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## Exploring the effects of market scarcity on consumers' demand for rarity in the wildlife trade

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### ABSTRACT

Consumers' preferences for rarity in the wildlife trade can potentially lead to unsustainable exploitation of species in the wild, further increasing their desirability and price in the market as species become rarer. Understanding the processes underpinning the construction of preferences for rarity could help inform more effective conservation actions to help address unsustainable wildlife trade. In this study, we discuss how perceptions of market scarcity, and its interplay with species rarity, can influence the construction of value and consumers' behaviours in the wildlife trade. First, we introduce the meanings of scarcity and its social construction as emerging from social practices within socio-economic framings, which can alter consumers' perceptions and preferences. Then, by following theoretical insights from psychology and economics, we explore some of the processes through which market scarcity may affect perception of value, increasing desirability, prices, and stimulating purchasing intentions, in relation to different, yet intertwined, consumers' goals and motivations. Desirability of rare species and products may be constructed and/or amplified by scarcity as consumers seek to i) purchase signs of social distinction, ii) conform with social norms and beliefs, iii) avoid future regrets, iv) preserve freedom of choice from bans and regulations. We then discuss the potential interplay between species rarity and market scarcity, how they may independently and synergically affect consumers' preferences for wildlife, and some of the potential conservation implications. We finish by discussing some ways forward and how future research may contribute to understanding the social construction of scarcity and how it might affect demand in the wildlife trade.

### 1. Introduction

Worldwide, one in every five wild vertebrate species is affected by wildlife trade (Scheffers et al., 2019). When unsustainable, harvesting of plant and animal species results in increased extinction risk (Morton et al., 2021), becoming a major threat to biodiversity and also affecting people's livelihoods and well-being (IPBES, 2020). Multiple conservation actions targeting supply (e.g.,

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anti-poaching activities, community-based initiatives), transactional (e.g., trade regulations, border controls) and demand (e.g., bans on purchase and/or possession, behavioural change campaigns) sides of the trade chain have been designed to address over-exploitation (t Sas-Rolfes et al., 2019). Given the large scope of the trade and its complexity, integrating different ecological, social and economic dimensions, and accounting for synergies among them, is crucial in order to develop targeted conservation approaches (Bennett et al., 2021; t Sas-Rolfes et al., 2019; Thomas-Walters et al., 2020). Recently, the need for understanding the drivers of consumers' demand for wildlife has received more attention (Verissimo et al., 2020), as these can inform interventions on the ground aimed at changing consumers' behaviour (e.g., reducing consumers desire to curb on poaching pressures, Thomas-Walters et al., 2020). Understanding the socio-cultural practices underpinning demand for wildlife and products thereof is crucial to inform the development of more adequate and effective actions (Thomas-Walters et al., 2020; Thomas-Walters et al., 2020).

Rare species have been found to be highly attractive and valued in the wildlife trade (Altherr and Lameter, 2020; Hall et al., 2008). Consumers' preferences for rarity may fuel unsustainable exploitation, further increasing value in the market as species become rarer (Chen, 2016; Courchamp et al., 2006). In ecological terms, a species is considered rare when it occurs at low population abundance (e.g., low density) globally or locally (e.g., a vagrant bird species is locally rare although abundant elsewhere) and/or has a limited geographical range (e.g., endemic to specific areas) (Gaston, 1994; Kunin and Gaston, 2012). Species can be rare because of ecological and evolutionary traits (e.g., life histories, genetic diversity, behavioural attributes, trophic level, dispersal capability, carrying capacity). In addition, they can become rare because of ecological disturbances and extreme climate events (Kunin and Gaston, 2012). However, many species are increasingly becoming rarer because of human activities causing population and/or range declines. While not all rare species are at high extinction risk, they are typically more vulnerable to increasing human pressures (e.g., land-use change, Sykes et al., 2020), and their disappearance may cause profound evolutionary and ecological consequences (e.g., disruption of ecosystem functioning; Lyons et al., 2005). By integrating different ecological, economic and social dimensions, preference for rarity in the wildlife trade represents a complex driver of consumers' demand across various taxa and markets (Courchamp et al., 2006; Hall et al., 2008). Consumers' preferences for rarity has been studied for different taxonomic groups, including caged-bird (Harris et al., 2017; Krishna et al., 2019; Ribeiro et al., 2019), orchids (Hinsley et al., 2015), reptiles (Altherr and Lameter, 2020; Lyons and Natusch, 2013; Sung and Fong, 2018), and arthropods (Tournant et al., 2012). Moreover, preference for rarity has been observed in different wildlife trade markets, including food delicacies (Gault et al., 2008), bushmeat (Shairp et al., 2016), trophy hunting (Johnson et al., 2010; Palazy et al., 2012; Prescott et al., 2012) and exotic pet trade (Altherr and Lameter, 2020; Harrington et al., 2022; Hausmann et al., 2023). Understanding how preferences for rarity may develop could help understand why consumers tend to pose higher value on some species and help inform more effective conservation actions to address unsustainable wildlife trade.

In economics, preferences are generally explained through classic utility theory, which postulates that consumers make choices by ranking alternatives based on their perceived value and would always choose the one with the highest subjective utility (Farquhar, 1984). Accordingly, consumers' purchasing behaviour, such as seeking species and products with more vigour if they are rare in the wild, is explained by their efforts to rationally maximize utility among alternatives. Since rarity is a relative concept, perceptions and demand for rare species are influenced by beliefs, values and interpretations of contextual factors and symbols (Hall et al., 2008). For example, cues of species' rarity, such as management actions (e.g., antipoaching activities), publicity (e.g., movies and documentaries) or conservation status (e.g., at risk of extinction according to the International Union for the Conservation of Nature – IUCN) may skew preferences and preconceptions of quality of wildlife products (Gault et al., 2008; Hall et al., 2008). While the utility theory assumes that preferences are complete (i.e., consumers are aware of all subjective values) and stable (i.e., consumers would make the same choice across contexts), they are in fact incomplete and unstable (Warren et al., 2011). In this sense, consumers' behaviour is subject to social influence in contexts where purchasing choices are made (e.g., they can change due to changes in context) (Warren et al., 2011). Therefore, understanding how preferences for rarity develop requires engaging with the interplay between species rarity and other components of the socio-economic system underpinning wildlife trade.

While rarity in the "wild" mainly concerns species ecologies and conservation, scarcity concerns social dimensions related to accessibility, desirability, markets, and social norms. From a neo-classical economics perspective, scarcity focuses on studying human behaviour in relation to tensions between desired goods or services and scarce means which have alternative uses (Dugger, 1996; Robbins, 1962). Under this notion, species can be considered scarce when their demand is greater than their availability in the market. Scarcity not only influences how people make decisions based on what can be accessed or afforded, but ultimately how value is constructed and perceived (Lynn, 1991; Shah et al., 2015). In the wildlife trade, the value of rarity may be constructed from meaning-making processes influenced by social and economic institutions, such as those determining social norms and signs of distinctions (Hall et al., 2008). Similarly, perceptions of scarcity and the value assigned to scarce goods are constructed as a response to normative signs and symbols produced within the socio-economic system where decisions are made (Panayotakis, 2012). This has important implications for conservation, as, for example, preferences towards scarce species and their products can be created and/or manipulated either unintentionally or purposefully to increase profits. Disentangling the role of scarcity and its interplay with rarity can help increase understanding of its effects on driving demand in the wildlife trade.

In this study, we discuss how perceptions of scarcity, and its interplay with species rarity, can influence the construction of value and consumers' behaviour in the wildlife trade. First, we present the meanings of scarcity and how the socio-economic contexts where consumers make decisions influence its social construction. By gaining insights from theories from psychology, economics, and marketing studies, we then explore some of the various processes underpinning the social construction of preferences in the market and how these may drive desire for rare species in the wildlife trade. We then discuss how to address the interplay between species rarity and market scarcity to better characterize demand in the wildlife trade and target adequate conservation actions. We conclude by discussing possible ways forward and how future research may help further develop the concepts highlighted here.

## 2. Scarcity and the social construction of consumers' preferences

Scarcity broadly describes the basic disparity between people's *needs* and *wants* and limited means to fulfil them (Baumgärtner et al., 2006). By restricting choices available, scarcity affects how people value resources and make trade-offs decisions to allocate means with alternative uses (e.g., goods, money, time, capabilities), influencing behaviour. The concept of scarcity has been developed in diverse ways to explain economic dimensions of human-nature relations. In particular, the concept of "absolute scarcity" has its roots in classic economic thought referring to the physical limit of finite natural resources that are non-substitutable and are essential to meet human basic needs and well-being (Baumgärtner et al., 2006). In neoliberal economic systems, the concept of scarcity has been abstracted from material natural resources and adopted to refer to the possibilities of substitutable goods and services to fulfil people's unlimited *wants* (Arenas, 2021; Panayotakis, 2012). From this perspective, the concept of "relative" scarcity provides the ground to study how people and societies make choices for alternative uses of goods to maximize satisfaction (e.g., utility) (Baumgärtner et al., 2006).

Rather than any essential characteristic of human existence (Robbins, 1962), people's wants and the notion of relative scarcity are socially constructed (Gowdy, 1998). In particular, these are shaped by socio-economic framings emerging from social practices which integrate the influence of people's agency (e.g., social relations in marketplaces) with that of complex social structures and institutions (e.g., the capitalist system; Kallis, 2019; Panayotakis, 2012). For example, the ability to fulfil wants through purchasing power in neoliberal economies can become a sign of social distinction and wealth, mediating class relations through consumption competition (Xenos, 2017). With the needs for ever higher levels of consumption as the core of the pursuit for economic expansion, the construction of wants, new tastes and preferences plays a central role (e.g., through marketing) in capitalist economies (Xenos, 2017). A sense of scarcity is thus produced as individuals' wants are driven to exceed what could be afforded. The construction of a sense of scarcity alters consumers' perceptions of value and preferences for goods and services, affecting how consumers make choice and purchasing decisions (Mittone and Savadori, 2009).

### 2.1. Scarcity effects in the wildlife trade

In the wildlife trade, a plurality of values (Feddemma et al., 2021) and personal motivations (Thomas-Walters et al., 2020) underpin consumers preferences and drive purchasing behaviour. Choice formulation encompasses several psychological processes involved to construct preferences, including consideration, valuation, and integration. These processes are informed by both previous personal experiences and the influence of the broader social context where the decisions are being made (Bettman et al., 1998; Warren et al., 2011). For instance, perceived behavioural control, as the ability to act certain behaviour in relation to contextual socio-economic facilitators or impediments, and habit were the most important determinants of intentions to purchase rhino horn among consumers (Dang Vu and Nielsen, 2022). In this sense, people's experience of scarcity, as indicated by its normative contextual framings and cues, plays a key role in influencing consumers' decision-making processes, usually increasing desire for obtaining even scarcer goods (Lichtenstein and Slovic, 2006). Understanding how scarcity may affect the desirability of products can provide insights on the mechanisms driving preferences for rare species in the wildlife trade. In marketing studies, different theories have been used to

**Table 1**

Potential scarcity effects on consumers' demand in the wildlife trade according to consumers' main goal, as explained by different theories. Effects are plural and may simultaneously enhance the desirability of species and products thereof according to different cases.

Theory	Description	Consumer's goal underpinning demand	Scarcity effect in the wildlife trade
Commodity theory	The value of any commodity is defined by its unavailability and is enhanced by scarcity.	Seeking to differentiate from others through signs of distinction. Scarce goods and services are sought after because of their uniqueness and exclusivity.	Scarcity per se increases prices and desirability. Species and products thereof which are scarce become luxury and signs of differentiation, symbolizing social status.
Conformity theory	People tend to align values, beliefs and behaviour with other people or social norms.	Seeking to conform with others or social norms. Scarce goods and services are sought after more if scarcity in the market is driven by popularity among other consumers.	Desirability increases as others within the consumer's social group, or someone trusted, purchase wildlife and uses products. Species and products thereof which are scarce may signal popularity, stimulating purchasing intentions.
Regret theory	Decision-making is influenced by fear to make the wrong choice and anticipation of regret (e.g., missing out on an opportunity)	Seeking to avoid future regrets. Scarce goods and services may be valued more if their future availability is unsure.	Desirability of species increases as populations decrease in the wild (e.g., because of human pressure). Labelling of species as threatened to extinction, or in relation to upcoming trade restrictions and bans, may signal scarcity, stimulating consumers to purchase before is too late.
Reactance theory	People respond with motivational arousal when their behavioural freedom is threatened or eliminated by persons, rules or regulations	Seeking to preserve autonomy and control. Scarce goods and services are valued more if restrictions in place limit possibilities to express behavioural freedom.	Desirability of species increases as a reaction towards trade restrictions and other conservation actions (e.g., anti-poaching) which limit freedom of choice (e.g., to engage with traditional social practices). The perception of scarce goods and services may stabilize across contexts as consumers focus on fulfilling pressing needs.

conceptualize a scarcity effect on the perception of value explaining preferences in relation to various consumers' goals and motivations (Shi et al., 2020). These include commodity, conformity, regret, and reactance theories (Table 1). These theories are not necessarily incompatible and they can provide complementary insights into the multiplicity of relevant factors involved in the case of valuing rare objects, providing a more comprehensive understanding of scarcity (Shi et al., 2020).

According to commodity theory, useful objects are valued based on their scarcity, as limited availability (intended as limited supply, unaffordability, restrictions and/or delays of provisions) to fulfil demands (Brock, 1968; Lynn, 1991). The scarcity principle establishes that scarcity *per se* increases consumers' preferences and demand for objects, which leads to increasing prices (Brock, 1968). When demand for a good or service is higher than its supply, it creates a *disequilibrium* between supply and demand. In this context, the theory states that scarcity leads to an increase in prices to meet demand into the new *equilibrium*. According to these processes, increasing rarity in the wildlife trade, driven by overharvesting or by conservation initiatives limiting the flow of supplies (e.g., anti-poaching efforts), can inflate prices (e.g., in the ivory and rhino horn markets; Chen, 2016; Di Minin et al., 2021). In addition, beyond its relation to price, scarcity can potentially generate attraction as consumers seek objects which can signal social distinction (Xenos, 2017). Objects that are difficult to obtain may be particularly sought after by consumers seeking to express unique identities compared to others who do not possess the object but wish so (need-for-uniqueness theory, Fromkin, 1970; Snyder and Fromkin, 1980). Scarce objects become symbols of "socially acceptable differentiation" as possessing them does not risk disapproval from the social context, but conveys social standing as expressions of the ability to purchase signs of distinctions (Panayotakis, 2012; Van Herpen et al., 2014; Xenos, 2017). Thus, a scarcity effect is determined by social and contextual cues that shape the perceptions of an object's value, by detaching it from its fundamental attributes (e.g., characteristics or use-value; Mittone and Savadori, 2009), to become a display of wealth. Similarly, expensive wildlife products that are difficult to obtain in the market may become symbols of social standing, exclusiveness and luxury (Dang Vu and Nielsen, 2018). These include, for example, distorting the perception of the caviar taste (Gault et al., 2008), and incentivizing consumption of expensive wild meat in social and lucrative business contexts (Shairp et al., 2016).

According to conformity theory, consumers seeking to conform with social norms may place higher value on scarce objects if these are popular among other people or among specific social groups (Verhallen & Robben, 1994). Thus, consumers' purchasing decisions are elicited and validated by others' behaviour in a specific situation (i.e., social proofing), and can be driven by social influence, but also by shared values, beliefs, and experiences within groups (Hamilton et al., 2019). In the wildlife trade, a scarcity effect may be produced when consumers seek to align attitudes, beliefs and behaviour with a social group's norms, such as cultural practices. For example, perceptions of higher efficacy of traditional medicine may drive consumers to value wild-sourced products more than farmed ones, although little attention may be paid to the products' properties (e.g., function and composition) during purchasing decisions (Liu et al., 2016). While consumers' goal for uniqueness may lead to increasing prices, the aim to conform with others (opposite to the former) may not necessarily result in higher prices, but in higher volume of traded goods on the shorter time. Popularity may generate spikes in demand that supply may not be able to fulfil, thus generating a demand-driven scarcity. For example, this could happen following publicity in movie releases or shows (Nijman and Nekaris, 2017b), viral content on social media (Harrington et al., 2019), or other emerging practices gaining attention among consumers (e.g., exotic pet cafes McMillan et al., 2021). Scarcity of species and products thereof, as well as increasing rarity in the wild, may signal popular use among peers, further accelerating demand from those who need to make a purchasing decision. Demand spikes may incentivize high initial harvesting effort of species and populations in the wild, exposing even larger populations to extinction risk (Holden and McDonald-Madden, 2017).

According to regret theory, scarce objects may be valued more if consumers goals are to avoid future regret (Loomes and Sugden, 1982). Scarcity driven by supply shortages may hasten consumers' decisions to obtain desired objects as consumers fear of missing out if future availability is uncertain (John et al., 2018). Contextual cues and signs of rarity are key in eliciting a scarcity effect, generating peaks in prices which, in the wildlife trade, may incentivize overharvesting in the wild. For example, collectors or specialist consumers may be targeting rare species with more vigour if their rarity is evident as indicated by cues, such as certification labelling, trade restrictions and other signs (e.g., listed as threatened in the IUCN Red list and in CITES listing of species) (Hinsley et al., 2015; Tournant et al., 2012). Specifically, species and thereof products that are threatened with extinction may attract investors seeking an increase of value linked to future unavailability in the market and wishing to secure supply e.g., by controlling captive breeding operations (Mason et al., 2012). In addition to scarcity signalled by limited-quantity, limited-time scarcity may also affect desirability as, for example, consumers are more willing to buy before trade restrictions come into effect (e.g., before CITES listing of species) (Chen et al., 2020; Hausmann et al., 2023; Rivalan et al., 2007). Thus, emerging contextual and social cues of scarcity and rarity may both affect demand, potentially increasing trade pressure and risk of local extinctions as even less threatened species and populations become rarer.

According to reactance theory, people may react to an agent's (person, rule, or regulation) attempt to restrict and/or eliminate their freedom of engaging in a specific behaviour, such as choosing or responding, by experiencing motivational arousal to restore such freedom (Brehm, 1966). Government policies and market regulations, posing restrictions on consumers' choices and alternatives, may be perceived as a threat by consumers whose goal is to preserve autonomy and control, stimulating reactance behaviour (Miyazaki et al., 2009). In the context of the wildlife trade, a scarcity effect on consumers' perception of value for species and products thereof may be stimulated by regulatory frameworks and wildlife products bans (e.g., Rivalan et al., 2007). In addition, other restrictive conservation activities, such as anti-poaching efforts, CITES listing of species, and confiscations, may generate a supply-driven shortage and long-term scarcity (Chen, 2016; 't Sas-Rolfes et al., 2014), which could be stimulating reactance by strengthening purchase intentions. For example, blanket trade bans which do not consider contextual dimensions, including the roles of certain wildlife products in social practices (e.g., food, curing diseases), as well as the influence of social institutions, values, and knowledge, may lead to conflict and injustices. From an instrumental perspective, it might also result in incomppliance and the spilling of trade activities and products into illegal, less controllable markets (Conrad, 2012; Roe et al., 2020; Roe and Lee, 2021; Weber et al., 2015).



When choices are constrained by restrictions and there are no suitable alternatives available, scarcity may elicit perceptions that individual's ability to fulfil needs is compromised, affecting consumers behaviour. Consumers attention may shift into fulfilling pressing needs, reducing the role of contextual factors on their preferences (e.g., conceptions of sufficiency). While people's wants and preferences are dynamic and susceptible to contextual cues, a scarcity effect on needs stabilizes the perception of value, making consumers' behaviour more consistent (Shah et al., 2015), and thus more challenging to transform.

### 3. Interplay between rarity and scarcity

As driven by different processes constructing consumers' preferences, the effect of scarcity on consumers' demand and behaviour may affect not only rare species, but also species that are not considered to be rare in the wild. Thus, species may be sought after because they are rare in the wild or because they are scarce in the market, even when common in the wild. In this sense, rarity and scarcity may independently and synergistically affect demand in the wildlife trade. Understanding the interplay between them may help better understand market forces underpinning demand for wildlife trade, and the different levels of threat to targeted species. In operational terms, different combinations of species rarity and scarcity can be assessed to further understand their synergistic effects (Fig. 1). While we acknowledge that both rarity and scarcity can take a continuous range of values, here we consider the extremes values for the sake of illustrating our argument. These include when species and products thereof are: i) scarce in the market and



Fig. 1. Synergistic effects of rarity and scarcity and potential risks to conservation of species affected by wildlife trade. Quadrants are meant as simplified illustrations of more continuous gradients of rarity and scarcity in wild and marketed populations. Horizontal arrows icons refer to the general trade status of a species and wildlife product. Supply and demand curves icons refer to potential scarcity effects. Warning sign icons refer to some of the conservation implications from scarcity effects. Numbers in each quadrant refer to explanations in the main text.

common in the wild; ii) abundant in the market and common in the wild; iii) abundant in the market and rare in the wild; and iv) scarce in the market and rare in the wild.

When species and their products have low supply in the market, but are common in the wild, a scarcity effect may be experienced from changes in demand (quadrant 1, Fig. 1). If species are not listed under CITES, which regulates their trade, and consumers are conscious about the species and products thereof, low trade volumes in wildlife markets may indicate a condition of low effective demand. However, low trade volumes may also relate to the fact that consumers may be unaware of the potential uses and availability of certain species and products on the market (potential demand) (Veríssimo et al., 2020). The creation of new products or the emergence of novel uses, combined with publicity or displays within social groups, may trigger new preferences and desire in potential consumers. For example, popular movie releases may increase demand and/or accelerate it, as in the case of Harry Potter and the increase in owl trade in Southeast Asia (Nijman and Nekaris, 2017). As supply in the market might be scarce compared to a relatively fast increased demand, consumers may experience a scarcity effect. For example, a scarcity effect on decision-making processes may be experienced by consumers whose goals are to possess something new that others do not have (goal for uniqueness), or to conform with others promoting or recommending the novel uses within social groups (e.g., following influencers recommendations on social media on fashion and cosmetics, Zak and Hasprova, 2020). While trade regulations (e.g., listing species on CITES) may represent an initial conservation intervention to address the problem, they may risk to turn effective demand into a latent one (i.e., from consumers who are aware of the species or product, desire it, but are constrained by access restrictions, Veríssimo et al., 2020). This would transform the situation into a case of supply-driven scarcity, potentially further escalating its effect. The implementation of additional measures along the supply chain, including the implementation of specific policies (e.g., content control on social media platforms, behavioural change), may be needed to curb escalation of demand (Davies et al., 2022).

When species and their products are in high supply in the market and are common in the wild, a scarcity effect may be experienced from changes in either supply or demand according to contextual factors (quadrant 2, Fig. 1). Species that are common in the wild may be harvested to be frequently traded in one or multiple wildlife markets. For example, pythons are heavily traded globally (Hierink et al., 2020), but most species are classified as Least Concern in the IUCN Red List (IUCN, 2021). Similarly, the distribution of the scarlet macaw (*Ara macao*) is widespread and the species is classified as Least Concern in the IUCN Red List (IUCN, 2021). However, trade of wild-caught individuals continues alongside trade of captive-bred specimens because of high demand in the exotic pet and feathers trade (Pires, 2012). The combination of high demand with other increasing human pressures, such as habitat loss, may negatively affect wild populations (Pires, 2012). The increase of local or regional rarities and risks of extinction may potentially cause supply shortages and supply-driven scarcity on the market, thus contributing to a scarcity effect on consumers' decision-making. Captive-breeding conservation programs (e.g., farming and ranching) and cultivations may help increase abundance in the market (e.g., by saturating demand) and mitigate a sense of supply-driven scarcity on consumers, therefore alleviating harvesting pressure on wild populations. However, large scale intensive breeding initiatives imply important conservation challenges. These include concerns over ensuring animal welfare, avoiding large scale selective breeding, preventing laundering of wild-sourced animals as captive-bred (Macdonald et al., 2021), and the raise of illicit trade networks. For example, even in the case of intensive captive-breeding, a demand-driven scarcity may be triggered by changes in signs of rarity, such as new listing of popular cultivated plants on CITES (Margulies et al., 2023), which may be used by traders to increase perceived value of species, and arouse fear of regret and motivational reactance behaviour among specialized consumers (e.g., collectors). In addition, a scarcity effect may be produced in otherwise common species as new rare morphological traits (e.g., colour varieties) are discovered through selective breeding, raising concerns over the sustainability of the trade. For example, the purposeful or accidental release of selected individuals may increase conservation risks in wild populations by causing "genetic pollution" and loss of local adaptations (Auliya et al., 2020). In addition, demand for rare genetic traits found in wild populations may incentivize harvesting of wild-caught individuals driving overexploitation of specific populations, negatively affecting genetic diversity and species survival (Lyons and Natusch, 2013).

When species and their products are frequently traded in the market, but populations are rare in the wild (e.g., because of over-harvesting, habitat loss, human-wildlife conflict), rarity leads to increasing prices even though species are common in the market (quadrant 3, Fig. 1). Captive breeding and commercial farming become financially profitable and can occur intensively, to the point that, as wild populations continue to shrink, captive populations might be the largest remaining (Nijman et al., 2021). In the songbird trade, for example, rare species, such as the black-winged mynas (*Acridotheres melanopterus*, *A. tricolor* and *A. tertius*), or extinct species in the wild, such as the Javan pied starling (*Gracupica jalla*), may be largely bred in captivity and traded at high prices to meet popular demand among cage bird keepers in Southeast Asia (Nijman et al., 2021, 2018). Species in this category may be particularly vulnerable to overexploitation, as a perception of scarcity (e.g., related to consumers interest for uniqueness or for regret avoidance) may be constructed by sellers to further ensure full control of supply sources and market prices as populations are depleted in the wild (e.g., Mason et al., 2012). In this sense, understanding stakeholders' power relations and how rarity might be exploited by traders to increase profits would be important to foster sustainable trade or to anticipate some of the potential risks behind implementing market-based interventions (e.g., easing restrictions on trade). Moreover, wildlife products are essential resources contributing to food sovereignty for millions of people globally (Cawthorn and Hoffman, 2015). When species and products thereof are frequently traded to fulfil people's needs, implementing or tightening of trade bans and restrictions, law enforcements efforts and other top-down restrictive policies may stimulate consumers' reactance behaviour and the raise of in-compliance as means to protest against prohibitions (trading on black markets). Actions that support the conservation of wild populations, while meaningfully involving stakeholders in decision-making processes, reducing prices and consumers' demand (e.g., behavioural change), may be crucial (Roe et al., 2020).

When species and their products are both rare in the wild and scarce in the market (e.g., because they are under strict trade restrictions, such as those listed in Appendix I of CITES), a synergistic effect between demand for rarity and scarcity may be experienced on consumers (quadrant 4, Fig. 1). Rarity in the wild makes some of these species particularly sought after by consumers because of

their uniqueness, becoming even more valuable in the market as populations decrease in the wild (Courchamp et al., 2006; Mandimbahasina et al., 2020). Consumers desiring uniqueness may purposely target species that are both rare and scarce as this combination contributes to inflating prices, producing an image of exclusivity, luxury and elite symbolisms (e.g., snob effect) (Chen, 2016; Hall et al., 2008). As captive breeding may be challenging or restricted for some species, supply may mostly come from wild-harvested individuals posing pressure on already threatened populations. Conservation interventions such as destroying stockpiles (t Sas-Rolfes et al., 2014), strong anti-poaching activities (Chen, 2016), and trade bans (Challender et al., 2015) could unintentionally further increase scarcity and thus positively influence attractiveness, as well as monetary and symbolic value of wildlife products. Examples of these dynamics include trade in elephant ivory (t Sas-Rolfes et al., 2014), rhino horn (Eikelboom et al., 2020), bear bile (Crudge et al., 2020), and pangolin meat and scales (Challender et al., 2019). Thus, synergistic effects of rarity and scarcity may pose a greater threat than they would produce when considered in isolation. Assessing context and species dependent factors (e.g., species productivity, consumers' demand, power relations among stakeholders, cultural and ethical aspects) and their connections influencing trade dynamics is crucial against "silver bullet" solutions.

#### 4. Ways forward

In this article, we highlighted the importance of disentangling the various influences of the socially constructed concepts of scarcity on consumers' perception of value and desirability in the wildlife trade. By drawing from different theories in psychology and economics, we explored how rarity and scarcity may independently and synergically affect preferences and demand. We argue that scarcity effects may stimulate demand and amplify desirability for rarity according to different, intertwined goals (distinctiveness, conformity, avoidance of regret, freedom of choice). Further exploring how the social construction of scarcity may affect demand, may help disentangling drivers of demand and enhance understanding of complex conservation problems in wildlife trade.

A more comprehensive understanding of the impacts of the trade on the conservation of species requires integrating multiple sources of information following inter and transdisciplinary approaches (Browne et al., 2021). Collaborative efforts between researchers and practitioners might provide more comprehensive understandings of the problems on the ground, contributing to the co-production of actionable research to address unsustainable wildlife trade. This includes assessing the interplay between species rarity and scarcity, including species ecology and status (e.g., population declines, evolutionary distinctiveness) and social institutions and dynamics influencing the trade (e.g., type of market, supply network, stakeholders' interests, and power relations). Understanding motivations, needs, and socio-economic conditions (Thomas-Walters et al., 2020), as well as the plurality of values and ethical positions (Cortés-Capano et al., 2022) underpinning wildlife trade may help better understand these aspects (Feddemma et al., 2021). This includes conducting stakeholder analyses to identify and assess the interest, power and legitimacy of different actors (e.g., harvesters, consumers, traders, criminal groups) in generating or controlling scarcity.

To conclude, it would be important to better understand how local contexts, national policies and institutions and global markets and networks interact to shape demand and to enable and constrain the implementation of conservation actions in different contexts. This has important justice implications, for example, to adequately empower indigenous and local communities and their traditional uses, practices, and knowledge to sustainably harvest wildlife. Finally, mainstreaming a more plural conception of value beyond the conflation of value into price, might contribute to broaden the way scarcity is socially constructed to include diverse non-commodifying relations between humans and non-humans (e.g., based on care and relational values).

#### CRedit authorship contribution statement

**Di Minin Enrico:** Conceptualization, Funding acquisition, Writing – review & editing. **Cortés-Capano Gonzalo:** Conceptualization, Investigation, Writing – original draft, Writing – review & editing. **Hausmann Anna:** Conceptualization, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Data availability

No data was used for the research described in the article.

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## Data accessibility

No data have been used for this manuscript.

## References

- Altherr, S., Lameter, K., 2020. The rush for the rare: reptiles and amphibians in the European pet trade. *Animals* 10, 1–14. <https://doi.org/10.3390/ani10112085>.
- Arenas, A., 2021. Pandemics, capitalism, and an ecosocialist pedagogy. *J. Environ. Educ.* 52, 371–383. <https://doi.org/10.1080/00958964.2021.1999197>.
- Auliya, M., Hofmann, S., Segniabeto, G.H., Assou, D., Ronfot, D., Astrin, J.J., Forat, S., Ketoh, G.K.K., D’Cruze, N., 2020. The first genetic assessment of wild and farmed ball pythons (Reptilia, Serpentes, Pythonidae) in southern Togo. *Nat. Conserv.* 38, 37–59. <https://doi.org/10.3897/NATURECONSERVATION.38.49478>.
- Baumgärtner, S., Becker, C., Faber, M., Manstetten, R., 2006. Relative and absolute scarcity of nature. Assessing the roles of economics and ecology for biodiversity conservation. *Ecol. Econ.* 59, 487–498. <https://doi.org/10.1016/j.ecolecon.2005.11.012>.
- Bennett, E.L., Underwood, F.M., Milner-Gulland, E.J., 2021. To trade or not to trade? Using Bayesian belief networks to assess how to manage commercial wildlife trade in a complex world. *Front. Ecol. Evol.* 9, 1–16. <https://doi.org/10.3389/fevo.2021.587896>.
- Bettman, J.R., Luce, M.F., Payne, J.W., 1998. Constructive consumer choice processes. *J. Consum. Res.* 25, 187–217. <https://doi.org/10.1086/209535>.
- Brehm, J.W., 1966. *A Theory of Psychological Reactance*. Academic Press.
- Brock, T.C., 1968. Implications of commodity theory for value change. In: *Psychological Foundations of Attitudes*. Elsevier, pp. 243–275. <https://doi.org/10.1016/b978-1-4832-3071-9.50016-7>.
- Browne, C., Ronis, E.M., Miller, J.R.B., Kapetanakis, Y., Gibbs, S., Hendrix, T., Carlson Bremer, D., 2021. Systems approaches to combating wildlife trafficking: expanding existing frameworks to facilitate cross-disciplinary collaboration. *Front. Conserv. Sci.* 2.
- Cawthorn, D.-M., Hoffman, L.C., 2015. The bushmeat and food security nexus: A global account of the contributions, conundrums and ethical collisions. *Food Res. Int., Food Nutr. Secur.: Can. Sci. Good Gov. Deliv. Dinn.* 76, 906–925. <https://doi.org/10.1016/j.foodres.2015.03.025>.
- Challender, D.W.S., Harrop, S.R., MacMillan, D.C., 2015. Towards informed and multi-faceted wildlife trade interventions. *Glob. Ecol. Conserv.* 3, 129–148. <https://doi.org/10.1016/j.gecco.2014.11.010>.
- Challender, D.W.S., ‘t Sas-Rolfes, M., Ades, G.W.J., Chin, J.S.C., Ching-Min Sun, N., Chong, J. Iian, Connelly, E., Hywood, L., Luz, S., Mohapatra, R.K., de Ornellas, P., Parker, K., Pietersen, D.W., Robertson, S.I., Semiadi, G., Shaw, D., Shepherd, C.R., Thomson, P., Wang, Y., Wicker, L., Wu, S.B., Nash, H.C., 2019. Evaluating the feasibility of pangolin farming and its potential conservation impact. *Glob. Ecol. Conserv.* 20, e00714 <https://doi.org/10.1016/j.gecco.2019.e00714>.
- Chen, F., 2016. Poachers and snobs: demand for rarity and the effects of anti-poaching policies. *Conserv. Lett.* 9, 65–69. <https://doi.org/10.1111/conl.12181>.
- Chen, T.Y., Yeh, T.L., Wang, Y.J., 2020. The drivers of desirability in scarcity marketing. *Asia Pac. J. Mark. Logist.* 33, 924–944. <https://doi.org/10.1108/APJML-03-2020-0187>.
- Conrad, K., 2012. Trade bans: a perfect storm for poaching? *Trop. Conserv. Sci.* 5, 245–254. <https://doi.org/10.1177/194008291200500302>.
- Cortés-Capano, G., Hausmann, A., Di Minin, E., Kortetmäki, T., 2022. Ethics in biodiversity conservation: the meaning and importance of pluralism. *Biol. Conserv.* 275, 109759 <https://doi.org/10.1016/j.biocon.2022.109759>.
- Courchamp, F., Angulo, E., Rivalan, P., Hall, R.J., Signoret, L., Bull, L., Meinard, Y., 2006. Rarity value and species extinction: the anthropogenic allee effect. *PLoS Biol.* 4, e415 <https://doi.org/10.1371/journal.pbio.0040415>.
- Crudge, B., Nguyen, T., Cao, T.T., 2020. The challenges and conservation implications of bear bile farming in Viet Nam. *Oryx* 54, 252–259. <https://doi.org/10.1017/S0030605317001752>.
- Dang Vu, H.N., Nielsen, M.R., 2018. Understanding utilitarian and hedonic values determining the demand for rhino horn in Vietnam. *Hum. Dimens. Wildl.* 23, 417–432. <https://doi.org/10.1080/10871209.2018.1449038>.
- Dang Vu, H.N., Nielsen, M.R., 2022. Understanding determinants of the intention to buy rhino horn in Vietnam through the theory of planned behaviour and the theory of interpersonal behaviour. *Ecol. Econ.* 195, 107361 <https://doi.org/10.1016/j.ecolecon.2022.107361>.
- Davies, A., D’Cruze, N., Senni, C., Martin, R.O., 2022. Inferring patterns of wildlife trade through monitoring social media: Shifting dynamics of trade in wild-sourced African Grey parrots following major regulatory changes. *Glob. Ecol. Conserv.* 33, e01964 <https://doi.org/10.1016/j.gecco.2021.e01964>.
- Di Minin, E., ‘t Sas Rolfes, M., Selier, J., Bradshaw, C., 2021. Dismantling the poachernomics of the illegal wildlife trade. *Biol. Conserv.*
- Dugger, W.M., 1996. Redefining economics: from market allocation to social provisioning. In: *Political Economy for the 21st Century*. Routledge.
- Eikelboom, J.A.J., Nuijten, R.J.M., Wang, Y.X.G., Schroder, B., Heitkönig, I.M.A., Mooij, W.M., van Langevelde, F., Prins, H.H.T., 2020. Will legal international rhino horn trade save wild rhino populations? *Glob. Ecol. Conserv.* 23 <https://doi.org/10.1016/j.gecco.2020.e01145>.
- Farquhar, P.H., 1984. State of the art—utility assessment methods. *Manag. Sci.* 30, 1283–1300. <https://doi.org/10.1287/mnsc.30.11.1283>.
- Feddema, K., Nekaris, K.A.I., Nijman, V., Harrigan, P., 2021. Re-evaluating the notion of value in wildlife trade research from a service marketing perspective. *Biol. Conserv.* 256, 109060 <https://doi.org/10.1016/j.biocon.2021.109060>.
- Fromkin, H.L., 1970. Effects of experimentally aroused feelings of undistinctiveness upon valuation of scarce and novel experiences. *J. Personal. Soc. Psychol.* 16, 521.
- Gaston, K.J., 1994. What is rarity? In: Såringer, D. (Ed.), *Rarity*. Springer, Dordrecht, pp. 1–21.
- Gault, A., Meinard, Y., Courchamp, F., 2008. Consumers’ taste for rarity drives sturgeons to extinction. *Conserv. Lett.* 1, 199–207. <https://doi.org/10.1111/j.1755-263X.2008.00038.x>.
- Gowdy, J., 1998. Introduction: Back to the Future and Forward to the Past. *Limited Wants and Unlimited Means: A Reader on Hunter-Gatherer Economics and the Environment*.
- Hall, R.J., Milner-Gulland, E.J., Courchamp, F., 2008. Endangering the endangered: The effects of perceived rarity on species exploitation. *Conserv. Lett.* 1, 75–81.
- Hamilton, R., Thompson, D., Bone, S., Chaplin, L.N., Griskevicius, V., Goldsmith, K., Hill, R., John, D.R., Mittal, C., O’Guinn, T., Piff, P., Roux, C., Shah, A., Zhu, M., 2019. The effects of scarcity on consumer decision journeys. *J. Acad. Mark. Sci.* 47, 532–550. <https://doi.org/10.1007/s11747-018-0604-7>.
- Harrington, L.A., Macdonald, D.W., D’Cruze, N., 2019. Popularity of pet otters on YouTube: evidence of an emerging trade threat. *Nat. Conserv.* 45, 17–45. <https://doi.org/10.3897/natureconservation.36.33842>.
- Harrington, L.A., Mookerjee, A., Kalita, M., Saikia, A., Macdonald, D.W., D’Cruze, N., 2022. Risks associated with the global demand for novel exotic pets: a new and emerging trade in snakehead fish (Channa spp.) from India. *Biol. Conserv.* 265, 109377 <https://doi.org/10.1016/j.biocon.2021.109377>.
- Harris, J.B.C., Tingley, M.W., Hua, F., Yong, D.L., Adeney, J.M., Lee, T.M., Marthy, W., Prawiradilaga, D.M., Sekercioglu, C.H., Suyadi, C.H., Winarni, N., Wilcove, D. S., 2017. Measuring the impact of the pet trade on Indonesian birds. *Conserv. Biol.* 31, 394–405. <https://doi.org/10.1111/cobi.12729>.
- Hausmann, A., Cortés-Capano, G., Fraser, I., Di Minin, E., 2023. Assessing preferences and motivations for owning exotic pets: care matters. *Biol. Conserv.* 281, 110007 <https://doi.org/10.1016/j.biocon.2023.110007>.
- Hierink, F., Bolon, I., Durso, A.M., Ruiz de Castañeda, R., Zambrana-Torrel, C., Eskew, E.A., Ray, N., 2020. Forty-four years of global trade in CITES-listed snakes: trends and implications for conservation and public health. *Biol. Conserv.* 248, 108601 <https://doi.org/10.1016/j.biocon.2020.108601>.
- Hinsley, A., Verissimo, D., Roberts, D.L., 2015. Heterogeneity in consumer preferences for orchids in international trade and the potential for the use of market research methods to study demand for wildlife. *Biol. Conserv.* 190, 80–86. <https://doi.org/10.1016/j.biocon.2015.05.010>.
- Holden, M.H., McDonald-Madden, E., 2017. High prices for rare species can drive large populations extinct: the anthropogenic Allee effect revisited. *J. Theor. Biol.* 429, 170–180. <https://doi.org/10.1016/j.jtbi.2017.06.019>.
- IPBES, 2020. Report on Biodiversity and Pandemics. Bonn, Germany. <https://doi.org/10.5281/zenodo.4147317>.
- IUCN, 2021. The IUCN Red List of Threatened Species. Version 2021–1 [WWW Document]. (<https://www.iucnredlist.org>). Downloaded on June 2021.
- John, M., Melis, A.P., Read, D., Rossano, F., Tomasello, M., 2018. The preference for scarcity: a developmental and comparative perspective. *Psychol. Mark.* 35, 603–615. <https://doi.org/10.1002/mar.21109>.

- Johnson, P.J., Kansky, R., Loveridge, A.J., Macdonald, D.W., 2010. Size, rarity and charisma: Valuing African wildlife trophies. *PLoS One* 5, 1–7. <https://doi.org/10.1371/journal.pone.0012866>.
- Kallis, G., 2019. *Limits: Why Malthus Was Wrong and Why Environmentalists Should Care*. Stanford University Press, California, USA.
- Krishna, V.V., Darras, K., Grass, I., Mulyani, Y.A., Prawiradilaga, D.M., Tschartke, T., Qaim, M., 2019. Wildlife trade and consumer preference for species rarity: an examination of caged-bird markets in Sumatra. *Environ. Dev. Econ.* 24, 339–360. <https://doi.org/10.1017/S1355770X19000081>.
- Kunin, W.E., Gaston, K.J., 2012. *The Biology of Rarity. Causes and Consequences of Rare-common Differences*, the Journal of Ecology. Springer Science & Business Media.
- Lichtenstein, S., Slovic, P. (Eds.), 2006. *The Construction of Preference*. Cambridge University Press, Cambridge.
- Liu, Z., Jiang, Z., Fang, H., Li, Chunwang, Mi, A., Chen, J., Zhang, X., Cui, S., Chen, D., Ping, X., Li, F., Li, Chunlin, Tang, S., Luo, Z., Zeng, Y., Meng, Z., 2016. Perception, price and preference: consumption and protection of wild animals used in traditional medicine. *PLoS One* 11, e0145901. <https://doi.org/10.1371/journal.pone.0145901>.
- Loomes, G., Sugden, R., 1982. Regret theory: an alternative theory of rational choice under uncertainty. *Econ. J.* 92, 805–824. <https://doi.org/10.2307/2232669>.
- Lynn, M., 1991. Scarcity effects on value: a quantitative review of the commodity theory literature. *Psychol. Mark.* 8, 43–57. <https://doi.org/10.1002/mar.4220080105>.
- Lyons, J.A., Natusch, D.J.D., 2013. Effects of consumer preferences for rarity on the harvest of wild populations within a species. *Ecol. Econ.* 93, 278–283. <https://doi.org/10.1016/j.ecolecon.2013.06.004>.
- Lyons, K.G., Brigham, C.A., Traut, B.H., Schwartz, M.W., 2005. Rare species and ecosystem functioning. *Conserv. Biol.* 19, 1019–1024. <https://doi.org/10.1111/J.1523-1739.2005.00106.X>.
- Macdonald, D.W., Harrington, L.A., Moorhouse, T.P., D’Cruze, N., 2021. Trading animal lives: ten tricky issues on the road to protecting commodified wild animals. *BioScience* 71, 846–860. <https://doi.org/10.1093/BIOSCI/BIAB035>.
- Mandimbihasina, A.R., Woolaver, L.G., Concannon, L.E., Milner-Gulland, E.J., Lewis, R.E., Terry, A.M.R., Filazaha, N., Rabetafika, L.L., Young, R.P., 2020. The illegal pet trade is driving Madagascar’s ploughshare tortoise to extinction. *Oryx* 54, 188–196. <https://doi.org/10.1017/S0030605317001880>.
- Margulies, J.D., Moorman, F.R., Goettsch, B., Axmacher, J.C., Hinsley, A., 2023. Prevalence and perspectives of illegal trade in cacti and succulent plants in the collector community. *Conserv. Biol.* 37, e14030 <https://doi.org/10.1111/cobi.14030>.
- Mason, C.F., Bulte, E.H., Horan, R.D., 2012. Banking on extinction: endangered species and speculation. *Oxf. Rev. Econ. Policy* 28, 180–192. <https://doi.org/10.1093/oxrep/grs006>.
- McMillan, S.E., Dingle, C., Allcock, J.A., Bonebrake, T.C., 2021. Exotic animal cafes are increasingly home to threatened biodiversity. *Conserv. Lett.* 14, e12760 <https://doi.org/10.1111/CONL.12760>.
- Mittone, L., Savadori, L., 2009. The scarcity bias. *Appl. Psychol.* 58, 453–468. <https://doi.org/10.1111/j.1464-0597.2009.00401.x>.
- Miyazaki, A.D., Rodriguez, A.A., Langenderfer, J., 2009. Price, scarcity, and consumer willingness to purchase pirated media products. *J. Public Policy Mark.* 28, 71–84. <https://doi.org/10.1509/jppm.28.1.71>.
- Morton, O., Scheffers, B.R., Haugaasen, T., Edwards, D.P., 2021. Impacts of wildlife trade on terrestrial biodiversity. *Nat. Ecol. Evol.* 5, 540–548. <https://doi.org/10.1038/s41559-021-01399-y>.
- Nijman, V., Nekaris, K.A.I., 2017. The Harry Potter effect: the rise in trade of owls as pets in Java and Bali, Indonesia. *Glob. Ecol. Conserv.* 11, 84–94. <https://doi.org/10.1016/j.gecco.2017.04.004>.
- Nijman, V., Langgeng, A., Birot, H., Imron, M.A., Nekaris, K.A.I., 2018. Wildlife trade, captive breeding and the imminent extinction of a songbird. *Glob. Ecol. Conserv.* 15, e00425 <https://doi.org/10.1016/j.gecco.2018.e00425>.
- Nijman, V., Campera, M., Ardiansyah, A., Balestri, M., Bizri, H.R.El, Budiadi, B., Dewi, T., Hedger, K., Hendrik, R., Imron, M.A., Langgeng, A., Morcatty, T.Q., Weldon, A.V., Nekaris, K.A.I., 2021. Large-scale trade in a songbird that is extinct in the wild. *Diversity* 13, 238.
- Palazy, L., Bonenfant, C., Gaillard, J.M., Courchamp, F., Linnell, J., 2012. Rarity, trophy hunting and ungulates. *Anim. Conserv.* 15, 4–11. <https://doi.org/10.1111/j.1469-1795.2011.00476.x>.
- Panayotakis, C., 2012. Theorizing scarcity: neoclassical economics and its critics, 45, 183–200. <https://doi.org/10.1177/0486613412458649>.
- Pires, S.F., 2012. The illegal parrot trade: a literature review. *Glob. Crime.* 13, 176–190. <https://doi.org/10.1080/17440572.2012.700180>.
- Prescott, G.W., Johnson, P.J., Loveridge, A.J., Macdonald, D.W., 2012. Does change in IUCN status affect demand for African bovid trophies? *Anim. Conserv.* 15, 248–252. <https://doi.org/10.1111/j.1469-1795.2011.00506.x>.
- Ribeiro, J., Reino, L., Schindler, S., Strubbe, D., Vail-Iloera, M., Araújo, M.B., Capinha, C., Carrete, M., Mazzoni, S., Monteiro, M., Moreira, F., Rocha, R., Tella, J.L., Vaz, A.S., Vicente, J., Nuno, A., 2019. Trends in legal and illegal trade of wild birds: a global assessment based on expert knowledge. *Biodivers. Conserv.* 28, 3343–3369. <https://doi.org/10.1007/s10531-019-01825-5>.
- Rivalan, P., Delmas, V., Angulo, E., Bull, L.S., Hall, R.J., Courchamp, F., Rosser, A.M., Leader-Williams, N., 2007. Can bans stimulate wildlife trade? *Nature* 447, 529–530. <https://doi.org/10.1038/447529a>.
- Robbins, L., 1962. *An Essay on the Nature and Significance of Economic Science*. Ludwig von Mises Institute.
- Roe, D., Lee, T.M., 2021. Possible negative consequences of a wildlife trade ban. *Nat. Sustain.* 4, 5–6. <https://doi.org/10.1038/s41893-020-00676-1>.
- Roe, D., Dickman, A., Kock, R., Milner-Gulland, E.J., Rihoy, E., ‘t Sas-Rolfes, M., 2020. Beyond banning wildlife trade: COVID-19, conservation and development. *World Dev.* 136, 105121 <https://doi.org/10.1016/j.worlddev.2020.105121>.
- Scheffers, B.R., Oliveira, B.F., Lamb, I., Edwards, D.P., 2019. Global wildlife trade across the tree of life. *Science* 366, 71–76. <https://doi.org/10.1126/science.aav5327>.
- Shah, A.K., Shafir, E., Mullainathan, S., 2015. Scarcity frames value. *Psychol. Sci.* 26, 402–412. <https://doi.org/10.1177/0956797614563958>.
- Shairp, R., Veríssimo, D., Fraser, I., Challender, D., Macmillan, D., 2016. Understanding urban demand for wild meat in Vietnam: Implications for conservation actions. *PLoS One* 11 (1), 14. <https://doi.org/10.1371/journal.pone.0134787>.
- Shi, X., Li, F., Chumnumpan, P., 2020. The use of product scarcity in marketing. *Eur. J. Mark.* 54, 380–418. <https://doi.org/10.1108/EJM-04-2018-0285>.
- Snyder, C., Fromkin, H., 1980. *Uniqueness: The Human Pursuit of Difference*. Springer Science & Business.
- Sung, Y.-H., Fong, J.J., 2018. Assessing consumer trends and illegal activity by monitoring the online wildlife trade. *Biol. Conserv.* 227, 219–225. <https://doi.org/10.1016/j.biocon.2018.09.025>.
- Sykes, L., Santini, L., Etard, A., Newbold, T., 2020. Effects of rarity form on species’ responses to land use. *Conserv. Biol.* 34, 688–696. <https://doi.org/10.1111/cobi.13419>.
- ‘t Sas-Rolfes, M., Moyle, B., Stiles, D., 2014. The complex policy issue of elephant ivory stockpile management. *Pachyderm* 55, 62–77.
- ‘t Sas-Rolfes, M., Challender, D.W.S., Hinsley, A., Veríssimo, D., Milner-Gulland, E.J., 2019. Illegal wildlife trade: scale, processes, and governance. *Annu. Rev. Environ. Resour.* 44, 201–228. <https://doi.org/10.1146/annurev-environ-101718-033253>.
- Thomas-Walters, L., Hinsley, A., Bergin, D., Burgess, G., Doughty, H., Eppel, S., MacFarlane, D., Meijer, W., Lee, T.M., Phelps, J., Smith, R.J., Wan, A.K.Y., Veríssimo, D., 2020. Motivations for the use and consumption of wildlife products. *Conserv. Biol.* <https://doi.org/10.1111/cobi.13578>.
- Thomas-Walters, L., Veríssimo, D., Gadsby, E., Roberts, D., Smith, R.J., 2020. Taking a more nuanced look at behavior change for demand reduction in the illegal wildlife trade. *Conserv. Sci. Pract.* 2, 1–10. <https://doi.org/10.1111/csp2.248>.
- Tournant, P., Joseph, L., Goka, K., Courchamp, F., 2012. The rarity and overexploitation paradox: Stag beetle collections in Japan. *Biodivers. Conserv.* 21, 1425–1440. <https://doi.org/10.1007/s10531-012-0253-y>.
- Van Herpen, E., Pieters, R., Zeelenberg, M., 2014. When less sells more or less: the scarcity principle in wine choice. *Food Qual. Prefer.* 36, 153–160. <https://doi.org/10.1016/j.foodqual.2014.04.004>.
- Veríssimo, D., ‘t Sas-Rolfes, M., Glikman, J.A., 2020. Influencing consumer demand is vital for tackling the illegal wildlife trade. *People Nat.* 2, 872–876. <https://doi.org/10.1002/pan3.10171>.

- Warren, C., McGraw, A.P., Van Boven, L., 2011. Values and preferences: defining preference construction. *WIREs Cogn. Sci.* 2, 193–205. <https://doi.org/10.1002/wcs.98>.
- Weber, D., Mandler, T., Dyck, M., De Groot, P., Lee, D., Clark, D., 2015. Unexpected and undesired conservation outcomes of wildlife trade bans-an emerging problem for stakeholders? *Glob. Ecol. Conserv.* 3, 389–400. <https://doi.org/10.1016/j.gecco.2015.01.006>.
- Xenos, N., 2017. *Scarcity and Modernity*. Routledge.
- Zak, S., Hasprova, M., 2020. The role of influencers in the consumer decision-making process. *SHS Web Conf.* 74, 03014. <https://doi.org/10.1051/shsconf/20207403014>.