

## NOTES ON ECONOMIC PLANTS

**Valuing undiscovered pharmaceuticals in tropical forests.**—A computational error appears in our manuscript entitled “The Value of Undiscovered Pharmaceuticals in Tropical Forests” (*1*). Our original calculations indicated that the value of undiscovered drugs is worth about \$96 million to a pharmaceutical company and that there are approximately 33 to 49 new drugs that a typical company could discover if it tested all tropical plants. Potential gross revenues would range from \$3.2–4.7 billion. Collection costs for the plant material would amount to \$75 million. However, testing for active drugs using screens is likely to cost between \$3.8–5.6 billion (which we mistakenly calculated as \$360–530 million). The cost of finding new drugs from a blanket testing program exceeds the expected benefits for private companies. Although pharmaceuticals have high market values, “undiscovered” drugs have little market value because they are expensive to find.

Nonetheless, the value of new drugs to society remains positive. Because society as a whole has more screens, it should expect to find more drugs. Further, the value of each drug is higher to society than it is to a private company because profits are only a fraction of the total value of new drugs. We estimate society enjoys benefits of about \$449 million per drug and is likely to find 328 new drugs for a gross benefit of \$147 billion. Subtracting the collection costs of \$75 million and the correct screening costs of \$37.5 billion (not the \$370 million reported earlier), yields a net value of \$109 billion. This is our estimate of the net value society should place on hidden drugs in all tropical forests. Given that there are about 3 billion hectares of tropical forest, this amounts to an average of about \$3 per hectare.

Of course, the value of selected samples of plants could well be higher than this average. Plants with known active ingredients have a much higher chance of having a useful drug. Plants used for traditional medicine tend to have

active ingredients making them far more likely to be useful as pharmaceuticals. Using ethnobotany to identify promising plants could substantially reduce the search costs for at least some pharmaceutical drugs. Forests with higher fractions of endemic species also have a higher than average chance of having hidden drugs since they contain more unique species per hectare. For example, an area with ten times more endemic species per hectare would have a hidden drug value of \$30 per hectare rather than just \$3. By carefully selecting samples to lower testing costs and by choosing as study sites forests with more endemic species, the value of hidden drugs could add substantially to the preservation value of select locations.

In this study, we have explored only the value of flowering plants. Bioprospecting that includes fungi, algae, microorganisms, insects, and animals will lead to higher values. However, what limits the value of undiscovered drugs is the high cost of finding them. Including these additional resources probably will not change the estimates in this paper substantially. Research budgets of most private companies will continue to include only a modest percentage for exploring nature for new pharmaceuticals. There exists a social incentive to protect forest for unknown pharmaceuticals, but in reality it is a relatively modest incentive. It is consequently important to examine and promote all motivations for tropical forest conservation and carefully preserve biodiversity-rich sites in need of protection and study.

Literature Cited. (*1*) Mendelsohn, R., and M. Balick. 1995. The Value of Undiscovered Pharmaceuticals in Tropical Forests. *Economic Botany* 49:223–228.

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