

Wildlife collection for scientific purposes

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Abstract: Illegal transfer of wildlife has 2 main purposes: trade and scientific research. Trade is the most common, whereas scientific research is much less common and unprofitable, yet still important. Biopiracy in science is often neglected despite that many researchers encounter it during their careers. The use of illegally acquired specimens is detected in different research fields, from scientists bioprospecting for new pharmacological substances, to taxonomists working on natural history collections, to researchers working in zoos, aquariums, and botanical gardens. The practice can be due to a lack of knowledge about the permit requirements in different countries or, probably most often, to the generally high level of bureaucracy associated with rule compliance. Significant regulatory filters to avoid biopiracy can be provided by different stakeholders. Natural history collection hosts should adopt strict codes of conduct; editors of scientific publications should require authors to declare that all studied specimens were acquired legally and to cite museum catalog numbers as guarantee of best practices. Scientific societies should actively encourage publication in peer-reviewed journals of work in which specimens collected from the wild were used. The International Commission on Zoological Nomenclature could require newly designated types based on recently collected specimens to be accompanied by statements of deposition in recognized scientific or educational institutions. We also propose the creation of an online platform that gathers information about environmental regulations and permits required for scientific activities in different countries and respective responsible governmental agencies and the simplification of the bureaucracy related to regulating scientific activities. This would make regulations more agile and easier to comply with. The global biodiversity crisis means data need to be collected ever faster, but biopiracy is not the answer and undermines the credibility of science and researchers. It is critical to find a *modus vivendi* that promotes compliance with regulations and scientific progress.

Keywords: biodiversity, biological conservation, biopiracy, invertebrate, natural history collection, taxonomy, trafficking

Recolección de Fauna con Motivos Científicos

Resumen: El traslado ilegal de fauna tiene dos objetivos principales: el mercado y la investigación científica. El mercado es el más común, a la vez que la investigación científica es mucho menos común y poco rentable, pero de igual manera importante. La biopiratería en la ciencia comúnmente se ignora a pesar de que muchos investigadores se encuentran con ella a lo largo de sus carreras. El uso de especímenes adquiridos ilegalmente está detectado en diferentes campos de investigación, desde los científicos que realizan bio-exploraciones en búsqueda de nuevas sustancias farmacológicas, pasando por los taxónomos que trabajan en las colecciones de historia natural, hasta los investigadores que trabajan en zoológicos, acuarios y jardines botánicos. Esta práctica puede deberse a la falta de conocimiento sobre los requerimientos de los permisos en diferentes países o, probablemente con mayor frecuencia, a la alta cantidad de burocracia asociada con el seguimiento de las reglas. Los diferentes actores pueden proporcionar filtros regulatorios importantes para evitar la biopiratería. Los dueños de las colecciones

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de historia natural deberían adoptar códigos estrictos de conducta; los editores de las publicaciones científicas deberían exigirle a los autores que declaren que todos los especímenes estudiados fueron adquiridos legalmente y también que citen el número de catálogo del espécimen como garantías de mejores prácticas. Las sociedades científicas deberían promover activamente la publicación en revistas revisadas por pares de los trabajos en los que se usaron especímenes recolectados en su hábitat natural. La Comisión Internacional sobre la Nomenclatura Zoológica podría requerir que la designación reciente de tipos basada en especímenes recolectados recientemente esté acompañada por declaraciones de deposición en instituciones científicas o educativas reconocidas. También proponemos la creación de una plataforma en línea que recopile la información sobre las regulaciones ambientales y los permisos requeridos para la actividad científica en diferentes países, así como las agencias gubernamentales responsables y la simplificación de la burocracia relacionada con la regulación de las actividades científicas. Esto haría que las regulaciones sean más ágiles y su cumplimiento más fácil. La crisis mundial de biodiversidad implica que los datos necesitan ser recolectados con mayor velocidad que nunca, pero la biopiratería no es la respuesta, además de que desvirtúa la credibilidad de la ciencia y de los investigadores. Es muy importante que encontremos un *modus vivendi* que promueva un acuerdo entre las reglas y el progreso científico.

Palabras Clave: biodiversidad, biopiratería, colección de historia natural, conservación biológica, invertebrado, tráfico de especies, taxonomía

摘要: 非法转移野生动物有两个主要目的:贸易和科学研究。其中贸易最为普遍,而科学研究虽然不那么普遍且不以营利为目的,但仍然很重要。尽管许多研究者在职业生涯中都曾遭遇科学领域的生物掠夺行为,然而此类事件却经常被忽视。许多不同的研究领域都存在使用非法获取的标本的情况,包括科学家对新的药理学物质的生物勘探、分类学家的自然历史收集工作,以及研究人员在动物园、水族馆和植物园的工作等等。存在这些做法可能是由于对不同国家的许可证要求缺乏了解,或者最常见的可能原因是与遵守规则有关的官僚主义普遍盛行。不同的利益相关者可以采取重要的监管筛选措施来避免生物掠夺行为。进行自然历史采集的机构应采取严格的行为规范;科学出版物的编辑应该要求作者声明所有研究标本都是合法获得的,并引用博物馆目录编号来保证研究采用最佳做法。科学协会应该积极鼓励在同行评审的期刊上发表从野外采集的标本。国际动物命名委员会可以要求在根据最近采集的本来指定模式标本时附上获得认可的科学或教育机构的标本保存声明。我们还建议创建一个在线平台来收集不同国家和负责的政府机构关于科学活动所需的环境法规和许可证的信息,并简化与规范科学活动相关的官僚制度。这些举措将使法规更灵活和易于遵守。全球面临的生物多样性危机需要人们以更快的速度收集数据,但生物掠夺行为并不是应对这一危机的答案,它反而会破坏科学研究及研究者的可信度。目前至关重要是找到能够促进遵守法规和推动科学进展的权宜之计。【翻译:胡怡思; 审校:聂永刚】

关键词: 生物多样性, 生物保护, 生物掠夺行为, 无脊椎动物, 自然历史收集, 分类学, 非法交易

Introduction

Whenever scientific misconduct is reported by the media, a discussion about trust in scientists ensues. Often, such discussions lead to the discredit of scientists or the search for alternative sources of expertise, which has major consequences. Although particularly visible in the field of medicine, conservation science is not immune to such problems. A recent description of the electric-blue-legged tarantula (*Birupes simoroxigorum* Gabriel & Sherwood 2019) from Malaysia, allegedly collected and transported without permits, ignited a passionate debate about the illegal collection of wildlife and the ethics of using such specimens in science (Law 2019; Gabriel & Sherwood 2019). This spider was captured by European collectors and transported into Europe from Malaysia (Law 2019), and it was later described as a new species in a journal published by a tarantula hobbyist society (Gabriel & Sherwood 2019). The case was brought to the attention of the public, triggering a heated discussion about the ethics of how scientific material is acquired.

Illegal transfer of wildlife has two main purposes (Fig. 1). The most common is trade, the illegal share of

which involves billions of U.S. dollars (Nellemann et al. 2016). A much less common and unprofitable, but still important, purpose is for use in science. Occasionally these 2 purposes are combined when new species are described from among traded specimens by hobbyists and amateurs in nonpeer-reviewed publications, as in the case of the Brazilian Black and White tarantula (*Nbandu coloratovillosus* Schmidt 1998) (Fig. 2). Another example entails the Mexican tarantulas *Brachypelma* Simon 1891 and *Tiltocatl* Mendoza and Francke 2020. These genera are very popular in the pet trade, and many of their species are listed as threatened on the International Union for Conservation of Nature Red List (2020) and included in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 2019) due to the threat posed by collection from the wild. Out of the 15 valid species of *Brachypelma* and *Tiltocatl*, 7 were described by hobbyists in nonpeer-reviewed journals with no mention of permits. Most likely they were obtained illegally.

There is a long tradition, since colonial times, of collection of invertebrates in the New World by European explorers on scientific expeditions, and they are still an

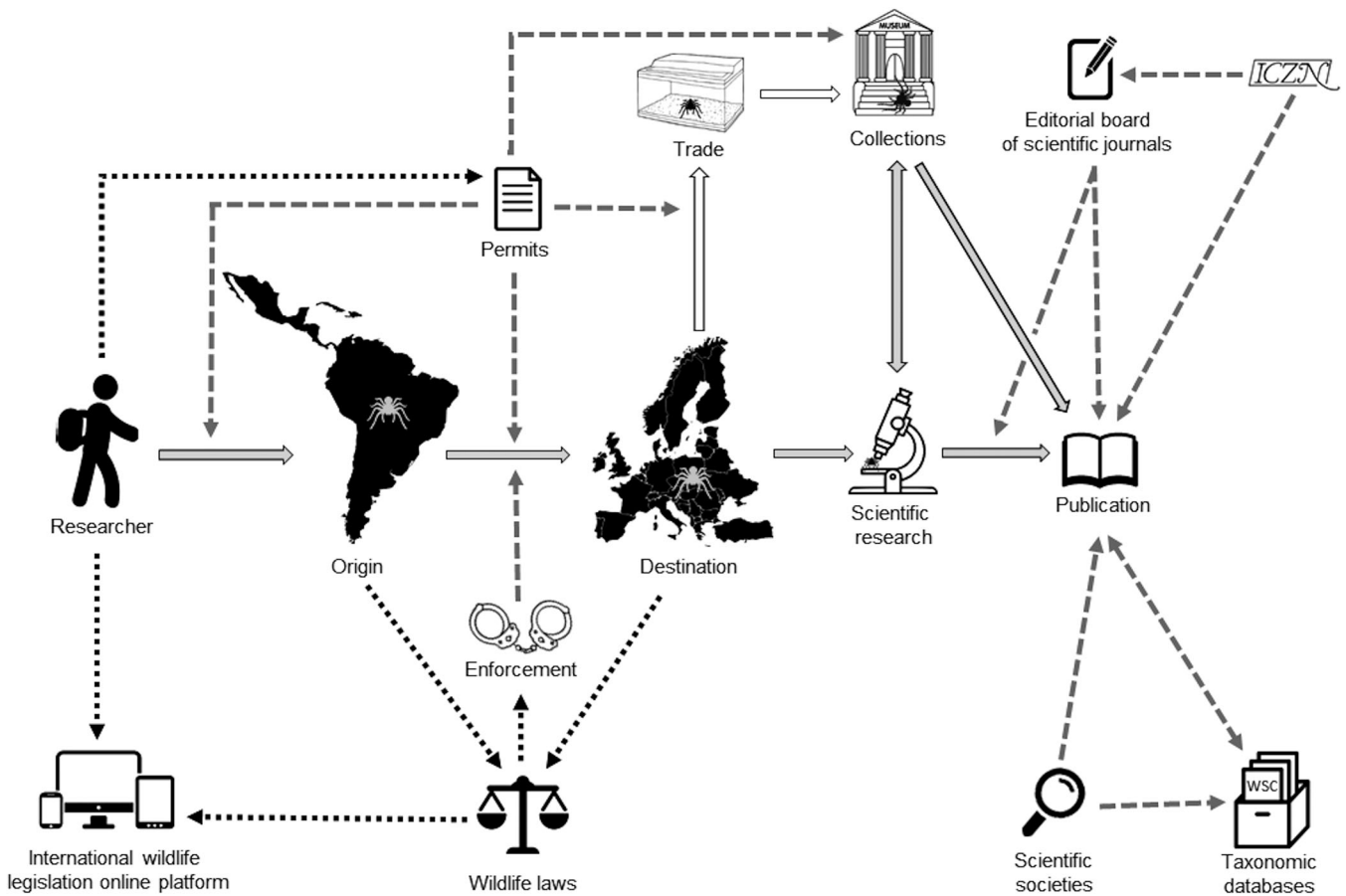


Figure 1. Transmission of wild-caught invertebrates from the country of origin to the country of destination to be used for scientific purposes, showing the players and stakeholders involved in the process (gray arrows, strict scientific path; white arrows, mixed path [science and trade]; black dashed arrows, bureaucratic connections; gray dashed arrows, part of the chain in which stakeholders already act or could act to regulate the use of illegally collected wildlife).

easy target for collectors in general. Invertebrates are the most species rich and abundant group in the world, yet there are many undescribed and visually appealing species. Moreover, they are easier to transport than mammals, birds, or reptiles. Although tarantulas are an illustrative case among invertebrates, they are not the only group of organisms poached to be traded and then used in science. New species of orchids, for example, have come to the attention of scientists via illegal trade (Vermeulen et al. 2014).

Besides hobbyists, scientists have also collected, transported, and exported biological specimens across borders without the required permits. In 2000 the former reptile curator at a zoo was found guilty of wire fraud and theft for illegal trafficking in rare and endangered reptiles (Associated Press 2000). In 2005 the curator of a botanical garden in Czech Republic pleaded guilty to charges of poaching 1167 plants and cuttings and 7024 seeds and seed pods of numerous succulent species in South Africa (Yeld 2005). Also in 2005, a botanical

garden in the United States was charged with a misdemeanor violation of the Endangered Species Act because of its role on the discovery and description of a new orchid species smuggled from Peru (Pittman, 2005). Scientists have been caught poaching multiple plant species, such as dwarf aloes and orchids (Steyn, 2015).

Why do scientists put themselves in these predicaments? One reason may be the lack of knowledge about the permit requirements and acquisition. Even when such knowledge exists, there are often insurmountable barriers to collecting and exporting, or the administrative delay in the permit process may tempt researchers to break the rules. Ignorance of local authorities regarding the respective legislation and even the complete absence of answers to requests are also frequently reported. In this sense, bureaucracy hampers not only entire projects, but also the search for new information on known and unknown wildlife species and, consequently, conservation.



Figure 2. Nhandu coloratovillosus Schmidt 1998, a Brazilian species described by an amateur arachnologist in a magazine without peer review. The description was based on specimens captured by a German collector who had been arrested multiple times in Brazil due to illegal collection and export of tarantulas (TRF-1 2006). Photo by Rick West.

Biopiracy is a controversial term that is more often applied to the use of biological resources or knowledge of indigenous communities without fair sharing of benefits (Efferth et al. 2016). In a broader sense, biopiracy can be defined as any type of unauthorized access of biological material, such as collecting and transporting wildlife without permits. Biopiracy in the pet market, for example, is more frequent, financially more substantial, and has stronger ecological impact than biopiracy related to science. Although it is 1 of the 2 central focuses of biopiracy discussions (the other being industrial use), here we considered only the less acknowledged, scientific biopiracy. This topic is often neglected despite that many researchers encounter it during their careers, from scientists bioprospecting for new pharmacological substances, to taxonomists working on natural history collections, and to researchers working in zoos, aquariums, and botanical gardens. We sought to extend the debate to include the use of smuggled specimens in research, its drivers, and the role of stakeholders in combating this problem and propose some best practices to deal with it.

Museum and Natural History Collections

Due diligence from institutions managing scientific collections should be the foremost approach, but not the only one. First, natural history museums and similar repositories have a legal and organizational framework that allows them to enforce best practices regarding the material they host. Second, collections are the point of

intersection of all players: they are the final destination of the wild-caught material and a starting point for scientific publications in many areas, including, but not limited to, taxonomy (Fig. 1).

Many institutions worldwide have codes of conduct with regard to acquisition, availability, data sharing, and repatriation of material. Technical solutions to implement these in collection curation are emerging (Heikkinen et al. 2019; Kuusijärvi et al. 2019). Recently, the Nagoya Protocol of the Convention on Biological Diversity, which regulates access and benefit sharing of biological resources, prompted many to adopt even stricter rules, depending on the interpretation made in each country. An example of this is provided by the Consortium of European Taxonomic Facilities (CETAF) (2018), which attempts to ensure that all biological resources entering any of the participant repositories are obtained with appropriate permits. Additionally, CETAF's code (CETAF 2018) states that the staff of the parties should not undertake any fieldwork until all relevant permits are agreed on and finalized in accordance with the laws and regulations of the nation in whose territory the fieldwork is carried out. This should be adopted as standard practice in all institutions hosting collections worldwide to avoid problems arising from scientific malpractice. However, it is not a matter of simply piling on more responsibility to natural history collections. Institutions that financially support them should recognize that implementing and complying with stricter rules will require more resources (money, physical space, and human) to expand and care for collections.

Scientific Publications

Editors of scientific publications should provide a significant regulatory filter for biopiracy. Although it is impossible to check the legality of each specimen referred to in a scientific work beyond what the authors provide, several steps could be put in place to minimize the occurrence of biopiracy. First, during the submission of a manuscript, authors should be required to self-declare that all material was obtained legally. Second, it should be mandatory to cite museum catalog numbers, at least when describing a new species. This is a practice that currently is not required by all journals. If adopted it would generate a cascading impact: museums must accession types before publishing, and so collection permits of the type material must be verified before they are accessioned to the museum. These criteria would also strengthen ties between scientific journals and museum collections. Similarly, author guidelines on publication ethics and malpractice statements should be clear and explicit. Additionally, journals should be cautious with manuscripts dealing with taxa or localities that are well-known targets for biopiracy and should retract or

otherwise flag articles where there is evidence of the use of illegally collected material. Unfortunately, these suggestions would be difficult to implement for journals that are published by nonscientific societies, such as hobbyist magazines, or by privately funded journals or books for which the editor is frequently also the author. Although these are considered valid venues for taxonomy and nomenclature studies, they are not regulated by scientific societies or academic organizations; hence, they constitute a recurrent problem for the taxonomy of many groups, for example, “the Raymond Hoser problem” in herpetology (Naish 2013). However, some changes are possible. For instance, peer review could be considered mandatory for publication of a new species to be considered valid according to the International Code on Zoological Nomenclature (see below).

Scientific Societies

The validity of species descriptions is usually unregulated. Scientific societies often do not get involved or act as referees in such activities. Some taxa, such as spiders and butterflies, have their own world catalogs in which the most important available taxonomic information is compiled. However, these databases are meant to track the current situation; hence, it is beyond their scope to regulate the validity of descriptions or names, although the editorial team may sporadically decide to exclude taxonomic information (Kropf et al. 2019). Transferring the responsibility of policing the legality of preserved specimens to scientific societies is neither feasible nor desirable, although scientific societies certainly should participate by having an explicit code of ethics and strongly encouraging their affiliates to publish only in peer-reviewed venues.

International Commission on Zoological Nomenclature (ICZN)

Another organization that could potentially regulate acquisitions of material is the ICZN. The ICZN does not regulate taxonomic acts because those acts are scientific decisions; rather, they regulate nomenclatural acts, which are decisions that affect the nomenclatural status of scientific names or typifications of nominal taxa (but not taxon descriptions as such). The ICZN recommends authors follow some general principles, which together constitute a code of ethics, but these are not part of the legislation of the International Code of Zoological Nomenclature (ICZN 1999). Ultimately, this means the commission is not empowered to investigate or rule on alleged breaches of these principles. Moreover, these principles do not specifically advise against the use of illegally acquired material in nomenclature (ICZN 1999),

although they most certainly should. The ICZN could make it a requirement that newly designated types based on recently collected specimens be accompanied by a statement of deposition in recognized scientific or educational institutions that maintain research collections with proper facilities. In this way, institutional zoological collections would be empowered by the ICZN to encourage best practices that will reduce biopiracy. As mentioned above, a peer-review process should be encouraged, but eventually enforcing this to validate nomenclatural acts would require that subjective criteria be incorporated in the code.

General Considerations

We are aware of the insufficient level of enforcement and of the low priority given to low-profile wildlife crimes, especially those involving invertebrates, which conflict with the central role these animals play in the balance of natural systems (Cardoso et al. 2020). Environmental and wildlife laws are generally designed primarily with vertebrates in mind and do not consider the important yet different dynamics of invertebrate populations. This oversight constitutes one of the major impediments to invertebrate conservation (Cardoso et al. 2011). We devised several general suggestions that, in addition to the ones mentioned above, may help curb wildlife trafficking for scientific purposes.

First, there is the recurrent problem of researchers and others claiming to be unaware of local regulations for capturing, transporting, exporting, or importing wildlife because of the difficulties in obtaining precise and correct information. In this case, a solution could be to establish an online platform that gathers information about environmental regulations and permits required for those activities in different countries and their respective governmental agencies (Fig. 1), similar to what the Nagoya Protocol's parties and signatories are doing to exchange access information and to share benefits of genetic resources to enhance legal certainty (CDB 2019). Because national authorities often require much paperwork before allowing collection and transport of wildlife, they should at least have a well-developed bureaucratic structure for quickly processing permit requests. This is, however, far from reality in many countries.

Second, there is an urgent need to simplify the bureaucracy related to regulating scientific activities so as to make them more agile and easier to comply with (Fig. 1). Ultimately, smugglers will smuggle regardless of how strict or lenient the laws are. Simply establishing stricter wildlife laws just to restrain a small fraction of researchers who continue breaking them would hamper other valid scientific projects and conservation. Governmental authorities would also benefit if more people acted according to their laws because they would have

more information about the biodiversity of their own countries. This information would make it easier to plan wildlife management and exploit its potential. Thus, regulations and the permit process should be clear, simple, and fast, which would minimize the potential for people to make excuses for not following them. They should specifically address the legal collection for research purposes. The idea is not to limit progress in collecting, describing, and conserving global biodiversity. On the contrary, it is to prevent the bureaucracy from being an extra constraint to the advance of science.

Third, hobbyist societies should collaborate on regulating the commerce of legally wild-caught or captive-bred specimens, instructing their members not to collect specimens without a permit and generating statements on their noncomplicity with illegal collecting (Fig. 1). Ideally, hobbyist societies should ban any member found or known to have collected or distributed illegally acquired wildlife. In this way, they would simultaneously be protected against liability and would not lose credibility in the eyes of scientists and environmental agencies. These societies could propose and take part in legal, responsible, and ethical breeding of specimens, following the example of Mexican tarantula breeders, who work in cooperation with the governmental commission of biodiversity (CONABIO) to achieve sustainable exploitation of wild populations.

The European Union (EU) is one of the largest markets for live specimens (Engler & Parry-Jones 2017) and plays an important role in the trafficking of wild animals, especially for the pet trade (Endcap 2012). The EU can be either the final destination or a hub for smuggled animals, and it is often cited as a laundering area of wild-caught specimens (Endcap 2012). Thus, it may be possible for scientists to buy specimens that have been laundered. In this sense, scientists might not be breaking any laws, but they are perpetuating biopiracy and illegal trade. An example of such acquisition is the purchase of Burmese amber by scientists in order to describe new species found in it (Sokol 2019). In contrast to the European Union, the United States follows a strict approach. The Lacey Act of 1900 declares that specimens coming from illegal sources are also illegal in the United States and requires that citizens comply with laws of the country of origin regarding the import, export, transport, sale, receiving, acquiring, or purchasing of specimens of fauna and flora. Thus, an interesting solution to tackle the global wildlife laundering problem would be the wide adoption, at least in the EU, of laws similar to the Lacey Act.

There is no simple way to tackle biopiracy because of the many factors involved (Fig. 1). More than proposing actions to deal with scientific biopiracy, we want to open a discussion about a problem that is usually ignored. It is critical to find a balance between legal constraints and progress of science. We are aware that it is impossible to regulate the material that has already been deposited

in institutional collections and hence are not suggesting that material previously obtained without permits in natural history collections should be discarded or banned from use. Rather, we strongly advocate that concerted efforts be made to regulate and verify the acquisition of new specimens and their use for scientific purposes. There should be a globally combined effort from different players to address the problem of using wildlife in science without proper permits or authority (Fig. 1). The biodiversity crisis is severely affecting humanity (IPBES 2019). Thus, scientists need to be able to work faster than ever; they do not need more obstacles. However, biopiracy undermines the underpinnings of science itself and has serious consequences in pure and applied research. The tarantula case is a warning that unethical acts diminish the scientific community in the eyes of governments, authorities, and the general public. Following codes of conduct in scientific activities is not just a matter of ethics. In times of global environmental and health crises, any misconduct can affect trust in scientists and consequently in science and have drastic results for society.

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