Title	NSW Biodiversity Modelling Tools
Abstract	A suite of spatial biodiversity modelling tools including software and code developed and maintained by NSW DCCEEW's Metrics and Forecasting Ecological Modelling Team (EMT).
	The EMT are part of the Science Impact and Assessment Branch in the New South Wales (NSW) Department of Climate Change, Energy, the Environment and Water's (DCCEEW's) Science and Insights Division. EMT deliver spatial biodiversity modelling methods, tools and information used to assess and improve biodiversity outcomes in NSW, Australia.
	Biodiversity modelling tools including software and code developed and maintained by the EMT and used by DCCEEW in NSW are being published here in the hope that they may have broader application within and beyond NSW.
	All software and code are Copyright(C) 2024 State of New South Wales and Department of Climate Change, Energy, the Environment and Water (DCCEEW) and are published here under version 3 of the GNU General Public Licence.
	All software and code are provided in the hope that they will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
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	Methods
	The software and code implement the following published spatial biodiversity modelling methods and tools:
	Spatial Links Tool (1).
	Spatial Cost Benefit Approach (2).
	 Generalised Landscape Connectivity Model (3).
	 Biodiversity Forecasting Tool (4).
	 Rapid Evaluation of Metapopulation Persistence (5, 6).
	Refer to the papers below for technical descriptions of these methods and their application.
	These methods have supported state and regional biodiversity assessments including regional conservation initiatives, habitat connectivity, native vegetation management, threatened species and climate impact assessments. Most recently, they have underpinned biodiversity and ecological integrity indicators published under the Biodiversity Indicator Program (BIP) and are currently supporting Saving our Species investment in landscape managed species.
	Adoption of these methods extend beyond NSW with use in external government and research programs. Examples include the Queensland Government's Spatial Biocondition method, and the Australian Department of Climate Change, Energy, the Environment and Water's National Connectivity Index; as well as collaborative research with CSIRO, the University of New England, Macquarie University and the University of Queensland.
	Software and code
	These related and interdependent tools are packaged together in a single 'Biodiversity Tools' software package. The software is written in C++ and makes use of Nvidia's CUDA graphics processing capabilities. When built, the software package contains binary executable console applications for the above methods and tools, along with static and dynamic software libraries required to implement the methods.
	The tools operate on spatial raster data stored in ESRI's floating point file format (fit

The tools operate on spatial raster data stored in ESRI's floating point file format (.flt, .hdr) however GeoTiff support is gradually being implemented across tools along with other improvements as time permits. Each of the console applications process plain text parameter (.par) files defining inputs, outputs and parameters. Template parameter files containing parameter descriptions can be created by passing the applications a parameter filename that doesn't already exist.

Whilst originally developed and maintained for the Windows OS environment only, a cmake build system (<u>https://cmake.org/</u>) has recently been adopted and the software has been modified to build and run in both Windows and Linux environments.

Development and testing in Linux is still ongoing.

The software is written using features from the ISO C++17 standard and relies on the following 3rd party software libraries for various functionality.

- GDAL <u>https://gdal.org/index.html https://gdal.org/license.html</u>
- Nvidia <u>https://developer.nvidia.com/cuda-toolkit</u> <u>https://docs.nvidia.com/cuda/eula/index.html</u>

All tools except Spatial Links require a CUDA compatible Nvidia graphics processing (GPU) device (graphics card). A list of compatible devices can be found at:

https://developer.nvidia.com/cuda-gpus

Running the software

The software once built consists of a set of console applications and supporting library files. Each application takes the path of a parameter file as its command line argument. The parameter file is processed if it exists otherwise it is created as a template. Template parameter files for each application list all required and optional parameters with brief descriptions.

Examples

Simple example parameter files and data are provided in the Examples folder. These can be used to test software compilation and execution and explore different parameter settings for each of the console applications. This data is also being used to test changes to the code.

Code access

The source code for this software package is available via GitHub:

https://github.com/EM-MAF-NSW-DCCEEW/BiodiversityTools

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Licence

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https://www.gnu.org/licenses/gpl-3.0.txt

References

(1) The spatial links tool: Automated mapping of habitat linkages in variegated landscapes. Michael Drielsma, Glenn Manion, Simon Ferrier, 2007. Ecological Modelling, Volume 200, Issues 3-4, Pages 403-411, ISSN 0304-3800. https://doi.org/10.1016/j.ecolmodel.2006.08.017

(2) A raster-based technique for analysing habitat configuration: The cost-benefit approach. Michael Drielsma, Simon Ferrier, Glenn Manion, 2007. Ecological Modelling, Volume 202, Issues 3–4, Pages 324-332, ISSN 0304-3800. https://doi.org/10.1016/j.ecolmodel.2006.10.016

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(5) Rapid evaluation of metapopulation persistence in highly variegated landscapes. Michael Drielsma, Simon Ferrier, 2009. Biological Conservation, Volume 142, Issue 3, Pages 529-540, ISSN 0006-3207. <u>https://doi.org/10.1016/j.biocon.2008.11.018</u>

(6) An equitable method for evaluating habitat amount and potential occupancy. Drielsma M, & Love J, 2021. Ecological Modelling, Vol.440, pp.109388.

	nttps://doi.org/10.1016/j.ecoimodei.2020.109388		
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Data Quality Statement Biodiversity Modelling Tools V20250130 (Current)	Name: Data Quality Statement		
	Protocol: WWW:DOWNLOAD-1.0-httpdownload		
	Description:		
	Data quality statement for NSW Biodiversity Modelling Tools		
	Function: download		
	Name: Biodiversity Modelling Tools V20250130 (Current)		
	Protocol: WWW:DOWNLOAD-1.0-httpdownload		
	Description:		
	A suite of spatial biodiversity modelling tools including software developed and maintained by NSW DCCEEW's Metrics and Forecasting Ecological Modelling Team.		
	Current Windows x64 version packaged on the 31/01/2025		
	Function: download		
Unique resource identifier			
Code	dbb35507-009f-4d50-97f6-f1466cb4e215		
Presentation form	Document digital		
Edition	20250130		
Dataset language	English		
Metadata standard			
Name	ISO 19115		
Edition	2016		
Dataset URI	https://datasets.seed.nsw.gov.au/dataset/dbb35507-009f-4d50-97f6-f1466cb4e215		
Purpose	Biodiversity - Conservation planning and climate adaptation		
Status	On going		
Spatial representation type	None		
Spatial reference system			
Code identifying the spatial reference system	4283		
Topic category			

Keyword set				
keyword value	VEGETATION			
	FLORA			
	FAUNA			
	ECOLOGY-Ecosystem			
Originating controlled vocabulary				
Title	ANZLIC Search Words			
Reference date	2008-05-16			
Geographic location				
West bounding longitude	138			
East bounding longitude	155			
North bounding latitude	-38			
South bounding latitude	-27			
NSW Place Name	NA			
Vertical extent information				
Minimum value	-100			
Maximum value	2228			
Coordinate reference system				
Authority code	urn:ogc:def:cs:EPSG::			
Code identifying the coordinate reference system	5711			
Temporal extent				
Begin position	2023-02-27			
End position	N/A			
Dataset reference date				
Resource maintenance				
Maintenance and update frequency	As needed			
Contact info				
Contact position	Data Broker			
Organisation name	NSW Department of Climate Change, Energy, the Environment and Water			
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Web address	https://www.nsw.gov.au/departments-and-agencies/dcceew			
Responsible party role	pointOfContact			

Limitations on public access			
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Metadata point of contact			
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Responsible party role	pointOfContact		
Metadata date	2025-04-09T00:35:23.841488		
Metadata language			