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trade

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Production from both wild harvest and cultivation: the cross-border *Swertia chirayita* (Gentianaceae) trade.A.B. Cunningham^{a,b*}, J.A. Brinckmann^c, U. Schippmann^d and D. Pyakurel^{e, f}^aSchool of Life Sciences, University of KwaZulu-Natal, King Edward Avenue, Pietermaritzburg, 3209, South Africa and^bKunming Institute of Botany, Chinese Academy of Sciences, 132# Lanhei Road, Heilongtan, Kunming, Yunnan, China^cTraditional Medicinals, 4515 Ross Road, Sebastopol, California 95472, USA^dBundesamt für Naturschutz (BfN), Konstantinstr. 110, Bonn 53179, Germany^eAgriculture and Forestry University, Faculty of Agriculture, Department of Agribotany and Conservation, Ecology, Rampur, Chitwan, Nepal^fUniversity of Copenhagen, Faculty of Science, Department of Food and Resource Economics, Rolighedsvvej 25, 1958 Frederiksberg C, Denmark*Corresponding author. *E-mail address*: tonyc05@bigpond.net.au (A.B. Cunningham)**ABSTRACT****Ethnopharmacological relevance:**

Swertia chirayita is the most widely traded species in a genus of 150 species, many of which are used in traditional medicine. *S. chirayita* is used mainly in Ayurvedic and Tibetan systems of medicine and the homoeopathic system of medicine as well as in regional folk medicine. Primarily wild collected, with some cultivation. *S. chirayita* is traded as a medicinal substance and exported in the forms of dried whole plant or extract of whole plant individually and/or as active ingredients of Ayurvedic medicines. *S. chirayita* export valuations continue to make *S. chirayita* one of Nepal's highest foreign exchange earning medicinal plant species.

Aims of the review:

The aims of this review were first, to assess the scale of the global trade in *S. chirayita*, second, to review evidence from plant population biology and from studies on the impacts of wild harvest on *S. chirayita* populations and cultivation as an alternative source of supply.

Methods:

The taxonomy and trade names for *S. chirayita* were reviewed, followed by a synthesis of published information on *Swertia* population biology and studies on impacts of wild *S. chirayita* harvest from across the geographic range of this species. Data on the prices paid for *S. chirayita* were then compiled for the period 2001 to 2017, followed by an analysis of global trade data for *S. chirayita*.

Results and Conclusions:

Based on India import data and assuming an estimate in an earlier study that 60% of Nepal's *S. chirayita* production goes to India and 35% to Tibet, then Nepal's 2013 annual production was about 711 metric tonnes (MT) of which about 675.6 MT would be exported (India + Tibet). Nepal's 2014 annual production would be an estimated 503.25 MT of which about 478 MT would be exported. Declines in *S. chirayita* populations have been widely noted across its range. In India, since 2004, a ban was placed on the export of wild harvested *S. chirayita* by the Government of India, where the Director General of Foreign Trade prohibited export of *S. chirayita* plants, plant portions and their derivatives and extracts obtained from the wild with the exception of 'formulations'. Cultivation of *S. chirayita* to meet commercial demand has been an important part of a solution to over-exploitation of wild stocks in eastern Nepal for 25 years, producing significant quantities that enter the export trade to India and Tibet. In Sankhuwasabha district, for example, 53.1 MT of *S. chirayita* were produced in 2013/014, just over half of which (27 MT) were exported to India, with the remainder exported to Tibet. Based on value-chain analysis and cost-benefit assessments, *S. chirayita* cultivation has been shown to be profitable in Nepal. However, since the first cost-benefit assessment was done (2013), prices

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