



CONTRIBUTED PAPER

Assessing the risk of overexploitation to a tarantula species in the pet trade

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Article impact statement: Trade dynamics show limited threat to *Tapinauchenius rasti* and thus opportunity for sustainable practices for wild population conservation.

Funding information

The Lucile Foundation; Fauna and Flora International

Abstract

The global pet trade in invertebrates remains poorly understood and underrepresented in policy and research. Tarantulas are a highly traded invertebrate group. Many individuals in trade are wild caught, and trade regulation is often lacking, raising concerns about the effect of trade on local ecosystems and populations. We addressed local concerns surrounding the international trade of *Tapinauchenius rasti* (Caribbean diamond tarantula), which is endemic to Saint Vincent and the Grenadines. We assessed the extinction risks associated with this widely traded species by analyzing supply of and demand for the species with the COM-B (capability, opportunity, motivation, behavior) model. This model breaks down decision-making into capability, opportunity, and motivation. We interviewed stakeholders throughout the supply chain and analyzed content of an online hobbyist forum and a time series of prices for this species and other tarantulas. In terms of motivation, there was limited preference for the Caribbean diamond tarantula due to its morphology and behavior. In terms of opportunity, the species was readily available, primarily through captive breeding. Collecting wild specimens is challenging due to enforcement measures and logistical difficulties, making it an unprofitable endeavor. In terms of capability, the species was relatively low in price, likely because it is easy to breed in captivity. As a result, the current wildlife trade does not pose a significant threat to the Caribbean diamond tarantula. Our methodology can serve as a valuable tool for assessing potential threats posed by trade to other spider species and possibly other invertebrates. Understanding these threats is crucial for promoting responsible and sustainable trade practices that minimize risks to wild populations while ensuring equitable benefits for communities coexisting with wildlife.

KEYWORDS

arachnid, invertebrates, trade dynamics, wildlife trade

INTRODUCTION

Wildlife trade policies, research, and public attention tend to focus on a relatively small subsection of charismatic and well-known animals (Hughes et al., 2023; Hutchinson et al., 2022; Sollund, 2011), namely, mammals and birds. However, the wildlife trade, and in particular the pet trade, affects many other species (Bush et al., 2014). Despite their ecological importance and presence in the global wildlife trade, invertebrates remain an overlooked and poorly regulated animal group. More than a

million invertebrate species have been described, and evidence demonstrates that hundreds of these species may be affected by the wildlife trade (Nelufule et al., 2020; Shivambu et al., 2020). The conservation of range-restricted species, especially those in high demand as pets on the international market, is a significant concern when it comes to the impact of trade. This concern extends to a large amount of tarantula species (Marshall et al., 2022).

Tarantulas, the arachnids in the family Theraphosidae, are one of the most traded invertebrate groups; over half of known

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tarantula species are found in online markets (Marshall et al., 2022). Nearly 25% of the tarantula species described since 2000 are being traded, and many more are potentially in the trade before they are officially known to science. Some tarantula species are particularly vulnerable to overharvesting due to their long life spans, limited geographic ranges, and slow reproductive rates (Ferretti et al., 2016; Mendoza, 2020; Mendoza & Francke, 2020). These characteristics increase the risk that too many individuals from these species may be harvested before they have time to reach sexual maturity or produce enough offspring to sustain a viable population. The lack of biological and ecological data for most tarantula species (e.g., population dynamics, geographic ranges, distributions, life history, etc.) prevents scientists from determining whether species collected for the pet trade are being harvested unsustainably (Marshall et al., 2022).

Tapinauchenius rasti exemplifies a range-restricted tarantula species with international demand that existed in the trade before scientific description. It was first observed in the pet trade on 27 December 2015 and was primarily being sold in the United States and the European Union (<https://arachnoboards.com>). Referred to as the Caribbean diamond due to the distinct coloration of the female, *T. rasti* was officially described in 2018. Although ecological and behavioral insights are limited, it is arboreal and nocturnal, inhabits large, old trees, and uses hollows as shelters (Hüsser, 2018). Lacking an International Union for Conservation of Nature (IUCN) Red List evaluation and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) listing, this species highlights the importance of recognizing that trade can involve species without international protection or visibility. The only recorded distribution of the arboreal species is in the country of Saint Vincent and the Grenadines (SVG) on the 9-km² Union Island (Hüsser, 2018), which makes it a single island endemic species. Island endemic species face an elevated risk of over-exploitation due to their restricted range (Janssen & Shepherd, 2018; Kanari & Xu, 2012; Nijman & Stoner, 2014; Shepherd & Ibarrondo, 2005). Recent illegal trade threatens other Union Island species, such as the Union Island gecko (*Gonatodes daudini*) and *Igana insularis insularis*, underscoring the urgency of investigating poaching's effects on endemic species on Union Island, including *T. rasti* and species throughout the Caribbean.

Mapping the supply and demand for *T. rasti* is a key step in assessing whether the pet trade poses potential risks to wild populations. The COM-B model provides a theoretical framework with which to examine the factors that influence decision-making (Michie et al., 2011), and which can help elucidate the behavior of actors on both the supply and demand sides. The central behavior we examined is acquisition of a *T. rasti* specimen, which can happen either through poaching by local or foreign individuals or through purchases made by traders and international consumers. The COMB model's 3 key components are capability, opportunity, and motivation, which then determine behaviour. Capability refers to the physical, psychological, and social resources necessary to perform a behavior. Opportunity represents the external factors that facilitate or hinder its occurrence. Motivation encompasses the conscious and unconscious processes that drive behavior. The

model explains that a behavior occurs only when a person has the capability and opportunity and is sufficiently motivated to engage in that behavior over other options (Molloy & Piquero, 2021). The COM-B model has been used in illegal wildlife trade research; however, its application has largely focused on the demand side (Thomas-Walters et al., 2021). By employing the COM-B model, we sought to improve understanding of supply and demand by examining human behavior related to the *T. rasti* trade and its determinants.

METHODS

We examined a publicly accessible online discussion board, Arachnoboards (a primary forum for tarantula enthusiasts), to analyze hobbyist interactions and gauge their perceptions of *T. rasti*. We used the following keywords to search the site: “*Tapinauchenius rasti*,” “*rasti*,” “*Caribbean diamond*,” and “*Caribbean diamond*.” Discussions about the species started in December 2015; therefore, we considered posts published from 1 December 2015 to 21 July 2023. The following information was collected on each post: search term used, date posted, post title, username, comment, type of post (i.e., post, media item, gallery comment), and comment or comments replying to the original post (if applicable). The search yielded 196 threads, 253 posts, 35 media items, and 82 unique users.

We conducted 24 semistructured interviews with traders (3), hobbyists (6), arachnologists (5), international wildlife trade experts (6), local wildlife trade experts (2), national government officials (1), and local conservationists (2) to determine the trade, ecology, and conservation of *T. rasti*. The number of respondents does not add up to the total sample size because some respondents were in multiple categories. Two interview guides (i.e., questionnaires) were developed (Appendix S3), one for individuals involved in keeping *T. rasti* and one for traders of *T. rasti*. These guides were subsequently adapted to suit various stakeholder groups. In each interview, we collected basic demographic information about the participant and investigated the person's level of experience. The qualitative technique of snowball sampling was used. Regarding pet owners and sellers, the process commenced with an initial sample of individuals who had either recently engaged in discussions about *T. rasti* ownership in online forums or included *T. rasti* in their pet shop inventories. For researchers, the process began with an initial sample of individuals who had previously published on tarantula trade and conservation. For conservationists, expert knowledge from one of the authors (I. Vique), who has been engaged in conservation efforts on Union Island for several years, was utilized. The significance of local individuals was emphasized in the trade due to their in-depth knowledge of the area.

Interviews were conducted from April to June 2022. Forty-four people or businesses were approached to participate. Of these, 29 agreed to participate, and 24 effectively participated in an interview. To ensure confidentiality, identifying markers, including personally identifying phrases, were withheld when reporting results. Interview participants and online discussion board users were coded as P1 to P102.

Twenty-one interviews were conducted online. Three were carried out in written format over email. We recognize that the latter responses may lack the depth typical of verbal interviews, but the questions asked remained consistent. Twenty-three interviews were conducted in English; one was conducted in Portuguese. All verbal interviews were voice recorded and transcribed either manually or with the online virtual transcribing software Otter.ai. In the latter case, the resulting transcripts were checked for accuracy and cleaned. Our research design was approved by the University of Oxford's Central University Research Ethics Committee (R79265/RE001).

The contents of the interview transcripts and discussion board comments were divided into themes and by the 3 COM-B behavioral model drivers. A thematic coding framework was designed based on the main topics that emerged from the data. The quotes and extracts added under each code were analyzed to generate descriptions of perceptions relevant to *T. rasti*. Codes were manually created by one author and cross-checked by a second author to ensure consistency. Finalized codes were grouped under the identified themes and examined and clarified by all authors. The themes were grouped by relevance to the components of the COM-B model (capability, opportunity, motivation, and behavior). For instance, positive descriptors of *T. rasti* characteristics, such as *speed*, *color*, and *ease of care*, were grouped as motivations to buy under the motivation aspect of the framework. In analyzing capability, the focus was on the attributes of harvesters and intermediaries in *T. rasti* trade. Opportunity assessment encompassed external elements affecting behavior, such as the environment, social norms, and resources, on both the supply and demand sides. Motivation assessment explored the driving forces behind engaging in a behavior, stemming from internal (e.g., personal interest) or external (e.g., financial gain) factors.

An online search was conducted to locate pet shops selling *T. rasti*. We used the search terms “*Tapinauchenius rasti* for sale,” “*Tapinauchenius rasti*,” “*Caribbean diamond tarantula* for sale,” and “*Union Island tarantula* for sale.” These searches were performed in English because English is the dominant language in online arachnid trade (Marshall, 2022). We used the Wayback Machine (web.archive.org) to review archived versions of past tarantula advertisements on these identified websites. Eight shops advertising *T. rasti* sales were identified (Appendix S1). A total of 772 tarantula advertisements were recorded. Two pet shops, selected based on their history of advertising multiple *T. rasti* specimens over time and the availability of substantial Wayback Machine data, were chosen for price data collection. Data were collected for 10 *Brachypelma* species (selected as a benchmark due to their popularity in the tarantula trade) and all *Tapinauchenius* species. Information gathered for each available archive included the date, species, size (inches), sex, price, country of origin, shop, and additional comments, such as color morphs or whether the individuals were hatchlings.

Prices for relevant taxon groups were tracked to examine demand and supply dynamics (i.e., to gauge species accessibility and estimate potential seller profit margins). Data included sales in Polish zloty and Canadian dollars, which were standardized to US dollars per inch (USDPI) with Microsoft Excel's Stockhis-

tory function for currency conversion. In anticipation of size- and sex-related price variations, the data were segmented by size (inches) from sales records, creating unique fields for price per inch in US dollars for each specimen, categorized by gender. The median sale prices of 3 groups were examined over time: *Brachypelma* species, *Tapinauchenius* species (excluding *T. rasti* and *T. sp. union island*), and *T. rasti* along with *T. sp. union island*. We used R Studio to calculate median and standard error values per group, further subdivided by sex.

RESULTS

Capability

Participants shared many detailed accounts related to the capabilities, such as knowledge and skills, necessary to the supply of *T. rasti*. Information gathered about wildlife pet trade chains from the Caribbean to international markets showed that sourcing and export of *T. rasti* were driven by traders and vendors with some knowledge of arachnid market demand and pet arachnid retailing options. To ensure the survival and reproduction of *T. rasti* specimens collected, actors on the supply side needed arachnid handling and care skills. Intermediaries were supported by social networks: they had the resources to hire residents local to the species' habitat as guides or harvesters and contacts to organize the smuggling of *T. rasti* (P19, P21). This was stressed by P21, a law enforcement official, who described the networks of those harvesting and exporting *T. rasti* as follows: “I have... local contacts ...to deliver, and they move from country to country, especially [for] ...species that can survive in a very small space.”

Demand for *T. rasti* primarily came from intermediate-level hobbyists with the necessary skills to care for this perceived difficult arboreal species. Several participants noted the challenges for beginners, emphasizing its speed and flighty nature. According to P8, a seller, “It's not a good [species for a] beginner, but I wouldn't say you need to have an advanced level of experience to own one. ...[T]hey're not good for a beginner...[s because] they're extremely fast. *Tapinauchenius* ...[are] incredibly fast, maybe the fastest. So, if you're not confident in dealing with a spider that's almost as fast as some of the true spiders out there, it's not a good place to start, they are very flighty. They are very skittish.” Another participant, P6, also a seller, cautioned against arboreal tarantulas as starter species, mentioning, “If somebody is asking me about what would be a good starter tarantula, I usually don't recommend arboreal [species], and with the *rasti* being an exceptionally quick small arboreal, I don't necessarily think of them as a starter, but ...they're not particularly prone to kicking hairs and they don't seem to be...defensive in my experience.” Knowledge and familiarity with a species also affected demand. *Tapinauchenius rasti* is relatively new in the trade; therefore, there was limited information on it in relation to other species. Participant 8 expressed a warning that the demand will grow for *T. rasti* over time as more people become acquainted with it: “I think they'll become more popular. [*T. rasti*] is quite popular...[because it is a], being the

new species, but I don't think many people have had much experience with them or they ... [don't] know so much about them. There's not that much [information] out there... [because it's] a new species."

Opportunity

On the demand side, price affected engagement by retail sellers and consumers. This relationship was linked to the species' ease of captive breeding, (described as highly feasible). This connection showed the direct link between market demand, breeder expertise, and captive breeding potential. Nonetheless, there was a prevailing perception that wild extraction will persist despite the ease of captive breeding. Participant 6, a seller, stated, "If there's a hobby interest, there's always some wild collection. Genetic limitations in captivity mean some wild collection will remain necessary." On the supply side, *T. rasti's* geographical distribution, habitat characteristics, and the presence of a conservation group deterred international market harvest.

There was a stigma against owning wild-caught tarantulas in the hobbyist community. All interviewed buyers disapproved of such specimens, emphasizing the preference for captive-bred tarantulas. Sellers shared this sentiment, with P6 stating, "captive bred was always the hobby's pinnacle; you never wanted wild caught if you could avoid it." Participants stressed the ethical responsibility of consumers to protect threatened species. Participant 1, a buyer, asserted, "I believe that tarantulas should only be purchased from breeders. Anyone who sells an animal caught in the wild contributes to the species' extinction." Participant 4, a buyer, expressed a desire for transparency in identifying the specimen's origin, stating, "As individuals, it's our responsibility to look after these species and have accountability. I avoid buying wild-caught adults whenever I can." This perspective illustrated the ethical dimension of individual responsibility in species conservation and the conscientiousness and accountability of some hobbyists.

With regard to price, the median price of *T. rasti* and *T. sp.* Union Island group was largely stable. The minimum price paid for a hatchling was US\$3.65 in 2017. The maximum price was US\$58.58 in 2018. Overall, 41 records from 2016 to 2021 (excluding 2020) were the basis for this figure for this group. The median price of *Tapinauchenius* species (excluding *T. rasti*) varied among years from 2016 to 2021, but the trend was stable. The median price for this group in 2016 was USDPI21.73 ($n = 3$). This price decreased to USDPI12.46 in 2021 ($n = 22$). Overall, 199 records from 2013 to 2021 were considered in this figure (Figure 1).

The median price of the *Brachypelma* group, a very popular taxon in the pet trade, varied the most between the 2 taxa from 2013 to 2021 (USDPI50.63 in 2013 [$n = 28$] and USDPI35.78 in 2021 [$n = 99$]). Overall, 574 records from 2013 to 2021 were considered in this figure for this group. Data on sex were largely only available for the *Brachypelma* group. Females cost more than males and the group for which not applicable (N/A) group across all years. The N/A group in this case refers to spiders for which the sex was not given, usually due to the individual being

too young or too small to be sexed. In 2014, the highest median price was USDPI689.91 for females ($n = 4$), USDPI47.74 ($n = 4$) for males, and USDPI5.40 ($n = 9$) for unsexed individuals.

The perception of *T. rasti's* price influenced the decision to buy, keep, or trade it. Compared with other species, it was seen as affordable, which deterred some hobbyists and attracted others. In some cases, this perception broadly correlated with nationality. Participant 7 (a seller) explained that "in Canada people buy a lot by their budget. They'll buy anything if the price is low enough ... The [US] is a strange thing because they also purchase by price, but they see value in the very expensive spiders. They like to brag about having that new, rare thing, super expensive. So then sometimes when the spider is too cheap, people find it not to be valuable." Participants thought market conditions affected poachers' motivations as well. They thought poachers were less inclined to put energy into a species perceived as inexpensive. Participant 12, a researcher, confirmed this: "the fact that [*T. rasti*] doesn't have a really high price is probably good because it means that incentives to take the species from the wild are not necessarily going to be inflated."

Harvesters and logisticians (i.e., those who plan, finance the collection, and ensure transport of the animals collected) also faced significant challenges due to the remote nature of the island where *T. rasti* is found. Participants reported that accessing the island was costly and time-consuming. One participant (P20) reported that the absence of postal service on the island made it difficult to use this common shipping and concealment method to export wildlife, legally or illegally. Participants with professional knowledge of wildlife trade issues in the Caribbean said that transportation by sea, with the assistance of third parties, was the preferred method for smuggling.

Participants reported that since 2017, a citizen conservation group, supported by government bodies, had been monitoring known *T. rasti* habitat and that this made it difficult for harvesters to operate undetected, especially in legally protected areas. They also reported limitations of this effort exist because of the limited presence of Forestry Department personnel. (The Forestry Department is responsible for wildlife management, including issuing licenses or permits and handling wildlife-related offenses.) All but one participant with a professional connection to the region mentioned that the Forestry Department was not able to have as strong a presence as they wished on the island due to its remote location relative to the nation's capital. Moreover, there was a perception that the focus of other law enforcement agencies, such as the police, was primarily on other issues, as highlighted by P19, "[T]he police are very anxious ... [about] when cocaine is transhipped... [and] catch[ing] marijuana [traffickers]... [and] [perpetrators of] domestic violence. They... [don't] really know anything about the environment or protecting species."

After review, it was confirmed that the 1990 Wildlife Protection Act of SVG does not include invertebrates in its definition of *wildlife* and does not list *T. rasti* as a protected species. *Tapinauchenius rasti* is also not a listed species under CITES, and that legality of imports varies by country was noted by P22, an SVG government official: "The law is weak in trying to

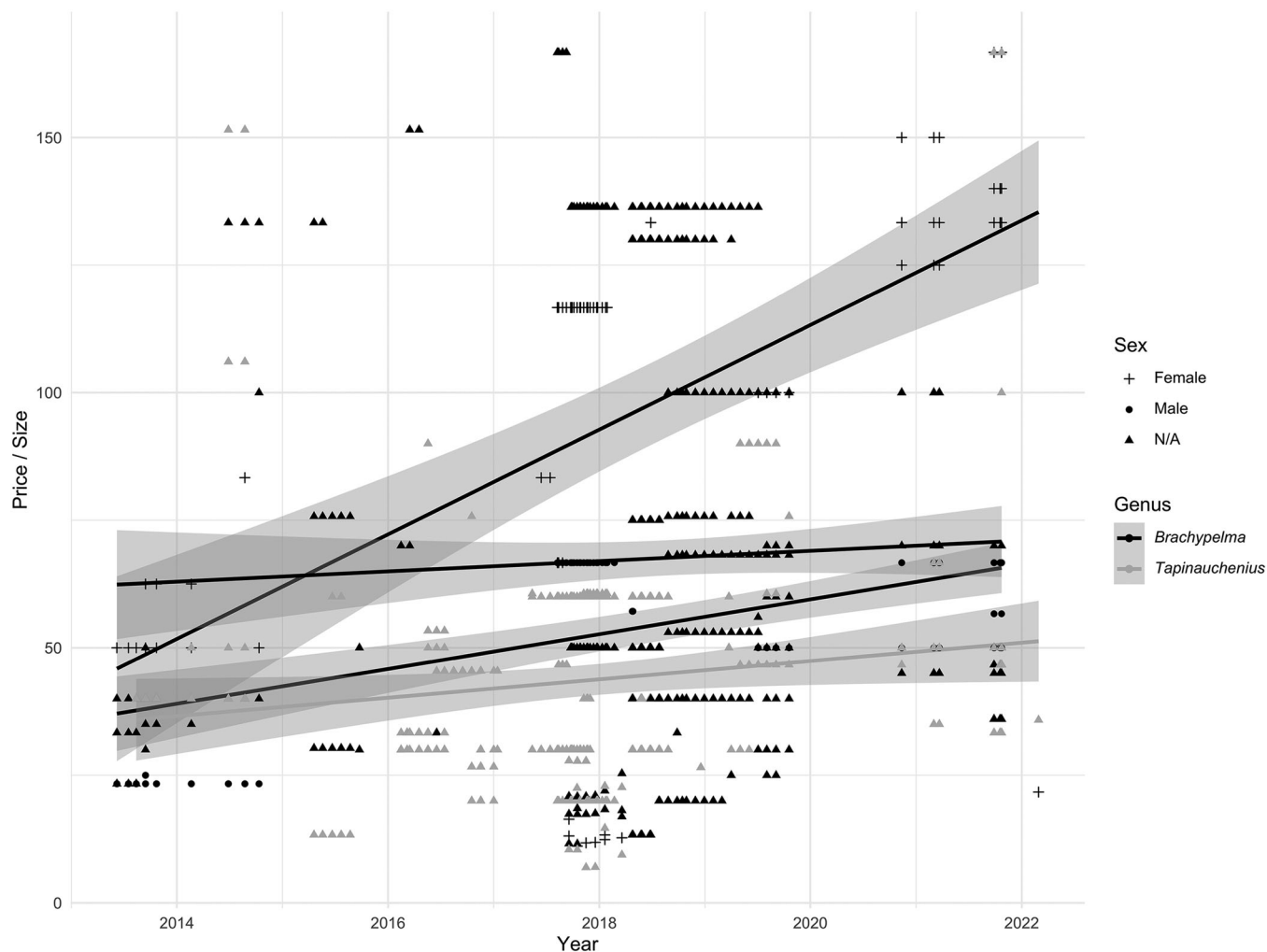


FIGURE 1 Median price per inch (US\$) over time when controlling for size split by sex (no inflation) of *Brachypelma* spp. and Union Island *Tapinauchenius* spp. (*Tapinauchenius rasti* and *Tapinauchenius* sp.) and excluding Union Island species and *rasti* in a shop in Poland and one in Canada from 2013 to 2021 (N/A, sex records not available; error bars, SE).

address matters with someone who already has it and is outside of the country. Within the country, with collected data... we could... address it. If it's already outside the country, there's not much the scientists or any legislation could do to help it."

Motivation

The motivation to buy, own, or sell *T. rasti* was driven largely by internal factors (personal interest and enjoyment) based on desired qualities and characteristics of the species. What was desired by some served as a deterrent to purchase for others. *Tapinauchenius rasti* qualities and characteristics that motivated the trade were also reasons buyers and sellers did not engage in the trade of the species. It appeared that although a niche market existed for *T. rasti*, this species retained a limited preference based on its physical and behavioral characteristics relative to overall market trends for tarantula species. Appearance, speed, feeding and webbing behavior, collectionism, temperament, economic needs, and external motivation factors were qualities

or characteristics that both positively and negatively influenced the motivation to buy or trade *T. rasti* in its respective market. These findings are based on interviews and discussion board comments.

Appearance, including physical attributes, such as color and size, was a primary motivator for buying, owning, or selling the species. A buyer and hobbyist, P26, stated, "*T. rasti* is one of the best-looking tarantulas in the hobby." The species was described as "beautiful," "pretty," and even a "show piece" (Appendix S2). In direct opposition to this finding, several participants found *T. rasti* lacking the typically sought-after physical attributes desired in the larger tarantula trade. Although *T. rasti* exhibits various colors (e.g., purple in females and orange in juveniles), the predominant brown color was not as highly desired as the colors of other popular species. A seller, P7, noted that "everybody wants to breed the blue species because blue always sells for some reason. ... *Rasti* is a beautiful spider but again, it belongs to a genus that is not an ultimate classic of the hobby."

Desirable size and growth rate were determined by remarks on growth rate and physical size. *Tapinauchenius rasti*'s fast growth

rate was considered a sought-after quality. A buyer, P27, said, “the good news is that Tapi will grow faster than a weed. Mine is easily my fastest growing sling.” However, its overall small size compared with other tarantulas appealed to some collectors and hobbyists but deterred others. As a desired trait, P6, a seller, discussed how the small size might be favorable in the care of *T. rasti*: “they would be a little easier than say...one of the other South American species because they don’t get really large, [so] they would be a little easier.” As a buyer and hobbyist, P38’s rationale for owning *T. rasti* was that “...they don’t get quite as big as Pokies.” (Pokies are species in the genus *Poecilotheria*.) Large tarantulas are generally in high demand, as P10, a researcher, explained: “what most people want is something that’s colorful, that’s big and impressive, that’s nasty, you know, there has got to be some aspect to it that draws in the hobbyist. It’s a very odd kind of a mentality but [they want] the biggest, badass, or prettiest. These are all the things that make a tarantula [a] high target.”

Speed, classified based on remarks on the species observed velocity, agility, and quick movement in captive settings, was identified as a top descriptor of *T. rasti*. Due to the mixed interpretations when discussing how fast *T. rasti* tarantulas are, we classified speed as both a motivation and a deterrent to buy, own, and sell the species. A buyer and hobbyist, P30, described them as “one of the fastest tarantulas known to man.” The idea that *T. rasti* has the reputation of being the fastest tarantula was perceived as a challenge to some collectors and hobbyists, making speed a desired quality to some. A buyer and hobbyist, P31, highlighted this perception: “This will certainly be fun! They are so fast!” Conversely, the majority collectors and hobbyists perceived speed as a deterrent. Collectors discussed the difficulty in handling *T. rasti* and likened the species’ speed to an ability to teleport (P32).

Feeding behavior was classified based on remarks on hunting, eating, feeding response, willingness to feed, and appetite in captive settings. Feeding and webbing behavior emerged as motivating factors to buy, own, and sell *T. rasti*. For example, P33, a buyer and hobbyist said, “I’ve been totally impressed with its beauty, webbing, and feeding response.” Webbing behavior was classified by remarks on the spinnerets, silks, and webs created by the species in captive settings. A buyer and hobbyist, P34, highlighted why tarantulas that create webs, including *T. rasti*, may be sought: “If you like webbers, go with the Caribbean diamond.” Being able to watch a tarantula hunt was determined to be a motivating factor, and pictures of tarantulas feeding were commonly shared in online forums. A buyer and hobbyist, 24, shared that *T. rasti* is perceived as a good hunter: “My adult female *T. rasti* is one of the best hunters I have.” The feeding behavior of *T. rasti* was even described as “endearing.” For example, P35, a buyer and hobbyist, said, “I’ve watched my *T. rasti* web crickets to a vertical surface and dance around them as well. I haven’t noticed any of the other arboreal species I have do the same, but it’s a very endearing behavior.”

Some collectors and hobbyists preferred a tarantula genus rather than specific species (an emerging phenomenon being called *collectionism*). For *Tapinauchenius*, collectionism was a motivating factor to buy, own, and sell *T. rasti*. A buyer and hobbyist,

P29, provided an example to this collecting style: “I want all the *Tapinauchenius* tarantulas. They are all beautiful, and I simply must have them.” People who collect *Tapinauchenius* were called T keepers, and all of the species in this genus were grouped under nicknames, such as Taps, Ts, Tapis, and Tappies. A buyer and hobbyist, P36, talked about collection location: “My Ts are in my home office, where I quietly work.” One buyer and hobbyist, P37, claimed ownership of 54 individual tarantulas of the genus *Tapinauchenius*, “...[O]ut of my 54 Ts, *Ephobopus* are one of the fastest I have, with maybe my [C]aribbean diamond being a bit more warpy.”

Descriptions of *T. rasti*’s temperament were a common focus among collectors and hobbyists, and comments reflected individual traits in captive settings. *Tapinauchenius rasti* was described as skittish on 9 occasions. *Tapinauchenius* were often mentioned as exhibiting the traits crankiness and reclusiveness. However, some participants portrayed *T. rasti* as docile, calm, outgoing, cooperative, and relaxed. For instance, P35, a buyer and hobbyist, said, “Mine seems to be an anomaly, quite calm and visible. She doesn’t flinch when I move her enclosure and isn’t shy about light.” It was apparent that traits perceived as negative attracted a niche group and deterred others, and vice versa for positive traits. Given these varied perceptions and no clear impact on demand, it was unclear whether temperament influenced motivation to buy, own, or sell the species. Overall, these descriptions revealed a wide range of personalities and temperaments within the species.

Although internal motivations dominated, personal enjoyment was also influenced by external factors, such as profit or social standing. Participants involved in breeding or selling *T. rasti* primarily emphasized their primary desire was motivated by personal interest first, rather than anticipation of profit. For example, P7, a seller, stated, “I didn’t like to be considered as a dealer, because at heart, I was a breeder, what I like is breeding tarantulas...I like to go...[into] the field to observe them in nature, [but] the sad truth about all tarantula species in the hobby is that not all of them survive long term because some breeders do it just for money. So, if there’s no demand, they stop doing it.” Profit remained a motivation for some, as P8, another seller, explained, “I’ve kept spiders since I was 11 [years old], and I started breeding from the age of 13... [O]ver the years...the funds that I raised from selling the spiders just went straight back to build my own collection. I’ve ...decided to try it as a business.”

Motivation linked to a levy system was seen as an external factor tied to the social stigma of owning potentially threatened species. A buyer, P4, said, “Just the knowledge of knowing that it is 100% a captive bred specimen and also part of that markup is going further towards conservation of the animal is just a nice thing to know. I said I can only speak for myself, but that would definitely be something I would be interested in if I had to guess about the rest of the community. I think there’s lots of people out there that would think likewise.” Several participants indicated they would be more willing to purchase a specimen, or purchase it for a higher cost, if a portion of the proceeds went to the conservation of the species. “In a perfect world, a portion of sales should go to conservation, but it’s challenging to track and

implement” (P3, buyer). A captive breeding project in Mexico was cited as a promising model for legal and sustainable trade. A researcher, P11, shared thoughts on the project: “It would be interesting to set up a system like that in Mexico, where the species is being bred in captivity, but in country, in situ, to meet demand, reduce wild collection, and potentially reintroduce to the wild. That’s not as simple as people think it is, but it can be done.”

DISCUSSION

Our method and the COM-B framework can be applied to similar species in the trade to support more robust regulatory decisions. Structured assessments are essential for sustainable management of spiders and invertebrates in the pet trade. Although our results suggest that the trade dynamics for *T. rasti* currently pose minimal risks to wild populations, further comprehensive data are needed to confirm this. Ongoing monitoring is crucial, given the volatile nature of supply, demand, and logistics in the pet trade. Regular assessments are necessary to conserve the species effectively and respond in a timely manner to changes in trade dynamics. We recommend mechanisms for benefit sharing from the trade of captive-bred animals to ensure greater ownership of the species in SVG and prevent unsustainable trade in wild animals in the future.

Capability

Our results shed light on the various capabilities and social networks involved in the supply and demand of *T. rasti*. Recognizing hobbyists as a diverse group, influenced by factors such as experience and consumer segmentation, is crucial. Social norms and the significance of social capital in these communities also play a role. Social capital, representing shared values and networks (Kreuter & Lezin, 2002), can greatly influence the success of ideas or industries. For instance, there is a perceived sense of shame associated with wild-caught specimens in the hobbyist community but not a strict taboo. This suggests the potential for stronger commitments to sustainable practices within hobbyist groups. Consequently, the demand for wild specimens may not be high because captive-bred individuals can meet market needs in some contexts. Leveraging this sense of shame and the hobbyist community’s conservation awareness can guide the development of accepted sustainable policies.

Opportunity

Our findings highlight the remarkable ability of trade networks to reach even the most remote locations, as demonstrated by the presence of *T. rasti* in the international pet trade, even before the species was documented officially. This is a concerning parallel with other species that entered the pet trade at the time of their description, or shortly after. There were disastrous consequences for the survival of some of these species in their

natural habitat (Altherr & Lameter, 2020; Daltry et al., 2016; Powell & Henderson, 2005; Stuart et al., 2006). This underscores the need for responsible data collection and publication by taxonomists and biologists. It also raises concerns about the potential increase in wild specimen acquisition if demand shifts, given limited resources for monitoring and enforcing wildlife trade laws. Despite enforcement challenges in online trade, the abundance of data mining tools, such as Web Archives, offers opportunities for improved monitoring. Such monitoring, including our price dataset, played a crucial role in analyzing profit margins and distinguishing captive-bred from wild-caught tarantulas.

Based on current knowledge, *T. rasti* is a single-island endemic species with clear habitat preferences. Although presenting an opportunity to effectively monitor the species and its habitat, their restricted distribution also renders *T. rasti* vulnerable by default to extreme natural events or intense harvest effort. Its very specific and restricted habitat presents an opportunity for harvesters to better locate it. The species’ biogeography remains uncertain due to the absence of population surveys on nearby islands (e.g., Mustique Island). Moreover, *T. rasti* and *T. sanctivincenti* could be conspecific, but the type specimen is reported as lost, which prevents a direct comparison (Cifuentes & Bertain, 2022). If either is true, this would have large implications for the species conservation, negate the validity of the single-island endemism characteristic, and reduce extinction risk.

The status of *T. rasti* and the arachnid trade in the country remains characterized by a legal gray area. *Tapinauchenius rasti*, along with all invertebrates, are excluded from the definition of *wildlife* in the 1990 Wildlife Protection Act of SVG, preventing them from being protected through legislation. The protection provisions of this act regulating, among other issues, the hunting and sale of wildlife do not explicitly apply to the *T. rasti*. Similarly, it is not clear whether the following provision regulating international trade in species found in the country applies to this species: “No person shall import or export any wildlife into or from S8732 SVG without the written permission of the Minister.” Much of the habitat of *T. rasti* is in a protected area regulated under the Forest Resource Conservation Act of 1992. Hunting and harvesting wildlife are illegal in this area, but the connection between specific animals and the area they were found in is challenging to prove once they have been removed. This ambiguity provides further opportunity for and contributes to the unregulated export of these species.

Through examination of opportunity, we found that there are efforts to detect illegal harvest of wildlife in the range of *T. rasti*; however, our results suggest there is limited capacity for formal sanctions and control of transportation off the island. Therefore, some opportunity remains for those involved in illegal wildlife trade.

Motivation

Our study’s findings on motivation highlight the significance of consumer research to a comprehensive understanding of

the diverse factors shaping trade decisions. These motivations can be complex and influenced by both animal traits and actor characteristics, creating multifaceted trade dynamics. To address the specific needs and preferences of various groups (e.g., extractors, breeders, transporters, consumers), it is crucial to understand their nuanced motivations along the trade chain. Socioeconomic aspects also play a role, particularly in regions with higher poverty rates, where individuals may engage in unsustainable trade for economic survival. Weaker governance facilitates illegal practices. The concept of conservation basic income (CBI) (unconditional cash awards to residents in critical conservation areas) offers promise as a solution (de Lange et al., 2023; Fletcher & Büscher, 2020). The island nation of SVG, with 17 key biodiversity areas (CBD, 2021), is a strong candidate for CBI implementation. The use of CBI can support effective, sustainable, and equitable conservation by offering alternative financial prospects to local communities and thus reduce reliance on extractive endeavors, such as poaching. In the case of the *T. rasti* trade, CBI has the potential to reduce the engagement of residents in supporting or facilitating or engaging in illegal harvest. However, this measure would have limited impact on other actors involved in the trade.

Income generation was one of the motivations interviewees identified as driving the supply of wildlife for the pet trade. The SVG is an upper-middle-income country, and in 2022, it had a high human development index of 0.772, just above the world average and comparable to that of other Caribbean island nations (UNDP, 2024). Yet, 30.2% of the individuals included in the latest publicly available national poverty assessment lived in poverty (Kairi Consultants Limited, 2008). Furthermore, *T. rasti* are found far from the capital and the main island of Saint Vincent in locations where people are relatively economically and politically marginalized (Daudin, 2000; Jack-Kadioglu et al., 2021). Engaging in the wildlife pet trade by supplying animals or guiding external harvesters could be one of a limited number of options available to generate cash income and improve economic well-being, aside from tourism, public sector employment, and remittances from relatives established abroad. This is particularly true after the passing of Hurricane Beryl in July 2024, after this research project concluded, which destroyed most of the buildings in the island.

Another mechanism involves creating sustainable wildlife trade practices to ensure benefits return to the species' native countries, such as SVG, and thus support equitable economic, social, and environmental gains (Hinsley & Roberts, 2018). One potential approach could be to institute a certification system, akin to the fair-trade model, where traders from nonrange countries contribute royalties per transaction to range countries' governments, as previously suggested for wildlife-derived profits (Brackowski et al., 2021). This kind of wealth and income redistribution measure can be advanced as a political and legal decision by the government of SVG. It aligns with the motivation of people living near wildlife to participate in conservation efforts when they receive benefits from the presence of that wildlife, including financial gains (Biggs et al., 2017; Roe & Booker, 2019). Implementing equitable benefit distribution mechanisms also underscores the importance of recognizing

nations' sovereignty in managing their biodiversity resources, which, particularly in historically underprivileged areas such as *T. rasti* habitat, can significantly support species conservation and sustainable development initiatives.

Regulation of *T. rasti* trade

Although current evidence suggests that trade does not immediately threaten *T. rasti*, it is essential to recognize that this could change in the medium to long term, especially with shifting consumer preferences. Increased demand and prices can harm habitat quality and have other impacts, as seen in the tarantula trade in Peninsular Malaysia (Law, 2019). To mitigate future risks and prevent unsustainable exploitation, better trade regulation is crucial. In SVG, the trade in *T. rasti* remains unregulated due to a legal loophole; arachnids are not legally considered wildlife, making it unclear whether the protection provisions of the 1990 Wildlife Act apply. Unregulated trade has received less attention compared with legal and illegal trade. One potential solution to close this loophole is to amend the Wildlife Act, currently under revision, to include all flora and fauna, including arachnids. This would require, at minimum, government permission to export arachnids, such as *T. rasti*, from the country. Adequate resources for implementation would enable monitoring and adaptive management. If its implementation is adequately resourced, this legal change would facilitate monitoring of volumes extracted and adaptive management of the trade. If trade threatened the survival of other arachnid or invertebrate species, they could be added to the act's list of protected wildlife, preventing hunting, ownership, or sale.

Value of methodology

Beyond the case of the *T. rasti*, the COM-B model and the integration of multiple data sources can be used as part of trade assessments and conservation planning for other arachnid species and, more broadly, species found in international trade. Integrating our approach offers valuable insights into the undocumented trade dynamics of arachnids (Marshall et al., 2022) and will aid targeted conservation efforts. A multidimensional analysis, such as the one we conducted, may be particularly relevant to conservation policy making. Currently, proposals to enhance international wildlife trade controls under CITES often rely on limited criteria that inadequately represent the trade's nature (Challender et al., 2022). For instance, a fraction of proposals to amend the appendices made from 2007 to 2022 took into account market size and price trends. Proposals provided limited information on consumer demand. Our method allowed us to gather and assess such critical market and trade chain information for *T. rasti* with the COM-B model. This approach could be used to bolster CITES and other trade regulation proposals to ensure suitable mechanisms are identified.

Although the pet trade does not currently appear to threaten the wild population of *T. rasti*, measures could be taken to ensure

that changes in demand do not pose a future risk. Addressing existing regulatory gaps and ensuring financial benefits from sustainable wildlife trade are 2 ways to promote sustainable trade practices for the species of SVG including *T. rasti*. Our research has the potential to contribute to conservation policy more broadly. Our data collection methodology and the COM-B helped us identify drivers of both the supply and demand in *T. rasti* and answer questions often overlooked in CITES listing processes. This approach could be replicated for evaluations of the threat posed by trade to wild populations of other internationally traded species.

ACKNOWLEDGMENTS

We thank the Saint Vincent and the Grenadines Forestry Department and the Union Island Environmental Alliance, who raised the trade of *Tapinauchenius rasti* as a concern, for their support of this research. We also thank C. Fukushima. The content of this article benefitted from several conversations with S. Henriques, chair of the SSC Spiders and Scorpions Specialist Group. This research has been funded by the Lucille Foundation.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Rivera, S. N., Joanny, L., Vique, I., Middleton, R., & Verissimo, D. (2024). Assessing the risk of overexploitation to a tarantula species in the pet trade. *Conservation Biology*, 38, e14362. <https://doi.org/10.1111/cobi.14362>