Additional file to:

What evidence exists on the impact of agricultural practices in fruit orchards on biodiversity? A systematic map

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Please find in this additional file photographs of different orchard systems, as well as tables and graphs providing additional information to the main article. To avoid confusion with the graphs and tables of the main text, we call them here "illustations".

Pictures

Picture 1: Orchards embedded in the landscape (top: Peloponnese, Greece; bottom: Les Baux-de-Provence, France) ................................................................. 2
Picture 2: Orchards embedded in the landscape (top: Sicily, Italy; bottom: Crete, Greece) .................... 3
Picture 3: Contrasting low-stem orchards ................................................................. 4
Picture 4: Water body near an orchard (top) and an industrial low-stem orchard bordered by mature grown trees .............................................................................................................. 5
Picture 5: Flower-strips near an orchard and a bee visiting an apple blossom. (Photo: Gisela Lüscher) 6
Picture 6: Highly industrialised low-stem orchards (top: berries; bottom: fruits) ........................................ 7
Picture 7: Polyculture landscape with cereals, grassland, and orchard-systems (low- and middle-stem and berries in the front of the upper picture) ........................................................................ 8
Picture 8: Middle stem orchard with old and newly planted trees ......................................................... 9
Picture 9: Traditional small high-stem orchards in Switzerland ............................................................... 10
Picture 10: Traditional orchard gardens using the orchard ground as horse pasture (top, Switzerland) or pig run (bottom, Greece) ................................................................. 11
Picture 11: Definition of four habitats in low-stem orchards .................................................................... 12

Illustrations

Illustration 1: Terms of indicator species groups (ISG) and agricultural practices in orchards (APO) chosen to compose the search strings .............................................................................................................. 13
Illustration 2: Inventory of orchard practices / Cultivation level I - III .............................................. 14
Illustration 2 (continued a): Inventory of orchard practices / Cultivation level III and options .... 15
Illustration 2 (continued b): Inventory of orchard practices / Cultivation level III and options ......... 16
Illustration 3: Basic search strings for literature databases (English), specialist sites and the internet (English, German, and French) .............................................................................................................. 17
Illustration 4: Mapping process and activities ................................................................................... 18
Illustration 5: Step-by-step exclusion-scheme for the searches and the exclusion process from the online search to the full-text assessment ................................................................. 19
Illustration 6: Digital check within the reference manager .................................................................. 20
Illustration 7: Structure of the map in Access®. ...................................................................................... 21

Pictures: So far not otherwise indicated, all photos by M. van der Meer
Picture 1: Orchards embedded in the landscape (top: Peloponnese, Greece; bottom: Les Baux-de-Provence, France)
Picture 2: Orchards embedded in the landscape (top: Sicily, Italy; bottom: Crete, Greece)
Picture 3: Contrasting low-stem orchards
Picture 4: Water body near an orchard (top) and an industrial low-stem orchard bordered by mature grown trees
Picture 5: Flower-strips near an orchard and a bee visiting an apple blossom. (Photo: Gisela Lüscher)
Picture 6: Highly industrialised low-stem orchards (top: berries; bottom: fruits)
Picture 7: Polyculture landscape with cereals, grassland, and orchard-systems (low- and middle-stem and berries in the front of the upper picture).
Picture 8: Middle stem orchard with old and newly planted trees.
Picture 9: Traditional small high-stem orchards in Switzerland
Picture 10: Traditional orchard gardens using the orchard ground as horse pasture (top, Switzerland) or pig run (bottom, Greece).

Additional file - systematic map – orchards, agricultural practices, & biodiversity indicator species groups; van der Meer et al.
Picture 11: Definition of four habitats in low-stem orchards.
Illustration 12: Terms of indicator species groups (ISG) and agricultural practices in orchards (APO) chosen to compose the search strings.

An asterisk (*) has been used as a wildcard to obtain suffixed and plural forms if necessary.

| Orchard* + | 
| --- | --- |
| ISG term | APO term |
| **Main:** | **Main:** |
| amphibian*, bees, bird*, butterfly*, carabid*, flora, grasshopper*, mammal*, slug*, snail*, spiders, reptile* | fertil*, hail*, irrigation, mow*, mulch*, pesticide*, insecticide*, fungicide*, pruning, thinning, tillage |
| **Secondary (wildcards not shown):** | **Secondary (wildcards not shown):** |
| bat, blossom, flower, frog, mouse, mice, toad, weed | canopy, cover, crop, disking, defoliation, extirpator, field cultivator, grazing, grid, grubber, habitat, harvest, high stem, lumber, management, meadow, nesting, plough, plow, ripper, sawnwood, timber |
## Liste aller Feldmassnahmen in den drei Obstbausystemen Nieder-, Mittel- und Hochstamm (= Habitat-Niveau I) *

tegliedert in die Bewirtschaftungs-Niveaus I – III in den Subhabitaten (= Habitat-Niveau II)

| Anlage   | Ernte               | Laubzone  | Boden (Fahrgasse, Baumstreifen, Wiese)** |
|----------|---------------------|-----------|------------------------------------------|
| Düngung  | Erntedurchführung   | Bodenpflege|                                          |
| Menge    | Typ. Ernte          | Falllaub/Schnittholz|                                 |
| Typ. Bewässerung | Zeitpunkt (Störungsfaktor) | unterstützende Präparate|                                    |
| Zeitpunkt/Dauer (Störungsfaktor) | Düngemittel|                                        |
| Hilfsmittel | Laub-/Holzarbeiten | Düngurad|                                        |
| Netze und Überdeckung | Auslauben (auch Sporenreduktion)**| Durchführung|                               |
| Maschinenale | Typ. Laubarbeiten| Häufigkeit (Störungsfaktor)|                                   |
| Verhüllung/Abdeckung | Zeitpunkt (Störungsfaktor) | Mengen (in % der Normängage)|                           |
| Zäune/Kerzen/Stützen | Ästachlit| Zeitpunkt (Störungsfaktor)|                                |
| Material (Abmaschung) | Erneuerungssystem| Pflanzenschutz - Begrünung|                               |
| Wuchshilfen | Zeitpunkt (Störungsfaktor) | Pflege|                                        |
| Pflanzenschutz - Pestizide (gg Fauna) | Behangregulierung | Anzahl Schnitte im Jahr|                               |
| Insektenregulierung | Typ. Biolog. andere | Begasung|                                           |
| Feinde    | Typ. Biolog. chemisch| Dauer|                                            |
| Muschregulierung | Typ. Biolog. manuell | Flüssig - Begasung|                                        |
| Typ. Mausregulierung | Zeitpunkt (Störungsfaktor) | Gassen - Allersanz|                                      |
| Nützlinge - Biologische Schädlingsbekämpfung | Holzschnitt | Mahlochn|                                         |
| Ansiedlung | Typ. Holzschnitt| Typ. Begrünung|                                       |
| Schneckenregulierung | Wundbehandlung| Zeitpunkt (Störungsfaktor)|                                  |
| Typ. Schneckenregulierung | Zeitpunkt (Störungsfaktor) | Zeitpunkt (Störungsfaktor)|              |
| Pflanzenschutz - präventive Massnahmen | Pflanzenschutz - Pestizide (gg Fauna) | Pflanzenschutz - Bodenbearbeitung| |
| Analysen       | Bakterizide         | Durchführung|                                         |
| Reduktion Frostschaden | Häufigkeit (Störungsfaktor) | Häufigkeit (Störungsfaktor)|                              |
| dünndünndünnende Massnahmen | Mengen| Zeitpunkt (Störungsfaktor)|                                      |
| Anlagenmassnahmen | Typ. Bakteriz 
| Applikationstechnik | Zeitpunkt (Störungsfaktor) | Typ. Bodil: Abdeckung|                                    |
| Maschregulierung | Fungizide| Typ. Bodil: manuell|                                        |
| Mausschutzgitter (Anlage) | Häufigkeit (Störungsfaktor) | Typ. Bodil: mechanisch|                                |
| Mausschutzgitter (Wurzelhölzer) | Mengen| Typ. Bodil: thermisch|                                        |
| Nützlinge – Förderung | Typ. Fungizide | Pflanzenschutz - Pestizide (gg Flora)| |
| Strukturen | Zeitpunkt (Störungsfaktor) | Unkrautregulierung herbizidfrei|                                         |
| Repellenten | Insektilize/Abartizide | Häufigkeit (Störungsfaktor)|                                  |
| gegen Wildtiere/Vogelbestand | Häufigkeit (Störungsfaktor) | Herbizid Einzelsockelbehandlung|                                |
| Mengen | Insektilize/Abartizide | Mengen|                                         |
| Typ. Insektilize/Akzeptize | Mengen| Typ. Herbizid|                                         |
| Zeitpunkt (Störungsfaktor) | Mengen| Zeitpunkt (Störungsfaktor)|                                    |
| Bemerkungen| * Nicht alle aufgeführten Feldmassnahmen werden in jedem Obstbausystem durchgeführt |
| Bewirtschafts-Niveau I | ** In HoST als Wiese erlaubt, in MST und NIST separate Erfassung für Baumstreifen und Fahrgasse. |
| Bewirtschafts-Niveau II | *** Ist im Obstbau eher unüblich, aber möglich. |

Continued on next pages
Illustration 14: Inventory of orchard practices / Cultivation level III and options

Continued on next side
### Illustration 15: Inventory of orchard practices / Cultivation level III and options

| Additional file - systematic map – orchards, agricultural practices, & biodiversity indicator species groups; van der Meer et al. |
Illustration 16: Basic search strings for literature databases (English), specialist sites and the internet (English, German, and French)

| English: |  |
| --- | --- |
| orchard* |  |
| AND (pesticide* OR insecticide* OR fungicide* OR fertili* OR hail* OR irrigation OR mow* OR mulch* OR pruning OR thinning OR tillage) |  |
| AND (spiders OR amphibian* OR bird* OR bees OR butterfl* OR carabid* OR flora OR grasshopper* OR mammal* OR slug OR snail OR reptile) NOT (mite OR tropic) |  |

| German: |  |
| --- | --- |
| obstbau |  |
| AND (pestizid OR insektizid OR fungizid OR düng* OR hagelschutz OR bewässerung OR mähen OR mulch OR schnitt OR ausdünnung OR bodenbearbeitung) |  |
| AND (spinnen OR amphibie OR vogel OR biene OR schmetterling OR carabid OR flora OR heuschrecke OR säuge OR reptil OR schnecke) NOT (milbe OR trop*) |  |

| French: |  |
| --- | --- |
| verger |  |
| AND (pesticide OR insecticide OR fongicide OR fertilisation OR grêle OR irrigation OR fauche OR mulch OR taille OR éclairc* OR sol) |  |
| AND (araignée OR amphibien OR oiseau OR abeille OR papillon OR carabid OR flore OR sauterelle OR mammifère OR limace OR escargot OR reptile) NOT (tropi*) |  |
Illustration 17: Mapping process and activities

**NEED:** Identify literature and scientific evidence possibly useful to score the impact of practices on organisms in orchards with a life cycle assessment tool: SALCA - Biodiversity

- Identify agricultural practices in low-stem orchards.
- Preliminary literature search → Systematic approach needed
- Outline a Systematic Map Protocol
- Systematic literature search
  - Consistency check
  - Additional validation
- **Inclusion / Exclusion Process**
  - Upon title - Online
  - Upon abstract - Skimming
  - Upon full-text – Digital Scan
  - Upon full-text – Reading
- Process data in spreadsheets
- Establish the **inventory** of 48 main agricultural practices structured in 3 cultivation levels and including 187 cultivation activities.
- Drafting the data to be extracted and their code sets
- Define: PICO elements, inclusion criteria, search strings, recorded fields, criteria for study quality assessment (SQA)
- Establish inclusion/exclusion scheme
- Record "citations" and download PDF in Reference Manager
  Amend citations
- **Mapping Process**
  - Create spreadsheets
  - Refine code sets
  - Reassessment of subsets by team members.
  - Define scores for SQA
- Evaluations of results
  - PICO elements
  - Further recorded data
- Discuss selected themes

**Redaction of a Systematic Map**

Manuscript submission including the **database** of identified literature and additional information.
| Eligibility scheme (inclusion/exclusion process) |
|-----------------------------------------------|
| **Eligible**                                   |
| 1st step: online search / reading title        |
| • ISG and/or APO                               |
| • Pip fruits, stone fruits, olives and kiwi;  |
|   nuts; citrus                                 |
| • Grown in dry, temperate and continental     |
|   climates worldwide                          |
| • APO-impact on ISG                            |
| • Habitat for ISG                              |
| Example: Effects of pesticides on songbird    |
|   productivity in conjunction with pecan      |
|   cultivation in southern georgia              |

| MAYBE                                         |
| • APO & Not-ISG                               |
| • Management System                           |
| • ISG life traits correlated to habitat       |
| • Culture: orchard might occur in text        |
| • Landscape influence on ISG or habitat       |
| • General terms like predators, enemies       |

Example: Viable bacterial population and  
persistence of foodborne pathogens on  
the pear carpoplane

| Not eligible                                  |
| • Berries, arable crops, vegetables, vineyards, forests or grasslands |
| • Tropical fruit and nut crops               |
| • Citrus fruits grown in tropical climates   |
| • No ISG                                     |
| • No APO                                     |
| • Agronomic aspects only                     |

|           |
| Download citation |  doubt / obvious | Exclusion |

| 2nd step: reference manager / reading abstract |
|-----------------------------------------------|
| • Same criteria as above +                    |
| • Management System                           |
| • ISG life traits correlated to habitat       |
| • Culture: orchard might occur in text        |
| • Landscape influence on ISG or habitat       |

Example: Changes in carabid beetle diversity  
within a fragmented agricultural landscape  
Check => orchards

Example: Attract and kill systems: efficiency  
against Ceratitis capitata (Diptera: Tephritidae)  
and effects on non-target insects in peach  
orchards

Check => No ISG

|           |
| Download *.pdf |  doubt / obvious | Exclusion |

| 3rd step: PDF / screening & reading full-text |
| Same criteria as above                        |
| Same criteria as above +                      |
| No comparator assessment                      |
| No outcome assessment                         |

| Inclusion                                      |
| Exclusion                                      |

ISG: flora of crops and grasslands (in extension: weeds), birds, mammals, amphibia, slugs and snails, spiders, carabids,  
butterflies, wild bees, and grasshoppers /// APO: all agricultural practices in orchards

Additional file - systematic map – orchards, agricultural practices,  
& biodiversity indicator species groups; van der Meer et al.
The digital check was implemented on the articles selected for the full-text screening. The search was first on "any field + PDF with notes", then on title and abstract within these grouped hits, to identify an order of importance.

The articles could then be grouped. Exporting the record numbers group by group allowed to build spreadsheets containing the information "term found by digital scan". Which in turn allowed the reviewer to know on what to focus in the respective articles. This might sound complicated and a lot of work - as a matter of fact it goes swiftly with a little exercise.

**Remarks**

In the reference manager, there is no need to set wildcards. E.g. "carab" will find carabe, carabid, carabidés, Carabiden etc. But to find words which can be syllabls of other words, there is need to set empty spaces in front and/or behind the searched term. E.g. to find "grass" it is needed to write " grass " - otherwise the search will return words like grasshopper, grassland etc.
Illustration 20: Structure of the map in Access®.

This structure allows to freely collating any information of the map, creating new spreadsheets by implementing specific queries.