

---

The Parliament of the Commonwealth of Australia

# **Bioprospecting: Discoveries changing the future**

**Inquiry into development of high technology industries in  
regional Australia based on bioprospecting**

**House of Representatives  
Standing Committee on Primary Industries and Regional Services**

August 2001  
Canberra

---

© Commonwealth of Australia 2001

ISBN [Click **here** and type ISBN Number]



# Contents

Foreword.....	vii
Membership of the Committee.....	ix
Terms of reference .....	xi
List of abbreviations.....	xiii
List of recommendations.....	xv
Glossary.....	xxi

## THE REPORT

<b>1 Introduction, definitions and inquiry scope.....</b>	<b>1</b>
High technology products and processes from natural sources.....	1
Definitions .....	2
Bioprospecting.....	2
High technology.....	3
Bioindustry development .....	3
Conduct of the inquiry .....	5
Report format.....	5
<b>2 Potential for industrial development based on bioprospecting.....</b>	<b>7</b>
The need for new products and processes .....	7
Australia's potential .....	8
Biological resources .....	8
Supporting factors .....	9

---

<b>Bioprospecting in Australia</b> .....	10
<b>Actual and potential Australian biobased products and processes</b> .....	12
<b>How big is the potential?</b> .....	14
<b>Conclusion</b> .....	17
<b>3 Overcoming impediments in establishing Australian bioindustries</b> .....	<b>19</b>
<b>Introduction</b> .....	19
<b>The knowledge base</b> .....	20
<b>Getting access to biological resources</b> .....	28
Ownership .....	30
A nationally consistent access regime .....	32
Benefit sharing.....	34
Criticism of the proposed access and benefit sharing scheme .....	37
Additional issues of concern in access and benefit sharing arrangements .....	41
Conclusions about access and benefit sharing.....	49
<b>Finding and using bioactive substances</b> .....	<b>52</b>
Biodiscovery .....	53
Bioprocessing and bioindustries.....	57
<b>Conclusion</b> .....	<b>61</b>
<b>4 Regional activity</b> .....	<b>63</b>
<b>The potential</b> .....	63
<b>Case studies</b> .....	68
<b>Impediments</b> .....	72
<b>Solutions</b> .....	73
<b>5 Environmental impacts</b> .....	<b>79</b>
<b>Introduction</b> .....	79
<b>Possible negative impacts</b> .....	79
<b>Positive impacts</b> .....	83
<b>Conclusion</b> .....	85

---

<b>6</b>	<b>A national strategy for the development of new biobased industries.....</b>	<b>87</b>
	Introduction.....	87
	Developing a strategy .....	88
	Role of Department of Agriculture, Fisheries and Forestry - Australia .....	92

## **APPENDICES**

	<b>Appendix A – List of submissions .....</b>	<b>95</b>
	<b>Appendix B – List of exhibits.....</b>	<b>97</b>
	<b>Appendix C – List of public hearings and witnesses .....</b>	<b>99</b>
	<b>Appendix D – Inspections and discussions.....</b>	<b>101</b>
	<b>Appendix E - Details of the access and benefit sharing scheme recommended in the Voumard Report .....</b>	<b>103</b>



## Foreword

At the start of the 21<sup>st</sup> century, the industrial world stands on the edge of a new revolution. The industries of the future will tap increasingly into the materials and processes in plants, animals and microorganisms. They will draw on the chemicals and genetic material of the world's biological resources to provide new feedstocks and new modes of manufacture.

Australia is well positioned to participate in this new industrial development. It is richly endowed with biological resources; it is one of the few mega diverse countries in the world. It also has the skills to develop these resources. It is vital that Australia seize the opportunities to search (to bioprospect) its biological resources for new chemicals and processes, and then develop industries based on them.

The potential for building new industries on the discoveries made from biological resources is huge. Biodiscoveries hold the promise of new medicines and agrichemicals, more efficient and less polluting industrial production, and environmental remediation. Immense economic, social and environmental benefits can accrue from these discoveries. It is vital that Australia is part of this new future. Australia must be able to make the best use possible from bioprospecting its biological resources.

This is the context in which the House of Representatives Standing Committee on Primary Industries and Regional Services undertook to inquire into the contribution that bioprospecting might make to the development of new industries, especially in regional Australia. The committee has considered the opportunities and impediments to development of this kind and its likely impact on the natural environment, and has made recommendations to facilitate future developments.

The committee is excited about the possibilities that bioprospecting offers the nation.

Fran Bailey, MP  
Chair



## Membership of the Committee

**Chair** Fran Bailey MP

**Deputy Chair** Mr Dick Adams MP

**Members** Mr Peter Andren MP

Hon Leo McLeay MP

Mr John Forrest MP (from 7/8/2001)

Mr Gary Nairn MP

Mr Alan Griffin MP

Mr Patrick Secker MP

Mr Bob Horne MP

Mr Alby Schultz MP (from 29/3/2001)

Hon Bob Katter MP (to 7/8/2001)

Mr Sid Sidebottom,MP

Mr Tony Lawler MP

Mr CameronThompson MP

Mr Ian Macfarlane (to 8/3/2001)

Dr Mal Washer MP

Mr Griffin and Dr Washer were appointed supplementary members of the committee for the purposes of the inquiry into the development of high technology industries in regional Australia based on bioprospecting.

## **Committee Secretariat**

<b>Secretary</b>	Mr Ian Dundas
<b>Inquiry Secretary</b>	Dr Sarah Hnatiuk
<b>Research Officers</b>	Ms Katherine Harrington
<b>Administrative Officers</b>	Ms Marlene Lyons
	Ms Jeannie Brooks





## **Terms of reference**

The House of Representatives Standing Committee on Primary Industries and Regional Services will inquire into and report on the following areas, with particular emphasis on the opportunities in rural and regional Australia:

- the contribution towards the development of high technology knowledge industries based on bioprospecting, bioprocessing and related biotechnologies;
- impediments to growth of these new industries;
- the capacity to maximise benefit through intellectual property rights and other mechanisms to support development of these industries in Australia; and
- the impacts on and benefits to the environment.

Referred by the Minister for Agriculture, Fisheries and Forestry on 4 October 2000.



## List of abbreviations

AFFA	Department of Agriculture, Fisheries and Forestry - Australia
AZGU	AstraZeneca R&D Griffith University
ABBRC	Australian Biodiversity and Biodiscovery Resource Centre
AIMS	Australian Institute of Marine Science
API	Australian Property Institute
ARC	Australian Research Council
ASM	Australian Society for Microbiology
BA	Biotechnology Australia
CVP	Cellulose Valley Project
CALM	Department of Conservation and Land Management, Western Australia
CBD	Convention on Biological Diversity
CRC	cooperative research centre
EA	Environment Australia
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FAO	Food and Agriculture Organization of the United Nations
FIP	Farm Innovation Program

GMO	genetically modified organism
GBIF	Global Biodiversity Information Facility
IP	intellectual property
ISR	Department of Industry, Science and Resources
IUPGR	International Understanding on Plant Genetic Resources
JCU	James Cook University
MNRF	Major National Research Facilities
MTA	material transfer agreement
NBS	National Biotechnology Strategy
NDIP	New Industries Development Program
PBR	plant breeders rights
R&D	research and development
RIRDC	Rural Industries Research and Development Corporation
SCU	Southern Cross University
SCUCP	Southern Cross University Phytochemistry Centre
UQ	University of Queensland
WIPO	World Intellectual Property Organization



## List of recommendations

### Overcoming impediments in establishing Australian bioindustries

Recommendation 1 ..... 25

The committee recommends that the Commonwealth government:

- increase funding for baseline studies of the Australian biota;
- target additional funds for collecting activities in bioactive hot spots;
- fund a larger volume of taxonomic work than at present and ensure sufficient young taxonomists are being trained to undertake this work;
- provide more funding to maintain and expand existing collections so that they provide a comprehensive coverage of Australia's biota, including microorganisms; and
- ensure that commercial users contribute in kind or financially, through benefit sharing arrangements, to growing and maintaining collections and databases.

Recommendation 2 ..... 26

The committee recommends that the Commonwealth government provide additional funding for digitising and networking information about all of Australia's biological resources.

- Recommendation 3** ..... 27
- The committee recommends that the Commonwealth government, in consultation with state and territory governments, industry and the research community:
- develop a national strategy for bioinformatics; and
  - assist in funding its implementation so that the necessary infrastructure and skills are available to provide efficient access to information about Australia's biota.
- Recommendation 4** ..... 31
- The committee recommends that Biotechnology Australia and the Attorney-General's Department, in conjunction with the state and territory governments, ensure that information about the ownership of biological resources is compiled, and made publicly available as a single, easily accessible source.
- Recommendation 5** ..... 32
- The committee recommends that the Attorney-General ask the Australian Law Reform Commission:
- to inquire into the impact on the use of native biota of the different property rights regimes across Australia; and
  - to recommend on a nationally consistent regime that would facilitate this use, with due consideration of the wider ramifications of any changes.
- Recommendation 6** ..... 34
- The committee recommends that Environment Australia, in consultation with state and territory agencies:
- develop an electronic gateway to information about access arrangements in all jurisdictions; and
  - take a lead in coordinating the development of a simplified, streamlined system of applying for permits.
- Recommendation 7** ..... 50
- The committee recommends that the regulations governing access and benefit sharing under section 301 of the *Environment Protection and Biodiversity Conservation Act 1999* be subject to review after 12 months to ensure that they are not impeding the development of opportunities arising from bioprospecting.

---

**Recommendation 8 ..... 50**

The committee recommends that, when finalising the regulations under section 301 of the *Environment Protection and Biodiversity Conservation Act 1999*, the Commonwealth government:

- ensure that the regulations do not create new property rights;
- obtain a detailed regulatory impact statement; and
- examine fully the implications of the regulations for Australia's access to overseas plant genetic material.

**Recommendation 9 ..... 51**

The committee recommends that Environment Australia and the Department of Agriculture, Fisheries and Forestry - Australia give a high priority to:

- finalising the regulations on access to biological resources and the sharing of benefits from them, under section 301 of the *Environment Protection and Biodiversity Conservation Act 1999*; and
- working with state and territory governments to establish nationally consistent arrangements.

**Recommendation 10 ..... 52**

The committee recommends that, when granting access to biological resources, the Commonwealth government:

- ensure access for non commercial activities; and
- with commercial activities, ensure a balance between open competitive access and restricting access by granting exclusive use.

Exclusivity should be restricted by permit conditions such as duration, area or species collected, and uses to be explored.

**Recommendation 11 ..... 52**

The committee recommends that, when finalising benefit sharing arrangements, the Commonwealth government ensure that commercial activity is not discouraged by the benefits bioprospectors are required to provide.

When negotiating non monetary benefits, emphasis should be placed on providing support for regional development and the lodging of information and specimens in publicly accessible databases and collections (see recommendation 1).

- Recommendation 12** ..... 52
- The committee recommends that the *Environment Protection and Biodiversity Conservation Act 1999* be amended to extend export controls to all elements of Australia's non human, native biota, with particular reference to microorganisms.
- Recommendation 13** ..... 56
- The committee recommends that the Commonwealth government ensure that the major publicly funded research organisations are sufficiently well funded to purchase the equipment needed to meet present and future demands.
- Recommendation 14** ..... 59
- The committee recommends that the Commonwealth government facilitate the establishment of a national biotechnology transfer centre that should include scaling up facilities for bioprocessing.
- Recommendation 15** ..... 60
- The committee recommends that the Commonwealth government:
- audit the availability of skills needed in the biotechnology sector, including those required to develop bioindustries;
  - ensure that relevant training is available; and
  - promote uptake of training opportunities.
- Recommendation 16** ..... 61
- The committee recommends that the Commonwealth government:
- continue to provide extensive information about biotechnology in its public awareness program; and
  - ensure that the contribution of bioprospecting and biodiscovery to economic development is covered in this program, including the benefits that bioindustries offer to the environment, medicine and agriculture.

## Regional activity

- Recommendation 17** ..... 76
- The committee recommends that Biotechnology Australia make information about grant programs available on its web site in a clear and easily accessible form, and provide a link to the GrantsLINK web site.

---

**Recommendation 18 ..... 78**

The committee recommends that the Rural Industries Research and Development Corporation:

- aggregate funds into a specific program for researching and promoting the development of industries based on bioprospecting Australia's native biota and bioprocessing using introduced plants; and

- implement this program in the context of all the components of business development involved in establishing a new industry.

## Environmental impacts

**Recommendation 19 ..... 86**

The committee recommends that Environment Australia give a high priority to continuing its work with state and territory governments to develop a nationally consistent approach to establishing conservation areas that comprehensively cover all species and ecosystems.

## A national strategy for the development of new biobased industries

**Recommendation 20 ..... 91**

The committee recommends that:

- a national strategy be developed to promote bioprospecting, bioprocessing and the establishment of industries based on these activities; and

- Biotechnology Australia sponsor the development and implementation of the strategy.

The strategy should:

- indicate how bioprospecting will be used over the next two decades to contribute to existing industries and develop new ones;

- provide information about the government support available for bioproduct development, especially for the earlier stages in the bioproduct chain;

- promote collaboration and networking; and

- address biobased industry development in regional Australia.



**Recommendation 21 ..... 91**

The committee recommends that Biotechnology Australia be sufficiently funded to develop and implement the strategy.

**Recommendation 22 ..... 93**

The committee recommends that Department of Agriculture, Fisheries and Forestry - Australia:

- give a higher profile to promoting the development and establishment of industries based on bioprospecting and bioprocessing; and
- work closely with AusIndustry to promote opportunities for developing industries from bioprospecting and bioprocessing.



## Glossary

Bioactivity	An abbreviation of 'biological activity', meaning the elicitation of a biological response through modifying the function of an enzyme or receptor, or interfering with other physiological processes.
Biobased	An abbreviation of 'biologically based', meaning derived from organic matter.
Biodegradable	Describes any material able to be decomposed by natural biological processes, such as by being digested by bacteria or fungi.
Biodiscovery	The extraction and testing of molecules for biological activity, identification of compounds with promise for further development, and research on the molecular basis for the biological activity.
Biodiversity	The variety of the world's organisms, including their genetic diversity and the assemblages they form. The breadth of the concept reflects the interrelatedness of genes, species, and ecosystems.
Biofuel	An abbreviation of 'biomass fuel', meaning any liquid, solid, or gaseous fuel produced by conversion of biomass. Biofuels include ethanol, biodiesel, and methanol, methane, and hydrogen.
Bioindustry	An industry based on biodiscovery which has been successfully developed and scaled up for commercial production.
Bioinformatics	All aspects of gathering, storing, handling, analysing, interpreting and spreading vast amounts of biological information in databases. The information involved includes gene sequences, biological activity/function,

pharmacological activity, biological structure, molecular structure, protein-protein interactions, and gene expression. Bioinformatics uses powerful computers and statistical techniques to accomplish research objectives, for example, to discover a new pharmaceutical or herbicide.

Biological resources	Include genetic resources, organisms, parts of organisms, populations and any other biotic component of an ecosystem with actual or potential use or value for humanity.
Biomass	Any organic matter which is available on a renewable basis, grown by the photosynthetic conversion of solar energy (for example, by plants), and organic matter from animals. Biomass includes forest and mill residues, agricultural crops and wastes, wood and wood wastes, animal wastes, livestock operation residues, aquatic plants, fast-growing trees and plants, and municipal and industrial wastes.
Biomining	The use of microorganisms to aid recovery of metals from ores.
Biopesticide	A pesticide in which the active ingredient is a virus, fungus, bacterium, or parasitic disease, or a natural product derived from a plant source.
Biopolymer	A high molecular weight organic compound found in nature, whose structure can be represented by a repeated small unit. Common biopolymers include cellulose and proteins.
Bioprocessing	The use of biological materials, generally microorganisms or enzymes, to carry out specific chemical reactions for industry, for example, to extract, process or purify.
Bioproduct	Product derived from biological materials.
Bioprospecting	The search for valuable chemical compounds and genetic material from plants, animals and microorganisms. The term is sometimes used more narrowly to refer only to the initial collection of biological material for subsequent use for biodiscovery,

---

	or more broadly to include the search for new bush foods.
Bioreactor	A contained vessel or other structure in which chemical reactions are carried out (usually on an industrial scale), mediated by a biological system, enzymes or cells. They are used to produce pharmaceuticals, antibodies, or vaccines, or for the bioconversion of organic waste.
Bioregion	An area of land or sea composed of ecosystems that occur in a repeating pattern throughout the region and can be distinguished from other regions with different patterns. They are described in terms of the dominant physical and biological attributes of the region (for example, climate, landform, vegetation, ocean currents, sea temperatures and salinities).
Bioremediation	The use of plants and microorganisms to consume or otherwise help remove materials (such as toxic chemical wastes and metals) from contaminated sites (especially from soil and water).
Biota	The combined flora and fauna of a region.
Biotechnology	The application of science and engineering principles to the processing of materials by biological agents to provide goods and services.
Bryozoan	Any of various small aquatic animals of the phylum Bryozoa that reproduce by budding and form mosslike or branching colonies permanently attached to stones or seaweed.
Combinatorial chemistry	The technologies that generate a large number of samples of (new) chemicals, which are then tested (screened) for potential use (for example, for therapeutic effect, in the case of a pharmaceutical).
Ecology	The study of the interrelationships between organisms and their environment.
Ecosystem	All of the organisms in a given area in interaction with their non-living environment.
Endemism	Being indigenous to only a specified area.

Enzymes	Proteins that act as catalysts, speeding the rate at which biochemical reactions proceed but not altering the direction or nature of the reactions.
Extremophiles	Organisms that require extreme (from a human perspective) environments for growth. They are found in environments characterised by <u>high</u> temperature, pH, pressure and salt concentration, or <u>low</u> temperature, pH, nutrient concentration, or water availability. Some can tolerate very extreme conditions including high levels of radiation or toxic compounds, or live in rocks 1.5 km below the surface of the earth. In addition, they may be found in environments with a combination of extreme conditions.
Fermenter	An apparatus that maintains optimal conditions for the growth of microorganisms. Fermenters exist in a wide variety of configurations, from experimental systems of less than one litre to large commercial towers, and are used in the commercial production of antibiotics and hormones.
Functional food	A food that has beneficial effects on target functions in the body, beyond adequate nutritional effects, in a way that is relevant to health and well-being and/or reduction in disease.
Gene	Each of the units of heredity which may be regarded as the controlling agents in the expression of single phenotypic characters. Genes are sequences of nucleotides within nucleic acid molecules, each of which determines the primary structure of some protein or polypeptide molecule.
Metabolism	The sum of all of the enzyme-catalysed reactions in living cells that transform organic molecules. The term covers the conversion of food and water into nutrients that can be used by cells, <i>and</i> the use of those nutrients by those cells (for example, to sustain life and grow).
Microorganism	An organism of microscopic or submicroscopic size, especially a bacterium or protozoan.
Nutraceutical	Any non-toxic food extract that is used as a dietary supplement and has scientifically proven health benefits for both disease treatment and prevention. In

---

	some uses of the term, whole diets; isolated nutrients; designer, biotechnology-enhanced foods; and functional foods are included.
Pathogen	A virus, bacterium, parasitic protozoan, or other microorganism that causes infectious disease by invading the body of an organism known as the host.
Peptide	Two or more amino acids joined by the sharing of one or more electrons between atoms. Polypeptides (protein) are chains of amino acids linked in this way. Each protein in nature is the ultimate expression product of a gene.
Petrochemical	A chemical derived from petroleum or natural gas.
Pharmaceutical	Relating to preparing and dispensing drugs.
Platform technology	A technology likely to have many applications. An example is a technology that links drugs with specialised fats to facilitate delivery of drugs and genes into cells could significantly enhance therapy in a number of human diseases.
Polyester	Any of numerous synthetic polymers in which the units are joined by ester linkages. Polyesters are used primarily as light, strong, weather-resistant resins in boat hulls, textile fibres, adhesives, and moulded parts.
Ramsar wetlands	Wetlands listed as internationally significant under the Convention on Wetlands of International Importance. This convention is known as the 'Ramsar Convention' after the city in which it was finalised.
Scale up	The transition step in moving a (chemical) process from experimental (test tube, small, bench) scale to a larger scale producing more or much more product than the bench scale (tons/year in a chemical plant). A process may require a number of scale-ups, with each scale-up producing more product than the last one.
Taxonomy	Theories and techniques of naming, describing, and classifying organisms. The taxonomic hierarchy is, from top to bottom: kingdom, phylum (for animals) or division (for plants and fungi), class, order, family, genus, species.

- Sources: *Academic Press Dictionary of Science and Technology*, Harcourt,  
<http://www.harcourt.com/dictionary/>.
- Adams, C, Acting Chief Executive, CSIRO, *Business Review Weekly*,  
v. 22(13), 7 April 2000, p. 46.
- Bioenergy glossary,  
[http://rredc.nrel.gov/biomass/states/bio\\_glossary/glossary.html](http://rredc.nrel.gov/biomass/states/bio_glossary/glossary.html).
- BiotechLife Science Dictionary,  
<http://biotech.icmb.utexas.edu/search/dict-search.phtml>.
- Cavicchioli, R. and Thomas, T. 2000. Extremophiles. In *Encyclopedia of Microbiology, Second Edition* (J. Lederberg, ed.), Vol. 2, pp. 317-337. Academic Press, San Diego.
- CSIRO briefing for the committee, 27 November 2000.
- Environment Protection and Biodiversity Conservation Act 1999*.
- Nil, K R, *Glossary of Biotechnological Terms*, Technomic Publishing, 2001, <http://biotechterms.org/>.
- Oxford English Dictionary*.
- Pacific Northwest National Laboratory and Battelle Pacific Northwest Division, <http://bioprocess.pnl.gov/>.
- ten Kate, K & Laird, S A, *The Commercial Use of Biodiversity: Access to Genetic Resources and Benefit-Sharing*, Earthscan Publications, London, 1999.
- Australian Nature Conservation Agency, Canberra, *The American Heritage® Dictionary of the English Language*, Fourth Edition, <http://www.dictionary.com/>.
- US Department of Energy, 'Glossary of energy terms', <http://www.eren.doe.gov/consumerinfo/glossary.html>.
- Wondur Holdings Pty Ltd, *New Pharmaceutical, Nutraceutical & Industrial Products: The Potential for Australian Agriculture*, Rural Industries Research and Development Corporation, November 2000.
- World Resources Institute, Washington, DC.