Modeling for decision-support

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LET’S BEGIN WITH BAD EXAMPLES

Collapse, past and future (?)

COFFEE AT VALE DO PARAÍBA, SP, BRAZIL

The collapse of a number 1 in the world economy

Coffee farm, Vale do Paraíba, SP, 19th C

Coffee plantation, horizontal lines

Innovation came with planting along vertical lines

This allowed more slaves to be controlled by a single foreman, reducing production cost and increased yield.

In late 19thC, the Vale do Paraíba became the N.1 coffee exporter in the world.

But…!

Who would know that planting along vertical lines was causing an inexorable loss of soil nutrients?

Predominant cover type of nowadays

THE UK LANDSCAPE

Thousands of years of unsustainable exploitation

A historical perspective on deforestation in Europe

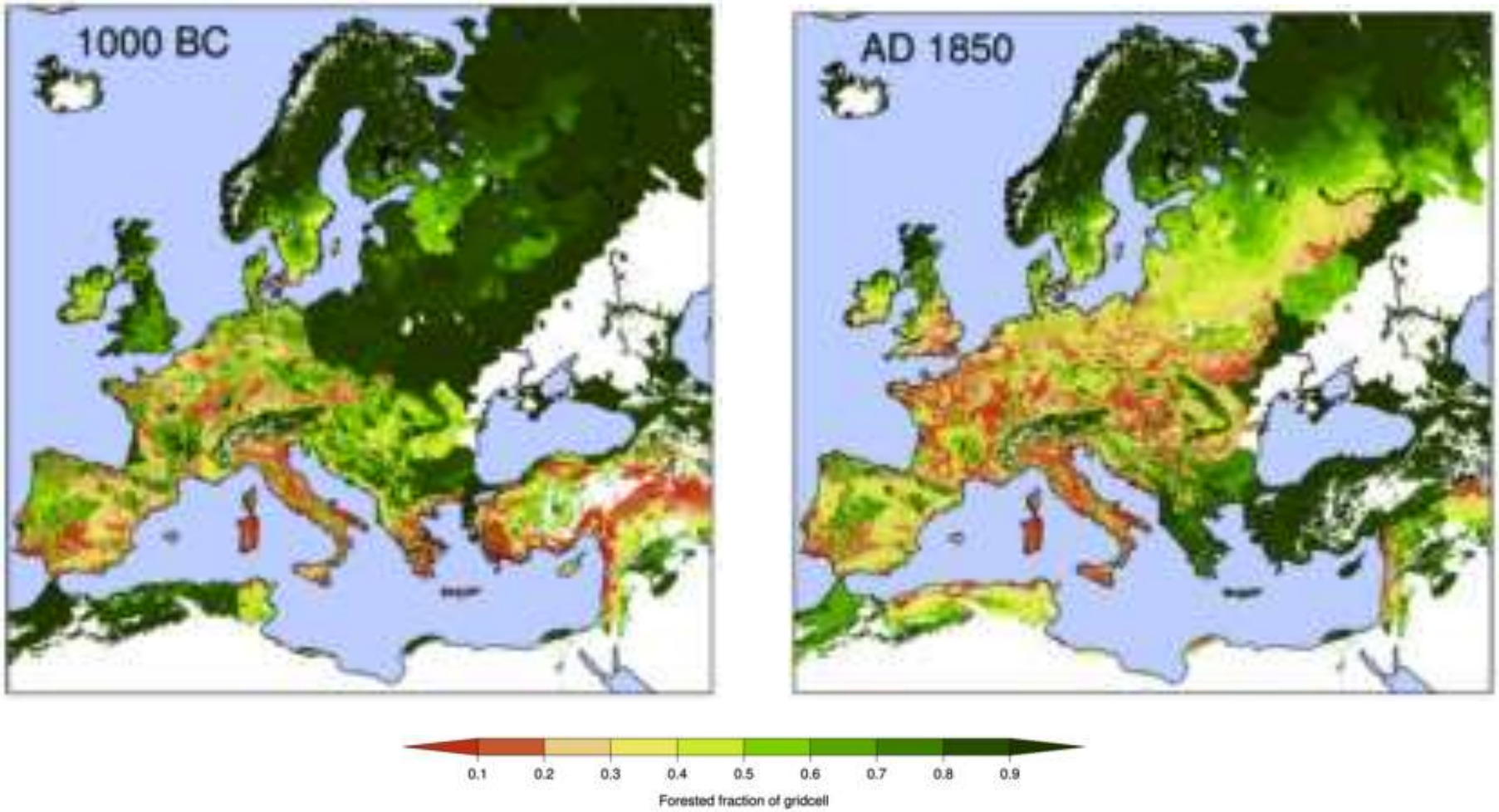
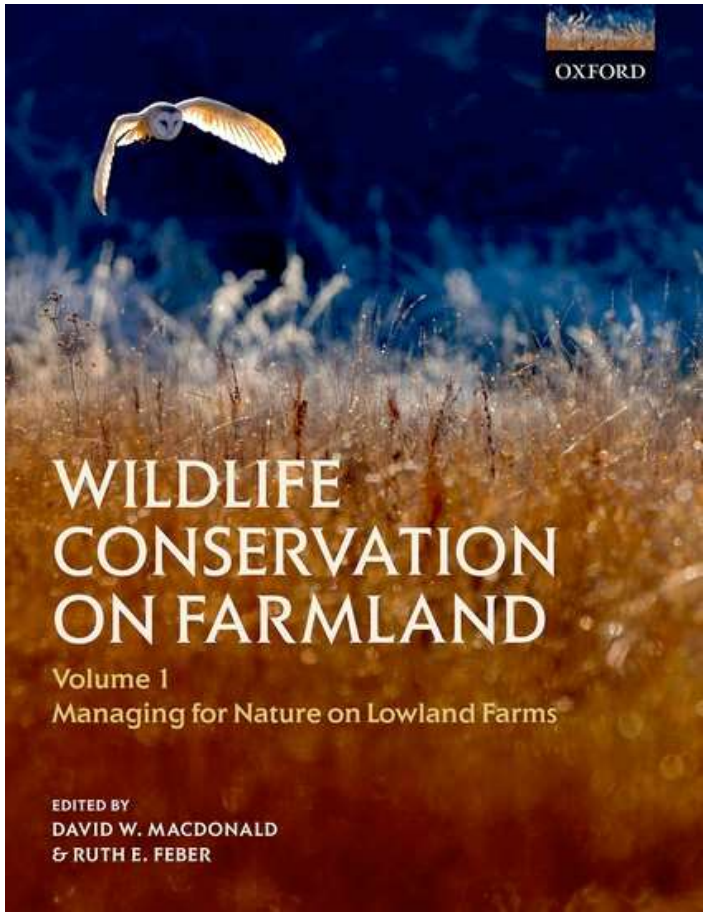


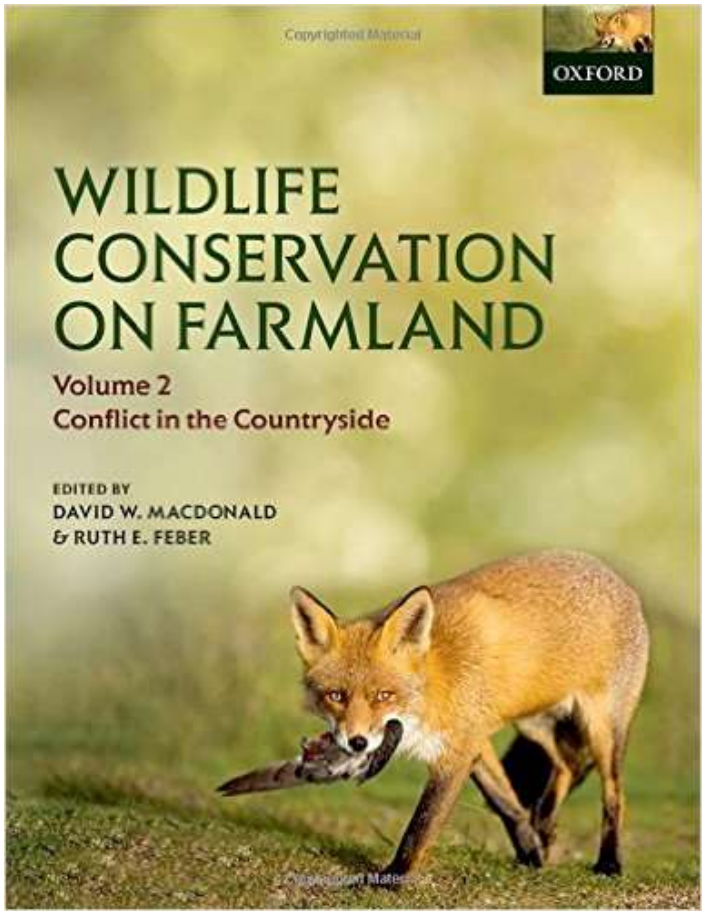
Fig. 7. Historical forest clearance maps generated by the technological change scenario version of the preindustrial anthropogenic deforestation model with the same presentation as in Fig. 6.

Large fauna driven to extinction in Britain

Popular name	Scientific name	Extinction date	Probable cause
Lynx	*Lynx lynx*	200 A.D.	Over-hunting
Brown bear	*Ursus arctos*	500 A.D.	Over-hunting
Beaver	*Castor fiber*	1300 A.D.	Over-hunting
Wild board	*Sus scrofa*	1500 A.D.	Over-hunting
Wolf	*Canis lupus*	1700 A.D.	Over-hunting
Muskrat	*Ondatra zibethicus*	1935 A.D.	Over-hunting
Coypu (roedor)	*Myocastor coypus*	1987 A.D.	Over-hunting

Source: A Short History of the British Mammal Fauna





Conflict with people, invasive species, agricultural pests, disease transmission, etc…

Some UK biodiversity-related issues

Brown rat (*Rattus norvegicus*)
Issue: agricultural pest

Badger (*Meles meles*)
Issue: bovine Tb

Grey squirrel (*Sciurus carolinensis*)
Issue: displacing native red squirrel

Am crayfish (*Pacifastacus leniusculus*)
Issue: displacing native crayfish

So, achieving this…

has been costing this…

The guy is the UK government and each coloured ball is a recurrent problem

Main message and questions

- The same innovation that catapults a system to the skies might inexorably lead it to collapse.

- When all appears extremely well, how to foresee demise?
- When all appears extremely well, how to convince ‘others’ that the system WILL collapse?

As answering questions like these requires collecting, synthesizing, simulating or exchanging data and information in ways that surpass human capabilities, scientific modelling is a valuable tool.

A side note: a proposal, or perhaps an appeal…

That here, at SUME, we **abandon the notions** of ‘Developed’ and ‘Developing countries’, ‘First’ and ‘Third world’, ‘Global north’ and ‘Global south’, and all other similar deliriums…

Let’s perhaps simply focus on the problems and examples of success or failure, wherever and from whichever culture they come from.

NOW, TO THE GOOD EXAMPLES

Modeling for decision-support

GREY PARTRIDGE MANAGEMENT IN THE UK

Background

- “In the UK, numbers of grey partridges have declined by over 80% during the last 25 years, and in many parts of the country the species has become locally extinct. Concerns over the magnitude of the decline led the UK Government to place the species on the short list of the UK Biodiversity Action Plan (BAP) for which the Game & Wildlife Conservation Trust was appointed lead partner in 1996.”

- The killing of Grey partridges for sport or food is historical in the UK and as of today there is a vivid economic system that relies on it.

Scientific challenge

- Estimate quotas for grey partridge (*Perdix perdix*) re-establishment, differentiating between areas where they're still present or where none or very few persist.
- Increase reproductive rate and decrease death rate

- Impact: species conservation and improvement of economic system

Data and method

- 26 sites split between East Anglia and southern England
- Fates and breeding success of 2,023 released grey partridges, of which 131 were radio-tagged (at one site per region).
- Experiments comparing five different releasing techniques.

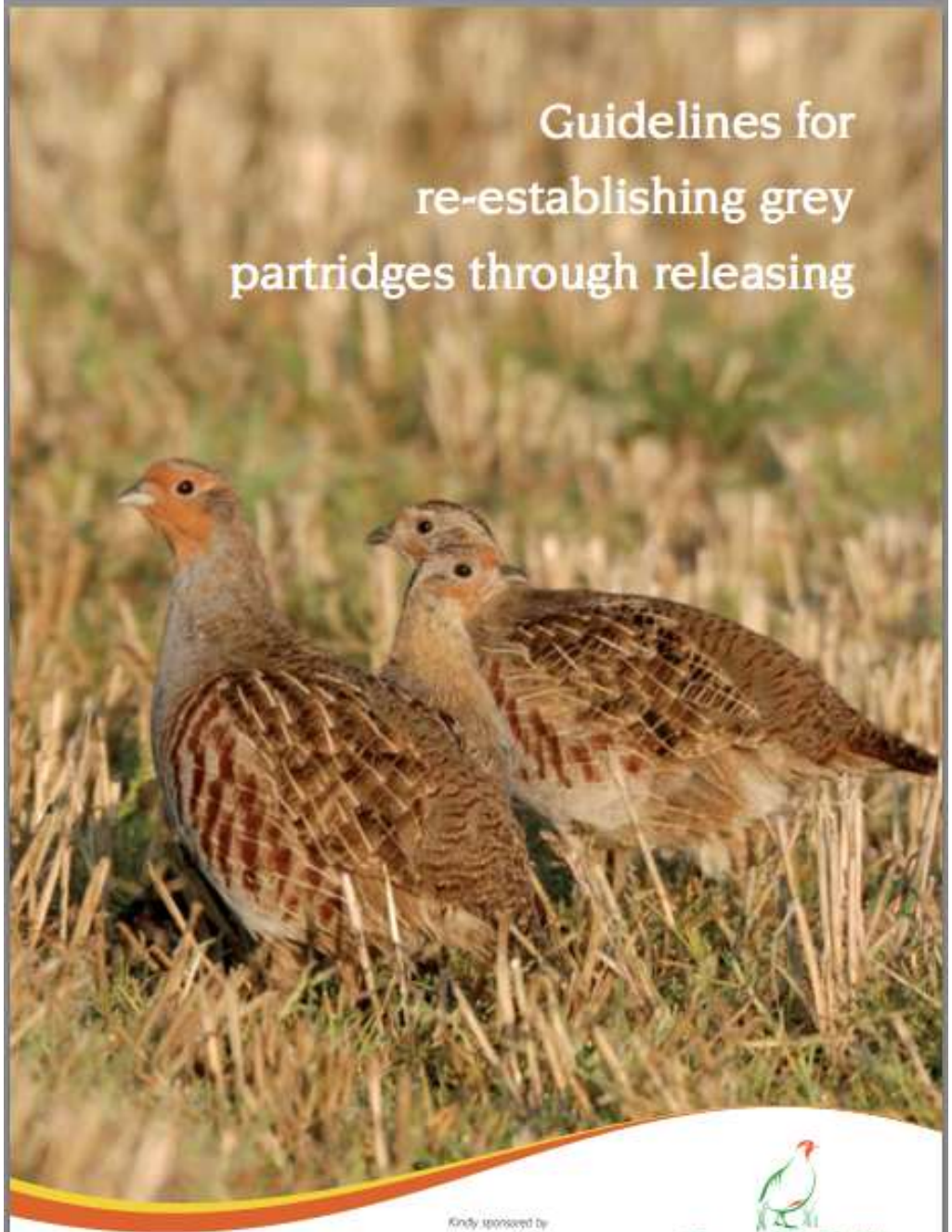
www.Perdixnet.org

assistido por

Game & Wildlife CONSERVATION TRUST

IUCN

Guidelines for re-establishing grey partridges through releasing



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www.gct.org.uk

From general guidelines…

Part one

Guidelines for grey partridge re-establishment

1.1. Is releasing appropriate?

The successful re-establishment of grey partridges through releasing is a serious affair. Grey partridge re-establishment efforts are lengthy, labour-intensive and expensive operations with no guarantee of success.

When is releasing appropriate as a means of re-establishing grey partridges on a piece of land? We know from our Grey Partridge Recovery Project at Royston, in Hertfordshire that, from a starting density of 2.9 pairs/km², it is possible to exceed 18 pairs/km² in five years with the correct management (see our leaflet The grey partridge recovery project for more information). As a result, our first guideline is:

'Where grey partridges are *still present* (over two pairs/km² on at least 4km² or 400 hectares), *releasing is inappropriate*.'

Partridge Count Scheme

Join the Partridge Count Scheme (PCS) and be part of one of the largest farmerled monitoring schemes in Europe. It provides free feedback on your count data to highlight where management may be improved. PCS members have seen a 38% increase in pairs since 2000 to 2005 compared with an ongoing national decline of 12%.

For further information or to join, please contact us on 01425 651066, or email partridgecountscheme@gct.org.uk

Where grey partridges are still present (over two pairs/km² on at least 4km² or 400 hectares), releasing is inappropriate. Instead, partridge recovery can and should be brought about solely through habitat improvements and predator management. Over the past 30 years, our research has provided practical recommendations addressing nesting, brood-rearing and over-winter habitats, together with food and predator management. Taken together, this is the strategy that has been so effective at Royston.

By inference, releasing is appropriate only where there are no or very few grey partridges still present (under two pairs/km² on at least 4km² or 400 hectares). Even where it is appropriate, we cannot over stress that releasing is only one component along the way to re-establishing grey partridges successfully. The same issues of habitat improvement, food and predator management apply as above. These **must** be addressed and detailed **advice sought** before re-establishment through releases is attempted. Attempts to re-establish birds in areas of unsuitable habitat contravene IUCN guidelines, and will fail and discredit the practice.

The first step towards re-establishing grey partridges on a piece of land must therefore be a systematic count to determine the number present, and hence the density. We strongly recommend joining our free Partridge Count Scheme (see box) for advice on how to count grey partridges effectively.

In the following three sections, we review the measures that are crucially important to have in place for re-establishment, whether it is through recovery of grey partridges that are already present or through releasing where they are not.

…to detailed suggestions

1.5. Tips and tricks - releasing

General code of practice

- Never release birds into unsuitable habitat.
- Never release sick or unhealthy-looking birds. If in doubt seek your local veterinary surgeon's advice.
- Aim for best quality. Best quality birds are wild birds, followed by parent-reared birds (reared and hatched by captive grey partridge parents), then bantam-reared birds and artificially-reared birds (eggs hatched in an incubator and kept in groups of no more than 17 individuals).
- Never release tame birds.
- Always provide food, water, grit and shelter in release pens (for more details see page 12).

Fostering

Tip 1. Never release the juveniles if there is no sign of a foster parent as they stand very little chance of survival.

- Before moving your juveniles to the release site, identify the location of free-living barren birds.
- Place your release pen (an A-frame or a framed pen that can be easily lifted and moved, see Appendix) together with just three to five juveniles, where you have seen or where you suspect barren adults. Always provide food, water and shelter and check daily.
- Once a barren bird, pair or group has approached the juveniles and seems to be keen to adopt them, add the remaining juveniles to the release pen.

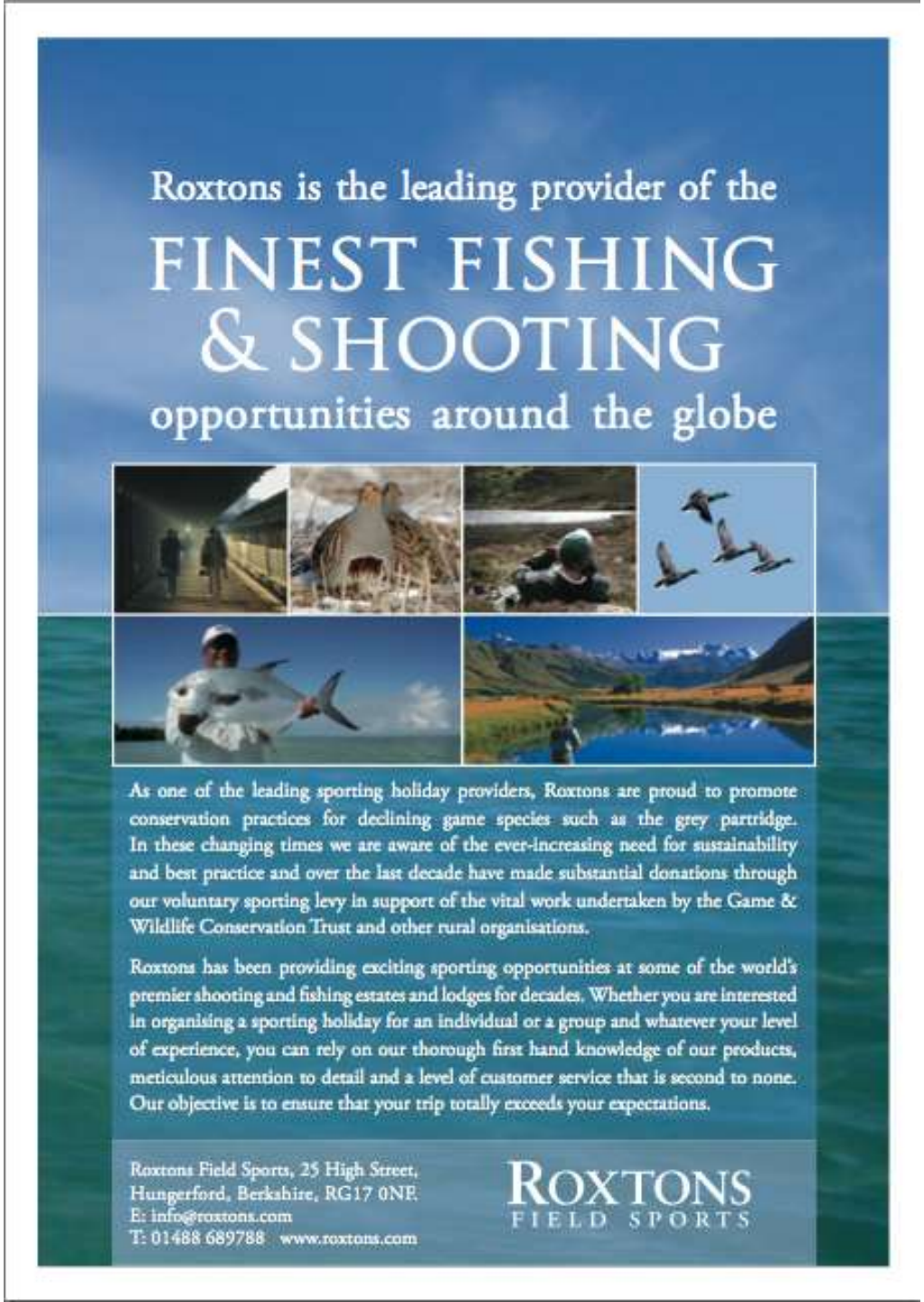
Tip 2. Make sure the foster parents are keen to adopt the juveniles. If there is no bond, the juveniles will most probably die and all your efforts will be for nothing.

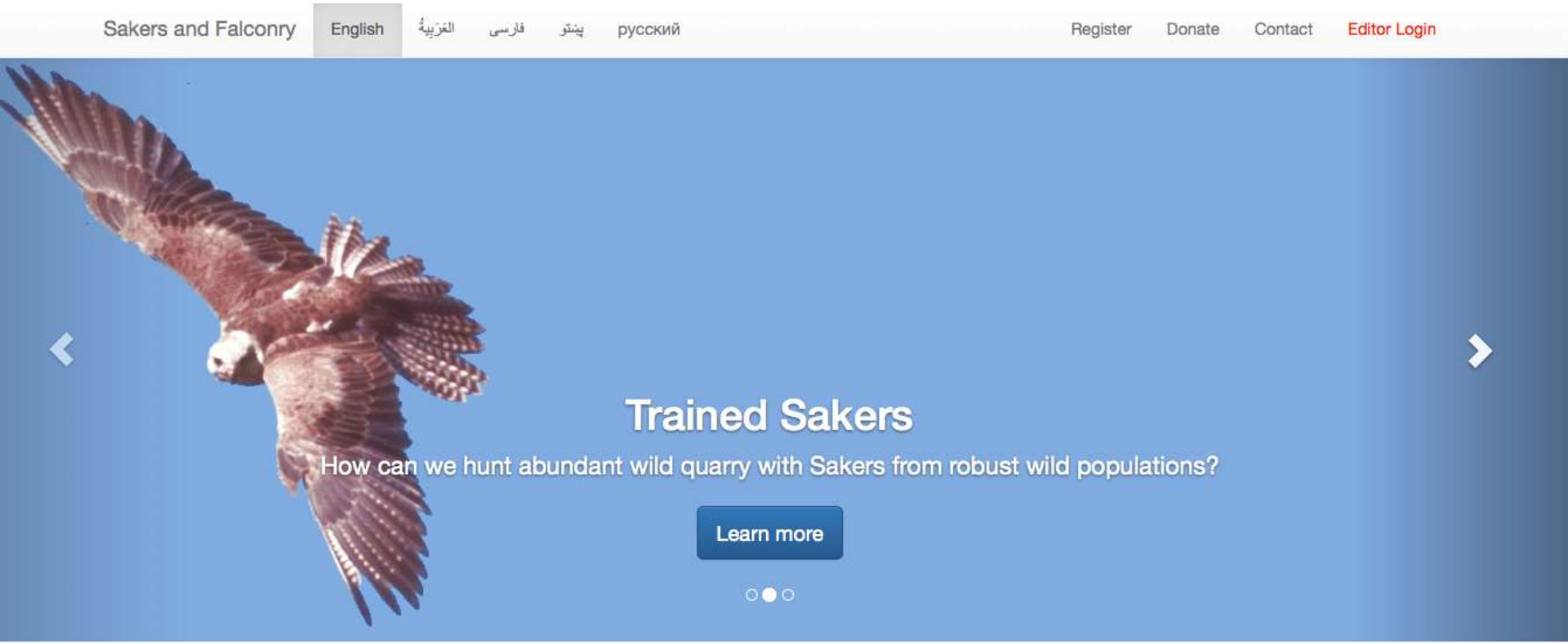
- Once you notice at least one adult bird around your release pen, watch from a vehicle at a safe distance. Keen adults will try to find a way into the pen and 'talk' to the juveniles. The juveniles in turn will respond by calling. If you observe such behaviour, leave the birds alone and come back the next day.

(Above and below) Wild barren grey partridges are usually very keen to adopt juveniles.

If fostered correctly, juveniles and foster parents will bond immediately after the juveniles have been released. © Markus Jenny

The loop with the political and economic systems was closed, making the project viable





SAKER FALCON MANAGEMENT IN KAZAKH

Example of decision-support at central level, based on a vertical network and via provision of user quotas from harvest models

Scientific challenge

- Estimate harvesting quotas for Saker falcons

- Impact: species conservation and improvement of economic system

Survival rates

	Original Kazakhstan Data	European Plausible Survival	Asian Plausible Survival
survival rate to 9 months	23%	*50%*	*50%*
survival rate 10-21 months	82%	*65%*	*65%*
survival rate 3+ year	82%	80%	80%
expected breeding rate for single adult	**65%**	**57%**	**42%**
young produced per pair that lay eggs	3.10	2.20	3.00
harvest rate of juveniles	0%	0%	0%

Wild Sakers

Saker Males and Females, Adults and Young

Sakers are the second largest falcon in the world, larger than the peregrine but smaller than the gyrfalcon. In all three sorts of falcon, the large ones are usually female and the small ones males. This makes the female better able to lay up to 6 substantial eggs and to defend the young from threats like large owls, while the smaller male is more agile and does most of the hunting until young are quite well grown. The adult Sakers are very variable in colour, even within the same region, but generally have paler plumage than younger birds, with stronger yellow on their feet and base of the beak, which can be grey tinged in juveniles and even blue when in the nest.

Like other falcons, Sakers don't build their own nests, but use ledges on cliffs that foxes cannot climb, or nests that were built by other birds in trees. The prey types during breeding are both birds and rodents, especially ground squirrels. Where rodents are abundant, and nest sites few so that there is little competition from other sakers, broods of five young are quite common.

Saker breeding landscapes in Central Asia

Safe Breeding Areas for Sakers

A clutch of 5 Saker eggs on a cliff ledge

Breeding areas with safe nests and abundant prey are very important for the wild Sakers, and therefore also for the falconers who wish to hunt with them, and for the trappers who supply those falconers. So too are the adult falcons, because fewer than half the young survive to breed and as much as a fifth of adults may die from accidents or disease each year. It is therefore very important for local people in breeding areas to be helped to protect the falcons, their nests and food. Trapping adult falcons in breeding areas is a grave mistake, like killing the nanny goats that give milk and kids each year. The breeding adult falcons should be left to rear their young.

When the young are about 6 weeks old, they leave the nest. At first they remain quite close to the nest, and are quite vulnerable to predators. However, when their flight feathers become hard they can fly several kilometres, out to where their parents are hunting. Three or four weeks after leaving the nest they can fly strongly. They then strike out on their own, often travelling many kilometres in all directions before any migration happens.

Healthy Sakers

Home
Wild Sakers
Migration
Healthy Sakers
Falcon Hospitals
Trained Sakers
Falconry
Survey Results

Avoid Aspergillosis

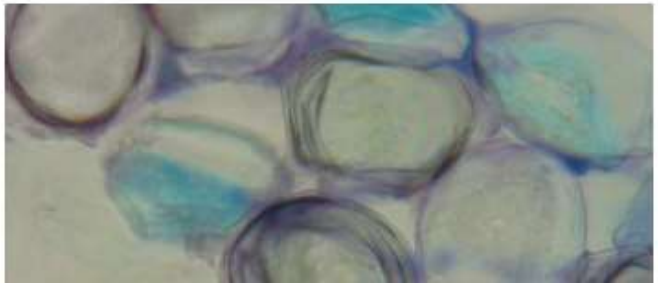
This common disease of falcons often causes death in captivity. Symptoms are heavy breathing, not flying well, frequent vomiting, loss of appetite, falling weight, and green faeces. Aspergillosis occurs when falcons inhale fungus spores which can be found in the air and in the soil. The fungus spores then reach the airsacs and cause an infection. Aspergillosis can be cured if detected early, but curing is not easy. Therefore it is wise to get a new falcon checked for aspergillosis. If you suspect your trained falcon is suffering from aspergillosis, immediately visit your vet.

Falcons are at risk of Aspergillosis at any time of year when sick, weak, or under stress. Stress can be caused by being kept in dark, humid or hot rooms with dust due to insufficient air ventilation, or by increased training without enough food, or by long travelling hours and distance, especially with changes in climate.

To prevent Aspergillosis, keep your falcon in a clean place without stress; feed a balanced diet of bones, feathers and fur; never keep healthy falcons and sick falcons in the same room.

Asperillosis can be diagnosed at a Falcon Hospital by a safe internal examination using an endoscope.

Check for Serratospiculum



One of the major diseases in falcons in the Middle East is the invasion of lungworms, the so-called Serratospiculum, into the airsacs. These worms are common in subtropical and tropical regions and wild Sakers have often caught them in the wild in their countries of origin. The worms come from beetles which falcons may eat on the ground or ingest from prey that have eaten them. The worm larvae move from the stomach to the airsacs and can grow into spaghetti-like adult worms of up to 20 cm.

Falcon Hospitals

On the web

Abu Dhabi Falcon Hospital
P.O.Box: 45553, Abu Dhabi-UAE Tel: +971 2 5755155, E-Mail: info@falconhospital.com

Dubai Falcon Hospital
P.O. Box: 23919, Dubai-UAE Tel: +971 4 3377576, +971 4 3346091 E-mail: antonio.disomma@dfh.ae

Zabeel Falcons Hospital
Highway 77 – Al Qudra Intersection, Marmoum, Dubai Tel: +971 50839 5672 E-mail: Raptor_uae@yahoo.com

Dr Reza Kiamarzy's Clinic
Esfahan, Iran E-Mail: rezakiamarzy@gmail.com

Dr. Faris Al-Timimi Veterinary Clinic
Katara Cultural Village, Doha Tel: +254 720 399 975, +974 7734 9193 E-mail: dicxieyvetaid@gmail.com

Souq Waqif Falcon Hospital, Doha, Qatar
Souq Waqif Falcon Hospital, Doha, Qatar Tel: +974 44145962 E-mail: ikdammajid@yahoo.com

Qatar Falcon Centre
PO Box 45989, Doha, Qatar Tel: +974 500651195 E-mail: drraihanrahim@gmail.com

Doha Veterinary Centre for Falcons
Tel: +974 44863674, +974 55316925 E-mail: osama.yagoub@yahoo.com

COMPLEXITY AND AGENT-BASED MODELS (ABM) FOR DECISION-SUPPORT

Dealing with complex, non-linear systems

Complex ≠ Complicated

Complicated is an **extrinsic** property – understand the parts, follow instructions and the result will be predictable

Complex is an **intrinsec property**. Understand the parts fully and you'll still likely have a very poor understanding of the whole.

Complicated is opposite of easy

Easy

vs

Complicated
(for a non-mechanic!)

What is a complex adaptive system?

(i.e. living systems)

Complex adaptive systems

Defined based on three characteristics:

1) Autonomous agents (individual, group, bank, idea)

2) Local interactions (ex. cooperation, competition)

3) Autonomous selective process (ex. natural selection)

A complex adaptive system often responds to stimuli in non-linear, sometimes counter-intuitive, ways.

COMMON BUZZARD IN SOUTHERN UK

Multi-level conservation based on scenarios

Scientific challenge

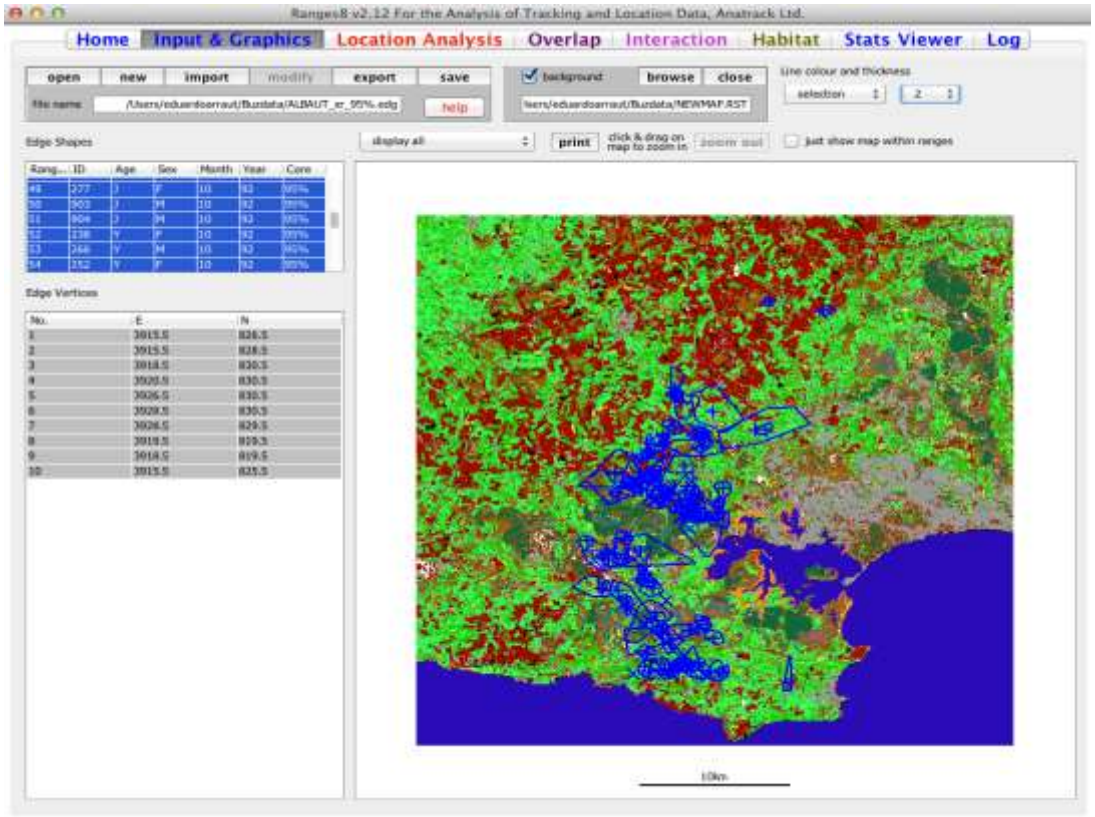
- Which **land covers** provide important resources for buzzards and how do **individuals** structure their **home ranges**?
- What factors limits buzzard **densities**?
- What buzzard densities are expected under different **landscape scenarios**? (management, climate, etc…)

- Impact: buzzard conservation and as proof-of-concept for building scenarios for other species

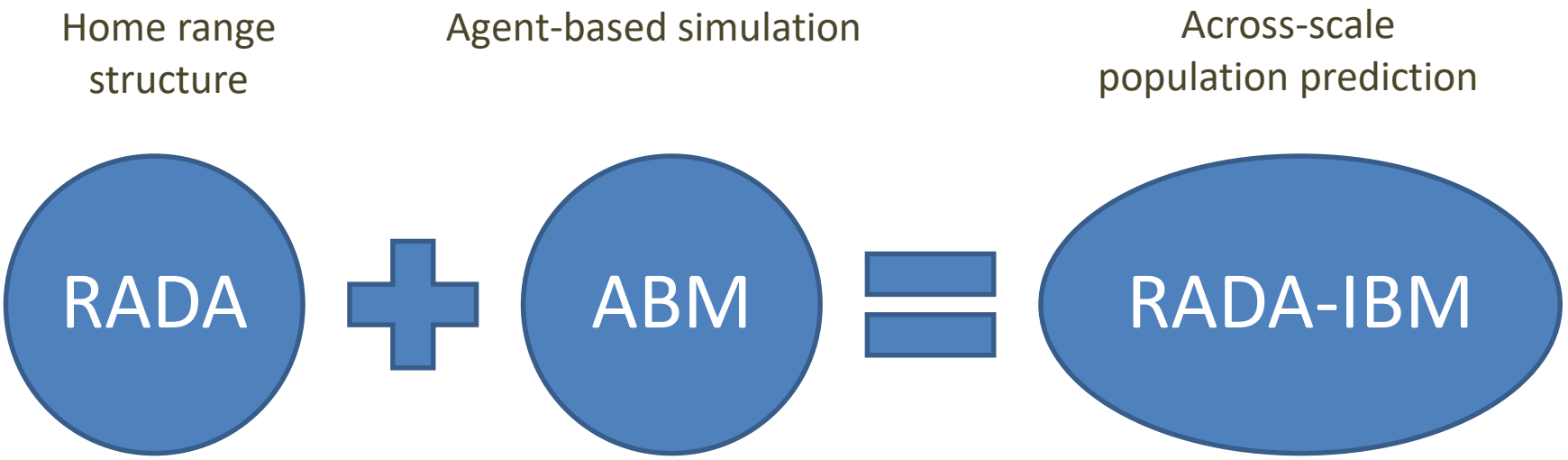
Data

1. 72 common buzzards radio-tracked between 1990-1995 in southern Britain

2. 1990 land cover map of Great Britain

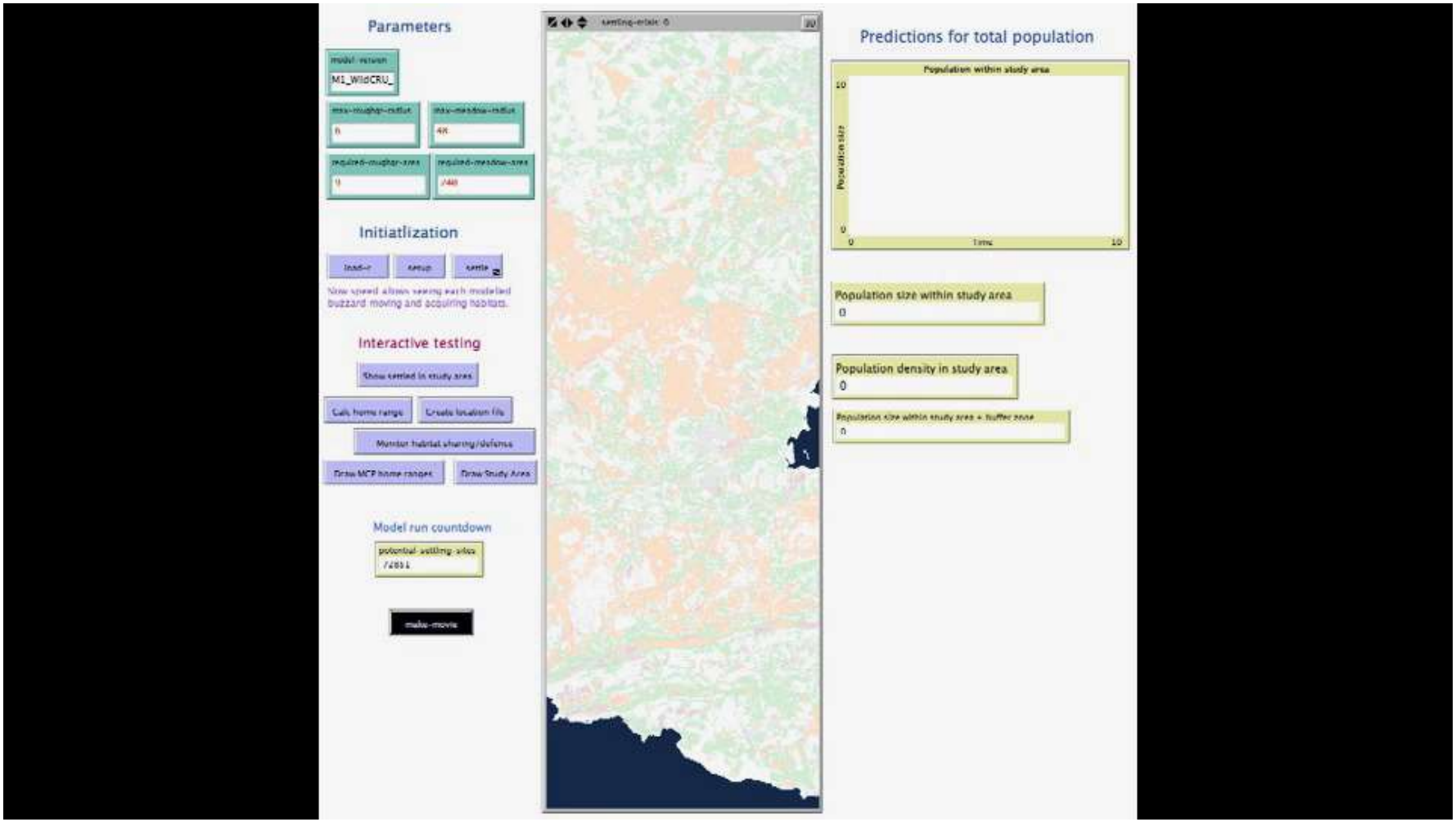


The modeling approach

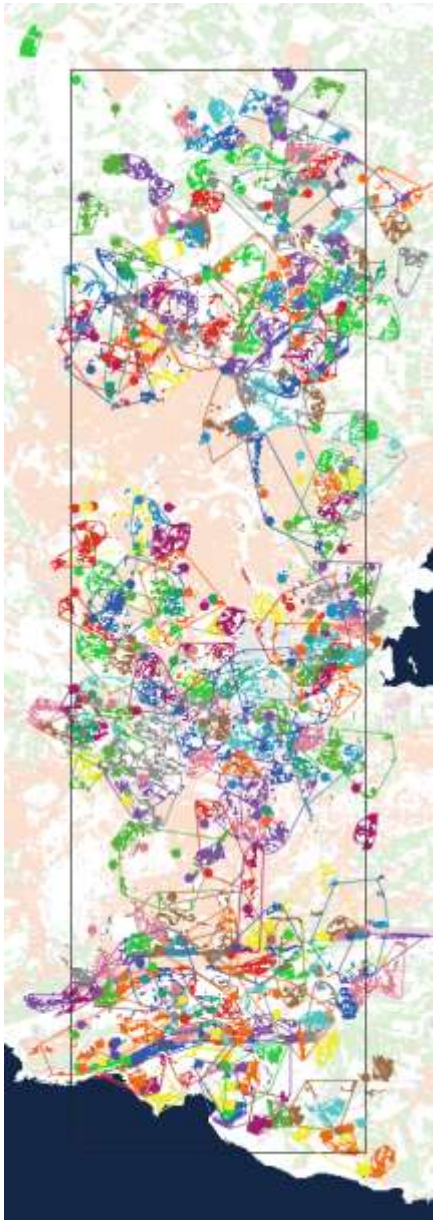


Mapping + Radio-tracking

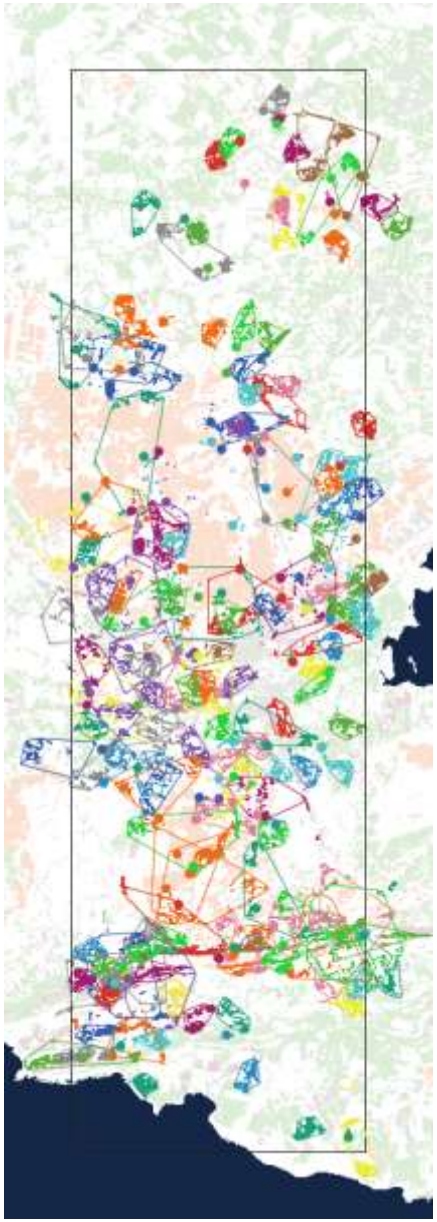
Ecologia para manejo integrado da paisagem



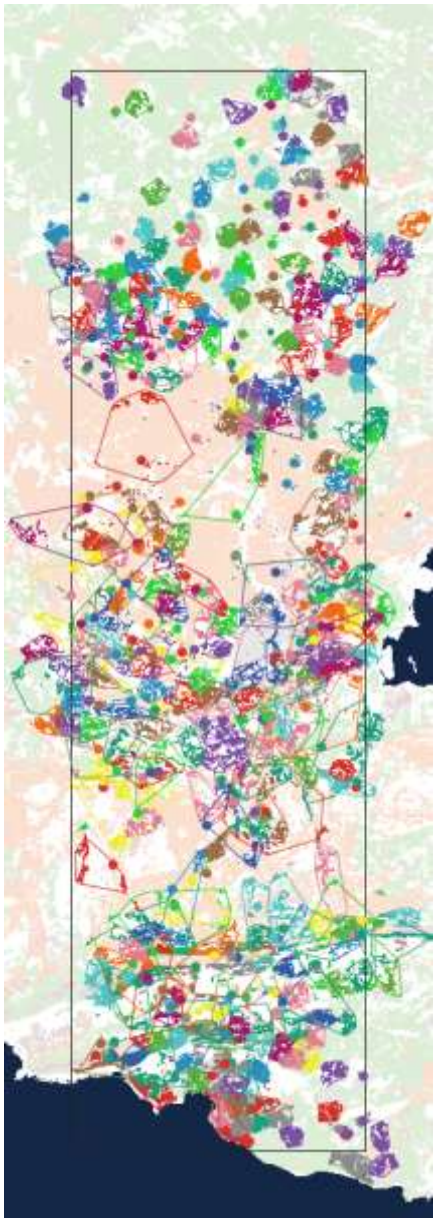
Arraut, Walls, Macdonald & Kenward (em submissão). Gavião comum virtual colonizando uma paisagem real.



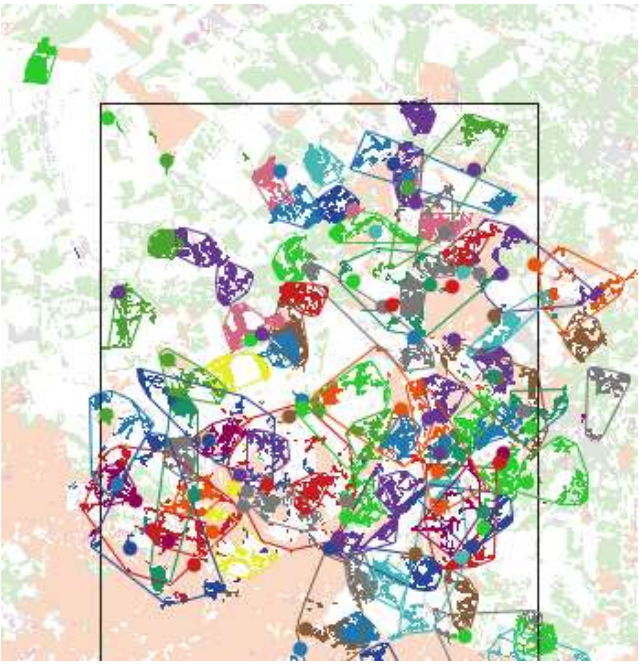
C – current
Density = 1.74 ind/km^2



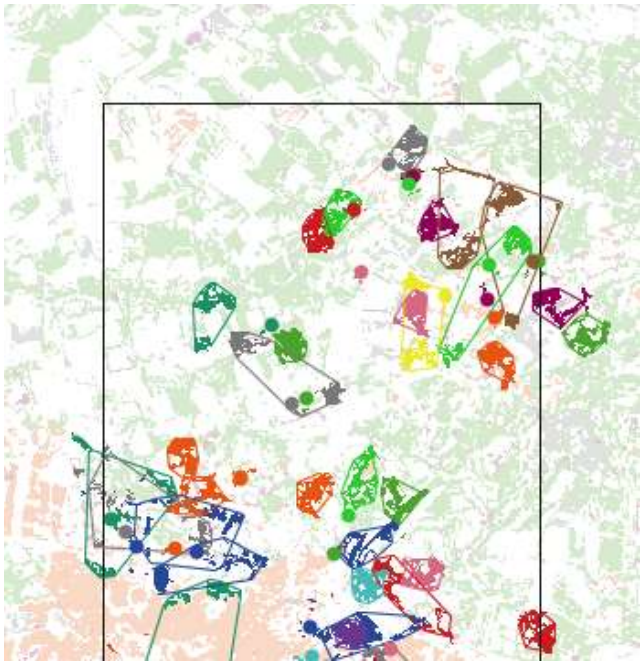
S1 – Dec-wood to agric
Density = 1.13 ind/km^2



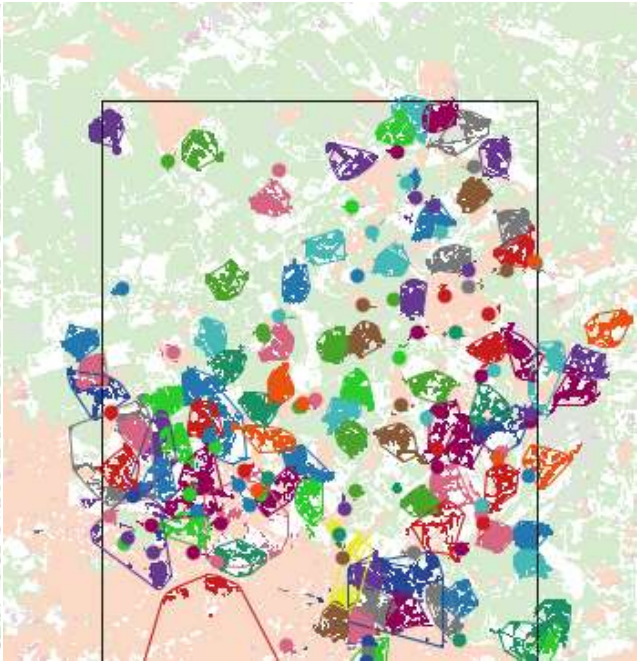
S2 – agric to meadow
Density = 2.01 ind/km^2



C – current
Density = 1.74 ind/km^2



S1 – Dec-wood to agric
Density = 1.13 ind/km^2



S2 – agric to meadow
Density = 2.01 ind/km^2

Building land management scenarios based on multiple viewpoints

Their problem

Common problem: pine encroachment

(Etienne et al. 2003)

Scientific challenge

- What is the best way to combat pine encroachment?

- Impact: improve land management and relationship between local people

The agents (actors)

Sheep farmer

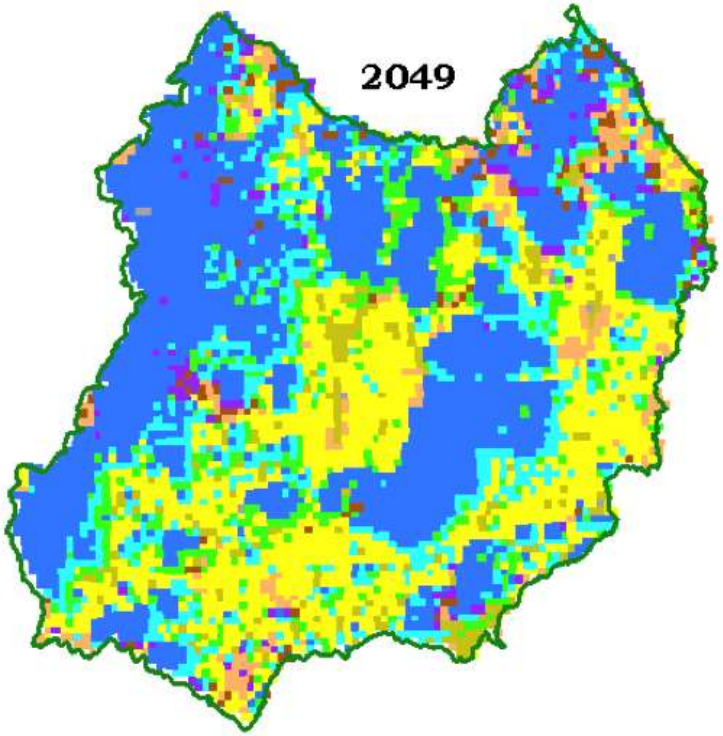
Timber harvester

Park ranger

Steps

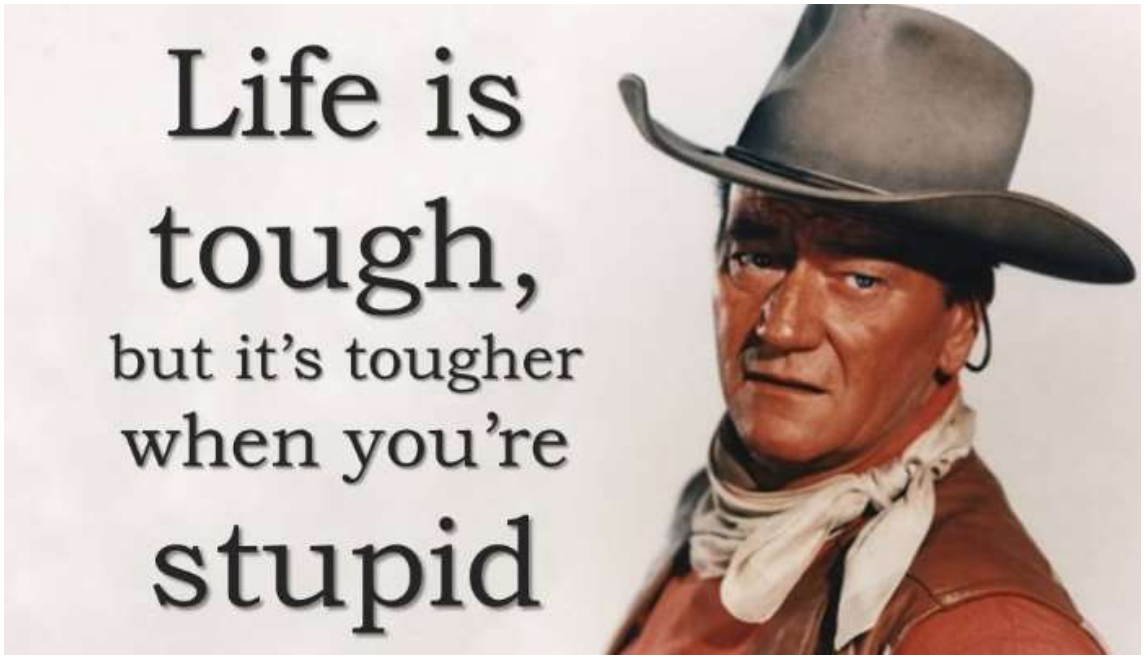
1. Built a first version of the ABM
2. Presented ABM to local community, acquired input about rules and possible management scenarios, and then updated ABM
3. Transformed ABM into role-playing game and played it with real agents
4. Created final version of ABM – results were welcomed by people

Foresters' scenario



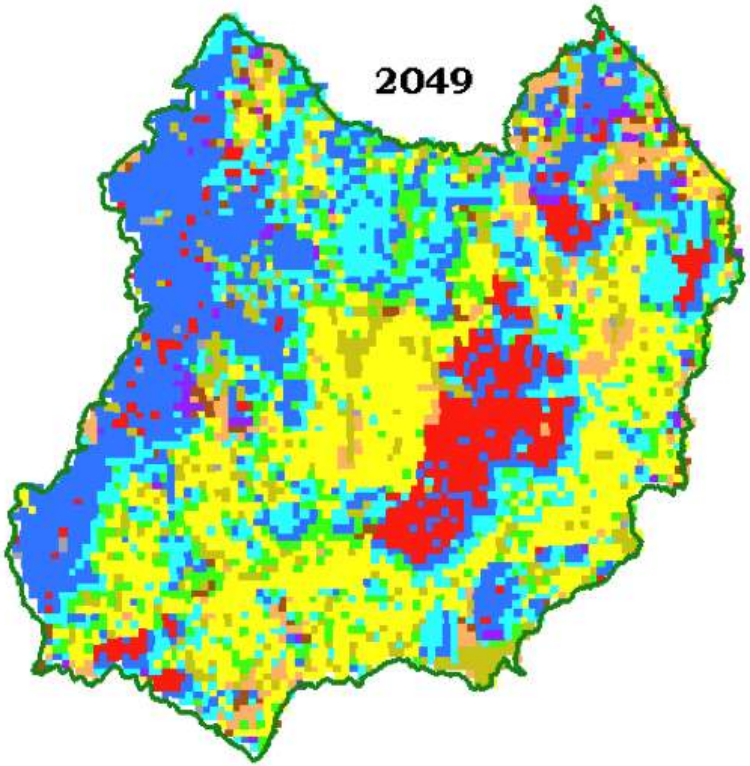
5.1

Foresters considered that pine encroachment is a natural process moving early succession stages (i.e. native grasslands) towards late succession stages (i.e. native or sub-spontaneous forests). They also pointed out that the intensity of the currently observed process demonstrated that sheep farmers were unable to manage correctly their rangelands. So they proposed a scenario called "let nature work" in which landscape dynamics depend only on natural succession according to the location of the current tree seed bearers. They hypothesised that grazing management was too extensive to control pine seedlings on rangelands and decided that any new land unit colonised by pines more than 20 years old would go under their management rules. They only accepted to respect the agreement they had made with the conservationists to stop undertaking new afforestation.



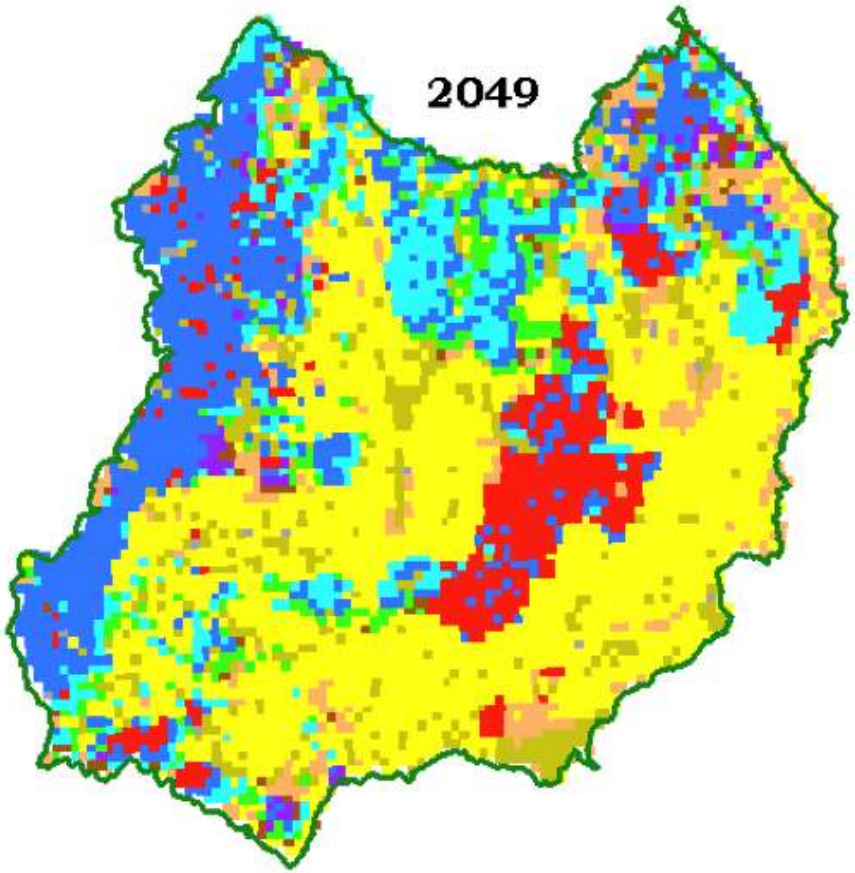
They also pointed out that the intensity of currently observed process demonstrated that sheep farmers were unable to manage correctly their rangelands.

Sheep farmers scenario



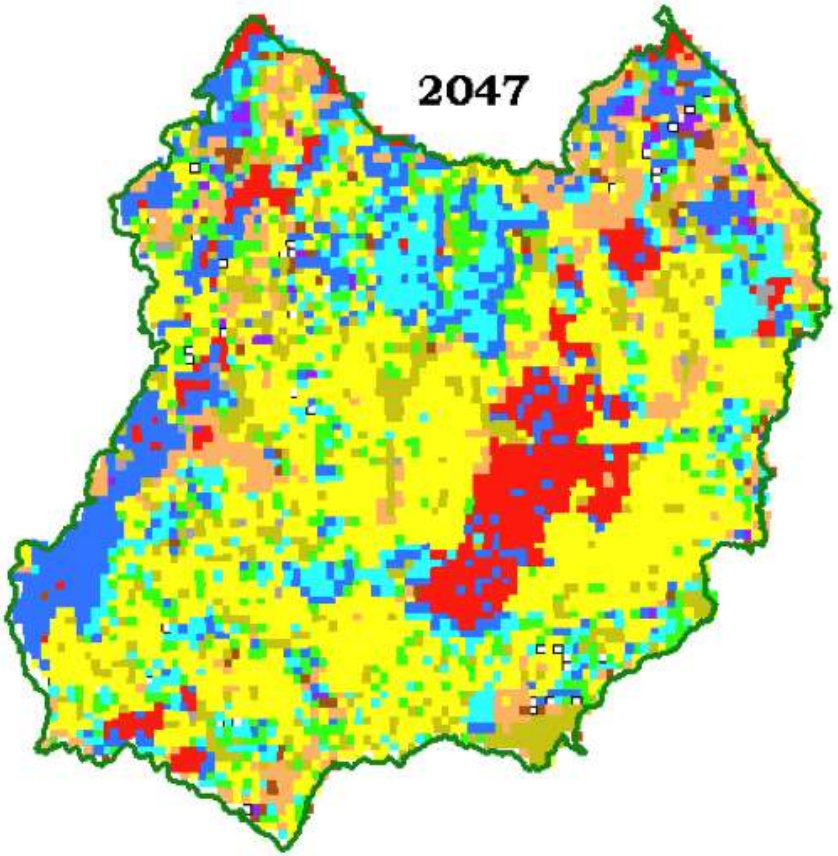
Farmers were ready to control pine encroachment only in places where it competed with farm production but they stressed the shortage of labour for such operations. The places to clear were determined according to the current land tenure pattern and requirements of the sheep production system. They hypothesised that pine encroachment was totally controlled in cultivated areas and partly reduced in grazed areas according to current grazing practices. They did not schedule any intervention on their planted pine stands but they supposed the other forests to be managed as usually by means of basic sylviculture following the standards proposed by the forest law and the regulations imposed by the National Forest Fund programme. No proposal was made for adapting the grazing calendar to increase grazing pressure on the threatened paddocks, and cooperation with the National Park agents was never mentioned.

Conservationists' scenario



The majority of the conservationists considered that they had mainly to prevent the areas with major heritage value to be invaded by pine trees. So they proposed to finance the eradication of pine trees already established in areas with high biodiversity or high habitat interest and to support the control by regular mechanical interventions of the establishment of new pines in these areas.

Joint scenario



Scenario 7 intensified the management of pine woodlands through a strong thinning of stands over 40 years old on 20-ha plots in order to set up rapidly rational grazing and to produce enough timber to make the venture worthwhile for loggers. It required the approval of the owner when the land did not belong to the farmers and it made it possible to anticipate the final harvest when the trees were about 60 years old.

- The elaboration of this set of perceptions through a step-by-step approach helped the participants to understand that **their views were all legitimate but also subjective and partial.**

- Beyond the classical use of modeling as a decision support to control a system, **agent-based models are also powerful supports to adaptive learning processes.**

Main messages

- Modeling is a valuable tool for conservation because it helps answer questions beyond human capabilities and connect people.

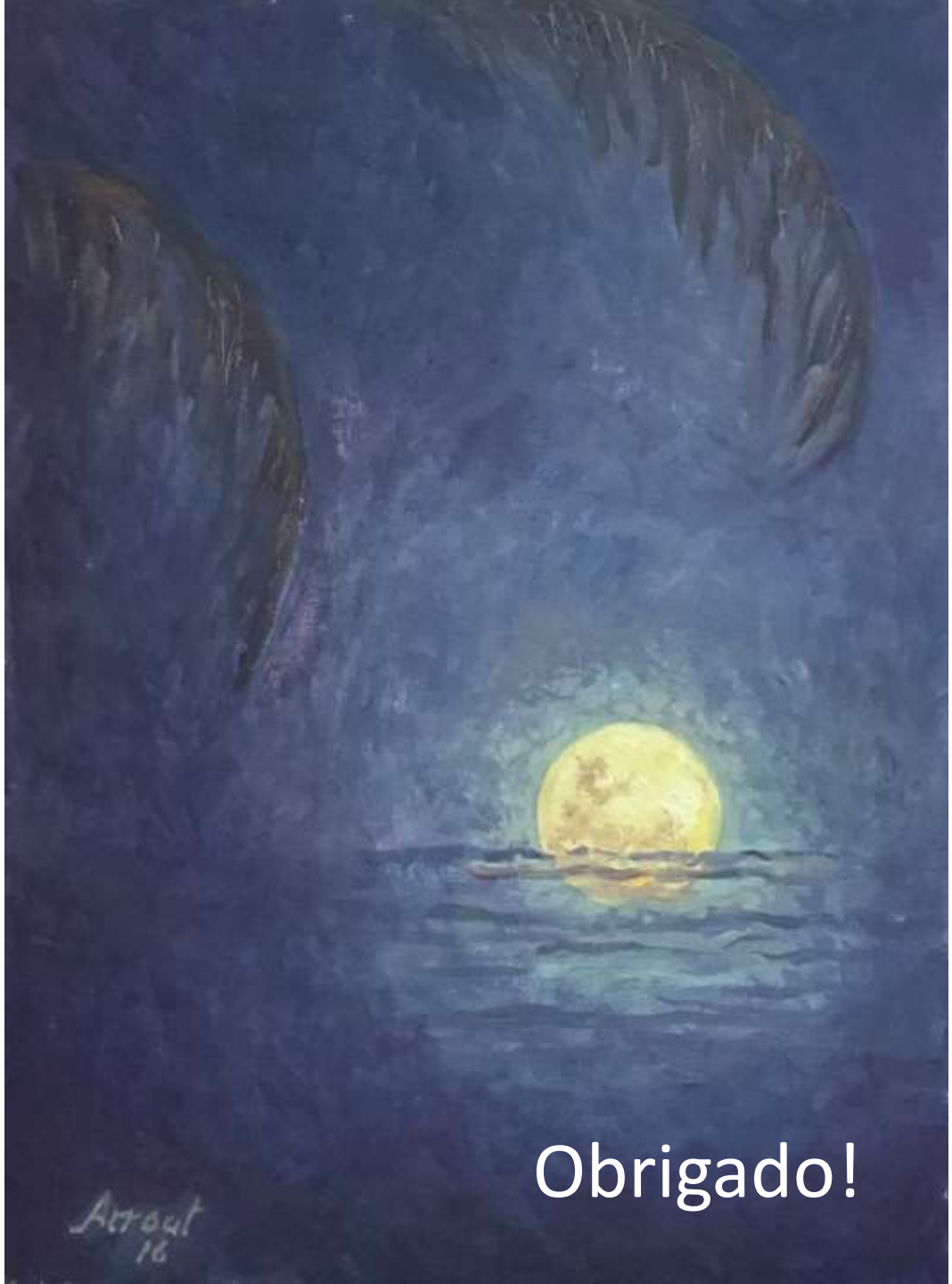
QUESTIONS TO THE AUDIENCE

Think about criteria to choose study cases for SA

1) Falconry!

2) What else? Desired characteristics?

- Public appeal, expected impact
  - How could we go viral? (as opposed to spending tons of time, money and saliva trying to convince people…)
- Historical and current contexts?
- Funding possibilities?
- Data availability?
- Probability of success?
- ?



Obrigado!