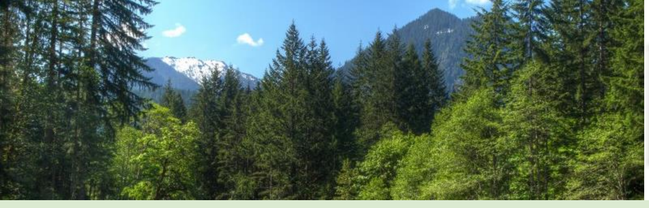



Philipps-Universität Marburg | FB 19 – Geographie | Globaler Wandel

Thorsten Nather | Alexander Schupp | Jan Schwalb | Andreas Schönberg

Bioinvasion – Distribution Patterns for Invasive Species on a Global Scale

Definition | Species are classified as invasive when they appear outside of their natural habitat and harm their newly occupied habitat in manners of ecosystems, biotopes, species or human health.[9,15] This can happen either intentionally or unintenionally.[7] A clear distinction between invasive species and non resident species or neobiota isn't always possible due to different focuses in fields of science and different main focuses in guidelines.[9]

own depiction based on *Nentwig 2010 & Klingenstein et al. 2005*

Flora and Fauna
Native, naturalized and unsettled animals and plants

Native species
(in regards of nature conservancy and science)
Native/established species and archaeobiota

Indigenous animals and plants
(regarding to e.g. BNatSchG)
= Native/established species, archaeobiota and established neobiota

Native species
Established naturally before human intervention OR after due to climate changes and evolution

Non resident species
Established due to human intervention either on purpose or accidentally OR evolutionary emerged under participation of non native species

Unsettled indigenous
Only occasionally and uncommon be found

Established indigenous species

Archaeobiota
Species introduced before 1492 and now established

Neobiota
Introduced after 1492

Established neobiota
Established over several generations or long time

Unsettled neobiota
Only occasionally and uncommon to be found

Not invasive
No ecological damage

Invasive
Generates ecological damage

For further information please scan the QR-Code with an appropriate device.

Importation of a species to an area outside of it's natural habitat with human influence

Accidentally

On purpose

Species remains in habitat or human sway

Introduced into nature trough

Escape

Liberation

No establishing

No establishing

No establishing

Establishing

After the import, invasive species tend to adapt and increase their numbers. Thus, they also enlarge their territory. As a result, the effects on native species and economy grows. In the final phase, all habitats in the new territory are occupied.[15]

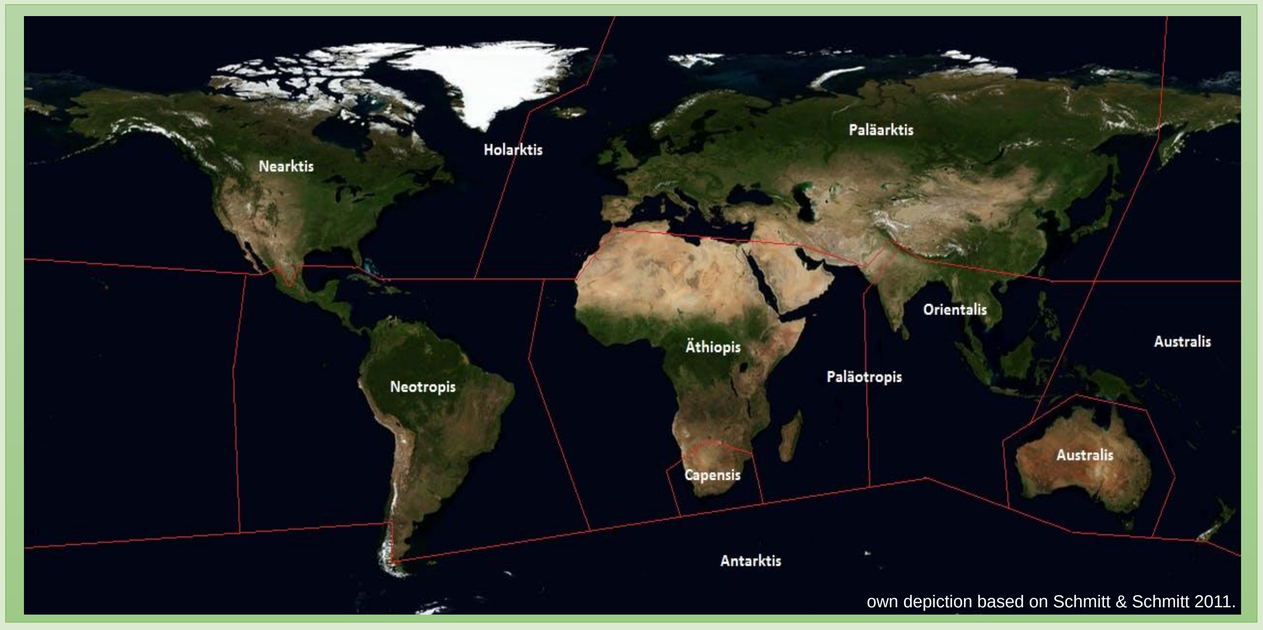
Import

Establishing and adaption

Invasion

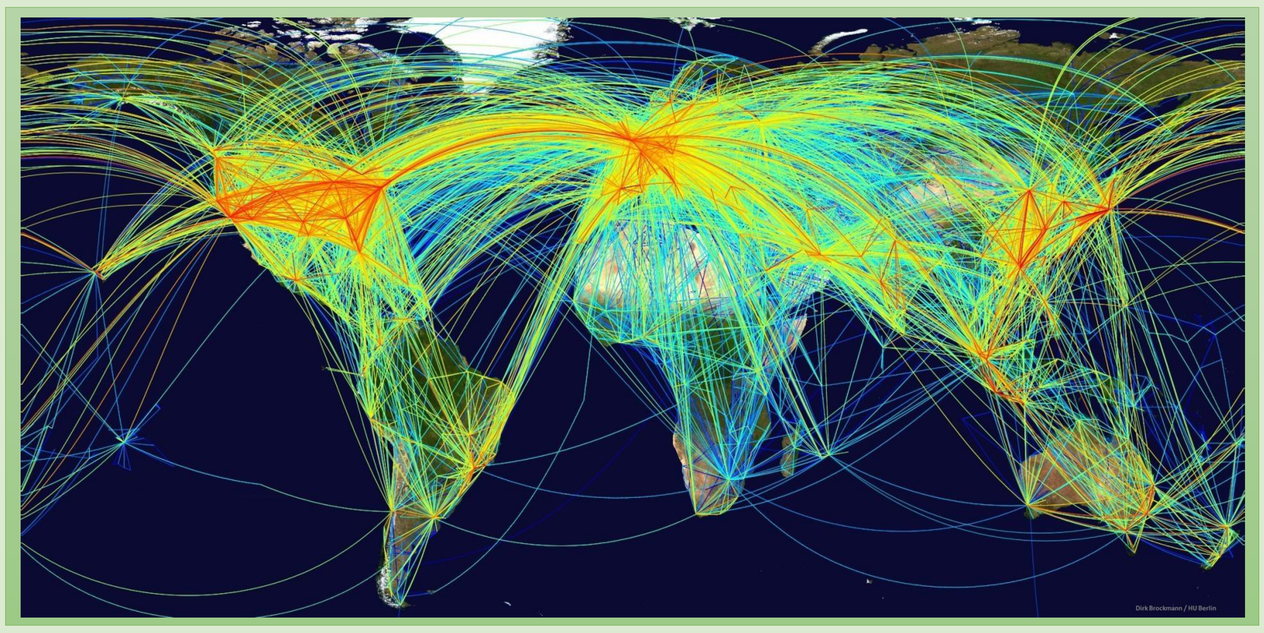
Repletion

Transport | Biological invasions strongly depend on human trade and transport.[16, 14] First indicators for traiding between humans settlements can be described since the Neolithic.[15] The further development of trading in times of the Roman empire lead to an sufficient transportation system all over Europe.[20] Three events linked the worlds floral and faunal realms like nothing before. The first impact took place in the year of 1492, with the end of the middle age in Europe, demographic changes and the discovery and colonization of the new world.[3] From the 18th century onwards industrialization, the extension of infrastructure, higher mobility and emigration from europe made the world even smaller.[2, 13] The third big impact is the modern day globalization and flow of goods in scales humankind have never seen before.[11, 19]



own depiction based on Schmitt & Schmitt 2011.

Flora and Fauna Realms | The figure above demonstrates the borders of the Flora and Fauna Realms on a satelliteborne world map. These borders are natural barriers like high mountains, oceans and deserts. Based on these barriers plants and animals are not able to overcome these obstacles. This results in an insurmountable seperation which can only be undermined by humankind and it's activities.



Worldwide transportation | Through out the increasing quantity of transported goods and global distribution the risk of Bioinvasions has dramatically risen in the past decades. The map above demonstrates the main global trading routes. This includes all transportation options (e.g. airborne and seaborne). Local maxima can be oberserved in Europe, North America and Asia.

Example | The Asian Longhorn Beatle

Pathway

- The Asian longhorn beetle is transported on infested fire wood, containers, pallets & dunage.
- Has reached the United States and other countries in wood packing materials headed from Asia.
- It is found frequently at ports and warehouses.
- So far the occurance is limited to urban areas.[6]

Nutrition

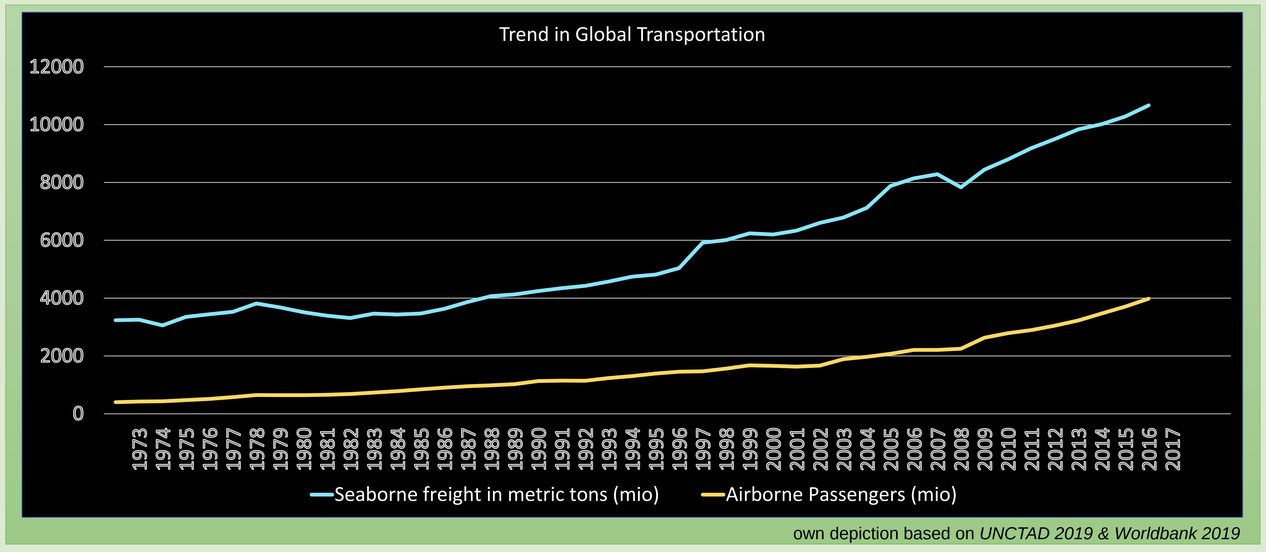
- Adult Asian longhorn beetles feed on leaves, petiole and twigs preferred on hardwood trees.
- They appear to attack healthy trees as well as stressed trees.
- Eggs are injected under the bark surface, where they hatch into larvae.
- The tunnels oft he larvaes destroy the structural integrety of the trees.[6]

North America Impacts

- 30-35% of trees in urban eastern states are susceptible to its attack.
- This could lead to a loss of 1.2 billion trees with an estimated value of $669 billion.
- If the beetle reaches natural forests, the potential impact could reach to the elimination of 71 billion trees valued at over $2 trillion dollars.
- In case of such an dramatic loss of trees, the whole forest ecosystems could be seriously damaged.[17, 21]

Management

- Eradication programms were implemented by the US Animal and Plant Health Inspection Service (APHIS) by the use of insecticides.
- Intensive visual inspections when the beetle is reported.
- Trees at high risk are felled and chipped (400m from the edge of the known infestation).[17]



own depiction based on *UNCTAD 2019 & Worldbank 2019*

Development of Global Trading | Compared to 1970 the volume of seaborne transportation is five times higher and airborne passenger transportaion has even increased by the factor of ten.[22, 23] About 90% of total international transportation of goods is carried out by seaway[5], while ballast water from cargo ships alone transfers high amounts of species alone.[18, 4] The key to handle such massive amounts of goods is the invention of the standardized ship container and huge improvements in mechanical engineering.[1, 10] While cargo transfer via plane takes a minor part for world economy, many invasive species are transfereed with luggage of passengers.[5, 12] Thus, the chances for bioinvasions has dramatically increased by overcoming natural borders of the floral realms.

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