

S3 Appendix. Titmice key example

```
{
  "$schema":
    "https://raw.githubusercontent.com/WouterKoch/Clavis/main/Schema/Clavis.
    json",
  "title": "A key to titmice in Norway",
  "language": "en",
  "license": "https://creativecommons.org/licenses/by/4.0/",
  "creator": "person:wouterkoch",
  "lastModified": "2022-03-19 21:41:00",
  "identifier": "9be11d7e-c147-400a-899e-b3d5e4bcc6a1",
  "geography": {
    "name": "Norway",
    "polygon": [
      [
        [
          33.22265625,
          69.56522590149099
        ],
        [
          29.267578125,
          71.15939141681443
        ],
        [
          23.5546875,
          71.28669893545877
        ],
        [
          17.2265625,
          69.97549253616164
        ],
        [
          12.392578125,
          68.366801093914
        ],
        [
          11.2939453125,
          65.91062334197893
        ],
        [
          3.8671874999999996,
          62.103882522897855
        ],
        [
          4.7021484375,
          58.516651799363785
        ]
      ]
    ]
  }
}
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],
[
    7.119140625,
    57.70414723434193
],
[
    11.953125,
    58.83649009392136
],
[
    13.3154296875,
    61.39671887310411
],
[
    12.8759765625,
    63.6267446447533
],
[
    14.94140625,
    64.07219957867282
],
[
    15.2490234375,
    66.05371622067922
],
[
    18.852539062499996,
    68.02402198693447
],
[
    25.048828125,
    68.51214331858073
],
[
    26.894531249999996,
    69.54987728327795
],
[
    29.003906249999996,
    68.8159271333607
],
[
    33.22265625,
    69.56522590149099
]
]
]
},
"persons": [
    {
        "id": "person:wouterkoch",

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        "name": "Wouter Koch"
    },
],
"organizations": [
    {
        "id": "organization:ntnu",
        "name": "Norwegian University of Science and Technology",
        "url": "https://www.ntnu.no"
    }
],
"externalServices": [
    {
        "id": "service:nbic_taxa",
        "title": "NBIC taxonomy scientificNameId",
        "provider": "Norwegian Biodiversity Information Centre",
        "url": "https://www.artsdatabanken.no/help"
    }
],
"taxa": [
    {
        "id": "taxon:paridae",
        "scientificName": "Paridae",
        "rank": "family",
        "vernacularName": "titmice",
        "externalReference": {
            "serviceId": "service:nbic_taxa",
            "externalId": "4362"
        },
    },
    "children": [
        {
            "id": "taxon:cyanistes",
            "scientificName": "Cyanistes",
            "rank": "genus",
            "externalReference": {
                "serviceId": "service:nbic_taxa",
                "externalId": "4364"
            },
        },
        "children": [
            {
                "id": "taxon:cyanistes_caeruleus",
                "scientificName": "Cyanistes caeruleus",
                "vernacularName": "blue tit",
                "rank": "species",
                "externalReference": {
                    "serviceId": "service:nbic_taxa",
                    "externalId": "4365"
                },
            }
        ]
    },
    {
        "id": "taxon:lophophanes",

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"scientificName": "Lophophanes",
"rank": "genus",
"externalReference": {
  "serviceId": "service:nbic_taxa",
  "externalId": "4368"
},
"children": [
  {
    "id": "taxon:lophophanes_cristatus",
    "scientificName": "Lophophanes cristatus",
    "vernacularName": "crested tit",
    "rank": "species",
    "externalReference": {
      "serviceId": "service:nbic_taxa",
      "externalId": "4369"
    },
    "geography": {
      "polygon": [
        [
          [
            11.997070312499998,
            58.74540696858028
          ],
          [
            13.0517578125,
            59.977005492196
          ],
          [
            12.8759765625,
            63.31268278043484
          ],
          [
            19.2041015625,
            68.57644086491786
          ],
          [
            13.4912109375,
            68.78414378041504
          ],
          [
            9.7119140625,
            64.47279382008166
          ],
          [
            4.21875,
            62.2679226294176
          ],
          [
            3.69140625,
            59.40036514079251
          ],
          [

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[
    6.723632812499999,
    57.70414723434193
],
[
    11.997070312499998,
    58.74540696858028
]
]
]
]
}
}
]
},
{
    "id": "taxon:parus",
    "scientificName": "Parus",
    "rank": "genus",
    "externalReference": {
        "serviceId": "service:nbic_taxa",
        "externalId": "4363"
    },
    "children": [
        {
            "id": "taxon:parus_major",
            "scientificName": "Parus major",
            "vernacularName": "great tit",
            "rank": "species",
            "externalReference": {
                "serviceId": "service:nbic_taxa",
                "externalId": "4372"
            }
        }
    ]
},
{
    "id": "taxon:periparus",
    "scientificName": "Periparus",
    "rank": "genus",
    "externalReference": {
        "serviceId": "service:nbic_taxa",
        "externalId": "4374"
    },
    "children": [
        {
            "id": "taxon:periparus_ater",
            "scientificName": "Periparus ater",
            "vernacularName": "coal tit",
            "rank": "species",
            "externalReference": {
                "serviceId": "service:nbic_taxa",

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        "externalId": "4375"
    }
}
]
},
{
    "id": "taxon:poecile",
    "scientificName": "Poecile",
    "rank": "genus",
    "externalReference": {
        "serviceId": "service:nbic_taxa",
        "externalId": "4378"
    },
    "children": [
        {
            "id": "taxon:poecile_palustris",
            "scientificName": "Poecile palustris",
            "vernacularName": "marsh tit",
            "rank": "species",
            "externalReference": {
                "serviceId": "service:nbic_taxa",
                "externalId": "4385"
            },
            "geography": {
                "polygon": [
                    [
                        [
                            11.997070312499998,
                            58.74540696858028
                        ],
                        [
                            13.0517578125,
                            59.977005492196
                        ],
                        [
                            12.8759765625,
                            63.31268278043484
                        ],
                        [
                            19.2041015625,
                            68.57644086491786
                        ],
                        [
                            13.4912109375,
                            68.78414378041504
                        ],
                        [
                            9.7119140625,
                            64.47279382008166
                        ]
                    ]
                ]
            }
        }
    ]
}

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4.21875,
62.2679226294176
],
[
3.69140625,
59.40036514079251
],
[
6.723632812499999,
57.70414723434193
],
[
11.997070312499998,
58.74540696858028
]
]
]
]
}
},
{
  "id": "taxon:poecile_montanus",
  "scientificName": "Poecile montanus",
  "vernacularName": "willow tit",
  "rank": "species",
  "externalReference": {
    "serviceId": "service:nbic_taxa",
    "externalId": "4382"
  }
},
{
  "id": "taxon:poecile_cinctus",
  "scientificName": "Poecile cinctus",
  "vernacularName": "Siberian tit",
  "rank": "species",
  "externalReference": {
    "serviceId": "service:nbic_taxa",
    "externalId": "4379"
  }
}
]
}
]
}
],
"characters": [
  {
    "id": "character:head_top",
    "title": "Top of the head",
    "states": [
      {
        "id": "state:black_or_dark_grey",

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        "title": "Black or dark grey"
    },
    {
        "id": "state:blue",
        "title": "Blue"
    },
    {
        "id": "state:speckled_crest",
        "title": "Speckled black and white, with a crest"
    }
]
},
{
    "id": "character:head_top",
    "title": "Top of the head",
    "states": [
        {
            "id": "state:black_or_dark_grey",
            "title": "Black or dark grey"
        },
        {
            "id": "state:brown",
            "title": "Brown"
        },
        {
            "id": "state:blue",
            "title": "Blue"
        },
        {
            "id": "state:speckled_crest",
            "title": "Speckled black and white, with a crest"
        }
    ]
},
{
    "id": "character:chest_color",
    "title": "Color of the chest",
    "states": [
        {
            "id": "state:yellow",
            "title": "Yellow"
        },
        {
            "id": "state:grey_brown",
            "title": "Grey to brown"
        }
    ]
},
{
    "id": "character:wing_bar",
    "title": "White bar on the wing",
    "states": [

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        {
            "id": "state:wing_bar",
            "title": "Present"
        },
        {
            "id": "state:no_wing_bar",
            "title": "Absent"
        }
    ]
},
{
    "id": "character:black_of_cheek",
    "title": "Color of the cheek at the back",
    "states": [
        {
            "id": "state:white_cheek_back",
            "title": "Entire cheek white"
        },
        {
            "id": "state:brown_cheek_back",
            "title": "Sullied brown"
        }
    ]
},
{
    "id": "character:wing_secondaries_color",
    "title": "Color of secondary wing feathers",
    "states": [
        {
            "id": "state:secondaries_pale",
            "title": "Paler than rest of the wing"
        },
        {
            "id": "state:secondaries_not_pale",
            "title": "No clear different from rest of the wing"
        }
    ]
}
],
"statements": [
    {
        "id": "statement:crested_tit_head",
        "taxon": "taxon:lophophanes_cristatus",
        "character": "character:head_top",
        "value": "state:speckled_crest",
        "frequency": 1
    },
    {
        "id": "statement:blue_tit_head",
        "taxon": "taxon:cyanistes_caeruleus",
        "character": "character:head_top",
        "value": "state:blue",

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    "frequency": 1
  },
  {
    "id": "statement:poecile_palustris_head",
    "taxon": "taxon:poecile_palustris",
    "character": "character:head_top",
    "value": "state:black_or_dark_grey",
    "frequency": 1
  },
  {
    "id": "statement:poecile_montanus_head",
    "taxon": "taxon:poecile_montanus",
    "character": "character:head_top",
    "value": "state:black_or_dark_grey",
    "frequency": 1
  },
  {
    "id": "statement:poecile_cinctus_head",
    "taxon": "taxon:poecile_cinctus",
    "character": "character:head_top",
    "value": "state:brown",
    "frequency": 1
  },
  {
    "id": "statement:great_tit_head",
    "taxon": "taxon:parus_major",
    "character": "character:head_top",
    "value": "state:black_or_dark_grey",
    "frequency": 1
  },
  {
    "id": "statement:coal_tit_head",
    "taxon": "taxon:periparus_ater",
    "character": "character:head_top",
    "value": "state:black_or_dark_grey",
    "frequency": 1
  },
  {
    "id": "statement:crested_tit_chest",
    "taxon": "taxon:lophophanes_cristatus",
    "character": "character:chest_color",
    "value": "state:grey_brown",
    "frequency": 1
  },
  {
    "id": "statement:blue_tit_chest",
    "taxon": "taxon:cyanistes_caeruleus",
    "character": "character:chest_color",
    "value": "state:yellow",
    "frequency": 1
  },
  {

```

```

        "id": "statement:poecile_chest",
        "taxon": "taxon:poecile",
        "character": "character:chest_color",
        "value": "state:grey_brown",
        "frequency": 1
    },
    {
        "id": "statement:great_tit_chest",
        "taxon": "taxon:parus_major",
        "character": "character:chest_color",
        "value": "state:yellow",
        "frequency": 1
    },
    {
        "id": "statement:coal_tit_chest",
        "taxon": "taxon:periparus_ater",
        "character": "character:chest_color",
        "value": "state:grey_brown",
        "frequency": 1
    },
    {
        "id": "statement:crested_tit_bar",
        "taxon": "taxon:lophophanes_cristatus",
        "character": "character:wing_bar",
        "value": "state:no_wing_bar",
        "frequency": 1
    },
    {
        "id": "statement:blue_tit_bar",
        "taxon": "taxon:cyanistes_caeruleus",
        "character": "character:wing_bar",
        "value": "state:wing_bar",
        "frequency": 1
    },
    {
        "id": "statement:poecile_bar",
        "taxon": "taxon:poecile",
        "character": "character:wing_bar",
        "value": "state:no_wing_bar",
        "frequency": 1
    },
    {
        "id": "statement:great_tit_bar",
        "taxon": "taxon:parus_major",
        "character": "character:wing_bar",
        "value": "state:wing_bar",
        "frequency": 1
    },
    {
        "id": "statement:coal_tit_bar",
        "taxon": "taxon:periparus_ater",
        "character": "character:wing_bar",

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        "value": "state:wing_bar",
        "frequency": 1
    },
    {
        "id": "statement:poecile_palustris_cheek_back",
        "taxon": "taxon:poecile_palustris",
        "character": "character:black_of_cheek",
        "value": "state:brown_cheek_back",
        "frequency": 1
    },
    {
        "id": "statement:poecile_montanus_cheek_back",
        "taxon": "taxon:poecile_montanus",
        "character": "character:black_of_cheek",
        "value": "state:white_cheek_back",
        "frequency": 1
    },
    {
        "id": "statement:poecile_palustris_wing_secondaries_color",
        "taxon": "taxon:poecile_palustris",
        "character": "character:wing_secondaries_color",
        "value": "state:secondaries_not_pale",
        "frequency": 1
    },
    {
        "id": "statement:poecile_montanus_wing_secondaries_color",
        "taxon": "taxon:poecile_montanus",
        "character": "character:wing_secondaries_color",
        "value": "state:secondaries_pale",
        "frequency": 1
    }
]
}

```