

Selection of non-target species for host specificity testing

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Overall aim of setting up test lists in biological control

To select those species which will allow generalization of the results obtained in host-specificity testing to describe the host range of the candidate agent, without undue expansion of the test list

Considerations for selecting non-target species

- What can we learn from current practice in weed biological control?
- What are the determinants of parasitoid/predator host/prey ranges?
- What kind of methods have been used so far for selecting non-target species in arthropod biological control using entomophagous agents?

Current practice in weed biological control

- Based on recommendations made by Harris and Zwölfer (1968) and Wapshere (1974)
- Guiding principle: centrifugal-phylogenetic method i.e. selecting and testing plants of increasingly distant relationship to the target weed
 - > however, selection is often based on taxonomic considerations
- Additional safeguard criteria used to date:
 - crop plants/ plants on which the candidate biocontrol agent has been recorded/
 - host-plants of congeneric species/ plants with similar chemistry/morphology/
 - plants occurring in the same habitat

What are the determinants of parasitoid host ranges?

- Two principle factors:
 - (1) host taxonomy and (2) host ecology
- Taxonomic affinity is related to physiological (and morphological) defenses of hosts that may require specific adaptations
- Ecological characteristics that influence host use
 - host plant
 - the microhabitat in which it feeds
 - host's phenology

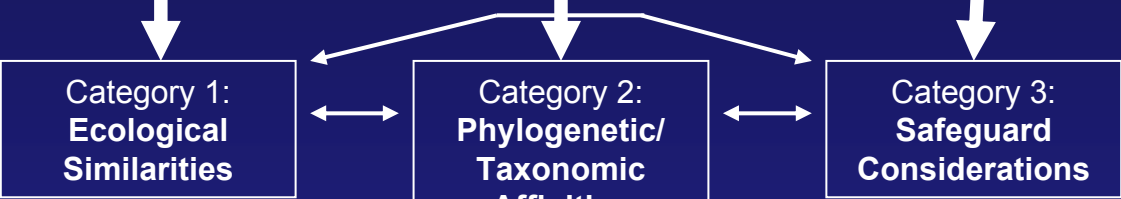
Methods used so far in arthropod biological control

- Recent studies are primarily for parasitoids (starting 1993; 19 published studies analyzed)
- Methods for selection of non-target species can be grouped into five categories
 - phylogenetic considerations
 - ecological parameters
 - biological parameters
 - socioeconomic information
 - availability

Recommendations for selecting non-target species

- Considers the peculiarities of fundamental and ecological host-ranges of parasitoids/predators
 - limited knowledge of taxonomic & biological information
 - phylogenetically disjunct host ranges
 - need to make the test list manageable
 - need to ensure that data generated is scientific

Ecological Host Range Information



Initial Test List

Filter 1: Spatial, Temporal & Morphological Attributes

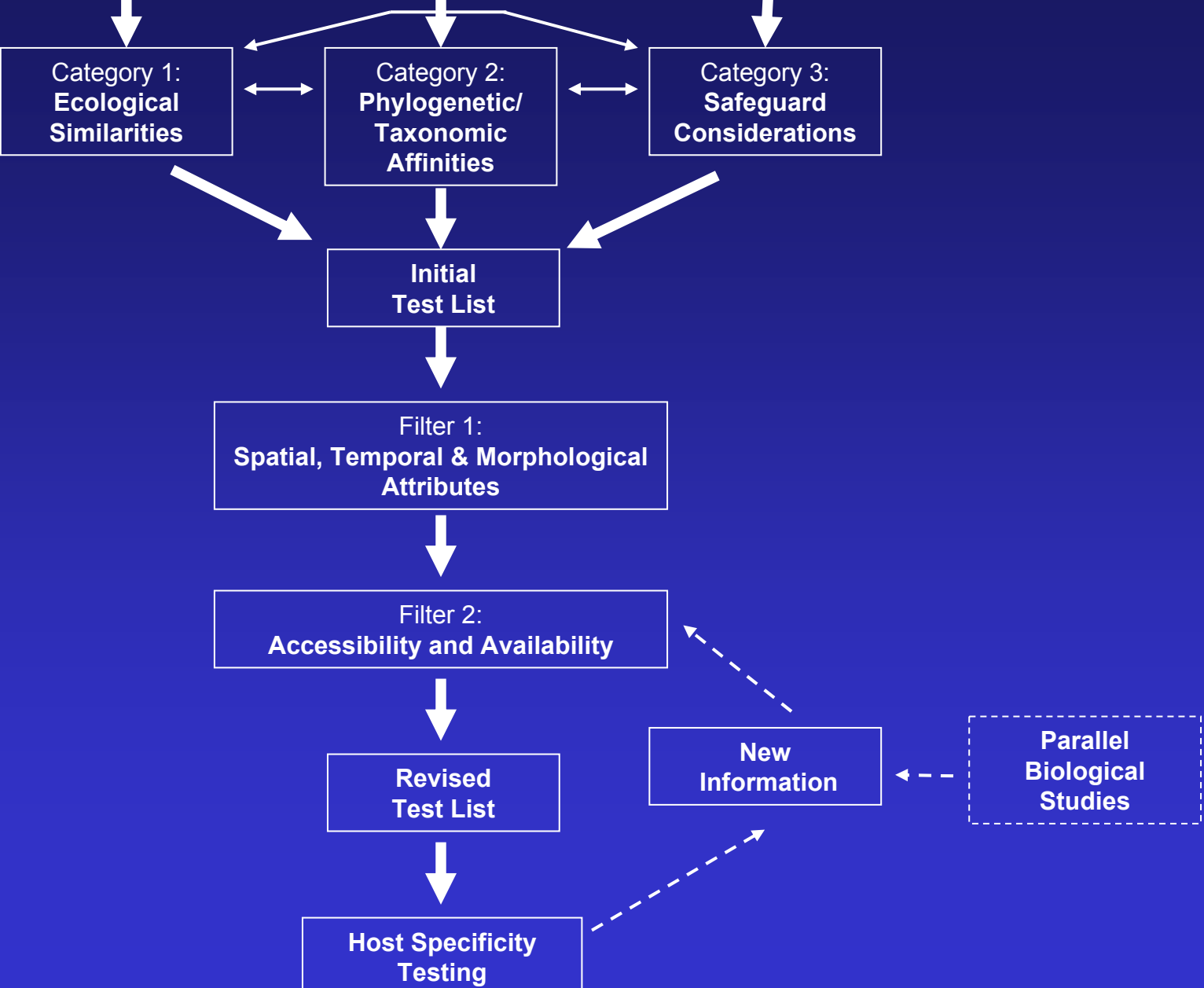
Filter 2: Accessibility and Availability

Revised Test List

Host Specificity Testing

New Information

Parallel Biological Studies



General considerations for use of flowchart

- Select a manageable number of species (i.e. 10 spp.; Sands 1997)
- Select species that represent more than one category (use categories simultaneously)
- Use surrogate species where appropriate (i.e. if can't obtain species of conservation concern)
- Select representatives of groups where more than one species could be tested
- Based on available information more species may be selected from one category
- Explain why each test species selected

Ecological host range information

- Literature records on field host ranges of biological control candidate and related species
 - Museum collection data
 - Ecological host range surveys in country of origin
 - Field surveys in area of introduction
 - Agent life history trait considerations (e.g. idiobionts/koniobionts, diapause, etc.)
- ➔ Use this information in Categories 1-3

Category 1: Ecological similarities

- Habitat – host habitat, adjacent, natural (representative selection based on country of origin information)
 - Host plants of target and closely related species
 - Feeding niche – root, galls, stem, seeds, etc.
- ➔ Species most ecologically similar should be considered first (“centrifugal principle”)

Category 2: Phylogenetic/ taxonomic affinities

- Adopt centrifugal phylogenetic approach (often based on taxonomy)
- Where appropriate select 2+ populations of the target and/or test species (intraspecific variation)
- Phylogenetically unrelated (outgroup) [in the context of the target habitat]

Category 3: Safeguard considerations

- Beneficial species (i.e. pollinators, biological control agents, etc.)
- Species of conservation concern (or surrogate) – consider keystone spp., flagship spp.
- Hosts of congeners of the biological control agent

Filter 1: Spatial, temporal and morphological attributes

- Non-overlapping geographic distribution (includes climatic requirements)
- Phenological asynchronisation
- Different morphological attributes (e.g. outside size range acceptable to agent)

Filter 2: Accessibility and availability

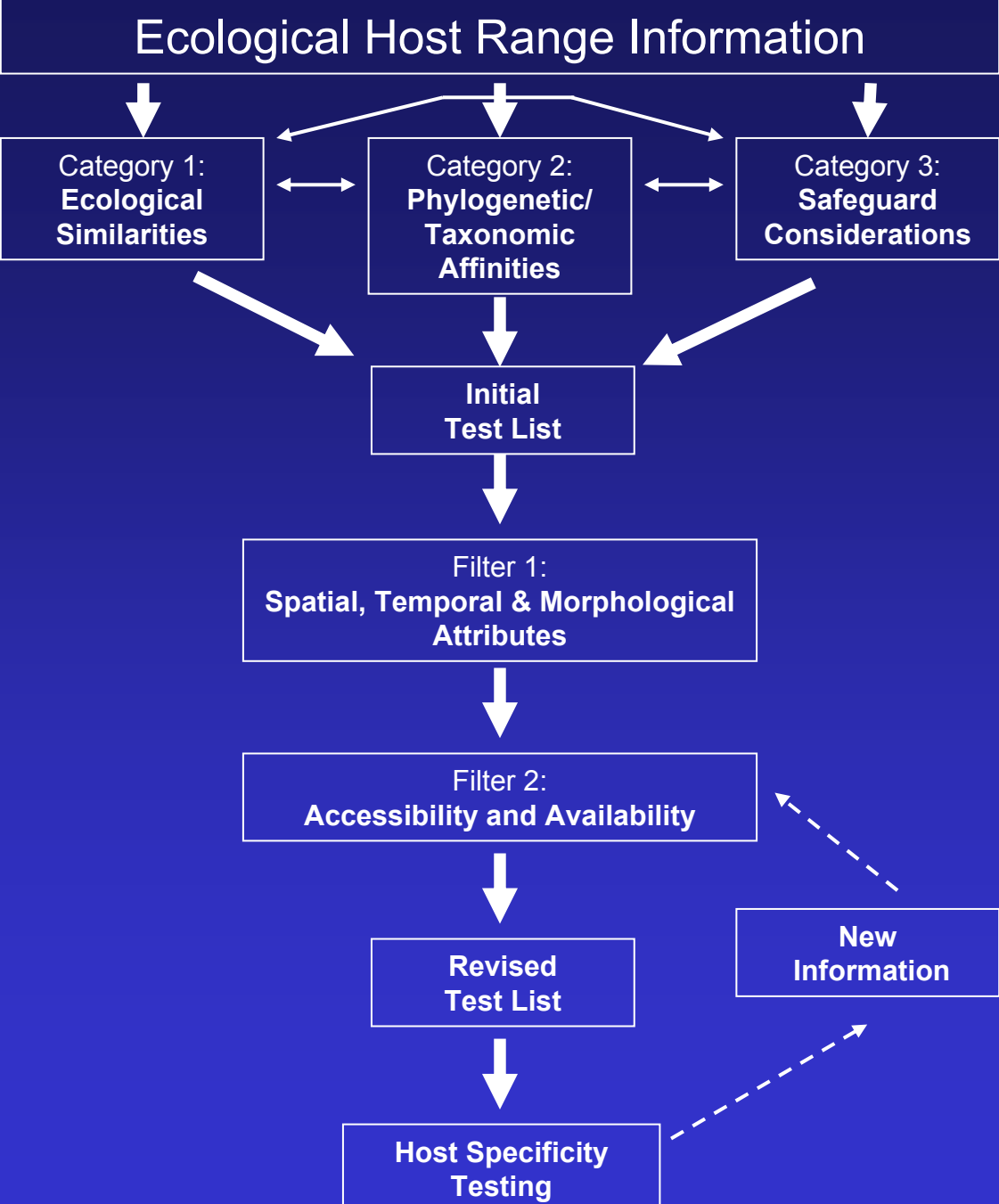
- Easily obtainable (priority on those spp. that can be reared)
- Sufficient numbers for replicated testing
- Use of surrogates for species of conservation concern if can't obtain
- Use field-collected material if information about biology & rearing lacking

Feedback: New information

- Information obtained during host specificity testing might lead to reconsideration of revised species test list (addition or elimination)
- Also data from parallel studies

Feed-in: Parallel biological studies

- New published information becomes available while host specificity testing being conducted
- Behavioural studies conducted to elucidate testing problems (e.g. host feeding, origin of cues involved in host selection)



Some definitions (1)

Performance: includes parameters that affect fitness components

Ecological Preference: feeding or oviposition is not distributed in proportion to the relative abundance of available hosts

Behavioural Preference: likelihood of accepting hosts that are encountered

Some definitions (2)

Fundamental host range: list of host species on which the organism can complete its life-cycle (split up for individual life-stages, e.g. larval fundamental host range)

Host Specificity: host range breadth (monophagous, oligophagous, polyphagous)

Ecological host range: list of plant species that are used under natural conditions (those species of the fundamental host range that pass through the behavioural and ecological sieve)

Some definitions (3)

Host range expansion: a new host is added to the ecological host-range (does not imply any mechanism)

Evolutionary host shift: a genetic shift in preference and/or performance