CONNECTING THE SPOTS: LEOPARD PRINT FASHION AND PANTHERA PARDUS CONSERVATION

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Abstract

Leopard print is a proliferating fashion design with perpetual, cross–market appeal. But as demand for textiles replicating the leopard's pattern soar, leopards themselves have disappeared from more than 75% of the historic range. This study quantifies the fashion interest in leopard print to evaluate whether its popularity reflects an interest in wildlife, specifically in leopards or spotted cats, and whether this has contributed, or has the potential to contribute, to conservation. Global interest is documented and quantified by leveraging user–generated internet data (Google Trends Index), the traditional editorial media (Lexis Nexis), and social media (Instagram). The results suggest little correlation between interest in leopard print and interest (or concern) over leopards in the wild. In this context, conservation and fashion preferences may currently be linked only tenuously by most consumers, presenting a challenge, and potentially great opportunity, if they could be connected in ways making the relationship become mutually beneficial. As one way of achieving this, we conclude by

proposing a wildlife royalties funding mechanism whereby the fashion print would benefit leopards through a payment scheme for rights of use for commercial purposes.

Statement of intended contribution

This is the first academic study of its kind to quantify and analyse public interest in leopard print fashion and explore whether liking, indeed purchasing, leopard print reveals an interest in wildlife that could be used for leopard conservation. The study is timely because leopard print is not only a perennial fashion favourite but has been making increasingly frequent news headlines in recent years due to its unstoppable popularity with fashion consumers. This cultural proliferation makes it a potentially influential charismatic ambassador for conservation marketing that has yet to be exploited.

This study will be of interest to conservation N.G.O.s looking for innovative marketing campaigns, for-profit fashion brands and retailers looking to engage with consumers demanding social responsibility from their brands, as well as those working more broadly in the fields of social marketing, wildlife conservation, big cats, fashion culture, big data analysis, social media, traditional news media, and user generated internet data. By quantifying leopard print's current disconnect from wild leopards, this paper offers a long-term solution to funding spotted cat conservation that could be implemented worldwide.

Introduction

Leopard print is a perennial fashion favourite [1.] This is remarkable because fashion trends are largely understood as perpetually volatile and time-dependent, following a pattern of seeping from the runways to the mainstream, saturating the market, and then fading away only to be reborn some years later [2.] But leopard print – an umbrella-term in fashion culture for the markings of all the 'spotted' big cats – bucks this trend. It is found simultaneously in high-end luxury and high-street brands, continually regenerating new versions of itself and infiltrating new markets [1.]. Leopards (*Panthera pardus*) themselves are in dramatic decline across Africa and Asia [3.4.5.]. From a wildlife conservation perspective, leopard prints' prevalence in fashion is therefore both pertinent and ironic. As demand for prints and textiles replicating its pattern continue to soar [6.], leopards have quietly disappeared from more than 75% of the historic range they inhabited 300 years ago. In parts of Southeast Asia, this decline has been calamitous across just the last few decades [4. 7].

One of the enduring challenges faced by conservation efforts is the absence of fervent public support and deployment. Whereas the rapid decline of biodiversity shows no sign of abatement, public mobilisation has failed to increase with the acuteness of the crisis [8.]. A positive for the leopard is its established status as a highly charismatic species [9. 10] meaning it is likely to draw backing from the public [11] as well as being an ideal candidate to represent conservation campaigns that address broader international concerns [12]. A negative for the leopard could however be its prolific representation culturally and commercially – creating a delusion that its wild population is similarly abundant [10]. Here we will quantify the fashion interest in leopard print to evaluate whether its popularity reflects an interest in wildlife, specifically in leopards or spotted cats, and whether this has contributed, or has the potential to contribute, to conservation. Drawing data from three

sources – internet search–engine data, the traditional editorial media, and social media – popular interest in leopard print will be established and quantified. The decision to use results from multiple sources comes from the conclusion of multiple recent studies that a multifaceted approach will likely yield more meaningful insights on social and cultural trends [13. 14. 15. 16]. Having evaluated the current popularity of leopard print in fashion and juxtaposed it against the dismal conservation status of many populations of spotted cats, we consider the potential for leveraging the cultural popularity of leopard print to greater conservation benefit and propose a 'wildlife royalty' mechanism which might deliver such benefit [17]. This type of mechanism has been implemented by and for individual businesses (Chantecaille beauty – https://chantecaille.com/pages/philanthropy; Save Your Logo – http://www.saveyourlogo.org/en/) and in specific sectors such as film and television (The Lion's Share Fund – https://www.thelionssharefund.com). Our proposal looks towards scaling up a leopard specific 'royalty' whereby the fashion print, far from distracting the consumers' attention from the threatened species that it emblematises, would instead benefit it through a payment scheme for license for commercial purposes.

Materials and Methods

User-generated internet data – Millions of fashion consumers actively use the internet to seek inspiration, source designs, and purchase with a click [18. 19]. In fact, 70% of luxury purchases are estimated to be influenced by online interactions [20]. Internet search engines have therefore emerged as an extensive source of data to investigate public trends.

With more than 75% of the world's internet searches conducted on Google [21], for this study the Google Trend Index (GTI) was chosen as a reliable metric for online consumer behaviour [22. 23.]. The GTI provides time-series information on fluctuations in public

interest in a topic across temporal (monthly) and spatial scales across the globe. Moreover, with data stretching back to 2004, it has become a valuable starting point for identifying historic trends, used in over 600 academic studies on IT, communications, medicine, health, business and economics [24.]. Conservation scientists have also begun exploring its potential, linking search volumes with unsolicited donations to a conservation charity [25.], measuring public interest in bird and butterfly species [26.], monitoring ecosystem degradation [27.], and analysing conservation science communication best practice [28.].

We extracted data from the GTI relating to monthly web search history for the search term *leopard print* as recorded globally from January 2004 (when Google Trends data were first available) to December 2018. Data were collected during 2019, but only complete years were included in the analysis to capture changes in seasonal variations visible in a time series (see Appendix 1).

To harness global search interest for *leopard print*, the search term needed to be analysed across all the world's languages and cultures. Testing (detailed in Appendix 1) revealed that searching trans-culturally using a GTI 'Topic' was most effective. Because the phrase *leopard print* is not an established 'Topic', the existing Topic *leopard – animal* was used instead and limited to fashion items via the 'shopping' Category.

Traditional editorial media – To quantify the time–relationship and character of traditional news media with the GTI time series, we used the LexisNexis Academic database. This database was chosen because it holds over 40,000 news records that cover online and print publications, from tabloids to broadsheets. Given leopard print fashion's ability to feature simultaneously in high-end and high-street goods [1] it is valuable to gather and compare different media sources aimed at a variety of audiences.

In social science research, the LexisNexis Academic database has been widely used in a diversity of studies to build sampling frames. It has been used for: event count studies to determine the frequency of specific events to understand social, cultural, and political trends at the national and international level [e.g. 29]; agenda-setting studies to analyse the attention news media give to a particular issue [e.g. 30. 31]; and framing studies to understand how issues and events are constructed in news articles by journalists [e.g. 32]. Content analysis of traditional editorial media has also been a research focus for conservation scientists (the Florida panther [33]; sharks [34]; and human-leopard conflict [35]). Following Ngheim *et al*, who assert that media content analysis can act as a significant driver of search interest [28.], it makes a useful comparative tool when working with user-generated internet data.

To make this comparison, we searched all English language news using *leopard print* and *animal print* as keywords. The keywords were separated by the Boolean operator OR. These keywords were selected to be as inclusive as possible to reduce the chance of missing leopard print–related stories from the database [see 36.]. All raw data collected were in monthly intervals (e.g. monthly news articles recorded in LexisNexis) from 2004–2018 (to correlate with the GTI data period). This resulted in a total of 87,867 individual published articles (data points) featuring leopard print. The results were then collated, the frequency and patterns of publication established, and the article text mined for relevant themes and key words (see Appendix 2). The celebrity names that occurred most frequently in the mined results were then analysed by year. Celebrity here follows the definition in Schouten et al 2019 of a 'traditional' celebrity such as actors, supermodels, and athletes [37]. To classify areas of emphasis we devised a thematic table with 11 categories of interest drivers: *clothing, celebrity, fashion week, high street, interiors, style advice, shopping, party, animal,*

endangered, conservation. Apart from *endangered* and *conservation*, these themes were selected because they were the top performers in the results and because all the articles could be defined by at least one of the chosen themes. *Endangered* and *conservation* were added to measure if any discussion occurred directly in leopard print reporting on its origin species. We also recorded the names and types of celebrities (e.g. *sports star* or *politician*), the types of publications recorded (e.g. *newspaper*), the city or country of publication, and whether the news article was *local*, *regional*, *national*, or *online.*

Social Media – To date, there has been limited conservation research using the popular social networking platform Instagram – the authors know of only one example: a study by Hausmann *et al* 2017 using social media content as a cost-efficient way to explore, and more continuously monitor, preferences for biodiversity and human activities in protected areas [38]. Instagram is a mobile application that has more than 400 million active users around the world [39]. The majority of active users live in the United States (25%), Europe (16%), and the Asia-Pacific region (16%) [40]. The application allows users to share photographs and short videos. Approximately eighty million photos are shared daily [41]. Users can add a short description to their photographs and then post them online. These descriptions often take the form of hashtags, which allow users to insert their photo into a wider 'hashtag conversation' [42. 43]. Photographs from Instagram can also be shared across other social media platforms including Facebook, Twitter, Tumblr, and Flickr.

In this study, Instagram was chosen because it has become the social media platform synonymous with fashion content and fashion marketing, being used by fashion consumers, retailers and marketers [44]. Its visual nature lends itself to product presentation and because images pose no language barrier, any post displayed on the application has the potential to be

shared internationally [45]. For the content analysis in this study, the photographic nature of the platform provides an ideal visual dimension through which the aesthetic appeal of the print of the leopard can be quantified. As of July 2019, there were upwards of 2 million public posts with the hashtag *leopardprint*. In comparison to traditional survey-based methods, Instagram data provide cost-effective information on the interests and preferences of people using leopard print. With such a high volume of posts with the hashtag *leopardprint*, Instagram-derived data could also overcome limitations related to sample size, time and location constrains, non-response bias, and self-reported errors [46].

To quantify the demographics and influence of social media, we collected a random sample of 10,000 public Instagram posts associated with the hashtag *leopardprint*. The dataset was collected on July 10, 2019. Because all the images were not posted on that day, the sample shows posts over 13 days dated from June 27 to July 10. The sample was crawled using the machine learning platform MetaEyes. MetaEyes was selected because it was the only available platform using machine learning based predictions of facial features to analyse for attributes that calculate age, gender, and hair colour – all helpful in establishing demographics. The sample size was limited to 10,000 because that is the maximum the platform facilitates during a one month period.

From the raw dataset a secondary content analysis sample was created using posts with 1,000 likes or more (See Appendix 3). This secondary subset was created to identify and analyse any patterns in the visual characteristics of high achieving posts. Likes (or positive measures of interaction) on social media are significant since the number of these units of recognition is considered to be the same as the number of followers who pay attention to a publication or

post and therefore provide a useful measure in public interest and behavioural patterns [47. 48. 49].

Separating the posts with over 1000 likes yielded a subset of 742 data-points. The associated 742 posts were downloaded individually and coded for content. The classification approach analysed the main subjects shown in the pictures [36]. The content of each data-point was manually classified and double-checked by a secondary party for consistency. The intercoder reliability (ICR) was 89%. Because the ICR scored highly, the contentious 11% of the data points were individually revisited and agreed upon by the primary and secondary coder.

Results

GTI Leopard print keyword results: Figure 1 shows the Google Trend Index time series from 2004 – 18 (Fig. 1). The overall search interest increases steadily up to December 2012. Interest then decreases while maintaining a seasonal pattern until July 2018 when interest surges, peaking four months later in October. While overall search interest has fluctuated, interest follows a strong seasonal pattern, annually declining in the late spring and increasing again in the early autumn. The troughs regularly hit a low at the end of May or early June, and a high between October and December. To test whether the seasonal effect results were at play, the results were separated into two groups of locations in the northern and southern hemispheres. These two groups showed the same seasonal pattern with interest lowest in May/June and peaking in October/November. This, in turn, implies that large populations are not manipulating the results.

Figure 2 maps regional interest globally. Searches recurred most frequently in Northern Europe and East Asia. Interest is also notable in North, Central and South America, as well as

Australia, New Zealand and Russia. As these countries are located in both hemispheres, local seasonal weather is unlikely to be the driver of this recurring autumnal interest in the print. Search interest is absent from Central Africa and the Middle East, notably both areas inhabited by real leopards. Figure 2 also shows the interest distribution for the top ten regional performers. Search interest is consistently scattered cross-country, frequently occurring at a local level. None of the ten countries show the highest interest levels occurring in a capital city.

Figure 1 also shows the most frequently searched Topics and Queries related to leopard print for the time series. These are fashion items (clothing and accessories) and online fashion stores. Leopard print tattoos, cakes, and wallpaper also feature. The GTI results are limited by the brief (one– or two–word) descriptions of the related queries and topics it calculates. There is no indicator, for example, of the age or the gender of the Googlers of these topics.

Focused searches of the two peak periods in the autumn of 2012 and 2018 show the same regional search interest. The related Topics and Queries reveal the increase of interest in 2012 to have been driven by the sportswear brand Nike's release of two shoe lines, the *Air Max Leopard* and the *Leopard Blazer*. Ten of the related Queries and Topics relate directly to the shoes. Unlike these peaks, which have a clear individual driver pushing a surge in interest, the colossal increase in search queries for *leopard print* in 2018 cannot be explained by one or even several events. What this may suggest is that rather than being impacted by one distinct driver, this surge in searches came about because all the Topics and Queries shown year-on year are inflated by further external Topics and Queries that the GTI does not have the capacity to reveal.

LexisNexis

In the time series for the 2004 – 2018, the autumn period – running from September to early November – displays peak frequency most years (the exceptions are 2008, 2015, 2016) (Fig. 1). Similarly, ten of the years show a smaller peak in February / March (the exceptions are 2005, 2012, 2016, 2018). Unlike the GTI, however, in the traditional news media this is present from 2004, and it is largely in the later years that it loses its prominence. Over the entire period, September is the month with the highest volume of publications, with a combined total of 8,195. April is the month with the lowest publications, with a combined total of 5,187. The volume of articles published per year increases dramatically from the start to the end of the period. 2004 records a total of count of 1,404. 2018 records 8,546. Throughout the entire period, the volume rises steadily, with the number of publications in any given year never falling below the previous one.

The content analysis shows that significant spikes in mentions occur when the multiple themes are reported on simultaneously. Actors and musicians were the most reported on celebrity types. However, the two individual celebrity figures who received the most mentions in relation to leopard print by a substantial margin were Kate Moss (model) 30% and Theresa May (politician) 28%. They were followed by Rhianna (musician), Kim Kardashian (reality star) and Victoria Beckham (fashion designer). The diversity of celebrity types was notable – from sports stars to art dealers, babies to grandmothers. 90% of the celebrities were female.

The average article length was 320 words. The longest was 3,241 words and the shortest 81 words. Long-form feature editorials consistently contained six to eight of the themes in tandem. 86% of the mentions were positive. Negative comments surfaced when trends were

shifting (e.g. from leopard to zebra print in the autumn of 2018). Negative comments also appeared in relation to the *style advice* theme. The negative mentions had no visible impact on the continued intensity of mentions. Overall, 4% of the articles included discussion of the real-life leopard, with 2% of the overall articles reporting on their vulnerable status in the wild.

Local and national news outlets were the most frequent sources, followed by online and lastly by regional. Newspapers were the dominant format. Mentions were found in a broad sweep of newspaper types, from national to small town dailies, and tabloids to broadsheets.

2018 Content Analysis: We carried out a content analysis to produce a focused survey of the 2018 period. 2018 was selected because it was both the most recent and the most data–rich period of the analyses and therefore promised the most relevant and abundant findings for informing future conservation strategy. We followed standard content-analysis procedures [50] and classified the 8,546 articles and editorials as either a primary leopard print article (*leopard print* or *animal print* appeared in the headline or first paragraph and at least once in the remaining text) or a secondary leopard print article (*leopard print* or *animal print* appeared at least once). This was to understand better the significant interest increase the both the traditional media and similarly the GTI results.

Mentions in national news articles surged in August. The quantity of mentions in national stories remained higher than the rest of the year throughout the next three months. They were surpassed in quantity by online stories in September and local stories in October. Local stories peaked in November, when leopard print in the news hit saturation point.

In this sample, the increase is driven by articles reporting on *runway shows* and *fashion weeks*. The runway shows for autumn/winter fashion weeks occur annually worldwide between February and March. While reporting on *fashion shows* featuring leopard print drive the most mentions in the spring period, and reporting on *celebrities* wearing leopard print drives the most mentions during the autumn period, a combination multiple themes are always at play. In other words, individual themes do not appear to drive mentions in isolation. The celebrities most reported on in conjunction with leopard print in 2018 were the supermodel sisters Gigi and Bella Hadid (28%), the JCrew businesswoman Jenna Lyons (21%), and the royal figure Meghan, Duchess of Sussex (21%).

Instagram

The results revealed the most common age group posting with the hashtag *leopardprint* was 25-34 (55%), followed by 18-24 (29%), 35-44 (7%), 0-17 (7%), 45-54 (1%) and 55+ (1%). Instagram has a billion monthly active users and as of January 2019, 71% of these are under the age of 35. The most popular age range is users between the ages of 25-34, followed by users between the ages of 18-24 [51]. This must be taken into consideration when reading the results from the sample as they do not display a marked trend away from the Instagram's user age distribution. Using Pearson's standard correlation coefficient, the distribution of leopard print users as a subset of Instagram users was examined (Fig. 3). The distribution by age of the leopard print sample correlates for males and females to the distribution by age of all Instagram users. Male Instagram users are a higher percentage of the population than the males in the Leopard print sample as a percentage of the total leopard print sample. This is true for all age groups, but in particular for the under 35s. The reverse is true for females. In the sample of hashtag *leopardprint* posts, 91% were female.

8.2% of the sample contained geotags. The results show some correlation with the results of the GTI limited to the Shopping category (see Figs 2 & 3). Six of the top 10 countries for both are the same (U.K., U.S.A., France, Japan, Spain, and China). The results also show how on Instagram, language does not seem to be limiting in the same manner as on the GTI. While the U.S. (1) and U.K. (3) rank highly, with India (8) and Canada (9) also faring well, the six remaining countries in the top 10 are non-English speaking. The demographics of Instagram users must again be taken into account here. The social media platform has the most users in the United States (140 million), India (120 million) and Brazil (95 million) [52]. Another consideration is that India is the only listed country that has real leopards.

Micro sample of Instagram posts with upwards of 1000 likes: The single Instagram post with greatest number of likes in our sample had 53,885 likes. A total of 743 posts had over 1,000 likes. Only one image did not feature a person or people. 95.7% were female, 1.15% were multiple people male and female, and 0.85% were declaredly transgender. 89% were adults, 1.3% were teenagers, 1.14% were children, 0.74% were infants and 0.74% seniors. 1.63% featured an adult and a child together.

Leopard print was featured on clothing (89%), fashion accessories (8.2%), cosmetics (1.9%) home furnishings (0.7%), tattoos (0.19%) and snow leopards (0.19%). The clothing type that recurred most frequently was the dress (27.4%). 32.5% of the posts featured fashion items that were for sale. The most liked Instagram post with the hashtag *leopardprint* featured the celebrity Perrie Edwards from the popular music group Little Mix. Overall, however, only 2.7% of posts featured a celebrity. The sample displayed a diverse array of picture moods. We identified 14 in total: fun (63%); sexy (17.6%); serious (3.07%); determined (3.07%); hip

(2.69%); relaxed (1.15%); punk (0.96%); professional (0.96%); classic (0.96%); moody (0.76%); cute (0.76%); classy (0.76%); cosy (0.76%); and casual (0.03%). The Instagram mood analysis from the sample of most liked images shows, in its diversity of dispositions, the adaptability of leopard print for its wearers.

Discussion:

Popular interest in leopard print is shown to be driven by fashion clothing and accessories (GTI), international fashion seasons and a diversity of mostly female (>90%) celebrities (LN). From the Instagram–derived data, leopard print was associated with a variety of moods, from 'professionalism' to 'punk', showing that while it is highly adaptable in its wearability, our insights into the emotions it evokes offer little evidence that they are at all related to issues surrounding biodiversity loss and the extinction crisis. In traditional news media, mentions of leopard print in association with the leopard's conservation status were less than 2%. Furthermore, of the countries where leopard print is shown to be most popular – France, Japan, Spain, China, the U.K. and the U.S.A. – only one is home to wild leopards, and it is plain that leopard print is most popular where wild leopards never occurred at all or are only a distant memory (fig. 4). This, however, may be a case where the adage that 'distance makes the heart grow fonder' might be turned to conservation advantage because these are countries which could be particularly impactful given that their citizens have sufficient wealth to allow them greater potential to fund conservation than may be typical of most contemporary range states (a potential that is not, at a national level, equitably realised in the conservation of megafauna) [53]. So while the results confirm that public interest in leopard print is consistent and reliable year on year, peaking annually in the autumn and, less so, each spring, the extent of an association, conscious or otherwise, between the fashion item and the real

374 animal (far less an awareness of its dire conservation status), while ultimately unknown, is
375 seemingly minimal. The drivers of interest in leopard print appear to be entirely different to
376 those that might drive an interest in leopard conservation, and thus might even be thought to
377 be a distraction from conservation: what currently springs to a person's mind upon seeing a
378 leopard print is, seemingly, not the plight of the wild species.
379
380 So while we have here documented the huge popularity of leopard print, our results indicate
381 that this interest has had minimal association with interest in leopards, wildlife, or
382 conservation. The crucial question, therefore, becomes whether this colossal opportunity can
383 be turned to conservation advantage in the future. Our results facilitate serious consideration
384 of that question and offer an exciting prospect of just how great the potential could be. The
385 challenge for conservationists is, therefore, not only to find a way to connect leopard print
386 fashion to the urgency of leopard conservation, but also to make that link in a way that
387 converts enthusiasm for the fashion item not merely to awareness but into practical benefit
388 for the emblematic wild species.
389
390 The good news for the leopard is that it has been established as a highly charismatic species
391 [9.10.], meaning it has the potential to attract substantial interest and empathy from the public
392 [11]. Moreover, in 2017 Macdonald et al identified leopards as a potential 'ambassador
393 species' – a species effective at generating attention for wider biodiversity within their
394 distribution [12]. This is significant because the study demonstrated that potential
395 'ambassador species' such as the leopard are more likely to be useful emblems for
396 conservation campaigns that target broader global issues [12]. In a world that is increasingly
397 interconnected and influenced by viral marketing campaigns [12], the leopard therefore has

substantial potential to save not only its own kind but the expansive habitats encompassed by their once colossal (although now sadly fragmenting) range.

But as the current plight of the leopard shows – with three of its nine subspecies classified as Critically Endangered, two as Endangered, two recommended for 'uplisting' to Critically Endangered and Endangered, and two as Near Threatened [3] – charisma alone has not been enough to save them thus far. Indeed, the renowned adaptability that is reflected in their extensive geographic range, and occupation of urban habitats [e.g. 35]. has probably fostered complacency about their conservation. At an extreme, contemporary leopard print's proliferation might even, in the manner speculated by Courchamp et al, involve a clearly charismatic animal, abundantly represented culturally and commercially, that is perceived as a virtual population whose widespread abundance creates a delusion that the wild population is similarly commonplace – a variant of the aphorism that familiarity breeds contempt [10]. Courchamp et al's suggestion was, therefore, that the competitive advantage (in the onlooker's mind's eye) of virtual populations (existing in much greater abundance and proximity to real ones) might have the perverse outcome of reinforcing a public perception that the natural population was secure and, in this way paradoxically accentuate the risk of extinction of these species most cherished by the general public [10]. While these links are speculative, the significant fact is that the huge popularity we have demonstrated for leopard print has not thus far saved the species. The crucial question for conservation is whether this situation can be reversed.

The question is important because addressing threats of the scale that imperil spotted cats will require significant global engagement and funding, running into millions of dollars annually [54] – a scale perhaps commensurate with the fashion industry built around leopard

print, and a scale that recruits the commitment of not only governments but also the international general public, who are increasingly being empowered to engage with specific political and social issues [55. 56]. Connecting the charisma of the leopard, its potential as an ambassador species, and the ubiquity of leopard print, will require commitments from all sides. One possibility, proposed by some of the authors of this article in 2016, is to create a royalties payment system whereby leopard print's commercial representation compensates its wild conservation [17]. Under this dynamic, fashion manufacturers and fashion consumers would contribute to leopard conservation every time they used or wore the animal's print. For example, in April 2019 there were 19,049 leopard print products for sale on the U.S. shop of Shopstyle.com. The average price for a leopard product on the site was $423.30. If 1% of the sale price went to leopard conservation each time one of every item was sold on the site, a fund in support of leopard would make over $8 million dollars. Such an effort would turn commercial competition into conservation cooperation between fashion prints and real populations.

As touched on at the start, voluntary programmes along these lines, such as 'The Lions Share' (specific to animals that feature in advertising – https://www.thelionssharefund.com) and 'Save your logo' (http://www.saveyourlogo.org/en/), have been attempted with some success. And in 2020, the big cat conservation group Panthera launched #leopardspotted, a campaign to raise awareness of the proliferation of leopard print in fashion, and with a target of raising 20 million U.S. dollars for leopard conservation (https://www.leopardspotted.org). By using the hashtag #LeopardSpotted on Instagram photos of leopard print, every post shared would act as both a marketing ambassador and a conservation fund-raiser for the species. This kind of campaign is likely to be highly beneficial, especially if the compensatory mechanism is coupled with an information campaign explaining the reasons

for such funding, i.e. the current conservation status and threats to the leopard and its habitat and the collateral benefits to other species within its ecosystem. The online nature of leopard print engagement through the social media platform could be a focus for further research in relation to the motivations of online donors – an under-studied group who are likely to become an increasingly important source of conservation funding [11.]. Likewise, such a campaign could be enhanced (and the narrative around leopard print altered more generally) by developing a trend for discussing the status of the leopard in fashion articles, such as the 87,000+ examined in this study. While we found these past examples to be lacking in conservation mentions, they were also revealed as being formulaic with the same topics recurring from one article to the next. In the context of the formulaic nature of these fashion articles, inserting the leopard issue into the print conversation could become part of a new formula and hold the potential to redirect public interest with some automaticity.

Finding an attractive benefit exchange is, however, a perpetual struggle for social marketers focusing on biodiversity [58]. As Veríssimo describes**,** the benefits to society of conserving biodiversity are often not accrued directly by a target audience, but are instead realized through long causal pathways, making them less clear and therefore less persuasively enacted. Furthermore, the gains are often long term, only accruing several years or even decades after the change is implemented [58]. The hope would be that if this kind of wildlife royalties campaign were adopted by fashion manufacturers, designers, and sellers of leopard print, not only would leopard conservation be benefitted but also the company and their consumers would be better perceived. Not participating in such a scheme might, through the pressure of emerging social mores, become embarrassing, and thus commercially disadvantageous. Being perceived as acting at the forefront of the conservation of the imperilled charismatic animal that represents them could even create a very positive response

from previous and new customers of such companies [10]. Indeed, these firms may improve their corporate social responsibility by helping to save an endangered species closely associated to their brand, an additional incentive to adhere to such a scheme.

The limits of classical economic approaches, with their dismissal of perceived externalities, to solve biodiversity conservation problems have been widely discussed in the literature [59. 60] The royalty mechanism that we propose is not a one-size-fits-all solution but rather a practical means, customised to the particular circumstances of leopard print and leopards, to connect the proliferation of the fashion item with its endangered real-life counterpart and secure the funding required to save it. Scaling up the idea might be achieved by firm codes of practice, incentivising, and perhaps even making regulatory requirements, mechanisms for the connection to be made between fashion and conservation most effectively.

It is beyond the scope of this study to explore the methods of implementing such a scheme. Similarly, because this is the first study of its kind attempting to quantify the popularity and possibly of leopard print for conservation, there are multiple limitations at play. Constraints within the three datasets (i.e. the small percentage of geotagged Instagram posts and the overall sample size, the ambiguities of the GTI functionality, and the confinement of traditional news media to English language articles) all leave open the possibility for much more inclusive analysis in the future. The wildlife royalties mechanism proposal is also just one possible means of connecting leopard print fashion with leopard conservation. We acknowledge that there may be bias on the part of the authors towards this particular solution, having proposed it in a previous study. But as a solution that closely connects with fashion’s commercial nature, we are confident that these biases are outweighed by its feasibility and potentially enormous impact on the conservation of spotted cats.

Conclusion

There is currently an exigent disconnect between those who design, sell, buy and wear leopard print with the plight of the leopard and, beyond that, caring about it. The timing for addressing this is pertinent because the fashion industry is under intense scrutiny and responding to growing pressure to change many of its fundamental practices [61.]. Fashion weeks and fast fashion brands are being boycotted by consumers who are becoming increasingly environmentally–minded [61.]. At the G7 Summit in August 2019, French president Emmanuel Macron debuted the Fashion Pact, an international coalition of fashion and textile companies (including their suppliers and distributors) with shared objective targets for reducing global warming, restoring biodiversity (with a focus on protecting species), and preserving the oceans [62.].

Real-life leopards have a reputation for being highly adaptable, and the irony is not lost that in fashion, leopard print exudes not just the aesthetic brilliance of the leopard's magnificent coat, but the very characteristic that has been so defining of the species itself. But just as cultural reverence for a species does not equate to that same cultural group opposing harms to the conservation of the species [63], even when there is an *aesthetic* appreciation or even admiration for a particularly charismatic species like the leopard, that does not necessarily lead to awareness of its endangered status or support for its conservation [57.]. The global prevalence of leopard print highlights the poignancy of a species having such traction on the minds and behaviour of such a colossal and worldwide public, while visibly diminishing in the wild. The real-life leopard and its fashion reflection are at present worlds apart, but its print popularity could instead be transformed into an opportunity for conservation.

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FIGURES

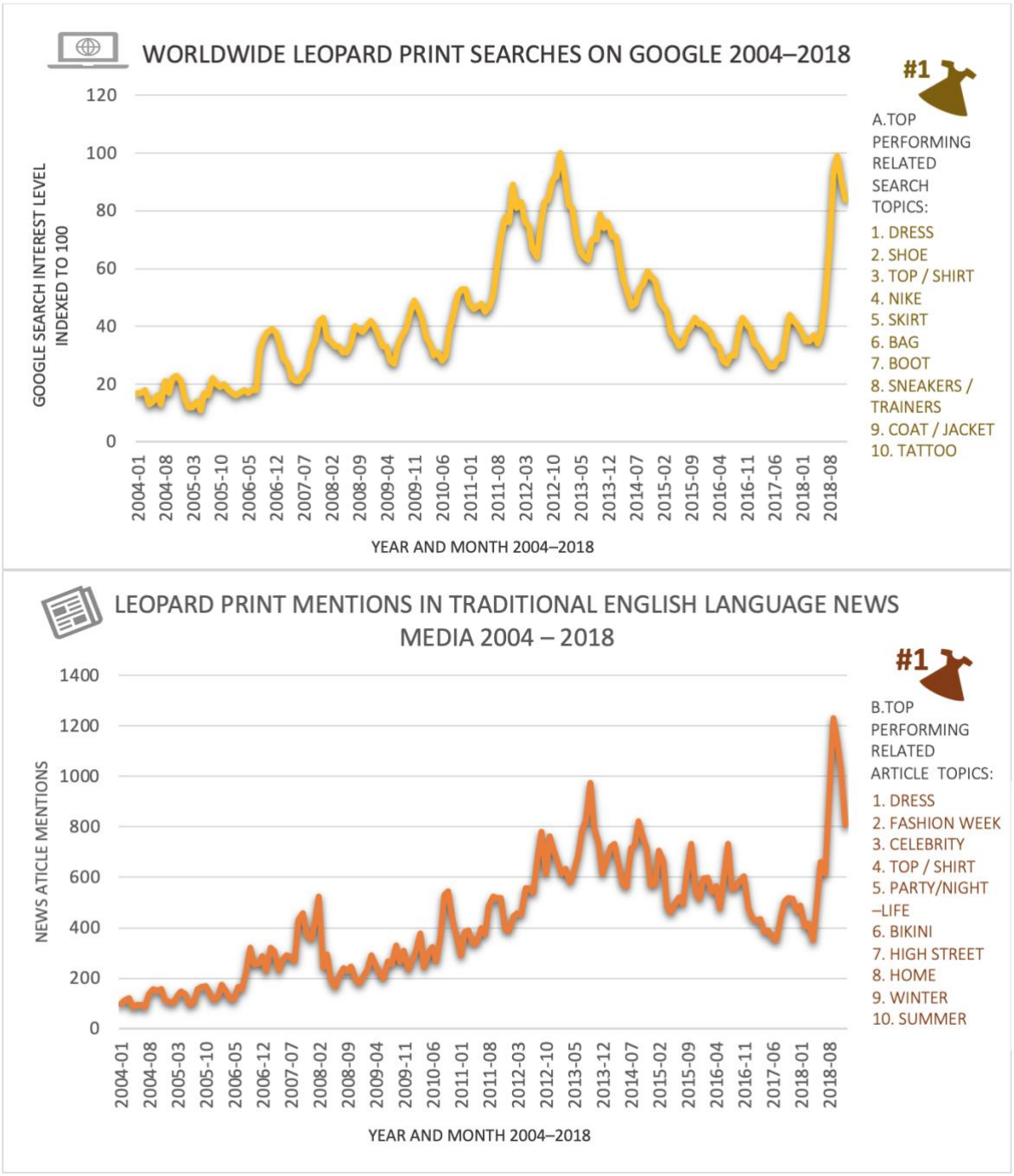

Figure 1. Time series results for Google Trends Index (GTI) and Lexis Nexis (LN) traditional news media between 1 January 2004 and 31 December 2018. The GTI shows time series results for the search for *leopard – animal* in the *shopping* category, and the top performing related search topics (A). The LN shows time series results for the articles featuring 'leopard print' or 'animal print', and the top performing related article topics (B)

Figure 2. Distribution of Google searches for leopard print fashion between 1 January 2004 – and 31 December 2018 using Google's 'leopard –animal' topic and 'shopping' category. The results are indexed 1–100 by the GTI.

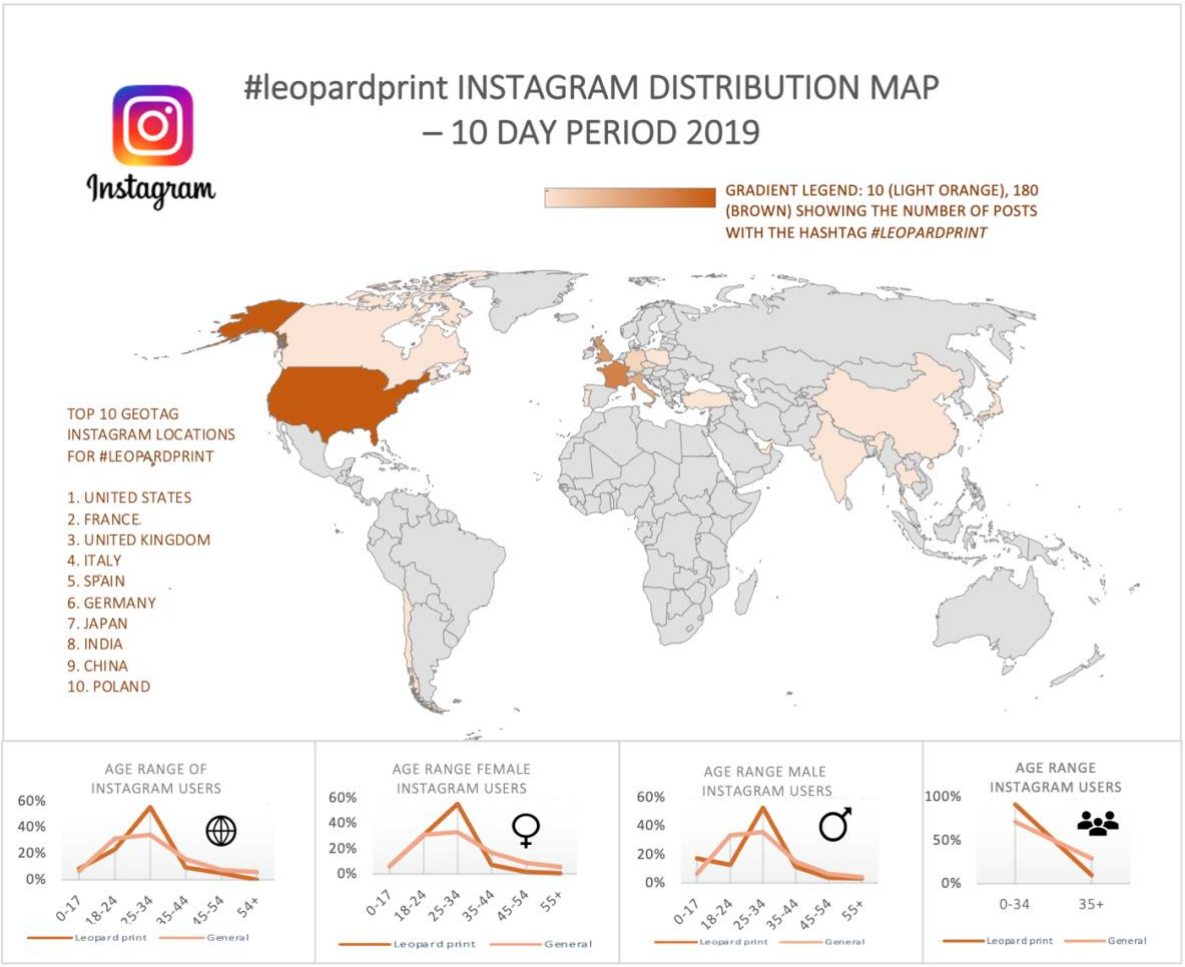

Figure 3. Distribution of geotagged Instagram posts with the hashtag #leopardprint between 27 June – 10 July 2018 (bottom). The comparative user demographics for the Instagram data is shown in the quartet of graphs below.

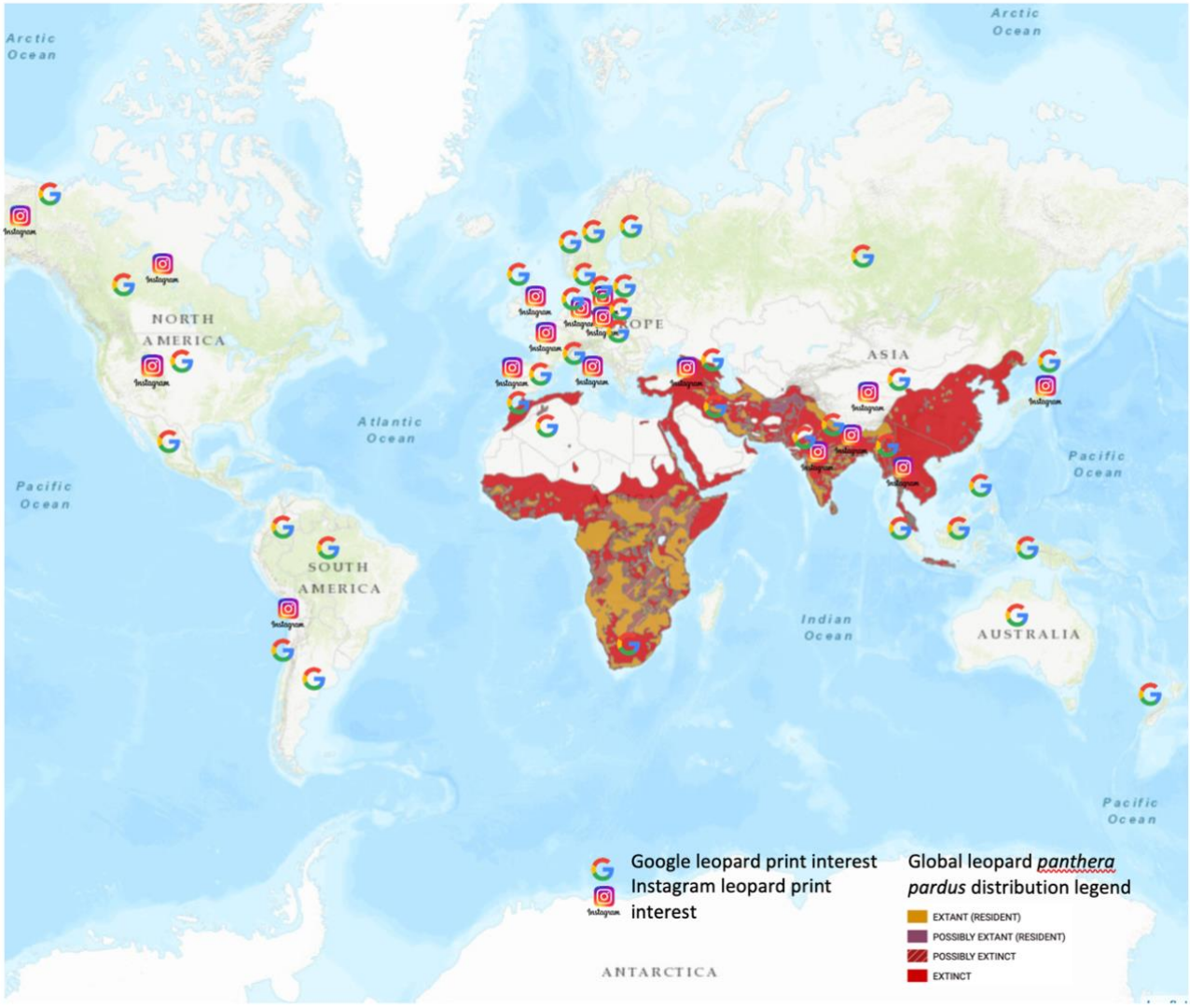

Figure 4. Map showing the present and historic distribution of the leopard *panthera pardus*, global Instagram posts relating to leopard print and global google searches related to leopard print consumer goods. Leopard distribution data and map are taken from the IUCN red list (Peter Gerngross 2019 https://www.iucnredlist.org/species/15954/163991139).