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1a Fore tibia without spur....Mystacides  
1b Fore tibia with 1 spur....Tagalopsyche

How useful are dichotomous keys?

Hans Malicky

Everyone knows the situation: one tries to identify an unknown insect with a dichotomous key and does not get a satisfactory result. How clever must the author of the key be, and how stupid may I be not to understand his intentions...?

There may be a key character with an unclear decision e.g. 'hindwing slightly broader than forewing', or 'fore tibia with one or two spurs' which cannot be seen because the leg is broken.

1a Forewing densely covered with scales....2  
1b Forewing with relatively few scales....3

What are relatively few or many scales?

1a Eyes of the male larger than in the female...2  
1b Eyes of equal size in both sexes.....3

What happens if you have only one specimen?

1a Forewing with a crossvein between R2 and R3...2  
1b Forewing with two crossveins between R2 and R3...3  
.....a number of other wing characters.....  
12a Discoidal cell in hindwing closed...13  
12b Discoidal cell in hindwing open. The female has reduced wings...15

How did the poor user arrive at point 12 with a wingless female?

1a Flower buds pilose...2  
1b Flower buds smooth...5  
2a Dry fruits with five openings...3  
2b Dry fruits closed...4

How to know what kind of dry fruits will appear on this plant three months later?

1a Mesonotum with sclerites...3  
1b Mesonotum without sclerites...2  
2a Mesonotum with 2 sclerites...  
2b Mesonotum with 4 sclerites...

Did this author ever read what he had written?

This is my most recent problem. All my specimens of Tagalopsyche (about 50) have no spur. I am still trying to solve this mystery.

1a One or more strong vibrissae usually present; incurved lower fronto-orbital bristles usually present; Sc more or less complete and separate from R1; lower calypter usually well developed (except in some Anthomyiidae and Fanniidae); R1 without a continuous series of dorsal setulae from near hm to apex; transverse sulcus of mesoscutum complete.....  
1b Not as above; if vibrissae and incurved lower fronto-orbitals both present, then Sc incomplete; lower calypter vestigial, except in many Platystomidae, which have a continuous series of dorsal setulae on R1 from near hm to apex; transverse sulcus of mesoscutum usually broadly interrupted medially.....

Everything clearly understood?

These are a few examples from the literature. Careful working may avoid confusion of this kind. If you produce a key, it is a good test to use it in student courses before publication. The author may overlook mistakes which may be easily found by students (not fellow workers because they may be thinking in the same way and overlook details as well). Mistakes may occur anywhere and can never be totally avoided. In dichotomous keys, however, they are more disturbing than elsewhere as a result of the basic dichotomous construction, with a heavy loss of information. Here is an invented example to explain this:

1a Body length under 4 mm.....minor  
1b Body length over 3 mm.....2  
2a Subcosta with 1 crossvein.....3  
2b Subcosta with 2 crossveins.....6  
3a Vertex red.....4  
3b Vertex brown.....5  
4a Foreleg with 5 tarsal segments.....major  
4b Foreleg with 4 tarsal segments.....alba  
5a Scape white.....nigra  
5b Scape brown.....rufa  
6a Discoidal cell long.....7  
6b Discoidal cell short.....vectis  
7a Subcosta ending in outer edge.....8  
7b Subcosta ending in R1.....populi  
8a Scape with 1 bristle.....vitrina  
8b Scape with 4 bristles.....linnaei

The same in a synoptic table, with the numbers as above:

Taxa	Characters							
	size mm	crossvein on Sc	vertex	foreleg segments	scape	discoidal cell	subcosta ends in	bristles on scape
minor	1a ↓	?	?	?	?	?	?	?
major	1b	2a	3a	4a ↑	?	?	?	?
alba	1b	2a	3a ↑	4b	?	?	?	?
nigra	1b	2a	3b	?	5a ↑	?	?	?
rufa	1b	2a ↑	3b	?	5b	?	?	?
vitrina	1b	2b	?	?	?	6a	7a	8a ↑
linnaei	1b	2b	?	?	?	6a	7a ↑	8b
populi	1b	2b	?	?	?	6a ↑	7b	?
vectis	1b	2b	?	?	?	6b	?	?

The same in a complete synoptic table:

Taxa	Characters							
	size mm	crossvein on Sc	vertex	foreleg segments	scape	discoidal cell	subcosta ends in	bristles on scape
<i>minor</i>	2-3	1	white	5	red	open	edge	2-3
<i>major</i>	4-6	1	red	5	red	open	edge	1
<i>alba</i>	4	1	red	4	red	long	RS	1
<i>nigra</i>	5-8	1	brown	5	white	open	R1	3-4
<i>rufa</i>	6-7	1	brown	5	brown	short	RS	2
<i>vitrina</i>	7	2	yellow	5	white	long	edge	1
<i>linnaei</i>	5-7	2	black	4	black	long	edge	4
<i>populi</i>	6-7	2	red	5	red	long	R1	3
<i>vectis</i>	8	2	white	3	white	short	edge	1

In this example it is seen that the dichotomous key provides a loss of information, compared with the synoptic table. Of 72 possible characters, only 35 are given in the former. If a decision is asked for between 4 or 5 tarsal segments, and the leg is broken in the specimen, a decision is not possible, and one has to struggle somewhere else. In the synoptic key however, some other characters are helpful in this case. The same is true if in the specimen the one or other key character is unusual, e.g. in a dwarf specimen, or with an unusual number of crossveins.

Another point of view is that dichotomous keys are not compatible with each other. For instance, it is not possible to compile a world key from several keys for Europe, America and Africa because their characters are arranged in a different sequence, even if they use the same characters.

It is true that synoptic keys may become too bulky if many species and characters are included. In such instances, a subdivision into several parts is possible.

Synoptic keys are however not the only alternative. Pictorial keys, with the immediate comparison of complicated structures, with arrows to the relevant structures, and with symbols for relevant information, may often help. My Atlas of European Trichoptera of 1983 is an example, although its construction is still rare in Entomology. But look at Ornithology: can you imagine that a birdwatcher tries to identify birds in the field with a dichotomous key? All identification books for birds are based on the pictorial principle.

I know from long experience that many people do not believe me. If a well established system like dichotomous keys is so widely used, it **must** be the best, despite objections.....?

I have often used the following experiment in my courses for students. Two groups of students get each a set of easily recognisable objects (not insects, but bottles or boxes). Each group is asked to produce a dichotomous key for their own collection. In the second step, the groups exchange their objects and keys, and they are asked to identify the objects from the other group with the corresponding key, but before I replace a few objects by others (which means that an insect sample may include a few species which are new or new for the region, and therefore not included in previous keys), and I remove some caps (which would mean that antennae and legs may be broken). What result would you expect? What is the percentage of correctly identified bottles? Try it, and you will be surprised, as we were.



A collection of boxes and bottles to be identified by a dichotomous key –



– and some of them replaced and caps removed.

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