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Biodiversity And Matchbox Decoration: An Introduction

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***Abstract* — Representations of biodiversity in art offer an opportunity to examine the level of knowledge and the biocultural relations humans have with other species. We studied BIO-decoration on matchboxes, given their socio-economical significance. Our methodology involved the statistical analysis of matchboxes from an Internet sample. Several parameters have been included in the research (i.e. species abundance, fauna, flora, habitats, geographical distribution). The results of the study show preference for the depiction of fauna and organisms with wide distribution. Most life forms depicted on the matchboxes are used in a promotional context. We conclude that the BIO-decoration of matchboxes has primarily a commercial and touristic purpose, aiming at the aesthetic satisfaction of customers based on certain criteria, such as the comparative popularity of animals, and at the presentation of the producer country's natural and cultural attractions.**

Keywords — biodiversity; biodecoration; species abundance; matchboxes; art

I. INTRODUCTION

Visual arts contribute to our knowledge of the past environmental conditions and the common perceptions surrounding them. According to [1] , the ratio of red and green color usage in art can be a telling sign of the level of atmospheric pollution at the time the artist was creating their artwork. Similarly, biological diversity in all its forms (taxonomic, genetic and ecological) seems to be reflected in a significant part of cultural activity. For instance, artwork but also ordinary object decoration could serve as a valuable source of information about the connection humans had with the concepts and values associated with biodiversity. Animals such as the dolphin, monk seal, wolf, bull, horse, wild goat, red deer, dog, lion and the swallow are depicted on wall paintings, vases and other objects [2], [3], [4]. As [4] pointed out, useful zoological information can be derived from the study of classical texts; this, among other benefits, may help historical zoogeographers as a supplement to paleontology, archaeology, and art in the reconstruction of faunas of older epochs. According to [5], apart from the direct value of biodiversity (in food resources, medicine, biological control, bio-based materials, recreational activities, ecotourism) and its indirect value via ecosystem services, its significant importance has inspired arts and culture. Besides, the meaning of this very value has been officially recognized by international conventions and treaties (e.g. the International Convention on Biodiversity in Rio de Janeiro, 1992) [5]. On the other hand, art as a communication medium has progressively claimed very particular purposes for its existence; it has been used in the trade or for the manipulation of the public opinion and it plays an integral role in advertising [6]. Therefore, these interactive relations between nature and culture contribute to the increased appreciation of works of art by more social groups [7]. According to [8], scientists examine to what degree art evokes an emotional response and thus consequently study the realization of environmental changes and their impact on biodiversity.

This study researches the patterns of biodiversity depiction in the decoration of matchboxes, photos of which are publicly available online as parts of private collections. The artistic decorations on the observed matchboxes tend to reveal information about their time of production, reflecting the interests of the respective social structures and functions. For instance, according to [9], matchbox decoration has been used for advertising, political propaganda and emotional manipulation. The match selling commerce has been in decline since the 1990s but it still survives thanks to matchbox collectors. After all, it is known that the interest and knowledge surrounding biodiversity are dependent on the aesthetic value associated with it [10]. It should be noted that up to the late twentieth-century matchbox collectors would sometimes showcase their hobby even by founding matchbox museums (https://matchesmuseum.com).

In this article the following research questions were addressed: (a) What are the distributional patterns of the basic categories of biodiversity-inspired decoration in matchboxes (the categories are further discussed in the section Materials and Methods); (b) How many countries are represented in the researched sample of matchboxes, and (c) where are these countries located in the great biogeographic realms of the world? Finally, (d) does the distribution of the BIO-decoration and the biogeographic distribution have the same distribution variables in question (type of BIO-decoration and biogeographic distribution tend to be the same or not)?

II. MATERIALS AND METHODS

The pictures observed and used for the analysis in this study were obtained by extensive online research. In total, the photos of 772 matchboxes were used as samples and the artworks on the examined matchboxes were grouped based on categories that are presented in Table 1.

The sample of 772 matchboxes (Table 2) was created randomly, therefore featuring different levels of representation for the countries of origin. The distribution of the countries in the various biogeographic realms, as defined by [5], was also random. Nonparametric statistical testing methods like Kruskal-Wallis ANOVA (H) and Mann-Whitney U test were used for the analysis of all data.

Countries for which the variables often presented a null value were excluded from the data analysis in order to avoid skewed results. In any case, our statistical hypothesis tests had a 95% confidence level.

TABLE I. CATEGORIES OF BIO-DECORATION IN THE INTERNET SAMPLE OF MATCHBOXES.

Categories	Descriptions	Examples
Matchbox abundance (N) per origin country (m-Boxes)	All matchboxes produced in a country, regardless of artwork.	
BIO-decorated matchbox abundance (N) (m-Bio)	All matchboxes produced in a country, depicting themes relevant to biodiversity.	
Abundance (N) of BIO-decorated matchboxes depicting Flora (m-Fl)	All matchboxes produced in a country, depicting one or more plant species.	
Abundance (N) of BIO-decorated matchboxes depicting Fauna (m-F)	All matchboxes produced in a country, depicting one or more animal species.	
Abundance (N) of BIO-decorated matchboxes depicting a Habitat (m-Hab)	All matchboxes produced in a country, depicting a habitat.	

Abundance (N) of BIO-decorated matchboxes depicting indigenous organisms (m-Ind.)	All matchboxes produced in a country, depicting at least one indigenous organism in that country.	
Abundance (N) of BIO-decorated matchboxes depicting allogenic organisms (m-All.)	All matchboxes produced in a country, depicting at least one allogenic organism for that country.	
Abundance (N) of BIO-decorated matchboxes depicting organisms with wide distribution (m-W.D.)	All matchboxes produced in a country, depicting at least one organism with wide distribution across the planet.	

TABLE II. ABUNDANCE OF MATCHBOXES FOUND IN VARIOUS WEBSITES DISTRIBUTED BASED ON COUNTRY OF ORIGIN, BIOGEOGRAPHIC REALM AND LATITUDE.

Countries	GPS	BIOG.REG.	m-Boxes	m-Bio	m-FI	m-F	m-Hab.	m-Ind.	m-All.	m-W.D.
Argentina	40°S-60°S	NEOT	27	15	2	12	0	0	1	2
Australia	20°S-40°S	AUST	6	4	2	4	0	0	1	5
Austria	60°N-40°N	PALA	16	12	8	5	1	1	6	6
Bangladesh	0°N-20°N	INDO	6	3	0	3	0	1	2	0
Belgium	60°N-40°N	PALA	30	13	3	8	0	1	3	3
Brazil	0°S-20°S	NEOT	14	6	3	3	1	1	0	1
Bulgaria	60°N-40°N	PALA	10	4	2	3	0	0	3	0
China	40°N-20°N	PALA	45	14	7	10	1	2	2	3
Colombia	0°S-20°S	NEOT	1	1	0	1	0	1	0	0
Croatia	40°N-20°N	PALA	7	6	0	6	0	0	0	6
Czech Rep.	60°N-40°N	PALA	3	3	0	3	0	0	1	2
Ecuador	0°S-20°S	NEOT	3	2	0	2	1	1	0	0
Egypt	40°N-20°N	PALA	1	1	1	0	0	0	0	0
Finland	80°N-60°N	PALA	1	1	0	0	0	0	0	0
France	60°N-40°N	PALA	39	32	4	28	1	0	7	22
Germany	60°N-40°N	PALA	33	31	5	20	1	0	2	12
Greece	40°N-20°N	PALA	12	7	0	6	2	0	1	1

Hungary	60°N-40°N	PALA	17	8	4	5	2	1	0	7
India	20°N-0°N	INDO	97	54	11	46	5	15	6	8
Indonesia	20°N-0°N	INDO	2	2	0	1	0	0	1	0
Ireland	60°N-40°N	PALA	1	1	0	0	0	0	0	0
Israel	40°N-20°N	PALA	5	3	1	3	0	0	1	2
Italy	40°N-20°N	PALA	31	25	16	11	2	8	6	8
Japan	40°N-20°N	PALA	109	92	9	84	3	29	20	21
Latvia	60°N-40°N	PALA	1	1	0	1	0	0	0	0
Lithuania	60°N-40°N	PALA	2	2	2	1	0	0	0	2
Mexico	40°N-20°N	NEOT	3	1	0	1	0	0	0	0
Morocco	40°N-20°N	PALA	3	3	0	3	0	0	1	1
Netherlands	60°N-40°N	PALA	8	4	1	4	1	0	2	2
Peru	40°S - 60°S	NEOT	1	1	0	1	1	1	0	0
Poland	60°N-40°N	PALA	21	21	7	16	1	3	4	9
Portugal	40°N-20°N	PALA	2	2	1	2	0	0	0	0
Romania	40°N-20°N	PALA	7	5	2	4	0	0	3	1
Russia	80°N-60°N	PALA	53	41	14	32	2	5	13	18
Saudi Arabia	20°N- 0°N	PALA	1	1	0	1	0	1	0	0
Slovakia	60°N-40°N	PALA	4	4	1	4	0	0	0	4
South Africa	20°S-40°S	AFRO	1	1	0	1	0	0	0	1
Spain	40°N-20°N	PALA	71	51	14	49	12	4	24	18
Sweden	80°N-60°N	PALA	32	23	4	18	1	0	7	8
Switzerland	60°N-40°N	PALA	1	1	1	1	1	0	1	0
UK	60°N-40°N	PALA	9	7	0	7	2	0	3	3
Uruguay	40°S - 60°S	NEOT	14	14	8	14	5	10	1	3
USA	60°N-40°N	NEAR	13	2	0	2	0	0	1	0
Venezuela	20°N-0°N	NEOT	9	9	8	9	0	6	2	0

III. RESULTS AND DISCUSSION

Based on the categories we established, we found that 534 matchboxes were decorated with artwork presenting living organisms (m-Bio), comprising 69% of the e-matches collection. The majority of the matchboxes (435) depicted animal species followed by 179 matchboxes decorated with widely distributed organisms (m-W.D.), 141 matchboxes depicting flora (m-Fl), 125 featuring allogenic species (m-All.), 91 showcasing indigenous species (m-Ind.) and 46 presenting a habitat (m-Hab.) (Fig.1).

Overall, only 44 countries are represented in the 772 matchboxes of the e-matches collection, comprising 23% of the UN nations. These countries are located in six (6) of the eight (8) biogeographic realms of the world [5] (Fig. 2). Thirty of these countries belong to the Palearctic realm, eight countries are found in the Neotropical realm and three are located in the Indotropical realm. The Nearctic, Afrotropical and Australasian realms were only represented by a single country each and therefore excluded from further statistical analysis.

According to the statistical analysis, it was surmised that the majority of the examined matchboxes came from the Palearctic biogeographic realm. It also seems that among the Bio-decorated matchboxes (m-Bio), those depicting fauna (m-F) were more common compared to all other categories (Fig. 3).

From the results produced by the statistical hypothesis testing, it is important to highlight the following two: (a) The null hypothesis of homogeneous distribution of the variables m-Ind., m-All. and m-W.D. was rejected based on the significant Kruscal-Wallis ANOVA test (H= 9.02, df=2, p=0.01), which means that the samples have no homogenous distribution for the variables in question. Variance heterogeneity was mainly revealed between the

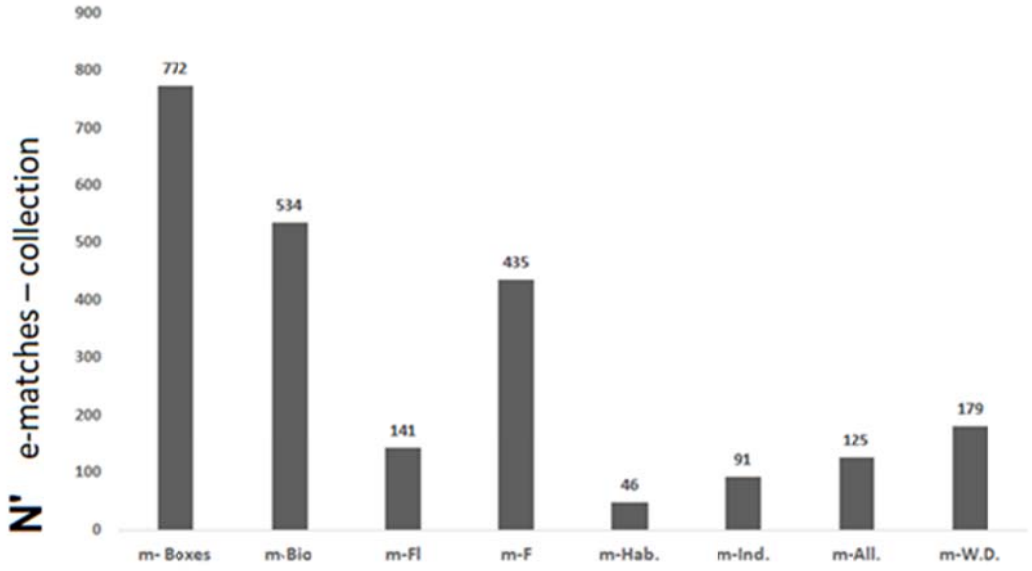

Fig. 1. *Distribution of the BIO-decorated matchboxes in the e-matches collection.*

variables m-W.D. vs. m-Ind. (z= -2.15, p=0.02) and m-W.D. vs. m-All. (z=-7.79, p=0.00) based on a Mann-Whitney U-Test. On the contrary, the null hypothesis for the variables m-Ind., m-All. was accepted (z= -1.72, p=0.086) (Fig. 4). (b) The null hypothesis of homogeneity for the samples of the categories m-Fl, m-F and m-Hab is rejected (H = 21.56, p=0.00), which is a clear indication of the preferences in matchbox BIO-decoration globally. There is a significant preference for depiction of animal species over the categories m-Fl and m-Hab. It is also evident that the second most popular choice is the depiction of plant species and the decoration with various habitats comes third (Fig. 5). (c) The hypothesis of homogeneous distribution of the samples of the BIO-decoration categories between two biogeographical realms was accepted (Fig. 6) (Table 3).

According to all the above, it seems that the levels of organization in biodiversity are represented emphatically in the preferences concerning matchbox artwork. This could be an important indication that human societies attribute particular significance to environmental topics. More than 69% of the matchboxes found online during this research were decorated with artwork associated with biodiversity. The higher representation of countries in the Palearctic biogeographical realm (30) is mostly linked to its larger land surface compared to others. In a similar pattern, the larger Neotropical realm is more frequently represented (8 countries) than the Indotropical (3 countries) [11]. The depiction of animal species (m-F) has a significantly higher frequency compared to the other BIO-decoration categories. This frequency might be linked to humans' greater interest in animals, which is sometimes rooted in emotional reasons [9]. Furthermore, the depiction of an animal on a matchbox works as a touristic promotion for the region of this species' geographical distribution (Fig. 7). It seems, however, that the humans' sensitivities regarding biodiversity are also reflected on the frequency of the representation of indigenous (m-Ind) and allogenic (m-All) species. The patterns for each category did not bear significant differences. This finding could be related to the average level of education in the countries represented in the e-matches collection or even to their level of active programs for environmental education which reinforces environmental sensibility [12].

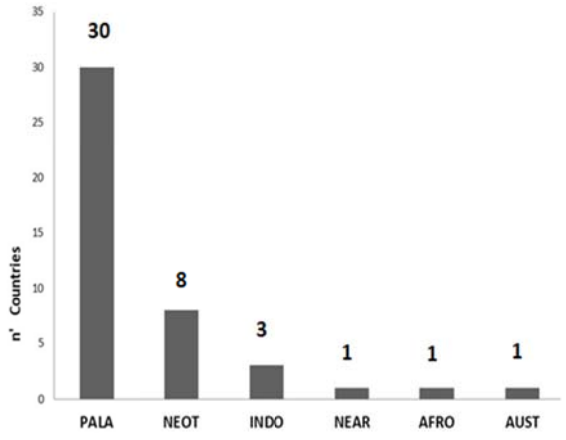

Fig. 2. *Distribution of the 44 countries represented in the e-matches collection in the eight (8) biogeographical realms. Where PALA= Palaearctic, NEOT= Neotropical, INDO= Indotropical, NEAR= Nearctic, AFRO= Afrotropical, AUST=Australasian.*

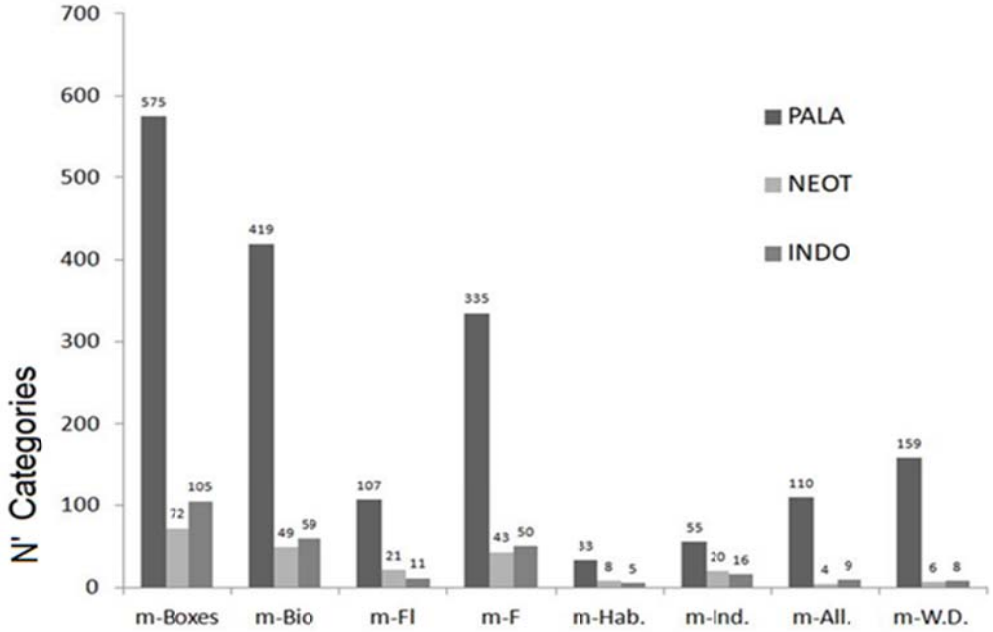

Fig. 3. *Abundance (N') of the BIO-decorated matchboxes categories for the three (3) most represented biogeographic realms. Where PALA= Palaearctic, NEOT= Neotropical, INDO= Indotropical, NEAR= Nearctic, AFRO= Afrotropical, AUST=Australasian.*

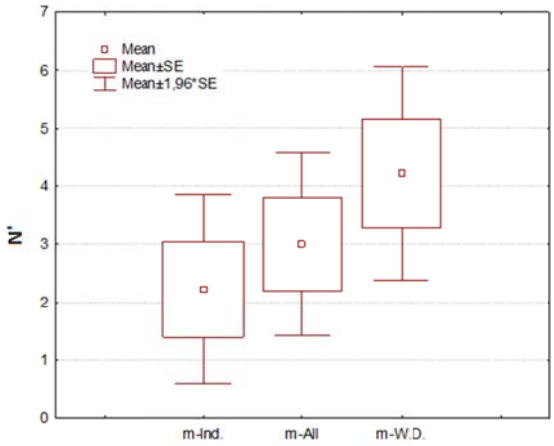

Fig. 4. *Variables of the abundance, N' of the samples for the categories Indigenous, m-Ind., Allogenic, m-All. and Wide Distribution, m-W.D.*

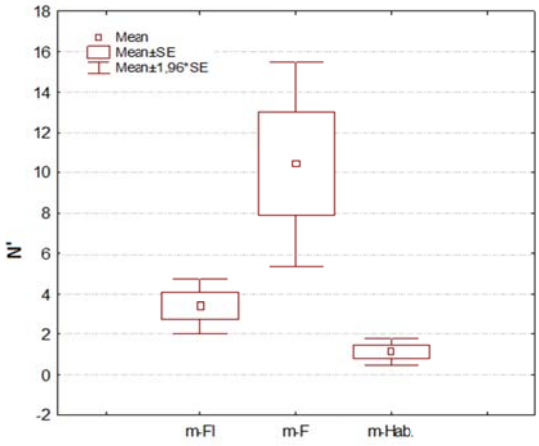

Fig. 5. Variables of the abundance, N' of the samples for the categories Flora, m-Fl, Fauna, m-F and Habitat, m-Hab.

TABLE III. KRUSKAL–WALLIS ANOVA (H) RESULTS.

Biogeographic regions as Independent Categories / Bio-Decorations Dependent Categories	**Kruskal –Wallis ANOVA (H)**
PALA – NEOT / m-Boxes	H = 0.72 p.= 0.40 > p.0.05
PALA – NEOT / m-Bio	H = 0.88 p.= 0.35 > p.0.05
PALA – NEOT / m-Fl	H = 0.34 p.= 0.56 > p.0.05
PALA – NEOT / m-F	H = 0.54 p.= 0.46 > p.0.05

In any case, the abundance of information provided from the analysis of matchbox decorations creates a particularly interesting field for research, which could also be relevant to human and economic sciences, besides those of biology and ecology.

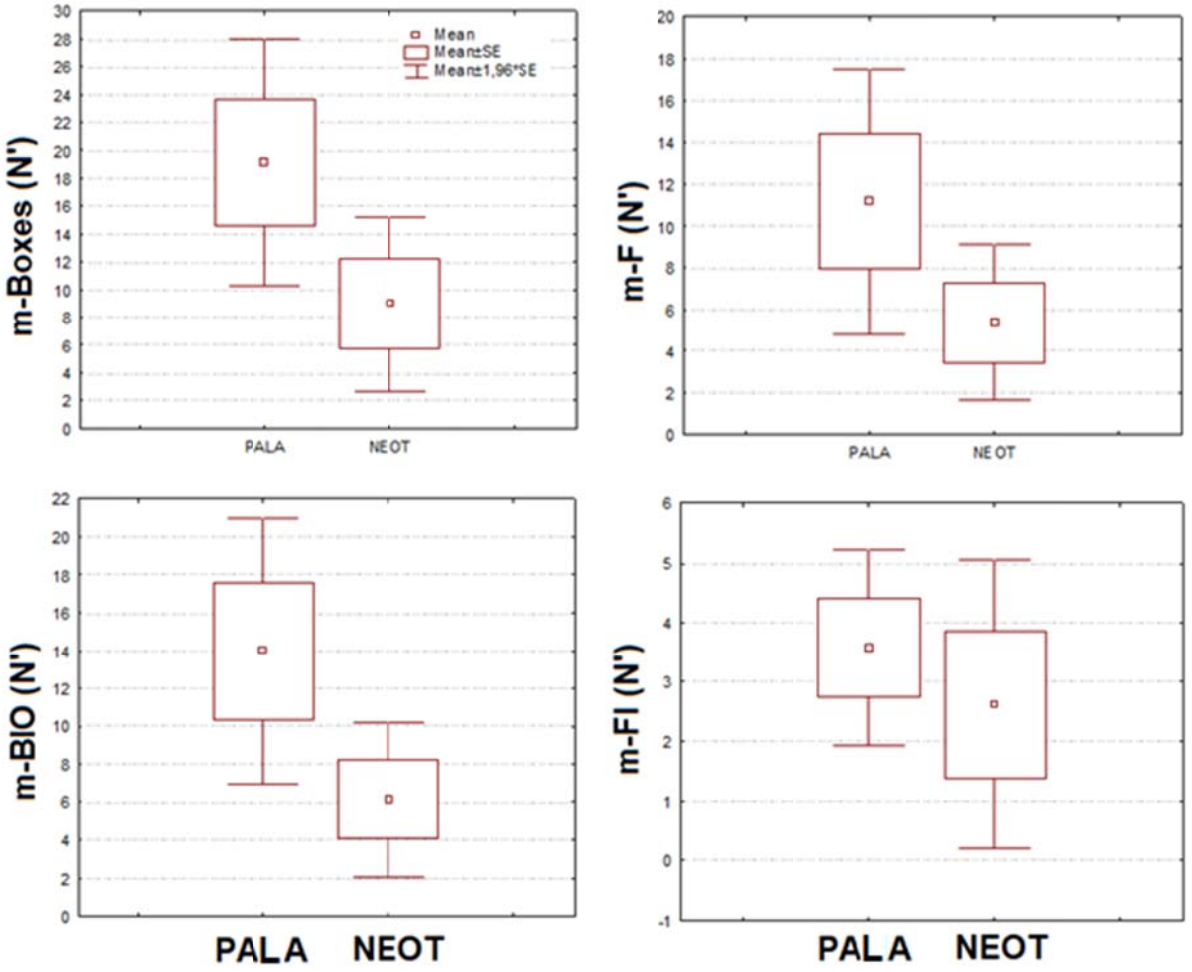

Fig. 6. *Distributions of the abundance, N' variables for the BIO-decoration categories in two select biogeographical realms (PALA = Palaearctic, NEOT= Neotropical).*

Fig. 7. *Matchboxes from Greece, Peru and India respectively, depicting indigenous animals and characteristic habitats or cultural elements, thus utilizing the match market for touristic promotion.*

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