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Japanese General Public Highly Fascinated by Hercules Beetles, *Dynastes hercules* (Linnaeus, 1758), of the Exotic Dynastine Beetles

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Abstract I investigated the popularity of different exotic dynastine species (86 species) in Japanese society, where people have a strong interest and special aesthetic sense toward dynastine beetles, as an issue in the field of cultural entomology. Popularity was assessed by the Google search volume for exotic dynastine species names in katakana script, using the Keyword Tool of Google AdWords. The search volume for hercules beetles, *Dynastes hercules* (Linnaeus, 1758), was extraordinarily high (3,600 searches) and the search volumes of three species, *Chalcosoma caucasus* (Fabricius, 1801), *Megasoma elephas* (Fabricius, 1775) and *Chalcosoma atlas* (Linnaeus, 1758), were also considerably high (880, 880 and 590 search, respectively) relative to other exotic dynastine species. On the other hand, no search volume was obtained for 60 species names in Japanese. As a whole, a relatively small number of dynastine species was represented by an extraordinarily high search volume, while an abundance of other species was represented by a low search volume, indicating the biased attention of Japanese to only a small number of dynastine species, and such popular dynastine species mostly show a tendency to have the characteristics of a large body and/or well-developed, robust and forward lengthened horns relative to most of the other dynastine species which are less popular in Japan. It appears that a high popularity of a small number of exotic dynastine species is due to (1) stimulation of dynastine species with such morphological characteristics toward the Japanese special aesthetic sense and (2) their high circulation in Japanese society.
Keywords: Cultural entomology, Japanese culture, Popularity, Exotic dynastine beetles

Introduction

The field of cultural entomology examines the impact of insects on human societies (Hogue, 1987; Mitsuhashi, 2000; Konishi, 2007; Meyer-Rochow *et al*., 2008; Takada, 2010 a) and explores which and how insect groups are represented and perceived in human culture, i.e. popularity of (or interest in) different insect groups and the perception of humans toward them in human society. In the field of cultural entomology, Japan has been frequently mentioned, because of Japanese traditional appreciation of insects with aesthetic value (Hogue, 1987; Dunn, 2000; Konishi, 2007; Takada, 2010 a). Previous studies on the issue of insect popularity mentioned the biased attention of Japanese to a small number of insect groups and suggested that the high popularity of some insect groups is due to their apparent characteristics to humans (Takada, 2010 b; 2011). However, the popularity of different insect groups has been explored only for insect orders represented in Japanese haiku poetry (Yuma, 2004), coleopteran families (Takada, 2010 b) and lampyrid species (Takada, 2011) in Japanese society, although many insects are used in a variety of ways and meanings in Japanese society (Okui, 1992; Meyer-Rochow *et al*., 2000; Konishi, 2007).

In contemporary Japan, dynastine beetles ("*Kabuto-mushi*" in Japanese), especially Japanese rhinoceros beetles *Trypocylus dichotoma* (Linnaeus, 1771), have strongly fascinated the general public with attractive and cool image due to their distinctive horn and large body, resulting that they are pop-

ular as pets and thus have a large market (LAURENT, 2000; KONISHI, 2007; KAWAHARA, 2007; TAKADA, 2010 c). In addition, they have been frequently used in such Japanese popular cultural media as movies, animations, cartoons, computer games and music (KAWAHARA, 2007; HOSHINA *et al.*, 2010; TAKADA, 2010 c).

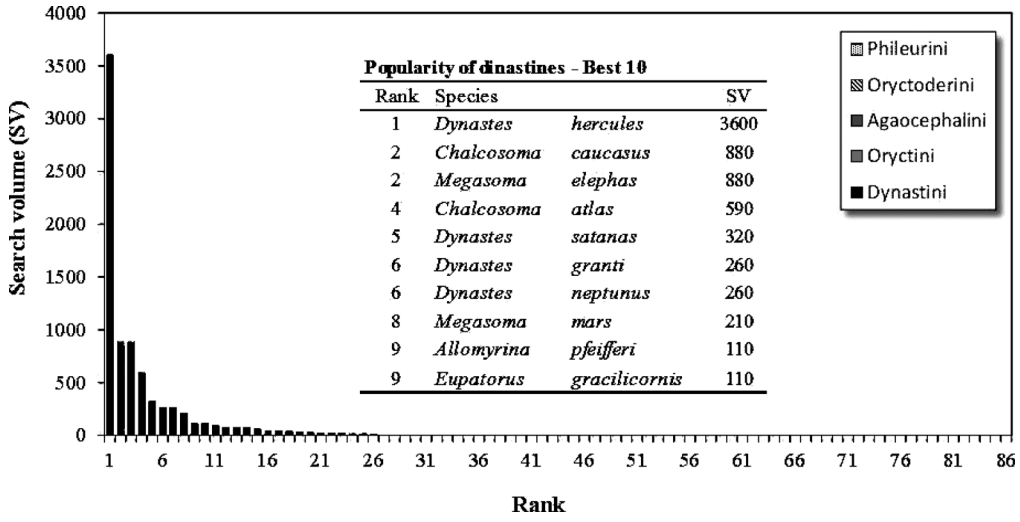
In particular, in recent years, not only endemic but also imported exotic species of dynastine beetles have assumed a position of special cultural significance in Japanese culture, because many exotic dynastine species have rapidly become popular and familiar as pets in Japan, and the market for exotic dynastine species is growing fast and the establishment of new breeding techniques has led to growth in the number of breeders after deregulation of the importation of exotic dynastine species by an amendment of Plant Protection Act in 1999 (KAMEOKA & KIYONO, 2003). Therefore, to understand Japanese interest and perception toward insects, it is meaningful to analyze the impact of exotic dynastine species on Japanese societies and to examine which and how exotic dynastine species are popular in Japan. However, popularity of different exotic dynastine species has not been sufficiently explored in Japanese culture because their popularity has never been assessed quantitatively. It is predicted that the popularity of exotic dynastine species is biased to a greater or lesser extent due to their diverse attributes such as morphology, ecology and biology.

I therefore investigated the popularity of different exotic dynastine species and examined which and how such species are represented in Japanese culture. The popularity of different exotic dynastine species was assessed by the Google search volume of group names. The search volume is used as a yardstick to measure a term's intention, interest or popularity, and thus can be applied to investigate the popularity of insects (TAKADA, 2010 b; 2011; 2012 a), as well as for internet marketing, search engine optimization (BATTELLE, 2005; RANGASWAMY *et al.*, 2009; GOEL *et al.*, 2010) and the public response to social issues (CHAY & SASAKI, 2011). This statistic breaks out of methodological constraints, which have limited the cultural entomologist's attempt to investigate the popularity of different insect groups (TAKADA, 2011).

Materials and method

I conducted a survey on the popularity of exotic dynastine species on 26th April, 2012, assessing the local monthly search volume in Japan using the Keyword Tool in Google AdWords (https://adwords.google.com/o/Targeting/Explorer?__c=1000000000&__u=1000000000&ideaRequestType=KEYWORD_IDEAS). The local monthly search volume shows the approximate average monthly number of search queries matching each keyword result searched for in the country selected. This statistic (called "search volume") applies to searches performed on Google and the search network over the past 12-month period. When Google AdWords has insufficient data on a particular keyword, it returns "–" (not enough data). Such a case is regarded as having no search volume (0) for the keyword. This statistic is considered a reliable indicator of the insect popularity in Japanese society because of the high abundance of computers in Japan (76% of the total number of households) (CABINET OFFICE OF JAPAN, 2011), although internet use is somewhat biased in favor of younger and well-educated people (BATTELLE, 2005). In addition, Google is currently one of the most popular search engines and receives 2.3 billion searches, or 39% of the market share in Japan in September 2008 (CHAY & SASAKI, 2011). In fact, CHAY & SASAKI (2011) assessed public responses to climate mitigation policies in Japan using search volumes for the related Japanese terms retrieved by the Keyword Tool in Google AdWords.

Overall, 86 species names of exotic dynastine beetles were used as keywords to evaluate the search volume of dynastine species (Table 1). I referred to the Japanese names of these dynastine spe-



Popularity of dinastines - Best 10

Rank	Species		SV
1	*Dynastes*	*hercules*	3600
2	*Chalcosoma*	*caucasus*	880
2	*Megasoma*	*elephas*	880
4	*Chalcosoma*	*atlas*	590
5	*Dynastes*	*satanas*	320
6	*Dynastes*	*granti*	260
6	*Dynastes*	*neptunus*	260
8	*Megasoma*	*mars*	210
9	*Allomyrina*	*pfeifferi*	110
9	*Eupatorus*	*gracilicornis*	110

Fig. 1. Distribution of the search volumes for the Japanese terms for different exotic dynastine species arranged in order of search volume.

cies in the list of insects which can be lawfully imported by the Plant Protection Act reported by Plant Protection Station (http://www.pps.go.jp/insect/NonPestList.html#Top), because exotic dynastine species listed in this reference are potentially kept as pets and thus are well known in Japanese society. The search volume of Japanese names of these dynastine species was assessed in katakana, a Japanese syllabic script used in the Japanese writing system (Fig. 1). Katakana is most often used for the transcription of words from foreign languages, onomatopoeia and technical and scientific terms, such as the names of animal and plant species and minerals (Takada, 2010 b; 2011; 2012 a). Thus, Katakana is more suitable than other Japanese scripts such as Hiragana and Kanji, to examine which and how insects are used and perceived in Japanese culture.

To evaluate the search volume, I employed the browser Firefox 12.0. The operating system was Windows 7 Home Premium Service Pack 1 (64 bit) installed on a Lenovo G570 4334CSJ (CPU: Intel Core i5 2410M (2.3 GHz)).

Results and discussion

The search volume for "*Herakuresu-oo-kabuto*", which is the hercules beetle [*Dynastes hercules* (Linnaeus, 1758)] in Japanese, was 3,600 searches, the highest of the exotic species name of dynastines (Table 1, Fig. 1). The search volumes for "*Kohkasasu-oo-kabuto*" [*Chalcosoma Caucasus* (Fabricius, 1801)] and "*Zou-kabuto*" [*Megasoma elephas* (Fabricius, 1775)] were the second highest (880 searches), and the search volume for "*Atorasu-oo-kabuto*" [*Chalcosoma atlas* (Linnaeus, 1758)] was the fourth highest in Japanese (590 searches). The search volume for Hercules beetles was 4.1 times higher than the search volumes for the second highest species in search volume. For species names in Japanese, a search volume frequency of 100 to less than 1,000 searches and of 10 to less than 100 searches occurred for 9 and 16 species, respectively. On the other hand, no search volume was obtained for 60 species names in Japanese, due to the lack of data on these keywords in Google AdWords.

The search volume for hercules beetles (*Dynastes hercules*) was extraordinarily high and the

Table 1. Google search volume for different exotic dynastine species.

Tribe	Genus	Species		Japanese (reading)	Search volume
Agaocephalini	*Aegopsis*	*curvicornis*	BURMEISTER, 1847	Oo-mitsuno-hina-kabuto	0
		peruvianus	ARROW, 1941	Kuro-mitsuno-hina-kabuto	0
	Agaocephala	*bicuspis*	ERICHSON, 1848	Midori-karakane-hina-kabuto	0
	Brachysiderus	*quadorimaculata*	WATERHOUSE, 1881	Yotsuboshi-tsuno-hina-kabuto	36
	Lycomedes	*buckleyi*	WATERHOUSE, 1880	Bakkurei-tateduno-kofuki-kabuto	0
		hirtipes	ARROW, 1902	Hime-eboshi-hina-kabuto	0
		ohausi	ARROW, 1908	Ohausu-tateduno-kofuki-kabuto	0
		velutipes	ARROW, 1902	Kobu-eboshi-kabuto	0
	Mitracephala	*humboldti*	THOMSON, 1859	Funborudei-Kabuto	0
	Spodistes	*batesi*	ARROW, 1902	Batesu-kofuki-kabuto	0
		grandis	Sternberg, 1903	Oo-tsuya-ke-kabuto	0
		mniszechi	(THOMSON, 1860)	Munisu-zecchi-kofuki-kabuto	36
Dynastini	*Allomyrina*	*pfeifferi*	(REDTENBACHER, 1867)	Sabi-kabuto	110
	Augosoma	*centaurus*	(FABRICIUS, 1775)	Kentaurusu-kabuto	73
		hippocrates	MILANI, 1995	Nise-kentaurusu-kabuto	0
	Beckius	*beccarii*	(GESTRO, 1876)	Sanbonduno-kabuto	22
	Chalcosoma	*atlas*	(LINNAEUS, 1758)	Atorasu-oo-kabuto	590
		caucasus	(FABRICIUS, 1801)	kohkasasu-oo-kabuto	880
		engganensis	NAGAI,2004	Engano-oo-kabuto	12
		moellenkampi	KOLBE, 1900	Mohrenkanpu-oo-kabuto	73
	Dynastes	*granti*	HORN, 1870	Guranto-shiro-kabuto	260
		hyllus	CHEVROLAT, 1843	Hirusu-shiro-kabuto	58
		neptunus	(Quensel in SCHÖNHERR, 1805)	Nepuchuhn-oo-kabuto	260
		hercules	(LINNAEUS, 1758)	Herakuresu-oo-kabuto	3,600
		satanas	(MOSER, 1909)	Satahn-oo-kabuto	320
		tityus	(LINNAEUS, 1763)	Teiteiusu-shiro-kabuto	73
	Eupatorus	*birmanicus*	ARROW, 1908	Biruma-gohonduno-kabuto	0
		gracilicornis	ARROW, 1908	Gohontsuno-kabuto	110
		hardwickei	(HOPE, 1831)	Hime-gohontsuno-kabuto	0
		siamensisi	(Laporte de CASTELNAU, 1867)	Tai-gohontsuno-kabuto	0
		sukkiti	MIYASHITA & ARNAUD, 1997	Sukitto-gohontsuno-kabuto	0
	Golofa	*claviger*	(LINNAEUS, 1771)	Kuraudeiga-tateduno-kabuto	0
		cochlearis	OHAUS, 1910	Kokerearisu-tateduno-kabuto	0
		costaricensis	BATES, 1888	Kosutarika-tateduno-kabuto	0
		globulicornis	DECHAMBRE, 1975	Buroburikorunisu-tateduno-kabuto	0
		imperialis	THOMSON, 1858	Inperiarisu-tateduno-kabuto	0
		minutus	STERNBERG, 1910	Minutousu-tateduno-kabuto	0
		obliquicornis	DECHAMBRE, 1975	Oburikikorunisu-tateduno-kabuto	0
		pelagon	BURMEISTER, 1847	Peragon-tateduno-kabuto	0
		pizarro	HOPE, 1837	Pisaro-tateduno-kabuto	0
		porteri	HOPE, 1837	Nokogiri-tateduno-kabuto	28
		pusillus	ARROW, 1911	Peshirusu-tateduno-kabuto	0
		tersander	BURMEISTER, 1847	Terusandah-tateduno-kabuto	0
		unicolor	(BATES, 1891)	Yunikarah-tateduno-kabuto	0

Table 1. (Continued)

Tribe	Genus	Species		Japanese (reading)	Search volume
Dynastini	*Golofa*	*xiximeca*	Moron, 1995	Shishimekata-tateduno-kabuto	0
	Megasoma	*actaeon*	(Linnaeus, 1758)	Akutaeon-zou-kabuto	12
		anubis	(Chevrolat, 1836)	Anubisu-zou-kabuto	36
		cedrosa	Cartwright, 1963	Kedouro-zou-kabuto	0
		elephas	(Fabricius, 1775)	Zou-kabuto	880
		gyas	(Herbst, 1785)	Giasu-zou-kabuto	16
		joergenseni	(Bruch, 1910)	Yorugensen-zou-kabuto	0
		lecontei	Hardy, 1972	Rekonte-zou-kabuto	0
		mars	(Reiche, 1852)	Marusu-zou-kabuto	210
		occidentalis	Bolívar y Pieltain, Jiménez-Asúa & Martínez, 1963	Mekishiko-zou-kabuto	0
		pachecoi	Cartwright, 1963	Bakeko-zou-kabuto	0
		punctulatus	Cartwright, 1952	Bunkutuuratuusu-zou-kabuto	0
		sleeperi	Hardy, 1972	Surihpah-zou-kabuto	0
		thersites	LeConte, 1861	Terushitesu-zou-kabuto	0
		vogti	Cartwright, 1963	Vohgu-zou-kabuto	0
	Pachyoryctes	*elongatus*	Arrow, 1941	Biruma-tategoto-kabuto	0
		solidus	Arrow, 1908	Tategoto-kabuto	0
	Trypoxylus	*kanamorii*	Nagai, 2006	Kanamori-kabuto	10
	Xyloscaptes	*davidis*	(H. Deyrolle et Fairmaire, 1878)	Shina-kabuto	0
	Xylotrupes	*florensis*	Lansberge, 1879	Nise-hime-kabuto	0
		pauliani	Silvestre, 1997	Pauria-nise-hime-kabuto	0
		pubescens	Waterhouse, 1841	Kebuka-hime-kabuto	22
Oryctini	*Blabephorus*	*pinguis*	Fairmaire, 1898	Kuriiro-munakubo-kabuto	0
	Ceratoryctoderus	*armatus*	Dechambre, 2001	Tuya-hirazu-tsutsu-sai-kabuto	0
	Coelosis	*bicornis*	Leske, 1779	Hiroduno-kabuto	0
		biloba	(Linnaeus, 1767)	Biroba-hiroduno-kabuto	0
	Dipelicus	*alveolatus*	(Heller, 1897)	Arubeoratosu-gokaku-sai-kabuto	0
		cantori	(Hope, 1842)	Oo-gokaku-sai-kabuto	0
		quadratifer	(Heller, 1897)	Kuwadoratelifah-gokaku-sai-kabuto	0
	Enema	*pan*	(Fabricius, 1775)	Pan-kabuto	28
	Heterogomphus	*carayoni*	Dechambre, 1986	Sasumata-amerika-hisashi-sai-kabuto	0
		hirtus	Prell, 1912	Kebuka-amerika-hisashi-sai-kabuto	0
		pilosus	Dechambre, 1998	Usuge-amerika-hisashi-sai-kabuto	0
		schoenherri	Burmeister, 1847	Oo-amerika-hisashi-sai-kabuto	0
	Oryctes	*nasicornis*	(Linnaeus, 1758)	Munakobu-sai-kabuto	0
	Podischnus	*oberthueri*	Sternberg, 1907	Togeashi-naga-sai-kabuto	0
	Strategus	*surinamensis*	Burmeister, 1847	Surinamu-mitsuno-kabuto	0
		talpa	(Fabricius, 1792)	Taruba-mitsuno-kabuto	0
	Trichogomphus	*martabani*	Guérin-Méneville, 1834	Mengata-kabuto	91
		vicinus	Dechambre, 1995	Kotsuno-arame-kobu-sai-kabuto	0
Oryctoderini	*Chalcocrates*	*borchmanni*	Endrdi, 1957	Borichimani-papua-kabuto	0
Phileurini	*Eophileurus*	*javanus*	Prell, 1913	Jawa-ko-kabuto	0
Japanese rhinocerus beetle					
	Trypoxylus	*dichotoma*		Kabuto-mushi	165,000

search volumes of three species (*Chalcosoma caucasus*, *Megasoma elephas*, *Chalcosoma atlas*) were also considerably high relative to other exotic dynastine species (Table 1, Fig. 1). As a whole, a relatively small number of dynastine species was represented by an extraordinarily high search volume, while an abundance of other species was represented by a low search volume, indicating the biased attention of Japanese to only a small number of dynastine species (Table 1, Fig. 1).

Such biased attention of humans to a small number of insect groups or species has been mentioned by previous studies (e.g. COELHO, 2000; COELHO, 2004; DICKE, 2004); including the results on Japanese culture (e.g. YUMA, 2004; TAKADA 2010 b; 2011). For example, YUMA (2004) demonstrated that only a small number of insect groups, such as Dipterans, Hemipterans, Lepidopterans and Orthoptreans, appear frequently in haiku poetry, which often praises insects and rejoices in the minuscule as a definite feature of a particular time and space for insects. Also, TAKADA (2010 b) revealed that "*Hotaru*" (Lampyrids) and "*Kabuto-mushi*" (Dinastines or Japanese rhinoceros beetles) are extraordinarily popular coleopteran groups in Japanese culture. In addition, TAKADA (2011) showed that only a small number of lampyrid species highly fascinate the Japanese general public. According to the survey of the popularity of different coleopteran families and different lampyrid species, TAKADA (2010 b; 2011) suggested that such biased attention is mostly due to (1) apparent morphological and ecological traits, (2) association with human survival (beneficial insects and pests), and/or (3) occurrence of insect groups around human habitation. In addition, Takada (2012 a) suggested that (4) high popularity of Japanese rhinoceros beetles is due to their widespread distribution in Japan. However, in this study, apparent morphological and ecological traits were important of the factors mentioned above to explain the biased attention to different exotic dynastine species, because imported exotic dynastine beetles are not used for practical purposes and are not considered as a pest, and were not originally distributed in Japan.

The most popular exotic dynastine species show a tendency to have the characteristics of a large body and/or well-developed, robust and forward lengthened horns relative to most of the other dynastine species, which are less popular in Japan. For example, hercules beetles, which are the most popular exotic dynastine species, have both characteristics in morphology and is the most largest dynastine species in the world. *Chalcosoma caucasus*, *Megasoma elephas* and *Chalcosoma atlas* also have relatively well-developed, robust and forward lengthened horns and/or a large body. This finding is not surprising, if we consider that Japanese rhinoceros beetles are the most popular of the Japanese coleopteran groups with an attractive and cool image due to their distinctive horn and large body. In passing, the origin of the word "*Kabuto-mushi*", which is the term for dynastines or Japanese rhinoceros beetles in Japanese, come from the association of that their distinctive horn with the crest of helmets (*kabuto* in Japanese) worn by Japanese traditional military warriors (KONISHI, 2007). In addition, in Japan, male dynastine beetles are kept as pets and pitted in fights against one another as a hobby, especially for children (KONISHI, 2007; KAWAHARA, 2007). Japanese people regard dynastine beetles in the same light as warriors, and thus their large body and/or well-developed, robust and forward lengthened horns stimulate the Japanese unique aesthetic sense toward insects and give cool, powerful and brave image. Such special aesthetic sense will not be explained with the pathos that represents a fleeting, varying beauty which was proposed and stressed as an explanation for the reason of Japanese love affair of insects including dynastine beetles by ORECK (2011) and TAKADA (2012 b), but may have originated from Japanese indigenous Shinto religion and Buddhism, both of which emphasize the spiritual harmonization between people and nature (BERENBAUM, 1995). In fact, most of the Japanese aesthetic sensitivity derived from Shinto religion, "the essence of which is the awe-inspired deification of nature" and Buddhism has been adapted it and enriched with new ideas (PRUSINSKI, 2012).

In addition, it is possible that the circulation of the particular dynastine species (including their

related goods and information) in Japanese society affects the popularity of different exotic dynastine species, because instead of the occurrence around human habitation of endemic dynastine species, their high circulation increases the opportunity for such dynastine species to be found by the general public. In fact, *Dynastes hercules* is apparently the most popular beetle sold, and other popular species sold were *Chalcosoma caucasus*, *Megasoma elephas* and *Chalcosoma atlas* in special pet shops in the Kanto and Kansai regions of Japan in 2002 (KAMEOKA & KIYONO, 2003). However, their circulation in Japanese society is also affected by the popularity of dynastine species related to Japanese aesthetic sense, i.e., their high popularity, which is probably associated with the needs of the general public, urging their high circulation generated by factors such as the rapid growth of the market and the number of breeders, and the establishment of new breeding techniques in Japanese society.

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要　　約

高田兼太：日本人は外国産カブトムシの中でもヘラクレスオオカブトに強く惹かれる．── 筆者は，文化昆虫学の研究の一環として，日本の法律上は国内に輸入可能である外国産カブトムシ86種の知名度を調べた．外国産カブトムシ各種の知名度は，片仮名で表記した外国産カブトムシ各種の名前に対応したGoogleの検索数（インターネット・ユーザーが，Googleを使ってあるキーワードを検索した回数）により評価し，Googleの検索数はGoogle AdWordsのキーワードツールを用いて査定した．調査の結果，外国産カブトムシの中でもヘラクレスオオカブトのGoogle検索数が極端に高く，またコーカサスオオカブト，ゾウカブト，アトラスオオカブトブトムシの知名度もまた相当に高いことがわかった．全体として，ごく僅かな種の検索数が極めて高く，一方で他のほとんどの種の検索数は低かったことから，多様な外国産カブトムシのなかでは極めて少数の種のみが，日本人に注目されていることがわかった．また，これら大きな注目を集めている種は，外国産カブトムシの中でも（1）よく発達した頑強で前方に伸びた角を持つ種であるか，もしくは（2）大型種である傾向がみられた．外国産カブトムシのうち，ごく一部の種に人気が集中する理由としては，（1）上述した形態的特徴をもつ種が日本人の美的感覚を刺激すること，（2）それらの種が日本国内においてよく流通していることが考えられた．

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