

## **Alien species and human health: Austrian stakeholder perspective on challenges and solutions**

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### **Supplementary Material 1**

#### **Questions and predefined response options of the online questionnaire**

**Question 1: Are alien species that affect human health a topic in your working responsibilities?**

- ☐ no
- ☐ yes
- ☐ n.a.

**Question 2: Which health-relevant alien species do you consider as the most important (multiple answers possible)?**

- ☐ allergenic plants. Which? \_\_\_\_\_
- ☐ other plants. Which? \_\_\_\_\_
- ☐ pathogens. Which? \_\_\_\_\_
- ☐ invertebrate disease vectors. Which? \_\_\_\_\_
- ☐ other invertebrates. Which? \_\_\_\_\_
- ☐ vertebrate disease vectors. Which? \_\_\_\_\_
- ☐ other vertebrates. Which? \_\_\_\_\_
- ☐ other organisms. Which? \_\_\_\_\_
- ☐ n.a.

**Question 3: How important do you consider the following specific health effects of alien species?**

	Very important	Important	Less important	Not important	n.a.
Transmission of diseases and infections	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Allergies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Toxic reactions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other impacts. Which? (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other impacts. Which? (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other impacts. Which? (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Question 2.4: How important do you consider the following general effects of alien species on the public health system?**

	Very important	Important	Less important	Not important	n.a.
Severe health impacts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Health impacts are occurring more and more frequently	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Future increase in health impacts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Impacts increasingly pose Challenger for the health sytysem	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Health system will need additional resources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Health system is not prepared for impacts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Awareness raising is required	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other impacts. Which? (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other impacts. Which? (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other impacts. Which? (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Question 2.5: Have you been discussing measures against health-related alien species in your institution (multiple answers possible)?**

- ☐ No, none.
- ☐ Yes, preventive environmental measures. For instance: \_\_\_\_\_
- ☐ yes, environmental control. For instance: \_\_\_\_\_
- ☐ yes, preventive medicine. For instance: \_\_\_\_\_
- ☐ yes, therapies. For instance: \_\_\_\_\_
- ☐ yes, education. For instance: \_\_\_\_\_
- ☐ yes, research. For instance: \_\_\_\_\_
- ☐ yes, legislative measures. For instance: \_\_\_\_\_
- ☐ yes, structural measures in the health system. For instance: \_\_\_\_\_
- ☐ yes, structural measures in public administration. For instance: \_\_\_\_\_
- ☐ yes, other measures. For instance: \_\_\_\_\_
- ☐ n.a.

**Question 6: Have you been implementing measures against health-related alien species in your institution (multiple answers possible)?**

- ☐ No, none.
- ☐ Yes, preventive environmental measures. For instance: \_\_\_\_\_
- ☐ yes, environmental control. For instance: \_\_\_\_\_
- ☐ yes, preventive medicine. For instance: \_\_\_\_\_
- ☐ yes, therapies. For instance: \_\_\_\_\_
- ☐ yes, education. For instance: \_\_\_\_\_
- ☐ yes, research. For instance: \_\_\_\_\_
- ☐ yes, legislative measures. For instance: \_\_\_\_\_
- ☐ yes, structural measures in the health system. For instance: \_\_\_\_\_
- ☐ yes, structural measures in public administration. For instance: \_\_\_\_\_
- ☐ yes, other measures. For instance: \_\_\_\_\_
- ☐ n.a.

**Question 7: Have you been facing any obstacles or problems with their implementation?**

- ☐ n.a. (no measures have been implemented)
- ☐ no, we did not face any obstacles or problems
- ☐ yes, we faced obstacles or problems during implementation. Which ?

\_\_\_\_\_

- ☐ n.a.

**Question 8: Which measures can you recommend for future implementation (multiple answers possible)?**

- ☐ No, none.
- ☐ Yes, preventive environmental measures. For instance: \_\_\_\_\_
- ☐ yes, environmental control. For instance: \_\_\_\_\_
- ☐ yes, preventive medicine. For instance: \_\_\_\_\_
- ☐ yes, therapies. For instance: \_\_\_\_\_
- ☐ yes, education. For instance: \_\_\_\_\_
- ☐ yes, research. For instance: \_\_\_\_\_
- ☐ yes, legislative measures. For instance: \_\_\_\_\_
- ☐ yes, structural measures in the health system. For instance: \_\_\_\_\_
- ☐ yes, structural measures in public administration. For instance: \_\_\_\_\_
- ☐ yes, other measures. For instance: \_\_\_\_\_
- ☐ n.a.

**Question sector: In which sectors do you work (multiple answers possible)?**

- ☐ health sector
- ☐ environment sector
- ☐ research
- ☐ education
- ☐ administration
- ☐ public administration
- ☐ other. Which? \_\_\_\_\_
- ☐ n.a.



## Supplementary Material 2

### Recommendations for future implementation

Category	Recommendation
<b>Environmental prevention</b>  <b>3 x</b>	Appropriate biotope management - also outside protected areas
	Appropriate biotope management to prevent further spread monitoring
	Awareness raising
	Central reporting center for health relevant neobiota
	Combat emerging (potentially) invasive alien species from the beginning
	Control of imports
	Creating awareness also in schools
	Detecting and removing allergenic neophyta early, when populations are still relatively small
	Education of the population, control of seed (ragweed) if possible
	Expansion of education, monitoring, mapping and early warning systems
	Implementation of a national plan for the early detection and control of health-related neobiota
	Increased climate protection
	Increased training and information in municipalities
	Information for garden owners
	Information, capacity building, training (including in forestry, agriculture), monitoring, networking of public authorities
	Information, data collection, data interpretation
	Monitoring of hibernating mosquitos - possibly control measures
	Monitoring of neobiota
	More funding for vector surveillance
	Prevention of spread (e.g. ban on birdseed contaminated with ragweed seeds)
	Prevention of the further spread of health relevant neobiota, definition of introduction pathways, early warning system, action plans for emerging alien species and species already in neighbouring countries, information campaigns

Repeated detailed information of the population about dangers and handling of (potentially) invasive alien species, e.g. via public media such as TV, community newspaper, brochures, bulk mail, etc.

Reporting centers for the occurrence of neobiota at federal level

Vector control

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### Environmental control

Action days to combat invasive neophytes involving municipalities

Active control: Extraction, excavation, mowing, use of herbicides. Observing and, if necessary, repeating the action

Adapted timing of mowing in all regions affected by ragweed

Appropriate control (e.g. ragweed control: to root out with the roots)

Consistent implementation of existing management plans

Control of populations

Cutting out of giant hogweed; ripping of ragweed; prevention of spread of contaminated earth material

Eradication of *Ambrosia artemisiifolia* along traffic routes in a targeted and timely manner

Information and guidance for municipalities and garden owners

Legally anchored management of problematic species

Mosquito control (standing waters)

Neophyte aftercare and precaution at major construction sites

Neophyte control applying various techniques (scouring, mowing, ringing, ...)

Ragweed control

Reduction of neophytes

Removal of invasive species, where appropriate - preliminary clarification of costs, benefits, efficiency and relevance => health risk, dispersal potential, sustainability of the measures

Removal of knotweed

Removal of relevant plants or breeding grounds of relevant animal species

Stronger involvement of the population

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### Education

Awareness raising about alien species, particularly in relation to infectious diseases

Awareness raising among citizens

Force identification of health relevant alien species by the general public

Further training if required by the responsible authorities

Information events in schools, communities, nature parks

Information of affected professional groups  
Internet information of citizens and target groups  
Regular training of practitioners  
Regular training sessions for the public health service  
Regular updates on status and trends of relevant species would be desirable  
Scientific networking  
Special training on ragweed for the concerned road service authorities and other authorities of the other federal states  
Stronger technical preparation of this topic, more events, training  
Training of employees of municipalities, nature guards, farmers, gardeners  
Workshops for specific groups, excursions

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## **Research**

Development of monitoring systems, prognosis models, studies to characterize vulnerable groups of citizens  
Early detection through taxonomic expertise and molecular methods  
Efficiency of control measures  
Further master theses and other studies  
Implementation of various methods (without use of pesticides)  
Increased research budget for applied research  
Optimization of control measures, improved scientific bases of biotope management  
Projects on ecology, management and risk analysis of neobiota  
Research on distribution and spread of relevant neophytes in Tyrol in the form of dissertations, master and bachelor thesis  
Status survey and interpretation  
Symptom forecasting (e.g. for allergic persons)  
Targeted calls in funding programs  
Vector surveillance should be of the highest scientific standard

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## **Preventive medicine**

Appropriate training and awareness raising  
Awareness raising campaigns, especially on Ambrosia, training of medical professionals, pharmacists  
Diagnostic measures (preparation for various pathogens to arrive)  
Improvement of modelling  
Information

Information, capacity building in public health systems, monitoring systems, development of forecasting models, networking of public authorities  
More funding for vector-associated pathogens  
Mosquito repellent  
Risk assessment  
Vaccinations

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#### **Legislative measures**

Anchoring of neophytes in nature conservation laws of federal states or nationwide legislation  
Ban on the release of harmful (and other) neobiota: regulations for construction companies  
Better anchoring of legal measures to health-relevant neobiota  
Extension of mandatory reporting  
Implementation of the polluter pays principle  
Legal definitions on dealing (e.g. control, disposal) with particularly invasive species  
Mandatory reporting of ragweed and regulations for mandatory elimination  
Monitoring and reporting obligations of competent institutions (road traffic administration, water traffic administration, federal railway services ...)  
Obligatory control of large populations  
Reporting obligations  
Responsibilities for control measures need to be clarified

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#### **Structural measures - public administration**

Collection of reports of occurrences  
Establishment of a contact point for newly introduced species  
Information for municipality workers  
Neobiota have been considered in the job descriptions of public administration of the Federal State Tyrol

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#### **Structural measures - health system**

Education of affected occupational groups  
Increase attractiveness of public health work for medical doctors

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#### **Therapy**

Extended approvals of drugs  
Therapies with respect to respiratory illnesses, impairments due to aggravation of allergens (ragweed); securing human resources

Vaccinations (e.g. related to allergies)

**Other measures**

Awareness raising among the general public and the public administration

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