

S3 Appendix. Titmice key example

```
{
  "$schema": "https://raw.githubusercontent.com/Artsdatabanken/Clavis/
60090011e4efed657f41cced3366b2b57d6cff3b/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",
  "regionMultiPolygon": [
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        [
          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
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        [
          4.7021484375,
          58.516651799363785
        ],
        [
          7.119140625,
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        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",
            "name": "Wouter Koch"
        }
    ],
    "organizations": [

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    {
      "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",
      "externalResource": {
        "serviceId": "service:nbic_taxa",
        "externalId": "4362"
      },
      "children": [
        {
          "id": "taxon:cyanistes",
          "scientificName": "Cyanistes",
          "rank": "genus",
          "externalResource": {
            "serviceId": "service:nbic_taxa",
            "externalId": "4364"
          },
          "children": [
            {
              "id": "taxon:cyanistes_caeruleus",
              "scientificName": "Cyanistes caeruleus",
              "vernacularName": "blue tit",
              "rank": "species",
              "externalResource": {
                "serviceId": "service:nbic_taxa",
                "externalId": "4365"
              }
            }
          ]
        }
      ]
    },
    {
      "id": "taxon:lophophanes",
      "scientificName": "Lophophanes",
      "rank": "genus",
      "externalResource": {
        "serviceId": "service:nbic_taxa",

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    "externalId": "4368"
  },
  "children": [
    {
      "id": "taxon:lophophanes_cristatus",
      "scientificName": "Lophophanes cristatus",
      "vernacularName": "crested tit",
      "rank": "species",
      "externalResource": {
        "serviceId": "service:nbic_taxa",
        "externalId": "4369"
      },
      "geoDistribution": [
        [
          [
            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
          ],
          [
            6.723632812499999,
            57.70414723434193
          ],
          [

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11.997070312499998,
58.74540696858028
]
]
]
]
}
]
},
{
  "id": "taxon:parus",
  "scientificName": "Parus",
  "rank": "genus",
  "externalResource": {
    "serviceId": "service:nbic_taxa",
    "externalId": "4363"
  },
  "children": [
    {
      "id": "taxon:parus_major",
      "scientificName": "Parus major",
      "vernacularName": "great tit",
      "rank": "species",
      "externalResource": {
        "serviceId": "service:nbic_taxa",
        "externalId": "4372"
      }
    }
  ]
},
{
  "id": "taxon:periparus",
  "scientificName": "Periparus",
  "rank": "genus",
  "externalResource": {
    "serviceId": "service:nbic_taxa",
    "externalId": "4374"
  },
  "children": [
    {
      "id": "taxon:periparus_ater",
      "scientificName": "Periparus ater",
      "vernacularName": "coal tit",
      "rank": "species",
      "externalResource": {
        "serviceId": "service:nbic_taxa",
        "externalId": "4375"
      }
    }
  ]
},
{

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    "id": "taxon:poecile",
    "scientificName": "Poecile",
    "rank": "genus",
    "externalResource": {
      "serviceId": "service:nbic_taxa",
      "externalId": "4378"
    },
    "children": [
      {
        "id": "taxon:poecile_palustris",
        "scientificName": "Poecile palustris",
        "vernacularName": "marsh tit",
        "rank": "species",
        "externalResource": {
          "serviceId": "service:nbic_taxa",
          "externalId": "4385"
        },
        "geoDistribution": [
          [
            [
              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:poecile_montanus",
    "scientificName": "Poecile montanus",
    "vernacularName": "willow tit",
    "rank": "species",
    "externalResource": {
        "serviceId": "service:nbic_taxa",
        "externalId": "4382"
    }
},
{
    "id": "taxon:poecile_cinctus",
    "scientificName": "Poecile cinctus",
    "vernacularName": "Siberian tit",
    "rank": "species",
    "externalResource": {
        "serviceId": "service:nbic_taxa",
        "externalId": "4379"
    }
}
]
}
],
"characters": [
    {
        "id": "character:head_top",
        "title": "Top of the head",
        "states": [
            {
                "id": "state:black_or_dark_grey",
                "title": "Black or dark grey"
            },
            {
                "id": "state:blue",
                "title": "Blue"
            },
            {
                "id": "state:speckled_crest",

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        "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": [
        {
            "id": "state:wing_bar",
            "title": "Present"
        },
        {
            "id": "state:no_wing_bar",
            "title": "Absent"
        }
    ]
}

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    ],
    {
      "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",
      "taxonId": "taxon:lophophanes_cristatus",
      "characterId": "character:head_top",
      "value": "state:speckled_crest",
      "frequency": 1
    },
    {
      "id": "statement:blue_tit_head",
      "taxonId": "taxon:cyanistes_caeruleus",
      "characterId": "character:head_top",
      "value": "state:blue",
      "frequency": 1
    },
    {
      "id": "statement:poecile_palustris_head",
      "taxonId": "taxon:poecile_palustris",
      "characterId": "character:head_top",
      "value": "state:black_or_dark_grey",
      "frequency": 1
    }
  ]
}

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

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"taxonId": "taxon:parus_major",
"characterId": "character:chest_color",
"value": "state:yellow",
"frequency": 1
},
{
  "id": "statement:coal_tit_chest",
  "taxonId": "taxon:periparus_ater",
  "characterId": "character:chest_color",
  "value": "state:grey_brown",
  "frequency": 1
},
{
  "id": "statement:crested_tit_bar",
  "taxonId": "taxon:lophophanes_cristatus",
  "characterId": "character:wing_bar",
  "value": "state:no_wing_bar",
  "frequency": 1
},
{
  "id": "statement:blue_tit_bar",
  "taxonId": "taxon:cyanistes_caeruleus",
  "characterId": "character:wing_bar",
  "value": "state:wing_bar",
  "frequency": 1
},
{
  "id": "statement:poecile_bar",
  "taxonId": "taxon:poecile",
  "characterId": "character:wing_bar",
  "value": "state:no_wing_bar",
  "frequency": 1
},
{
  "id": "statement:great_tit_bar",
  "taxonId": "taxon:parus_major",
  "characterId": "character:wing_bar",
  "value": "state:wing_bar",
  "frequency": 1
},
{
  "id": "statement:coal_tit_bar",
  "taxonId": "taxon:periparus_ater",
  "characterId": "character:wing_bar",
  "value": "state:wing_bar",
  "frequency": 1
},
{
  "id": "statement:poecile_palustris_cheek_back",
  "taxonId": "taxon:poecile_palustris",
  "characterId": "character:black_of_cheek",
  "value": "state:brown_cheek_back",

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

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