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BIOPROSPECTING AND SUSTAINABLE CONSERVATION - A PRACTICABLE APPROACH TO CONSERVING BIOLOGICAL DIVERSITY

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Abstract

Conservation of biodiversity will fail in the long term unless its economic value is realized and demonstrated. If ignorance of the world's biodiversity continues (e.g. the majority of fungi and invertebrates are yet to be discriminated or named), the considerable scientific, economic and social values of our bio-resources will never be realized.

It is obviously in the interest of bio-resource managers to ensure that these resources are used sustainably. What is not so obvious is that it is very much in the interest of the resource holder (usually a Nation or State) to conserve adequate and representative samples of all habitat types. It is the nexus between taxon discrimination, screening for active agents, perpetual provision of the resource and reservation of indigenous vegetation which guarantees bio-conservation.

Accurate taxonomy (discrimination, classification and vouchering of taxa) is indispensable to an efficient and effective drug discovery (bioprospecting) program. When a lead compound is discovered by screening material collected from a taxon, and is then progressed to preclinical toxicological testing, it is essential that perpetual provision of the resource is secured. The provision of a fair and equitable royalty derived from such compounds will enable resource managers to fund the science and provide the infrastructure required to conserve the resources being used.

Sustainable drug discovery programs must be conducted in good faith. The alternative is that naive or unscrupulous scientists give away or sell off intellectual property embodied in the biota to outside interests and the Nation or State which owns the resource receives no scientific, financial or social returns. It is only through the realization of the "bio-wealth" of our biota that its conservation will be assured.

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"The truth is that technology and prosperity are not the inherent nuisances of which environmentalists continually complain but, rather, the means by which a better environment could be created".
John Maddox (1972 : 98-99), Editor of the International Science Journal *Nature*.

The Problem

It is widely accepted that increasing populations of humans are expanding the area being cleared of native vegetation. Suitably-sized remnants of representative native vegetation are, however, indispensable for the conservation of existing biodiversity. The problem is to devise an incentive which will stop this clearing of native vegetation.

The laudable ecological and ethical reasons advanced by conservationists for conserving biodiversity have unfortunately proved insufficient to put a stop to land clearing. The reality is that native vegetation is regarded as producing too few economically valuable natural products - it is more profitable to clear the vegetation (to waste or for a wood product cash crop) and grow food (crops, cattle) or extract minerals or precious metals.

The alternative requires only a subtle paradigm shift. Instead of native vegetation being regarded as an impediment to the creation of economic wealth, native vegetation (and its associated biota) is conceived of as a biological resource with a substantial, though latent, economic value (Armstrong and Abbott, in press).

Before this economic value can be realized, it is necessary to be able to discriminate the species correctly. Otherwise individual organisms cannot be named (identified to species). The bulk of the birds and mammals on Earth have already been named, and a substantial fraction of vascular flora has also been named. However, 99% of the world's biological species comprise fungi and invertebrates; relatively few of these taxa have been discriminated or named. Understandably, Governments in general have accorded support for taxonomic research very low priority relative to more pressing issues of human health and education. We have, therefore, a vicious circle - it is difficult to extract natural products usefully when organisms have not been discriminated or assigned a formal name; the rate of describing new species is dependent on a large number of productive taxonomic scientists; Governments view taxonomic research as an esoteric pursuit and thus commit few resources to it.

A Solution

Any area of native vegetation holds a wealth of native species. Take for example the nature reserve with the median area of the 25 reserves studied in the WA Wheatbelt by a team led by Kitchener (1976). East Nugadong Nature Reserve, situated east of Dalwallinu, has an area of 772 ha. Just over 100 species of vascular flora have been recorded on it (Muir 1979). We could expect *c.* 1000 insect species and *c.* 700 fungal species to be present also. This Reserve is vested in the National Parks and Nature Conservation Authority of WA and currently is an asset returning nothing of economic value to the people of WA. It would be fair to say that this Nature Reserve is being managed currently by 'benign neglect'.

In the past year, Western Australia (33% of the land area of Australia) has devised a new approach to commercialize natural products from its native flora. This strategy rests on three fundamental concepts:

- Any utilization of natural resources must be sustainable.
- The science-based knowledge needed to underpin the utilization must involve the Western Australian scientific community.
- There must be a fair return to the citizens of Western Australia from any utilization of natural resources.

The strategy consists of the following steps:

- *Collections, Identification, Taxonomy* Specimens of each species of flora will be collected, vouchered in the WA Herbarium, identified or, if new to science, formally described.

- *Screening* Different parts of a small sample of individual organisms of each species (eg root tissue, stem tissue, leaf tissue) will be collected, coded, and screened for agents active against cancers, viruses etc.

- *Drug Discovery* The chemical method of extracting potential drugs constitutes intellectual property and is patentable.

- *Drug Development* Natural products that prove to be efficacious and satisfy the rigorous standards required of a drug intended for human use will be put out to international tender, and the best return for the State of Western Australia will be accepted. This will yield substantial royalty to Western Australia.

- *Improved science infrastructure and biodiversity conservation* Part of this royalty, which will be expected to amount to several millions of dollars per annum, will be used to improve research infrastructure, provide more taxonomists and other scientists, and ultimately, to provide a reason for Governments and private individuals to set aside more areas of native vegetation from clearing (Fig. 1).

The Pitfalls

Aesop's fable, the Goose that Laid the Golden Eggs, has the moral that 'much wants more and loses all'. It is essential that Resource Provision is sustainable, in two senses. First, populations of the target species must not be harvested faster than they can reproduce or grow. This principle of sustained yield management is a tenet of natural resource management. Second, populations of non-target species must not be harmed during the resource provision phase - in WA this signifies that pathogenic fungi must not be inadvertently introduced through inadequate hygiene This second sense has only been explicitly articulated since the 1980s under the concept of ecological sustainability.

The issue of sustainability in this context is essentially one of curbing avarice, being content to live off 'interest' and not use 'capital', and not imperilling the persistence of other species living in the same locality as the target species.

The second major pitfall relates also to amoral behaviour: Sustainable drug discovery programs must be conducted in good faith. We know of many cases where scientists have in bad faith sought a collecting permit from the appropriate WA Authority on the basis of advancing scientific knowledge, but have then onsold collected samples to commercial pharmaceutical screening facilities. Follow-up of any 'hits' would result in poaching from populations in order to supply the larger quantities of resource required for preclinical testing (Fig. 2).

The third pitfall concerns eagerness to grow and then harvest species producing prospective drugs away from the Reserve(s) on which they occur. If successful, this approach effectively removes any incentive to manage the Reserve properly. The Reserve is no longer needed for harvesting. We recognize, however, that *ex situ* harvesting may be essential for those species that occur in natural populations too small to allow sustainable harvesting. Related to this issue is that of remnant areas of native vegetation on private land. For example, in the WA Wheatbelt (90% cleared of its original vegetation), some farms still have substantial areas of privately owned remnants of the original vegetation. It is the landholder's right to clear these

remnants for agricultural pursuits. From time to time Governments in WA have legislated to ban further clearing of native vegetation in certain catchments, but this provokes resentment in rural communities, and understandably Governments are reluctant to exercise this prerogative. In contrast, payment to landholders for providing the resource from such remnant vegetation would be an incentive for the landholder not to clear (cf. Armstrong and Abbott 1994).

In conclusion, bioprospecting and sustainable conservation offer a feasible way to conserve biodiversity. We believe that it is only through the realization of the 'bio-wealth' of the World's biota that its conservation will be assured.

Acknowledgements

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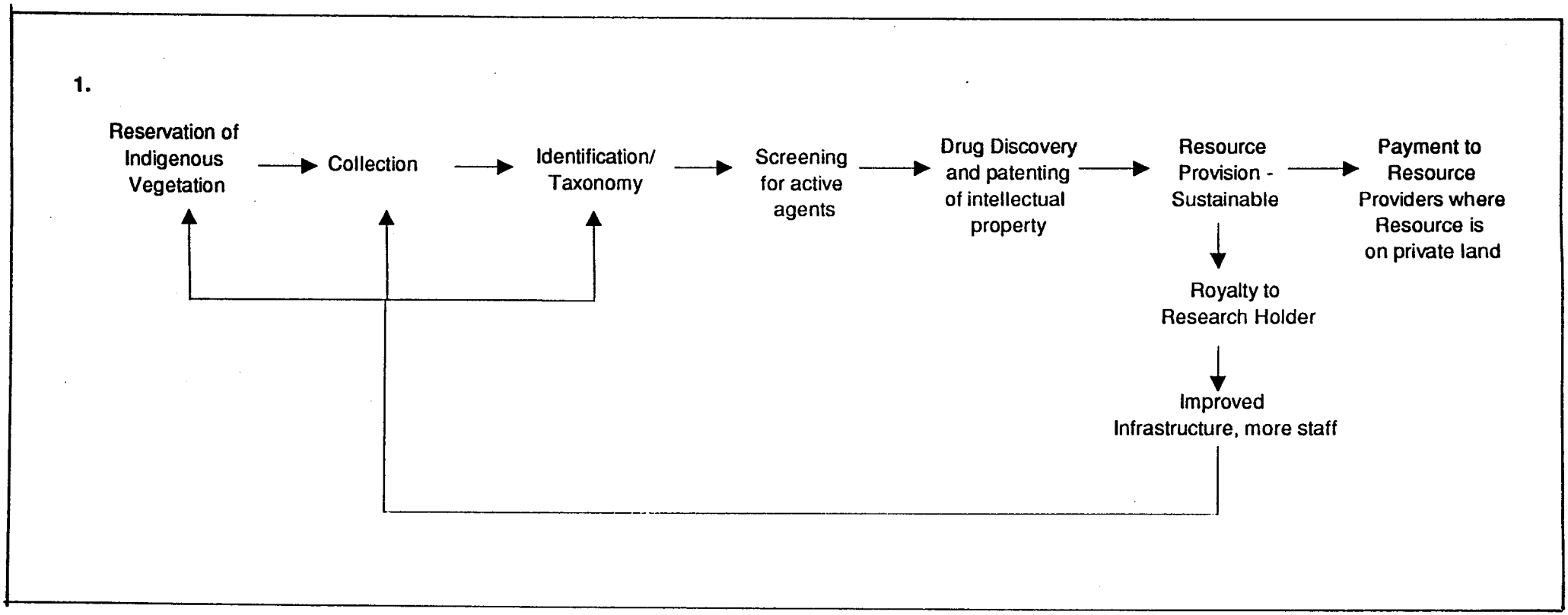
Figure Captions

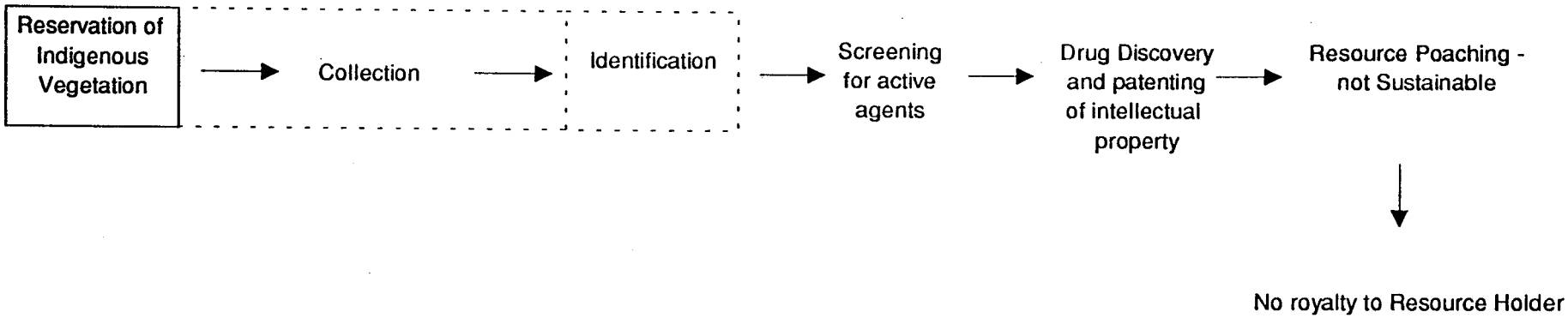
1. Preferred model of how bioprospecting can facilitate the conservation of biological diversity. Note that the linkages between actions are "tight" and are effectively controlled by the Resource Holder (represented by the box).

2. Schematic model of how bioprospecting has worked in the past. The solid box represents at action controlled by the Resource Holder; the dotted boxes represent actions that may or may not be under the control of the Resource Holder. Note the absence of a feedback loop between Royalty and Reservation of indigenous vegetation, collection and identification.

1.


Reservation of Indigenous Vegetation
Collection
Identification/ Taxonomy
Screening for active agents
Drug Discovery and patenting of intellectual property
Resource Provision - Sustainable
Payment to Resource Providers where Resource is on private land
Royalty to Research Holder
Improved Infrastructure, more staff

2.


Reservation of Indigenous Vegetation
Collection
Identification
Screening for active agents
Drug Discovery and patenting of intellectual property
Resource Poaching - not Sustainable
No royalty to Resource Holder