

Spectrum of plant and animal diet of European Great Bustard (*Otis tarda tarda*) – an overview

Sándor FARAGÓ

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Abstract We have pointed out 272 plant and 217 animal, altogether 489 taxa in the diet of Great Bustard on the basis of data received from 9 (10) countries for *Otis tarda tarda* (Portugal, Spain, United Kingdom, Germany, Austria, Slovakia, Hungary, Ukraine, Kazakhstan, former Soviet Union). Out of 272 plant taxa, 40 were classified as cultivated plants, 232 wild plants and weeds. From the latter, 43 taxa were monocotyledons and 189 were dicotyledons. Animal food is shared among Annelida (n = 3), Arthropoda (189) Mollusca (2) and Vertebrata (23) phyla. Arthropods are mostly represented with Insecta (181), Arachnoidea (3), Chilopoda (2), Diplopoda (2) and Crustacea (mostly Isopoda) (1) classes. The component of the diet is possibly not related to selection but to the change of the abundance and availability of food and the ever present demand for animal food needed for the organism. Owing to the high number of taxa known as food, Great Bustard is definitely a generalist species. Due to the wide spectrum of animal taxa and because of the ability to subsidize the inefficient quality of food with quantity, Great Bustards can be regarded as a species with positive adaptation ability. It can be explained with a wide plant and animal food spectrum that Great Bustards even in intensive agricultural habitats can find food with indispensable quantity and quality.

Keywords: European Great Bustard, *Otis tarda tarda*, plant diet, animal diet, spectrum of diet

Összefoglalás Az *Otis tarda tarda* areájának 9 (10) országából (Portugália, Spanyolország, Egyesült Királyság, Németország, Ausztria, Szlovákia, Magyarország, Ukrajna, Kazahsztán, egykori Szovjetunió) származott közlések alapján a túzok táplálékaként 272 növényi és 217 állati, összesen 489 taxont mutattunk ki.

A 272 növényi taxon közül 40 természetű növény, 232 vadon élő, illetve gyomnövény volt. Ez utóbbi közül 43 taxon egyszikű és 189 taxon kétszikű volt. Az állati táplálék az Annelida (3 taxon), Arthropoda (189) a Mollusca (2) és Vertebrata (23) törzsek között oszlott meg. Az Arthropodákat leginkább az Insecta (181), Arachnoidea (3), Chilopoda (2), Diplopoda (2), Crustacea (elsősorban Isopoda) (1) osztályok képviselik. A táplálék összetétele feltehetően nem a válogatással, hanem a táplálék bőségének, hozzáférhetőségének változásával, illetve a szervezet állati táplálék iránti mindenkori igényével függ össze. A táplálékként ismert taxonok magas száma okán a túzokot egyértelműen generalista fajnak kell tekinteni. A fogyasztott növény és állati taxonok széles spektruma miatt, továbbá azon képessége alapján, hogy a táplálék elégtelen minőségét mennyiséggel tudja pótolni a túzok, a faj pozitív adaptációs képességének tekinthető.

A széles növényi és állati táplálékspektrummal magyarázható, hogy a túzok még az intenzív mezőgazdasági területeken is megtalálja a számára elengedhetetlen mennyiségű és minőségű táplálékot.

Kulcsszavak: európai túzok, *Otis tarda tarda*, növényi táplálék, állati táplálék, táplálékspektrum

Institute of Wildlife Management and Vertebrate Zoology, University of Sopron, 9400 Sopron, Bajcsy-Zsilinszky u. 4., Hungary, e-mail: farago.sandor@uni-sopron.hu

Introduction

During the conservation of the declining population (Alonso 2014) of the globally threatened Great Bustard (*Otis tarda*), it is inevitable to possess information on one of the most important segments of its feeding ecology, the trophic relations.

The former, general ornithological monographs (Glutz *et al.* 1973, Cramp & Simmons 1980, Morales & Martín 2002 etc.) address the diet of Great Bustard. In a previous work, Faragó (1986) detected 114 plant and 155 animal taxa as Great Bustard food on the distribution area of *Otis tarda tarda*, mostly based on bromathologic investigations collected by hunting. In many cases, the authors have provided only the family names of plants or animals, and the more precise classification was not possible as a result of the digestibility. Since our knowledge on this topic has increased, mostly because of the examination of faeces and many other new data found in specific literature resources, we have found it adequate to provide an overview on the bustard's diet spectrum.

Material and methods

The basis of the classification of the food list was given by the following publications, in which well-defined plant and animal taxa were shown for the Great Bustard. The publication years of these papers range 1781 and 2018. The study locations of these articles are as follows, listed by countries.

Portugal: Rocha *et al.* (2005)

Spain: Gil-Lletget (1945), Palaus Soler (1960), Palacios *et al.* (1975), Lucio (1985), Redondo & Tortosa (1994), Hellmich (1995), Lane *et al.* (1999), Suárez (2002), Alonso & Palacín (2009), Bravo *et al.* (2012), Bravo *et al.* (2014), Bravo *et al.* (2016)

United Kingdom: Jourdain (1948), Gooch *et al.* (2015)

Germany: Rörig (1900), Hennicke (1905), Niethammer (1942), Gewalt (1954), Gewalt (1959), Mansfeld (1958), Glutz *et al.* (1973), Heneberg (2016)

Austria: Dangel & Winkler (1971), Rab *et al.* (2015)

Slovakia: Nečas & Hanzl (1956)

Hungary: Huszthy (1781), Chernel (1899), Bodnár (1924), Greschik (1939), Vasvári (1949), Horváth (1958), Fodor *et al.* (1971), Sterbetz (1977), Faragó (1981), Faragó (1986), Faragó & Csatári (1993), Faragó (2018)

Former Soviet Union: Dementiev & Gladkov (1951), Spangenberg (1951), Stegman (1955), Isakov & Flint (1989)

Ukraine: Spangenberg (1951), Kistjakinskij (1957)

Kazakhstan: Dolgushin (1962), Rjabov & Ivanova (1971)

Since the Great Bustard is an omnivorous species, we separately discuss the plant and animal diet. Owing to the fact that in the taxonomy of plants and animals respectively, certain countries use different terminologies, and at the same time, we can find scientific synonyms

in previous investigations, we also give both the scientific and the well-known synonyms as a compromise solution. However, we also give the source-publication as well in the case of each taxon.

In the case of the food list for plants, we declare the spectrum of the species in terms of cultivated plant, wild plants and weeds and then we give the family names – within that – in alphabetical order. In relation with plants, we use the Király (2009) nomenclature.

In the animal food list – due to its different particularity of taxonomy – we also share the ranging of phylum, classis, ordo, family, genus and species. Within orders (ordo) we give taxa in alphabetical order (including family, subfamily, genus and species). In relation with Coleoptera we have used the names of Merkl and Vig (2009).

Result

Plant diet of Great Bustard

Cultivated plants consumed by Great Bustard

Allium sativum – Spangenberg (1951), Cramp & Simmons (1980)

Avena sativa – Gil-Lletget (1945), Mansfeld (1958), Fodor *et al.* (1971), Suárez (2002)

Beta vulgaris – Chernel (1899), Dangel & Winkler (1971), Glutz *et al.* (1973), Cramp & Simmons (1980)

Brassica napus – Chernel (1899), Rörig (1900), Nečas & Hanzl (1956), Mansfeld (1958), Gewalt (1959), Fodor *et al.* (1971), Glutz *et al.* (1973), Sterbetz (1977), Cramp & Simmons (1980), Isakov & Flint (1989), Gooch *et al.* (2015), Raab *et al.* (2015)

Brassica juncea – Gooch *et al.* (2015)

Brassica nigra – Glutz *et al.* (1973), Lucio (1985), Bravo *et al.* (2016)

Brassica oleracea – Jourdain (1948), Mansfeld (1958), Glutz *et al.* (1973), Cramp & Simmons (1980), Suárez (2002)

Brassica rapa – Jourdain (1948), Mansfeld (1958), Glutz *et al.* (1973), Cramp & Simmons (1980)

Cicer arietinum – Palacios *et al.* (1975), Lucio (1985), Bravo *et al.* (2012), Bravo *et al.* (2016)

Citrullus lanatus – Hellmich (1995)

Cucurbita pepo – Gooch *et al.* (2015)

Eruca vesicaria – Cramp & Simmons (1980), Lucio (1985), Morales & Martín (2002), Bravo *et al.* (2016)

Fragaria ananassa – Gewalt (1954)

Helianthus annuus – Fodor *et al.* (1971), Sterbetz (1977)

Hordeum sativum – Stegman (1906), Mansfeld (1958), Fodor *et al.* (1971), Gooch *et al.* (2015)

Hordeum vulgare – Lucio (1985), Lane *et al.* (1999), Bravo *et al.* (2012), Bravo *et al.* (2016)

Lens culinaris – Palacios *et al.* (1975), Lucio (1985)

- Lupinus angustifolia* – Lane *et al.* (1999)
Medicago sativa – Mansfeld (1958), Fodor *et al.* (1971), Glutz *et al.* (1973), Palacios *et al.* (1975), Cramp & Simmons (1980), Lucio (1985), Isakov & Flint (1989), Lane *et al.* (1999), Bravo *et al.* (2012), Gooch *et al.* (2015)
Olea europaea – Palacios *et al.* (1975), Redondo & Tortosa (1994), Suárez (2002), Bravo *et al.* (2012), Delibes *et al.* (2012), Bravo *et al.* (2016)
Onobrychis viciifolia – Mansfeld (1958), Fodor *et al.* (1971), Glutz *et al.* (1973), Cramp & Simmons (1980)
Oryza sativa – Fodor *et al.* (1971)
Panicum miliaceum – Stegman (1906), Fodor *et al.* (1971)
Papaver somniferum – Mansfeld (1958), Fodor *et al.* (1971)
Phaseolus vulgaris – Stegman (1906)
Pisum sativum – Jourdain (1948), Nečas & Hanzl (1956), Mansfeld (1958), Fodor *et al.* (1971), Glutz *et al.* (1973), Cramp & Simmons (1980), Bravo *et al.* (2016)
Prunus domestica – Glutz *et al.* (1973)
Raphanus sativus – Mansfeld (1958), Glutz *et al.* (1973), Cramp & Simmons (1980)
Ribes rubrum – Glutz *et al.* (1973)
Secale cereale – Mansfeld (1958), Fodor *et al.* (1971)
Sorghum sp. – Fodor *et al.* (1971)
Trifolium sp. – Jourdain (1948)
Trifolium pratense – Mansfeld (1958), Fodor *et al.* (1971), Glutz *et al.* (1973), Cramp & Simmons (1980)
Trifolium repens – Mansfeld (1958), Fodor *et al.* (1971), Glutz *et al.* (1973), Cramp & Simmons (1980)
Triticum sp. – Palacios *et al.* (1975)
Triticum aestivum – Chernel (1899), Bodnár (1924), Gil-Lletget (1945), Nečas & Hanzl (1956), Mansfeld (1958), Fodor *et al.* (1971), Palacios *et al.* (1975), Sterbetz (1977), Lucio (1985), Lane *et al.* (1999), Gooch *et al.* (2015), Bravo *et al.* (2016)
Triticum turgidum – Suárez (2002)
Vicia sativa – Bodnár (1924), Fodor *et al.* (1971), Lucio (1985), Lane *et al.* (1999), Bravo *et al.* (2012), Bravo *et al.* (2016)
Vitis vinifera – Gil-Lletget (1945), Palacios *et al.* (1975), Lucio (1985), Lane *et al.* (1999), Suárez (2002), Bravo *et al.* (2012), Bravo *et al.* (2016)
Zea mays – Stegman (1906), Mansfeld (1958), Fodor *et al.* (1971)

Wild plants and weeds consumed by Great Bustard

Dicotyledonopsida

Fagaceae

Quercus sp. – Glutz *et al.* (1973)

Quercus coccifera – Spangenberg (1951)

Polygonaceae

Polygonum sp. – Thaisz (1899)

Polygonum aviculare – Lane *et al.* (1999), Bravo *et al.* (2012), Bravo *et al.* (2016)

Polygonum convolvulus – Kistjakinskij (1957)

Polygonum lapathifolium – Mansfeld (1958), Fodor *et al.* (1971)

Rumex pulcher – Bravo *et al.* (2012)

Chenopodiaceae

Atriplex hastata (prostrata) – Lucio (1985)

Chenopodium sp. – Bravo *et al.* (2012)

Chenopodium album – Lane *et al.* (1999), Gooch *et al.* (2015), Bravo *et al.* (2016)

Salsola kali – Palacios *et al.* (1975)

Amaranthaceae

Amaranthus sp. – Lucio (1985), Bravo *et al.* (2012)

Caryophyllaceae

Silenoideae – Palacios *et al.* (1975)

Cerastium holosteoides – Lane *et al.* (1999), Bravo *et al.* (2016)

Holosteum umbellatum – Lane *et al.* (1999), Bravo *et al.* (2016)

Sagina apetala – Lucio (1985)

Silene sp. – Lane *et al.* (1999)

cf. *Spergula* sp. – Palacios *et al.* (1975)

Spergula arvensis – Palacios *et al.* (1975)

Spergularia sp. – Lane *et al.* (1999)

Spergularia rubra – Lucio (1985), Suárez (2002)

Stellaria media – Mansfeld (1958), Fodor *et al.* (1971)

Vicia sp. – Suárez (2002)

Ranunculaceae

Ranunculus arvensis – Lucio (1985), Lane *et al.* (1999), Bravo *et al.* (2016)

Ranunculus repens – Lucio (1985)

Papaveraceae

Papaver roeas – Lane *et al.* (1999), Bravo *et al.* (2012), Bravo *et al.* (2016)

Roemeria hybrida – Bravo *et al.* (2016)

Brassicaceae (Cruciferae)

Brassicaceae – Palacios *et al.* (1975)

Alyssum minus – Lane *et al.* (1999), Bravo *et al.* (2012), Bravo *et al.* (2016)

Biscutella auriculata – Bravo *et al.* (2012), Bravo *et al.* (2016)

Brassica sp. – Palacios *et al.* (1975), Lucio (1985), Suárez (2002)

Brassica barrelieri – Palacios *et al.* (1975)

Camelina sp. – Lane *et al.* (1999), Bravo *et al.* (2012)

Camelina microcarpa – Lane *et al.* (1999), Bravo *et al.* (2016)

Camelina sativa – Glutz *et al.* (1973), Lane *et al.* (1999)

Capsella bursa-pastoris – Mansfeld (1958), Fodor *et al.* (1971), Lucio (1985), Lane *et al.* (1999), Suárez (2002), Bravo *et al.* (2012), Gooch *et al.* (2015), Bravo *et al.* (2016)

Descurainia sophia – Bravo *et al.* (2012), Bravo *et al.* (2016)

Diplotaxis sp. – Cramp & Simmons (1980)

Diplotaxis catalica – Palacios *et al.* (1975)

Diplotaxis eruroides – Lane *et al.* (1999), Bravo *et al.* (2016)

Erophila verna – Lane *et al.* (1999), Suárez (2002)

Lepidium sp. – Lucio (1985)

Lepidium heterophyllum – Lucio (1985)

Malcolmia africana – Bravo *et al.* (2016)

Neslia paniculata – Bravo *et al.* (2016)

Rapistrum sp. – Bravo *et al.* (2016)

Raphanus raphanistrum – Rörig (1900), Mansfeld (1958), Glutz *et al.* (1973), Palacios *et al.* (1975), Cramp & Simmons (1980), Bravo *et al.* (2012), Bravo *et al.* (2016)

Sinapis arvensis – Chernel (1899), Bodnár (1924), Fodor *et al.* (1971)

Sisymbrium sp. – Bravo *et al.* (2012)

Resedaceae

Reseda lutea – Gooch *et al.* (2015)

Rosaceae

Potentilla anserina – Fodor *et al.* (1971)

Sanguisorba minor – Palacios *et al.* (1975), Lane *et al.* (1999)

Fabaceae (Papilionaceae)

Anthyllis vulneraria – Gooch *et al.* (2015)

Astragalus sp. – Lucio (1985), Bravo *et al.* (2012)

Astragalus incanus – Bravo *et al.* (2016)

Cicer sp. – Palacios *et al.* (1975)

Cicer arietinum – Suárez (2002)

Coronilla scorpioides – Lane *et al.* (1999), Bravo *et al.* (2016)

Lathyrus sp. – Lucio (1985), Bravo *et al.* (2016)

Lathyrus sativus – Gil-Lletget (1945)

Lens squalenta – Bravo *et al.* (2016)

Lotus sp. – Lucio (1985)

Medicago sp. – Palacios *et al.* (1975), Cramp & Simmons (1980), Suárez (2002), Bravo *et al.* (2012), Bravo *et al.* (2016)

Medicago turbinata – Palacios *et al.* (1975)

Medicago minima – Palacios *et al.* (1975)

Medicago cf. polycarpa – Palacios *et al.* (1975)

Medicago polymorpha – Lucio (1985)

Melilotus sp. – Palacios *et al.* (1975)

Ononis sp. – Suárez (2002)

Ononis spinosa – Lucio (1985), Bravo *et al.* (2012), Bravo *et al.* (2016)

cf. *Ornithopus* sp. – Palacios *et al.* (1975)

Ornithopus compressus – Lane *et al.* (1999), Suárez (2002), Bravo *et al.* (2016)

Ornithopus sativus – Mansfeld (1958)

Scorpiurus sp. – Palacios *et al.* (1975)

Trifolium sp. – Palacios *et al.* (1975), Lane *et al.* (1999), Suárez (2002), Bravo *et al.* (2012), Gooch *et al.* (2015), Bravo *et al.* (2016)

Trifolium angustifolium – Lane *et al.* (1999), Bravo *et al.* (2016)

Trigonella monspeliaca – Bravo *et al.* (2016)

Vicia sp. – Palacios *et al.* (1975), Bravo *et al.* (2012), Bravo *et al.* (2016)

Geraniaceae

Erodium sp. – Bravo *et al.* (2016)

Erodium cicutarium – Lane *et al.* (1999)

Geranium sp. – Bravo *et al.* (2012)

Geranium molle – Lane *et al.* (1999)

Linaceae

Linum sp. – Fodor *et al.* (1971)

Euphorbiaceae

Euphorbia serrata † – Lucio (1985)

Malvaceae

Malva sylvestris – Bravo *et al.* (2012), Bravo *et al.* (2016)

Onagraceae

Epilobium sp. – Bravo *et al.* (2012)

Apiaceae (Umbelliferae)

Daucoideae – Palacios *et al.* (1975)

Caucalis sp. – Bodnár (1924)

Conium maculatum † – Glutz *et al.* (1973), Cramp & Simmons (1980)

Daucus sp. – Palacios *et al.* (1975), Suárez (2002)

Daucus carota – Lucio (1985), Lane *et al.* (1999)

Erygium (syn. *Eryngium*) sp. – Gil-Lletget (1945)

Pimpinella sp. – Chernel (1899)

Thapsia villosa – Lucio (1985)

Torilis nodosa – Bravo *et al.* (2016)

Primulaceae

Anagallis arvensis – Bravo *et al.* (2016)

Primula elatior – Gooch *et al.* (2015)

Plumbaginaceae

Limonium gmelini – Faragó & Csátári (1993)

Convolvulaceae

Convolvulus sp. – Gil-Lletget (1945), Bravo *et al.* (2016)

Convolvulus arvensis – Chernel (1899), Palacios *et al.* (1975), Lucio (1985), Lane *et al.* (1999), Suárez (2002), Bravo *et al.* (2012)

Boraginaceae

Boraginaceae – Gooch *et al.* (2015)

Alkanna lutea – Lucio (1985)

Anhusa azurea – Bravo *et al.* (2016)

Echium sp. – Lucio (1985), Bravo *et al.* (2016)

Echium plantagineum – Lane *et al.* (1999), Bravo *et al.* (2016)

Heliotropium europaeum – Lane *et al.* (1999), Bravo *et al.* (2012), Bravo *et al.* (2016)

Lithospermum sp. – Bravo *et al.* (2016)

Myosotis sp. – Lucio (1985), Lane *et al.* (1999)

Lamiaceae (Labiatae)

Lamium amplexicaule – Bravo *et al.* (2012), Bravo *et al.* (2016)

Salvia verbenacea – Bravo *et al.* (2016)

Solanaceae

Solanum nigrum – Lucio (1985), Lane *et al.* (1999), Bravo *et al.* (2012), Bravo *et al.* (2016)

Scrophulariaceae

Kickxia spuria – Bravo *et al.* (2012)

Veronica sp. – Gooch *et al.* (2015), Bravo *et al.* (2016)

Veronica hederifolia – Lucio (1985), Lane *et al.* (1999), Bravo *et al.* (2016)

Veronica triphyllos – Lane *et al.* (1999)

Orobanchaceae

Parentucellia latifolia – Lane *et al.* (1999)

Rubiaceae

Asperula cf. arvensis – Palacios *et al.* (1975)

Galium sp. – Suárez (2002)

Galium tricornutum – Bravo *et al.* (2012), Bravo *et al.* (2016)

Sherardia arvensis – Bravo *et al.* (2016)

Plantaginaceae

Plantago sp. – Jourdain (1948), Cramp & Simmons (1980), Lane *et al.* (1999), Bravo *et al.* (2012), Bravo *et al.* (2016)

Plantago coronopus – Palacios *et al.* (1975), Lane *et al.* (1999)

Plantago lanceolata – Mansfeld (1958), Fodor *et al.* (1971), Palacios *et al.* (1975), Lucio (1985), Lane *et al.* (1999), Gooch *et al.* (2015)

Plantago major – Mansfeld (1958), Fodor *et al.* (1971)

Plantago media – Mansfeld (1958), Fodor *et al.* (1971)

Valerianaceae

Valerianella sp. – Hennicke (1905), Jourdain (1948)

Dipsacaceae

Cephalaria syriaca – Lane *et al.* (1999)

Scabiosa sp. – Lane *et al.* (1999)

Scabiosa stellata – Bravo *et al.* (2016)

Campanulaceae

Jasione montana – Suárez (2002)

Asteraceae (Compositae)

Achillea ageratum – Bravo *et al.* (2012)

Achillea millefolium – Mansfeld (1958), Fodor *et al.* (1971)

Anacyclus clavatus – Lane *et al.* (1999), Bravo *et al.* (2012), Bravo *et al.* (2016)

Andryala integrifolia – Lane *et al.* (1999), Bravo *et al.* (2012), Bravo *et al.* (2016)

Anthemis sp. – Palacios *et al.* (1975), Lucio (1985)

Anthemis arvensis – Lane *et al.* (1999)

Anthemis cotula – Palacios *et al.* (1975)

Apargia sp. – Jourdain (1948)

- Arnoseris* sp. – Cramp & Simmons (1980)
Bellis perennis – Lane *et al.* (1999)
Carduus tenuiflorus – Bravo *et al.* (2012)
Carthamus lanatus – Lane *et al.* (1999), Bravo *et al.* (2016)
Chondrilla juncea – Bravo *et al.* (2012)
Cichorium intybus – Bravo *et al.* (2012)
Cirsium sp. – Bravo *et al.* (2016)
Cirsium arvense – Nečas & Hanzl (1956), Glutz *et al.* (1973), Cramp & Simmons (1980), Lucio (1985)
Cnicus benedictus – Bravo *et al.* (2016)
Conyza canadensis – Bravo *et al.* (2012)
Corimbiferae – Palacios *et al.* (1975)
Crepis sp. – Jourdain (1948), Cramp & Simmons (1980), Lucio (1985), Gooch *et al.* (2015)
Crepis virens (capillaris) – Lucio (1985)
Filago sp. – Bravo *et al.* (2016)
Filago pyramidata – Lane *et al.* (1999)
Galinsoga parviflora – Mansfeld (1958), Fodor *et al.* (1971)
Hedypnois cretica – Suárez (2002)
Hedypnois polymorpha – Palacios *et al.* (1975)
Hieracium sp. – Jourdain (1948), Cramp & Simmons (1980), Gooch *et al.* (2015)
Hieracium aurantiacum – Gooch *et al.* (2015)
Hyoseris sp. – Jourdain (1948)
Hypochaeris (syn. *Hypohoesris*) sp. – Palacios *et al.* (1975), Cramp & Simmons (1980)
Hypochaeris (syn. *Hypohoeris*) *glabra* – Palacios *et al.* (1975)
Lactuca serriola – Bravo *et al.* (2012)
Lactuca viminea – Lane *et al.* (1999)
Lapsana communis – Gooch *et al.* (2015)
Leontodon sp. – Jourdain (1948), Glutz *et al.* (1973), Cramp & Simmons (1980)
Leontodon taraxacoides – Bravo *et al.* (2012)
Leontodon hispidus – Gooch *et al.* (2015)
cf. *Leucanthemum* – Palacios *et al.* (1975)
Leucanthemum vulgare – Gooch *et al.* (2015)
Mantisalca salmantica – Bravo *et al.* (2012)
cf. *Podospermum* sp. – Palacios *et al.* (1975), Cramp & Simmons (1980)
Podospermum laciniatum – Palacios *et al.* (1975)
Scolymus sp. – Palacios *et al.* (1975)
Scorzonera sp. – Dolgushin (1962), Isakov & Flint (1989), Bravo *et al.* (2016)
Senecio sp. – Palacios *et al.* (1975), Gooch *et al.* (2015)
Senecio vulgaris – Lane *et al.* (1999)
Sonchus sp. – Lucio (1985), Suárez (2002)
Sonchus arvensis – Lucio (1985)
Sonchus oleraceus – Glutz *et al.* (1973), Cramp & Simmons (1980), Lucio (1985), Suárez (2002), Bravo *et al.* (2016)

Tanacetum vulgare – Mansfeld (1958), Glutz *et al.* (1973), Cramp & Simmons (1980)
Taraxacum sp. – Palacios *et al.* (1975), Cramp & Simmons (1980), Lucio (1985), Isakov & Flint (1989), Lane *et al.* (1999)
Taraxacum officinale – Mansfeld (1958), Fodor *et al.* (1971), Glutz *et al.* (1973), Palacios *et al.* (1975), Lucio (1985), Bravo *et al.* (2012), Gooch *et al.* (2015), Bravo *et al.* (2016)
Thrinicia sp. – Palacios *et al.* (1975), Cramp & Simmons (1980)
Thrinicia hispida – Palacios *et al.* (1975)
Thrinicia hirta – Palacios *et al.* (1975)
Tolpis (Hieracium) barbata – Lane *et al.* (1999), Bravo *et al.* (2016)
cf. Tragopogon sp. – Dolgushin (1962), Palacios *et al.* (1975), Isakov & Flint (1989)
Tripleurospermum perforatum – Gooch *et al.* (2015)
Tubiflorae – Palacios *et al.* (1975)

Monocotyledonopsida

Colchicaceae

Muscari sp. – Bravo *et al.* (2016)
Muscari comosum – Lane *et al.* (1999)
Muscari racemosum (neglectum) – Palacios *et al.* (1975), Lane *et al.* (1999)
Ornithogalum umbellatum – Rörig (1900), Glutz *et al.* (1973), Cramp & Simmons (1980)

Alliaceae

Allium sp. – Glutz *et al.* (1973)
cf. Allium longicauspis – Dementiev & Gladkov (1951)

Juncaceae

Luzula sylvatica – Lucio (1985)

Poaceae (Gramineae) – Thaisz (1899), Sterbetz (1977), Cramp & Simmons (1980), Faragó (1981), Faragó & Csatári (1993), Bravo *et al.* (2012)

Aegilops sp. – Palacios *et al.* (1975), Bravo *et al.* (2016)
Aegilops ovata – Palacios *et al.* (1975)
Agropyron repens – Glutz *et al.* (1973), Cramp & Simmons (1980)
Aira caryophyllea – Palacios *et al.* (1975)
Antinoria agrostidea – Lane *et al.* (1999)
Avena fatua – Lucio (1985)
Avena sterilis – Bravo *et al.* (2016)
Brachypodium pinnatum – Lucio (1985)
Bromus sp. – Fodor *et al.* (1971), Lucio (1985), Lane *et al.* (1999), Bravo *et al.* (2016)
Bromus diandrus – Lane *et al.* (1999)
Bromus rubens – Lane *et al.* (1999)
Bromus squarrosus – Bravo *et al.* (2016)
Bromus tectorum – Palacios *et al.* (1975)
Cynodon dactylon – Bravo *et al.* (2016)
Dactylis glomerata – Lucio (1985)
Echinochloa crus-galli – Fodor *et al.* (1971)
Festuca sp. – Sterbetz (1977), Isakov & Flint (1989)
Festuca pseudovina – Fodor *et al.* (1971), Faragó & Csatári (1993)

- Hordeum asperum* – Lane *et al.* (1999)
Hordeum murinum – Fodor *et al.* (1971), Lane *et al.* (1999), Bravo *et al.* 2016
Lolium perenne – Lucio (1985)
Lolium rigidum – Bravo *et al.* (2016)
Mibora minima – Lane *et al.* (1999)
Phalaris sp. – Palacios *et al.* (1975), Lucio (1985)
 cf. *Phleum* sp. – Palacios *et al.* (1975)
Phleum pratense – Lane *et al.* (1999)
Poa sp. – Palacios *et al.* (1975), Lucio (1985)
Poa annua – Lucio (1985), Lane *et al.* (1999)
Poa bulbosa – Palacios *et al.* (1975), Lane *et al.* (1999)
Poa pratensis – Fodor *et al.* (1971), Lucio (1985)
Setaria sp. – Bodnár (1924)
Taeniatherum caput-medusae – Bravo *et al.* (2016)
Tragus recemosus – Dolgushin (1962)
Vulpia sp. – Palacios *et al.* (1975), Lane *et al.* (1999)
Vulpia myuros – Palacios *et al.* (1975), Lucio (1985)

Animal diet of Great Bustard

Annelida

Oligochaeta – Rocha *et al.* (2005)

Lumbricidae – Jourdain (1948), Gewalt (1959), Cramp & Simmons (1980)

Lumbricus terrestris – Fodor *et al.* (1971)

Arthropoda

Crustacea

Isopoda – Gewalt (1959), Cramp & Simmons (1980)

Chilopoda – Rocha *et al.* (2005)

Scolopendra sp. – Palacios *et al.* (1975)

Diplopoda – Rocha *et al.* (2005)

Julus sp. – Suárez (2002)

Insecta

Mantidea

Mantidae – Rocha *et al.* (2005)

Mantis sp. – Spangenberg (1951), Rjabov & Ivanova (1971), Bravo *et al.* (2012)

Mantis religiosa – Palacios *et al.* (1975), Suárez (2002)

Orthoptera

Acrididae – Spangenberg 1951, Dementiev & Gladkov (1951), Dolgushin (1962), Rjabov & Ivanova (1971), Palacios *et al.* (1975), Cramp & Simmons (1980), Rocha *et al.* (2005), Bravo *et al.* (2014)

Acheta sp. – Palacios *et al.* (1975)

Calliptamus italicus – Palacios *et al.* (1975), Isakov & Flint (1989)

Decticus verrucivorus – Gewalt (1959)

Gryllidae – Dolgushin (1962), Cramp & Simmons (1980), Rocha *et al.* (2005)

Gryllus campestris – Jourdain (1948), Spangenberg (1951), Gewalt (1959), Fodor *et al.* (1971), Sterbetz (1977)

Gryllotalpa gryllotalpa – Jourdain (1948), Spangenberg (1951), Gewalt (1959), Fodor *et al.* (1971), Palacios *et al.* (1975), Cramp & Simmons (1980)

Oedipodinae – Palacios *et al.* (1975)

Pachytylus migratorius – Spangenberg (1951), Fodor *et al.* (1971)

Platystolus surcularius – Palacios *et al.* (1975)

Tettigonidae – Jourdain (1948), Dementiev & Gladkov (1951), Rjabov & Ivanova (1971), Cramp & Simmons (1980), Isakov & Flint (1989), Rocha *et al.* (2005)

Tettigonia (syn. *Phasgonura*) *viridissima* – Gewalt (1959), Palacios *et al.* (1975), Sterbetz (1977)

Dermaptera – Jourdain (1948), Cramp & Simmons (1980)

Forficula sp. – Spangenberg (1951), Sterbetz (1977)

Forficula auricularia – Fodor *et al.* (1971)

Coleoptera – Dolgushin (1962)

Agriotes lineatus – Fodor *et al.* (1971)

Alleculidae – Bravo *et al.* (2016)

Amphimallon solstitialis – Gewalt (1959), Fodor *et al.* (1971), Sterbetz (1977)

Anisoplia sp. – Palacios *et al.* (1975)

Anisoplia austriaca – Kistjakinskij (1957)

Anomala sp. – Rörig (1900), Hennicke (1905)

Anomala vitis – Sterbetz (1977)

Apion sp. – Mansfeld (1958)

Aromia sp. – Jourdain (1948)

Aromia moschata – Hennicke (1905)

Asida sp. – Palacios *et al.* (1975), Lucio (1985)

Asidae – Palacios *et al.* (1975)

Blittophaga opaca – Mansfeld (1958)

Blittophaga undata – Rörig (1900), Mansfeld (1958), Gewalt (1959)

Brachycerus barbarus – Palacios *et al.* (1975), Suárez (2002)

Brachyderinae – Palacios *et al.* (1975)

Buprestidae – Rocha *et al.* (2005)

Calandrynae – Palacios *et al.* (1975)

Calosoma sp. – Jourdain (1948)

Calosoma sycophanta – Hennicke (1905)

Calosoma denticolla – Kistjakinskij (1957)

Cantharidae – Bravo *et al.* (2016)

Cantharis sp. – Suárez (2002)

Capnodis tenebricosa – Palacios *et al.* (1975)

Carabidae – Nečas & Hanzl (1956), Kistjakinskij (1957), Dolgushin (1962), Rjabov & Ivanova (1971), Palacios *et al.* (1975), Cramp & Simmons (1980), Isakov & Flint (1989), Lane *et al.* (1999), Rocha *et al.* (2005), Bravo *et al.* (2012), Bravo *et al.* (2016)

- Carabus* sp. – Rörig (1900), Hennicke (1905), Fodor *et al.* (1971)
Carabus auratus – Niethammer (1942), Gewalt (1959), Glutz *et al.* (1973)
Carabus nitens – Niethammer (1942), Gewalt (1959)
Cassida sp. – Jourdain (1948), Lucio (1985)
Cassida nebulosa – Rörig (1900), Hennicke (1905), Gewalt (1959)
Cassida subferruginea – Kistjakinskij (1957)
Cerambycidae – Dolgushin (1962), Rocha *et al.* (2005), Bravo *et al.* (2016)
Cetonia aurata – Huszthy (1781), Nečas & Hanzl (1956), Dolgushin (1962)
Chrysomela sp. – Lucio (1985)
Chrysomela banksi – Suárez (2002)
Chrysomela fastuosa – Gewalt (1959)
Chrysomela polita – Gewalt (1959)
Chrysomela sanguinolenta – Rörig (1900)
Chrysomelidae – Dolgushin (1962), Cramp & Simmons (1980), Lucio (1985), Lane *et al.* (1999), Rocha *et al.* (2005), Bravo *et al.* (2012), Bravo *et al.* (2016)
Cleonus sp. – Rörig (1900), Hennicke (1905), Bodnár (1924), Jourdain (1948)
Cleonus nigrivittis – Kistjakinskij (1957)
Cleonus piger – Glutz *et al.* (1973)
Cleonus punctiventris – Kistjakinskij (1957)
Coccinella septempunctata – Palacios *et al.* (1975), Lucio (1985), Suárez (2002)
Coccinellidae – Lane *et al.* (1999)
Coniocleonus sp. – Palacios *et al.* (1975), Suárez (2002)
Cryptocephalus sp. – Lucio (1985)
Cryptocephalus sericeus – Gewalt (1959)
Curculionidae – Hennicke (1905), Nečas & Hanzl (1956), Dolgushin (1962), Rjabov & Ivanova (1971), Palacios *et al.* (1975), Cramp & Simmons (1980), Lucio (1985) Isakov & Flint (1989), Lane *et al.* (1999), Rocha *et al.* (2005), Bravo *et al.* (2012), Bravo *et al.* (2014), Bravo *et al.* (2016)
Cycloderes sp. – Palacios *et al.* (1975), Suárez (2002)
Dorcadion aethiops – Fodor *et al.* (1971), Sterbetz (1977)
Dorcadion fulvum – Nečas & Hanzl (1956), Fodor *et al.* (1971), Sterbetz (1977)
Dytiscus sp. – Jourdain (1948)
Elater sp. – Jourdain (1948)
Elateridae – Chernel (1899), Hennicke (1905), Mansfeld (1958), Gewalt (1959), Palacios *et al.* (1975)
Epuraea sp. – Lucio (1985)
Erodiinae – Palacios *et al.* (1975)
Eusomus sp. – Bodnár (1924)
Geotrupes sp. – Rörig (1900), Hennicke (1905), Jourdain (1948), Palacios *et al.* (1975)
Geotrupes cf. stercorarius – Palacios *et al.* (1975)
Geotrupes laevigatus – Suárez (2002)
Geotrupinae – Dolgushin (1962), Isakov & Flint (1989)
Haltica sp. – Jourdain (1948)

Haltica oleracea – Hennicke (1905)

Helopatus sp. – Lucio (1985)

Helopinae – Palacios *et al.* (1975)

Histeridae – Lane *et al.* (1999)

Hister fimetarius – Glutz *et al.* (1973)

Hypera sp. – Palacios *et al.* (1975), Suárez (2002)

Hylobiinae – Palacios *et al.* (1975)

cf. Labidostomis sp. – Palacios *et al.* (1975)

Lachnaea sexpunctata – Palacios *et al.* (1975)

Larinus sp. – Palacios *et al.* (1975)

Larinus buccinator – Suárez (2002)

Leptinotarsa decemlineata – Gewalt (1959), Fodor *et al.* (1971), Glutz *et al.* (1973), Sterbetz (1977), Cramp & Simmons (1980)

Leucosomus pedestris – Nečas & Hanzl (1956)

Meloë sp. – Vasvári (1942), Nečas & Hanzl (1956), Kistjakinskij (1957), Palaus Soler (1960), Dolgushin (1962), Palacios *et al.* (1975), Lucio (1985)

Meloë collaris – Lucio (1985)

Meloë (syn. *Physomeloe*) *corallifer* – Palacios *et al.* (1975), Lucio (1985)

Meloë hungarus – Greschik (1939)

Meloë (syn. *Berberomeloe*) *majalis* – Entz (1904), Palacios *et al.* (1975), Lucio (1985), Suárez (2002), Sánchez-Barbudo *et al.* (2012)

Meloë proscarabeus – Vasvári (1942), Palacios *et al.* (1975)

Meloë rugosus – Vasvári (1942)

Meloë tuccius – Palacios *et al.* (1975), Suárez (2002)

Meloë variegatus – Vasvári (1942), Lucio (1985)

Meloë violaceus – Greschik (1939), Vasvári (1942), Lucio (1985)

Meloë violaclur – Vasvári (1942)

Meloidae – Palacios *et al.* (1975), Lane *et al.* (1999), Rocha *et al.* (2005), Bravo *et al.* (2014), Bravo *et al.* (2016), Heneberg (2016)

Melolontha sp. – Jourdain (1948)

Melolontha melolontha – Nečas & Hanzl (1956), Mansfeld (1958), Fodor *et al.* (1971), Glutz *et al.* (1973), Sterbetz (1977)

Melolonthinae – Isakov & Flint (1989)

Melyridae – Lane *et al.* (1999), Rocha *et al.* (2005)

Microlarinus sp. – Suárez (2002)

Micrositus sp. – Lucio (1985)

Mylabris quadripunctata – Kistjakinskij (1957)

Nitidulidae – Rocha *et al.* (2005)

Opatrum sabulosum – Fodor *et al.* (1971), Sterbetz (1977)

Otiorrhynchus sp. – Rörig (1900), Hennicke (1905), Bodnár (1924), Jourdain (1948)

Oxythyrea funesta – Palacios *et al.* (1975)

Phalacridae – Rocha *et al.* (2005)

Phylam sp. – Lucio (1985)

Phyliam abbreviatus. – Lucio (1985)

Phytodecta formicata – Fodor *et al.* (1971)

Phytodecta variabilis – Suárez (2002)

Phytonomus variabilis – Fodor *et al.* (1971)

Pimelia sp. – Palaus Soler (1960), Palacios *et al.* (1975), Suárez (2002)

Pimelia rugulosa – Palacios *et al.* (1975)

Pimelia baetiva – Lucio (1985)

Pimelia punctata – Lucio (1985)

Psilothrix cyaneus – Palacios *et al.* (1975)

Rhizortogus aequinoctialis – Fodor *et al.* (1971)

Rhynchiitinae – Palacios *et al.* (1975)

Rhytidoderes sp. – Palacios *et al.* (1975)

Scarabaeidae – Cramp & Simmons (1980), Lucio (1985), Lane *et al.* (1999), Rocha *et al.* (2005), Bravo *et al.* (2012), Bravo *et al.* (2014), Bravo *et al.* (2016)

Scarabaeus sp. – Fodor *et al.* (1971), Sterbetz (1977)

Sepidium bidentatum – Palacios *et al.* (1975), Lucio (1985)

Silpha sp. – Jourdain (1948), Suárez (2002)

Silpha atracta – Hennicke (1905)

Silpha obscura – Gewalt (1959)

Silpha reticulata – Hennicke (1905)

Silphidae – Cramp & Simmons (1980)

Staphylinidae – Palacios *et al.* (1975), Lane *et al.* (1999), Rocha *et al.* (2005)

Staphylinus sp. – Suárez (2002)

Stenus sp. – Suárez (2002)

Subcoffinella vigintiquatuorpunctata – Fodor *et al.* (1971)

Tenebrionidae – Dolgushin (1962), Rjabov & Ivanova (1971), Palacios *et al.* (1975), Cramp & Simmons (1980), Lucio (1985), Isakov & Flint (1989), Lane *et al.* (1999), Rocha *et al.* (2005), Bravo *et al.* (2012), Bravo *et al.* (2012), Bravo *et al.* (2014), Bravo *et al.* (2016)

Tentyria sp. – Suárez (2002)

Tentyria bassil – Lucio (1985)

Timarcha sp. – Suárez (2002)

Tropinota hirta – Palacios *et al.* (1975), Lucio (1985)

Tropinota squalida – Suárez (2002)

Zabrus tenebrioides – Fodor *et al.* (1971), Sterbetz (1977)

Zonabris (Mylabris) sp. – Palacios *et al.* (1975)

Hymenoptera

Formica sp. – Palacios *et al.* (1975)

Formicidae – Dementiev & Gladkov (1951), Fodor *et al.* (1971), Isakov & Flint (1989), Rocha *et al.* (2005), Bravo *et al.* (2012), Bravo *et al.* (2014), Bravo *et al.* (2016)

cf. Braconidae – Palacios *et al.* (1975)

Diptera – Jourdain (1948), Bravo *et al.* (2012), Bravo *et al.* (2016)

Brachycera – Palacios *et al.* (1975)

Musca sp. – Gewalt (1959)

Lepidoptera – Rjabov & Ivanova (1971), Palacios *et al.* (1975), Cramp & Simmons (1980), Rocha *et al.* (2005), Bravo *et al.* (2012), Bravo *et al.* (2016)

Agrestis sp. – Bodnár (1924)

Cucullinae – Palacios *et al.* (1975)

Hyles (syn. *Deilephila*, *Celerio*) *euphorbiae* – Gewalt (1959)

Hamestra sp. – Bodnár (1924)

Noctuidae – Gewalt (1959), Palacios *et al.* (1975)

Noctuinae – Palacios *et al.* (1975)

Papilio machaon – Gewalt (1959)

Pieridae – Gewalt (1959), Palacios *et al.* (1975)

Pieris brassicae – Gewalt (1959)

Hemiptera – Bravo *et al.* (2014)

Heteroptera – Hennicke (1905), Niethammer (1942), Gewalt (1959)

Carpocoris fuscispinus – Suárez (2002)

Eurydema sp. – Fodor *et al.* (1971), Sterbetz (1977), Lucio (1985)

Eurydema ornatum – Suárez (2002)

Eurygaster sp. – Fodor *et al.* (1971), Sterbetz (1977), Lucio (1985)

Eurygaster austriaca – Suárez (2002)

Eurygaster maura – Kistjakinskij (1957), Suárez (2002)

Nabis sp. – Suárez (2002)

Pentatomidae – Palacios *et al.* (1975), Bravo *et al.* (2016)

Reduvius personatus – Suárez (2002)

Scutellaridae – Glutz *et al.* (1973)

Stolia sp. – Suárez (2002)

Homoptera – Isakov & Flint (1989)

Arachnoidea

Areaneidea – Jourdain (1948), Gewalt (1959), Dolgushin (1962), Palacios *et al.* (1975), Bravo *et al.* (2012), Bravo *et al.* (2016)

Araneae – Rocha *et al.* (2005)

Solifuga – Rocha *et al.* (2005)

Mollusca

Gastropoda

Agriolimax agrestis – Jourdain (1948), Fodor *et al.* (1971), Cramp & Simmons (1980)

Helix pomatia – Fodor *et al.* (1971), Cramp & Simmons (1980)

Vertebrata

Amphibia – Jourdain (1948), Cramp & Simmons (1980)

Hyla arborea – Gewalt (1954), Rjabov & Ivanova (1971)

Bufo viridis – Rjabov & Ivanova (1971)

Rana arvalis – Gewalt (1954)

Reptilia – Jourdain (1948), Dementiev & Gladkov (1951), Dolgushin (1962), Cramp & Simmons (1980)

Lacerta sp. – Spangenberg (1951), Nečas & Hanzl (1956)

Lacerta agilis – Rjabov & Ivanova (1971)

Podarcis hispanicus – Gil-Lletget (1945)

Aves – Spangenberg (1951), Fodor *et al.* (1971)

Alauda arvensis – Chernel (1899), Jourdain (1948), Cramp & Simmons (1980)

Alaudidae juv. – Dolgushin (1962)

Melanocorypha yeltonensis juv. – Dementiev & Gladkov (1951), Spangenberg (1951)

Motacilla flava juv. – Rjabov & Ivanova (1971)

Numenius arquata ov. – Gewalt (1954), Cramp & Simmons (1980)

Oenanthe oenanthe juv. – Rjabov & Ivanova (1971)

Mammalia

Lagurus lagurus – Glutz *et al.* (1973)

Lepus europaeus (juv.) – Jourdain (1948), Fodor *et al.* (1971), Cramp & Simmons (1980)

Microtus arvalis – Chernel (1899), Gewalt (1959), Cramp & Simmons (1980)

Microtus agrestis – Jourdain (1948)

Microtus (syn. *Pitymys*) *duodecimcostatus* – Palacios *et al.* (1975)

Microtus socialis – Dolgushin (1962)

Muridae – Dolgushin (1962), Rjabov & Ivanova (1971), Sterbetz (1977)

Mus sp. – Fodor *et al.* (1971)

Other ingredients in the stomach of Great Bustard

For digestion, the Great Bustard swallows pebbles and quartz pieces so-called *gastrolits* even as chicks. Besides, Hennicke (1905) mentioned coins, Gewalt (1959) mentioned metal pieces and relatively large pieces of rubber. According to Nečas and Hanzl (1956), some other indigestible objects such as glass splinters, pieces of china also occur in the Great Bustard's stomach regularly. According to Moltoni (1968) in the county of Vicenza, Italy, the stomach of a shot-down young male Great Bustard also included a piece of ceramics, and a strongly corroded German 2 Pfennig coin. Sterbetz (1977) found gastrolits in the stomach of three bustards out of 16. In one of these, there was a tile fragment with three cm diameter, in the other there were 2 pebbles of 6 and 10 mm and in the last one a pebble of 30 mm showed up. We conclude that the gastrolits assist in digestion by the fragmentation of the food.

Discussion

We have detected 272 plant and 217 animal, altogether 489 taxa as Great Bustard diet based on data received from 9 (10) countries for *Otis tarda tarda* area: (Portugal, Spain, United Kingdom, Germany, Austria, Slovakia, Hungary, Ukraine, Kazakhstan, former Soviet Union). Out of 272 plant taxa, there were 40 cultivated plants, 232 wild plants and weeds. From the latter, 43 taxa were monocotyledons and 189 were dicotyledons.

The families of wild plants and weeds taken, in succession were as follows: dicotyledons (30 families) – Asteraceae/Compositae (59 taxons), Fabaceae/Papilionaceae (26), Brassicaceae

(22), Caryophyllaceae (11), Apiaceae/Umbelliferae (9), Boraginaceae (8), Polygonaceae (5), Plantaginaceae (5), Chenopodiaceae (4), Geraniaceae (4), Scrophulariaceae (4), Rubiaceae (4), Dipsacaceae (3), Ranunculaceae (2), Papaveraceae (2), Rosaceae (2), Primulaceae (2), Convolvulaceae (2), Lamiaceae/Labiatae (2), Fagaceae (2), Amaranthaceae (1), Resedaceae (1), Linaceae (1), Euphorbiaceae (1), Malvaceae (1), Onagraceae (1), Plumbaginaceae (1), Solanaceae (1), Orobanchaceae (1), Valerianaceae (1), Campanulaceae (1). Monocotyledons (4 families) – Poaceae/Gramineae (36 taxa), Colchicaceae (4), Alliaceae (2), Juncaceae (1).

Animal food is shared among Annelida (3 taxa), Arthropoda (189) Mollusca (2) and Vertebrata (23) phyla. Arthropods are mostly represented with Insecta (181), Arachnoidea (3), Chilopoda (2), Diplopoda (2), and Crustacea (mostly Isopoda) (1) classes.

The orders of Insects based on the regularity of taxon-numbers are as follows: Coleoptera (134), Orthoptera (12), Lepidoptera (10), Hemiptera (13), Mantidea (3), Dermaptera (3), Hymenoptera (3), Diptera (2), Homoptera (1).

The phylum of Vertebrates is represented by all the four terrestrial classes: Mammalia (8 taxa), Aves (7), Amphibia and Reptilia (4–4).

Considering the high number of 489 taxa taken as food, we definitely *need to regard Great Bustard as a generalist species*. The Bustard's great adaptation ability is the base and evidence of the wide spectrum of the consumed plant and animal taxa.

The cited, detailed publications also have shown that the volume of certain taxa in total, seasonally and also in various age-groups were different. This means that the inner rates of diet components constantly change.

Young Great Bustard chicks, but even older ones, consume fresh shoots, crops and seeds of plants. During the period of reproduction of female Great Bustards, „grazing” cannot be observed, which in contrast, is a characteristic type of behaviour in males. However, they consume more insects. During mating season, male Great Bustards feed on animals in a large proportion. Hens can very often digest rough plant parts and seeds. They defecate them even without digestion (Gewalt 1959).

In Spain, according to the examinations of Palacios *et al.* (1975), 90.2% of the volume of *spring* was plant food. Most of plant diet was represented by the families of Compositae/Asteraceae (51.3%), a Fabaceae (11.4%), a Cruciferae/Brassicaceae (11.4%) and Gramineae/Poaceae (9.3%). In diet composition made up by Arthropoda, coleopterans (Scarabaeidae, Curculionidae, Tenebrionidae and from the Meloidae family) dominated by 95.50%. In the *summer diet*, the importance of green plant parts was decreasing, however, seeds of grains and Arthropods increased (Mantidae, Orthoptera and Formicidae). In the *autumn* aspect, comparing the summer one, there was no significant difference, but the consumption of cultivated plants was increasing. The rate of Orthoptera in the diet remained unchanged at the same time (Locustidae, Gryllidae), just like in the case of Hymenoptera (Formicidae). In the *winter* period, similarly to that of spring, the green plant parts dominated, though the animal diet was practically missing.

Based on the investigation of stomach content and summer/winter faeces, Lucio (1985) analysed the diet of Great Bustard, collected at the Duero Basin. During the whole year, alfalfa played an important role, though at the end of summer and in winter the seeds of winter wheat and winter barley, grapes and Papilionaceae dominated the diet. Besides cultivated

plants, he detected the presence of 35 species belonging to the following families: Compositae/Asteraceae (8 species), Gramineae/Poaceae (8 species), Cruciferae/ Brassicaceae (6 species), Boraginaceae (3 species), Caryophyllaceae (2), Ranunculaceae (2), Plantaginaceae (1), Euphorbiaceae (1), Scrophulariaceae (1), Umbelliferae (2) és Juncaceae (1). In the *spring* season, most of the animal food in the investigated stomachs was Coleoptera (97.16%) – within that mostly Tenebrionidae, Meloidae, Chrysomelidae – and Heteroptera. Out of the faeces collected during the *summer* period, coleopteras, hymenopteras and heteropteras were shown to be present with 20–47% frequency, though in *winter* Arthropoda was only possible to make out in one out of ten faeces.

The diet spectrum of a Northwest Spanish Great Bustard population was analysed based on faeces investigation by Lane *et al.* (1999). The analysis considering the data of the whole year, detected 65 plant species – some of them lacking in earlier analyses – in the course of consumption of summer, winter and autumn. The ratio of green plant parts referring to dry material was 48.4%, and seeds in August 10.6%. In the second half of summer, there were seeds of winter wheat and winter barley in the faeces. In the course of the whole year, alfalfa was the most chosen food component and types of grass were preferred to a lesser extent only. Besides plant food, the specimens of 8 Insect orders were found in the faeces, out of which Coleoptera, Hymenoptera and Orthoptera were available in the largest number and ratio. They consumed coleopteras during the whole year although orthopteras were eaten, in a smaller amount than they were disposable. Hymenopteras in May were of less significant, they were consumed mostly in September and November.

Based on the investigation of stomach content of young bustards, Bravo *et al.* (2012) concluded, that diet – referring to dry material – was 33% arthropods, 30% green plant material and 23% seed. Gastrolits in stomachs were only be found in summer and autumn. Food components changed by aspects. In summer, they consumed mostly arthropods (50%), green plant parts mostly in wintertime (56%). The volume and the average size of the Arthropod component – in the case of males – were larger than that of females, but there was no significant difference between sexes. In winter, weeds, Papilionaceae, seeds of cultivated plants dominated, although grain types were preferably consumed and the seeds of these (wheat, barley) were of great importance during autumn and winter.

Based on faeces samples of 299 hens and 320 cocks, Bravo *et al.* (2016) investigated if there was a sex-specific difference between the food spectrum, diversity and the degree of overlaps of food spectra and size of Arthropod preys, working at 9 Spanish Great Bustard sites. They confirmed that both sexes were mainly herbivorous and they particularly consumed papilionaceous plants, if available. Males fed on less Arthropod diet than females, but at the same time, the size of those are significantly larger than in the case of females. The diet of males shows a bigger diversity than that of the hens, though except for the period after mating. The overlap in food between sexes was found to be 0.7, which is one of the smallest rates in the case of birds. The investigation has shown that in relation with the sexual dimorphism of particular scales, the difference between the sexes' dietary niche can be explained by the dissimilar reproduction role of Great Bustard males and females.

In southwest England, Gooch *et al.* (2015) examined the diet of the reintroduced Great Bustards on free territories, both in the time of without feeding and in the time of supplementary

feeding (October-December). In the course of the investigation of the faeces sample, they used the method of microhystology. The ingredients of the food were formed in the function of plant availability and the period of phenology. Animals of lower orders were rarely made evident as food. The main food were green part and seeds of cultivated plants such as rape, mustard, barley, at the same time the monocyledonous and dicotyledonous weeds were only of second importance (25%).

Benchmark investigations were made in Kazakhstan (Rjabov & Ivanova 1971) – adult (n = 25) and juveniles (n = 12) birds – analysing stomach content. Among the listed taxa, there were 25 plant species; considering one stomach, it was usually dominated by 2–3 species and 25 specimens, on average.

The great value of the investigation is that it provided the relations of volume as well. Accordingly, in the case of adult birds the relation of animal and plant food was found to be 37.8 : 62.2 volume %, though in the case of chicks it is 96.5 : 3.5 volume %. They have shown that from May to August, Great Bustards shifted from the dominance of plant materials to insect food, gradually. One of the reasons of this is that in nature, the availability of insects is increasing and that of plant decreasing, however, before migration (on the investigated area the Great Bustard is a regular migratory bird) the organism is required to accumulate protein and fat. At the same time, there is an interesting statement by declaring that with the increase of nutritional value, the fullness rate of the stomach was decreasing. *The Great Bustard's ability to subsidize the inefficient quality of food with quantity is regarded to be positive adaptation ability by the authors.* When the bird consumes food of low energy value (plants) it consumes a large quantity of that. From food of big nutritional value they consume only moderately. The mixed food makes it possible for Great Bustards to turn from food of one type into another one and they are capable of doing so quite quickly. The animal food for Great Bustards contains protein of 13–30%, though in the case of plants it is 3.5–5.3%. By aging, protein consumption for the body volume is decreasing; at the end of growing protein consumption nearly stops and in the case of adult specimens nitrogen-balance comes into place. It might be observed that out of the feeding birds with different ages, younger ones rather have animal, older ones plant food. The diversified component of these diet guarantees all the amino-acids needed for protein-synthesis.

To summarize, we can declare that in the food of young Great Bustards animal food, in the older ones plant food is dominating. *The component of diet is possibly not related to selection, rather to the abundance of it and the change of availability receptively to the ever present demand for animal food.*

Simultaneously, it is important to conclude that it can be explained with a wide plant and animal food spectrum (richness) that Great Bustards even in intensive agricultural habitats can find food with indispensable quantity and quality. This is improved by the fact that neither in Europe (Kollar 1996, Nagy 2009, Alonso 2014) nor regional (Kollar 2001, Faragó 2004, Bankovics 2005, Alonso & Palacín 2009, Spakovszky *et al.* 2011, Raab *et al.* 2014, Vadász & Lóránt 2014, Faragó 2018) level can we find the lack of food among the endangering factors for the globally threatened species as opposed e.g. to Grey Partridge (*Perdix perdix*) for instance (Potts 1986, 2012).

Request

Neither the resource list nor the diet list gained from it can be complete, so the author wishes to be informed about references concerning missing data.

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