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Importance of MAPs and Climate Change

Climate change, exemplified by changing weather patterns, increased temperatures, and melting of polar ice caps and glaciers, is the third biggest driver of change in nature. Earlier springs and later winters, unpredictable last frosts of the season, variability in pollinator population, and threats from invasive pests can all contribute to challenges for our medicinal and aromatic plants (MAPs). MAPs have been instrumental in traditional medicine and rituals throughout civilization, and currently play a role in conventional medicine as well. Furthermore, there is increasing use of herbal medicines and ongoing research has been ongoing to fill in knowledge gaps. Recognizing the importance of MAPs, The World Health Organization (WHO) has published monographs on selected medicinal plants since 1999 to address safety, efficacy, and quality of commonly used medicinal plants (WHO). Knowing about the importance of MAPs and understanding the threats of climate change, how can we select herbs and use them responsibly? Focusing on improving global awareness, supporting local companies and cooperations, limiting harvests, performing quality control checks, protecting land, and preserving genetics are all tactics that can help us use medicinal plants and use them more responsibly.

In 1994, the International Union for Conservation of Nature (IUCN) Species Survival Commission started the Medicinal Plant Specialist Group (MPSG) to increase global awareness of conservation threats to medicinal plants and to promote sustainable use and conservation action. The MPSG is one of more than 160 Specialist Groups within the IUCN and has played a pivotal role in raising awareness and setting standards (IUCN). Identifying species based on level of concern from a conservation standpoint enables at-risk species to be followed more closely to hopefully limit over harvesting and diminish incidences of species extinction. This is a lofty task and is most likely to succeed with group cooperation and clear communication. Encouraging local groups to become involved in sustainable harvesting while utilizing international resources to help our more vulnerable species may become necessary. It is important to share knowledge on the global level to increase awareness and work together to troubleshoot problems as they arise. With increased globalization and use of the Internet to bring communities together, increased awareness of communities to help spread awareness will help increase communal knowledge and hopefully share what is known.

Companies such as RUNA exemplify efforts to increase conservation and sustainability. RUNA had 477 hectares of guayusa cultivation area under the US Department of Agriculture (USDA) National Organic Program (NOP) certification. Another organic guayusa operation, Runatarpuna Exportadora S.A. (exporter to US-counterpart, RUNA), utilizes a multi-crop traditional agroforestery system along with cacao, coffee, and yuca; this system is preferable to mono-cropping, minimizing some of the effects of climate change while improving the livelihood of smallholder farmers (Brinckmann and Brendler). Encouraging development of enhanced multi-crop operations that focus on conservation and sustainability can help in contrast to relying on mono-crop operations that often deplete soil of nutrients and increase risk of spreading parasites and disease. Advertising the benefits of traditional agroforestry system and the operations that use these techniques to conserve MAPs may be helpful in spreading awareness while supporting sustainable cultivation. Furthermore, multi-crop operations can improve duration of harvest when various crops mature at different rates, improving financial stability for smaller farms and food security for local communities. These are all positive attributes that can remain sustainable as long as there is a market for MAPs. Luckily, it is unlikely that the market will diminish anytime soon, especially as COVID-19 remains a threat to global society.

Placing limits to prevent overharvesting, while promoting education may be beneficial for long term health and sustainability of MAPs. Supporting local communities and encouraging practices that maximize appreciation for these valuable resources may help slow habitat loss. Habitat loss, whether due to climate change or human destruction, is a significant threat that affects flora, fauna, and human citizens. If land could be protected, this may help diminish some species threat, but does not take into account changes in temperature or carbon dioxide levels. Understanding how climate change affects physiochemical properties of MAPs can also play a role in cultivation. A study by Harish et al studied the effects of increased levels of carbon dioxide and herb qualities, focusing on secondary metabolite production. Surprisingly, it was found that ultra-high levels of carbon dioxide increased fresh leaf, root, and shoot weight of spearmint, thyme, and water mint, compared to high carbon dioxide levels and ambient air. It was also found that elevated carbon dioxide levels increased fresh weight and leaf and root numbers in lemon basil, peppermint, spearmint, and thyme compared to cultures grown on the same media under ambient air. This may be due to stressed plants producing secondary metabolites instead of being allocated to growth. In foxglove (Digitals lantana), tripling the air's carbon dioxide content increased concentration of digoxin by 11 percent under well-watered and 14 percent under water-stressed conditions. It was also emphasized that there must be understanding of the effect on threats to medicinal plant species, through loss, gain, or change of parasites, and loss of habitat. It is interesting and important to note that increased stress can increase the qualities that may be desired in certain species. As every plant is different, it is imperative to learn how stressors affect composition to determine course of action for the final product.

Performing quality control to check for levels of digoxin, for example, or any other quality, can identify a specimen's potency, and determine how much raw material is needed for a final product. While quality control may be more expensive and time consuming before producing a final product, it is a good practice to gather data and understand its importance. This is especially true for MAPs that are ultimately used as a life-saving medication. Using a smaller quantity of MAPs can help make cultivation and harvesting more efficient, while decreasing waste. Furthermore, knowing that a specimen falls short of expected physiochemical properties will alert growers that something is amiss. Whether changes are due to inferior soil quality or other changes can help determine what can be changed for the next harvest. Finding cost effective and fool-proof methods of performing quality control can be determined and discussed amongst harvesters for a superior final product. This should go without saying, yet there are many herbal companies that do not do their due diligence in proper quality control, and harvesting without following up on quality may undermine MAP potential.

Another option for protecting land currently used for MAPs is to locate alternative locations for cultivation. Climate change has forced species to move to higher altitudes and more inland, yet deforestation and urban development makes this difficult. If necessary, spaces such as biodomes, warehouse or garden rooftops may be necessary to keep population numbers stable. These alternative harvesting locales, though unconventional, can be used to train interested members of the public and further increase educational opportunities. Connecting humans with the power of MAPs in a location that is more easily accessible can help improve appreciation and respect for their healing properties. Unfortunately, these man-made farms cannot supply the same soil quality, diversity of pollinators, or interactions between species that may coexist in symbiosis. Unfortunately, this option may be a future realty that should be considered now for its benefits and downfalls. If it is possible to include pollinator diversity and find a way to naturally improve soil quality, this would be an improvement.

An additional possibility that is currently being used for some species is genetic preservation through DNA banks. Saving and cataloging species genetics alleviates fear that extinction is eternal by safeguarding for the future. Utilizing preserved genetics to “bring back” or hybridize species can help scientists learn from past mistakes and try to revitalize a species into existence. This may not be ideal, as preventing extinction is preferred, but it is helpful to know there is a “back up plan”. Ensuring that MAPs of importance are accounted for, with additional samples in a second or third gene bank would be recommended. Genebanks exist in Spain (Spanish Plant Genetics Resources National Center (CRF), including IMIDRA in Spain, SERIDA in Asturais, IMIDA in Murcia, CCBAT in the Canary Islands, and others. Region-specific genebanks, such as the ones mentioned previously, are wonderful for providing a safe haven for local plant genes, but this comes at a price. The question of funding is obvious and finding room for genes of utmost importance can be a cause of debate. Regardless, this option does exist and may be necessary for the future.

In conclusion, climate change has required cultivation of MAPs to be investigated to determine the best course of action to preserve these species. Supporting local communities, putting limits on harvesting, understanding physiochemical composition, preserving habitat or finding alternative habitats, and archiving genetics in a DNA bank are all steps that can be taken to help alleviate the threat of climate change. Ultimately, each individual must do their part to decrease personal contribution to climate change. Until major steps ae taken to decrease carbon emissions, it is necessary to prepare for the worst but hope for the best.

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