

Everything you wanted to know about MARXAN but were afraid to ask

Hugh Possingham

Director, Centre for Applied Environmental Decision Analysis
Professor, Department of Mathematics
Professor, School of Integrative Biology

αεδα



the ecology centre
university of queensland
australia
www.uq.edu.au/spatialecology

Spatial Ecology Lab – 50 Quantitative Ecologists



and Eddie Game
and Hedley Grantham
and Bob Pressey
and Carissa Klein
and Matthew Watts
and Rom Stewart
and ...

Overview

- History of Marxan
- Frequently Asked Questions
- Marxan Developments

Brief History

- 1992 - I get interested in conservation planning
- 1994 - Ian Ball starts his PhD with me at The University of Adelaide
- DEH (Andrew Taplin) and other supporters
- SPEXAN, SITES, and SPOT and other unfortunate event
- Front ends: CLUZ, P.A.N.D.A., teaching and other tools
- Now, in Matt Watt's hands

FAQs – Why Marxan?

- Why don't we just use scoring systems again?
- What problem is MARXAN solving? This is the key!

Mathematical Formulation

Minimise $\sum_{j=1}^m c_j x_j + \alpha \cdot \text{BoundaryLength}$

Subject to $\sum_{j=1}^n a_{ij} x_j \geq 1 \quad i = 1, \dots, m$

$x_j \in \{0, 1\}$ a_{ij} = amount of feature i in
planning unit j

$x_j = 1$ if the planning unit is in the reserve system

FAQs – Why Marxan?

- Simulated annealing is very crude – can't you morons do any better?
- But ecological “models” aren't very good, why should I trust MARXAN?
 - Models, algorithms and problems
- My species has 17 young in leap years – can your software include that?

FAQs – General

- What is appropriate spatial scale (planning units and region?)
- How can I engage stakeholders with MARXAN?
- Could you make it easier to use?
- Why should I trust this “black box” called Marxan?
- Not all of us have GBR quality/quantity data, how do you use Marxan in a data poor region?

FAQs – Functionality

- Why doesn't anyone use the risk spreading, size, or spacing functionalities in Marxan?
- The BLM seems arbitrary, how should I set my BLM?
- Can we use MARXAN iteratively? (i.e. locking in sites, and rerunning)
- Why can't you nerds figure out how to incorporate connectivity, as it is essential in marine systems?

FAQs – Planning Unit Costs

- What is summed irreplaceability and how should I use it?
- Is the cost of a planning unit its area?
- Can I include multiple costs?
- MARXAN is based on economic principles but look where economics has got us

FAQs – and the list goes on...

- What if we solve the problem now with 10% targets and 10 years later we go to set 20% targets, wont that be inefficient?
- Why does MARXAN best solutions have the odd scattered PU - cant we get rid of them?

Marxan Developments

- Using cluster analysis and ordination to find very different individual solutions (Stewart, Watts, Klein, Linke - TNC)
- Incorporating Threats – Eddie Game et al
- Dynamic conservation planning with threat – a solution to Meir et al 2004 (Ecology Letters)
- Marxan Optimized (VERY large datasets)
- Zoning, **MARZONE** (a sister not successor) and the general Conservation Resource Allocation Problem

UQ is a research institute not a software provider

Collaborations

Department of Conservation (NZ)



Department of Environment and Heritage (Au)



Ecotrust (USA)



Natural Heritage Trust (Au)



Ontario Ministry of Natural Resources (Canada)



The Nature Conservancy



UC Santa Barbara

