Supporting Online Material for

Boosting CITES

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SOM Text

The international trade of live wild dolphins from the Solomon Islands offers a quintessential example of how data gaps affect decisions about trade regulation. Conservationists have challenged this trade on the basis that there are limited data on local dolphin populations, making it impossible for the Solomon Islands to demonstrate that trade is non-detrimental, while the best available information suggests that the trade may be harmful (*S1*). In response, the CITES authorities of the Solomon Islands justify continued trade by suggesting that conservationist claims are based on insufficient data and lack of peer review (*S1*). Cases where data are deficient are especially susceptible to political maneuvering (see *S2*).

The international trade of shark fins offers a similar example (*S3*). Five commercially valuable shark species were proposed and rejected for CITES listing and trade restriction during the March 2010 Conference of Parties. Although financial, cultural, and political factors heavily influenced the negotiations, data gaps also hindered science-based decision-making. Although harvest and by-catch (fish caught accidentally when intending to harvest other fish) data for shark fins are collected in a number of different fisheries, uncertainties linger due to illegal harvest, noncompliance, underreporting, and failures to systematically gather species-specific information (*S4*-*S6*). In the absence of robust baseline data, scientists have turned to models to interpret existing shark harvest and trade data and to filter species-level information (*S4, S5*). Models have returned estimates of at least 3–4 times as much harvest and trade as is reflected by official records (*S4*), which suggests the need for heightened protection and more accurate data collection. However, as CITES member countries struggle with negotiations to catalyze consensus on contentious issues among member countries with diverse interests (*S1, S7*), arguments for increased regulation are only as strong as their supporting data and are more likely to garner support with more empirical data rather than models. Given significant uncertainties over wildlife harvest and trade, regulations may fail to materialize or may prove, at best, arbitrary (*S8*).

The failure to capture reasonable data about shark trade is also representative of a general inability of customs agencies and monitoring bodies to develop responsive methodologies appropriate for the many aspects of wildlife trade. Harvester self-reporting, for example, requires incentives backed up by monitoring and enforcement. For example, conventional CITES methods fail to account for a large-scale Southeast Asian trade of wild-collected orchids due to an “airport bias” and methodological limitations. Trade in all wild-collected orchids is regulated, and from 2000 to 2009, CITES recorded that a total of 20 individuals in three genera were illegally traded from Lao People’s Democratic Republic (PDR) into Thailand (*S9*). In contrast, author Phelps visited border markets along the Thailand-Lao PDR border in February 2010, and found that a single small-scale trader of wild-collected orchids sold 168 plants in eight genera in one day—more than 8 times that reported by CITES over 9 years (see table in text). This preliminary inventory targeted one market stall at a weekly market on the Thai bank of the Mekong River that sells plants imported from Lao PDR (market name not disclosed). Upon arrival at the market (8 a.m., 14 February 2010), plants at the target stall were identified to genus-level and photographed for confirmation. Sale volume was based on the number of individual plants and the number of bundles of plants sold of each genus. This small data set was compared with the CITES Trade Database

records for 2000–2009 (*S9*). The CITES count is based on the number reported, with method unreported. Observed count is based on the number of plant bundles (potentially including multiple individuals) plus the number of individuals (potentially divisions of larger plants), both recorded as single counts. This is conservative relative to traditional customs recording, but not necessarily representative of the number of genetically distinct individuals. Huge underreporting arose over the same period with wild orchid trade reported by CITES from Myanmar (18 individuals reported), Cambodia (0 individuals reported), and Vietnam (10 individuals reported) (*S9*). These inaccuracies, however, are only evident through enhanced data collection and improved analysis.

The open-access CITES Trade Database (*S9*) and complementary trade statistics (e.g., U.S. Fish and Wildlife Service and United Nations statistics) remain underutilized by the conservation community (see *S4*), though a number of independent studies have demonstrated the need for bolstered data analysis (see main text). A comparison of U.S. CITES trade data and customs data from 1997 to 2002 revealed massive inaccuracies across diverse taxa and years, with important implications for trade management, conservation efforts, and resource allocation (*S10*). Analysis of CITES data has uncovered loopholes within the international trade of threatened and endangered poison arrow frogs from South America into Asian pet markets, identifying inconsistencies between CITES reported exports and imports, as well as complex trade networks (*S11*). Similarly, analysis of historical CITES data revealed huge shifts in trade patterns of protected African chameleons (*S12*). Analysis of CITES data and field-based research recently revealed that the CITES National Authority of Indonesia approved exports of reportedly captive-bred reptiles that were likely wild-collected (*S13*). Based on a wider range of data sources, Warkentin *et al.* (*S14*) identified massive inconsistencies between reported frog leg exports from Indonesia and India and reported imports by the United States and France, highlighting the scale and routes of a previously underrecognized trade. The CITES Secretariat and Parties must be able to identify these types of inconsistencies and trade dynamics in order to achieve their mandate. However, as evidenced by these independent studies, enhanced analysis alone is insufficient, and peer reviews are also necessary at multiple levels.

The pilot CITES Policy Review Project, which ran from 2006 to 2008 in Madagascar, Nicaragua, Uganda, and Viet Nam (*S15*), is an example of the type of checks and balances that CITES requires. This type of review can enhance data quality and the objectivity of Party decisions. However, many of the problems we identify and describe in this *Science* Policy Forum are linked, in part, to the relation between Party Management Authorities and advisory Scientific Authorities. For example, in Singapore both Authorities lie within the Agri-Food and Veterinary Authority, which may hinder transparency and objective review. In a number of other countries, such as Cuba and Azerbaijan, Management and Scientific Authorities are separate, and the Scientific Authority is tied to academic institutions (see *S15*).

Table S1.General strategies for improving CITES.

Challenge	Potential solutions	Principal benefits	Major socioeconomic and political barriers	Refs
Systematic and standardized data collection				
	Increased number of inspections. Higher effort is a prerequisite for a number of the following proposed solutions.	Improved data quality to inform conservation interventions. Improved CITES enforcement.	High cost to Parties. Party capacity limitations.	*S13*, *S14*, *S16-18*
	Mandate standardized, species-level reporting, such as through the use of standard international species codes.	Increased specificity of reported trades. Would make data more retrievable and comparable. Relatively low-cost measure through which to increase detailed data collection, as that does not require new technology, and implementation/training costs can be shared among Parties.	Challenges in achieving international consensus on reporting and with database and protocol harmonization. Challenges associated with species-level identification in many taxa.	*S10*, *S19*
	Provide standardized training for customs officials, drawing on domestic expertise to provide support.	Improved species-level statistics. Increased identification of non-compliant traders. Increased communication and information exchange between government officials and the scientific community.	Party resource limitation. Lack of available domestic expertise.	*S17*, *S18*, *S20*

Challenge	Potential solutions	Principal benefits	Major socioeconomic and political barriers	Refs
		Achievable at a low internal cost to Parties.		
	Develop tested, taxon-specific identification guides, decision-trees, and decision-making tools for customs officials. This can be done in collaboration with local and/or scientific experts.	Improved species-level statistics. Increased identification of non-compliant traders.	Party resource limitations. Extreme diversity and endemism in tropical regions, and the need for local taxonomic guides. Particular taxonomic challenges with some taxa (e.g., corals, identifying orchids based on vegetative characteristics).	*S17*, *S18*, *S21*
	Integrate DNA bar-coding with inspections. This could be done as part of random spot checks and in collaboration with universities and research institutes.	Improve identification. Provide accurate estimates of misidentifications using traditional techniques. Reveal accidental or intentional species introductions and substitutions. Could increase communication and information exchange between government officials and the scientific community. Especially relevant for taxonomically challenging groups (e.g., plants, corals).	Equipment. Human capacity and training. Laboratory facilities. Cost will correlate with intensity, but could be prohibitive in species-rich exporting countries.	*S18*, *S22*

Challenge	Potential solutions	Principal benefits	Major socioeconomic and political barriers	Refs
	Establish joint research agendas and agreements among Parties and academic institutions to collect domestic baseline data for target species, by using common methodologies.	Larger data sets on populations. Comparable data. Could increase communication and information exchange between government officials and the scientific community. Peer-review enhanced through increased inter-party collaboration and exchange. Opportunities for CITES-relevant research and for wildlife managers to access new sources of funding tied to academic or other institutions.	Institutional barriers and challenges associated with coordination among agencies. Political barriers, e.g., consensus on investment in data collection. Academic interest in collecting monitoring data. Consensus on target species and methodologies. High diversity in tropical regions and the need for species-specific information. High cost to Parties, and general lack of funding for basic research.	
	Develop more private sector / harvester engagement in point-of-harvest data collection.	Increased precision and accuracy of harvest data. Increasing awareness of status of resource with collectors. Potential long-term involvement of harvesters in efforts to sustainably manage the resource.	Strong incentive to misreport. Low levels of trust between harvesters and government. Real and perceived opportunity costs to harvesters. Lack of political will to place requirements on private sector.	

Challenge	Potential solutions	Principal benefits	Major socioeconomic and political barriers	Refs
Rigorous data analysis				
	Formalize, strengthen, and expand analysis networks (e.g., World Conservation Monitoring Centre, TRAFFIC) to utilize CITES and non-CITES data for robust analyses, such as Reviews of Significant Trade.	Periodic, planned analyses will increase scientific rigor of Animals and Plants Committees recommendations. Will uncover previously overlooked trade issues. Will provide more permanent institutional linkages.	Will require consistent funding to the external partners.	*S4, S23*
Flexible methods				
	Establish and/or strengthen regional CITES support networks. This could be done through the creation of formalized networks, as well as informal, online, and face-to-face forums sponsored by the CITES Secretariat and Parties, and NGOs.	Increased experience sharing among stakeholder groups (e.g., customs officials). Timely information exchange about innovative smuggling techniques and ways to counter them. Opportunity to increase involvement of civil society (academia, citizenry) in CITES.	Achieving political consensus. Long-term functionality of volunteer networks.	*S17*
	Develop and implement novel monitoring methods (e.g., for nontraditional trade networks, local-level and self-monitoring,	Will begin to capture data where the vast majority of CITES-listed species are traded.	Novel, possibly country-specific, methodological and training needs. Political feasibility, particularly	For example, *S13, S24*

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	especially for small-scale and artisanal harvest). This will require enhanced collaboration with academic institutions to maximize expertise and resources.	Improved communication between government and civil society.	related to sovereignty near poorly demarcated national borders. Lack of institutional support in remote regions, increasing the chance of violence. High cost to the Parties for increased manpower and mobility. Possible lack of academic interest in monitoring.	
	Review guidelines for decisions pertaining to allowing trade [non-detriment findings (NDFs)], trade quotas, and suspensions, to ensure that they are objective and science-based.	Increased confidence that allowable trade is biologically sustainable. Reduces opportunity for political maneuvering. Review / revision would be low-cost to the Secretariat.	Possible difficulty in achieving Party consensus on revisions necessary. Implementation of requirements would require empirical data. Compliance with stricter guidelines would be high cost to Parties.	*S25, see also S26*
Implement peer-review processes				
	Facilitate external scientific reviews of international-level CITES decisions, such as pertaining to allowing trade (NDFs), trade quotas, suspensions, and changing the status (up/down-listing) of	Increased rigor and credibility of decisions. Reduced space for political haranguing. Increased communication and	Acceptance and implementation of review findings.	*S27*

Challenge	Potential solutions	Principal benefits	Major socioeconomic and political barriers	Refs
	species on lists of threatened species	information exchange between government officials and the scientific community.		
	Engage external agencies and scientists in reviews of individual Party country decisions.	Scientifically robust analyses and decisions. Greater CITES transparency. Increased access to scientific expertise.	Increased administrative burden on Parties. Assurance of independence of reviewer.	For example, *S1, S13, S18*
	Review and enhance standards for Parties to monitor and better differentiate captive-bred and artificially propagated specimens from wild-caught individuals. This is especially relevant for high-value, rare species, and could be done as part of strengthened, random spot checks of CITES-approved breeders.	Improve credibility of legitimate breeders. Reduce instances of misreporting wild individuals as captive bred or artificially propagated, reducing pressures on wild populations.	Challenges associated with increasing the collaboration of breeders. Human capacity and training. Cost will correlate with intensity, but could be shared or carried by breeders, especially for high value species.	*S13*

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