How to upgrade current management plans for the invasive species Giant Hogweed in Denmark – a case study from Vordingborg municipality, Zealand

The future use of natural resources

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Abstract
Invasive Alien Species (IAS) is a global issue that poses a threat to native biodiversity and human health. Globalization and associated processes of rapid infrastructure development in recent decades have increased the rate of dispersal across the globe, allowing IAS to establish populations in hitherto unseen quantities and varieties across the countries of the global North. In Denmark, municipal authorities are obligated to eradicate invasive species in accordance with current EU-regulation. This work is coordinated through management plans for each species which are drawn up by the municipalities. The process of creating such plans is resource consuming for most municipalities and also for the municipality of Vordingborg which is the subject for the study reported. An action plan for the invasive species **Giant Hogweed** (*Heracleum mantegazzianum)* was created in this municipality in 2014, but a high number of populations are still present and municipal officers have no clear ideas of how to approach the problem of eradicating them. In order to test a new approach to eradication planning, which could potentially be used in municipal contexts across Denmark, we tested two different techniques to produce various types of probability maps for the occurrence of Giant hogweed in Danish landscapes. Based on an array of environmental variables co-predicting the distribution of the species, a statistically-based Species Distribution Model (SDM) and a process-based GIS suitability analysis were created. The two models, both of which are spatially explicit, were tested and evaluated by comparison with in situ observations collected in May and June 2019 in Vordingborg Municipality. On this basis an upgraded action plan for Vordingborg Municipality was drawn up, consisting of a general risk map**,** a cadastral explicitly risk map, a map of landscape types associated with the occurrence of the species and a guidance document detailing how to manage the threat of this species based on the new datasets and strategic plans made available. In this paper, we discuss the validity, usefulness and further development of the models which were created for the species and the strategic planning instruments derived from the new data, including how our case study results from Vordingborg Municipality may be used in a broader geographical context.

Acknowledgements
Our acknowledgments go to Dr. Andreas Aagaard Christensen for inspiration and guidance throughout the project period. Throughout the project, Andreas inspired the group to follow and test new theories and ideas. As a group, we would also like to send our appreciations to Dr. Andreas Aagaard Christensen and Dr. Peter Stubkjær Andersen for a well-structured and educative field trip to the municipality of Vordingborg. A special thanks go to Rasmus Scharling from the municipality of Vordingborg. Rasmus provided the group with vital information about existing management practices and guidance to calibrate the different risk maps and communication tools. Finally, we would like to express our deep gratitude to Dr. Charles P.-A. Bourque at the University of New Brunswick, and Dr. Nan Zeng at the Nature Conservancy for their patient guidance on developing the SDM model and constructing the action plan.

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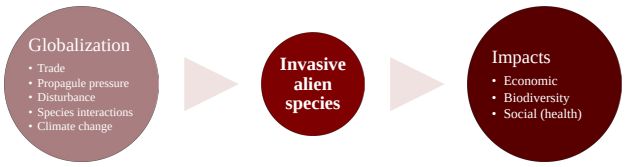
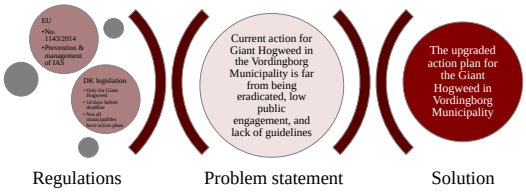
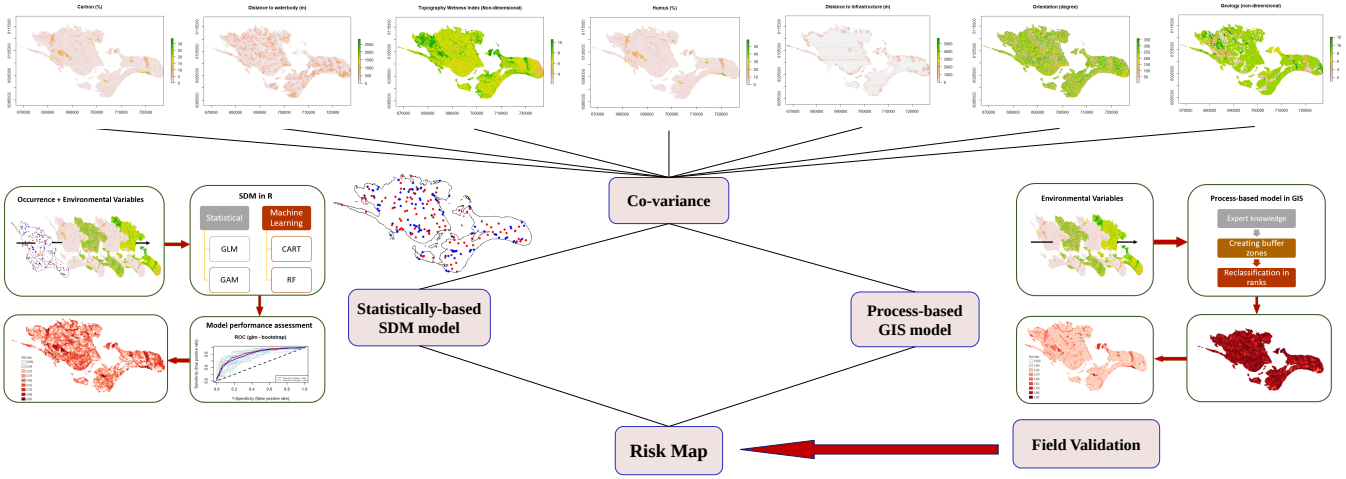
Backgrounds



Study Objective



Methods

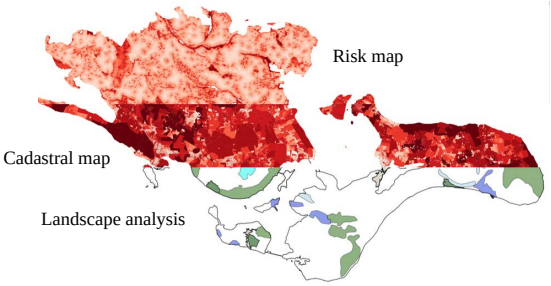


Action Plan

1. Security Protocol

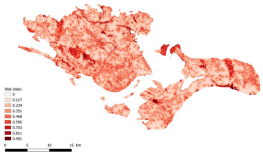
- Ensure a safe identification & management
- Phototoxic sap can cause serious **lesions** to human skin
- Security & Safety recommendations

2. Distribution Map

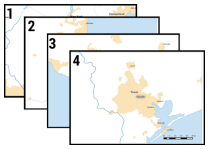


3. Communication & Education

Web-based probability map



Automatic Atlas Generation



Letter to landowners

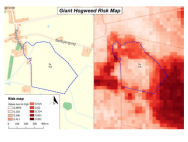
Information about the Giant Hogweed

To:
Landowner Landownersen
Hogweed road 21 – 4760 Vordingborg

Giant Hogweed and your property

The Municipality of Vordingborg has carried out a landscape analysis in order to map potential habitats of the invasive plant species Giant Hogweed (Heracleum mantegazzianum). According to the Giant Hogweed action plan of Vordingborg municipality you as a landowner are obliged to eradicate individual plants and colonies of Giant Hogweed at your property before the 1st of June. A quick way to search for Giant Hogweed at your property would be to plan a route along streams, edges and wetlands. Areas with a high level of disturbance could also be included.

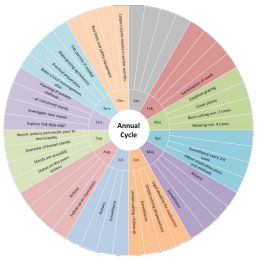
Some parts of your property are found to be suitable for this invasive plant species. The part of your property with cadastral reference 5a, Dumsholte Sogn scored a risk value of 0.8 on a scale from 0-1. This means that you as a landowner should pay attention to occurrences of this species. To get more information about the Giant Hogweed and eradication methods please visit our homepage or contact the municipal official responsible for Giant Hogweed.
(www.Vordingborg Hogweed now.dk).



Best regards Vordingborg Municipality

4. Specific Management Plans

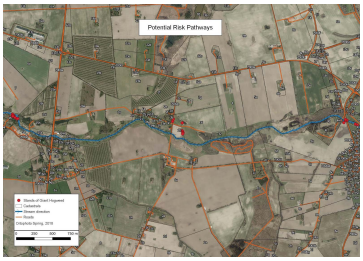
Annual cycle of actions



Best practice eradication methods

	Manual methods				Machine methods			Changed maintenance	
	Root cutting	Mowing	Umbel removal	Spraying	Soil preparation	Mowing	Spraying	Re-cultivating	Grazing
Individual plants and small stands									
The edge streams, 2-meters of fringe, fences, depots etc.	☺	😐	😐	😐	☹	😐	☹	☹	😐
Meadows and nature areas	☺	😐	☹	☹	☹	😐	☹	☹	☺
Agricultural land	☺	😐	☹	☺	☺	😐	☺	☺	😐
Large stands									
The edge streams, 2-meters of fringe, fences, depots etc.	😐	😐	☹	😐	☹	😐	☹	☹	😐
Meadows and nature areas	😐	☹	☹	☹	☹	😐	☹	☹	☺
Agricultural land	☹	☹	☹	☺	☺	😐	☺	☺	☺

5. Risk Network & Infection Routes



6. Distribution map renewal & preventive action

7. Monitoring, Reporting & Evaluation