

## S1 Appendix. Clavis JSON-schema

```
1 {
2   "$schema": "http://json-schema.org/draft-07/schema#",
3   "title": "Clavis identification key schema",
4   "description": "Clavis-compliant keys contain knowledge that may be
5 used to distinguish taxa from each other.",
6   "type": "object",
7   "required": [
8     "$schema",
9     "title",
10    "language",
11    "license",
12    "creator",
13    "lastModified",
14    "identifier",
15    "taxa",
16    "characters",
17    "statements"
18  ],
19  "properties": {
20    "$schema": {
21      "description": "The schema url of (this) schema defining the
22 format of the key.",
23      "$ref": "#/definitions/url"
24    },
25    "title": {
26      "description": "The name of the key",
27      "comment": "Accepts array for multilingual support.",
28      "$ref": "#/definitions/localizedString",
29      "examples": [
30        "Birds of Norway"
31      ]
32    },
33    "media": {
34      "description": "The logo/illustration image of the key.",
35      "$ref": "#/definitions/mediaID"
36    },
37    "description": {
38      "description": "Short description of the key (valid markdown).",
39      "comment": "Accepts array for multilingual support.",
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40     "$ref": "#/definitions/localizedString",
41     "contentMediaType": "text/markdown"
42 },
43     "descriptionDetails": {
44         "description": "Extended description of the key that supplements
45 the description (valid markdown).",
46         "comment": "Accepts array for multilingual support.",
47         "$ref": "#/definitions/localizedString",
48         "contentMediaType": "text/markdown"
49     },
50     "descriptionUrl": {
51         "description": "Hyperlink to more information on the key (valid
52 url).",
53         "comment": "Accepts array for multilingual support.",
54         "$ref": "#/definitions/localizedUrl"
55     },
56     "audience": {
57         "description": "Description of the intended audience for the
58 key.",
59         "comment": "Accepts array for multilingual support.",
60         "$ref": "#/definitions/localizedString",
61         "examples": [
62             "Undergraduate students and up."
63         ]
64     },
65     "source": {
66         "description": "Source of the key.",
67         "comment": "Accepts array for multilingual support.",
68         "$ref": "#/definitions/localizedString",
69         "examples": [
70             "Koch, Wouter (2019). Birds of Norway. ISBN 1234567890"
71         ]
72     },
73     "sourceUrl": {
74         "description": "Hyperlink to the source of the key (valid url).",
75         "comment": "Accepts array for multilingual support.",
76         "$ref": "#/definitions/localizedUrl",
77         "examples": [
78             "https://doi.org/10.1126/science.1251554"
79         ]
80     },
81     "geography": {
82         "description": "The region for which the key is valid (e.g. covers
83 all subtaxa), represented as a geography object.",
84         "$ref": "#/definitions/geography"
85     },

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86     "primaryContact": {
87         "description": "The organization- or person-id that is the main
88 contact point for the key.",
89         "oneOf": [
90             {
91                 "$ref": "#/definitions/personID"
92             },
93             {
94                 "$ref": "#/definitions/organizationID"
95             }
96         ]
97     },
98     "creator": {
99         "description": "The id(s) of the creator(s) of the key",
100         "oneOf": [
101             {
102                 "$ref": "#/definitions/personID"
103             },
104             {
105                 "type": "array",
106                 "items": {
107                     "$ref": "#/definitions/personID"
108                 }
109             }
110         ]
111     },
112     "contributor": {
113         "description": "The id(s) of the contributor(s) of the key",
114         "oneOf": [
115             {
116                 "$ref": "#/definitions/personID"
117             },
118             {
119                 "type": "array",
120                 "items": {
121                     "$ref": "#/definitions/personID"
122                 }
123             }
124         ]
125     },
126     "publisher": {
127         "description": "The id(s) of the publishing institutions of the
128 key.",
129         "oneOf": [
130             {
131                 "$ref": "#/definitions/organizationID"

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132         },
133         {
134             "type": "array",
135             "items": {
136                 "$ref": "#/definitions/organizationID"
137             }
138         }
139     ],
140 },
141     "license": {
142         "description": "The url to the license under which the key
143 falls.",
144         "$ref": "#/definitions/url",
145         "examples": [
146             "https://creativecommons.org/licenses/by/4.0/"
147         ]
148     },
149     "language": {
150         "description": "The ISO 639-1 code(s) of the key language(s).",
151         "comment": "String for a single language, array of strings for
152 multilingual support. If used as an array, be sure to use the
153 localizedString and localizedUrl as arrays too.",
154         "oneOf": [
155             {
156                 "type": "string",
157                 "pattern": "^[a-z]{2}$"
158             },
159             {
160                 "type": "array",
161                 "items": {
162                     "type": "string",
163                     "pattern": "^[a-z]{2}$"
164                 }
165             }
166         ],
167         "examples": [
168             "en",
169             "nb",
170             [
171                 "en",
172                 "nb"
173             ]
174         ]
175     },
176     "created": {
177         "description": "The moment the key was made or first published, as

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178 'YYYY-MM-DD hh:mm:ss'.",
179     "type": "string",
180     "pattern": "~20\d\d-(0[1-9]|1[0-2])-(0[12]\d|3[01])
181 ([01]\d|2[0-3]):(0-5)\d:(0-5)\d$",
182     "examples": [
183         "2019-05-21 22:51:55"
184     ]
185 },
186     "lastModified": {
187         "description": "The most recent moment the key was modified, as
188 'YYYY-MM-DD hh:mm:ss'.",
189         "type": "string",
190         "pattern": "~20\d\d-(0[1-9]|1[0-2])-(0[12]\d|3[01])
191 ([01]\d|2[0-3]):(0-5)\d:(0-5)\d$",
192         "examples": [
193             "2019-05-21 22:51:55"
194         ]
195     },
196     "identifier": {
197         "description": "The GUID of this key (persistent regardless of
198 version).",
199         "type": "string"
200     },
201     "url": {
202         "description": "The url of where the key lives (to check for newer
203 versions).",
204         "$ref": "#/definitions/url"
205     },
206     "externalServices": {
207         "description": "Services used by the key for lookups of images,
208 taxa, etc.",
209         "type": "array",
210         "items": {
211             "$ref": "#/definitions/externalService"
212         }
213     },
214     "userRequirements": {
215         "description": "Requirements to the users of the various
216 characters, so that the user can be warned, helped, etc.",
217         "type": "array",
218         "items": {
219             "$ref": "#/definitions/userRequirement"
220         }
221     },
222     "taxa": {
223         "description": "Taxa (e.g. species) the key can resolve to. Do not

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224 have to be exclusively taxonomic units.",
225     "comment": "Taxa to which the key can resolve (either the taxa
226 directly or their children).",
227     "type": "array",
228     "items": {
229         "$ref": "#/definitions/taxon"
230     }
231 },
232     "characters": {
233         "description": "Characters (questions, e.g. 'Wing color' or
234 'Number of spots') used to distinguish between two or more taxa.",
235         "type": "array",
236         "items": {
237             "$ref": "#/definitions/character"
238         }
239     },
240     "statements": {
241         "description": "Relationships between taxa and character states
242 (or lack thereof) that define those taxa.",
243         "type": "array",
244         "items": {
245             "$ref": "#/definitions/statement"
246         }
247     },
248     "persons": {
249         "description": "Persons that are connected to (parts of) the key,
250 such as creators.",
251         "type": "array",
252         "items": {
253             "$ref": "#/definitions/person"
254         }
255     },
256     "organizations": {
257         "description": "Organizations that are connected to (parts of) the
258 key or persons, such as employers and publishers.",
259         "type": "array",
260         "items": {
261             "$ref": "#/definitions/organization"
262         }
263     },
264     "mediaElements": {
265         "description": "Media elements that are used in the key.",
266         "type": "array",
267         "items": {
268             "$ref": "#/definitions/localizedMediaElement"
269         }

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270     }
271 },
272 "additionalProperties": false,
273 "definitions": {
274     "localizedString": {
275         "description": "Language-dependent string or object of strings,
276 with keys corresponding to the languages supported by the key.",
277         "oneOf": [
278             {
279                 "type": "string"
280             },
281             {
282                 "type": "object",
283                 "propertyNames": {
284                     "pattern": "^[a-z]{2}$"
285                 },
286                 "properties": {},
287                 "additionalProperties": {
288                     "type": "string"
289                 }
290             }
291         ]
292     },
293     "localizedUrl": {
294         "description": "Language-dependent urls or object of urls,
295 corresponding to the languages supported by the key.",
296         "oneOf": [
297             {
298                 "$ref": "#/definitions/url"
299             },
300             {
301                 "type": "object",
302                 "propertyNames": {
303                     "pattern": "^[a-z]{2}$"
304                 },
305                 "properties": {},
306                 "additionalProperties": {
307                     "$ref": "#/definitions/url"
308                 }
309             }
310         ]
311     },
312     "localizedMediaElement": {
313         "type": "object",
314         "description": "Language-dependent media element or object of
315 media elements, corresponding to the languages supported by the key.",

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316     "properties": {
317         "id": {
318             "description": "Internally unique id of the localized media
319 element.",
320             "$ref": "#/definitions/mediaID"
321         },
322         "mediaElement": {
323             "description": "The media element or media elements (one for
324 each language).",
325             "oneOf": [
326                 {
327                     "$ref": "#/definitions/mediaElement"
328                 },
329                 {
330                     "type": "object",
331                     "propertyNames": {
332                         "pattern": "^[a-z]{2}$"
333                     },
334                     "properties": {},
335                     "additionalProperties": {
336                         "$ref": "#/definitions/mediaElement"
337                     }
338                 }
339             ]
340         },
341     },
342     "additionalProperties": false
343 },
344 "url": {
345     "description": "String formed as a url, or an external
346 resource.",
347     "oneOf": [
348         {
349             "type": "string",
350             "format": "uri"
351         },
352         {
353             "$ref": "#/definitions/externalResource"
354         }
355     ]
356 },
357 "taxonID": {
358     "description": "String used as an internal ID for a taxon.
359 Lowercase alphanumeric and underscores are allowed.",
360     "type": "string",
361     "pattern": "^taxon:[a-z0-9_]+$"

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362     },
363     "characterID": {
364         "description": "String used as an internal ID for a character.
365 Lowercase alphanumeric and underscores are allowed.",
366         "type": "string",
367         "pattern": "^character:[a-z0-9_]+$"
368     },
369     "stateID": {
370         "description": "String used as an internal ID for a state.
371 Lowercase alphanumeric and underscores are allowed.",
372         "type": "string",
373         "pattern": "^state:[a-z0-9_]+$"
374     },
375     "personID": {
376         "description": "String used as an internal ID for a person.
377 Lowercase alphanumeric and underscores are allowed.",
378         "type": "string",
379         "pattern": "^person:[a-z0-9_]+$"
380     },
381     "organizationID": {
382         "description": "String used as an internal ID for an organization.
383 Lowercase alphanumeric and underscores are allowed.",
384         "type": "string",
385         "pattern": "^organization:[a-z0-9_]+$"
386     },
387     "serviceID": {
388         "description": "String used as an internal ID for a service.
389 Lowercase alphanumeric and underscores are allowed.",
390         "type": "string",
391         "pattern": "^service:[a-z0-9_]+$"
392     },
393     "statementID": {
394         "description": "String used as an internal ID for a statement.
395 Lowercase alphanumeric and underscores are allowed.",
396         "type": "string",
397         "pattern": "^statement:[a-z0-9_]+$"
398     },
399     "userRequirementID": {
400         "description": "String used as an internal ID for a user
401 requirement. Lowercase alphanumeric and underscores are allowed.",
402         "type": "string",
403         "pattern": "^requirement:[a-z0-9_]+$"
404     },
405     "mediaID": {
406         "description": "String used as an internal ID for a media element.
407 Lowercase alphanumeric and underscores are allowed.",

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408         "type": "string",
409         "pattern": "~media:[a-z0-9_]+$"
410     },
411     "mediaFile": {
412         "type": "object",
413         "properties": {
414             "title": {
415                 "description": "The title of the media file.",
416                 "$ref": "#/definitions/localizedString"
417             },
418             "url": {
419                 "description": "The reference to the media file (url or
420 resource).",
421                 "$ref": "#/definitions/url"
422             },
423             "file": {
424                 "description": "The actual media file (base64 or svg) as a
425 data URI scheme.",
426                 "oneOf": [
427                     {
428                         "type": "string",
429                         "pattern": "~data:([a-z0-9/]+);base64,([a-zA-Z0-9+/=]+)$"
430                     },
431                     {
432                         "type": "string",
433                         "pattern": "~data:image/svg+xml;utf8,(.*)$"
434                     }
435                 ]
436             },
437             "width": {
438                 "description": "The number of pixels horizontally (if a bitmap
439 image or video).",
440                 "type": "integer"
441             },
442             "height": {
443                 "description": "The number of pixels vertically (if a bitmap
444 image or video).",
445                 "type": "integer"
446             },
447             "length": {
448                 "description": "The length in seconds of an audio or video
449 file.",
450                 "type": "integer"
451             },
452             "placeholder": {
453                 "description": "Image file that can be shown instead of the

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454 video or audio file.",
455     "$ref": "#/definitions/mediaID"
456 },
457 "creator": {
458     "description": "The id(s) of the creator(s) of the media
459 file",
460     "oneOf": [
461         {
462             "$ref": "#/definitions/personID"
463         },
464         {
465             "type": "array",
466             "items": {
467                 "$ref": "#/definitions/personID"
468             }
469         }
470     ],
471 },
472 "contributor": {
473     "description": "The id(s) of the contributor(s) of the media
474 file",
475     "oneOf": [
476         {
477             "$ref": "#/definitions/personID"
478         },
479         {
480             "type": "array",
481             "items": {
482                 "$ref": "#/definitions/personID"
483             }
484         }
485     ],
486 },
487 "publisher": {
488     "description": "The id(s) of the publishing institutions of
489 the media file.",
490     "oneOf": [
491         {
492             "$ref": "#/definitions/organizationID"
493         },
494         {
495             "type": "array",
496             "items": {
497                 "$ref": "#/definitions/organizationID"
498             }
499         }
500     ]
501 }

```

```

500         ]
501     },
502     "license": {
503         "description": "The url to the license under which the media
504 file falls.",
505         "$ref": "#/definitions/url",
506         "examples": [
507             "https://creativecommons.org/licenses/by/4.0/"
508         ]
509     },
510 },
511     "additionalProperties": false
512 },
513     "mediaElement": {
514         "description": "A media element (collection of various formats of
515 the same media object).",
516         "type": "object",
517         "properties": {
518             "file": {
519                 "description": "The various formats of the same media
520 object.",
521                 "oneOf": [
522                     {
523                         "$ref": "#/definitions/mediaFile"
524                     },
525                     {
526                         "type": "array",
527                         "items": {
528                             "$ref": "#/definitions/mediaFile"
529                         }
530                     }
531                 ]
532             }
533         },
534         "additionalProperties": false
535     },
536     "multiPolygon": {
537         "description": "The coordinates array of a GeoJSON
538 MultiPolygon.",
539         "type": "array",
540         "items": {
541             "type": "array",
542             "items": {
543                 "type": "array",
544                 "items": {
545                     "type": "array",

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```

546         "items": {
547             "type": "number"
548         }
549     }
550 }
551 },
552 "geography": {
553     "description": "A geographic element (name, polygon, and/or
554 external service).",
555     "type": "object",
556     "properties": {
557         "name": {
558             "description": "The name of the area(s).",
559             "comment": "Accepts array for multilingual support.",
560             "$ref": "#/definitions/localizedString",
561             "examples": [
562                 "Norway",
563                 "Europe",
564                 "Trøndelag",
565                 [
566                     "Norge",
567                     "Norway"
568                 ]
569             ]
570         },
571         "polygon": {
572             "description": "The geographical area(s), represented as the
573 coordinates array of a GeoJSON MultiPolygon.",
574             "$ref": "#/definitions/multiPolygon"
575         },
576         "service": {
577             "description": "An url or external service that returns
578 geographical information.",
579             "$ref": "#/definitions/url"
580         }
581     },
582     "additionalProperties": false
583 },
584 "externalResource": {
585     "description": "A resource managed elsewhere.",
586     "type": "object",
587     "properties": {
588         "serviceId": {
589             "description": "The id to one of the externalServices
590 defined.",

```

```

592         "$ref": "#/definitions/serviceID"
593     },
594     "externalId": {
595         "description": "The id of the resource at the
596 externalService.",
597         "type": "string"
598     }
599 },
600     "additionalProperties": false
601 },
602     "externalService": {
603         "description": "Service used by the key, for media files, taxonomy
604 and/or nomenclature, species distributions, etc.",
605         "type": "object",
606         "required": [
607             "id"
608         ],
609         "properties": {
610             "id": {
611                 "description": "Internally unique id to the service.",
612                 "$ref": "#/definitions/serviceID"
613             },
614             "title": {
615                 "description": "Name of the service.",
616                 "type": "string"
617             },
618             "description": {
619                 "description": "Description of the service.",
620                 "type": "string"
621             },
622             "provider": {
623                 "description": "Provider of the service.",
624                 "type": "string"
625             },
626             "url": {
627                 "description": "Url for the service documentation.",
628                 "$ref": "#/definitions/url"
629             }
630         },
631         "additionalProperties": false
632     },
633     "person": {
634         "type": "object",
635         "required": [
636             "id",
637             "name"

```

```

638     ],
639     "properties": {
640         "id": {
641             "$ref": "#/definitions/personID"
642         },
643         "name": {
644             "description": "Full name of the person",
645             "comment": "Accepts object for multilingual support.",
646             "$ref": "#/definitions/localizedString"
647         },
648         "email": {
649             "description": "Email address of the person",
650             "type": "string",
651             "format": "email"
652         },
653         "url": {
654             "description": "Hyperlink to more information on the person
655 (valid url).",
656             "comment": "Accepts object for multilingual support.",
657             "$ref": "#/definitions/localizedUrl"
658         },
659         "media": {
660             "description": "A media file (image) representing the
661 person.",
662             "$ref": "#/definitions/mediaID"
663         },
664         "affiliation": {
665             "description": "Organization id(s) the person is affiliated
666 with.",
667             "oneOf": [
668                 {
669                     "$ref": "#/definitions/organizationID"
670                 },
671                 {
672                     "type": "array",
673                     "items": {
674                         "$ref": "#/definitions/organizationID"
675                     }
676                 }
677             ]
678         },
679         "additionalProperties": false
680     },
681     "organization": {
682         "type": "object",
683

```

```

684     "required": [
685         "id",
686         "name"
687     ],
688     "properties": {
689         "id": {
690             "$ref": "#/definitions/organizationID"
691         },
692         "name": {
693             "description": "Name of the organization",
694             "comment": "Accepts object for multilingual support.",
695             "$ref": "#/definitions/localizedString"
696         },
697         "url": {
698             "description": "Hyperlink to more information on the
699 organization (valid url).",
700             "comment": "Accepts object for multilingual support.",
701             "$ref": "#/definitions/localizedUrl"
702         },
703         "primaryContact": {
704             "description": "The person-id that is the main contact point
705 for the organization.",
706             "$ref": "#/definitions/personID"
707         },
708         "media": {
709             "description": "A media file (image) representing the
710 organization, such as a logo.",
711             "$ref": "#/definitions/mediaID"
712         }
713     },
714     "additionalProperties": false
715 },
716 "userRequirement": {
717     "type": "object",
718     "required": [
719         "id"
720     ],
721     "properties": {
722         "id": {
723             "$ref": "#/definitions/userRequirementID"
724         },
725         "title": {
726             "comment": "Accepts array for multilingual support.",
727             "$ref": "#/definitions/localizedString"
728         },
729         "warning": {

```



```

730         "comment": "Accepts array for multilingual support.",
731         "$ref": "#/definitions/localizedString"
732     },
733     "description": {
734         "description": "Short description of the requirements to the
735 user (valid markdown).",
736         "comment": "Accepts object for multilingual support.",
737         "$ref": "#/definitions/localizedString",
738         "contentMediaType": "text/markdown"
739     },
740     "descriptionDetails": {
741         "description": "Extended description of the requirements to
742 the user that supplements the description (valid markdown).",
743         "comment": "Accepts object for multilingual support.",
744         "$ref": "#/definitions/localizedString",
745         "contentMediaType": "text/markdown"
746     },
747     "descriptionUrl": {
748         "description": "Hyperlink to more information on the
749 requirements to the user (valid url).",
750         "comment": "Accepts object for multilingual support.",
751         "$ref": "#/definitions/localizedUrl"
752     },
753     "media": {
754         "description": "Media or illustration that informs the user on
755 the requirements to the user.",
756         "comment": "Accepts object for multilingual support.",
757         "$ref": "#/definitions/mediaID"
758     }
759 },
760 "additionalProperties": false
761 },
762 "taxon": {
763     "type": "object",
764     "oneOf": [
765         {
766             "required": [
767                 "id",
768                 "scientificName"
769             ]
770         },
771         {
772             "required": [
773                 "id",
774                 "externalReference"
775             ]

```

```

776     },
777     {
778         "required": [
779             "id",
780             "label"
781         ]
782     }
783 ],
784 "properties": {
785     "id": {
786         "description": "Internally unique id to the taxon.",
787         "$ref": "#/definitions/taxonID"
788     },
789     "scientificName": {
790         "description": "Scientific name of the taxon.",
791         "minLength": 5,
792         "type": "string",
793         "examples": [
794             "Vulpes lagopus"
795         ]
796     },
797     "scientificNameAuthor": {
798         "description": "Author string of the scientific name of the
799 taxon.",
800         "type": "string",
801         "examples": [
802             "Koch, 1888"
803         ]
804     },
805     "placeholderName": {
806         "description": "Name that can be shown while fetching the name
807 externally. Also useful for editing the key.",
808         "comment": "Accepts object for multilingual support.",
809         "$ref": "#/definitions/localizedString",
810         "examples": [
811             "B. hortorum (melanistic queen)"
812         ]
813     },
814     "vernacularName": {
815         "description": "Vernacular name of the taxon.",
816         "comment": "Accepts object for multilingual support.",
817         "$ref": "#/definitions/localizedString",
818         "examples": [
819             "fjellrev",
820             {
821                 "no": "fjellrev",

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822         "en": "Arctic Fox"
823     }
824 ]
825 },
826 "media": {
827     "description": "Media elements of the taxon.",
828     "oneOf": [
829         {
830             "$ref": "#/definitions/mediaID"
831         },
832         {
833             "type": "array",
834             "items": {
835                 "$ref": "#/definitions/mediaID"
836             }
837         }
838     ]
839 },
840 "description": {
841     "description": "Short description of the taxon (valid
842 markdown).",
843     "comment": "Accepts object for multilingual support.",
844     "$ref": "#/definitions/localizedString",
845     "contentMediaType": "text/markdown"
846 },
847 "descriptionDetails": {
848     "description": "Extended description of the taxon that
849 supplements the description (valid markdown).",
850     "comment": "Accepts object for multilingual support.",
851     "$ref": "#/definitions/localizedString",
852     "contentMediaType": "text/markdown"
853 },
854 "descriptionUrl": {
855     "description": "Hyperlink or resource to more information on
856 the taxon.",
857     "comment": "Accepts object for multilingual support.",
858     "$ref": "#/definitions/localizedUrl"
859 },
860 "rank": {
861     "description": "Name of the level of the taxon.",
862     "comment": "Accepts object for multilingual support.",
863     "$ref": "#/definitions/localizedString",
864     "examples": [
865         "slekt",
866         {
867             "no": "slekt",

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868         "en": "genus"
869     }
870 ]
871 },
872 "label": {
873     "description": "Type of morph of the taxon.",
874     "type": "string",
875     "minLength": 0,
876     "examples": [
877         "male",
878         "♀",
879         "larva"
880     ]
881 },
882 "isEndPoint": {
883     "description": "Whether the key should stop when this taxon is
884 the only remaining possibility, even when it has multiple children
885 remaining.",
886     "comment": "Default is FALSE (if not specified). A taxon
887 without children is always an endpoint by definition, unless one of its
888 ancestors overrides this by being specified as an endpoint.",
889     "type": "boolean"
890 },
891 "children": {
892     "type": "array",
893     "items": {
894         "$ref": "#/definitions/taxon"
895     }
896 },
897 "externalReference": {
898     "description": "Reference to a taxon at one or more providers,
899 each as an object with a provider id and a taxon id at that provider.",
900     "comment": "Accepts an array for multiple sources. Each
901 element accepts an object for multilingual support.",
902     "oneOf": [
903         {
904             "$ref": "#/definitions/localizedUrl"
905         },
906         {
907             "type": "array",
908             "items": {
909                 "$ref": "#/definitions/localizedUrl"
910             }
911         }
912     ]
913 },

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914     "followUp": {
915         "description": "Url or reference to instance at external
916 service for a key for this taxon, that for instance can be used to
917 identify to a lower rank than the current key can.",
918         "comment": "Accepts array for multilingual support.",
919         "$ref": "#/definitions/localizedUrl"
920     },
921     "geography": {
922         "description": "The area(s) in which the taxon occurs,
923 represented as a geography object.",
924         "$ref": "#/definitions/geography"
925     }
926 },
927 "additionalProperties": false
928 },
929 "character": {
930     "type": "object",
931     "required": [
932         "id",
933         "title",
934         "states"
935     ],
936     "properties": {
937         "id": {
938             "description": "Internally unique id to the character.",
939             "$ref": "#/definitions/characterID"
940         },
941         "title": {
942             "description": "Name of the character.",
943             "comment": "Accepts array for multilingual support.",
944             "$ref": "#/definitions/localizedString",
945             "examples": [
946                 "Color of the wings"
947             ]
948         },
949         "media": {
950             "description": "The media element(s) of the character. Can be
951 used to inform user of relevant structures etc.",
952             "oneOf": [
953                 {
954                     "$ref": "#/definitions/mediaID"
955                 },
956                 {
957                     "type": "array",
958                     "items": {
959                         "$ref": "#/definitions/mediaID"

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960         }
961     }
962 ]
963 },
964 "description": {
965     "description": "Short description of the character (valid
966 markdown).",
967     "comment": "Accepts object for multilingual support.",
968     "$ref": "#/definitions/localizedString",
969     "contentMediaType": "text/markdown"
970 },
971 "descriptionDetails": {
972     "description": "Extended description of the character that
973 supplements the description (valid markdown).",
974     "comment": "Accepts object for multilingual support.",
975     "$ref": "#/definitions/localizedString",
976     "contentMediaType": "text/markdown"
977 },
978 "descriptionUrl": {
979     "description": "Hyperlink or resource to more information on
980 the character.",
981     "comment": "Accepts object for multilingual support.",
982     "$ref": "#/definitions/localizedUrl"
983 },
984 "type": {
985     "description": "Type of the character (exclusive when states
986 are categorical and mutually exclusive, non-exclusive when these are
987 non-exclusive, or numerical when the state is numerical).",
988     "comment": "Default is exclusive (if not specified).",
989     "type": "string",
990     "enum": [
991         "exclusive",
992         "non-exclusive",
993         "numerical"
994     ]
995 },
996 "userRequirement": {
997     "description": "Id to the userRequirement required to answer
998 this character.",
999     "comment": "Has to be one of the userRequirement defined on
1000 the key level.",
1001     "$ref": "#/definitions/userRequirementID"
1002 },
1003 "logicalPremise": {
1004     "description": "Logical requirement that has to be fulfilled
1005 for this question to be asked.",

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1006         "comment": "Has to refer to stateIds, that have to be fully
1007 true (either answered or all alternatives ruled out). Can use !, &&, ||,
1008 (, ), <, >, =.",
1009         "type": "string",
1010         "pattern": "^( ( && ) | ( \\|\\|
1011 ) | ( && ) | ( \\|\\| ) | [a-z0-9_:(!<>=)]+ $"
1012     },
1013     "states": {
1014         "oneOf": [
1015             {
1016                 "type": "array",
1017                 "items": {
1018                     "$ref": "#/definitions/state"
1019                 }
1020             },
1021             {
1022                 "$ref": "#/definitions/state"
1023             }
1024         ]
1025     },
1026     "additionalProperties": false
1027 },
1028 "state": {
1029     "description": "The value a character can have.",
1030     "type": "object",
1031     "oneOf": [
1032         {
1033             "required": [
1034                 "id",
1035                 "title"
1036             ]
1037         },
1038         {
1039             "required": [
1040                 "id",
1041                 "min",
1042                 "max",
1043                 "stepSize",
1044                 "unit"
1045             ]
1046         }
1047     ],
1048     "properties": {
1049         "id": {
1050             "description": "Internally unique id of the state.",

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1052         "$ref": "#/definitions/stateID"
1053     },
1054     "title": {
1055         "description": "Content of the state.",
1056         "comment": "Only to be used for categorical characters.
1057 Accepts object for multilingual support.",
1058         "$ref": "#/definitions/localizedString"
1059     },
1060     "media": {
1061         "description": "Media element(s) that illustrate the state.",
1062         "oneOf": [
1063             {
1064                 "$ref": "#/definitions/mediaID"
1065             },
1066             {
1067                 "type": "array",
1068                 "items": {
1069                     "$ref": "#/definitions/mediaID"
1070                 }
1071             }
1072         ]
1073     },
1074     "description": {
1075         "description": "Short description of the state (valid
1076 markdown).",
1077         "comment": "Accepts object for multilingual support.",
1078         "$ref": "#/definitions/localizedString",
1079         "contentMediaType": "text/markdown"
1080     },
1081     "descriptionDetails": {
1082         "description": "Extended description of the state that
1083 supplements the description (valid markdown).",
1084         "comment": "Accepts object for multilingual support.",
1085         "$ref": "#/definitions/localizedString",
1086         "contentMediaType": "text/markdown"
1087     },
1088     "descriptionUrl": {
1089         "description": "Hyperlink or resource to more information on
1090 the state.",
1091         "comment": "Accepts object for multilingual support.",
1092         "$ref": "#/definitions/localizedUrl"
1093     },
1094     "min": {
1095         "description": "Lowest numerical value of the state (over all
1096 taxa).",
1097         "comment": "Only to be used for numerical characters",

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1098         "type": "number"
1099     },
1100     "max": {
1101         "description": "Highest possible numerical value of the state
1102 (over all taxa).",
1103         "comment": "Only to be used for numerical characters",
1104         "type": "number"
1105     },
1106     "stepSize": {
1107         "description": "Step size of the state (steps between min and
1108 max, over all taxa).",
1109         "comment": "Only to be used for numerical characters",
1110         "type": "number"
1111     },
1112     "unit": {
1113         "description": "Unit in which the state is measured or
1114 counted.",
1115         "comment": "Only to be used for numerical characters. Accepts
1116 object for multilingual support.",
1117         "$ref": "#/definitions/localizedString",
1118         "examples": [
1119             "mm",
1120             "meters below the surface",
1121             "spots",
1122             "legs",
1123             "kg"
1124         ]
1125     }
1126 },
1127     "additionalProperties": false
1128 },
1129     "statement": {
1130         "description": "A fact connecting a taxon and a character through
1131 a certain value.",
1132         "type": "object",
1133         "required": [
1134             "id",
1135             "taxon",
1136             "character",
1137             "value",
1138             "frequency"
1139         ],
1140         "properties": {
1141             "id": {
1142                 "description": "Internally unique id of the statement.",
1143                 "$ref": "#/definitions/statementID"

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1144     },
1145     "taxon": {
1146         "description": "Id of the taxon this statement is about.",
1147         "$ref": "#/definitions/taxonID"
1148     },
1149     "character": {
1150         "description": "Id of the character this statement is
1151 about.",
1152         "$ref": "#/definitions/characterID"
1153     },
1154     "value": {
1155         "description": "A value for this character for this taxon.
1156 Must be either the id of a state, or an array of floats [min, max] for a
1157 numerical range.",
1158         "oneOf": [
1159             {
1160                 "$ref": "#/definitions/stateID"
1161             },
1162             {
1163                 "type": "array",
1164                 "items": {
1165                     "type": "number"
1166                 },
1167                 "minItems": 2,
1168                 "maxItems": 2
1169             }
1170         ]
1171     },
1172     "frequency": {
1173         "description": "The frequency with which the taxon has this
1174 value for this character.",
1175         "type": "number",
1176         "minimum": 0,
1177         "maximum": 1
1178     },
1179     "geography": {
1180         "description": "The area(s) in which the taxon can have this
1181 property, represented as a geography object.",
1182         "$ref": "#/definitions/geography"
1183     },
1184     "media": {
1185         "description": "Illustration(s) of this particular taxon
1186 having this particular property (this value for this character).",
1187         "oneOf": [
1188             {
1189                 "$ref": "#/definitions/mediaID"

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1190         },
1191         {
1192             "type": "array",
1193             "items": {
1194                 "$ref": "#/definitions/mediaID"
1195             }
1196         }
1197     ]
1198 },
1199     "description": {
1200         "description": "Short description of the taxon having this
1201 property (valid markdown).",
1202         "comment": "Accepts array for multilingual support.",
1203         "$ref": "#/definitions/localizedString",
1204         "contentMediaType": "text/markdown"
1205     },
1206     "descriptionDetails": {
1207         "description": "Extended description of the taxon having this
1208 property that supplements the description (valid markdown).",
1209         "comment": "Accepts array for multilingual support.",
1210         "$ref": "#/definitions/localizedString",
1211         "contentMediaType": "text/markdown"
1212     },
1213     "descriptionUrl": {
1214         "description": "Hyperlink or resource to more information on
1215 the taxon having this property.",
1216         "comment": "Accepts array for multilingual support.",
1217         "$ref": "#/definitions/localizedUrl"
1218     }
1219 },
1220     "additionalProperties": false
1221 }
1222 }
1223 }

```