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Rough Trade: Animal Welfare in the Global Wildlife Trade

SANDRA E. BAKER, RUSS CAIN, FREYA VAN KESTEREN, ZINTA A. ZOMMERS, NEIL D'CRUZE, AND DAVID W. MACDONALD

Wildlife trade is a big and burgeoning business, but its welfare impacts have not been studied comprehensively. We review the animal welfare impacts of the wildlife trade as they were reported in the literature between 2006 and 2011. Rarely was the term welfare mentioned, evidence of welfare impact documented, or welfare improvement recommended. Literature focused on mammals and on animals killed on site, for luxury goods or food, and for traditional medicine. Welfare impacts may be underreported, particularly in international, illegal, and wild-caught trade and trade in reptiles. Greater attention should perhaps be paid to the welfare of animals traded alive and in larger numbers (e.g., birds, reptiles, amphibians) and to those—including mammals—potentially subject to greater impacts through live use (e.g., as pets). More evidence-based research is needed. Animal welfare should be integrated with wider issues; collaboration between conservationists and welfarists and the development of health and welfare levers to influence trade offer benefits to both people and wildlife.

Keywords: animal welfare, five freedoms, systematic review, welfare impact, wildlife trade

The global demand for wildlife and wildlife products is estimated to be worth billions of US dollars each year (Wyler and Sheikh 2008, Barber-Meyer 2010). As the human population increases and as the economies of historically poor countries (e.g., China; Hale and Hale 2003) grow rapidly, demand for wildlife—and hence the wildlife trade (legal and illegal)—flourishes. The wildlife trade can have impacts such as biodiversity loss, species loss, the introduction of invasive species, and disease. Unsustainable trade in wildlife has been identified as one of the main challenges to wildlife conservation (e.g., in Asia; Nijman 2010). Although international and domestic legislation exist to regulate the wildlife trade, the risk-to-reward ratio for traders who ignore this legislation is low, and there is significant illegal trade (e.g., Pantel and Awang Anak 2010). Illegal trade involves a range of different actors and is linked with other criminal activity, including drug trafficking, organized crime, and terrorism (Wyler and Sheikh 2008, Dutton et al. 2013). The literature on the wildlife trade and its impact on conservation is substantial and growing (Zhang et al. 2008). Although the concept of welfare concerns in the wildlife trade has been raised (e.g., Zhang et al. 2008, Bailey 2011), little research has been focused on the implications of the wildlife trade for animal welfare; this is important because as the wildlife trade grows, the associated welfare impacts are likely to increase.

Animals are used in many ways that may compromise their welfare, including in farming, as working animals, for

traditional medicine, as pets and companion animals, for entertainment, as wild meat, and as status symbols and ornamentation. Mellor and colleagues (2009) argued that, where humans have an impact on animals, they should take responsibility for monitoring the welfare impacts and for mitigating them when they are judged unacceptable. Various approaches have been used to assess animal welfare (Fraser 2008). In 1979, the Farm Animal Welfare Council was charged with advising the UK government on farm animal welfare issues and, consequently, published its list of five freedoms (FAWC 1979). These freedoms define ideal states for an animal's physical and mental condition rather than standards for acceptable welfare. Today, the five freedoms are articulated as (1) freedom from hunger and thirst; (2) freedom from discomfort; (3) freedom from pain, injury, or disease; (4) freedom to express normal behavior; and (5) freedom from fear and distress (FAWC 2009). Mellor and Reid (1994) developed, from the five freedoms, five domains of potential welfare compromise, in order to produce a system for predicting the welfare impacts of scientific procedures on experimental animals. These domains covered an animal's nutrition, environment, health, behavior, and mental state. The system has been refined (Mellor and Stafford 2001) and can be applied to other areas of human impact on animals (Mellor et al. 2009; e.g., pest animal management; Sharp and Saunders 2011). We use Mellor and Reid's (1994) domains in our assessment of the animal welfare impact of the wildlife trade.

Conventional, descriptive (i.e., narrative) literature reviews are used to summarize the state of play and to inform decision-making in many fields. However, these reviews are usually qualitative and may be biased by the subjective judgment of their authors (Gates 2002). Narrative reviews also often lack methodological transparency and repeatability (Roberts et al. 2006). Many applied disciplines now use an evidence-based approach, known as *systematic review*, a framework most fully developed in medicine (Pullin and Stewart 2006). Although systematic reviews in medicine are focused on the assessment of clinical trials, many aspects of a systematic review may be applied to reduce bias in ecological reviews (Fazey et al. 2004, Roberts et al. 2006). Pullin and Stewart (2006) developed guidelines for this purpose, and Harrington and colleagues (2013) modified those to review welfare in wildlife reintroductions. We modify the guidelines here to examine animal welfare in the wildlife trade.

We provide an overview of the global wildlife trade, involving terrestrial wild mammals, birds, reptiles (including marine turtles), and amphibians, and its relevance to wild animal welfare. First, we summarize the key features of the trade as it was reported in the literature between 2006 and 2011, including, for example, whether trade is domestic or international, the role played by different geographical regions, the drivers of trade, the taxa involved, and whether it is legal or illegal. Then, we examine aspects of animal welfare in the wildlife trade literature and whether these are influenced by the key trade features identified. We present data on the literature studied, which may not fully reflect the realities of the wildlife trade and which highlight trade sectors that may be underrepresented. Finally, we discuss the welfare impacts of wildlife trade and what might be done to improve the welfare of wildlife in trade.

Analyzing wildlife trade and its welfare impact

The main methods are outlined here, but the full details of how articles were sourced and screened and how data were extracted and analyzed are available in the supplemental material, available online at www.dx.doi.org/10.1525/bio.2013.63.12.6.

Data collection. Much of the wildlife trade is illegal, which makes it difficult to document in a formal study, and gray literature is often the only source of data on some trade sectors. There is a large body of gray literature reports on the wildlife trade, many produced by nongovernmental organizations (NGOs). We included such reports and peer-reviewed scientific papers in this review in order to capture issues reported from these different perspectives, to avoid publication bias and to allow a comparison of the types of trade and welfare issues reported in the two different types of article. Both Pullin and Stewart (2006) and Harrington and colleagues (2013) included peer-reviewed and non-peer-reviewed literature in their reviews concerning wildlife conservation. Articles for potential inclusion in the present study were identified using standardized techniques from

online library databases and from the Web sites of the main international NGOs and international coalitions, agreements, or conventions associated with the wildlife trade. The articles were screened for their suitability for inclusion in the review. A total of 292 articles (196 peer-reviewed scientific papers and 96 gray literature reports; see the list in the supplemental material), published between 2006 and 2011, survived screening and were included in the study.

We read the articles and recorded data on key features of the trade and on the following three aspects of animal welfare: (1) whether the article mentioned the word *welfare* (in an animal welfare context) and whether it mentioned *pain, suffering, distress, or harm* (PSDH, important criteria regulating scientific procedures involving animals in the United Kingdom; see the Animals [Scientific Procedures] Act of 1986); (2) whether the trade occurred in any of three welfare impact categories—killed on site; captured, transported, and killed shortly before or after sale; and used alive following capture, transportation, and sale—and (3) which of five welfare impact domains—*food deprivation, water deprivation, or malnutrition; environmental challenge; disease, injury, or functional impairment; behavioral or interactive restriction; and anxiety, fear, pain, or distress* (Mellor and Reid 1994)—were compromised, when evidence for this was reported (e.g., killing or capture methods, transport conditions, injuries, provision of food and water). These methods will inevitably have involved a degree of subjectivity, as would any attempt to document animal welfare-related articles. However, we took an inclusive and liberal approach in which we made every effort to identify welfare-related articles.

Statistical analysis. The data were manipulated using MATLAB (version R2011a; MathWorks, Natick, Massachusetts) and analyzed using SAS (SAS Institute, Cary, North Carolina). Where the sample sizes differ from the number of articles reviewed (292), this is either because the data were subsampled or because an article provided more than one data point. More details are available in the supplemental material.

Key features of the wildlife trade

International wildlife trade was reported more often (in 59% of nationality or internationality reports, $n = 342$) than domestic trade (41%). We summarized, by continent, the countries reported to be involved in domestic trade, and those listed as sources, transit countries, and end destinations of international trade. We then examined patterns among the continents in these trade sectors in order to determine the relative importance of each continent in trade.

The patterns among continents with countries involved in domestic trade (figure 1a) were correlated with those of the continents with countries acting as sources in international trade (figure 1b; Spearman's rank correlation, $\rho = .943$, $p = .005$), with Asia, Africa, and then Central and South America being the main players. The transit countries

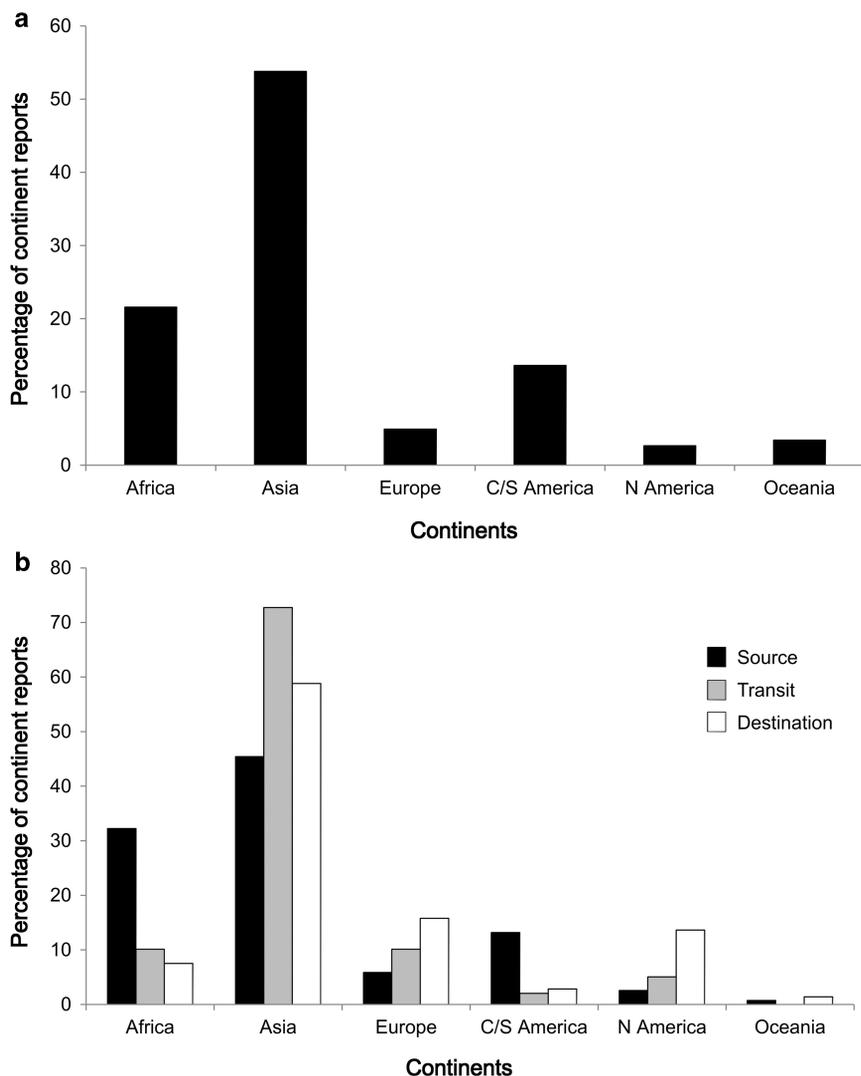


Figure 1. (a) Continents with countries involved in domestic trade (n = 264). (b) Continents with countries involved in international trade shown as source (n = 546), transit (n = 99), and destination (n = 425) continents. Abbreviations: C/S, Central and South; N, North.

in international trade were predominantly Asian, whereas the most frequently reported destination countries were in Asia, followed by Europe and North America (figure 1b). The pattern of continents with countries involved in international transit was correlated with patterns both among continents containing source countries ($\rho = .783, p = .066$) and those containing destination countries ($\rho = .899, p = .015$). The patterns differed among the continents with countries involved in domestic trade and those containing either transit ($\rho = .667, p = .148$) or destination ($\rho = .371, p = .469$) countries in international trade and among the continents with countries acting as sources and those with countries acting as destinations in international trade ($\rho = .543, p = .266$).

Asia dominated domestic trade and all sectors of international trade. Within Asia, China was the principal consumer

country, being the main participant in domestic trade and the main destination in international trade. The main Asian countries acting as source and transit countries were Indonesia and Thailand, respectively. See the supplemental material for more detail regarding the key Asian countries reported in the trade. Countries in both Africa and Central and South America were more important suppliers than consumers in international trade, whereas those in Europe and North America were more important consumers than suppliers.

Overall, illegal wildlife trade was described more frequently (in 59% of legality reports, $n = 301$) than legal trade (41%). The reported drivers of trade were luxury goods and food (in 36% of driver reports, $n = 374$), traditional medicine (25%), pets and entertainment (22%), subsistence food (7%), culture (5%), research and education (3%), and financial reasons (such as macroeconomic changes within a country—e.g., the emerging young middle classes in China and Vietnam—deemed sufficient to change the standard of living for a significant proportion of the population; 3%). The reported trade species were mammals 2–4 times more frequently than other taxa (46% of taxon reports, $n = 417$), followed by reptiles (24%), birds (19%), and amphibians (11%). The focus was heavily on wild-caught (72% of provenance reports, $n = 298$) rather than on captive-bred animals (28%). There was no evidence that the

taxonomic composition of the trade differed among continents, within either domestic (Fisher’s exact test, $p = .318$) or international trade (source, transit, or destination sectors; $ps \geq .261$).

Past interventions to influence or limit trade were generally reported not to have achieved their goal (58%, $n = 204$), whereas positive impacts were reported in 24% and mixed results in 18%. Recommendations for the future made in the articles included improved enforcement (15% of the recommendations made, $n = 976$), improved regulation or legislation (13%), more study (12%), improved monitoring of trade (11%), increased education (11%), changes to the Convention on International Trade in Endangered Species (CITES; 6%), identifying or promoting substitutes (5%), and improved species identification (4%). Only 2% of the recommendations involved changes to benefit animal welfare

directly. The remaining 21% of the recommendations did not fall into an obvious category but included captive breeding, habitat protection, economic development, increasing available funding and technical support, campaigning, demonstrations, increased intelligence sharing between governments, and developing partnerships to work together to close trade.

Levers are arguments that might be used to influence a cause. Most articles (71%, $n = 292$) mentioned possible conservation levers, 32% mentioned human health levers, and 30% included economic levers. Other potential levers were

mentioned in a few cases, including bad public relations, national security threats resulting from wildlife trade funding terrorism, political embarrassment, and animal welfare.

The pattern of trends reported for the wildlife populations involved in trade and the trends reported for the wildlife trade itself differed significantly (chi-squared test, $\chi^2(2) = 223.0$, $p < .001$). When wildlife population trends were mentioned, they had usually declined (in 91% of trend reports, $n = 148$), whereas 6% were stable, and 3% had increased. When trends in wildlife trade were mentioned, it had largely increased (in 70% of trend reports, $n = 187$), less often remaining stable (25%) or decreasing (5%) (figure 2).

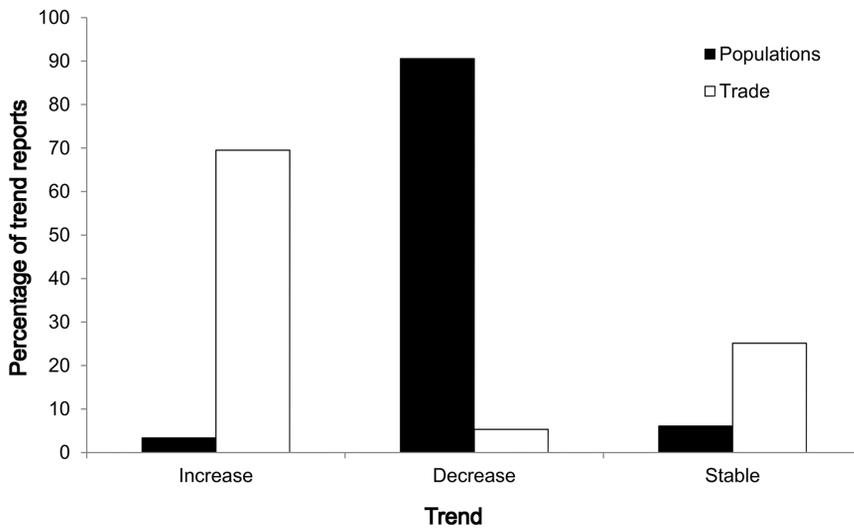


Figure 2. Trends in wildlife populations ($n = 148$) and in wildlife trade ($n = 187$).

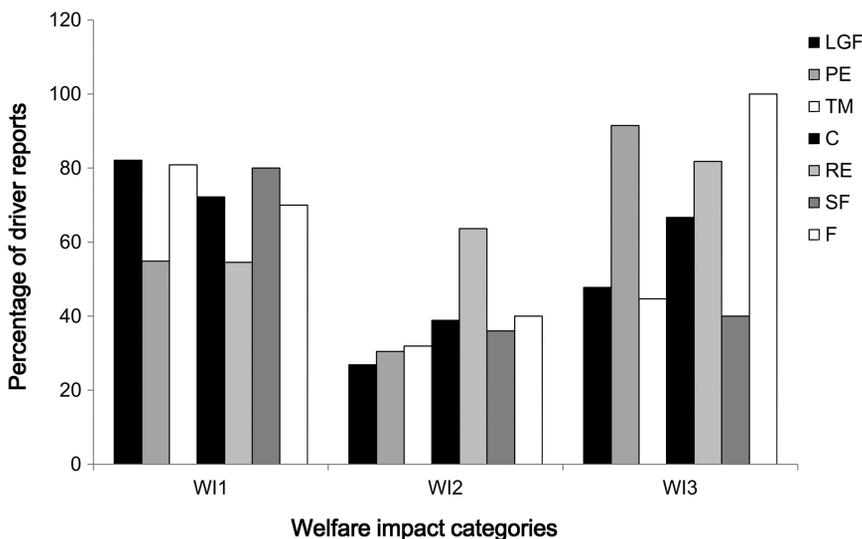


Figure 3. Relationship between trade drivers and welfare impact categories. Abbreviations: C, culture ($n = 18$); F, financial reasons ($n = 10$); LGF, luxury goods or food ($n = 134$); PE, pets and entertainment ($n = 82$); RE = research and education ($n = 11$); SF, subsistence food ($n = 25$); TM, traditional medicine ($n = 94$); WI1, welfare impact category 1: animal killed on site; WI2, welfare impact category 2: animal captured, transported, and killed; WI3, welfare impact category 3: animal used alive.

Animal welfare in wildlife trade

The term *welfare* was used in 17% of the articles ($n = 292$), and one or more of the PSDH terms appeared in 12%. Whether *welfare* or the PSDH terms were used did not depend on whether the article was peer reviewed; whether the trade was legal or illegal; whether the trade was domestic or international; or on the taxa, levers, continents, welfare impact domains, welfare impact categories involved, recommendations made, drivers, or reported trends in wildlife populations or in wildlife trade ($\chi^2(1-9) = 0.46-2.95$, $p = .36-1.0$; Fisher's exact test, $p = .98$). However, *welfare* and the PSDH terms tended to be used more often when the animals were used alive or captured alive (see supplemental figure S1).

We also analyzed trade according to the three welfare impact categories: animals were killed on site in 60% of articles ($n = 292$); captured, transported, and killed in 21%; and used alive in 43%. Animals were most often killed on site, but trade involving live capture was reported slightly more often, in total. The welfare impact category depended on the trade drivers involved ($\chi^2(12) = 32.2$, $p = .001$). The demand for luxury goods or food and for traditional medicine were important drivers of killing on site, whereas the demand for pets and entertainment was important in driving the use of live animals; samples for other drivers were small (figure 3).

The welfare impact category was also related to the taxa involved ($\chi^2(6) = 15.2$, $p = .019$). Animals killed on site were most likely to be mammals

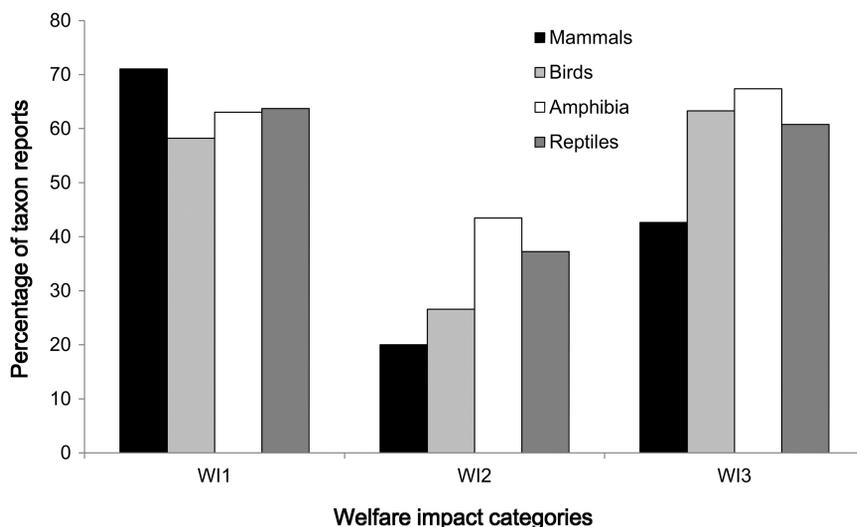


Figure 4. Relationship between taxa (mammals, $n = 190$; birds, $n = 79$; amphibians, $n = 46$; reptiles, $n = 102$) involved in trade and welfare impact categories. Abbreviations: WI1, welfare impact category 1: animal killed on site; WI2, welfare impact category 2: animal captured, transported, and killed; WI3, welfare impact category 3: animal used alive.

(and mammals were the taxa most likely to be killed on site)—for example, for elephant ivory (Wasser et al. 2007) and for tiger bones, teeth, claws, whiskers, and skin used in traditional medicine and magic (Ng and Nemora 2007). The animals captured alive and either killed later or used alive were most likely to be birds, reptiles, or amphibians (and these taxa were most likely to be captured alive)—for example, frogs for the frog-legs trade (Gratwicke et al. 2010) and animals traded as pets, including parrots (Cantú Guzmán et al. 2007), freshwater turtles and tortoises (Nijman and Shepherd 2007), and iguanas (Chomel et al. 2007) (figure 4). In a forthcoming review of the exotic pet trade, Emma Bush and colleagues (Oxford University, Oxford, United Kingdom, personal communication, 12 June 2013) found that, although birds, reptiles, and mammals were all traded as pets in great abundance, the numbers were greatest for birds and least for mammals.

The welfare impact category was not significantly related to whether the article was peer reviewed; to whether the trade was legal or illegal, domestic or international; or to the levers or continents involved, recommendations made, or reported trends in either wildlife populations or wildlife trade ($\chi^2(2-8) = 0.01-10.26$, $p = .11-1.0$). However, improving animal welfare was the least likely recommendation in the cases in which the animals were killed on site, and it was the most likely recommendation in those in which the animals were used alive (supplemental figure S2). Conservation and economics were the levers most often mentioned when animals were killed on site, and human health was the most often cited when animals were captured and either killed or used alive (supplemental figure S3).

Trade was associated with the five welfare impact domains: Animals were affected by *disease, injury, or functional impairment* in 25% of 292 articles; *environmental challenge* (i.e., exposure to hot or cold temperatures or injurious structures or floors) in 20%; *behavioral or interactive restriction* in 20%; *anxiety, fear, pain, or distress* in 18%; and *food deprivation, water deprivation, or malnutrition* in 13%. The welfare impact domains affected were not significantly related to the welfare impact categories ($\chi^2(8) = 1.68$, $p = .989$). However, the impacts in all five domains were least likely to be reported when animals were killed on site. The impacts in the domains *food or water deprivation or malnutrition, environmental challenge, and disease, injury, or functional impairment* were more likely to be reported when animals were captured, transported, and killed, and *behavioral or interactive restriction* and *anxiety,*

fear, pain, or distress were more often associated with animals being used alive (figure 5).

The welfare impact domains were not significantly related to whether the article was peer reviewed; to whether the trade was legal or illegal, domestic or international; to whether it involved wild-caught or captive-bred animals; to the taxa, levers, or continents involved; to the recommendations made; to reported population or trade trends ($\chi^2(4-36) = 0.3-9.18$, $p = .42-1.0$); or to the drivers involved (Fisher's exact test, $p = 1.0$). However, amphibians were the taxa most often associated with *environmental challenge; behavioral or interactive restriction; and anxiety, fear, pain, or distress*, and birds were associated with *disease, injury, or functional impairment*. Reptiles were the taxa least often associated with four of the five domains (see supplemental figure S4). Although international trade, illegal trade, and trade in wild-caught animals were more frequently reported than were domestic trade, legal trade, and the trade in captive-bred animals, respectively, welfare impacts tended to be reported more often in each domain when trade was domestic, legal, or involved captive-bred animals (see supplemental figure S5).

The state of animal welfare in the wildlife trade

The three broad welfare impact categories examined here represent a vast spectrum of potential suffering. For example, an animal killed on site with a well-placed shot, made using an appropriate firearm and ammunition, may be dispatched quickly in its natural environment and may not suffer a great deal (HAP 2009). However, killing on site may be conducted inhumanely—for example, through poor shooting practice (Fox et al. 2005), poisons, snares,

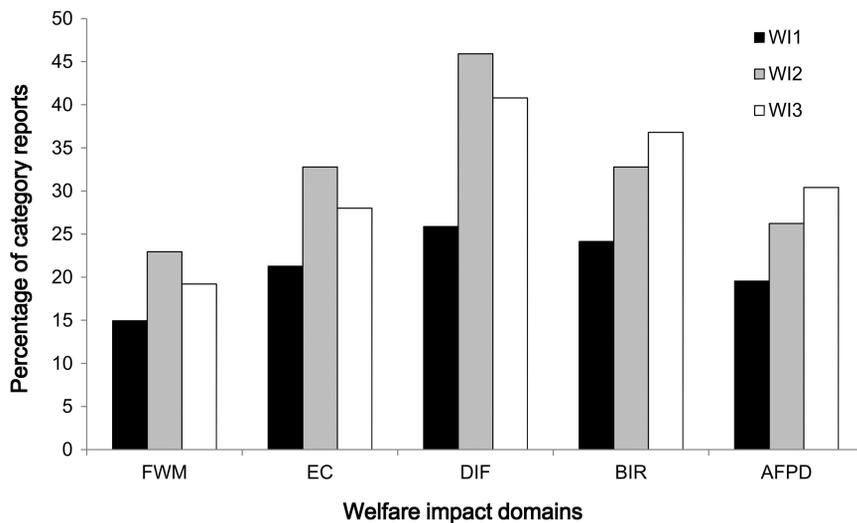


Figure 5. Relationship between welfare impact categories involved in trade and whether the trade incurred the five domains of welfare impact. Abbreviations: AFPD, anxiety, fear, pain, or distress; BIR, behavioral or interactive restriction; DIF, disease, injury, or functional impairment; EC, environmental challenge; FWM, food or water deprivation or malnutrition; WI1, welfare impact category 1: animal killed on site (n = 174); WI2, welfare impact category 2: animal captured, transported, and killed (n = 61); WI3, welfare impact category 3: animal used alive (n = 125).

landmines, or explosive traps (Sainsbury et al. 1995, Johnson et al. 2006, Oswell 2010). Alternatively, as soon as a wild animal is captured alive and removed from its environment, its welfare will suffer through the animal's being restrained and through its enforced proximity to people and, potentially, to other animals, including predators and conspecifics (Van Der Veen and Sivars 2000, Gelling et al. 2009, 2010). The intensity and duration of suffering depend on whether and how the animal is restrained, transported, kept, fed and watered, marketed, and either killed or used alive. Many animals that have been captured alive for trade die in transit, through crushing, asphyxiation, starvation, dehydration, temperature shock, disease, injury, or stress, and never make it into trade (e.g., see Cantú Guzmán et al. 2007).

For animals killed on site, there is at least the possibility that this occurs humanely, but animals captured alive are bound to suffer to some degree—potentially greatly—and for a much longer time. This assertion was supported by our findings that welfare impacts in all five domains and the mention of welfare-related terms were most likely when animals were captured or used alive. Although such trade was usually in birds, reptiles, and amphibians, for use as pets and entertainment, the primary focus of the literature reviewed here was on mammals killed on site, either for luxury goods or food or for traditional medicine.

We cannot say whether this apparent focus on mammals reflects reality, but there are a few possibilities. First, trade may genuinely be biased toward mammals. Second, trade in mammals may be more conspicuous than trade in other taxa and, therefore, more likely to be reported. Third,

each article relating to birds, reptiles, and amphibians in trade may concern a larger number of individuals than each article on mammals, so the apparent emphasis on mammals may be misleading. In their review of the pet trade, Emma Bush and colleagues (Oxford University, Oxford, United Kingdom, personal communication, 21 February 2013) discovered that mammals tended to be traded in small numbers, by request, whereas other taxa were traded in larger numbers, at markets. Although we recorded the taxa reported in trade—and, therefore, the proportion of articles in which each taxon was mentioned—it was not possible to examine the number of individual animals involved, because this information was rarely available and was not reported in comparable ways. However, some examples reveal the vast numbers reported in some non-mammalian cases. For instance, a single illegal shipment of 10,000 Asian turtles was seized by Hong Kong customs

officials (Schoppe 2008), 950,251 turtles were observed in market surveys in three Chinese cities over 3 years (Sze and Dudgeon 2006), and more than 3 million wild CITES-listed birds (and an unknown number of non-CITES listed birds) were traded internationally (and an unknown number of birds were traded domestically) between 2000 and 2003 (Rybanic 2006). The fourth possible reason for the literature focus on mammals is that the trade in mammals attracts disproportionately greater research effort, perhaps because people relate more easily to mammals (Ceballos and Brown 1995, Feldhamer et al. 2002) and may consider them more sentient than other taxa (Broom 2007). Funding may therefore be more readily available for studying them (Simon et al. 1995).

This focus on mammals killed on site might not reflect the trade that actually occurs, in terms of either scale or welfare impacts. Indeed, mammals suffer greatly in some trade sectors involving live use (e.g., bear bile farming; Haikui and Zhi 2007). In welfare terms, greater attention should perhaps be paid to animals traded alive in larger numbers (e.g., birds, reptiles, and amphibians) and to those (including mammals) potentially subject to greater welfare impacts through live use, such as those whose use is driven by demand for pets and entertainment.

Welfare impacts may be underreported in general and under some impact domains more than others. Evidence of impacts in each of the five domains (Mellor and Reid 1994) was reported in only 13%–25% of the articles examined. These domains may not be comparable in importance, severity, or breadth, but the reported impacts most often

related to *disease, injury, or functional impairment*, which suggests either that these were the most common types of impact or that there was a tendency to report more conspicuous physical impacts. This is not surprising, because good physical health is widely recognized as the foundation of good welfare (Stamp Dawkins 2012). We found that impacts that might be considered more immediate or acute (*food or water deprivation or malnutrition; environmental challenge; and disease, injury, or functional impairment*) were most often reported when animals were captured, transported, and killed (e.g., live turtles in supermarkets face environmental challenges such as being kept on ice; CWI 2007). In contrast, potentially more chronic effects (*behavioral or interactive restriction or anxiety, fear, pain, or distress*) were most frequently reported when the animals were used alive (e.g., tigers kept as tourist attractions may have tiger urine sprayed in their faces, which they perceive as an aggressive display and which elicits submissive behavior and stress responses; CWI 2008). Traders handling animals that are captured alive but destined to be killed before use may allow them to suffer acute types of impact associated with captivity, in the belief that sufficient numbers of animals will survive, in sufficient condition, to complete the trade and that the costs of keeping the animals in better conditions outweigh the benefits. Those handling animals destined for live use may care for them sufficiently to avoid acute impacts that could result in the animal dying before it can be sold or that could otherwise reduce the chance of sale. Animals already in live use, when this was reported in the literature, may be better cared for (and may therefore avoid acute impacts), but they may be subject to the chronic impacts of captivity.

Recommendations for the direct benefit of animal welfare were rarely made, but were nevertheless the most likely recommendation when the trade involved live use and the least likely when the animals were killed on site. This reflects our findings regarding the reporting of welfare impacts when animals were captured alive, and when they were killed on site, respectively. An example of a welfare recommendation was that an improvement in animal welfare standards and practices should be mentioned explicitly in the Trans-Pacific Partnership Free Trade Agreement as a priority area for further development and cooperation (HSI 2009).

International trade, illegal trade, and trade in wild-caught animals were reported more often than were domestic, legal, and captive-bred trade, respectively. This might reflect the relative volumes of trade, but it is perhaps more likely that international, illegal, and wild-caught trade has a higher profile and attracts greater research attention. However, we found that welfare impacts (under all five domains) were most often reported when the trade was domestic, legal, or involved captive-bred animals—perhaps because it is easier to observe these trade sectors and their associated welfare impacts closely. The welfare impacts of international, illegal, and wild-caught trade may be more difficult to observe or detect and may be underreported as a result. Researchers

may also be more inclined to raise welfare concerns in relation to legal forms of wildlife trade because of the real or perceived difficulties associated with amending or creating new legislation. Reptiles were the taxon least frequently associated with four of the welfare impact domains, and recognition of welfare indicators in reptiles is considered to be difficult (Hernandez-Divers 2001). Because reptiles were fairly well represented in the literature, it may be that the details of welfare impacts on reptiles, in particular, were underreported. An example of an impact suffered by reptiles in live trade is behavioral restriction, such as when traders pack as many live turtles as is physically possible into individual boxes to maximize shipments from Malaysia to China (Schoppe 2008).

There was no evidence that any of the three welfare measures gathered from the literature were influenced by which of the continents were involved in trade. However, the scale of involvement of the different regions, together with an awareness of possible cultural differences, provides an indication of potential differences in the animal welfare impact of the regions. The concept of what constitutes *animal welfare* or “a good life” varies among societies (Fraser 2008). Much of the literature specifically regarding animal welfare originates in Europe or North America (e.g., Fraser 2008, FAWC 2009, Stamp Dawkins 2012, Dubois and Fraser 2013); therefore, European and North American views on animal welfare may be overrepresented. Worldwide, ideas of what is important for animals are influenced by the standard of human welfare and, for example, the ethos regarding human freedom and discipline (Fraser 2008). In many areas, including China, animal welfare is a relatively new and still-evolving concept, albeit often influenced by European or North American welfarists (Li 2006). In the present study, Asia dominated all sectors of the wildlife trade, and (as has been recognized elsewhere; McNeely et al. 2009) China had a prominent role. In addition to Asia, both Africa and Central and South America were important in domestic trade and as sources of international trade, whereas North America and Europe were important destinations in international trade. More detail is required regarding the actual destination of wildlife and wildlife products in the United States and Europe.

Moving welfare forward in the wildlife trade

The wildlife trade is worth billions of US dollars (Wyler and Sheikh 2008), it supplies desired goods and services to many consumers, and it creates or contributes to livelihoods in some of the world’s most biodiversity rich and financially poorest countries (e.g., Cambodia or Myanmar; CI 2012). Legal trade allows for the inclusion of animal welfare regulation and, if it is properly monitored, can contribute to economies worldwide. However, much of the wildlife trade is illegal (including the majority reported here) and, therefore, unregulated and uncontrolled. When trade is uncontrolled, it may become unsustainable, and we found that when trends were reported, trade was largely increasing

and wildlife populations were declining. This poses problems not only for conservation and potentially for animal welfare but also for the livelihoods of future generations.

We are not in a position to judge whether wildlife trade is right or wrong; how much trade might be acceptable; or what compromises should be made, for example, among the pleasure someone gets from keeping wild-caught birds as pets, the livelihoods of families supported by the trade, and conservation and animal welfare priorities. Stamp Dawkins (2012) suggested that the way forward in animal welfare science must be to find solutions that both benefit people and ensure the welfare of animals. Perhaps a reasonable aspiration might therefore be to limit (or eradicate) trade that is illegal, unsustainable, or otherwise deemed irretrievably unacceptable (e.g., on welfare grounds) and to improve animal welfare in the remaining wildlife trade.

The sciences of conservation and animal welfare both address social concerns about animals. Conservation is focused largely on wild animal populations and threats to biodiversity, whereas animal welfare is focused on individuals and groups and threats to their health and quality of life (Fraser 2010). However, the wildlife trade literature is dominated by conservation issues, with conservation levers being the most often mentioned (in 71% of 292 articles), and animal welfare considered in only a minority of articles. This may be a symptom of authors' reluctance to refer directly to animal welfare because of real or perceived negative views held by their target audiences (e.g., governments and enforcement bodies). An emphasis on conservation rather than on animal welfare is also apparent in the monitoring and regulation of wildlife trade, as is demonstrated by how CITES is interpreted (Teresa Telecky, Humane Society International, Washington, DC, personal communication, 21 February 2013). Article IV (part 2) of CITES imposes both conservation and welfare controls on the preparation and shipment of appendix-II species (species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled). In addition, article III imposes welfare controls to ensure that the proposed recipients of living specimens are suitably equipped to house and care for them (CITES 1973). However, the parties to CITES pay relatively little attention to the welfare—as compared with the conservation—requirements (Teresa Telecky, Humane Society International, Washington, DC, personal communication, 21 February 2013). Of the recommendations made in the articles that were studied here, 6% suggested making changes to CITES. CITES plays a crucial role in regulating the international trade in wild animal specimens. It is a potentially powerful and currently underused tool for improving animal welfare in the international wildlife trade and for reducing trade in some species groups. With nearly 180 member countries (www.cites.org), CITES has the capacity to reach many wildlife-trading countries and, potentially, to persuade members to adopt measures for improved animal welfare in wildlife trade. However, to date, the only welfare policies adopted by CITES are those of

the International Air Transport Association (www.iata.org). CITES could better emphasize the importance of animal welfare by implementing existing policies and creating new ones; this might have a significant impact on the composition and volume of the wildlife trade.

Although animal welfare was almost never mentioned as a trade lever in the literature, animal welfare education could prove persuasive in some circumstances, but concern for animal welfare is likely to be minimal where human poverty is rife (Ramaswamy 1998). In the long run, education, which could lead to cultural change, may be the most powerful tool in influencing wildlife trade and its impact on animal welfare, because it could eliminate the need for other action. Before the mid-1990s, there was no concept of or term for *animal welfare* in the Chinese language. However, the term is gradually entering the popular Chinese vocabulary (Hobson 2007), and awareness may be changing with increasing wealth. Given China's dominance of the global wildlife trade, welfare may become a greater concern in China and other parts of Asia in due course.

Conclusions

In order to develop and use animal welfare arguments for influencing trade, it will be necessary to increase the scientific credibility of those arguments. Moving welfare onto the political wildlife trade agenda requires more and better scientific evidence, and animal welfare needs to be seen not as an isolated peripheral interest but as associated with wider concerns that conspicuously affect our collective future (Stamp Dawkins 2012). Future research could be focused on gathering evidence and on developing ways of using this evidence as levers to reduce illegal, unsustainable, or otherwise unacceptable wildlife trade and to improve animal welfare in the remaining trade. Some such research has already been conducted. For example, the threat of emerging disease was a recurrent theme in the literature that we studied, and human health issues were reported as potential levers in one-third of the articles overall and were the levers reported most often when the trade involved live capture. The wildlife trade has been linked to the 2003 SARS (severe acute respiratory syndrome) outbreak, which killed at least 774 people worldwide (Jenkins 2007). Internationally traded animals may also serve as vectors for BSE (bovine spongiform encephalopathy, or mad cow disease), exotic Newcastle disease, monkeypox, reptile-associated salmonellosis, foot and mouth disease, avian influenza, swine fever, and heartwater disease (Kroeger 2007). Stamp Dawkins (2012) suggested that the most powerful welfare argument for persuading people who do not value animals is the physical health of an animal, because animal health affects human health. Animals are more susceptible to infection when they are kept in a poor environment, on a poor diet, or under stress (Humphrey 2006). Human health risks and the related animal welfare arguments might therefore constitute useful levers for influencing trade among consumers when there is demand for wildlife as luxury meat, for traditional

medicine, or as pets or status symbols (e.g., in parts of Asia, Europe, or the United States).

Welfare science could be used to directly influence the wildlife trade and its impact on animal welfare through education. The greatest welfare gains might be made from research that demonstrates the welfare impacts of long-term captivity on wild animals used alive and their unsuitability for this purpose (e.g., parrots; Engebretson 2006). Welfare arguments could also prove indirectly useful, but great care should be taken to avoid perverse consequences for animal welfare. For example, in cases in which animals are eaten as luxury food, it has been argued that improving welfare conditions during their transport, captivity, and slaughter might improve the taste and quality of the meat (Gruber et al. 2010, Guàrdia et al. 2012, Schwartzkopf-Genswein et al. 2012). Food quality might therefore be a potentially useful argument for improving animal welfare, particularly to affluent consumers, who might be otherwise immune to such persuasion (Stamp Dawkins 2012). If more scientific evidence were available that suggests that improving animal welfare reduces risks to human health and improves food quality, this could help stakeholders improve the welfare of traded wildlife. However, the catch may be that improving welfare in a particular trade sector legitimizes that trade and encourages it and any associated poaching. Similarly, for trade involving live capture or live transport and use, future studies could be focused on the relationship between welfare and survival and, therefore, profit. For example, 75% of the parrots captured in Mexico for the pet trade die before reaching a buyer; 31% die en route, with 50 birds per $45 \times 30 \times 15$ centimeter box (Cantú Guzmán et al. 2007). If these birds were transported under better welfare conditions, more of them might survive to reach a buyer, therefore increasing not only the welfare of the animals but also the profit to the traders. The potential catch, in this case, is not only that improvements in transport conditions could legitimize and encourage the trade but that, as a result, more wild animals may survive to experience a lifetime of potentially poor welfare in captivity, which might be worse than dying in transit.

Conservation is already widely used as a lever to influence trade, but perhaps it could be combined with welfare arguments. Indeed, Fraser (2008) suggested that conservationists and welfarists should collaborate more often, because their interests overlap considerably. Better communication and cooperation between them could improve science and could allow wildlife managers to develop actions that address their shared priorities and to produce better shared practical outcomes (Fraser 2008, Dubois and Fraser 2013). Paquet and Darimont (2010) proposed that a modified version of the five freedoms could help integrate conservation and animal welfare interests. This might apply even when wild species are reared in captivity (e.g., as pets), if welfare improvements (and, potentially, survival) in captivity reduced the need to take animals from the wild. Mellor and Reid (1994) originally created their welfare impact domains from the five

freedoms for assessing the impact of scientific procedures on animals, and we have demonstrated that they could form the basis of a system for studying welfare in the wildlife trade. The domains could be developed further, by incorporating information on the numbers of animals affected, their capacity for suffering, and the duration and intensity of the suffering endured (see Kirkwood et al. 1994), perhaps partly along the lines of Sharp and Saunders's (2011) model for assessing welfare impacts in wildlife management. The resulting information could be used to inform decision-making regarding whether certain types of trade should be banned or welfare standards improved, as well as in developing welfare levers and for education purposes.

Assessing welfare may be more difficult in some circumstances than in others. For example, some taxa may not exhibit obvious indicators of stress or disease (e.g., reptiles; Hernandez-Divers 2001), and others may be better at disguising illness or injury (e.g., prey species; Wolfensohn and Lloyd 2003). Some trade sectors (e.g., international, illegal, and wild-caught trade) and some aspects of trade (e.g., killing or capture) may be more challenging to observe, which may reduce the chances of welfare impacts' being recorded. Therefore, any system for recording welfare impacts needs to be objective and appropriate for the species concerned (Wolfensohn and Lloyd 2003), and suitable, easily observed indicators may need to be developed.

Finally, we return to the apparent focus of the wildlife trade literature on mammals, despite the fact that other traded taxa may be suffering in greater numbers or to a greater extent. This focus may be related to the fact that people consider mammals more sentient than other taxa (see Broom 2007). However, this is probably not a sound basis for deciding how to reduce animal welfare impacts in wildlife trade. Stamp Dawkins (2012) suggested that the "hard problem" of animal consciousness remains unresolved and that animals would be better served—welfarewise—if research were focused on fundamental questions (e.g., regarding animal health, movements, feeding preferences, and behavior—i.e., "what animals want"), because this could contribute to our understanding of animal welfare. In addition, greater efforts may be needed to target research (and research funding) toward trade involving less charismatic taxa, especially those in live trade.

Much has been written about the wildlife trade, and although animal advocacy groups have tried to bring welfare concerns associated with this trade to the forefront, the literature has largely failed to embrace welfare issues. The literature is focused strongly on mammals and on animals killed on site to meet the demand for luxury goods or food and for traditional medicine. However, in welfare terms, greater attention should perhaps be paid to animals traded alive and in larger numbers (e.g., birds, reptiles, amphibians) and to those—including mammals—that are potentially subject to greater welfare impacts through live use, such as that driven by the demand for pets and entertainment. The welfare impacts of trade may be underreported in general

and particularly in international, illegal, and wild-caught trade and trade in reptiles. CITES could make better use of its potential power to influence the treatment of wild animals in trade by emphasizing the importance of animal welfare through the implementation of existing and the creation of new policies. More evidence-based research is needed in order to bring animal welfare onto the wildlife trade agenda and to integrate it with wider concerns, such as disease and food availability. Collaboration between conservationists and animal welfarists might prove mutually beneficial, and human health and animal welfare levers might be better developed to influence trade in a way that benefits people and wildlife.

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