Trade-off dilemmas between provisioning ecosystem services and non-native organisms

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Structure

Ecosystem services, use & status
Domestication & non-natives
Niche construction & cultural NC
Consequences & examples
Conclusions & warning
Human use of provisioning services

Carpenter et al. 2009 PNAS
Status of provisioning services
Human domination of the Earth

• More land was converted to cropland in the 30 years >1950 than 1700 - 1850.
• Biologically available N in terrestrial systems doubled, P tripled since 1960
• >50% of all the synthetic nitrogen fertilizer ever used has been used since 1985
A map depicting known or likely centers of plant domestication.

Dolores R. Piperno PNAS 2017;114:6429-6437
Centres of origin vs. production
Domestication as niche construction

“niche-modifying behaviors alter selection pressures on organisms living within the niche that shape their own and other organisms’ evolutionary trajectories” (Zeder 2016)
Consequences of NC

New (alien) primary producer appears in new habitat

Habitat is modified to favour new PP

Other organisms react
- New trophic links form (Ostrinia nubilalis)
- Community rearrangement
Relocative niche construction

Moving into anthropogenic niches and developing relationships with humans:
- neutral commensal (mice, weedy plants)
- or negative parasitic (lice, kudzu)

Advantage: lack of natural enemies => promote increased adaptive plasticity by reducing the costs of plasticity and increasing its benefits (Huang et al. 2015).
Consequences of CNC

CNC: cultural niche construction – humans continue to manage new PP

Intentional: introductions of new species

[Intentional pest introduction – no examples]

- Pollinators (honey bee)
- Symbionts (Rhizobium inoculation)
- Natural enemies of pests
Consequences of intentional introductions

“Success stories” – kiwifruit industry in NZ, bumblebee pollinators

Unintended negative effects:

H. axyridis introduction for biocontrol; Europe, N America => detrimental for native coccinellids

Host change of Argentine stem weevil parasitoid, NZ (Barratt & al. 1997 Env Entomol)
Emerging problems

Argentine stem weevil Listronotus bonariensis (accidentally introduced)

Parasitoid Microctonus hyperodae Loan (intentional introduction)

Plant: tetraploid Italian Lolium multiflorum, diploid L. perenne and diploid hybrid L. perenne ×L. multiflorum;

compare with observations in 1990s using the same host plant species

parasitism on diploid perennial: 46%, diploid hybrid: 52% vs. 75% in both during 1990s

parasitism on tetraploid did not change

Goldson & Tomasetto 2016 Front Pl Sci 7:1259
Consequences of CNC

CNC: cultural niche construction – humans continue to manage new PP

*Unintentional* introductions of new species
Invasion of maize-eating caterpillars worsens hunger crisis in Africa

Crops that feed 200 million people at risk from destructive march of fall armyworm, as agriculture experts call for urgent action

Ruth Maclean In Dakar

Wednesday 25 October 2017 12.59 BST
Fall Armyworm rapid spread in Africa

Early 2016
(Georgen et al. 2016)

April 2017

August 2017

Click [here](#) to download the 10 page summary of the evidence note

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Possible impact of invasions on C storage
Conclusions

Primary production linked to NC & CNC

Moving species through biogeographical barriers is integral part of CNC

Species will fit into the “new ecological theatre”, creating wanted & unwanted, predictable & unpredictable changes

Network view can give help to interpret or predict effects & live with the dilemma
Warning 1: The ultimate risk of invasions

From Lovei 1997, Nature
Warning 2: ESs need biodiversity

Isbell & al. 2015. Nature