Arthropod identification using DNA metabarcoding
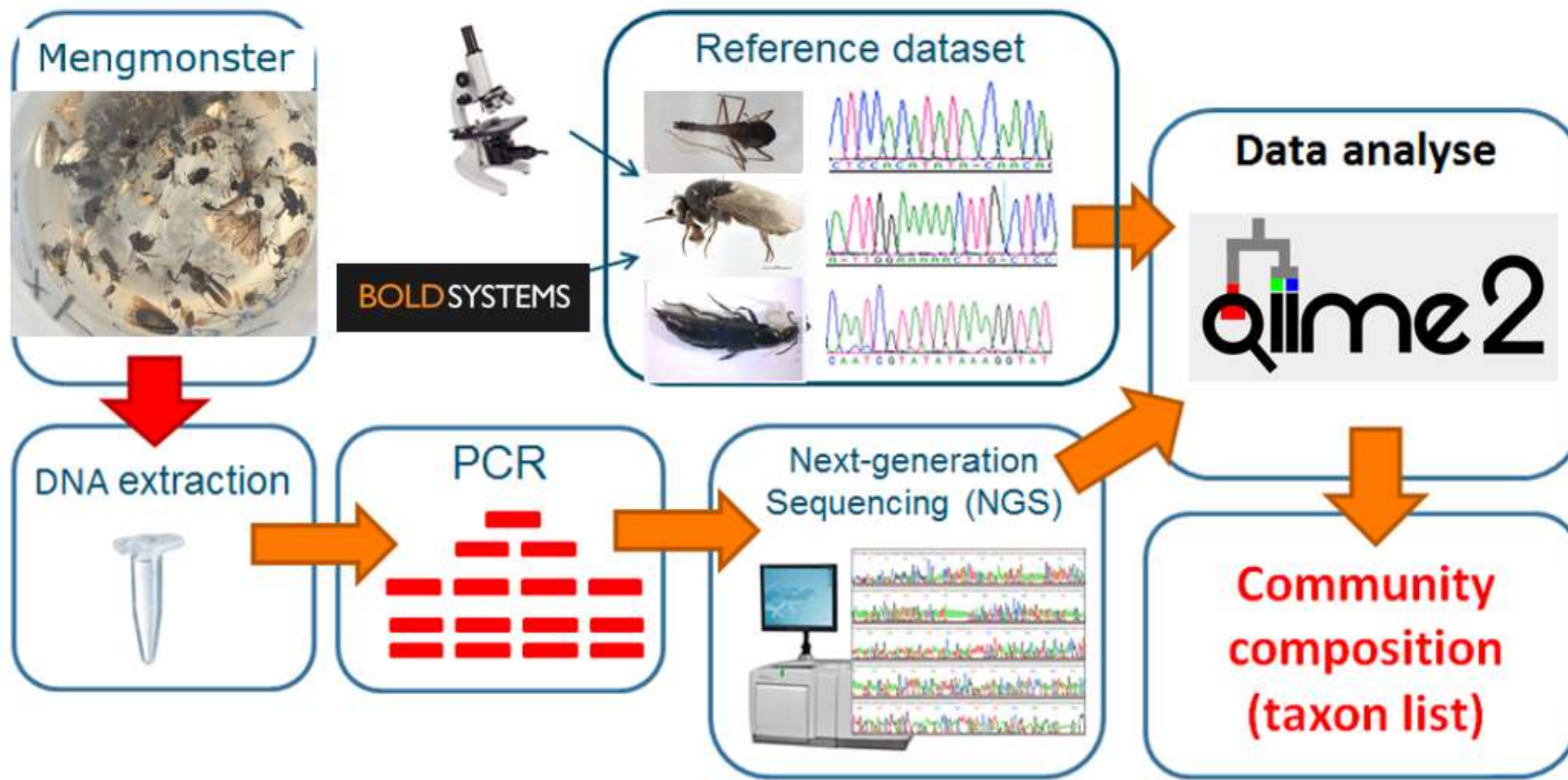
And combining results with AI and RS

Marcel Polling and Arjen de Groot

Team Animal Ecology, WENR

17/11/2022 RS&AI

DNA Metabarcoding

Insects collected using many different traps

▶ Projects on biodiversity, land use management, agriculture etc.

Projects: e.g. KB Efficiente monitoring for durable agriculture, OBN litter degradation micro-arthropods, PPS DZK Herb rich Grasslands, EcoCertified, SISEBIO (Univ. Barcelona)

# DNA and morphology match very well, but DNA finds many more species
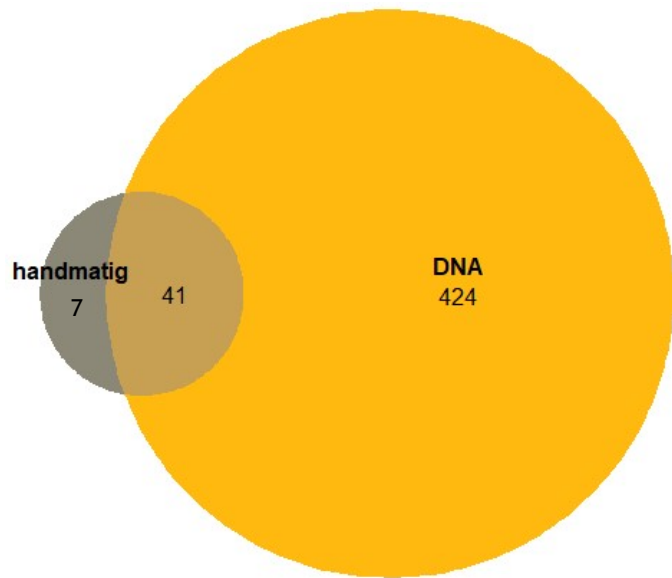
PPS Kruidenrijke graslanden

Staphorst Grassland – Dunnink 3 2009 Tube 40 (E201387)			Morphology		DNA	
Order	Family	Species	count	%	reads	%
Araneae	Lycosidae	*Trochosa ruricola*			12	0.2
Coleoptera	Staphylinidae		1	1.7		
Coleoptera	Staphylinidae	*Philonthus cognatus*			45	0.7
Coleoptera	Staphylinidae	*Philonthus splendens*			135	2.2
Diptera	Anthomyiidae		2	3.4		
Diptera	Anthomyiidae	*Delia florilega*			1757	28.8
Diptera	Anthomyiidae	*Delia platura*			155	2.5
Diptera	Cecidomyiidae		1	1.7		
Diptera	Cecidomyiidae	*Campylomyza flavipes*			16	0.3
Diptera	Ceratopogonida		1	1.7		
Diptera	Ceratopogonida	*Culicoides obsoletus*			14	0.2
Diptera	Ceratopogonida	*Culicoides punctatus*			273	4.5
Diptera	Chironomidae		5	8.6		
Diptera	Chironomidae	*Camptocladius stercorarius*			100	1.6
Diptera	Chironomidae	*Procladius culiciformis*			1219	20.0
Diptera	Chironomidae	*Pseudorthocladius*				
Diptera	Chironomidae	*Pseudorthocladius curtistylus*			9	0.1
Diptera	Chironomidae	*Pseudorthocladius filiformis*			24	0.4

Advantages:

- Faster and cheaper than morphological identification

- Objective: does not rely on taxonomic expertise

- Higher resolution (species level) allowing much more detailed ecological interpretations

- Semi-quantitative results possible
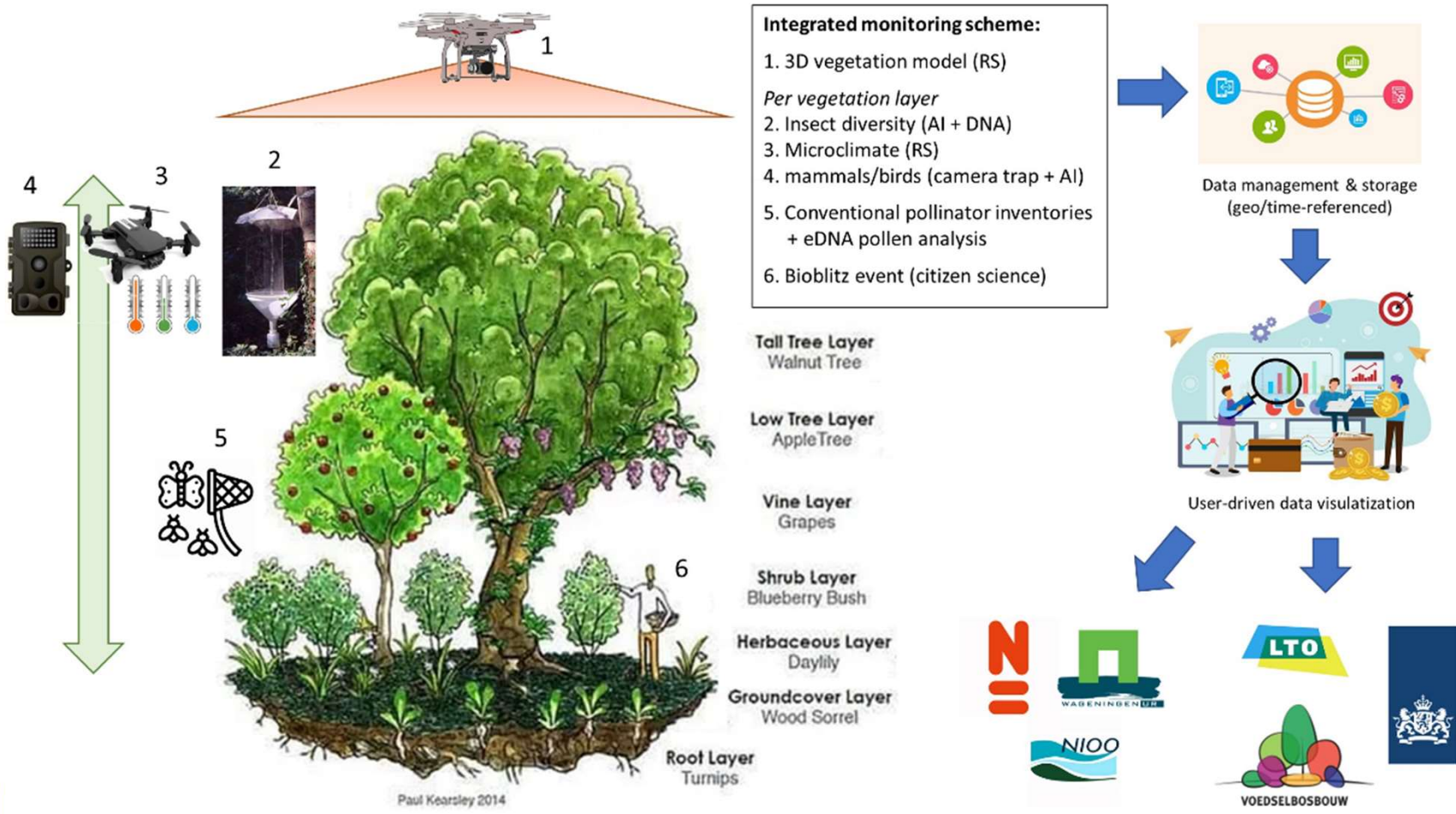
- Species ID for juvenile and subadult species
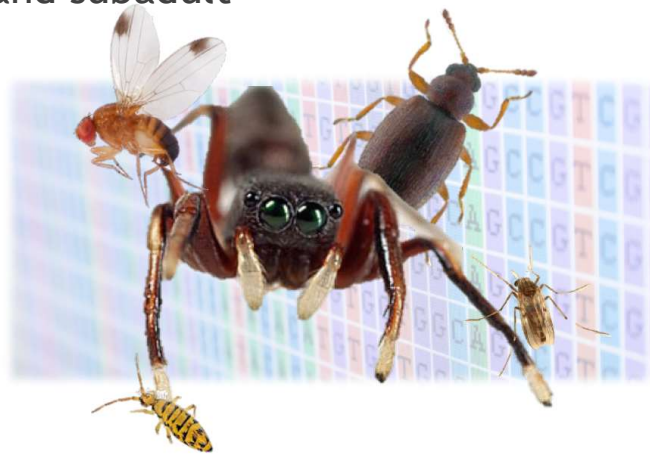
Disadvantages:

- No distinction between adults and juveniles possible

- Dependant on availability reference sequences

- No absolute quantities, abundance information lost

KB36 Cluster 5: Data Driven Biodiversity (food forests)

Collaboration with Earth Observation and Environmental Informatics group, Biodiversiteit en Beleid and FFC Post Harvest Technology

Integrated monitoring scheme:

1. 3D vegetation model (RS)

Per vegetation layer
2. Insect diversity (AI + DNA)
3. Microclimate (RS)
4. mammals/birds (camera trap + AI)

5. Conventional pollinator inventories + eDNA pollen analysis

6. Bioblitz event (citizen science)

Tall Tree Layer
Walnut Tree

Low Tree Layer
AppleTree

Vine Layer
Grapes

Shrub Layer
Blueberry Bush

Herbaceous Layer
Daylily

Groundcover Layer
Wood Sorrel

Root Layer
Turnips

Paul Kearsley 2014

Data management & storage (geo/time-referenced)

User-driven data visulatization

Integrating technologies showcase: AI and DNA for insect abundance estimations