



POSITION STATEMENT

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Conservation of Biodiversity: Protecting Molecular Diversity and Biomedical Discoveries

Earth is experiencing a biodiversity crisis. There are an estimated ten million species of fungi, plants, and animals, yet only about two million have been named. For the two million species that have been named, more than 50% of all species may go extinct by the end of this century. Of the two million named species, 20% are at risk of extinction right now and for these we have not completely explored their basic biology and the molecules they contain—let alone the large numbers of rare and not yet described species.

This biodiversity crisis, both the rapidly accelerating rate of species extinction, and the lack of knowledge of most species on Earth, poses a direct threat to human health. More than 67% of people around the world use natural products as their primary source for health and medicine. It is the case that 70% of drugs used for treating human health are derived from nature and that 11% of the 252 drugs considered as basic and essential by the World Health Organization are derived from flowering plants. One of these drugs, Taxol, a chemical discovered in the Pacific Yew, is still one of the leading compounds used to treat cancer.

Substantial effort was devoted previously to exploring biodiversity for biomedical applications. The United States' National Institutes of Health supported International Cooperative Biodiversity Groups to identify molecules from nature. Pharmaceutical companies have identified many natural products and successfully harnessed the potential of biodiversity for improving human health. These efforts have decreased in recent years as efforts to find significant molecules have moved away from nature to synthetic approaches. This decrease in effort has happened concurrently with powerful new tools in molecular biology that allow an even greater ability to discover molecules from nature.

Given the biodiversity crisis underway, the lack of knowledge of most species, and the powerful new tools in molecular biology, a renewed effort is needed to both protect and explore biodiversity for biomedical applications. The loss of biodiversity decreases our ability to discover new products, metabolites, and genes beneficial for human

health. With the extinction of each species, molecular diversity is lost forever, hindering efforts to discover promising new molecules that could be developed as therapeutic agents. Looking for molecules in nature is promising because many of the molecules found in organisms protect them from predators, herbivores, diseases, and infections and are deeply integrated in the lives of the organisms that produce them. Many of these molecules are not predictable through existing chemical principles – it is only through research that we will find them; yet with increasing loss of biodiversity, our ability to discover these molecules is rapidly diminishing.

The Global Young Academy (GYA) believes that an urgent cross-national and cross-disciplinary initiative is required to support scientists working to prevent loss of biodiversity and partnerships to discover natural product-based therapeutic agents. The GYA, through collaboration among early career scientists from all disciplines and from around the world, is uniquely positioned to facilitate new initiatives towards protecting biodiversity for biomedical applications. To address this problem, the GYA has created the “Biodiversity via Biomedicine for Survival” working group with members from all continents and disciplines including ecology, wildlife conservation, biochemistry, epigenetics, pharmacology, and public health. The GYA believes that collecting, curating, and disseminating knowledge on biodiversity, as it relates to the treatment of human diseases, will promote the conservation of bio- and molecular diversity while creating the international cooperation needed to safeguard well-being for all communities. In doing so, we can protect biodiversity and discourage the unsustainable exploitation of natural products. The GYA’s working group is focusing on the following objectives to protect the molecular diversity needed for novel biomedical discoveries and development:

- Creating open interdisciplinary international dialogue among conservation and molecular scientists, physicians, engineers, patients, policy-makers, and the business sector in the areas of medicine, health, and well-being;
- Establishing best practices and codes of conduct, including ethical considerations, for sustainable natural product collection, production, storage, preparation, and purification of compounds;
- Promoting the fair and equitable sharing of benefits obtained from drug discoveries among stakeholders and the sustainability of natural products and the systems to which they are integral;
- Standardizing high capacity biological assays to test natural products against cell-based disease models.

To fully realize these initiatives, compliance with local and international law is required. The increasingly strict permit standards to conduct biodiversity work around the world, while necessary to protect and manage resources, are creating barriers that decrease collaboration at a time when biodiversity is being lost at unprecedented rates. New interdisciplinary efforts like the GYA’s working group are essential first steps in creating

partnerships that help overcome barriers to protecting biodiversity, and increase research for biomedical discovery and development. The 2010 Nagoya Protocol on Access and Benefit Sharing, a supplement to the 1992 Convention on Biological Diversity, provides a framework for sharing the benefits that arise from research on natural resources, especially molecules that improve human health. It is also essential to acknowledge the unique relationships of indigenous peoples with nature and their ancient knowledge on the healing properties of fungi, plants, and animals. This knowledge can help guide research and every effort must be made to protect these communities and safeguard their knowledge for the benefit of human health. Without the equitable sharing of biomedical discoveries, we will continue to lose biomedical benefits from nature and the mechanisms to support local communities that depend on biodiversity.

The GYA believes that the objectives outlined above require interdisciplinary approaches that connect with international and government agencies, pharmaceutical companies, academic institutions, non-governmental organizations, scientific societies, and private foundations. Efforts to disseminate information on existing natural products used for the treatment of human diseases will help promote research, protection, conservation, and international cooperation. Connecting government and medical organisations focused on collecting and testing natural products will help develop new biological and biomedical assays, health/nutrition regimens, ecological protocols, and policy for best practices in drug development in the interest of the survival of humans and other species. These efforts will aid in the conservation of biodiversity and promote the sustainable harvest of biomedical discoveries for all human well-being and survival.

Authors

This statement was prepared by GYA members Christian Agyare (Ghana), Almas Taj Awan (Brazil), Yusuf Baran (Turkey), Kit Chan (UK), Meghnath Dhimal (Nepal), Thomas Edison dela Cruz (Philippines), Dilfuza Egamberdieva (Uzbekistan), Simon Elsässer (Sweden), Vinicius Farjalla (Brazil), Mari-Vaughn Johnson (USA), Alexander (Sasha) Kagansky (UK/Russia), Bartłomiej Kolodziejczyk (Australia), Shoji Komai (Japan), Andrey Konevega (Russia), John Malone (USA), Paul H. Mason (Australia), Vidushi Neergheen-Bhujun (Mauritius), Rothsopal Nguon (Cambodia), Milica Pesic (Serbia), Samuel Sojinu (Nigeria), and Uttam Babu Shrestha (Nepal). For further information, see <https://globalyoungacademy.net/activities/biodiversity-of-survival-via-biomedicine/>.

Further Reading List

Agyare C, Awan AT, Baran Y, Chan K, Dhimal M, dela Cruz TE, Egamberdieva D, Elsässer S, Farjalla V, Johnson M-V, Kagansky A, Kolodziejczyk B, Komai S, Konevega A, Malone JH, Mason P, Neergheen-Bhujun V, Nguon R, Pesic M, Sojinu S, Shrestha U. 2017. Biodiversity, drug discovery, and the future of global health – introducing the biodiversity to biomedicine consortium, a call to action. *J Glob Health*. 2017. doi: 10.7189/jogh.08.010301.

Blackwell, M. The fungi: 1,2,3...5.1 million species. *Am J Bot.* 2011;98: 426-438. doi:10.3732/ajb.1000298

Carter GT. Natural products and Pharma 2011: Strategic changes spur new opportunities, *Nat. Prod. Rep.* 2011;28:1783.

Harvey A, Edrada-Ebel R, Quinn RJ. The re-emergence of natural products for drug discovery in the genomics era. *Nat Rev Drug Discov.* 2015;14:111–129.

Newman DJ, Cragg GM. Natural products as sources of new drugs from 1981 to 2014. *J Nat Prod.* 2016 Mar 25;79:629-61. doi: 10.1021/acs.jnatprod.5b01055. Epub 2016 Feb 7.

Partridge E, Gareiss P, Kinch MS, Hoyer D. An analysis of FDA-approved drugs: natural products and their derivatives. *Drug Discov Today.* 2015 <http://dx.doi.org/10.1016/j.drudis.2015.01.009>

Pimm SL, Jenkins CN, Abell R, Brooks TM, Gittleman JL, Joppa LN, et al. The biodiversity of species and their rates of extinction, distribution, and protection. *Science.* 30 May 2014; 344:6187, 1246752. doi:10.1126/science.1246752

Pimm S, Russell G, Gittleman J, Brooks T. The future of biodiversity. *Science.* 1995;269:347.

Reidpath DD, Gruskin S, Allotey P. Is the right to health compatible with sustainability? *J Glob Health.* 2015;5:010301. doi:10.7189/jogh.05.010301.

Scannell JW, Bosley J. When quality beats quantity: decision theory, drug discovery, and the reproducibility crisis. *PLoS ONE.* 2016;11:2 e0147215. <https://doi.org/10.1371/journal.pone.0147215>