



# Response-based Calculation of Nature Values - The Finnish Model

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## **Response-based Nature Values - The Finnish Model**

- Developed as part of the introduction of the Finnish biodiversity offset legislation in 2022-2023
- Co-designed with large number of experts and stakeholders
- Has since become the fore-runner mechanisms to calculate nature credits for the emerging national nature market



# Biodiversity offsetting VS Nature credit markets

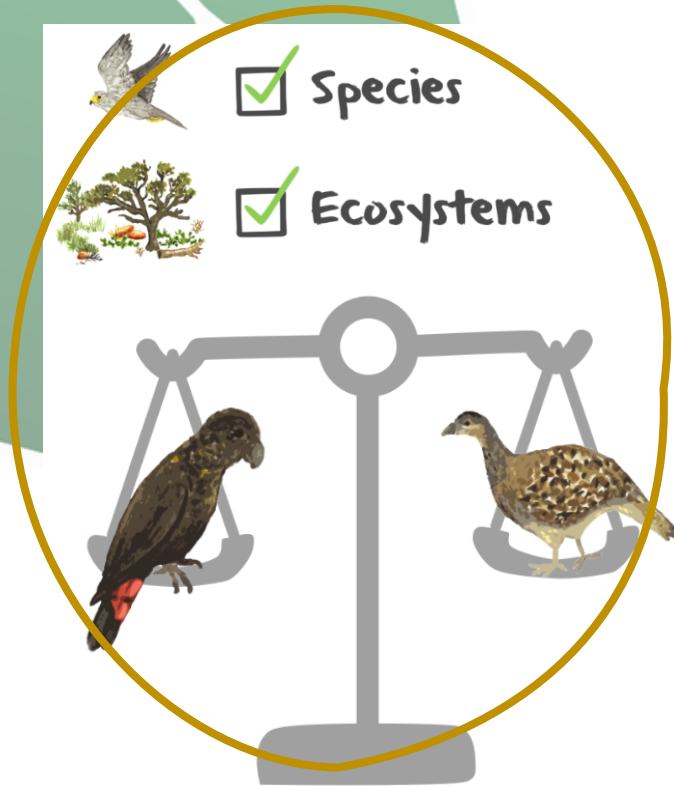
## Offsetting

**Biodiversity losses** have to be compensated with equivalent amount and type of **biodiversity gains**  
→ No Net Loss claims possible

## Nature credit market

**Biodiversity gains** can be purchased for any reason and without matching with **biodiversity losses**  
→ No Net Loss claims cannot be made

**Offsetting scheme and nature credit markets can still use the same units and operate on the same market**



Loss ✓  
10 ± 1



Gain?  
10 ± 5

Time lag



Loss



Gain

# Components of the Finnish model

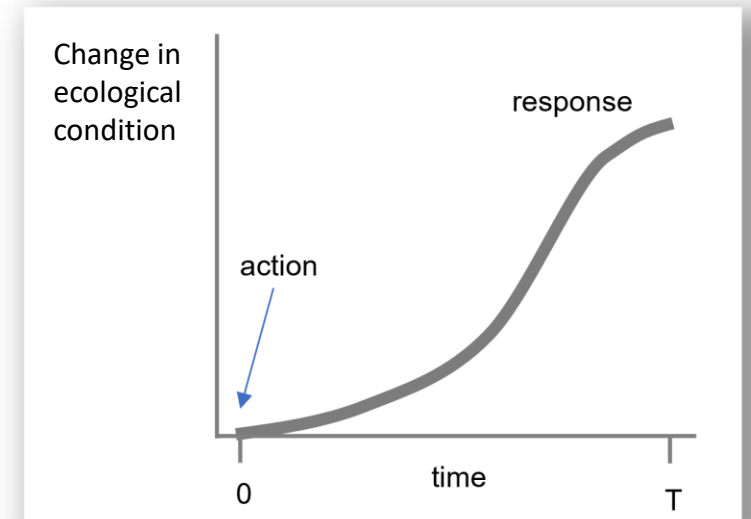
## Common metric

Biodiversity measured in *habitat hectares*

$$\text{Habitat hectare} = \text{Area} \times \text{Ecological condition}$$

## Realistic biodiversity gains that include time-lags and uncertainty

Habitat types and species respond differently to actions (magnitude, time, certainty)



# Habitat hectares (hha)

Area x Ecological condition (0-1)

1 = in natural state

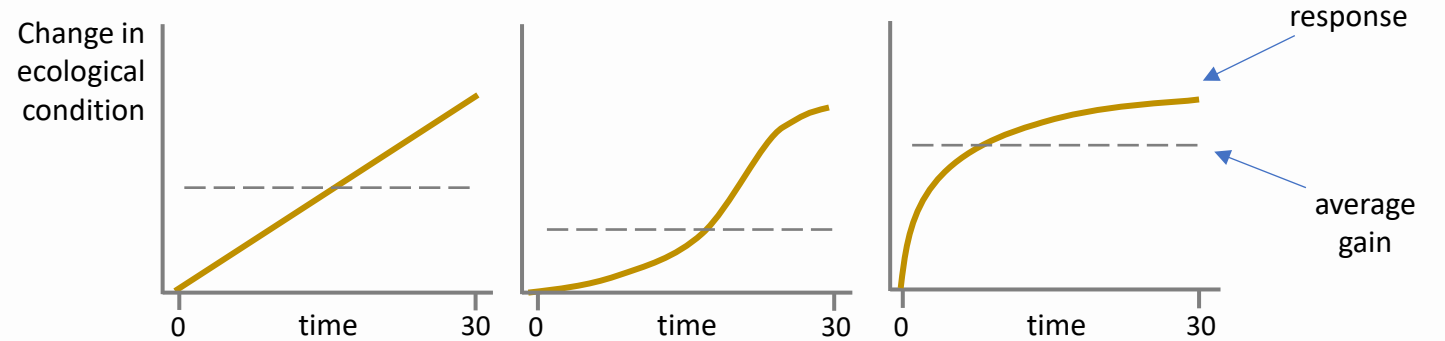
0 = destroyed

1 ha of pristine habitat = 1 hha

1 ha with 50% degraded condition = 0.5 hha



# Response-based biodiversity gains



**Response** = Change in ecological condition following an action

- responses are action and species/habitat specific

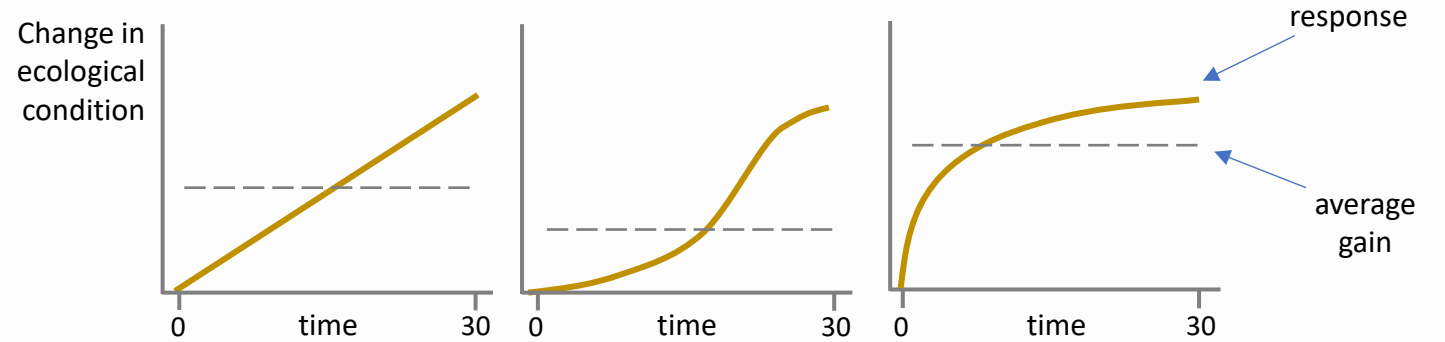
**Gain** = average improvement in condition across an agreed time-period

- in Finland, time-period set to 30 years

Accounts explicitly for the magnitude of gain and time-lags, and can be further couple with likelihood of success

→ the faster, larger and more certain the response, the more gain

# Response-based biodiversity gains



- Ideally, responses are based on quantitative measurements – but such data rarely exists
- Responses can be estimated based on literature and/or using expert elicitation

# Defining measures of ecological condition and responses to actions

## Expert elicitation 2022-24

111 experts, 22 workshops + online discussions  
– utilising the IDEA protocol

1. Criteria for ecological condition – *how is condition measured?*  
→ condition matrices for all Finnish Red Book habitat types
2. Response estimates – *how do actions improve habitats?*  
→ biodiversity responses for >200 habitat type x action – combinations





DEVELOPMENT CLASS  
← Old forest  
Clearcut →

FOREST STRUCTURE  
← Natural  
No structural elements →

DEAD-WOOD  
← Natural amount & quality  
None →

LARGE TREES (>40 cm DBH)  
← Natural amount  
None →

UNDERSTOREY VEGETATION  
← Natural  
Disturbed/missing →

HUMAN INFLUENCE  
← Natural  
Fully transformed, drained →





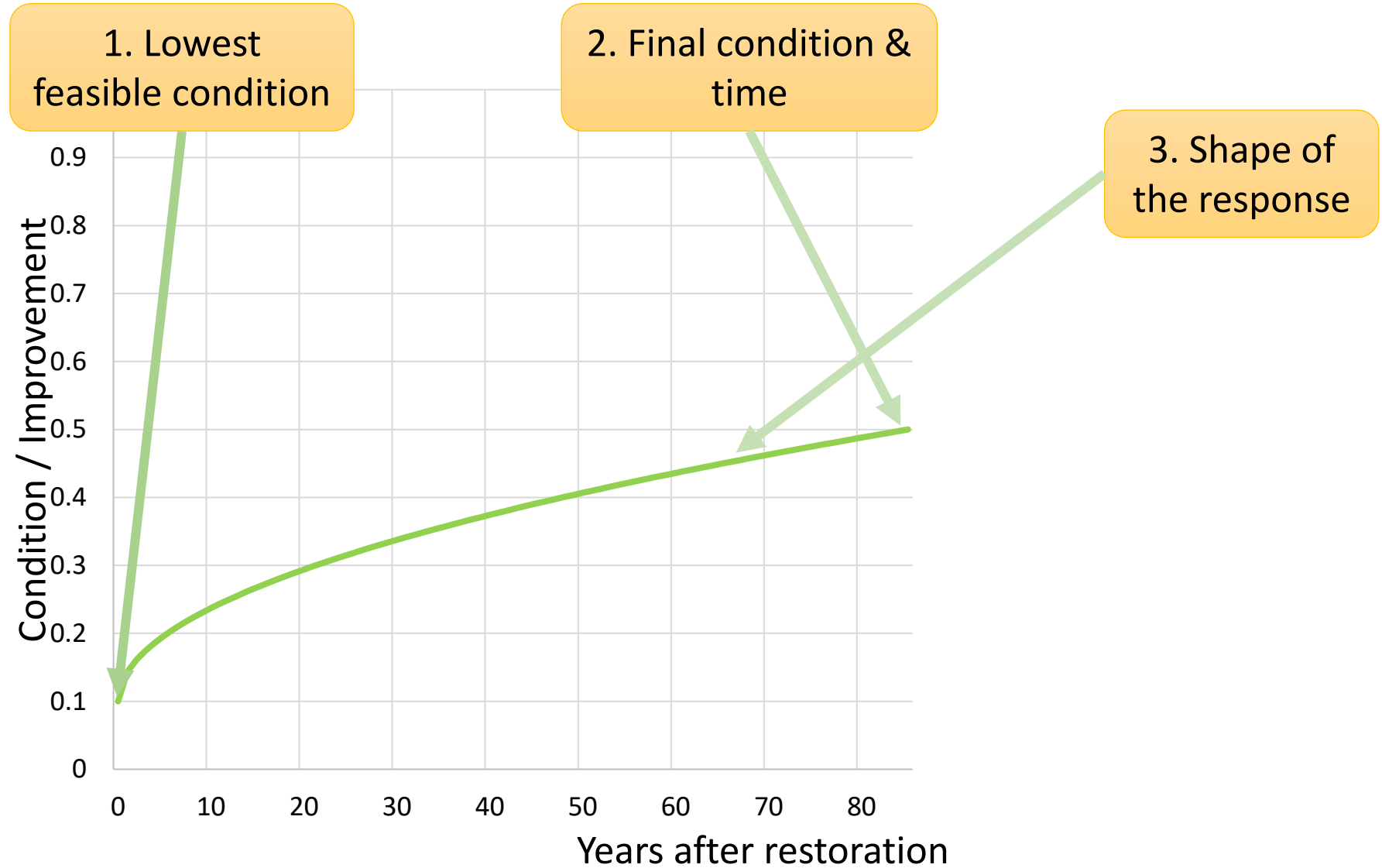
# Forests on mineral soils

(simplified example)

	PRIMARY			SECONDARY			
	Development class	Presence of forest structure attributes	Dead-wood quantity and structural attributes	Vegetation representativeness	Number of large-diameter trees	Invasive alien plant species	Other anthropogenic impact
<b>Relative attribute weight</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>
<b>1.0 (EXCELLENT)</b>	Old forest	All structural attributes present	Amount of dead-wood is characteristic to habitat type and all structural attributes are present	Vegetation is representative to habitat type	Quantity characteristic of habitat type	No invasive alien plant species present	No signs or very few signs of anthropogenic activity
<b>0.9</b>							
<b>0.8</b>							
<b>0.7 (GOOD)</b>	Mature commercial forest stand or older	At least three structural attributes present	At least moderate quantities of naturally generated dead-wood, and at least two structural attributes present	Essential community characteristic observable but representativeness is somewhat reduced. Vegetation structure may be slightly altered	Number of large-diameter trees is reduced but still several		Minor anthropogenic activity
<b>0.6</b>							
<b>0.5 (SATISFACTORY)</b>	Young to middle-aged commercial forest	Two structural attributes	Low levels of naturally generated dead-wood, and at least one structural attribute is present.	Vegetation representativeness is distinctly decreased. Community and/or vegetation structure exhibit clear changes, some representative species are present	Individual large-diameter trees	Individual invasive alien plants present	Moderate anthropogenic activity. For example, terrain erosion, littering, or forest ditches
<b>0.4</b>							
<b>0.3 (POOR)</b>	Seedling or sapling stand or seed-tree stand	One structural attribute	Individual dead-wood objects, no structural attributes are present			Several occurrences of invasive alien plants	
<b>0.2</b>							
<b>0.1 (VERY POOR)</b>	Clear-cut area or seed-tree stand	No structural attributes are present, or a single-species non-native forest	No dead-wood present	Vegetation is unrepresentative. Community is greatly altered, and/or species characteristic to habitat type are barely present, vegetation structure is uncharacteristic of habitat type	No large-diameter trees present	Area largely overtaken by invasive alien plants	Intensive anthropogenic activity. For example, marked terrain erosion, wide-scale forest ditching, soil tillage, or significant littering.

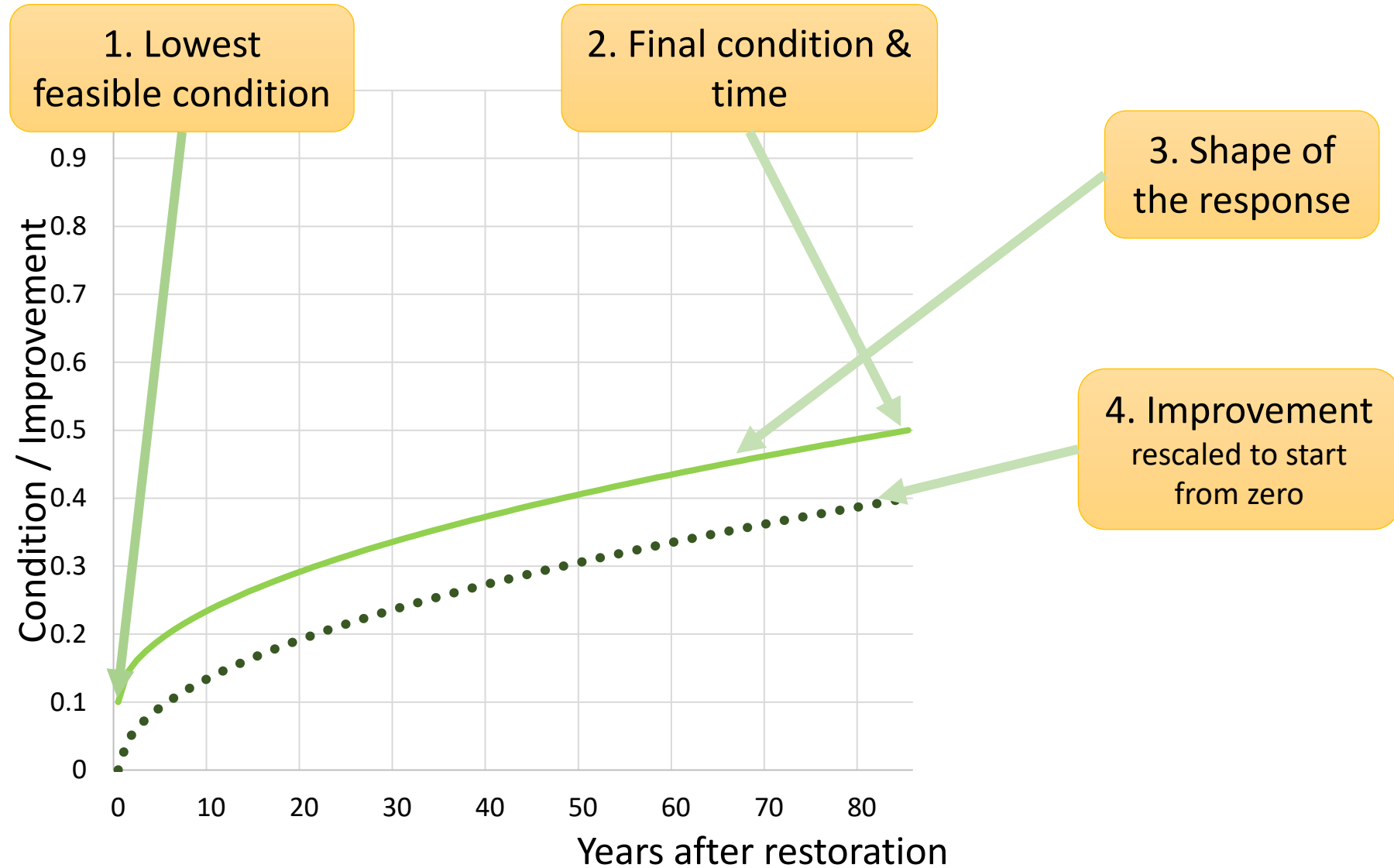
# Action response

How does the action improve a site's ecological condition over time?



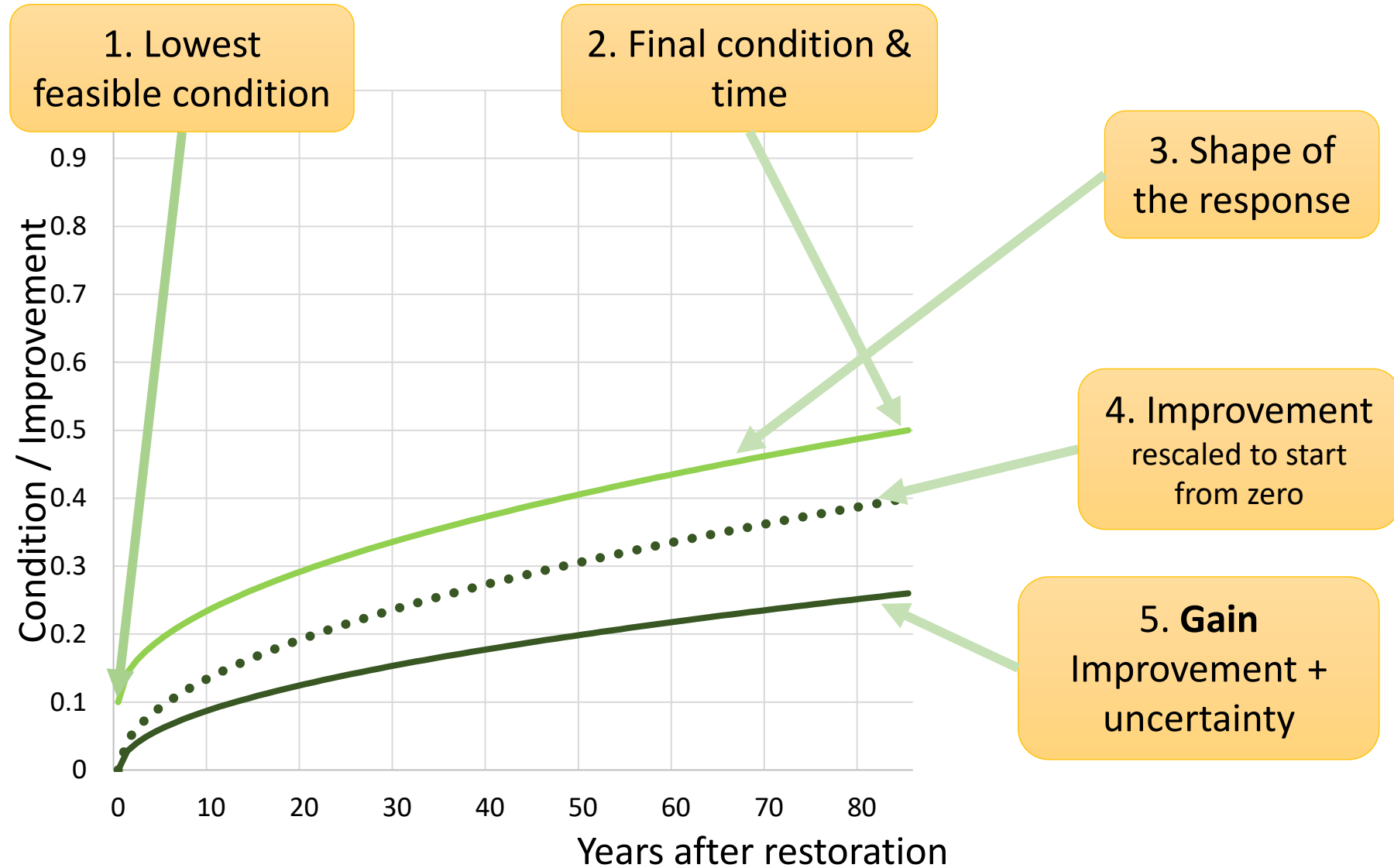
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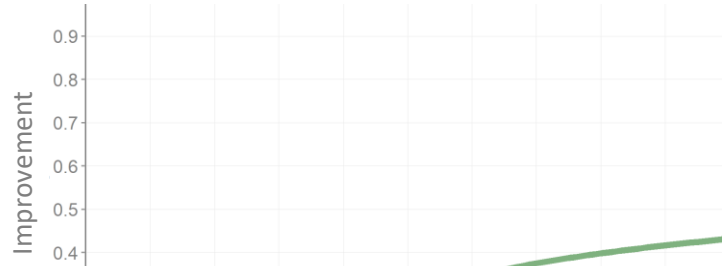
# Action response

How does the action improve a site's ecological condition over time?



# 216 restoration or management response estimates

Dry heathland forests: Restoration of heterogeneous forest structure, S-Finland

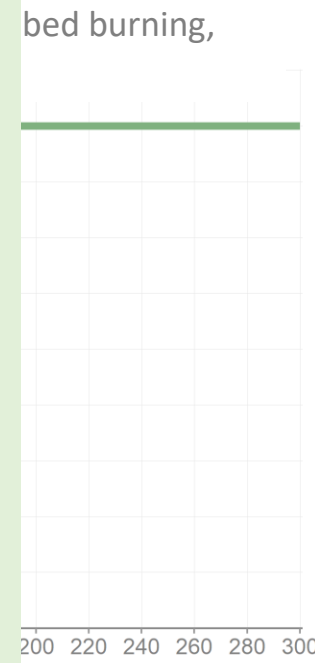


Calcereous rocks: Creation of novel habitats, S-Finland



- Response based gain estimates bring ecological realism and credibility to producing biodiversity benefits
- Notable variation in the likely gains between habitat types and actions
  - e.g. for Finnish habitat types, the commonly used upper end offset multiplier of 6 would overshoot offsetting needs in 36% and undershoot in 58% of the cases
- The produced responses can be used to plan and target conservation efforts also for other mechanism

Scientific article: Jalkanen et al. (in review)  
<https://www.biorxiv.org/content/10.64898/2026.01.26.701764v1.abstract>



200 220 240 260 280 300

0 10 20 30 40 50

Year

BOOST  
strateginen

Julkistamistilaisuus 30.1.2025

Ohjeistus luonnonsuojelulain mukaisen ekologisen kompensaaion laskentaan

Annukka Valkeapää, säätiö;  
Seppo Niskanen, kenttäpäällikkö, Maa- ja metsätaloustuottajain Keskusliitto MTK ry;  
Tiina Paajanen, johtava konsultti, Ecobio Oy;  
Salli Uljas, ylitarkastaja, Varsinais-Suomen ELY-keskus

LUOMUS  
JYU.WISDOM



Suomen ympäristökeskuksen raportteja 1 | 2025

## Heikennys- ja hyvitysalueiden luonnonarvohehtaarien laskeminen luonnonsuojelulain mukaisessa ekologisessa kompensaatiossa

Joel Jalkanen, Eini Nieminen, Aapo Ahola, Päivi Salo, Minna Pekkonen, Emma Luoma, Anni Kettunen, Panu Halme, Minna Pappila, Janne Kotiaho, Heini Kujala

Suomen ympäristökeskus  
Finlands miljöcentral  
Finnish Environment Institute



Scientific article: Jalkanen et al. (in review)  
<https://www.biorxiv.org/content/10.64898/2026.01.26.701764v1.abstract>



# Rapid uptake

## Municipalities

- Helsinki: offsetting model 2026
- Jyväskylä: biodiversity offset pilot 2023-25
- Lahti: city-owned habitat bank (ongoing)
- Joensuu: offsetting of a zoning plan (starting)
- Vantaa: 1<sup>st</sup> official biodiversity offset

## Other applications using habitat hectares

- S-group, Lähitapiola, Finsilva: nature market pilot (2026)
- habitat hectares used in EIA assessments

# Transferability of the Finnish model

- Habitat hectares or equivalent units already used in many countries that mandate or allow offsetting
- Response-based gains are not location or unit specific but can be built for any biodiversity value (including species)

Marshall et al. (2020) What are we measuring? A review of metrics used to describe biodiversity in offset exchanges  
<https://doi.org/10.1016/j.biocon.2019.108250>

Marshall et al. (2023) A global analysis reveals a collective gap in the transparency of offset policies and how biodiversity is measured  
<https://doi.org/10.1111/conl.12987>





## Joint markets for nature credits and biodiversity offsets?

- Although gains are traded differently, the integrity requirements for nature credits should not be any less than they are for offsets
- Shared market and currency will increase access – availability of purchase-ready gains can boost mandatory biodiversity offsetting schemes
- Both will require public oversight and monitoring to confirm the expected gains and to inform improvements of the system

Boisvert 2015 <https://doi.org/10.1016/j.ecoser.2015.02.004>

Vatn 2015 <https://doi.org/10.1016/j.ecolecon.2014.07.017>

Kujala et al. (2022) <https://doi.org/10.1016/j.oneear.2022.05.011>

Moilanen et al. (2024) <https://doi.org/10.1016/j.gecco.2024.e03039>

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# Thank you

