

1 **Title**

2 Use it or lose it: measuring trends in wild species subject to substantial use

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55 **Abstract**

56 The unsustainable use of wild animals and plants is thought to be a significant driver of
57 biodiversity loss in many regions of the world. The international community has therefore
58 called for action on taking greater responsibility for ensuring the sustainable use of our living
59 resources and safeguarding them so that they are available for future generations. For that
60 reason, indicators that can track changes in populations of species used by humans are
61 essential tools for measuring progress towards these ideals and informing management
62 decisions. Here we present two indicators that could be used to track change in populations
63 of utilised vertebrate species and levels of harvest sustainability. Preliminary results, based
64 on example data at both the global level and for the Arctic, show that utilised species are
65 faring better than other species overall. This could be a consequence of better management
66 of these populations, as indicated by harvest levels becoming more sustainable in recent
67 decades. Limitations of the indicators are still apparent, in particular, data on harvested
68 populations of some vertebrate classes and those from specific regions are lacking.
69 Focussing monitoring efforts on broadening the scope of data collected, as well as
70 identifying interactions with other potential drivers of decline, will serve to strengthen these
71 indicators as policy tools, and improve their potential to be incorporated into future sets of
72 indicators used to track progress towards global biodiversity targets.

73 **Keywords**

74 Arctic, Aichi Targets, biodiversity indicators, Convention on Biological Diversity, population
75 trends, sustainable use

76 **Introduction**

77 In many situations the use of wild animals and plants is essential for human livelihoods and
78 well-being, while in others it is considered an active choice (Hutton & Leader-Williams,
79 2003). In many regions, the use of wild resources is thought to be unsustainable and a major
80 driver of biodiversity loss (Butchart, 2008; Baillie et al., 2010). As the world's human
81 population increases and demand for biological resources grows, this pressure that humans
82 exert on exploited species and the ecosystems in which they live will become even greater.
83 In order that wild species meet our needs now, and in the future, it is vital that these species
84 are used in a biologically sustainable way.

85 Sustainable use is defined by the Convention on Biological Diversity (CBD) as the '*use of*
86 *components of biological diversity in a way and at a rate that does not lead to the long-term*
87 *decline of biodiversity, thereby maintaining its potential to meet the needs and aspirations of*
88 *present and future generations*' (CBD, 1992). Sustainable use was a focal area under the CBD
89 target of significantly reducing biodiversity loss by 2010 (Decision VII/30). Failure to meet
90 this target has resulted in the Parties to the CBD adopting a revised Strategic Plan for
91 addressing biodiversity loss (CBD, 2010a). The new Strategic Plan, which includes 20
92 measurable targets (the 'Aichi Targets') maintains the goal of sustainable use.

93 Building on the existing CBD indicator framework, the CBD has called for the development of
94 a new suite of indicators that can be used to track progress towards targets in the CBD
95 Strategic Plan (CBD, 2010b). In conjunction to a new suite of indicators, it has been
96 recommended that consideration be given as to how indicators can be 'linked' or presented
97 as integrated sets (Walpole et al., 2009; Butchart et al., 2010; Sparks et al., 2011). Sparks *et*
98 *al.* (2011) illustrate that linking indicators can create a more comprehensive understanding
99 of trends and patterns observed, can aid in communicating complex messages, and that

100 linked indicator sets can provide decision makers with a tool for effectively addressing
101 biodiversity loss.

102 In order to determine whether the use of wild species is biologically sustainable, any
103 indicator or set of indicators must reflect the status and trends of species in the wild, as well
104 as the impact of this harvest on the species concerned. Despite the known importance of
105 wild species to human economies and livelihoods, there are, however, relatively few
106 indicators specifically developed to monitor the species that people use and rely upon, and
107 few attempts to examine how indicators of species use and harvest sustainability could be
108 linked to provide a broader picture of what, where and how people are using wild species.

109 In this paper we aim to develop, (1) an indicator that can track change in populations of
110 species that are utilised by humans ('Utilised Species Index'); and (2) an indicator that tracks
111 sustainability of the harvest of a selection of utilised species ('Harvest Index') with an overall
112 view to examining their feasibility as effective and robust sustainable use biodiversity
113 indicators. We first present trends in the Utilised Species Index at a global scale. We then use
114 a case study to critically examine how the Harvest Index and the Utilised Species Index can
115 be used together to provide a more thorough understanding of the state of utilised species
116 in the Arctic – a region which is rich in biodiversity, but where species are subject to high
117 levels of exploitation.

118 Arctic biodiversity is particularly vulnerable to the pressures of commercial, subsistence and
119 traditional harvest and trade of its wild species because many are concentrated in limited
120 areas of biological productivity, such as polynas and coastal plains. This pressure adds to that
121 already being applied by rapid environmental change such as that observed in sea-ice extent
122 (Gleason & Rode, 2009; CAFF, 2010; Heide-Jørgensen et al., 2010; Kovacs et al., 2010). Hence
123 there is growing concern that, because of the limited functional redundancy in Arctic

124 ecosystems, the loss of a single species could have cascading effects on the state and
125 function of the entire system (Post et al., 2009).

126 The Conservation of Arctic Flora and Fauna (CAFF), through the Circumpolar Biodiversity
127 Monitoring Programme (CBMP), is addressing these concerns by coordinating a number of
128 programmes and projects that assess biodiversity status and trends, and which improve
129 understanding of the drivers of change and of management options (Gill et al., 2008). An
130 important contribution to the CBMP, and of tracking the response of Arctic wildlife to
131 growing pressures, has been the development of the Arctic Species Trend Index (ASTI)
132 (McRae et al., 2010). The ASTI is the Arctic disaggregation of the Living Planet Index (Loh et
133 al., 2005; Collen et al., 2009), which tracks trends in vertebrate populations. In the case
134 study presented here, we examine whether the indicators we developed can be applied to
135 track changes in Arctic species which are utilised by people, and can complement the
136 findings of the ASTI, thereby providing further information for managing these populations.

137 **Methods**

138 Two indicators for wild commodities were developed. The first, based on the Living Planet
139 Index (LPI, Loh et al., 2005; Collen et al., 2009) tracks changes in populations of vertebrate
140 species utilized by humans since 1970 and which we refer to as the 'Utilised Species Index'.
141 The second combines population and harvest data to track the sustainability of the harvest
142 of a selection of vertebrate utilized species, herein, the 'Harvest Index'.

143 ***Utilized Species Index***

144 **Selection of Species:** Vertebrate population data was sourced from the LPI and ASTI
145 databases as compiled in October 2010. General information on each population in the LPI
146 and ASTI is coded including: to which vertebrate class it belongs, and what system

147 (freshwater, marine, terrestrial) and zone (LPI: temperate, tropical; ASTI: polar) it is most
148 dependent on for survival and reproduction (Loh et al., 2005; Collen et al., 2009).

149 A decision tree (**Appendix I**) was used to further code species within the LPI database as
150 'utilized' by humans, based on cross-referencing information on the 'use' of each species
151 contained in a variety of publically available databases. These databases included: the IUCN
152 Red List (www.iucnredlist.org), the World Bird Data Base ([http://avibase.bsc-
154 eoc.org/avibase.jsp?lang=EN&pg=home](http://avibase.bsc-
153 eoc.org/avibase.jsp?lang=EN&pg=home)), the CITES trade database
(www.cites.org/eng/resources/trade.shtml), FAO forestry country profiles
(www.fao.org/forestry/nwfp/en/ and www.fao.org/forestry/country/en/), the International
156 Tropical Timber Organisation (www.itto.int), publications by the Centre for International
157 Forestry Research (www.cifor.cgiar.org), the University of British Columbia Sea Around Us
158 Project (www.seararoundus.org), and the Fishbase online database
(www.fishbase.org/search.php). The coding generated a 'utilised species' database.

160 The type of use each species in the utilised species database is subject to, was classified,
161 where possible, according to the IUCN Utilisation Classification Scheme
162 (<http://intranet.iucn.org/webfiles/doc/SSC/RedList/AuthorityF/utilization.rtf>) which divides
163 use into 17 different categories: food (for humans or animals), medicine, poison,
164 manufacturing chemicals, other chemicals, fuels, fibre, construction/structural materials,
165 wearing apparel, household goods, handicrafts, pets, research, sport hunting, other and
166 unknown. Note, these categories are not mutually exclusive. Due to small sample sizes in
167 other categories, analyses on specific types of use were restricted to those where species
168 are used as food for humans, for sport hunting or as pets.

169 Species in the utilised species database were also categorized as 'substantially used' where
170 sufficient evidence existed that they are widely used and are particularly important to

171 people. Evidence on the scale of trade or volume of harvest at the local, national, regional
172 and international level was obtained from the databases listed above, the global Forestry
173 Resources Assessments (www.fao.org/forestry/fra/en/), regional reports and expert
174 knowledge (pers comm., IUCN Sustainable Use Steering Group). Evidence for each species
175 was subjectively ranked from 1 to 5, where 1 equated to a low amount of evidence for
176 substantial use, and 5 equated to a high amount of evidence for substantial use. Results of
177 this whole process generated a list of 'substantially used species'. Trend analyses on
178 'substantially used species' were only conducted on those species with evidence scores ≥ 3 .

179 Vertebrate Arctic species within the ASTI database were coded as 'utilized' by humans based
180 on expert opinion (pers comm. C. Zöckler), generating a list of 'Arctic utilised species'.

181 **Indices calculated:** Data were extracted from these datasets (Utilized Species, Substantially
182 Used Species, Arctic Utilized Species), and used to generate different indices to assess
183 change in populations of wild species used as commodities: a) Utilized Species; b)
184 Freshwater Utilized Species; c) Marine Utilized Species; d) Terrestrial Utilized Species; e)
185 Index of species used to provide food for humans; f) Index of species used for sport hunting;
186 g) Index of species used as pets; h) Substantially Used Species; i) Arctic Utilized Species.

187 A description of each index and the number of species and populations in each dataset can
188 be found in Table 1. For a further breakdown of the number of species and populations in
189 each data set by system (freshwater, marine, terrestrial), zone (temperate, tropical) and
190 vertebrate class (amphibian, bird, fish, mammal, reptile), see Appendix II.

191 **Calculation of index:** The indices of utilized and substantially used species were calculated
192 using the technique developed for the global LPI (see Loh et al., 2005 for more details; Collen
193 et al., 2009). Briefly, the index was calculated using population time series data (1970-2007)
194 on 6,214 populations of 1,501 species coded as utilised, and 1100 populations of 187 species

195 coded as substantially used. The changes in the population size of each species were
196 aggregated and presented as an index relative to 1970, which is given a value of 1. Tropical
197 and temperate species were weighted equally within each system (freshwater, marine,
198 terrestrial) to account for the over-representation of temperate compared to tropical
199 species.

200 The index of Arctic utilised species was calculated using the technique developed for the
201 ASTI (McRae et al., 2010), using time series data from 1970 to 2007 on 663 populations of
202 147 Arctic species coded as utilised. It should be noted that the authors are aware that the
203 ASTI database has been updated and a new ASTI generated since the analyses for the study
204 presented here were conducted (see Eamer et al., 2012). However, because the overall
205 pattern of Arctic vertebrate abundance has not changed between the two iterations of the
206 ASTI, we only include comparisons of our results with the ASTI trend line published in 2010
207 (McRae et al., 2010), but are mindful of the revised, disaggregated regional and system
208 differences depicted in the ASTI trend line published in 2012 (Eamer et al., 2012).

209 Following Loh *et al.* (2005) as adapted by Collen *et al.* (2009), a bootstrap re-sampling
210 technique was used to generate annual 95% confidence intervals (95% CI) around each index
211 value (10,000 iterations).

212 ***Harvest Index***

213 The Harvest Index is the ratio of the estimated annual harvest rates to the potential for
214 biological recovery (the theoretical maximum recovery rate). If harvest rates exceed this
215 recovery rate then this implies that harvest rates are more likely to be unsustainable than if
216 the harvest rates are less than the recovery rate. The estimates of annual population
217 recovery rates are made using a single simple equation (the Potential Biological Removal

218 [PBR] model (Wade, 1998); see below) derived from insights from simple theoretical models
219 (principally based on the logistic equation) (Elert, 2007).

220 The Harvest Index was calculated by the following:

221 *Step 1:* For each year in each population, the PBR was calculated – i.e. the maximum number
222 of individuals that can be harvested whilst still allowing the population to reach/maintain its
223 maximum stable population:

$$224 \quad \text{PBR}_{(t)} = n_{(t)\text{min}} \times (0.5 \times R_{\text{max}}) \times F_R \quad (1)$$

225 Where,

226 $n_{(t)\text{min}}$ = An estimate of the minimum number of individuals in the population at time t . As
227 population sizes are extremely difficult to measure accurately, this component is
228 routinely estimated as 90% of the number of individuals thought to be present (Wade,
229 1998).

230 R_{max} = The maximum theoretical productivity rate of the species. This parameter will vary
231 within a species from population to population, however, if unknown, this value is
232 given a weight of 0.5 which is considered a conservative estimate of the current net
233 production of a depleted population (Wade, 1998).

234 F_R = This represents a recovery factor which is the proportion of the net production of the
235 population which contributes to population growth (default value = 0.5).

236

237 *Step 2:* The ratio between the PBR (i.e. the theoretically sustainable harvest) and the actual
238 number of individuals harvested (H) was calculated. At each time point (t) the ratio between
239 H and PBR is calculated in the following way:

$$240 \quad H_{(t)\text{ratio}} = H_{(t)} / \text{PBR}_{(t)} \quad (2)$$

241 To calculate the ratio in Step 2, PBR and H for all populations of a specific species was
242 calculated from the mean PBR and mean H of each individual population of that species.

243 *Step 3:* The Harvest Index (HI) was then calculated from the geometric mean of all
244 populations for each time point. If $HI > 1.5$, then this indicates that the harvest is
245 unsustainable (coded as being in the 'red' zone); if $HI < 0.5$ then this indicates that the harvest
246 is within sustainable limits (coded as being in the 'green' zone); and if HI is between 0.5-1.5,
247 this indicates the harvest is on the threshold of sustainable limits (coded as being in the
248 'orange' zone).

249 In this study the HI was calculated for species in the Arctic Utilized Species dataset where
250 information on the harvest of a species was also available, which was possible for 73
251 populations of 20 species of birds, fish and mammals (Table 1). Harvest data were recorded
252 by volume or number of individuals taken.

253 **Results**

254 ***Utilized Species Index***

255 **Trends in utilized species:** The utilised species index (USI) shows a decline of around 14%
256 between 1970 and 2007 (Figure 1a: 2007 USI value 0.86; 95% CI 0.77-0.97). The decline
257 started at about the same time as that seen in the global LPI (i.e. early 1980s) but declined
258 by approximately half the amount (Figure 1a: LPI value 0.72; 95% CI 0.64-0.80). The utilised
259 species index is based on trends in amphibian, bird, fish, mammal and reptile species from
260 freshwater, marine and terrestrial systems around the world, however a large proportion
261 (88%) of the time-series data used to generate this global index is from information on birds
262 (Appendix II).

263 **Trends in utilised freshwater, marine and terrestrial vertebrate species:** Trends in
264 utilised species from each system vary: between 1970 and 2007 populations of utilised
265 freshwater species declined by around 3% (2007 Freshwater USI value 0.97; 95% CI 0.78-
266 1.23), populations of utilised marine species by around 17% (2007 Marine USI value 0.83;
267 95% CI 0.66-1.04), and populations of terrestrial utilised species by around 21% (2007
268 Terrestrial USI value 0.79; 95% CI 0.68-0.93) (Figure 1b). Since the early 2000s the rate of
269 decline in marine and terrestrial utilised species indexes slowed or stabilised. The freshwater
270 utilised species index has shown a steady increase since 2000.

271 **Trends in utilised vertebrate species according to what they are used for:** The
272 indices shown in Figure 1c display trends for species where their end use is food for people,
273 being hunted for sport by humans, or as pets. These categories are not mutually exclusive,
274 and the majority of species have more than one use. Therefore some species may be
275 represented in more than one trend line.

276 Trends are variable between use types. The index for species used to provide food for
277 humans, and that for species used as pets declined by 17% (2007 Food USI value 0.83; 95%
278 CI 0.72-0.97) and 9% (2007 Pets USI value 0.91; 95% CI 0.77-1.08), respectively, between
279 1970 and 2007, however both show a pattern of stabilizing since the early 2000s. The index
280 for species which are hunted by humans has shown an overall increase by 14% between
281 1970 and 2007 (2007 Sports hunting USI value 1.14; 95% CI 0.94-1.42); however the pattern
282 has varied over time, with the index increasing between 1970 and the early 1980s before a
283 slow decline to about 2005 and then increasing again in recent years.

284 The indices track change in populations of amphibians, bird, fish, mammal and reptile
285 species from freshwater, marine and terrestrial systems, however data is biased towards
286 birds and fish (Appendix II).

287 **Trends in substantially used vertebrate species:** This index tracks change in populations
288 of birds, fish, mammal and reptile species that they are widely traded and used at local,
289 national, regional, and international levels (Appendix II). It shows that apart from an
290 apparent rise starting in the early 2000s, there has been a constant trend of no change in the
291 populations of this selection of species since 1970 (Figure 1d: 2007 Substantially Used
292 Species Index value 1.11; 95% CI 0.75-1.68). Data is biased towards fish and mammals.

293 **Trends in Arctic utilised species:** Populations of utilised Arctic species has shown an
294 upward trend between 1970 and 2007, increasing by 83% in this time (Figure 2a: Arctic
295 Utilised Species Index value 1.83; 95% CI 0.75-1.68). This is five times the increase seen in
296 the 2010 ASTI, which increased by 16% between 1970 and 2004 (Figure 2b: 2004 ASTI value
297 1.16; 95% CI 1.02-1.32) (McRae et al., 2010). The trend in utilised Arctic species has not been
298 constant, rising between 1970 and 1994, then undergoing a period of apparent stabilization,
299 before rising again as of 2005. This index is based on bird, fish and mammal species only,
300 from freshwater, marine and terrestrial systems (Appendix II).

301 ***Harvest Index***

302 This index is made up of trends in the harvest and stock estimates of Arctic species of birds,
303 fish, and mammals. Harvest levels between 1970 and 1985 were generally predicted to be
304 unsustainable (i.e. they are in the red zone; Figure 2b). However, the Harvest Index has
305 shown a steady decrease in value from a high of greater than 2.0 in 1976 to about 0.3 in
306 2006, meaning that the overall level of harvesting is now within predicted sustainable limits
307 (green zone). For many years (1985 to early 2000s), the levels of harvest fluctuated around
308 predicted sustainable harvest thresholds (orange zone). It should be noted, though, that a
309 number of individual populations in the index (particularly fish) are still predicted as being
310 over-harvested.

311 **Discussion**

312 The international community has called, through Multi-Lateral Environmental Agreements
313 such as the CBD, that greater responsibility is taken for ensuring the sustainable use of our
314 living resources. Indicators that can track changes in populations of species used by humans
315 (both status and harvest levels) are therefore essential tools for measuring progress towards
316 this ideal and making informed management decisions. The two indicators presented here
317 have the potential to provide valuable input into future guidelines for the sustainable use of
318 wild species at global, regional and national levels, and, after further development could be
319 incorporated into future sets of indicators used to track progress towards global biodiversity
320 targets.

321 ***Global trends in the Utilised Species Index***

322 At a global level, the Utilised Species Index shows a decline of about 14% between 1970 and
323 2007, implying that our use of these species has not been sustainable. The decline began in
324 the early 1980s and although it has been declining in a relatively steady pattern ever since, it
325 does appear to have started to stabilize in recent years. Although it was not possible to
326 generate a separate index of non-utilised species, (given that a lack of evidence for use does
327 not mean non-use can be automatically assumed), and hence not possible to compare
328 trends of non-utilised with utilised species, it was possible to compare the Utilised Species
329 Index with the global LPI, which contains species whether their use is known or not. Trend
330 lines of both indicators showed similar trajectories, however a striking difference between
331 the two is that the Utilised Species Index has only declined by about half as much as the LPI.
332 This suggests that utilised species are, in general, faring better than other species overall.
333 This could be because people are more likely to use and rely upon common, and hence more
334 easily exploited species rather than rare ones, or because populations of utilised species are

335 likely to be managed more effectively or under greater protection than populations of non-
336 utilised species. This creates what might be considered a paradoxical situation in terms of
337 conservation management in that species subjected to significant utilisation have a lower
338 risk of being threatened (i.e. a 'use it or lose it' scenario). Similarly, the Red List Index of
339 Threatened Species has shown that the conservation status of known utilised species,
340 particularly birds, was better than non-utilised species and that they were less threatened
341 with extinction (Butchart, 2008).

342 The concept of this 'use it or lose it' scenario is further strengthened when the trend in
343 Substantially Used Species is examined. This index included species which are most widely
344 used and which are considered most important to people. Although the confidence intervals
345 are relatively broad (in part due to reduced sample sizes), the trend shows that there has
346 been no overall change in the size of these populations in relation to the start of the index.
347 When compared against the Utilised Species Index trend, this suggests that species which
348 are used more widely or more intensely are likely doing better than species that have a
349 lower incidence of use.

350 Sufficient data were available to examine trends in only three use categories (food, sport
351 hunting, pets) in detail. However differences in trends between categories also support the
352 idea of 'use it or lose it'. While populations of vertebrates used for food and pets declined
353 below the 1970 baseline, suggesting their use is unsustainable, the trend for species that are
354 hunted for sport has remained relatively stable after an initial rise from the start of the
355 index. The apparent rise in these latter populations may be because in many places sport
356 hunting has become much more highly managed and regulated in recent years (Lamoureux,
357 1999; Robinson et al., 2008; Reid et al., 2010).

358 ***Trends in wild commodities indicators for Arctic Species***

359 A majority of Arctic species are utilised either in commercial, subsistence, or traditional
360 harvest and trade. It is evident that both local and global environmental and economic
361 changes in the last 60 years, in particular, have altered and complicated harvest trends in the
362 Arctic, and are exerting growing pressure on Arctic biodiversity (CAFF, 2010). However there
363 is still a limited understanding of how Arctic wildlife populations are responding to these
364 changes.

365 The wild commodities indicators calculated for Arctic species in this study provide an initial
366 insight into the response by utilised species to these pressures. The Arctic Utilised Species
367 Index shows that the average abundance of utilised Arctic vertebrates increased by a total of
368 83% between 1970 and 2007. The greatest period of increase was between 1970 and 1994,
369 before a slight decline and stabilisation until 2005, when the trend appears to be on the rise
370 again. This increase is substantially higher than that seen for all species in the 2010 ASTI,
371 which only increased by 16% between 1970 and 2004 (McRae et al., 2010). Therefore this
372 also implies that, in general, utilised Arctic species are faring even better than all Arctic
373 vertebrate species for which data is available, and in particular from the early to mid-1990s
374 where there is little overlap between the confidence intervals of the Arctic Utilised Species
375 Index with that of the ASTI.

376 It has been suggested the increasing trend in the ASTI may be partly driven by the recovery
377 of some vertebrate populations (e.g. marine mammals) from historical overharvesting, as
378 well as the rapid increase of some populations (e.g. Bering Sea Pollock, *Boreogadus saida*
379 and lesser snow geese, *Chen c. Caerulescens*) both inside and outside the Arctic as a result of
380 recent changes in environmental conditions (CAFF, 2010). Indeed, these reasons could help
381 explain the trend seen in the Arctic Utilised Species Index.

382 Further insight can be obtained by examining trends of the ASTI and Arctic Utilised Species
383 index alongside those of the Harvest Index developed and presented here. The Harvest
384 Index combines data on biological characteristics of a species with information on
385 population changes and harvest levels in order to determine a threshold above which
386 individuals harvested can be replaced. When applied to a subset of utilised Arctic species, it
387 predicted that harvest levels have become more sustainable since 1970, and although it is
388 not known if they have recovered to pre-exploitation levels, they are likely to currently be
389 within sustainable limits. Therefore, this could also help to explain the increasing trend
390 observed in populations of Arctic utilised species. It also highlights that by examining related
391 indicators in concert with each other, instead of in isolation, a stronger narrative of the
392 potential responses of various taxa to human induced and natural pressures can be
393 revealed.

394 ***Strengths and weakness of the wild commodities indicators***

395 If biodiversity indicators are to be used as tools to inform decisions about conservation and
396 management it is important to assess the strengths and limitations of their utility and
397 identify ways in which they may be improved. The two indicators proposed here show
398 potential to track changes in components of the use of wild species that are pertinent to the
399 management of those species, however they should still be considered under development
400 and the trends presented as illustrative of their usefulness as a mechanism or tool. With this
401 in mind, we outline current strengths and limitations of each indicator, and some
402 suggestions for their future development.

403 **Strengths**

404 Both the Utilised Species Index and the Harvest Index have characteristics as to what
405 constitutes an effective indicator (Gregory et al., 2005; 2010 Biodiversity Indicators

406 Partnership, 2010). Both are relatively easy to understand and communicate conceptually
407 and empirically. They are tractable, with data on most species available over a long time-
408 period. They appear to be responsive to change and, given the growing demand to develop
409 tools for addressing issues related to sustainable use of wild species (Hutton & Leader-
410 Williams, 2003; UNEP/CBD/COP/11/2, 2011), they are policy-relevant. However the ultimate
411 test of their effectiveness will be if they are used to measure progress, enhance
412 understanding, or raise awareness of these issues (2010 Biodiversity Indicators Partnership,
413 2010).

414 The Utilised Species Index, like the LPI upon which it is based, also has the potential to be
415 applied at multiple scales (e.g. global, regional, national) or disaggregated to examine
416 population trends in different systems, biomes or vertebrate classes, and hence provide
417 further insight into overall trends. Although not possible to disaggregate the Utilised Species
418 Index by vertebrate class (due to insufficient sample sizes), it was possible to examine trends
419 by system. In this study, different trends in the abundance of populations of freshwater,
420 marine and terrestrial species were observed. Although the species populations of all three
421 have declined since 1970, they have done so at different rates, and in recent years,
422 populations of freshwater species appear to be increasing. Similar patterns were seen in the
423 global LPI (WWF, 2012). Due to inadequate sample sizes it was not possible to examine
424 trends in Arctic utilised species disaggregated by region (e.g. high, low, sub-Arctic),
425 ecological system or vertebrate class. However, as seen in the latest ASTI trend (Eamer et al.,
426 2012), it is likely that significant differences in these categories exist. For example, trends in
427 population abundance of sea-ice dependent species of the high Arctic currently show a
428 decline (McRae et al., 2010; Eamer et al., 2012). It is not known exactly why differences
429 between systems or classes might exist in either the Utilised Species Index or the ASTI

430 indices, but could, in part, be influenced by the availability of underlying data (see further
431 discussion below).

432 The Harvest Index is an extension of the established and tested Potential Biological Removal
433 model (Wade, 1998; Johnston et al., 2000; Milner-Gulland & Akcakaya, 2001; Marsh et al.,
434 2004), therefore giving the Harvest Index credibility and added strength. Although the PBR
435 has some limitations (see below), using this model as a basis for the Harvest Index is also
436 advantageous because it is relatively simple, adopts a precautionary approach in its
437 assumptions and accounts for some of the uncertainties in the parameters it uses (Wade,
438 1998; Milner-Gulland & Akcakaya, 2001; Cooke et al., 2012).

439 **Limitations**

440 A limitation of both indicators is that they rely on estimates of total population size, which
441 can be difficult to obtain. Estimates are more commonly available for only part of the
442 population in part of its range, which may not be representative of the species on the whole.
443 Related to this, population estimates may not always be from harvested populations. In this
444 study, data were only coded to the species level and so it is likely that there are population
445 contributing to the index that are not utilised; it is just that they belong to a species which is
446 used in another part of its range. The specificity of the indices could be improved by coding
447 threats to the population level. This can difficult (see further discussion below), however
448 should be attempted where possible so that only estimates from those populations which
449 are harvested are used in calculations of the wild commodities indicators.

450 A second limitation of both indicators is that not all populations, taxa, systems and regions
451 are adequately represented – at the global level, more data are available for tropical areas.
452 In the Arctic, crucial data from many fish, most whales and seals and polar bears are lacking.
453 The imbalance of geographic representativeness is somewhat accounted for in the Utilised

454 Species Index by weighting species evenly in tropical and temperate regions, however it is
455 more difficult to address biases introduced by over-representation of certain vertebrate
456 classes (Loh et al., 2005; Collen et al., 2009). The majority of data underlying both the global
457 and Arctic Utilised Species Indices were from birds, followed by fish and then mammals.
458 Intrinsically, the indices are not invalidated if, for arguments sake, there is more bird than
459 mammal species in the index, if more species of bird are truly used or threatened by use.
460 However, there is a considerable lack of data on how many species in each vertebrate class
461 are used and how much is harvested. For example, data on harvested Arctic species is biased
462 towards that on marine mammal and marine fish populations which could mask declines in
463 some seabird colonies that are over-harvested. Once these factors are known an assessment
464 of the representativeness of the dataset(s) can be assessed and potential biases accounted
465 for. Therefore, prioritising research and monitoring programmes to fill data gaps in under-
466 represented classes will serve to make these indices more robust and enhance their
467 usefulness in providing guidance for wildlife management and in tracking sustainable use.

468 Other limitations are indicator specific. For the Utilised Species Index, although all species in
469 the index are used, it is likely that the cause of decline for most populations of these species
470 is something other than harvest alone. For example, the house sparrow (*Passer domesticus*),
471 which is used in traditional Chinese medicine, may be harvested intensively in some parts of
472 Asia, but is unlikely to be harvested at a similar level in other parts of its range around the
473 world. Therefore this index (and its associated cuts) can reflect changes in the species people
474 use and by proxy their availability to people, but as yet it cannot determine the extent to
475 which use is a driver of those changes. In order to improve this, it may be possible to go
476 through the index and classify each population by its cause of decline. But, diagnosing threat
477 can be difficult due to the diverse nature of both threatening processes and species'
478 response to threats, resulting in threats being distributed in a heterogeneous manner across

479 the globe, certain species being intrinsically more vulnerable to specific threat-types (see
480 Owens & Bennett, 2000; Purvis et al., 2000; Issac & Cowlshaw, 2004; Kotiaho et al., 2005;
481 Price & Gittleman, 2007; Corey & Wait, 2008; Thomas, 2008), and particular extrinsic
482 pressures resulting in non-linear population responses (Lomolino & Channell, 1995;
483 Rodriguez, 2002; Thomas, 2008). Therefore a decline in the index by no means implies that
484 use is universally detrimental to the species as a whole, that use in every population is
485 unsustainable, or that by simply reducing harvest pressure will result in improved trends,
486 particularly if other (potentially larger) factors are driving negative trends.

487 For the Harvest Index, in addition to incorporating data from a broader range of species, we
488 recommend three other steps to improve its development: (1) harvest and population
489 abundance estimates should ideally be from the same population to avoid skewing
490 estimates of harvest sustainability; (2) it is widely recognised that R_{max} values for many
491 species are highly uncertain. Therefore R_{max} should ideally be based on maximum rates of
492 recovery likely to be witnessed in the field, rather than based on theoretical principals,
493 especially for high R_{max} species. High R_{max} species may have high recovery potential, but may
494 also have highly variable population dynamics (even natural population dynamics) which
495 could result in mis-representative estimates of n_{min} and population status; (3) populations
496 should be between their PBR abundance and carrying capacity. If the method is used on
497 over-depleted populations, the index will not yield correct results because even harvests less
498 than the PBR will be unsustainable if they are greater than the rate of recovery of a heavily
499 depleted population.

500 **Future Directions**

501 To provide a complete picture of the trade and use of a given species, information needs to
502 be collected on both the status of species in the wild ('supply') and the volume of products

503 from those species in the market ('demand'). Indicators have the potential to provide an
504 overview of trends and drivers of both these elements. The wild commodities indicators
505 presented here currently provide information on 'supply' only – i.e. trends in individual
506 source populations over time or trends in the amount and sustainability of harvests. Future
507 work, in addition to addressing the caveats outlined above, should also focus on developing
508 a complementary indicator for 'demand'– i.e. an indicator that can be used to track changes
509 in market value and market size for wild commodities, or how much end consumers are
510 willing to pay for products from wild species and what motivates them to buy them.

511 Further, and specific to the Arctic, in particular, there is a need for more information on
512 whether species are used inside or outside the Arctic region (or both). Many migratory
513 species, such as geese, plovers, some fish, sharks and whales, that breed in the Arctic and
514 hence are classified as Arctic species, are almost exclusively harvested outside of the Arctic
515 region. Examination of trends in these species is likely to be both revealing and important for
516 establishing management plans.

517 In conclusion, although the wild commodities indicators presented here are still limited in
518 their utility and reliability, they do show strong potential to be useful indicators of
519 sustainable use. A concerted effort by both researchers and decision makers to enable more
520 data to become available and broaden their scope will only serve to strengthen them as
521 much needed policy and reporting tools.

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653

654 **Tables**

655 **Table 1:** Species and population numbers in each index generated. A breakdown of the
 656 number of species and populations in each index by system (freshwater, marine, terrestrial),
 657 zone (temperate, tropical) and vertebrate class (amphibian, bird, fish, mammal, reptile) are
 658 provided in Appendix II.
 659

Index	Description	No. Species	No. Populations
Utilised Species	Based on trends in species that are utilised by humans	1501	6214
Freshwater Utilised Species	Based on trends in species that are utilised by humans found in a broad range of temperate and tropical freshwater habitats	446	2256
Marine Utilised Species	Based on trends in species that are utilised by humans found in a broad range of temperate and tropical marine habitats	388	1650
Terrestrial Utilised Species	Based on trends in species that are utilised by humans found in a broad range of temperate and tropical terrestrial habitats	795	2302
Species used for food	Based on trends in species that are utilised by humans for food	892	4500
Species used for	Based on trends in species that are	514	3423

sport hunting	utilised by humans for sport hunting		
Species used as pets	Based on trends in species that are utilised by humans as pets	907	3624
Substantially Used Species	Based on trends in species where evidence exists that they are substantially utilised by humans (based on scale of trade or volume of harvest at local, national, regional and international levels)	187	1100
Arctic Utilised Species	Based on trends in freshwater, marine and terrestrial Arctic species that are utilised by humans	147	663
Harvest index	Combines population and harvest data to track the sustainability of the harvest of select utilised Arctic species	20	73

660

661

662 **Figure Captions**

663 **Figure 1:** Trends ($\pm 95\%$ confidence intervals) in **a)** Utilised Species compared to the Global
664 Living Planet Index (WWF, 2012); **b)** Utilised Freshwater, Marine and Terrestrial Species; **c)**
665 Species used as food for humans, for sport hunting, or as pets; and **d)** Substantially Used
666 Species in evidence categories 3, 4 or 5, between 1970 and 2007. Note confidence intervals
667 not shown for b) and c) to maintain clarity of main trends; these are presented separately in
668 Appendix III.

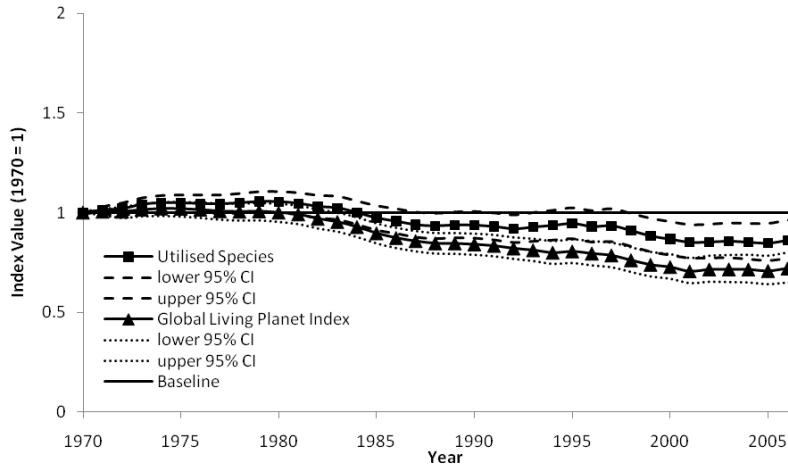
669

670 **Figure 2:** **a)** Trends ($\pm 95\%$ confidence intervals) in Arctic Utilised Species compared to the
671 Arctic Species Trends Index (McRae et al., 2010) between 1970 and 2007; and **b)** Harvest
672 Index of Arctic species between 1970 and 2006. Zones of unsustainable (light grey),
673 cautionary (medium grey) and sustainable (dark grey) harvest levels shown.

674 **Figures**

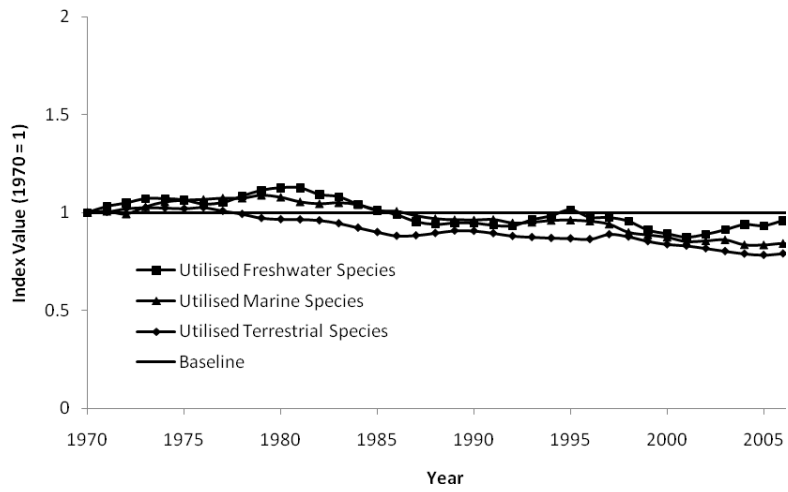
675 **Figure 1**

676 **a)**



677

678 **b)**



679

680

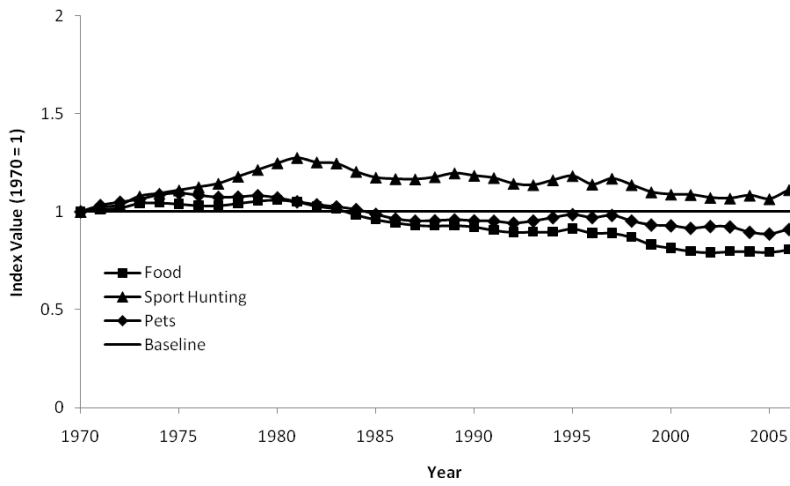
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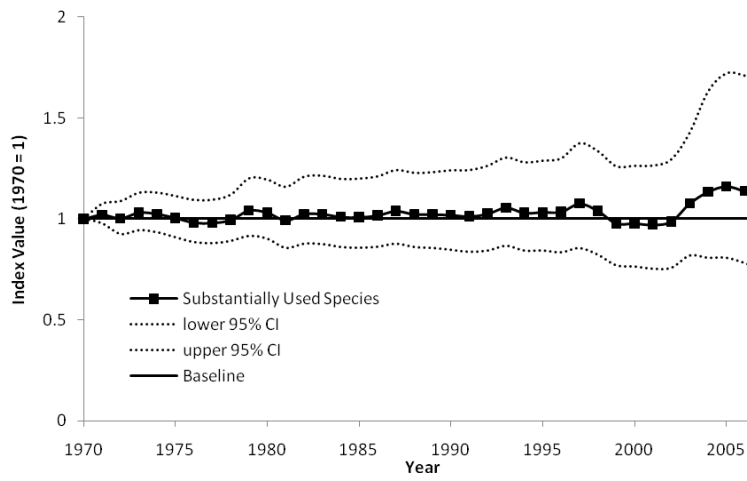
685 c)



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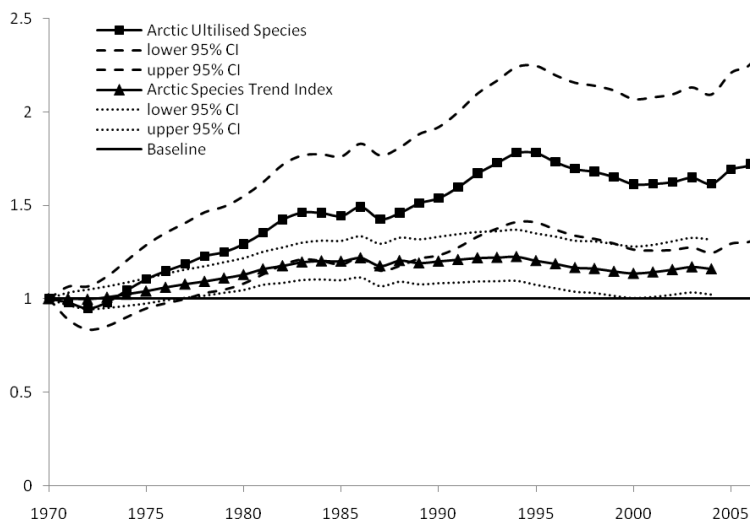
688 d)



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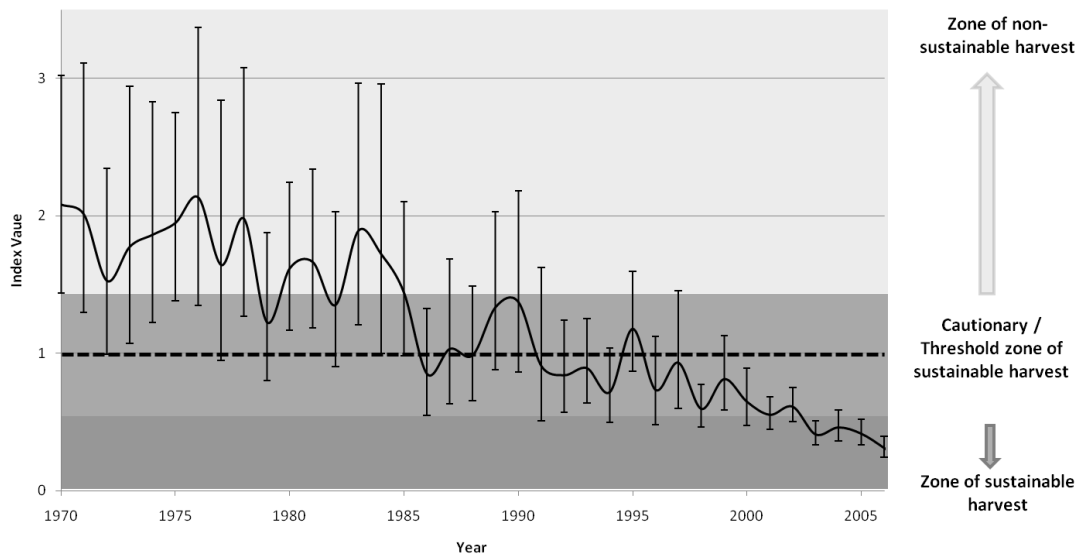
690 **Figure 2**

691 **a)**



692

693 **b)**



694

Appendix I

Flow chart used to code whether a species listed in the Living Planet Index (LPI) is utilised.

Datasets used include:

IUCN Red List databases

The IUCN Red List database includes 12,378 species, all classified as in use and/or threatened by use. Includes species in the global bird, mammals and amphibian assessments, the sampled Red List of marine and freshwater fish, plus additional phyla and classes in the Red List classified as being threatened by use, including reptiles, molluscs and plants.

CITES listed species

The CITES trade database, managed by UNEP-WCMC on behalf of the CITES Secretariat, is a unique resource and currently holds 7 million records of trade in wildlife and 50,000 scientific names of taxa listed by CITES. Currently, more than 500,000 records of trade in CITES-listed species of wildlife are reported annually.

Species were classified as 'used' if the CITES database recorded permits being issued between 1992 and 2006.

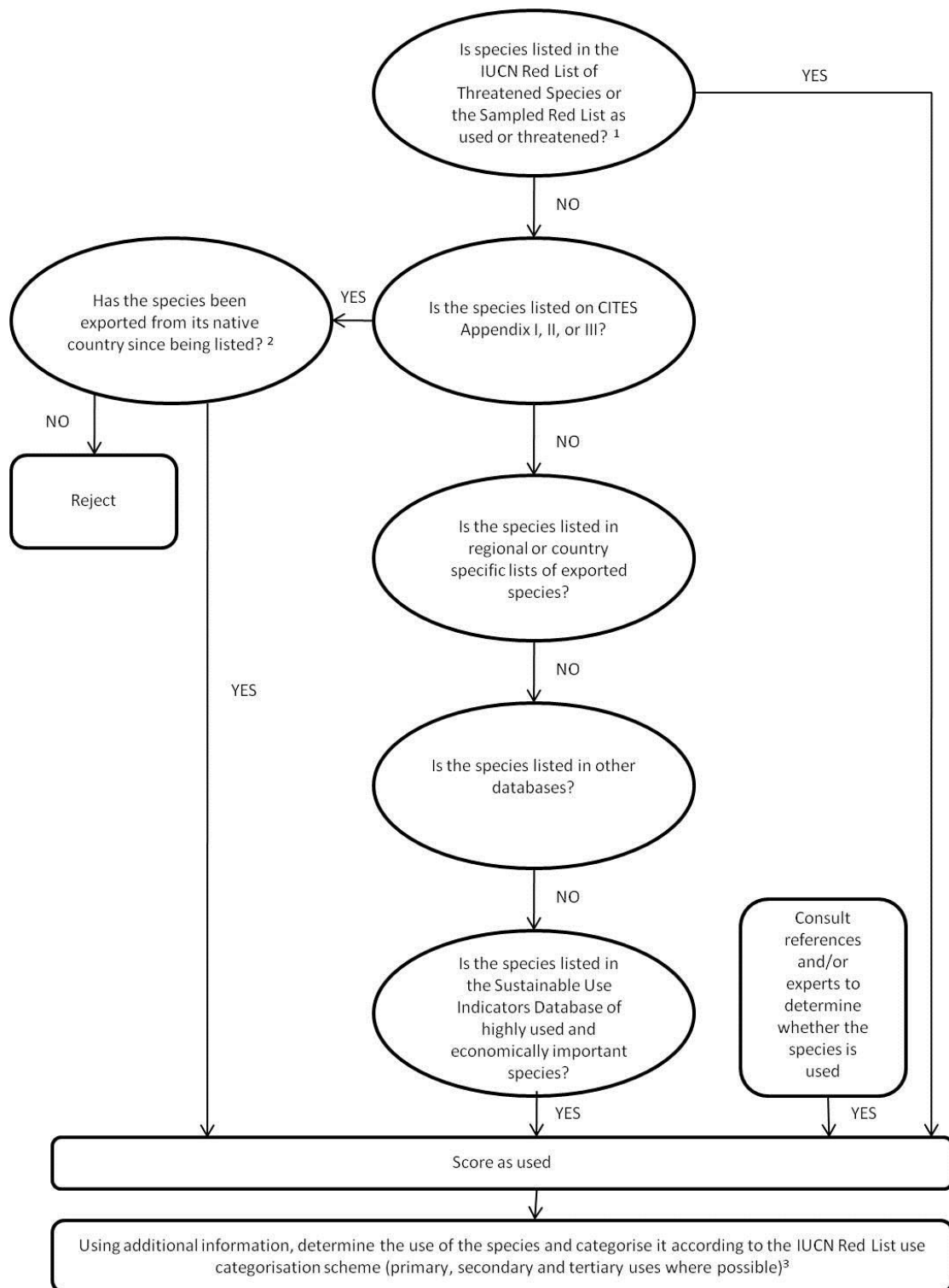
Regional or country specific lists of species:

EU Annex 4 - a list of non-CITES listed species in trade that the EU are actively monitoring

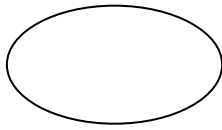
Other

- Avibase (World Bird Database) is an extensive database information system about all birds of the world, containing over 5 million records about 10,000 species and 22,000 subspecies of birds, including distribution information and taxonomy.
- FAO Forestry Country Profiles is a database containing facts and information on forests, forestry and non-wood forest products for some 200 countries and areas in the world.
- International Tropical Timber Organization (ITTO) promotes the conservation and sustainable management, use and trade of tropical forest resources. The annual review statistics database contains information on forest products and trade.
- Centre for International Forestry Research (CIFOR) provides information for decision makers about the use and management of forests in less-developed countries. CIFOR manages an extensive database on the use and trade of forest products.
- Species for whom articles have been published in the FAO publication Non-Wood Forest Product News (NWFP) news - species names extracted from the index of NWFP News from 1994 to 2005.
- The Sea Around Us project (University of British Columbia) collates catch time series starting in 1950 on all fish and crustacean species landed worldwide.
- The Fishbase online database is a global information system with data on nearly all known fish species, including whether they are used by humans.

Flow chart for coding whether a species listed in the Living Planet Index or the Global Population Dynamics Database is in use



Key



Indicates that a list or lists of species known to be in use are matched with the populations in the LPI. If the population refers to a species in one of those lists then it is coded as being used.



Indicates an action - e.g. coding the species as internationally traded or not.

Footnotes

- ¹ A new version of the Red List utilisation module is being released which will provide more specific and detailed information on the scale and scope of use, and the severity of the threat intentional use poses to the species. These data are already coded as part of the global bird assessment. The assessments for other species provide information on whether the species is used (in the case of birds, mammals, amphibians and some freshwater and marine fish) or threatened by use (for remaining classes) and this information forms the basis of the analysis presented here.
- ² CITES listed species not in trade since being listed are currently coded as being 'not in use' on the precautionary assumption that if a species has a CITES export quota but no permits have been registered, it is unlikely that there is an international market for this species. This does not exclude the possibility of national or local level use or illegal trade, and more information is needed on each of these species before they can be included in the list of 'used' species.

- ³ The IUCN Utilisation Classification Scheme consists of 17 categories of end use and was extracted from the report for a use classification workshop held at UNEP-WCMC in June 2008 (<http://intranet.iucn.org/webfiles/doc/SSC/RedList/AuthorityF/utilization.rtf>).

Appendix II

Species and population numbers in each of the datasets used to generate trends in the

Utilised Species and Harvest Indices.

Table A1: Species and population numbers in the Utilised Species database shown by class of vertebrate. Species and population numbers of vertebrates in the Freshwater, Marine and Terrestrial Utilised Species datasets are also displayed, shown by class and zone (Temperate/Tropical). Note, because some species occur in more than one system, the total number of species and populations in the Utilised Species database does not necessarily equal the sum total of species and populations in the Freshwater, Marine and Terrestrial datasets.

Index	Description	Zone	Class	No.	
				No. Species	Populations
Utilised Species	Based on trends in species that are utilised by humans		Amphibian	40	118
			Bird	865	3543
			Fish	303	1177
			Mammal	261	1201
			Reptile	32	175
		Total All		1501	6214
Freshwater Utilised Species	Based on trends in species that are utilised by humans found in a	Temperate	Amphibian	21	81
			Bird	148	1056

broad range of temperate and tropical freshwater habitats	Fish	83	599
	Mammal	10	36
	Reptile	8	21
	<i>Total Temperate</i>	<i>270</i>	<i>1793</i>
Tropical	Amphibian	8	17
	Bird	106	316
	Fish	45	68
	Mammal	5	13
	Reptile	12	49
	<i>Total Tropical</i>	<i>176</i>	<i>463</i>
	Total Freshwater	446	2256

Marine Utilised Species	Based on trends in species that	Temperate	Amphibian	0	0
	are utilised by humans found in a		Bird	94	737
	broad range of temperate and		Fish	143	400
	tropical marine habitats		Mammal	35	158

	Reptile	3	24
	<i>Total Temperate</i>	<i>275</i>	<i>1319</i>
Tropical	Amphibian	0	0
	Bird	44	120
	Fish	55	111
	Mammal	10	29
	Reptile	7	71
	<i>Total Tropical</i>	<i>116</i>	<i>331</i>
	Total Marine	388	1650

Terrestrial Utilised Species	Based on trends in species that are utilised by humans found in a broad range of temperate and tropical terrestrial habitats	Temperate	Amphibian	5	7
			Bird	369	879
			Fish	0	0
			Mammal	66	478
			Reptile	3	7
			<i>Total Temperate</i>	<i>443</i>	<i>1371</i>

Tropical	Amphibian	9	13
	Bird	207	420
	Fish	0	0
	Mammal	135	497
	Reptile	1	1
	<i>Total Tropical</i>	<i>352</i>	<i>931</i>
	Total Terrestrial	795	2302

Table A2: Species and population numbers in the dataset of species that are used as food for humans, that are hunted for sport by humans, or used as pets, shown by class of vertebrate. Species and population numbers of vertebrates in the Freshwater, Marine and Terrestrial Utilised datasets of species that are used for food for humans, that are hunted for sport by humans or used as pets are also displayed, shown by class and zone (Temperate/Tropical). Note, because some species occur in more than one system, the total number of species and populations in the database of all species used for food, sport hunting or as pets does not necessarily equal the sum total of species and populations in the Freshwater, Marine and Terrestrial datasets.

Index	Description	Zone	Class	Food		Hunting		Pets	
				No. Species	No. Populations	No. Species	No. Populations	No. Species	No. Populations
Species	Based on trends		Amphibian	14	51	5	11	24	77
used for	in species that		Bird	390	2322	285	1867	766	3123
specific	are utilised by		Fish	279	1091	114	743	73	205
purposes	humans for		Mammal	204	913	100	750	39	197
	food, hunting or		Reptile	5	123	10	52	5	22
	as pets	Total All		892	4500	514	3423	907	3624
Freshwater	Based on trends	Temperate	Amphibian	7	36	3	8	14	57

species	in species that		Bird	100	854	100	900	132	965
used for	are utilised by		Fish	68	538	53	532	28	126
specific	humans for		Mammal	6	25	0	0	0	0
purposes	food, sport		Reptile	4	10	1	1	6	13
	hunting or as	<i>Total Temperate</i>		<i>185</i>	<i>1463</i>	<i>156</i>	<i>1441</i>	<i>180</i>	<i>1161</i>
	pets in a broad	Tropical	Amphibian	4	11	32	144	4	6
	range of		Bird	62	220	0	0	95	284
	temperate and		Fish	32	54	20	34	23	28
	tropical		Mammal	4	12	0	0	0	0
	freshwater		Reptile	6	12	1	1	1	2
	habitats	<i>Total Tropical</i>		<i>108</i>	<i>309</i>	<i>53</i>	<i>179</i>	<i>123</i>	<i>320</i>
		Total Freshwater		293	1772	209	1620	303	1481
Marine	Based on trends	Temperate	Amphibian	0	0	0	0	0	0
species	in species that		Bird	63	538	34	215	66	593
used for	are utilised by		Fish	138	392	58	144	16	38

specific	humans for		Mammal	32	135	16	68	2	7
purposes	food, sport		Reptile	3	24	2	21	0	0
	hunting or as	<i>Total Temperate</i>		<i>233</i>	<i>1089</i>	<i>108</i>	<i>448</i>	<i>84</i>	<i>638</i>
	pets in a broad	Tropical	Amphibian	0	0	0	0	0	0
	range of		Bird	26	68	11	27	33	92
	temperate and		Fish	58	107	17	33	10	13
	tropical marine		Mammal	10	29	2	15	1	1
	habitats		Reptile	7	71	3	29	0	0
		<i>Total Tropical</i>		<i>94</i>	<i>275</i>	<i>31</i>	<i>104</i>	<i>43</i>	<i>106</i>
		Total Marine		327	1364	139	552	127	744
Terrestrial	Based on trends	Temperate	Amphibian	1	1	2	3	3	4
species	in species that		Bird	150	513	154	536	333	792
used for	are utilised by		Fish	0	0	0	0	0	0
specific	humans for		Mammal	37	252	39	379	10	43
purposes	food, sport		Reptile	2	6	0	0	3	7

hunting or as	<i>Total Temperate</i>		190	772	195	918	349	846
pets in a broad	Tropical	Amphibian	3	3	16	45	6	10
		Bird	61	129	0	0	193	397
range of		Fish	0	0	0	0	0	0
temperate and		Mammal	117	460	43	288	26	146
tropical		Reptile	0	0	0	0	0	0
terrestrial								
habitats	<i>Total Tropical</i>		181	592	59	333	225	553
	Total Terrestrial		371	1364	254	1251	574	1399

Table A3: Species and population numbers in the Substantially Used Species database shown by class of vertebrate. Species and population numbers of vertebrates in the Freshwater, Marine and Terrestrial Substantially Used Species datasets are also displayed, shown by class and zone (Temperate/Tropical). Note, because some species occur in more than one system, the total number of species and populations in the Substantially Used Species database does not necessarily equal the sum total of species and populations in the Freshwater, Marine and Terrestrial datasets. Only species in evidence categories 3, 4 or 5 are included.

Index	Description	Zone	Class	No. Species	No. Populations
Substantially Used Species	Based on trends in species where evidence exists that they are substantially utilised by humans (based on scale of trade or volume of harvest at local, national, regional and international levels)		Amphibian	0	0
			Bird	27	124
			Fish	77	322
			Mammal	65	508
			Reptile	18	146
		Total All	187	1100	
Freshwater Substantially Used Species	Based on trends in freshwater species found in a broad range of temperate and	Temperate	Amphibian	0	0
			Bird	9	51

tropical habitats where evidence exists		Fish	2	51
that they are substantially utilised by		Mammal	2	9
humans (based on scale of trade or		Reptile	3	9
volume of harvest at local, national,	<i>Total Temperate</i>		<i>16</i>	<i>120</i>
regional and international levels)	Tropical	Amphibian	0	0
		Bird	2	13
		Fish	1	2
		Mammal	1	5
		Reptile	11	48
	<i>Total Tropical</i>		<i>15</i>	<i>68</i>
	Freshwater Total		31	188

Marine Substantially Used	Based on trends in marine species found	Temperate	Amphibian	0	0
Species	in a broad range of temperate and		Bird	3	26
	tropical habitats where evidence exists		Fish	0	0
	that they are substantially utilised by		Mammal	3	31

	humans (based on scale of trade or		Reptile	3	24
	volume of harvest at local, national,		<i>Total Temperate</i>	<i>61</i>	<i>293</i>
	regional and international levels)	Tropical	Amphibian	0	0
			Bird	2	4
			Fish	0	0
			Mammal	1	1
			Reptile	5	65
			<i>Total Tropical</i>	<i>38</i>	<i>127</i>
			Marine Total	99	420
Terrestrial Substantially Used	Based on trends in terrestrial species	Temperate	Amphibian	0	0
Species	found in a broad range of temperate and		Bird	6	13
	tropical habitats where evidence exists		Fish	0	0
	that they are substantially utilised by		Mammal	25	256
	humans (based on scale of trade or		Reptile	0	0
	volume of harvest at local, national,		<i>Total Temperate</i>	<i>31</i>	<i>269</i>

regional and international levels)	Tropical	Amphibian	0	0
		Bird	8	17
		Fish	0	0
		Mammal	34	206
		Reptile	0	0
		<i>Total Tropical</i>		42
	Terrestrial Total		73	492

Table A4: Species and population numbers in the Arctic Utilised Species database shown by system (Freshwater, Marine, Terrestrial) and class of vertebrate. There are no amphibian or reptile species in the Arctic Utilised Species database.

Index	Description	System	Class	No. Species	No. Populations
Arctic	Based on trends	Freshwater	Bird	19	34
Utilised	in freshwater,		Fish	13	72
Species	marine and		Mammal	1	3
	terrestrial Arctic	<i>Freshwater Total</i>		33	109
	species that are	Marine	Bird	16	147
	utilised by		Fish	39	98
	humans		Mammal	15	41
		<i>Marine Total</i>		70	286
		Terrestrial	Bird	29	110
			Fish	0	0
			Mammal	15	158
		<i>Terrestrial Total</i>		44	268
Total All				147	663

Table A5: Species and population numbers in the Arctic Harvest Index database shown by system (Marine, Terrestrial) and class of vertebrate. No harvest data was available for freshwater species.

Index	Description	System	Class	No. Species	No. Populations
Harvest index	Combines population and harvest data to track the sustainability of the harvest of select utilised Arctic species.	Marine	Fish	6	11
		<i>Marine Total</i>		6	11
		Terrestrial	Bird	4	17
			Mammal	10	45
		<i>Terrestrial Total</i>		14	62
Total All				20	73

Appendix III

Table A6: Index and 95% confidence intervals (CI) for each of the indices.

Index	Year	1970	1975	1980	1985	1990	1995	2000	2005	2007
Utilised Species	Index	1.00	1.05	1.05	0.97	0.94	0.95	0.87	0.85	0.86
	Lower 95% CI	1.00	1.00	1.00	0.91	0.87	0.87	0.79	0.76	0.77
	Upper 95% CI	1.00	1.09	1.11	1.04	1.01	1.03	0.96	0.95	0.97
Freshwater	Index	1.00	1.06	1.13	1.01	0.95	1.01	0.89	0.93	0.97
Utilised Species	Lower 95% CI	1.00	1.00	1.03	0.90	0.82	0.86	0.74	0.75	0.78
	Upper 95% CI	1.00	1.13	1.23	1.15	1.10	1.20	1.09	1.16	1.23
Marine Utilised	Index	1.00	1.06	1.08	1.01	0.96	0.96	0.87	0.83	0.83
Species	Lower 95% CI	1.00	0.97	0.96	0.88	0.83	0.81	0.72	0.67	0.66
	Upper 95% CI	1.00	1.15	1.19	1.14	1.10	1.13	1.05	1.03	1.04
Terrestrial Utilised	Index	1.00	1.02	0.97	0.90	0.91	0.87	0.84	0.78	0.79

Species	Lower 95% CI	1.00	0.95	0.89	0.83	0.83	0.78	0.75	0.69	0.68
	Upper 95% CI	1.00	1.09	1.04	0.98	0.99	0.96	0.94	0.90	0.93
Species used for	Index	1.00	1.04	1.06	0.96	0.92	0.91	0.82	0.79	0.83
Food	Lower 95% CI	1.00	0.99	0.99	0.89	0.85	0.82	0.72	0.69	0.72
	Upper 95% CI	1.00	1.09	1.13	1.04	1.01	1.01	0.92	0.92	0.97
Species used for	Index	1.00	1.11	1.25	1.17	1.18	1.18	1.09	1.07	1.14
Sport Hunting	Lower 95% CI	1.00	1.05	1.15	1.06	1.05	1.02	0.92	0.89	0.94
	Upper 95% CI	1.00	1.18	1.36	1.30	1.33	1.37	1.31	1.30	1.42
Species used as	Index	1.00	1.09	1.07	0.99	0.95	0.99	0.93	0.89	0.91
Pets	Lower 95% CI	1.00	1.04	0.98	0.88	0.84	0.86	0.80	0.75	0.77
	Upper 95% CI	1.00	1.15	1.17	1.11	1.08	1.13	1.08	1.04	1.08
Substantially Used	Index	1.00	1.00	1.03	1.01	1.02	1.03	0.98	1.16	1.11
Species	Lower 95% CI	1.00	0.91	0.90	0.86	0.85	0.84	0.77	0.81	0.75
	Upper 95% CI	1.00	1.11	1.19	1.20	1.24	1.29	1.26	1.72	1.68
Arctic Utilised	Index	1.00	1.11	1.29	1.44	1.54	1.78	1.61	1.69	1.83

Species	Lower 95% CI	1.00	0.95	1.08	1.18	1.23	1.41	1.26	1.29	1.38
	Upper 95% CI	1.00	1.29	1.55	1.76	1.92	2.25	2.07	2.21	2.44
