NEW CRITERIA FOR AWARDING MEDALS TO GOLDEN JACKAL TROPHIES

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Abstract

Hunting exhibitions are valuable sources of morphometric data. Although considering only two craniometric measurements, i.e. maximum length and zygomatic breadth, a huge data base has been created. Trophies from almost all predator species are presented at hunting exhibitions and measured, thus making it possible to collect much more craniometric data in addition to the standard trophy evaluation. However, the CIC (Conseil International de la Chasse) have firmly established and appropriate criteria for awarding medals for only a very few carnivore species. Golden jackal (*Canis aureus* Linnaeus, 1758) is hunted as a game species in many European countries, following its ongoing expansion, but still very few trophies are presented and measured at hunting exhibitions. Often different criteria have been applied for awarding medals to jackal trophies decided on an *ad hoc* basis by the evaluation committees. Recently, new criteria for awarding jackal trophies were officially adopted by CIC in the latest edition of the Handbook for the Evaluation and Measurement of Hunting Trophies. However, not so many trophies of jackal skulls were measured since then and it seems that these criteria are determined arbitrarily and are not based on research or large amounts of data. Bulgarian territory is considered the core area of Golden jackal distribution in Europe with the highest population density, but morphometric studies, including skulls from Bulgaria, are very scarce and local so far. In the present research an extensive morphometric data of jackal skulls from Bulgaria and Romania was analysed to suggest and justify new criteria for awarding medals to jackal trophies. Statistical distribution of trophy scores was approximated by normal distribution with mean and variance calculated from the large Bulgarian sample. According to the results, gold medals must be awarded to a trophy scoring 27.00 CIC points and above, silver – from 26.50 to 26.99 and bronze – from 26.00 to 26.49.

Key words: *Canis aureus*, CIC scores, cranial variability, hunting exhibitions, skull morphometry, trophy.

Introduction

Golden jackal (*Canis aureus* Linnaeus, 1758) is one of the most widely distributed canid species and is found in many areas of Europe and Asia (Jhala and Moehlman 2004, Arnold et al. 2012, Hoffmann et al. 2018, Moehlman and Hayssen 2018, Spassov and Acosta-Pankov 2019). Since the 1980s, jackals have increased in their distribution and abundance in what is arguably the most dramatic recent expansion among native predators on the continent (Jhala and Moehlman 2004, Šálek et al. 2014, Koepfli et al. 2015, Trouwborst et al. 2015). The jackal expansion in the last

two decades has been rapid and is still on-going. Jackals have spread into Switzer-land, Lichtenstein, Germany, Denmark, Poland, France, Netherlands, Belarus, Ukraine, Baltic states and, in 2019, also to Finland (Pyšková et al. 2016, Volokh and Roženko 2016, Krofel et al. 2017, Potočnik et al. 2019). The ongoing expan-sion of the species in Europe has caused concerns regarding the possible negative effects that its presence could exert, due to excessive predation of other wildlife species or livestock, and the transmis-sion of pathogens (Rutkowski et al. 2015, Ćirović et al. 2016). In addition, there are several uncertainties regarding jackal management and policies, often in asso-ciation with the unknown origins of jack-al populations (Trouwborst et al. 2015). Nowadays Golden jackal is hunted as a game species in Austria, Bulgaria, Bosnia and Herzegovina, Montenegro, Estonia, Latvia, Lithuania, Hungary, Moldova, Po-land, Romania, Russia, Slovakia, Slove-nia, Serbia, Turkey and Ukraine (Potočnik et al. 2019), but still very few trophies are presented and measured at hunting exhi-bitions. Jackal expansion in the last de-cades has triggered research interest in Europe. However, very few studies have focused on cranial variability of Golden jackal in Europe (Kryštufek and Tvrtković 1990, Stoyanov 2012, Volokh and Rožen-ko 2016, Markov et al. 2017, Rezić et al. 2017, Krendl et al. 2018, Stoyanov 2019, Stoyanov 2020), despite its wide distribu-tion in recent decades.

Natural history collections are valuable source of morphometric data. However, for many game species in Bulgaria like Grey wolf (*Canis lupus* Linnaeus, 1758), Golden jackal and Red fox (*Vulpes vulpes* (Linnaeus, 1758)), a big part of skulls is stored in hunters' private trophy collec-tions, and such data remains hidden and inaccessible to researchers. Hunting ex-hibitions provide good opportunities for scientists to collect such data, but hunt-ers should be motivated to present their trophies. The idea to evaluate hunting trophies of carnivore species came for the first time in Florence in 1964, where skulls of Brown bear (*Ursus arctos* Lin-naeus, 1758) were measured, and data collection started (Ninov 2015). In all the exhibitions conducted so far, the skulls of 19 species and 5 subspecies of car-nivores were evaluated (Hromas 1998). Although considering only two craniomet-ric measurements, i.e. maximum length and zygomatic breadth, a huge data base was created exceeding in the number of measured skulls all the world's natural history collections. Initially, only the skulls of Brown bear, Grey wolf and European wildcat (*Felis silvestris* Schreber, 1777) were evaluated. Nowadays, hunting tro-phies from almost all predator species are presented at hunting exhibitions and mea-sured, thus making it possible to collect much more craniometric data in addition to the standard trophy evaluation. More-over, estimating the age of animals by up-per incisive teeth wear (Lombaard 1971) or by counting the annual cementum lay-ers in canines (Klevezal and Kleinenberg 1967) provides valuable data on popula-tion demography. Although the skulls of all carnivore game species are presented and evaluated at hunting exhibitions, not for all of them CIC (Conseil International de la Chasse) have firmly established and appropriate criteria for awarding medals, as they had been developed and accept-ed for Brown bear, Grey wolf and Europe-an wildcat. In the most popular 'Blue book' of CIC, where criteria for awarding medals were published (Whitehead et al. 1986), such criteria are missing for the Golden jackal and many other carnivore species.

A Jackal skull from Africa was first presented, but not evaluated, at an exhibition in 1954 in Düsseldorf. For the first time Golden jackal trophies were evaluated and awarded medals by certain criteria at the 1996 hunting exhibition in Novi Sad (Ninov 2015). Most often during the hunting exhibitions different criteria have been applied for awarding medals decided on an *ad hoc* basis by the evaluation committees. Such criteria are usually determined arbitrarily and are not based on research or a large database. Angelescu (2004), in his monograph on Golden jackal in Romania, proposed criteria for awarding jackal trophies, which were officially adopted by CIC in the latest edition of Handbook for the Evaluation and Measurement of Hunting Trophies (Crombrugghe et al. 2014) that replaced the old 'Blue book'. In Plovdiv (2013) only 25 Golden jackal skulls were measured and received 10 gold, 3 silver and 5 bronze medals, according to these criteria. However, not so many trophies of Golden jackal skulls were measured since then and it seems that these criteria are determined arbitrarily and are not based on large database either. Still more research is needed.

Bulgarian territory is considered the core area of golden jackal distribution in Europe with the highest population density (Stoyanov 2013, Spassov and Acosta-Pankov 2019), but morphometric studies, including skulls from Bulgaria, are very scarce and local so far (e.g. Markov et al. 2017, Krendl et al. 2018). In the most comprehensive recent morphometric research in Bulgaria an extensive morphometric data of jackal skulls was analysed (Stoyanov 2019) and this database was used in the present study to suggest and justify new criteria for awarding medals to Golden jackal trophies.

Material and Methods

A total of 210 skulls of Golden jackal, 137 from Bulgaria and 73 from Romania were analysed. The Bulgarian sample comprised of 73 specimens, collected between 1998 and 2007 from 20 different sites all over the country, but most of them coming from three main regions with the jackal's highest population density: Yambol, Veliko Tarnovo and Burgas. It also included 36 skulls, collected by Stoyan Vassilev in the end of 1980s, 12 specimens from the scientific collection of the National Museum of Natural History dating back to the last century, and 18 skulls, collected between 2005 and 2012, measured at a national trophy exhibition in 2013. Most of skulls are with known sex, but 11 skulls with unknown sex were also included. The age of jackals was determined by assessment of upper incisive teeth wear (Lombaard 1971) and for some individuals also by counting the annual cementum layers in canines (Klevezal and Kleinenberg 1967). Both methods are reliable enough for the purposes of the study and provide accurate results, with precision up to one year for the first one (Harris et al. 1992, Raichev 2002). The skulls were assigned to three age groups: juveniles, subadults and adults. Juveniles were defined as individuals with fully developed second dentition, but less than 11 months of age, subadults as individuals older than 10 months, when they reach sexual maturity, but less than two years of age, and adults as two years and older. Skulls of juveniles were excluded from further analyses. For comparison 73 skulls from Romania (Angelescu 2004) were included. On each skull two measurements were taken by using digital sliding calliper, maximum length and zygomatic breadth (Fig. 1), corresponding to
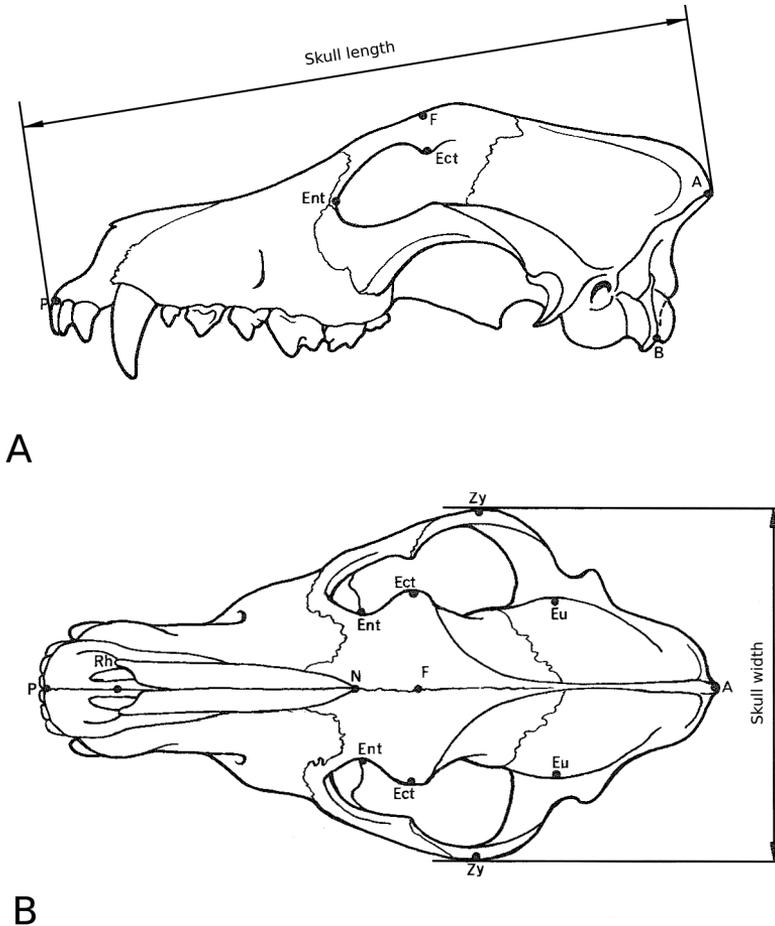
Fig. 1. Measurement parameters for trophy evaluation of carnivore skull
(Hromas 1998, Crombrugghe et al. 2014, Ninov 2015).
Note: A. *Canis* cranium, left side view; B. *Canis* cranium, dorsal view.

skull length and skull width, accordingly, following the rules for evaluation of carnivore trophies (Hromas 1998, Crombrugghe et al. 2014, Ninov 2015). According to these rules, skull length is measured between the foremost part of the teeth and Akrokranion, and skull width is the maximum breadth at the zygomatic arches (Zygion-Zygion). For a detailed description of craniometric measurements of *Canis* skull see von den Driesch (1976). Both measurements were taken with precision up to 0.1 mm. The CIC score of the trophy in points is the sum of both measurements in centimetres and is calculated with precision up to 0.01 points.

Statistical methods

All measurements and calculated trophy scores were tested for normality by QQ

plot and Shapiro-Wilk test. Distribution of trophy score for all measured skulls was approximated by normal distribution with mean and variance calculated from our sample. All statistical and graphical analyses were performed with R, version 3.6.1 (R Core Team 2019). For some graphics, software package 'lattice' (Sarkar 2008) was employed.

Ethics Statement

The skull samples used in this study were obtained from individuals that died in vehicle collisions, due to natural causes or as a result of legal hunting. Specimens from Natural history museum and private collections were measured as well. No animal was killed for the purpose of this study.

Results and Discussion

Comparison between Bulgarian and Romanian jackal trophies showed that the two samples had similar distribution (Fig. 2). However, the age of the animals was not known for the Romanian sample, and the presence of several Romanian trophies with a score below 23 points could
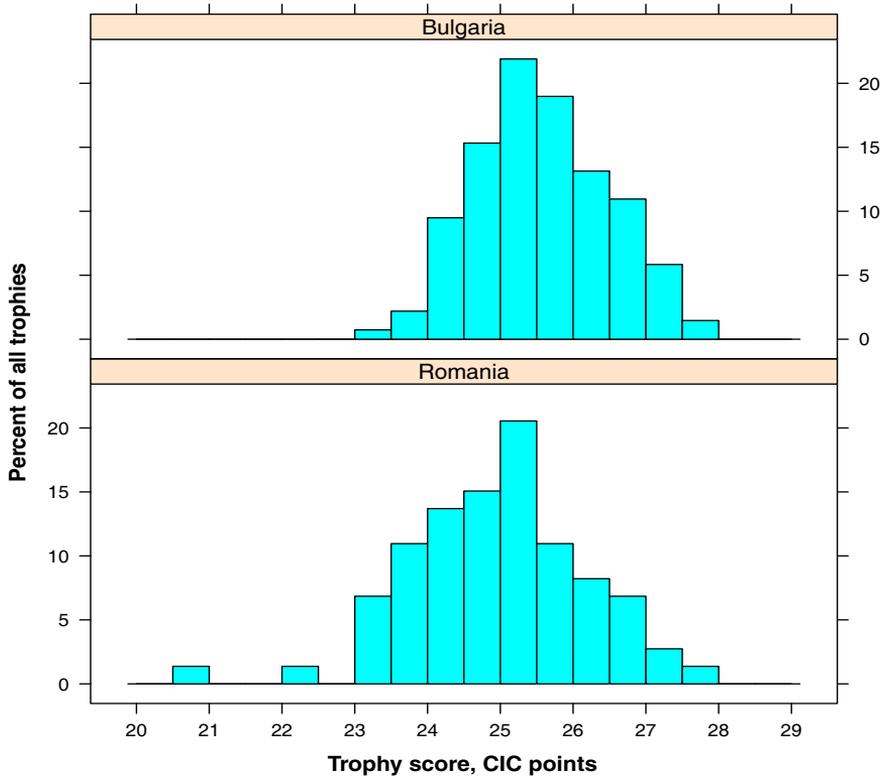
Fig. 2. Distribution of jackal trophies according to their CIC score.

be explained by the age-related differences in size of skulls. Recent morphometric research in Bulgaria (Stoyanov 2019) showed that the differences in shape and size of jackal skulls, as far as they exist, are age-related, but only juveniles, i.e. younger than 11 months, could be easily distinguished. According to the same study, subadult and adult jackals largely overlap in skull size and shape, and sexual dimorphism in jackal skulls is weakly pronounced, with older males having slightly larger skull than females. Hence Romanian sample was excluded from further analyses. Although subadult and adult jackals differ in zygomatic breadth, they were included in one sample, considering the CIC score of the trophy. Males and females were not divided either, because of slightly pronounced differences in size, but with a large overlap between sexes (Stoyanov 2019).

Shapiro-Wilk test and QQ plot showed that the CIC trophy score did not deviate significantly from normal distribution (Fig. 3). Hence, we can approximate it by normal distribution with mean and variance calculated from our sample.
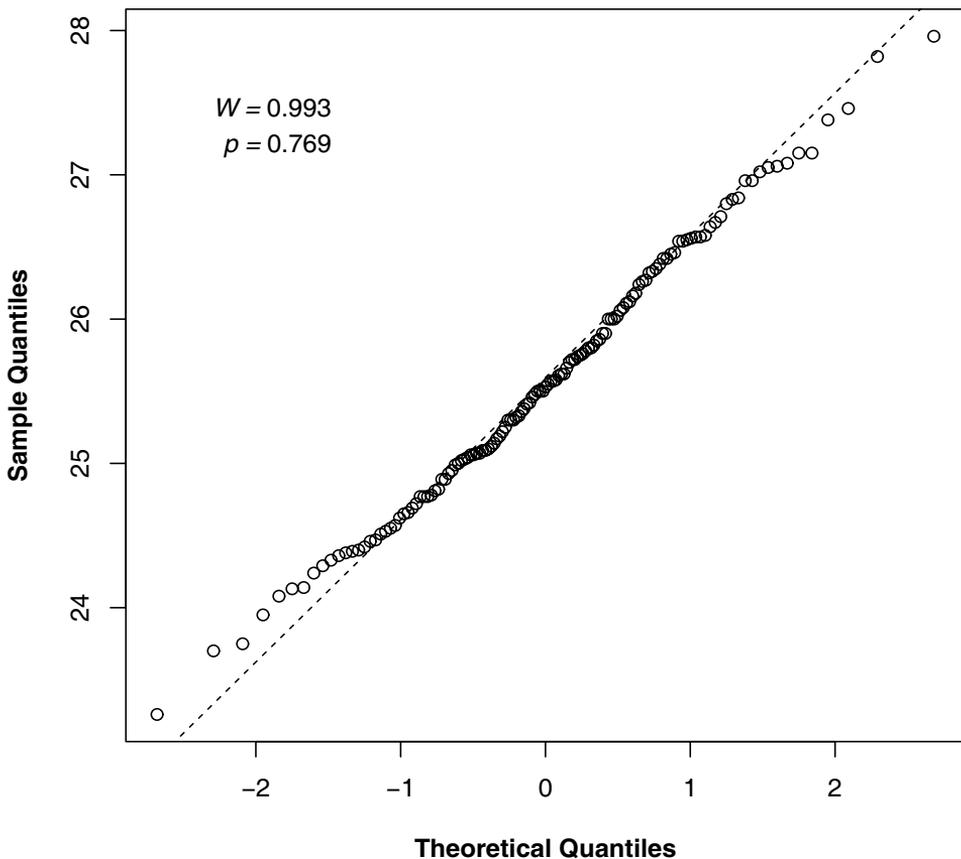

Fig. 3. Tests for normal distribution of CIC trophy score by QQ plot and Shapiro-Wilk test.
Note: W – test statistic, p – level of statistical significance.

The ranking of trophies and the awarding of medals can be compared with the evaluation in each field of activity, e.g. in academic grading, sport competitions etc. It is logical that the strongest 10 % of all trophies are considered the best. On the other hand, the lower limits of the criteria for awarding medals to trophies are usually related to integers or half of integers. During the first hunting exhibition where Golden jackal trophies were evaluated in Novi Sad (1996) and in Plovdiv (2013) with the largest number of evaluated jackal trophies so far, various criteria had been applied for awarding medals decided on an *ad hoc* basis by the evaluation committees (Table 1). According to the criteria used at the Novi Sad exhibition (1996), 6.7 % of jackals from our Bulgarian sample would receive a gold medal, 24.6 % – silver and 41.8 % – bronze, or a total of 73.1% of trophies would be awarded medals. According to the criteria proposed by Angelescu (2004), adopted by CIC, and applied at the trophy exhibition in Plovdiv (2013), 31.3 % of trophies would receive a gold medal, 19.4 % – silver and 22.4 % – bronze. Similar distribution of medals was shown for 19 trophies of male jackals from Ukraine, evaluated according to the present CIC criteria, 6 gold, 3 silver and 3 bronze medals, or 63 % of trophies would be awarded medals (Volokh 2018). The percentage distribution of trophy scores within fixed intervals allows us to determine which criteria are most appropriate for jackal trophies (Table 2).

Table 1. Criteria for awarding medals to Golden jackal trophy applied so far.

Hunting exhibition	Medal		
	Bronze	Silver	Gold
Novi Sad, 1996	25.00–25.99	26.00–26.99	27.00+
Plovdiv, 2013	25.00–25.49	25.50–25.99	26.00+

Note: The values in table cells show trophy scores for the respective medal.

Table 2. Empirical and theoretical distribution of Golden jackal trophy scores.

Sample	Trophy score, CIC points				
	25.00–25.49	25.50–25.99	26.00–26.49	26.50–26.99	27.00+
Bulgaria	22.4 %	19.4 %	13.4 %	11.2 %	6.7 %
Romania	20.5 %	11.0 %	8.2 %	6.8 %	4.1 %
Theoretical distribution[*]	20.6 %	21.5 %	16.5 %	9.4 %	5.5 %

Note: The values in table cells show the percent of all skulls falling within respective interval. [*]Normal distribution with mean and standard deviation based on our Bulgarian sample.

According to our results, new criteria for awarding medals should be adopted by CIC. We suggest that gold medal must be awarded to a trophy rated 27.00 CIC points and above, silver – from 26.50 to 26.99 and bronze – from 26.00 to 26.49 (Fig. 4).

If accepted by the CIC, 6.7 % of the analysed skulls in our sample would receive a gold medal, 11.2 % – silver and 13.4 % – bronze (Table 2), or just over 30 % of all trophies would be awarded a medal. The exact limits for the intervals depend on how many trophies should be awarded medals. If the experts of CIC and evaluation committees decide that more than 70 % of all trophies should be awarded, then the criteria applied in Novi Sad
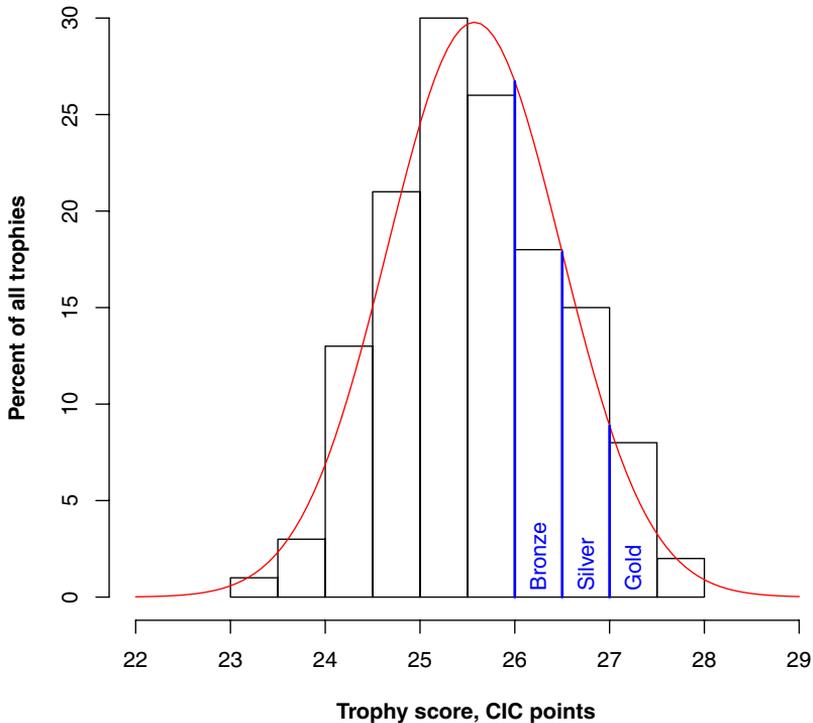
Fig. 4. Suggested new criteria for awarding medals to Golden jackal trophies.
Note: Bars represent the percent of trophies falling within each interval, according to their score in CIC points. The red curve represents theoretical normal distribution with mean and standard deviation calculated about trophy scores from Bulgarian sample.

(1996) could be adopted. According to the criteria used in recent exhibitions, more trophies are awarded a gold medal, than silver and bronze, which is not acceptable. If no more than 35 % of all trophies should be awarded medals, then the suggested criteria in the present study are the most appropriate.

Acknowledgements

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