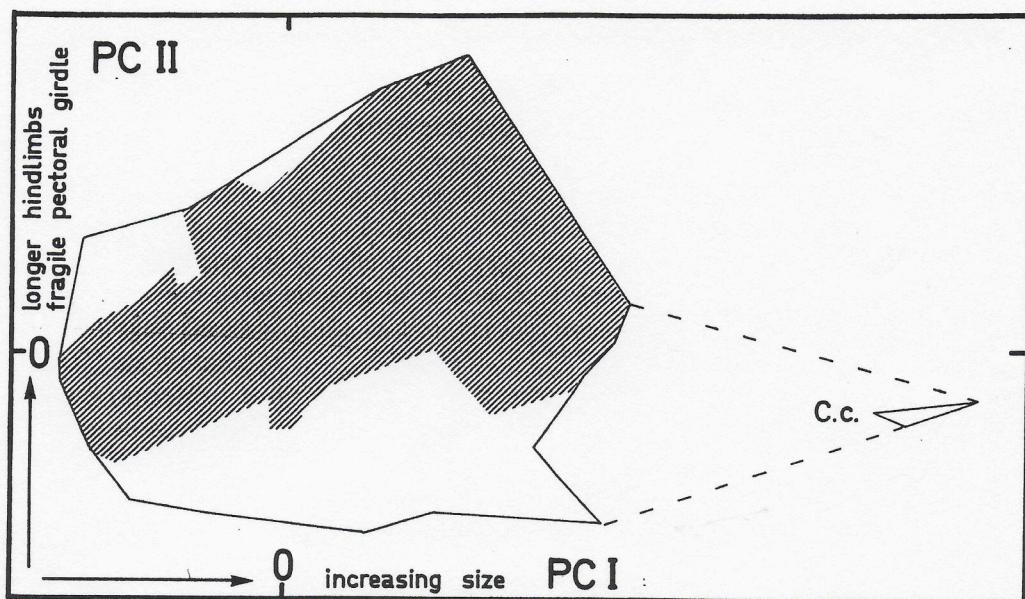


Fig. 2: PCA of 44 skeletal characters; morphological ranges of African canaries (shaded) within the whole sample of carduelids. *C. c.* = *Coccothraustes coccothraustes*.

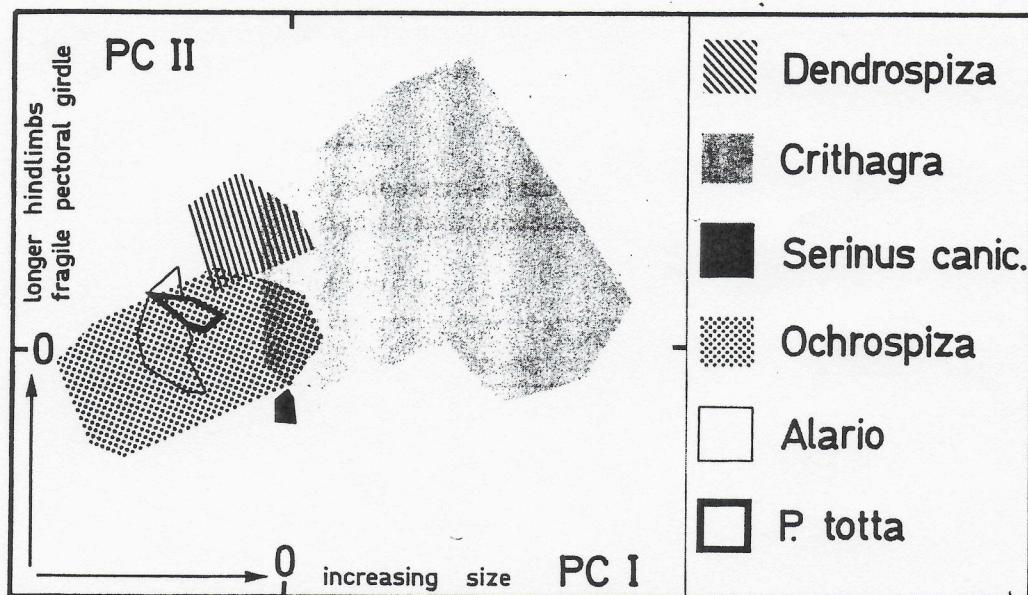


Fig. 3: PCA of 44 skeletal characters; morphological ranges of Afro-tropical species-groups (= genera).

Desert in Namibia, forms the cluster of the smallest sized birds with a well-developed flying apparatus. Almost equally sized, but with accentuated cranial-hindlimb features, are members of the genus *Dendrospiza*. They live in woodland to forests along moun-