
Large Predator Hunting and Its Interpretation: Leopards, Bears and Lions in the Archaeological Record of the Southern Levant

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In this paper, we discuss the occurrence of lions, bears and leopards in south Levantine archaeological assemblages between the last glacial maximum (c. 25,000 years ago) and the Iron Age (c. 2500 years ago). We argue that the occurrence of these large carnivores constitutes a significant long-term cultural feature that begins with the first settled hunter-gatherer communities of the Natufian culture. Importantly, we show that carnivoran species representation in the archaeological record shifts through time, with leopards common during the Neolithic and lions and bears during the Bronze and Iron ages. These shifts, we suggest, are best understood as reflecting the interplay between costly signalling and symbolism as they interacted through processes of increasing socio-political complexity.

Introduction

Faunal remains relate to numerous spheres of practice: diet, technology, environment, landscape exploitation, mobility patterns, social agency, and many more (e.g. Allsen 2006; Bar-Oz 2004; Cartmill 1993; Munro *et al.* 2016; Stiner 2002; Stiner & Kuhn 2009; Stiner *et al.* 2009). Leafing through hundreds of archaeozoological reports from the southern Levant, it is evident that herbivore mammals comprise the major component of faunal assemblages, with gazelle and fallow deer dominating the prehistoric archaeozoological record and sheep, goats and cattle later periods (Bar-Oz & Weissbrod 2017; Tsahar *et al.* 2009). From time to time, however, the odd bone of a lion, a bear, or a leopard is reported (e.g. Dayan *et al.* 1986; Kaplan & Ritter-Kaplan 1993; Wapnish & Hesse 2000). Until now, such rare carnivoran finds were treated as mere curiosities, because of their sparse representation when viewed at the scale of a single archaeological stratum, site, or even cultural period; single finds are often perceived as unable to support a grounded discussion of their significance. We would like to challenge

this view, and argue that if these rare traces seem insignificant, it is because they are observed in too narrow a temporal scale. We demonstrate that, when observed from a broad temporal perspective, clear patterns emerge with significant ideological and symbolic implications.

Our investigation consists of three parts. First, we hypothesize about the anthropological mechanisms that may have been responsible for the occurrence of large carnivoran bones in archaeological sites. Next, based on the review of more than 500 archaeozoological assemblages, we trace the temporal distribution of large carnivoran remains. Finally, we examine our hypotheses about the anthropological mechanisms at work against the temporal distributions of carnivore remains, seeking to produce an integrated account of the processes and mechanisms responsible for the observed patterns.

Setting the stage

Our discussion focuses on lions, leopards and bears. Our choice of these three large carnivores is due to their charismatic presence and visibility in ancient

Table 1. *The periodical timeframe examined.*

		Period		Chronology: cal. BC
Trans Egalitarian Societies	Pleistocene	Early–middle Epipaleolithic	Simple Hunter-Gatherers	23,000–13,000
		Late Epipaleolithic	Complex Hunter-Gatherers	13,000–9700
	Holocene	Pre-Pottery Neolithic A	Farmers-Hunters	9700–8500
		Pre-Pottery Neolithic B		8500–6900
		Pre-Pottery Neolithic C		6900–6300
		Pottery Neolithic	Farmers	6300–4700
Chalcolithic		4700–3700		
Urban/Early State Societies	Early Bronze Age	Urban/State Societies	3700–1950	
	Middle Bronze Age		1950–1550	
	Late Bronze Age		1550–1200	
	Iron Age		1200–586	

Near Eastern iconography (e.g. Allsen 2006; Beard 2020; Russell 2012; Russell & Meece 2006; Strawn 2005; Türkcan 2007). Other large, south Levantine carnivores are not considered here due to technical and substantive reasons: wolves are often difficult to distinguish from dogs, hyenas are strongly and negatively associated with scavenger niches (Orbach & Yeshurun 2019) and cheetahs (*Acinonyx jubatus*) are too few to warrant an analysis (e.g. Richardson 1997).

Anchored in the southern Levant, our study unfolds in the *longue durée*. It spans the Last Glacial Maximum and the Iron Age, incorporating four major socio-cultural chapters of human history (Table 1). The first chapter encompasses the early and middle Epipaleolithic (c. 25,000–15,000 BP), when mobile hunter-gatherers occupied open-air camps for short durations (Goring-Morris 2017; Maher *et al.* 2012). Hunted ungulates and smaller animals were the staples of their animal economies (e.g. Bar-Oz 2004). The second chapter in our sequence encompasses the late Epipaleolithic Natufian culture (Stage 2a: 15,000–11,500 BP), attributed to complex hunter gatherers (Belfer-Cohen & Goring-Morris 2013; Maher *et al.* 2012) and the Pre-Pottery Neolithic period (Stage 2b: 11,500–8300 BP). Broadly speaking, it embodies the Neolithic Revolution, entailing settling down in larger sedentary communities, plant and animal domestication and a transition from egalitarian to trans-egalitarian modes of social organization (Hayden 2004; Zeder 2012).

The third chapter spans the subsequent Pottery Neolithic and Chalcolithic periods, embodying the ultimate institutionalization of the agricultural way of life. Among its many features, the institutionalization of agriculture includes complete reliance on crop

farming and herd management (Gopher 2012), the disappearance of hunting as an economically significant practice (Tsahar *et al.* 2009), the intensification of long-distance commerce and specialized industries (e.g. metal, stone, ceramic), the proliferation of prestige artefacts, and crystallization of religious institutions (Rowan & Golden 2009). Although it is widely agreed these developments have considerable implications for the distribution of wealth and power, no definitive evidence was found to date to support claims for the institutionalization of social inequality, comparable to those observed in north Mesopotamia (Marcus 2008). The fourth and last chapter in our sequence spans the Bronze and Iron Ages (3700–586 BC), and represents the formation of urban societies. Temples, palaces, public buildings and writing are among the material manifestations that constituted cities and states. Broadly stated, it was a time preoccupied with the development of managerial and administrative apparatuses (Gilboa 2014; Greenberg 2019; Joffe 2002).

Given the economic insignificance of carnivores, we suggest three non-exclusive hypotheses to explain the occurrence of the discussed carnivore finds in archaeological sites throughout the four chapters: contingencies, costly signalling and symbolism.

Contingencies

Our first hypothesis for the occurrence of leopards, bears and lions in the archaeological record states that it is principally the consequence of incidental encounters. Large predators occupy the same or neighbouring ecological niches as humans do. Consequently, humans and large predators are bound to meet; it is a simple matter of probabilities. In this respect, carnivore bones become incorporated

in archaeological sites when a chance encounter ends in the animal's death and the collection of its carcass.

Exploring the implications of this mechanism further, we ought to consider two main lines of variation: (1) ecological variability and diversity across space and time and (2) changing nature of human–carnivore relations. Beginning with ecological variability, it is notable that, despite the extensive temporal framework considered, the Levant proved to be remarkably stable, and most species survived well into the Holocene (Tsahar *et al.* 2009). Nonetheless, encompassing several climatic zones, the southern Levant witnessed shifts of ecological niche boundaries—e.g. between the Mediterranean and arid zones (Palmisano *et al.* 2019). However, for our concerns and within our long-term temporal purview, these are but small-scale variations with limited significance for the broader picture. Nonetheless, it urges us to verify that patterns do not coincide with specifiable geographic or climatic zones (i.e. between a Saharo-Arabian desert and Mediterranean mountain terrain), rather compiled into a wide and inclusive frame.

Concerning the second point of human–carnivore encounters, two types of circumstances are notable, pertaining to hunter-gatherers and farmers, respectively. While hunter-gatherers rarely seek confrontation with predators (e.g. Marshall Thomas 2003, 74, 78; Naveh & Bird-David 2014), such events are expected to occur under competitive circumstances over the same prey. Under these conditions, hunters may end up killing a competing predator while seeking to extract their game (O'Connell *et al.* 1988a,b), although such events were probably not very common. Among farmers, on the other hand, the confrontation of predators may be induced by the latter's choice to feed on domesticated livestock (Stein *et al.* 2010; Thorn *et al.* 2012). Here, we may expect more frequent human–carnivore encounters as human settlements expand and economic enterprises reach into larger territories for agriculture and herding. While this holds for all three species of concern here, it is notable that, compared to lions and leopards, bears are less likely to attack herds.

Although bears and lions avoid arid climate zones, these species are considered generalists with respect to physical habitat. Therefore, within our scale of analysis and given herding and hunting exploration zones, spatial variations within the southern Levant are too closely clustered to make a quantitatively significant mark in their distribution. Accordingly, if contingencies were the principal mechanism responsible for the occurrence of large carnivores in

the archaeozoological assemblages, we would expect to find a random pattern of taxa throughout the sequence (with a possible decline in bears) and an overall increase in the frequency of carnivore remains, which would reflect a higher rate of encounters correlated with a trend of human population growth.

Costly signalling

Costly signalling speaks for the hunt of large carnivores as a deliberate move intended to acquire social capital. Among hunter-gatherers, hunting and the subsequent distribution of meat can form means to acquire social capital (Hawkes 1991). The logic behind this social mechanism is often explained using the evolutionary theory of 'costly signalling' (e.g. Bliege Bird & Smith 2005; Hawkes & Bliege Bird 2002; Smith & Bliege Bird 2000; Stibbard-Hawkes 2019). Ethnographic and historical research has demonstrated that the same general principles of prestige through hunting also apply to more complex societies (Allsen 2006; Cartmill 1993; Darimont *et al.* 2017; Mihalik *et al.* 2019). The tradeoff is more or less as follows: by putting oneself in harm's way, confronting a fierce and dangerous opponent, the hunter gains social status, influence and power. Lions, bears and leopards—perhaps the most fearsome predators in the region—undoubtedly constitute high-profile targets, bolstering the hunter's image in terms of bravery, strength and skill. Moreover, when these animals are regarded as a threat to the community or its livestock, the successful hunter also emerges as a saviour.

If costly signalling were a major contributing factor to large carnivores' incorporation in archaeological deposits, we would expect their frequency to increase with social complexity. This is because the ferocity of competition over power, resources and prestige is likely to be correlated with the intensity of ostentatious demonstrations (e.g. Owens & Hayden 1997; Hayden & Villeneuve 2011). Following the logic of costly signalling, therefore, *we expect to find (1) that substantial engagement with these large predators began with the emergence of complex hunter-gatherer societies, (2) that it increased steadily throughout our temporal sequence, and (3) that it reached its peak as power was being institutionalized and contended during the Bronze and Iron Ages.*

Symbolism

Animals figure widely in oral traditions as symbols and embodiments of abstract ideas, signifying anything from gods to human traits (e.g. fox for cunning, chicken for cowardice and peacock for vanity) (Werness 2006). In this vein, the third hypothesis suggests that the occurrence of leopards, bears and

lions in faunal assemblages be viewed as the archaeologically visible component of an otherwise abstract and symbolic preoccupation with animals. One should bear in mind, however, that an animal's symbolic importance can manifest itself in practice as a taboo over their hunting, as suggested by former research of leopard in Neolithic Anatolia, where their iconography is rich but their skeletal remains are almost absent (Hodder 2006, 261). *Thus, if symbolically driven, we may expect that the occurrence of large carnivore remains will correlate—either positively or negatively—to the temporal trajectories charted by other symbolic media, namely the iconographic record.* In other words, a positive correlation will be due to a positive view of their hunt (i.e. increase), whereas a negative correlation will imply that a taboo on the hunt was in place. Either way, a pattern should be observed.

Generally speaking, a pattern of this sort is expected to emphasize a shift between leopards and lions. The leopard constituted an important symbol during the Near Eastern Neolithic, evoked in stone, clay, plaster, paint and other media. Some of the most striking examples were recorded in sites like Tell 'Abr 3 in Syria (Yartah 2005), Göbekli Tepe in southeast Turkey (Peters & Schmidt 2004) and Çatalhöyük in central Turkey (Hodder 2006; Mellaart 1967). In the southern Levant, the site of 'Uvda 6 is a notable case, consisting of stone constructions in the form of leopards (Avner 2002). Lions, on the other hand, are widely evoked during the Bronze and Iron Ages, represented in a range of media that span monumental orthostats and small cups or seals (e.g. Strawn 2005; Zuckerman 2008); lion-hunt scenes become a conspicuous iconographic theme that repeatedly occurs in palatial and imperial contexts (Betzig 2008).

As for bears, according to this line of reasoning, we would expect them to be inconspicuous throughout the sequence. While iconographic representations of bears have been documented during the Neolithic and the Bronze and Iron Ages, they are too few and far between (Beard 2020; Türkcan 2007) to indicate the operations of a substantive symbol.

Searching patterns in the archaeozoological data

A total of 516 faunal assemblages were consulted, each assigned to a specific site and archaeological period or culture (database modified from Bar-Oz & Weissbrod 2017; Tsahar *et al.* 2009). Of these, only 47 contained large predator remains, consisting of 18 leopards, 19 bears and 19 lions, each represented by isolated bones. The temporal and spatial

distribution of these species is presented in Figure 1 and Tables 2–5.

The first noteworthy observation is that large carnivores constitute a tiny fraction of the rich archaeozoological assemblages of the Levant. Importantly, having consulted hundreds of assemblages that derive from a small but intensively researched region, it is difficult to attribute the small numbers to inadequate sampling or inappropriate field practices. Instead, the low frequency of large felids and bears in archaeological deposits is better considered a feature of the phenomenon explored. As such, it underscores and qualifies the exaggerated references to these animals in other media (e.g. Russell 2016). First-millennium Mesopotamian literature and iconography are particularly notable in this regard. They portray Assyrian and Babylonian kings killing hundreds of lions, sometimes on foot and sometimes from a chariot (Betzig 2008 and references therein). While scholars have already argued that the numbers cited in such documents ought to be considered symbolically rather than concretely (e.g. Strawn 2005, 162–4), our results suggest that practices of this sort may have been few and far between.

Notwithstanding the small size of our sample, we posit that it is large enough for purposes of statistical analysis and validation. This is in line with a series of methodical assertions on the matter (Motulsky 2018, 258): most statisticians do not determine a formal lower limit for sample size. When such lower limits are set, they tend to vary. Kraemer and Blasey (2015), for instance, argued that, for statistical validity, each group ought to comprise at least 10 counts. On the other hand, setting a standard in pharmacology, Curtis and colleagues (2015) determined that a sample consisting of at least five counts per group is sufficient for publication of a statistical analysis. An even lower minimum was set by de Winter (2013), who used simulations to argue that a t-test can be successfully applied with $n=3$ per group. Given these claims, we feel confident that although our samples are small, they are sufficiently large—they exceed 15 counts per taxonomic group—to support statistically valid quantitative analyses (see Lazagabaster *et al.* 2021 for a similar argument on archaeological carnivore frequencies).

Carnivore frequencies are clearly associated with the socio-cultural chapters outlined above, and clearly differentiate the mobile hunter-gatherer episode from those that follow. During the 10,000 years of our first chapter, spanning the early and middle Epipaleolithic, only four instances of large carnivores were recorded (Table 2). On the other

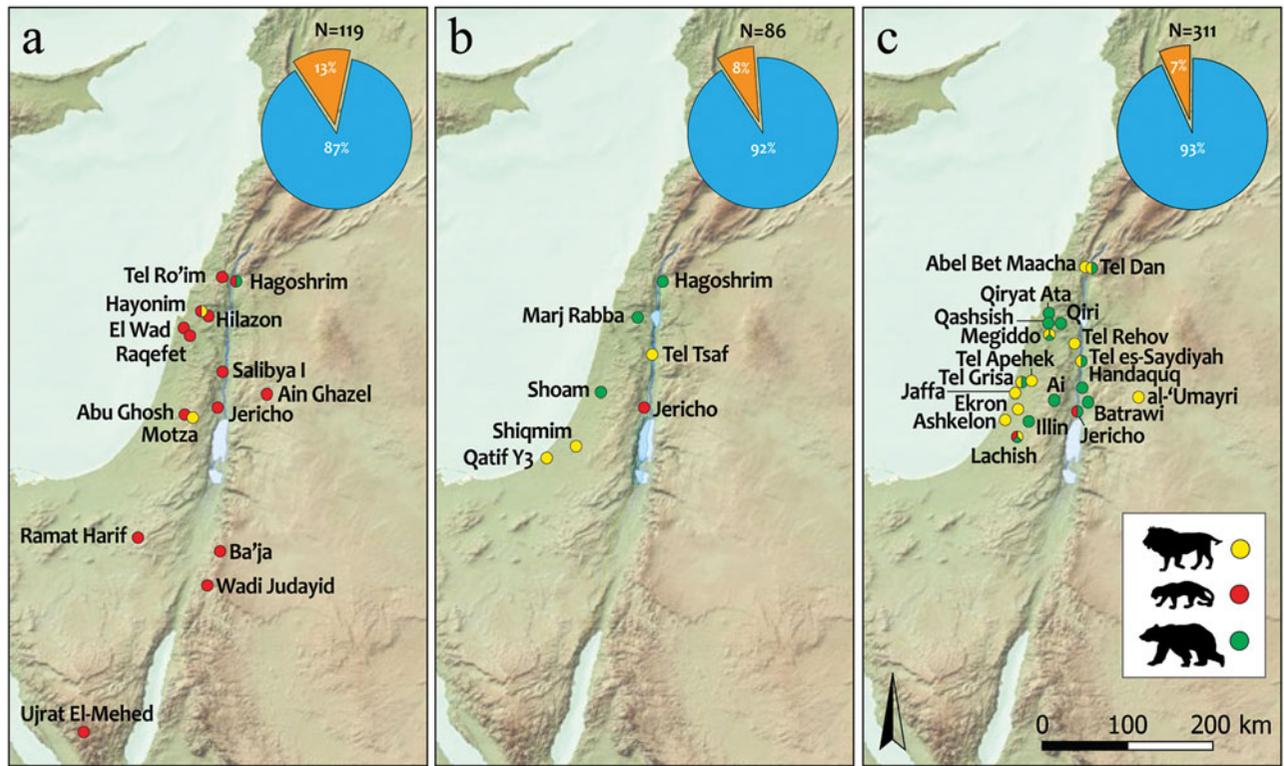


Figure 1. Maps of sites bearing lion, bear and leopard remains: (a) late Epipaleolithic and Pre-Pottery Neolithic; (b) Pottery Neolithic and Chalcolithic; (c): Bronze and Iron Ages. Pie diagrams represent percentage of sites bearing bones of lions, bears and leopards.

Table 2. Stage 1, Early–Middle Epipaleolithic representation of leopards (*Panthera pardus*), bears (*Ursus arctos syriacus*) and lions (*Panthera leo*) in the southern Levant.

	Period	Context	MNI	Bone	Taphonomy/Modification	Species	References
Hayonim	Kebaran	–	1	Phalanx ×3	1 fractured; 2 cut-marked	Leopard	Stiner 2005, 103–4
Hayonim	Kebaran	–	1	2 bones, one is phalanx	–	Brown bear	Stiner 2005
Nahal Hadera V	Kebaran	–	1	Phalanx ×2	–	Lion	Bar-Oz 2004, 22 (appendix 1)
Tor Segeer	Kebaran	–	1	–	–	Leopard	Munro <i>et al.</i> 2016

hand, over the nearly 12,500 years of the rest of our sequence, 52 instances were recorded, manifesting a substantial increase in frequency (Tables 3–6).

Two points are of further interest here. The first is that the turning point coincides with the emergence of the complex Natufian hunter-gatherer societies in the late Epipaleolithic (Belfer-Cohen & Goring-Morris 2013; Hayden 2004). The second point is that the rise in large carnivore occurrences transpires while the frequency of hunted animals declines (Fig. 2), best reflected also in that the majority of the cases in stage 2 are from the Pre-Pottery

Neolithic B (Stage 2b). This is a very important observation, because it counters the argument that more excavations and sites in the later part of the sequence could result in an increase in the number of large carnivores through more intensive sampling. This rising carnivore trend peaked in the third and fourth stages, in which the basis to urban communities were laid. At this point, hunting was of marginal economic significance, but, within the declining component of wild game in these assemblages, large carnivores constituted an increasingly substantial portion.

Table 3. Stage 2, Late Epipaleolithic to Pre-Pottery Neolithic, representation of leopards (*Panthera pardus*), bears (*Ursus arctos syriacus*) and lions (*Panthera leo*) in the southern Levant.

	Period	Context	MNI	Bone	Taphonomy/Modification	Species	Reference
El Wad	Natufian	–	1	–	–	Leopard	Garrard 1980
Hayonim B	Natufian	–	1	–	–	Leopard	Stiner 2005
Hayonim Terrace	Natufian	–	1	–	–	Brown bear	Stiner 2005
Hilazon Tachtit	Natufian	Shaman burial	1	Pelvis	–	Leopard	Grosman <i>et al.</i> 2008
Salibiya I	Natufian	Hut floor?	1	Second phalanx	Cut marks on plantar surface	Leopard	Crabtree <i>et al.</i> 1991
WadI Judayid	Natufian	–	1	Humerus	Medial shaft break	Leopard	Henry <i>et al.</i> 1985
Ramat Harif	Harifian	–	1	–	–	Leopard	Munro <i>et al.</i> 2020
Abu Gosh	PPNB	–	1	Two bones	–	Leopard	Ducos & Horwitz 2003, 109
Ain Ghazal	PPNB	–	1	Ulna	–	Leopard	von den Driesch & Wodtke 1997
Ba'ja	PPNB	–	1	Radius + metacarpal 5 + first phalanx	–	Leopard	von den Driesch <i>et al.</i> 2004
Motza	PPNB	–	1	–	–	Lion	Sapir-Hen <i>et al.</i> 2009
Raqefet	PPNB	–	–	–	–	Brown bear	Garrard 1980
Tell Jericho	PPNB	–	1	Second phalanx	–	Leopard	Clutton-Brock 1979
Tell Ro'im	PPNB	–	1	–	–	Leopard	Agha <i>et al.</i> 2019
Ujrat El-Mehed	PPNB	–	1	Metapodial	–	Leopard	Dayan <i>et al.</i> 1986
Hagoshrim	PPNC	–	1	–	–	Leopard	Haber 2001, 51
Hagoshrim	PPNC	–	1	–	–	Brown bear	Haber 2001, 51

Table 4. Stage 3, Pottery Neolithic to Chalcolithic, representation of leopards (*Panthera pardus*), bears (*Ursus arctos syriacus*) and lions (*Panthera leo*) in the southern Levant.

	Period	Context	MNI	Bone	Taphonomy/Modification	Species	References
Hagoshrim	PN	–	1	–	–	Brown bear	Haber 2001, 51
Marj Rabba	PN	–	1	–	–	Brown bear	Price <i>et al.</i> 2013
Tell Jericho	PN	–	1	Calcaneum	Charred	Leopard	Clutton-Brock 1979
Qatif Y3	Chalcolithic	–	1	1	1	Lion	Grigson <i>n.d.</i>
Shoham	Chalcolithic	–	1	5× teeth	–	Brown bear	Sade 2007
Shiqmim I	Chalcolithic	–	1	Tooth	–	Lion	Grigson 1987
Tel Tsaf	Chalcolithic	–	1	Phalanx	–	Lion	Hill 2011

Tracing the relative proportions of the three carnivore species throughout the stages provides the following observations (Fig. 3). Leopards are unequivocally dominant in the second socio-economic stage, accounting for 76.5 per cent (n = 13) of the large carnivores, followed far behind by bears (17.6 per cent, n = 3) and lions (5.9 per cent, n = 1).

In the third stage, the pattern is different. Leopard frequencies decline, constituting 14.3 per cent (n = 1) of the large carnivores, while bears and lions come to occupy centre stage with 42.9 per cent (n = 3) each). Finally, the fourth stage seems to continue this trend: the frequency of leopards continues to decline (7.1 per cent, n = 2), while lions and bears

Table 5. Stage 4, Bronze and Iron age representations of leopards (*Panthera pardus*), bears (*Ursus arctos syriacus*) and lions (*Panthera leo*) in the southern Levant.

	Period	Context	MNI	Bone	Taphonomy/ Modification	Species	References
Ai	Early Bronze	–	1	–	–	Brown bear	Hesse & Wapnish 2001
Ashqelon Afridar	Early Bronze	Deposit	1	Calcaneum + mandible	–	Lion	Whitcher-Kansa 2004
Horvat 'Illin Tahtit	Early Bronze	–	1	Radius, ulna, scapula, lunar-scaphoid carpal	Cut marks on scapula and scaphoid	Brown bear	Allentuck 2013
Khirbet al-Batrawi	Early Bronze	Palace	1	2× metatarsal	Cut marks	Brown bear	Nigro & Sala 2011
Megiddo	Early Bronze	'Great temple'	1	–	–	Lion	Wapnish & Hesse 2000
Megiddo Tomb 903	Early Bronze	burial	1	Distal end of humerus	–	Lion	Bates 1938
Megiddo Tomb 903	Early Bronze	burial	1	Humerus	–	Brown bear	Bates 1938
Qiryat Ata	Early Bronze	–	1	–	–	Brown bear	Horwitz 2003a
Tel Handaquq	Early Bronze	–	1	First phalanx	1	Lion	Price <i>et al.</i> 2018
Tel Qashish	Early Bronze	–	1	Ulna	–	Brown bear	Horwitz 2003b
Tell Jericho	Middle Bronze	–	1	First phalanx	Severe damage	Leopard	Clutton-Brock 1979
Tell Jericho	Middle Bronze	–	1	Phalanx	–	Brown bear	Clutton-Brock 1979
Tell Aphek-Antipatris II	Late Bronze	Palace, house fill	1	First phalanx ×2 + radius	–	Lion	Horwitz 2009
Tell Gerisa	Late Bronze	–	1	Metacarpal ×2	–	Lion	Sade 2001
Tell Gerisa	Late Bronze	–	1	-	–	Brown bear	Sade 2001
Tell Lachish	Late Bronze	–	1	Phalanx	–	Leopard	Croft 2004
Tell Lachish	Late Bronze	–	1	Tarsal + phalanx 1, 2	Cut marks on phalanx 2	Lion	Croft 2004
Tell Lachish	Late Bronze	–	1?	Astragalus, 4× phalanges, 3× teeth, maxilla, radius, 2× tarsal, metatarsal, ulna, 2× metacarpal, metapoidal	Chopping marks on astragalus, cut marks on radius	Brown bear	Croft 2004
Tall al-'Umayri	Late Bronze –Iron Age	'Ceremonial'	1	Phalanx	–	Lion	London 2011
Abel Beth Maacah	Iron	–	1	Phalanx, scapula	–	Lion	Marom <i>et al.</i> 2020
Jaffa	Iron	Temple	1	Skull	–	Lion	Kaplan & Ritter-Kaplan 1993
Tel Dan	Iron	Altar Room	1	Metacarpal	Cut marks	Lion	Wapnish & Hesse 1991

Continued

Table 5. Continued

	Period	Context	MNI	Bone	Taphonomy/ Modification	Species	References
Tel Dan	Iron	Altar Room and its surrounding	1	4x phalanges, 6x metacarpals, metatarsal, radius, scapula, tooth	Cut marks	Brown bear	Wapnish & Hesse 1991; Greer 2013
Tel Ekron/Miqne	Iron	ceremonial	1	-	-	Lion	Maher 2003
Tel es-Sa'idiyeh	Iron	-	1	Medial phalanx	-	Lion	Martin 1988
Tel es-Sa'idiyeh	Iron	-	1	Radius, tarso-scaphoid	-	Brown bear	Martin 1988
Tel Qiri	Iron	-	1	-	-	Brown bear	Davis 1987
Tel Rehov	Iron	Collapse between walls	1	First phalanx + incisor tooth	-	Lion	Tamar <i>et al.</i> in press

Table 6. Contingency table of the occurrence of taxa across stages 2–4. Data are presence/absence.

Stage	Leopard	Lion	Bear
2a	6	0	1
2b	7	1	2
3	1	3	3
4	2	14	12

become dominant, constituting 50.0 per cent (n = 14) and 42.9 per cent (n = 12) of the carnivoran remains, respectively.

Evidently, our second and fourth socio-cultural chapters present us with the most distinctive patterns, suggesting the association of large carnivore species with key episodes of human history. Thus, we find that the emergence of trans-egalitarian societies and the Neolithic Revolution was linked with the leopard, whereas the crystallization of cities and early state societies was associated with lions and bears. Indeed, drawing on contingency Table 6, we found this difference to be statistically significant (Fisher's exact test, p-value = 0.0006), although the sample sizes are below the recommended five counts for each cell of the contingency table. Moreover, plotting chi-square residuals as a measure for a species departure from the null hypothesis produced striking and definitive trends for all three species (Fig. 4): a sharp and consistent decline of leopards, concomitant with a steady increase of lion and bear frequencies. Notwithstanding the small sample size, the inverse correlations between leopard and lion (r = -0.99, P = 0.0008) and leopard and bear (r = -0.99, P = 0.002) are striking.

Having discussed the temporal trends, let us complete our review of the emerging patterns by exploring regional variations in the distribution of carnivore remains. A glance is enough to note some regional patterns: in the arid zones south of Be'er Sheva, one finds only leopards, while the Shephela region (between the southern coastal plain and the mountain terrain) is notable for the high frequency of lions (Fig. 1). This indicates that there is some regional variation in accord with taxa-dependent habitat preferences. However, these patterns are attributable to specific episodes of our sequence—the second and fourth, respectively—and do not seem to suggest a broader trend that transcends our periodic division. In other words, the absence of lions in the Shephela, during our second episode, and the absence of leopards in the arid zones, during the third and fourth episodes, cannot be attributed to

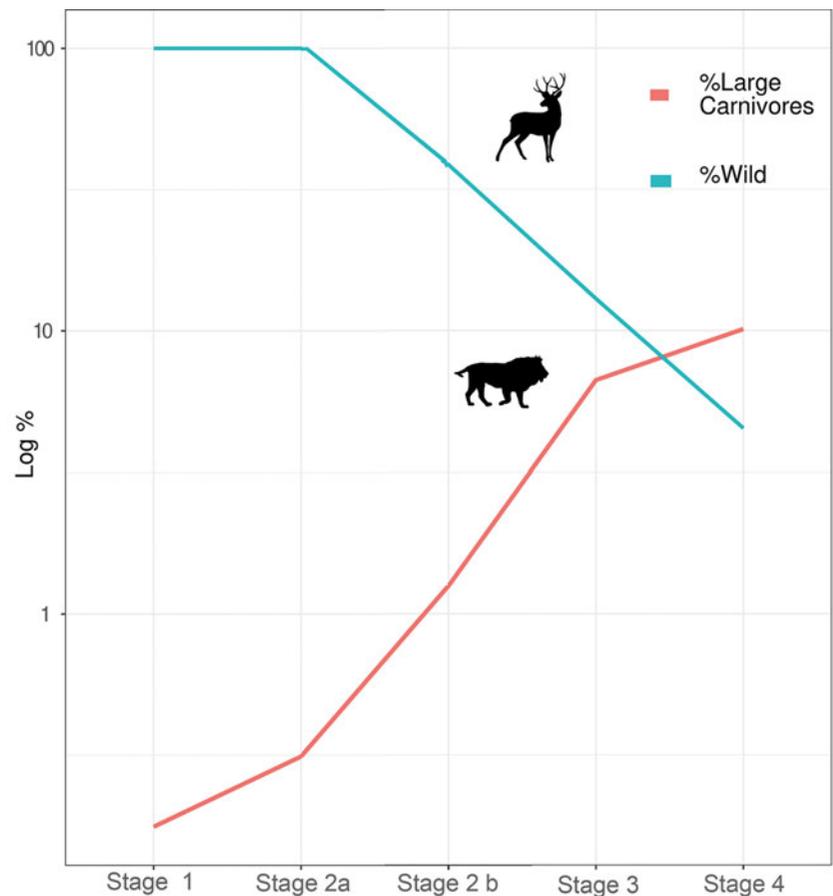


Figure 2. Changes in the relative frequency of large carnivores out of the total number of large game, and of the ratio of hunted (cervids, gazelles, lions, bears and leopards) versus domestic species across the four stages (data retrieved from the reports listed in Tables 2–5). Stage 2 is divided into Natufian (2a) and Pre-Pottery Neolithic (2b). Y-axis is in log(10) scale.

ecological factors as lions and leopards survived in these regions into historical (and even modern) times. Therefore, we argue they reflect cultural choices. A complementary perspective can be provided by the Jordan Valley and the northern part of the studied region, where leopards are characteristic of the early stage 2, whereas lions and bears are notable in the later stage 4.

Further indications of purposeful cultural choices emerge from the body parts represented (Tables 2–5; Fig. 5). While leopards are represented by an assortment of postcranial bones, lions and bears show a definitive leaning towards feet and head bones. Given that feet and head bones are characteristic of pelts, the observed difference may indicate that bear and lion skins were valuable, those of leopards less so.

The contexts of recovery are also telling. There seems to have been a greater tendency to deposit lion remains in special locations (e.g. caches, temples and palaces: Horwitz 2009; Kaplan & Ritter-Kaplan 1993; Wapnish & Hesse 1991; Whitcher Kansa 2004). Seven of the 18 lions recorded in stages 2–4 were retrieved from special deposits of this sort,

while only three of the 18 bears and one of 16 leopards derive from similar contexts.

Hypotheses revisited

Above, three tentative hypotheses were offered to explain leopard, bear and lion remains in archaeological assemblages: one spoke for contingencies, another for costly signalling and a third for symbolic discourse. Now that the data and empirical patterns have been outlined, we may revisit them one at a time to estimate their suitability.

Contingencies

According to the contingencies hypothesis, the first expectation is that frequency of the discussed carnivore bones ought to increase steadily with time as people claim more land and resources for themselves and their herds, in the process creating more opportunities for human–carnivore conflicts (Marshall Thomas 2003; Stein *et al.* 2010; Thorn *et al.* 2012). This is clearly the case at hand, as reflected in Figure 2.

Nevertheless, the temporally patterned differentiation between leopards, on the one hand, and bears

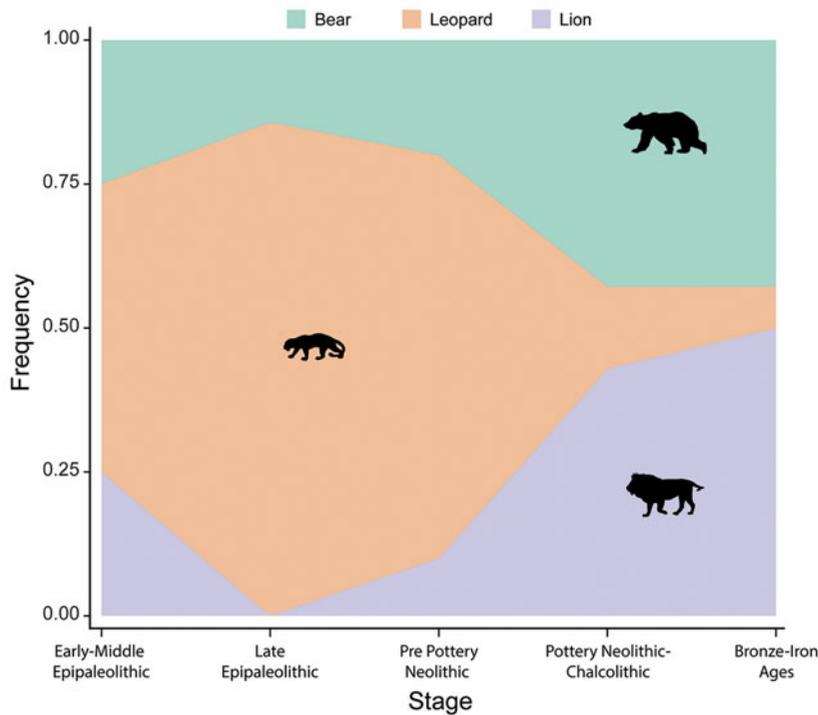


Figure 3. The relative frequency in percentages of lions, leopards and bears throughout the sequence (for details, see Tables 2–5). Stage 2 is divided into Natufian (2a) and Pre-Pottery Neolithic (2b).

and lions, on the other, speaks against the contingencies hypothesis. It expects to find a more-or-less consistent ratio of these large carnivores throughout the sequence. Perhaps it could tolerate subtle changes due to small-scale environmental shifts, but nothing as dramatic as the observed wholesale shift from one species to another. Also, the possibility that bear relative frequency will decline, following the expectation felids are more likely to attack the growing herds, was not found to be valid. Accordingly, contingencies alone cannot account for the distinct temporal distributions of the species. Some other mechanisms had to intervene between the physical engagement of large predators and the incorporation of physical remains of these animals in archaeological assemblages.

Costly signalling

The hypothesis of costly signalling, as outlined above, suggests the engagement with leopards, bears and lions was a mode of strategic conduct by social actors seeking to boost their standing and influence (e.g. Hayden 1998). Several observations speak in favour of this hypothesis in the context of south Levantine archaeological carnivore assemblages. The first signs of earnest engagement with these large carnivores coincide with the emergence of the complex hunter-gatherers of the Natufian culture (Belfer-Cohen & Goring-Morris 2013; Hayden 2004). It is a time when social mechanisms designed

to maintain an egalitarian ethos and discourage boastful behaviour (Bird-David 2005; Kent 1993; Lee 1979; Wiessner 1983; Woodburn 1982) began to relax, mainly due to the shift to sedentism and attendant implications. Consequently, a way opened for hitherto discouraged practices, including a strategic search for new media to boost status (e.g. Bliege Bird & Smith 2005; Hawkes & Bliege Bird 2002; Smith & Bliege Bird 2000). Without these levelling mechanisms, successful hunters find themselves in an advantageous position to accumulate prestige and power (Hayden & Villeneuve 2011; Woodburn 1982). Within this social climate, it is not far-fetched to consider the pursuit of large carnivores as a form of purposefully orchestrated social extravaganza

Moreover, the need for such an extravaganza is likely to have increased during the Neolithic period, as domesticates acquired an increasingly significant part in the animal economy (e.g. Hayden & Villeneuve 2011; Russell 2012; Twiss 2008). As this process unfolded, the hunt and the hunter were economically marginalized, and the large-sized game no longer carried the social benefits and gratitude it used to. Under these circumstances, a search for mightier or more exotic targets constitutes a logical response (Mihalik *et al.* 2019). Large predators are likely to have been well suited for the purpose, and their pursuit would have heralded the transformation of the hunt and the hunter from subsistence

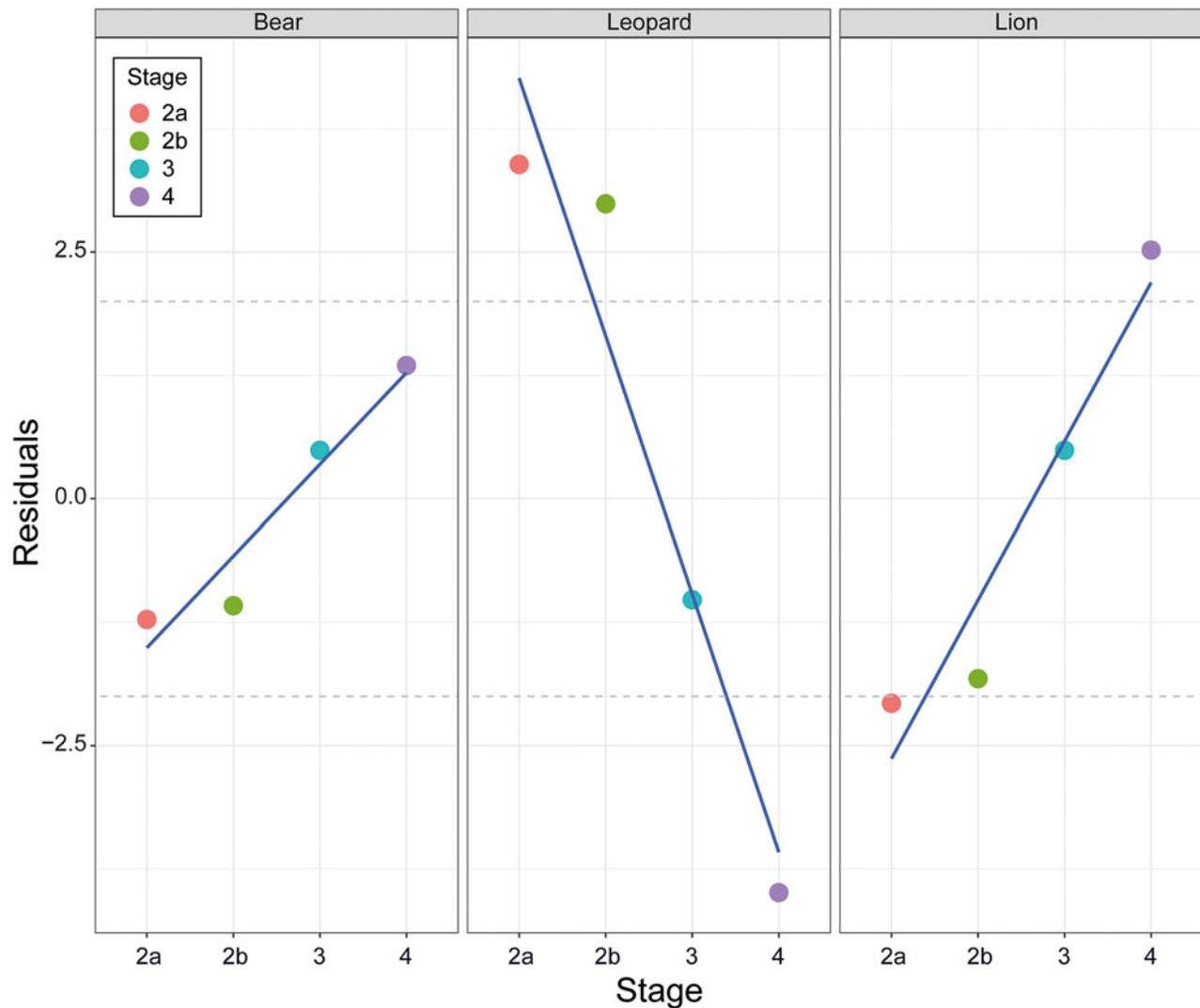


Figure 4. Change in chi-squared adjusted residuals showing the steady increase of bear and lion numbers and the decrease of leopards in relation to a hypothesis of no association between period and taxonomic frequency.

providers to combatants, a trend that reached its fruition in the Bronze and Iron Ages.

This leads us to the apparent correlation between the observed preference for lions during the Bronze and Iron Ages and the growing popularity of lion-hunt scenes with their explicit political and imperial agendas. The latter explicitly use the lion and its defeat to advance and legitimize claims for power (Betzig 2008; Strawn 2005), and it seems likely that the increasing frequency of lion remains at this time would be channelled in the same way. Moreover, the semblance of regulated management and the tendency to deposit them in unique locations reinforces this institutionalized power-driven connection.

Nevertheless, costly signalling seems to fall short in explaining the shift from leopards to bears

and lions. In principle, the three predators are interchangeable and make little difference for the social mechanics of self-aggrandisement. While the superiority of hunting lions in this frame might be a concern, there is no reason to relinquish the other two if the goal is to demonstrate one's power. Thus, costly signalling is likely to form part of the answer, but certainly not all of it.

Symbolism

If the costly signalling hypothesis has an instrumental tenor, the appeal to symbolic discourse is concerned with conceptual infrastructures. It suggests that leopard, bear and lion remains in archaeological assemblages be understood as the visible tips of a broader preoccupation with these

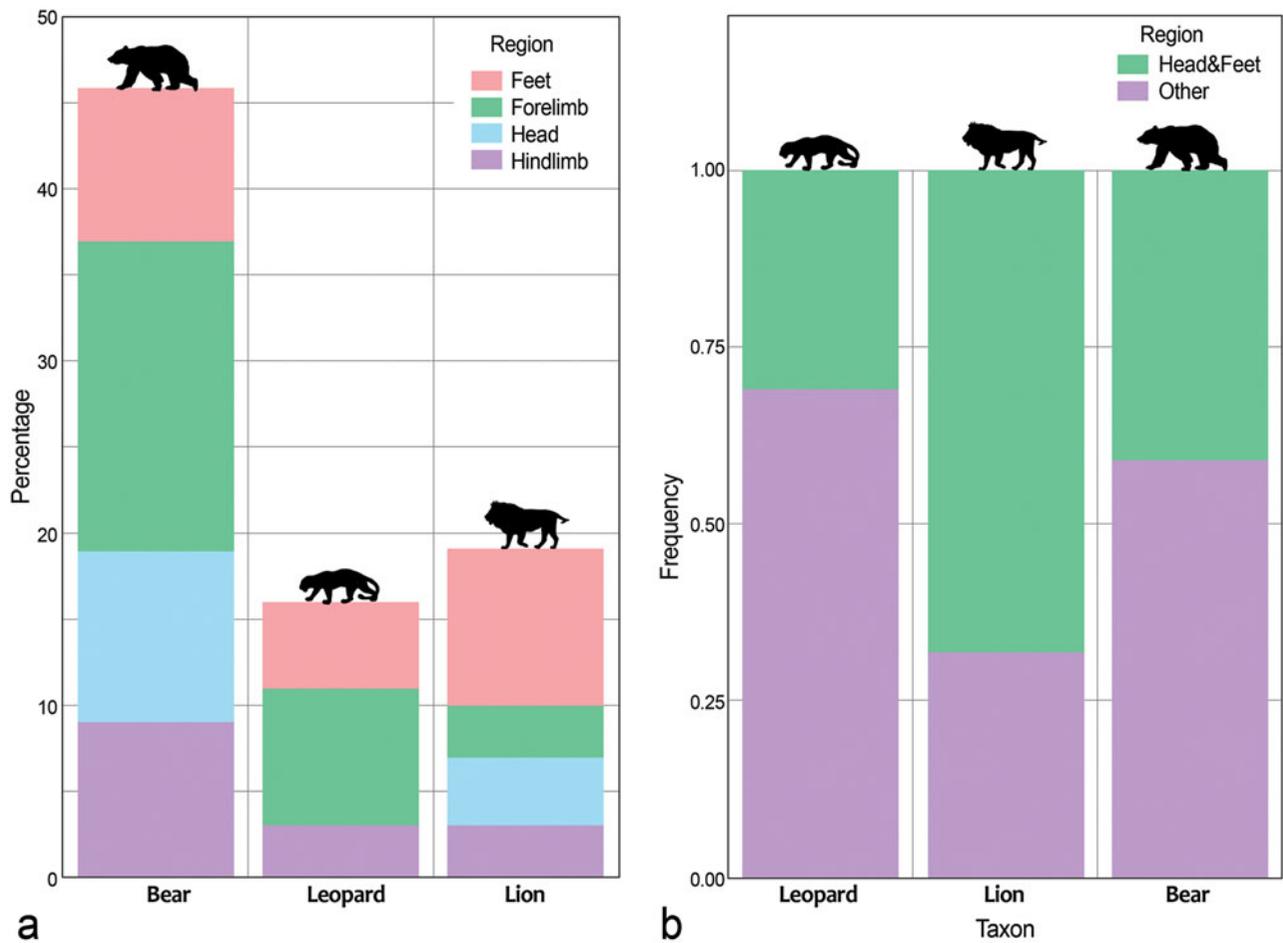


Figure 5. Skeletal element representation by anatomical region and taxon (a). Recalculated to show the percentage of heads and feet only (b) (for details, see Tables 2–5).

animals as symbols and metaphors. That such a concern did, in fact, exist in the region at the time is demonstrated by the proclivity to evoke these animals in other media: clay, stone, paint, etc. (Betzig 2008; Hodder 2006; Mellaart 1967; Peters and Schmidt 2004; Russell 2012; Russell & Meece 2006; Strawn 2005).

There is little in the empirical patterns observed that speaks directly against this hypothesis. However, at least one feature speaks strongly in its favour: the definitive distinction between an early leopard-oriented period and the later lion- and bear-oriented period. This distinction seems to accord with trends observed in other modes of symbolic expression throughout the Near East and implies that these animals’ symbolic significance was not taboo-oriented. It also suggests that the recorded succession be viewed as embodiments of the symbols’ careers, including their emergence, negotiation and displacement. In this capacity, the shift from leopard

to lion/bear underscores a profound turn in cultural reasoning, priorities and temperament.

In this respect, the case of the bear is puzzling. While the frequency of bears becomes significant in the fourth phase of our sequence, alongside the lions, they figure poorly in other media of symbolic expression (Beard 2000; Türkcan 2007). Lions’ and bears’ different contexts of recovery is another point of note. While many of the lions were found in special ritual and palatial contexts, this can only be said for a fraction of the bears. Also, the body parts found may attest to the differences, with lions showing the most striking case of feet and heads that correlate to the use of pelts, thus prolonging the hunt into an ongoing social display.

Discussion: towards an integrated account

Having reviewed the three hypotheses, it is evident that none offers a satisfactory explanation on its

own. The hypothesis of contingencies underscores the necessary precondition but is insufficient to explain the shifting patterns between the species; costly signalling puts the finger on a robust social mechanism that may have driven the process forward but is unable to account for the change in media; lastly, symbolism provides a prism through which different meanings might have been attached to the leopard, the bear and the lion but remains agnostic concerning all other matters. Fortunately, because these hypotheses occupy different territories—environmental circumstance, politics and metaphors, respectively—one does not exclude the others. In fact, they are probably complementary. Accordingly, in this section, we will try to weave them together. However, for the sake of simplicity, we will set the contingencies hypothesis aside. We do so not because we consider it irrelevant but because it operates at a level that enables the observed phenomena, yet does not seem to account for their particularities.

Hence, we begin with the intertwining of symbolism and costly signalling. On the one hand, for costly signalling embedded in large predator hunting to be socially effective, it must rely on an appropriate pre-existing symbolic infrastructure. Thus, if hunting a lion is to be useful to boost one's social status, it must rest on an agreed understanding of what a lion means. Only if the large predator is conceived as an objectification of strength, confidence and power can its hunt be mobilized to assert the strength and power of the hunter. On the other hand, abstract symbols and ideas exist and persist only insofar as they are put to work (Bourdieu 1990; Giddens 1984). In other words, a symbol needs to be evoked if it is not to disappear. Accordingly, while costly signalling wields symbols in the service of short-term goals, it also reinforces them. In this manner, acts that draw on the leopard or the lion for political purposes also actively support and fuel these animals' symbolic efficacy. Moreover, in doing so, such practices and applications also negotiate and transform the implicated meanings, applying them under varying circumstances and with shifting emphases.

Thus, our two hypothesized mechanisms—costly signalling and symbolic discourse—are intertwined. They carry each other along a path of their own making. In this vein, we may consider the species' changing frequencies and, especially, the shift from the leopard to the lion and bear as an expression of the furrow that the two mechanisms ploughed together, making up a play in three acts. The first act corresponds to our second episode,

spanning the late Epipaleolithic and Pre-Pottery Neolithic periods. This episode witnessed a substantial increase in the frequencies of large carnivore bones in archaeological assemblages, mainly attributed to leopards. The second act spans the Pottery Neolithic and Chalcolithic periods and corresponds to our third episode; we observe a general increase in the frequency of large carnivores along with a definitive displacement of leopards by bears and lions. The final act, attributed to the fourth episode in our sequence, spans the Bronze and Iron Ages and consists of further increase in frequencies of carnivore bones while maintaining the dominance of lions and bears. Equipped with a cursory understanding of the relationship between the two hypotheses and a threefold temporal structure for their mutual course, we may now try to follow them with greater detail. We will do so by setting them against the backdrop of the broad evolutionary trends that transpired at the time.

Our first act, marked by leopards, coincides with the Neolithic Revolution. It is a period in the course of which humans were busy negotiating and redefining their place in the world (Cauvin 2000; Hodder 1990). They did so first by gravitating away from mobility and towards a sedentary way of life, and later by gradually displacing hunting and gathering with herding and farming (Abbo *et al.* 2014; Gopher 2012; Zeder 2012). Three features seem particularly pertinent to our discussion. The first is that, in the process of these negotiations, a line was drawn, distinguishing between humans and the rest of the world. This line that was initially but a tentative boundary of the permanent camp—a place to step out of in order to return to it—was persistently reified as more swathes of daily life were domesticated and brought under human control and management. As this human domain continued to evolve and distinguish itself through work and planning, so the world beyond it was alienated, culminating with Nature that is opposed and external to Culture (Hodder 1990).

The second feature concerns the erosion and subsequent undermining of mechanisms that maintain egalitarian relations among individuals. These mechanisms were part and parcel of a mobile hunter-gatherer way of life (Bird-David 2005; Kent 1993; Lee 1979; Woodburn 1982). As people moved towards sedentism and food production, these mechanisms began to falter, incrementally making way for differential distributions of influence and power (Hayden 1998). As suggested above, the hunter was probably one of the early beneficiaries of this condition, allowing a successful hunt to be translated better into

prestige and social capital (Bliege Bird & Smith 2005; Hawkes & Bliege Bird 2002; Smith & Bliege Bird 2000; Stibbard-Hawkes 2019). This brings us to our third feature of concern: the incremental but consistent marginalization of the hunter. As the subsistence economy drew more heavily towards agriculture and the management of domesticated livestock (Abbo *et al.* 2014; Gopher 2012; Zeder 2012), the hunter's economic significance waned and, with it, his/her social esteem.

How does the leopard fit in here? We would like to suggest, in correlation to former research (Hodder 1990), that it crystallized into a symbol of an increasingly mysterious and dangerous world located beyond the confines of the human circle. As the natural environment becomes demarcated and pushed away, the various elements that constitute it inevitably become less familiar, strange and potentially dangerous, encroaching on the carefully structured world people have contrived for themselves. The leopard seems particularly well suited to embody these fears (Hodder 2006). It is a dangerous predator; unlike humans, it is solitary and roams the landscape alone; it is stealthy and covert, out of sight but lurking nearby. Accordingly, the unplanned face-to-face encounter of leopards is likely to have been extremely rare (e.g. O'Connell *et al.* 1988a,b). Otherwise, a leopard's presence becomes known indirectly via tracks, scat and consumed animal carcasses, rendering its elusiveness a prime feature. In this capacity, it was a symbol drawn upon to articulate and negotiate the distinction between the human and non-human, embodying an ambivalence of fear and yearning, rejection and admiration, which permeated both sides of this still-crystallizing distinction. Thus, the capturing of a leopard, or leopard remains, and bringing it into the cultural realm may have functioned as a device of symbolic negotiation. It offered an opportunity and a channel to conceptualize, apprehend and process something—the non-human realm—that is becoming increasingly ambiguous and threatening. In this respect, the person who hunts the leopard or retrieves its remains is likely to have enjoyed the community's esteem and reverence. He or she brought from the precarious unknown that which the group needed to comprehend and manage their changing place in the world.

It is not improbable that for some, the priorities would have reversed and that the capture of a leopard or its remains acquired the qualities of strategic socio-political practice. Indeed, the hunt of large felids as a means of prestige accumulation is a familiar theme in anthropological and historical research

(Buxton 1968; Evans-Pritchard 1956; Hazzah *et al.* 2009; Pickenpaugh 1997). However, a movement in this direction is likely to have intensified with the increasing investment in pastoralism and herd management (Arbuckle & Hammer 2019). As these practices became widespread, leopards would become more conspicuous and economically menacing as they preyed on livestock (Stein *et al.* 2010; Thorn *et al.* 2012). Under these circumstances, two crucial developments would have merged: (a) the diminishing social standing of the hunter and (b) a 'demystification' of the leopard. In this vein, hunters may have sought to curb the attrition of their status and assert their economic relevance by hunting leopards (e.g. Mihalik *et al.* 2019; Owens & Hayden 1997). Hence, the increasing frequency of leopard bones during the Pre-Pottery Neolithic.

These trends would have ultimately culminated in the second act of our sequence. It spans the Pottery Neolithic and Chalcolithic periods that mark the closure of the Neolithic Revolution: hunting (and gathering) was now an occupation of negligible economic significance, and the agricultural village with its attendant reliance on domesticated species became the new orthodoxy (Gopher 2012); the new economic structures continued to spin in novel ways as domesticated species divulged unexpected benefits in the form of secondary products (Sherratt 1983); otherwise rare materials—metals, ivory, basalt—begin circulating in greater intensity and over larger distances; and religious institutions begin to crystallize (Ein Gedi, Ghassul, Gilat: Rowan & Golden 2009).

Under these circumstances, the symbolic boundary-policing that maintained and negotiated the line that separates the human/cultural realm from the non-human/natural one was no longer valued. This Nature/Culture divide was institutionalized, becoming an inseparable and self-perpetuating feature of the agricultural mode of existence (Descola 2013; Hodder 1990). Accordingly, the leopard lost its symbolic significance and, by extension, its capacity to draw political weight. It has been reduced to an economic nuisance. While leopards are likely to have remained as much a hazard as they were before, calling for their hunt (see Avner *et al.* 2011; Porat *et al.* 2013), there was no motivation to engage with them further. Hunting of large carnivores, however, did not decline and the endeavour shifted to the larger and more dangerous bears and lions.

The third act of our sequence marks the emergence of a new thesis. Letting go of cosmological questions about humans' place in the world, the focus shifts to humans' relations among themselves.

Specifically, spanning the Bronze and Iron Ages, it is a time of the institutionalization of power, embodied in temples, palaces, armies, city walls, treasuries and other establishments of this sort (Jennings & Earle 2016). Among these, the lion is readily appropriated as a symbol of vigour, courage and determination, as numerous murals and other depictions readily demonstrate (Betzig 2008; Strawn 2005). The costly signalling associated with the lion hunt is practically fused with the animal's symbolic significance, converting the lion's physical strength into the king's political authority (Cornelius 1989; Strawn 2005: 158–60). It is based on a state of mind that is effective to this day: that power begets power, a political variation of sympathetic, almost Frazerian, logic. The king appropriates the lion's power by vanquishing it, thus justifying his right to rule. In this respect, the striking increase in the frequencies of lion remains in the archaeological record of the Bronze and Iron Ages indicates a growing disposition towards the admiration of physical force and an intense effort to justify and consolidate political authority by means of costly signalling.

The place of the bear is ambiguous, however. While in some cases it might have been symbolically equivalent to the lions, as noted in several first-millennium BC texts, its literary and iconographic prominence was nowhere nearly as substantial as the lion's (Beard 2020). In other words, while the shift from leopards to lions is also observable in the iconographic record, the case of the bear is different. Perhaps this is a matter of medium and bears figured more prominently in verbal discourse. Maybe also relevant here is the observation that lion remains are more closely associated with ritual and palatial contexts than bears. This possibly implies that, while both were mobilized by costly signalling, they operated in different social spheres and may have carried distinct symbolic and ideological charges.

This leads us to consider how the representation of the different body parts of the large carnivores can contribute to our understanding of the dynamics between their role in costly signalling and ideological manifestations. Costly signalling displayed by the hunt is a short-lived event, even if the carcass is brought back to the site. Pelts, on the other hand, constitute a medium to maintain a long-term effect. While leopard pelts are illustrated on the walls of Çatalhöyük (Mellaart 1967), our results (Fig. 5) suggest that this practice seems to have been more pertinent for lions. In this respect, the use of pelts, which may have emerged as an effort to prolong the impact of the successful hunt, would have shifted away from costly signalling as the honest signal (e.g.

Bliege Bird & Smith 2005) of performing the hunt by themselves become obscured and possibility also irrelevant. By doing so, however, it entered more clearly into the symbolic and ideological discourse.

Thus, to summarize our integrated narrative, in the beginning, we find a concern with the world; in the end, we find politics. Whereas the 'Neolithic leopard' was symbolically cosmological, the 'stately lion' was inherently authoritarian. Whereas political benefits drawn from the leopard were necessarily circuitous and probably meagre, the lion was a symbol designed to rake in political advantages.

Supplementary material

Supplementary material may be found at <https://doi.org/10.1017/S0959774322000221>

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