

S3 Appendix. Titmice key example

```
1 {
2   "$schema":
3   "https://raw.githubusercontent.com/WouterKoch/Clavis/main/Schema/Clavis.
4   json",
5   "title": "A key to titmice in Norway",
6   "language": "en",
7   "license": "https://creativecommons.org/licenses/by/4.0/",
8   "creator": "person:wouterkoch",
9   "lastModified": "2022-03-19 21:41:00",
10  "identifier": "9be11d7e-c147-400a-899e-b3d5e4bcc6a1",
11  "geography": {
12    "name": "Norway",
13    "polygon": [
14      [
15        [
16          [
17            33.22265625,
18            69.56522590149099
19          ],
20          [
21            29.267578125,
22            71.15939141681443
23          ],
24          [
25            23.5546875,
26            71.28669893545877
27          ],
28          [
29            17.2265625,
30            69.97549253616164
31          ],
32          [
33            12.392578125,
34            68.366801093914
35          ],
36          [
37            11.2939453125,
38            65.91062334197893
39          ],
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40      [
41          3.8671874999999996,
42          62.103882522897855
43      ],
44      [
45          4.7021484375,
46          58.516651799363785
47      ],
48      [
49          7.119140625,
50          57.70414723434193
51      ],
52      [
53          11.953125,
54          58.83649009392136
55      ],
56      [
57          13.3154296875,
58          61.39671887310411
59      ],
60      [
61          12.8759765625,
62          63.6267446447533
63      ],
64      [
65          14.94140625,
66          64.07219957867282
67      ],
68      [
69          15.2490234375,
70          66.05371622067922
71      ],
72      [
73          18.852539062499996,
74          68.02402198693447
75      ],
76      [
77          25.048828125,
78          68.51214331858073
79      ],
80      [
81          26.894531249999996,
82          69.54987728327795
83      ],
84      [
85          29.003906249999996,

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86             68.8159271333607
87         ],
88         [
89             33.22265625,
90             69.56522590149099
91         ]
92     ]
93 ]
94 ],
95 },
96 "persons": [
97     {
98         "id": "person:wouterkoch",
99         "name": "Wouter Koch"
100     }
101 ],
102 "organizations": [
103     {
104         "id": "organization:ntnu",
105         "name": "Norwegian University of Science and Technology",
106         "url": "https://www.ntnu.no"
107     }
108 ],
109 "externalServices": [
110     {
111         "id": "service:nbic_taxa",
112         "title": "NBIC taxonomy scientificNameId",
113         "provider": "Norwegian Biodiversity Information Centre",
114         "url": "https://www.artsdatabanken.no/help"
115     }
116 ],
117 "taxa": [
118     {
119         "id": "taxon:paridae",
120         "scientificName": "Paridae",
121         "rank": "family",
122         "vernacularName": "titmice",
123         "externalReference": {
124             "serviceId": "service:nbic_taxa",
125             "externalId": "4362"
126         },
127         "children": [
128             {
129                 "id": "taxon:cyanistes",
130                 "scientificName": "Cyanistes",
131                 "rank": "genus",

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132     "externalReference": {
133         "serviceId": "service:nbic_taxa",
134         "externalId": "4364"
135     },
136     "children": [
137         {
138             "id": "taxon:cyanistes_caeruleus",
139             "scientificName": "Cyanistes caeruleus",
140             "vernacularName": "blue tit",
141             "rank": "species",
142             "externalReference": {
143                 "serviceId": "service:nbic_taxa",
144                 "externalId": "4365"
145             }
146         }
147     ]
148 },
149 {
150     "id": "taxon:lophophanes",
151     "scientificName": "Lophophanes",
152     "rank": "genus",
153     "externalReference": {
154         "serviceId": "service:nbic_taxa",
155         "externalId": "4368"
156     },
157     "children": [
158         {
159             "id": "taxon:lophophanes_cristatus",
160             "scientificName": "Lophophanes cristatus",
161             "vernacularName": "crested tit",
162             "rank": "species",
163             "externalReference": {
164                 "serviceId": "service:nbic_taxa",
165                 "externalId": "4369"
166             },
167             "geography": {
168                 "polygon": [
169                     [
170                         [
171                             [
172                                 11.997070312499998,
173                                 58.74540696858028
174                             ],
175                             [
176                                 13.0517578125,
177                                 59.977005492196

```

```

178         ],
179         [
180             12.8759765625,
181             63.31268278043484
182         ],
183         [
184             19.2041015625,
185             68.57644086491786
186         ],
187         [
188             13.4912109375,
189             68.78414378041504
190         ],
191         [
192             9.7119140625,
193             64.47279382008166
194         ],
195         [
196             4.21875,
197             62.2679226294176
198         ],
199         [
200             3.69140625,
201             59.40036514079251
202         ],
203         [
204             6.723632812499999,
205             57.70414723434193
206         ],
207         [
208             11.997070312499998,
209             58.74540696858028
210         ]
211     ]
212 ]
213 ]
214 }
215 }
216 ]
217 },
218 {
219     "id": "taxon:parus",
220     "scientificName": "Parus",
221     "rank": "genus",
222     "externalReference": {
223         "serviceId": "service:nbic_taxa",

```

```

224         "externalId": "4363"
225     },
226     "children": [
227         {
228             "id": "taxon:parus_major",
229             "scientificName": "Parus major",
230             "vernacularName": "great tit",
231             "rank": "species",
232             "externalReference": {
233                 "serviceId": "service:nbic_taxa",
234                 "externalId": "4372"
235             }
236         }
237     ]
238 },
239 {
240     "id": "taxon:periparus",
241     "scientificName": "Periparus",
242     "rank": "genus",
243     "externalReference": {
244         "serviceId": "service:nbic_taxa",
245         "externalId": "4374"
246     },
247     "children": [
248         {
249             "id": "taxon:periparus_ater",
250             "scientificName": "Periparus ater",
251             "vernacularName": "coal tit",
252             "rank": "species",
253             "externalReference": {
254                 "serviceId": "service:nbic_taxa",
255                 "externalId": "4375"
256             }
257         }
258     ]
259 },
260 {
261     "id": "taxon:poecile",
262     "scientificName": "Poecile",
263     "rank": "genus",
264     "externalReference": {
265         "serviceId": "service:nbic_taxa",
266         "externalId": "4378"
267     },
268     "children": [
269         {

```

```

270 "id": "taxon:poecile_palustris",
271 "scientificName": "Poecile palustris",
272 "vernacularName": "marsh tit",
273 "rank": "species",
274 "externalReference": {
275   "serviceId": "service:nbic_taxa",
276   "externalId": "4385"
277 },
278 "geography": {
279   "polygon": [
280     [
281       [
282         [
283           11.997070312499998,
284           58.74540696858028
285         ],
286         [
287           13.0517578125,
288           59.977005492196
289         ],
290         [
291           12.8759765625,
292           63.31268278043484
293         ],
294         [
295           19.2041015625,
296           68.57644086491786
297         ],
298         [
299           13.4912109375,
300           68.78414378041504
301         ],
302         [
303           9.7119140625,
304           64.47279382008166
305         ],
306         [
307           4.21875,
308           62.2679226294176
309         ],
310         [
311           3.69140625,
312           59.40036514079251
313         ],
314         [
315           6.723632812499999,

```

```

316                                     57.70414723434193
317                                 ],
318                             [
319                                 11.997070312499998,
320                                 58.74540696858028
321                             ]
322                         ]
323                     ]
324                 ]
325             }
326         },
327         {
328             "id": "taxon:poecile_montanus",
329             "scientificName": "Poecile montanus",
330             "vernacularName": "willow tit",
331             "rank": "species",
332             "externalReference": {
333                 "serviceId": "service:nbic_taxa",
334                 "externalId": "4382"
335             }
336         },
337         {
338             "id": "taxon:poecile_cinctus",
339             "scientificName": "Poecile cinctus",
340             "vernacularName": "Siberian tit",
341             "rank": "species",
342             "externalReference": {
343                 "serviceId": "service:nbic_taxa",
344                 "externalId": "4379"
345             }
346         }
347     ]
348 }
349 ]
350 }
351 ],
352 "characters": [
353     {
354         "id": "character:head_top",
355         "title": "Top of the head",
356         "states": [
357             {
358                 "id": "state:black_or_dark_grey",
359                 "title": "Black or dark grey"
360             },
361             {

```



```

362         "id": "state:blue",
363         "title": "Blue"
364     },
365     {
366         "id": "state:speckled_crest",
367         "title": "Speckled black and white, with a crest"
368     }
369 ]
370 },
371 {
372     "id": "character:head_top",
373     "title": "Top of the head",
374     "states": [
375         {
376             "id": "state:black_or_dark_grey",
377             "title": "Black or dark grey"
378         },
379         {
380             "id": "state:brown",
381             "title": "Brown"
382         },
383         {
384             "id": "state:blue",
385             "title": "Blue"
386         },
387         {
388             "id": "state:speckled_crest",
389             "title": "Speckled black and white, with a crest"
390         }
391     ]
392 },
393 {
394     "id": "character:chest_color",
395     "title": "Color of the chest",
396     "states": [
397         {
398             "id": "state:yellow",
399             "title": "Yellow"
400         },
401         {
402             "id": "state:grey_brown",
403             "title": "Grey to brown"
404         }
405     ]
406 },
407 {

```

```

408         "id": "character:wing_bar",
409         "title": "White bar on the wing",
410         "states": [
411             {
412                 "id": "state:wing_bar",
413                 "title": "Present"
414             },
415             {
416                 "id": "state:no_wing_bar",
417                 "title": "Absent"
418             }
419         ]
420     },
421     {
422         "id": "character:black_of_cheek",
423         "title": "Color of the cheek at the back",
424         "states": [
425             {
426                 "id": "state:white_cheek_back",
427                 "title": "Entire cheek white"
428             },
429             {
430                 "id": "state:brown_cheek_back",
431                 "title": "Sullied brown"
432             }
433         ]
434     },
435     {
436         "id": "character:wing_secondaries_color",
437         "title": "Color of secondary wing feathers",
438         "states": [
439             {
440                 "id": "state:secondaries_pale",
441                 "title": "Paler than rest of the wing"
442             },
443             {
444                 "id": "state:secondaries_not_pale",
445                 "title": "No clear different from rest of the wing"
446             }
447         ]
448     }
449 ],
450 "statements": [
451     {
452         "id": "statement:crested_tit_head",
453         "taxon": "taxon:lophophanes_cristatus",

```

```

454         "character": "character:head_top",
455         "value": "state:speckled_crest",
456         "frequency": 1
457     },
458     {
459         "id": "statement:blue_tit_head",
460         "taxon": "taxon:cyanistes_caeruleus",
461         "character": "character:head_top",
462         "value": "state:blue",
463         "frequency": 1
464     },
465     {
466         "id": "statement:poecile_palustris_head",
467         "taxon": "taxon:poecile_palustris",
468         "character": "character:head_top",
469         "value": "state:black_or_dark_grey",
470         "frequency": 1
471     },
472     {
473         "id": "statement:poecile_montanus_head",
474         "taxon": "taxon:poecile_montanus",
475         "character": "character:head_top",
476         "value": "state:black_or_dark_grey",
477         "frequency": 1
478     },
479     {
480         "id": "statement:poecile_cinctus_head",
481         "taxon": "taxon:poecile_cinctus",
482         "character": "character:head_top",
483         "value": "state:brown",
484         "frequency": 1
485     },
486     {
487         "id": "statement:great_tit_head",
488         "taxon": "taxon:parus_major",
489         "character": "character:head_top",
490         "value": "state:black_or_dark_grey",
491         "frequency": 1
492     },
493     {
494         "id": "statement:coal_tit_head",
495         "taxon": "taxon:periparus_ater",
496         "character": "character:head_top",
497         "value": "state:black_or_dark_grey",
498         "frequency": 1
499     },

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```

500     {
501         "id": "statement:crested_tit_chest",
502         "taxon": "taxon:lophophanes_cristatus",
503         "character": "character:chest_color",
504         "value": "state:grey_brown",
505         "frequency": 1
506     },
507     {
508         "id": "statement:blue_tit_chest",
509         "taxon": "taxon:cyanistes_caeruleus",
510         "character": "character:chest_color",
511         "value": "state:yellow",
512         "frequency": 1
513     },
514     {
515         "id": "statement:poecile_chest",
516         "taxon": "taxon:poecile",
517         "character": "character:chest_color",
518         "value": "state:grey_brown",
519         "frequency": 1
520     },
521     {
522         "id": "statement:great_tit_chest",
523         "taxon": "taxon:parus_major",
524         "character": "character:chest_color",
525         "value": "state:yellow",
526         "frequency": 1
527     },
528     {
529         "id": "statement:coal_tit_chest",
530         "taxon": "taxon:periparus_ater",
531         "character": "character:chest_color",
532         "value": "state:grey_brown",
533         "frequency": 1
534     },
535     {
536         "id": "statement:crested_tit_bar",
537         "taxon": "taxon:lophophanes_cristatus",
538         "character": "character:wing_bar",
539         "value": "state:no_wing_bar",
540         "frequency": 1
541     },
542     {
543         "id": "statement:blue_tit_bar",
544         "taxon": "taxon:cyanistes_caeruleus",
545         "character": "character:wing_bar",

```

```

546         "value": "state:wing_bar",
547         "frequency": 1
548     },
549     {
550         "id": "statement:poecile_bar",
551         "taxon": "taxon:poecile",
552         "character": "character:wing_bar",
553         "value": "state:no_wing_bar",
554         "frequency": 1
555     },
556     {
557         "id": "statement:great_tit_bar",
558         "taxon": "taxon:parus_major",
559         "character": "character:wing_bar",
560         "value": "state:wing_bar",
561         "frequency": 1
562     },
563     {
564         "id": "statement:coal_tit_bar",
565         "taxon": "taxon:periparus_ater",
566         "character": "character:wing_bar",
567         "value": "state:wing_bar",
568         "frequency": 1
569     },
570     {
571         "id": "statement:poecile_palustris_cheek_back",
572         "taxon": "taxon:poecile_palustris",
573         "character": "character:black_of_cheek",
574         "value": "state:brown_cheek_back",
575         "frequency": 1
576     },
577     {
578         "id": "statement:poecile_montanus_cheek_back",
579         "taxon": "taxon:poecile_montanus",
580         "character": "character:black_of_cheek",
581         "value": "state:white_cheek_back",
582         "frequency": 1
583     },
584     {
585         "id": "statement:poecile_palustris_wing_secondaries_color",
586         "taxon": "taxon:poecile_palustris",
587         "character": "character:wing_secondaries_color",
588         "value": "state:secondaries_not_pale",
589         "frequency": 1
590     },
591     {

```

```

592         "id": "statement:poecile_montanus_wing_secondaries_color",
593         "taxon": "taxon:poecile_montanus",
594         "character": "character:wing_secondaries_color",
595         "value": "state:secondaries_pale",
596         "frequency": 1
597     }
598 ]
599 }

```