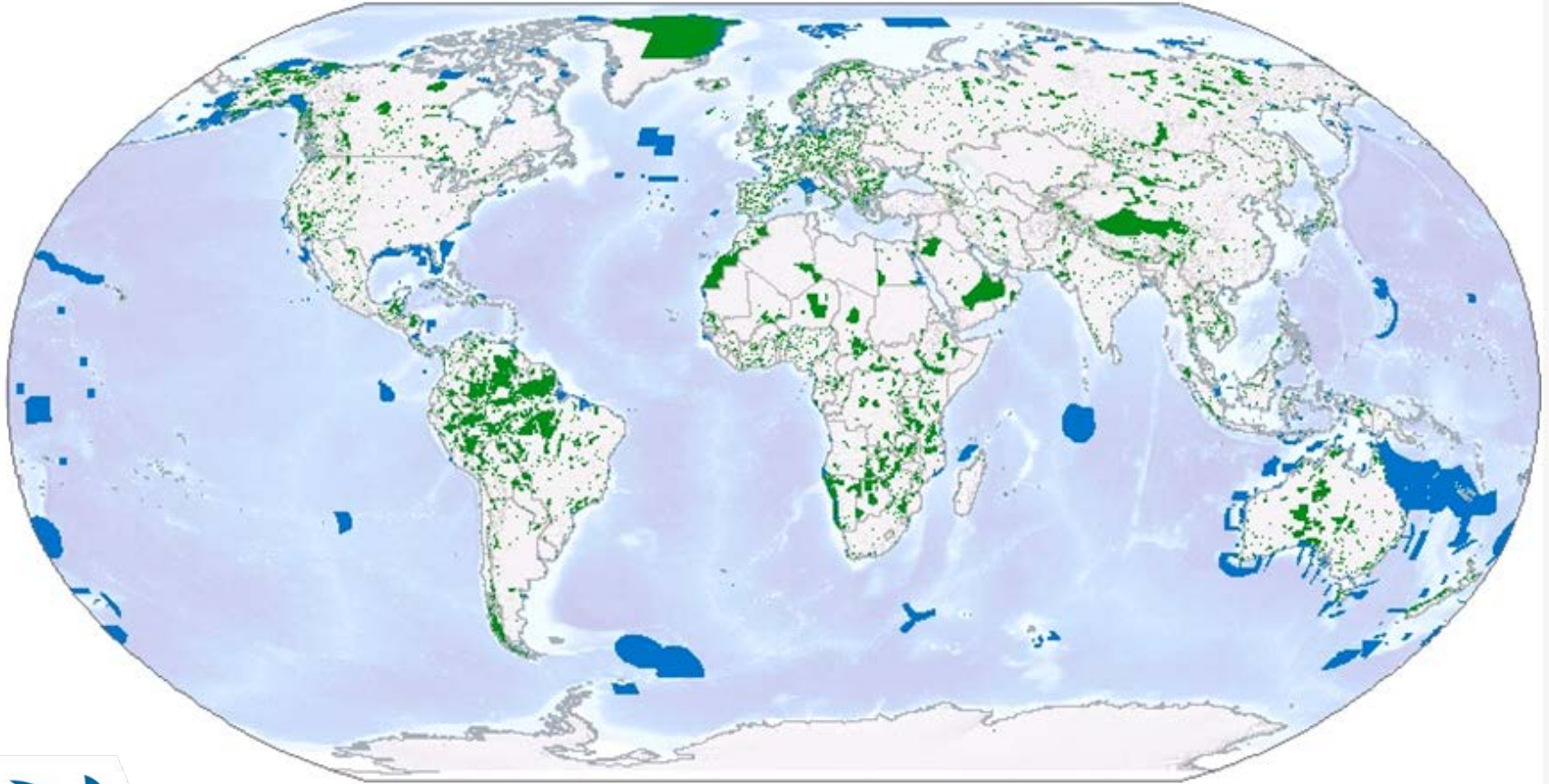


# How well do protected areas cover biodiversity?



## Collaboration



Funded by the Cambridge  
Conservation Initiative Collaborative  
Fund for Conservation and Arcadia

CambridgeConservationInitiative

## Aichi Target 11

By 2020, at least **17** per cent of **terrestrial** and inland water areas, and **10** per cent of coastal and **marine** areas, **especially areas of particular importance for biodiversity** and ecosystem services, are conserved through effectively and equitably managed, **ecologically representative** and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

Here we focus on:

- Numeric thresholds for terrestrial (17%) & marine (10%) environments
- Areas of biodiversity importance
- Ecological representativeness: ecoregions, biomes, realms, species

## Coverage of sites

- Target 11 refers to “areas of particular importance for biodiversity”
- There are many global prioritization schemes for broad regions of biodiversity importance e.g. Hotspots, Ecoregions, Wilderness Areas etc
- But only two systematically identified networks of such sites (Key Biodiversity Areas) have been identified globally:
  - Important Bird and Biodiversity Areas
  - Alliance for Zero Extinction sites

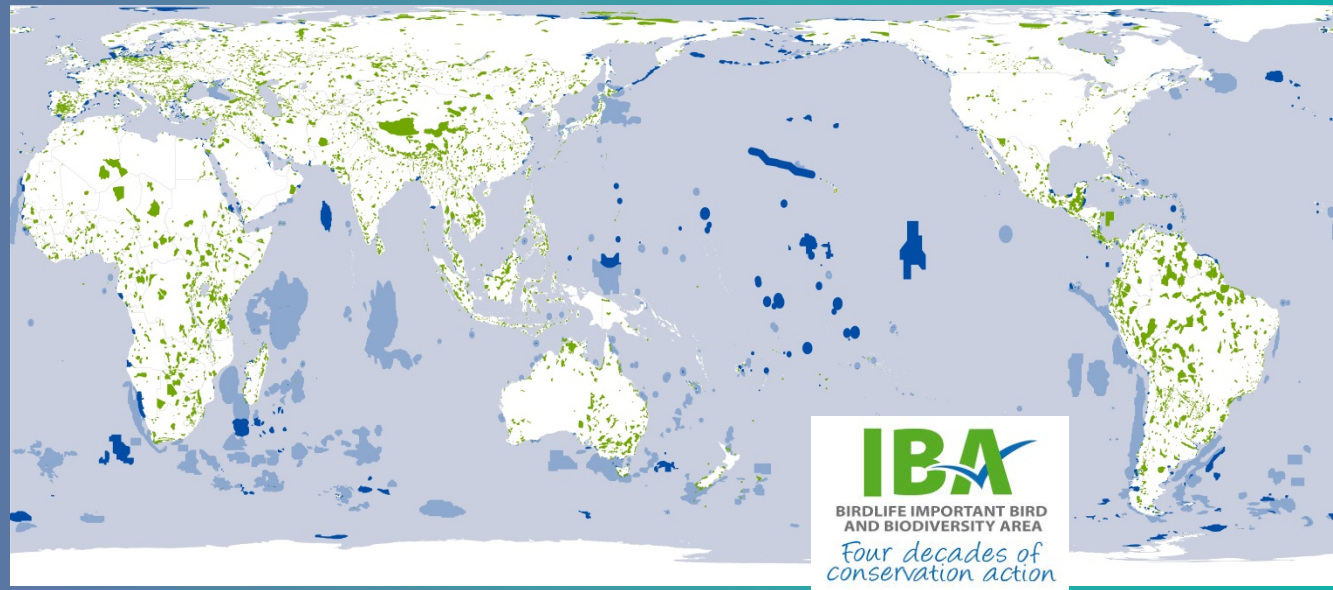


## Coverage of sites

### Important Bird and Biodiversity Areas

[www.birdlife.org/datazone](http://www.birdlife.org/datazone)

- Identified nationally through multi-stakeholder processes, coordinated by BirdLife International and its Partners
- Globally standardized criteria with quantitative thresholds based on populations of globally threatened, restricted-range, biome-restricted, and/or congregatory species
- Identified for birds, but documented to be v important for other taxa
- Over 12,000 terrestrial and marine sites identified
- Actual or potential management units, i.e. candidates for protected areas

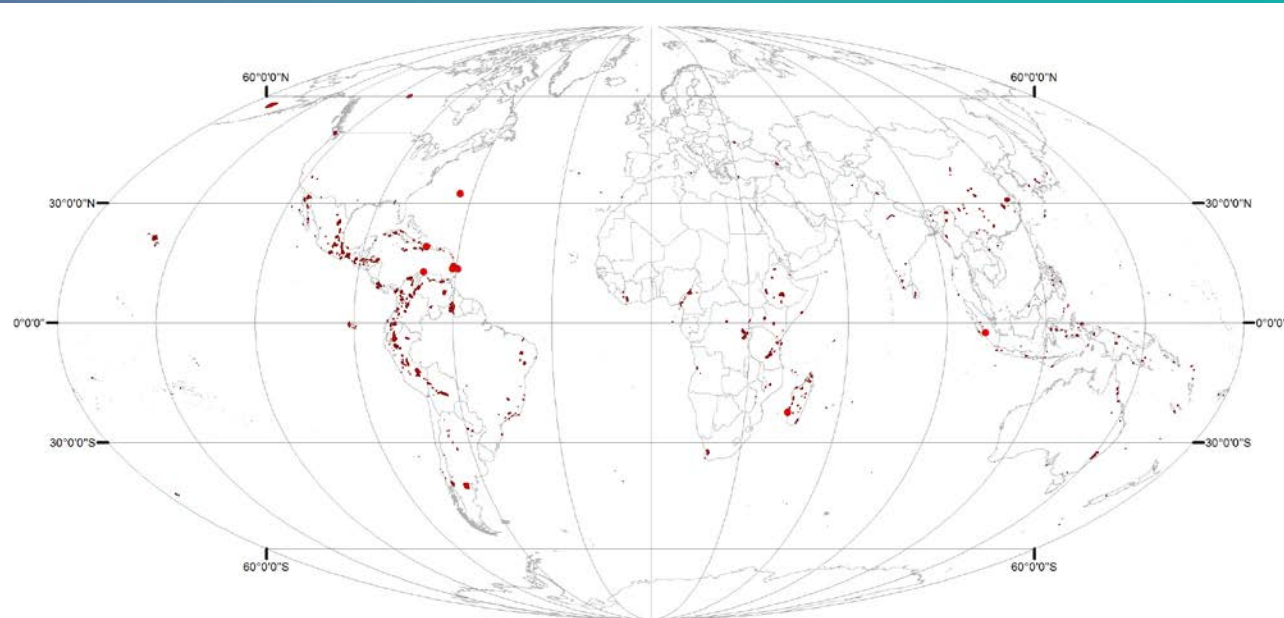


## Coverage of sites

Alliance for Zero Extinction sites

[www.zeroextinction.org](http://www.zeroextinction.org)

- Sites holding the last remaining population of at least one Critically Endangered or Endangered species
- Identified for mammals, birds, amphibians, reptiles, conifers & corals
- 587 sites for 920 species globally
- Actual or potential management units, i.e. candidates for protected areas



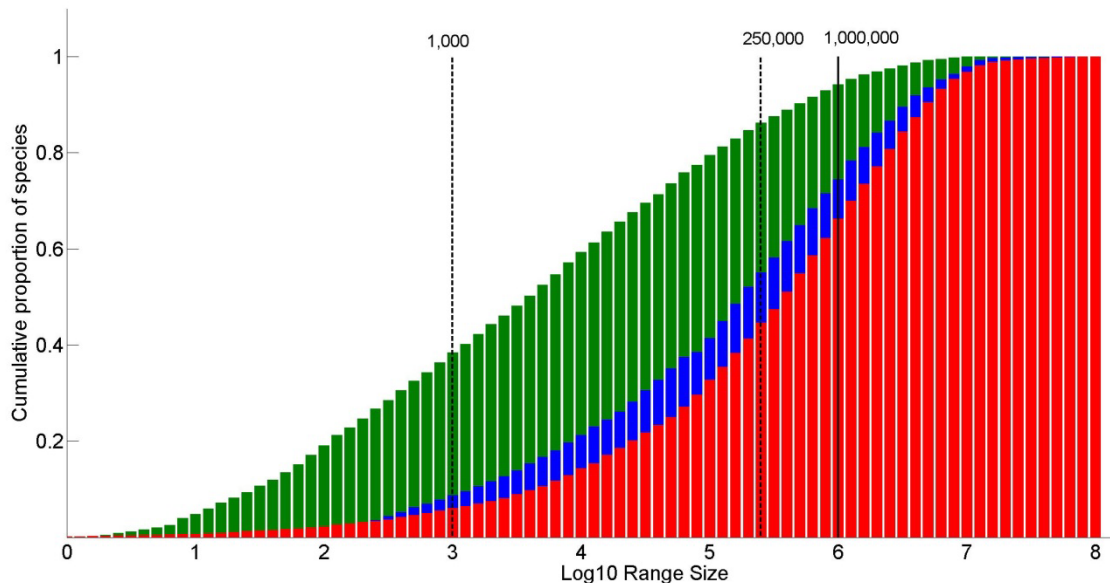
## Coverage of species

- Governments have committed to preventing extinction of known threatened species under Aichi Target 12
- Protected areas play an important role in species conservation, particularly for those with smaller ranges
- Spatial data on species distributions are available from IUCN Red List assessments for all species worldwide in 9 species groups:
  - Mammals, birds, amphibians
  - Cartilaginous fishes, marine bony fishes (selected groups)
  - Lobsters & crayfish
  - Corals
  - Mangroves, seagrasses
  - 25,380 species in total

## Coverage of species

- But protected areas are not the most appropriate tool for conservation of species with very large ranges
- Such species need policy measures at a landscape or seascape scale
- Therefore set species-specific targets for % range required to be protected:
  - 100% for species with distributions  $<1,000 \text{ km}^2$
  - 10% for species with distributions  $>250,000 \text{ km}^2$
  - Linearly interpolated on a log-linear scale between these two thresholds
  - Set a cap so that no species has a target  $>1 \text{ million km}^2$

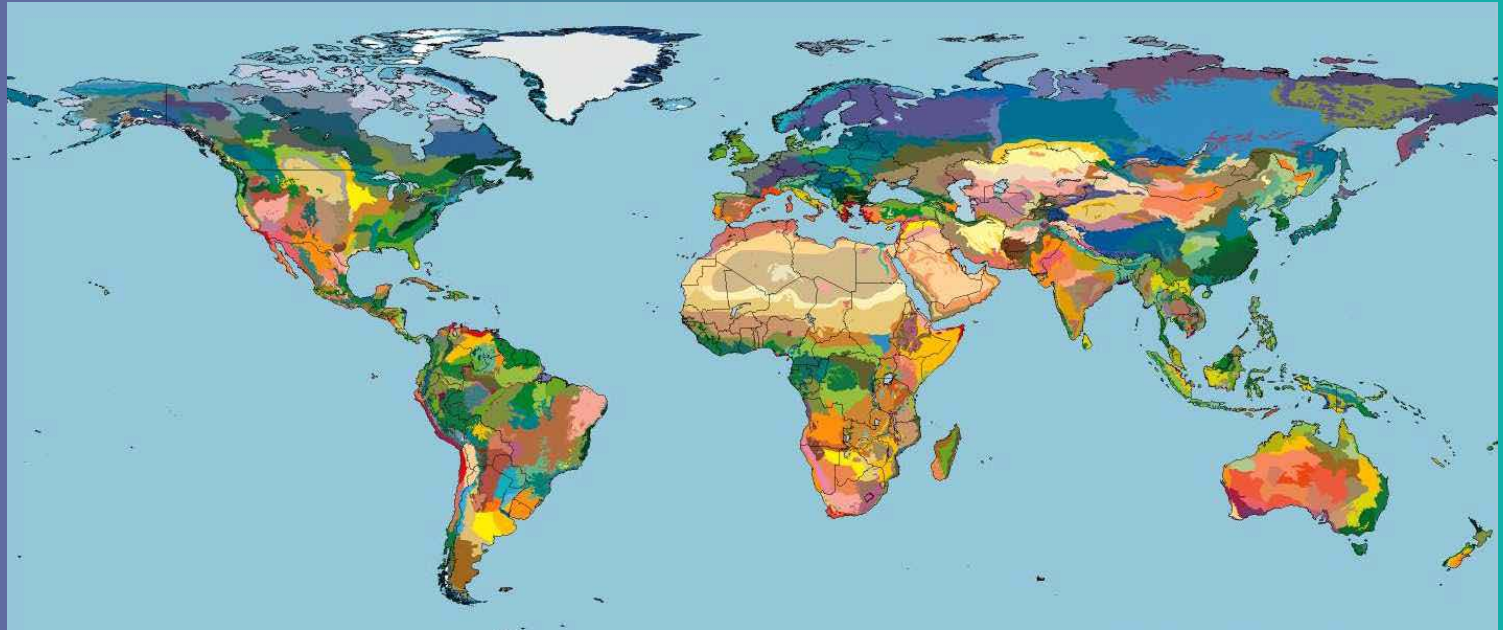
Red = birds  
Blue = mammals  
Green = amphibians





## Coverage of ecoregions

- Target 11 calls for protected areas to be ecologically representative
- We examined protected area coverage of:
  - terrestrial ecoregions, biomes, realms
  - marine ecoregions, provinces, realms & pelagic provinces
- Plus coverage by country (terrestrial + marine)



## Results: coverage

Red = no PA coverage

Blue = partial PA coverage

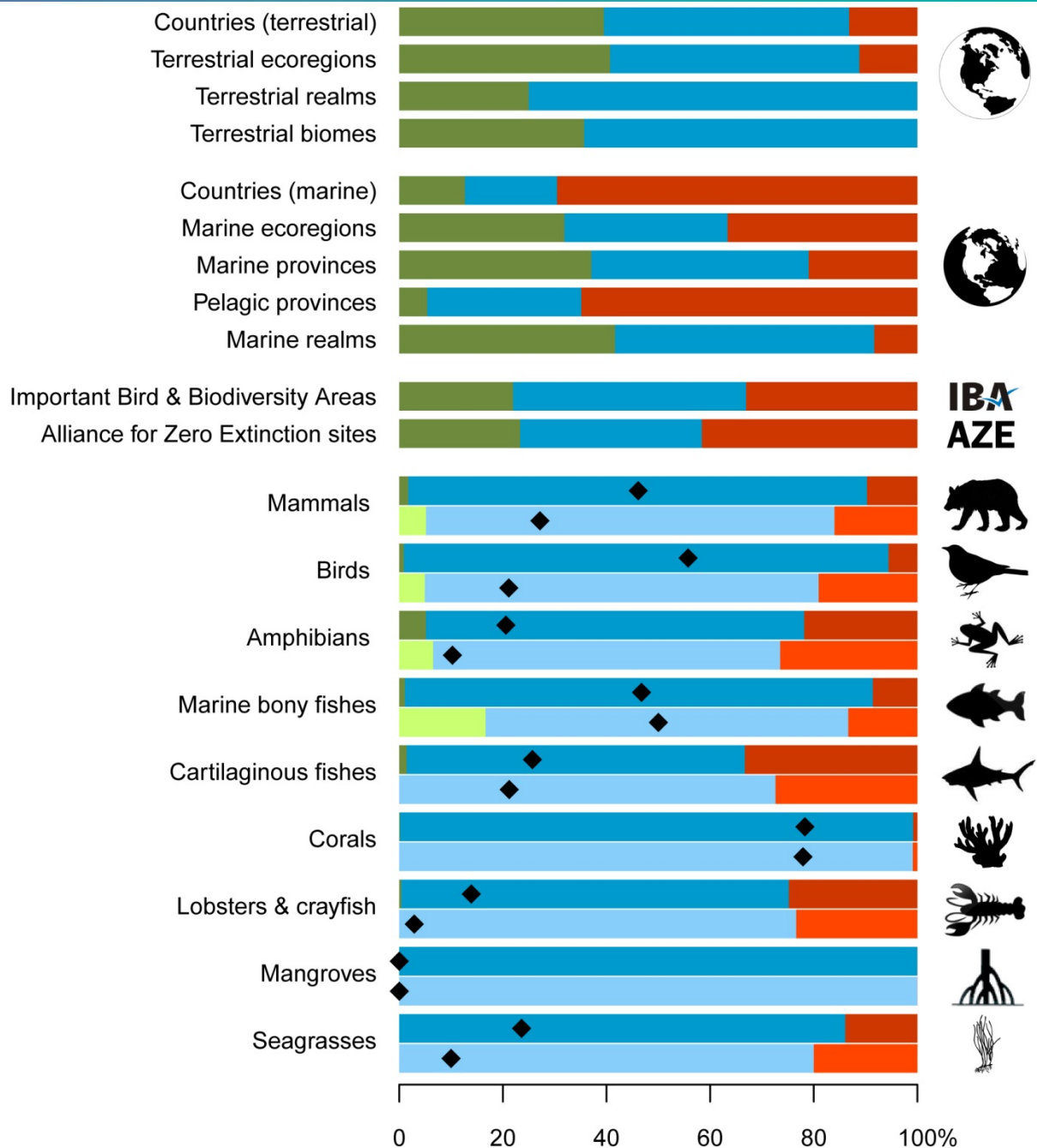
Green =

Terrestrial:  $\geq 17\%$

Marine:  $\geq 10\%$

Sites/species: 100%

Diamonds = % species  
with target levels of  
coverage

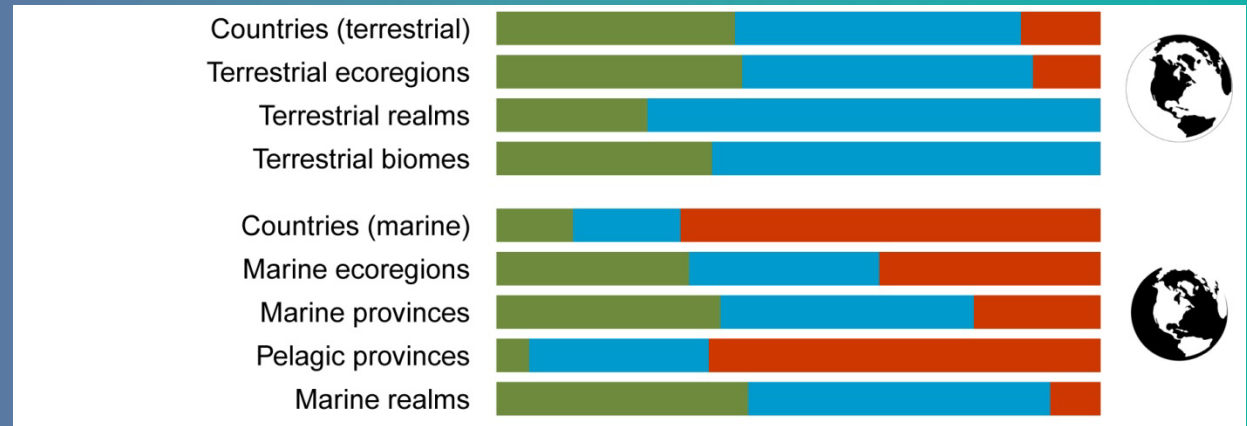


## Results: coverage

Red = no PA coverage

Blue = partial PA coverage

Green =  $\geq 17\%$  (terrestrial)  
 $\geq 10\%$  (marine)



- 40% of countries/territories meet target for terrestrial coverage
- 41% terrestrial ecoregions meet target levels of coverage
- 13% countries/territories meet target for marine coverage
- 32% marine ecoregions meet target levels of coverage
- 0.2% of high seas covered
- 5% pelagic provinces meet target levels of coverage

## Results: coverage

Red = no PA coverage

Blue = partial PA coverage

Green = complete coverage

Important Bird & Biodiversity Areas

Alliance for Zero Extinction sites



- 22% IBAs completely covered, 33% have no coverage
- 23% AZEs completely covered, 42% have no coverage
- 49% of the area each IBA covered on average
- 41% of the area of each AZE covered on average

## Results: coverage

Red = no PA coverage

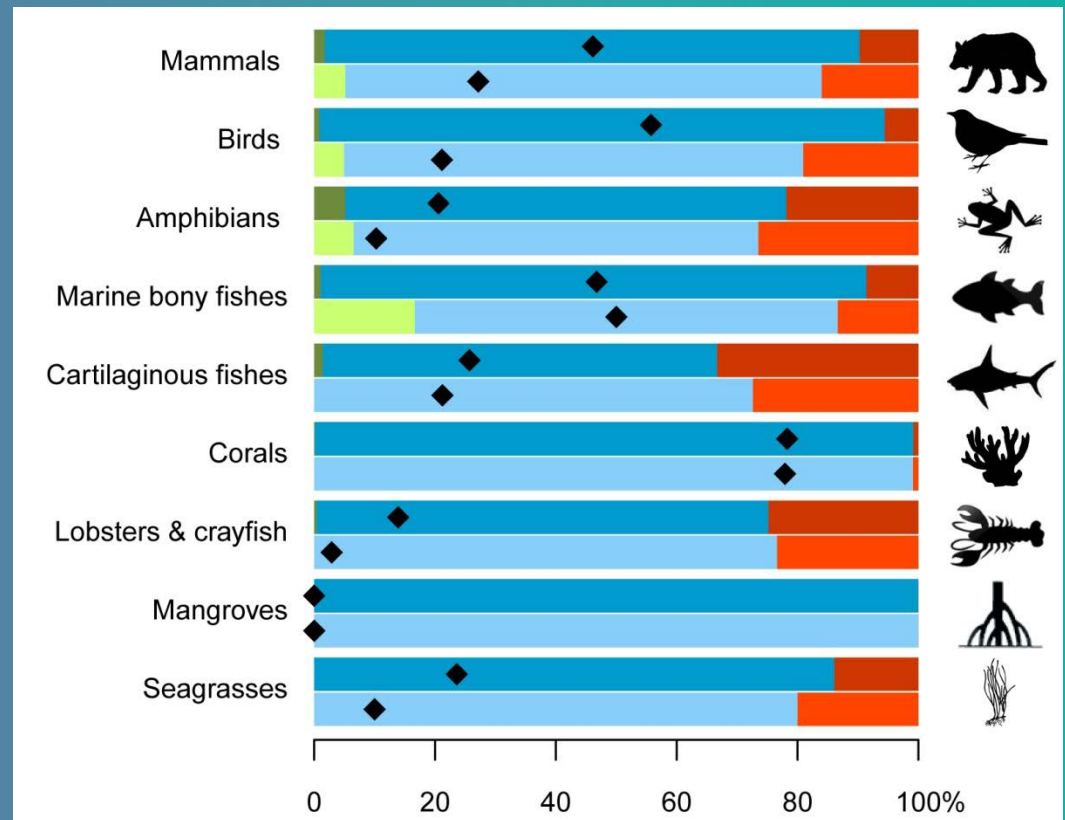
Blue = partial PA coverage

Green = complete coverage

Diamonds = % species with target levels of coverage

Upper bars = all spp

Lower bars = threatened species



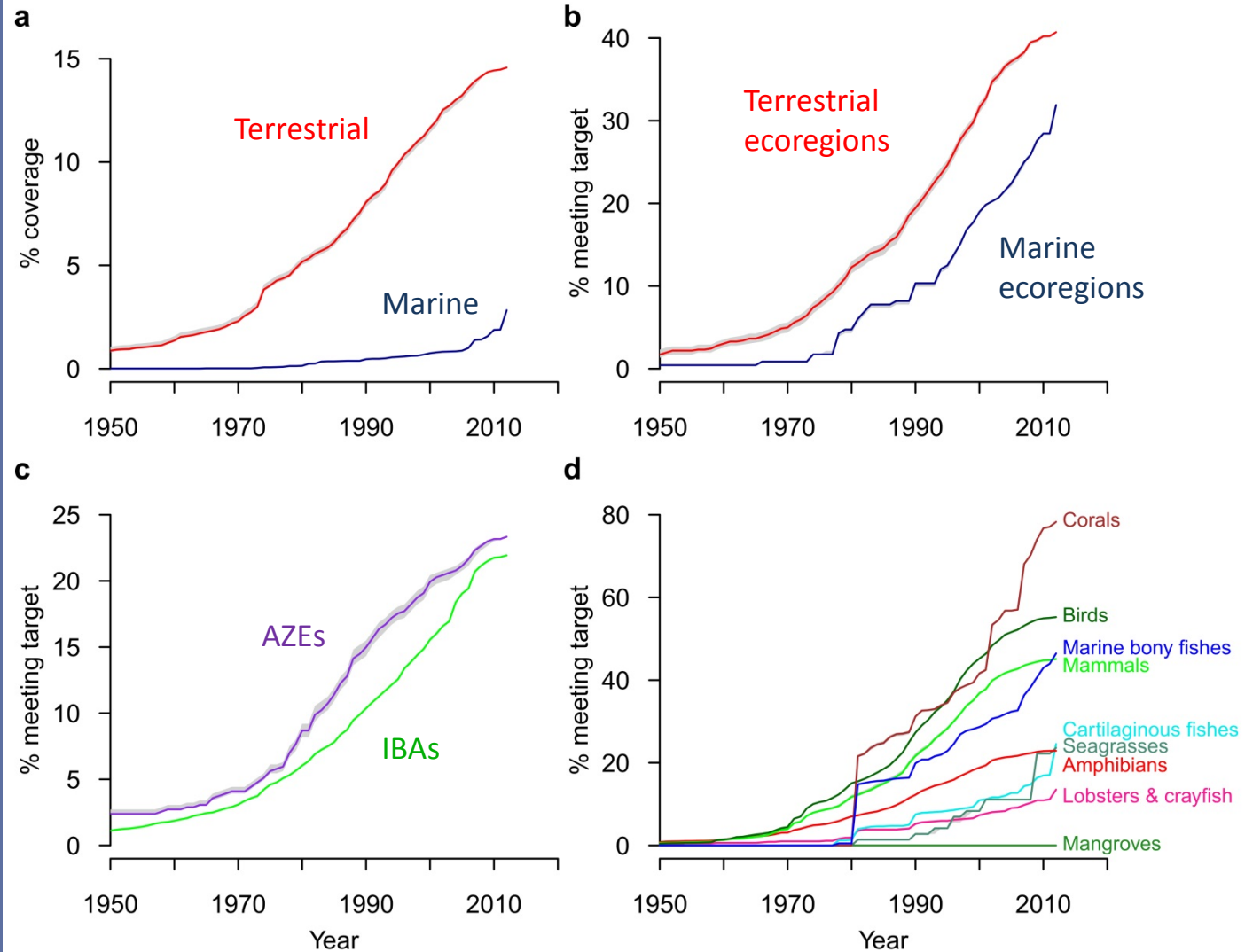
- <50% of species meet target levels of coverage
- Highest for birds (56%), corals (48%), bony fish (47%)
- Lower for threatened species e.g. 21% birds, 27% mammals
- CITES-listed species have marginally greater coverage (99% with coverage >0 vs 85% non-CITES)



## Results: trends

PA coverage has increased since 1990 by:

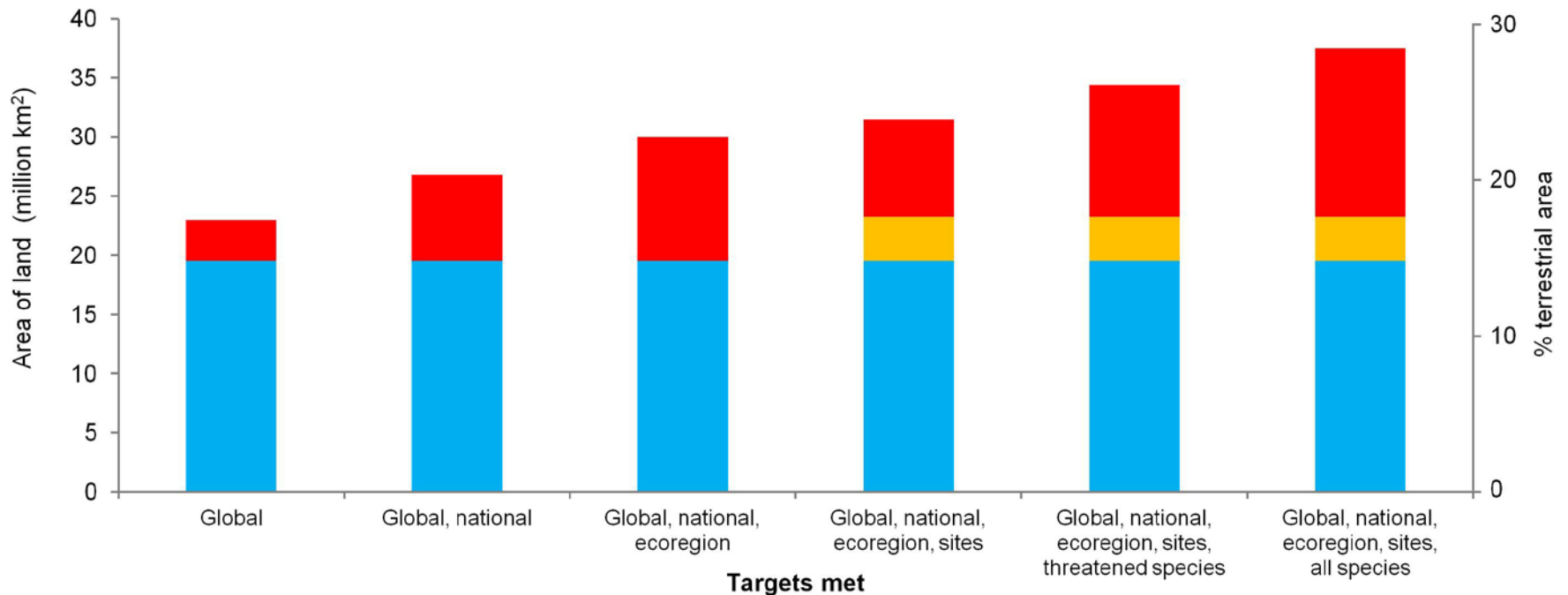
92% for terrestrial  
513% for marine  
environments



## Results: shortfall

- How much land is needed to cover:
  - 17% of terrestrial environment
  - each country's nationally set % coverage target
  - 17% each ecoregion
  - 100% each IBA & AZE
  - target levels of coverage per species (scaled by range size)
- Used Marxan conservation planning software (30x30 km planning units)
- Human population density data as a cost layer (surrogate for opportunity cost and difficulty of establishing PAs): heavily populated areas avoided unless needed for target attainment
- For each combination of targets, ran Marxan 100 times, each with 100 million iterations
- Identified least costly of the 100 portfolios & determined its total area

## Results: land needed



Blue = existing protected area

Orange = unprotected IBAs & AZEs

Red = additional land needed

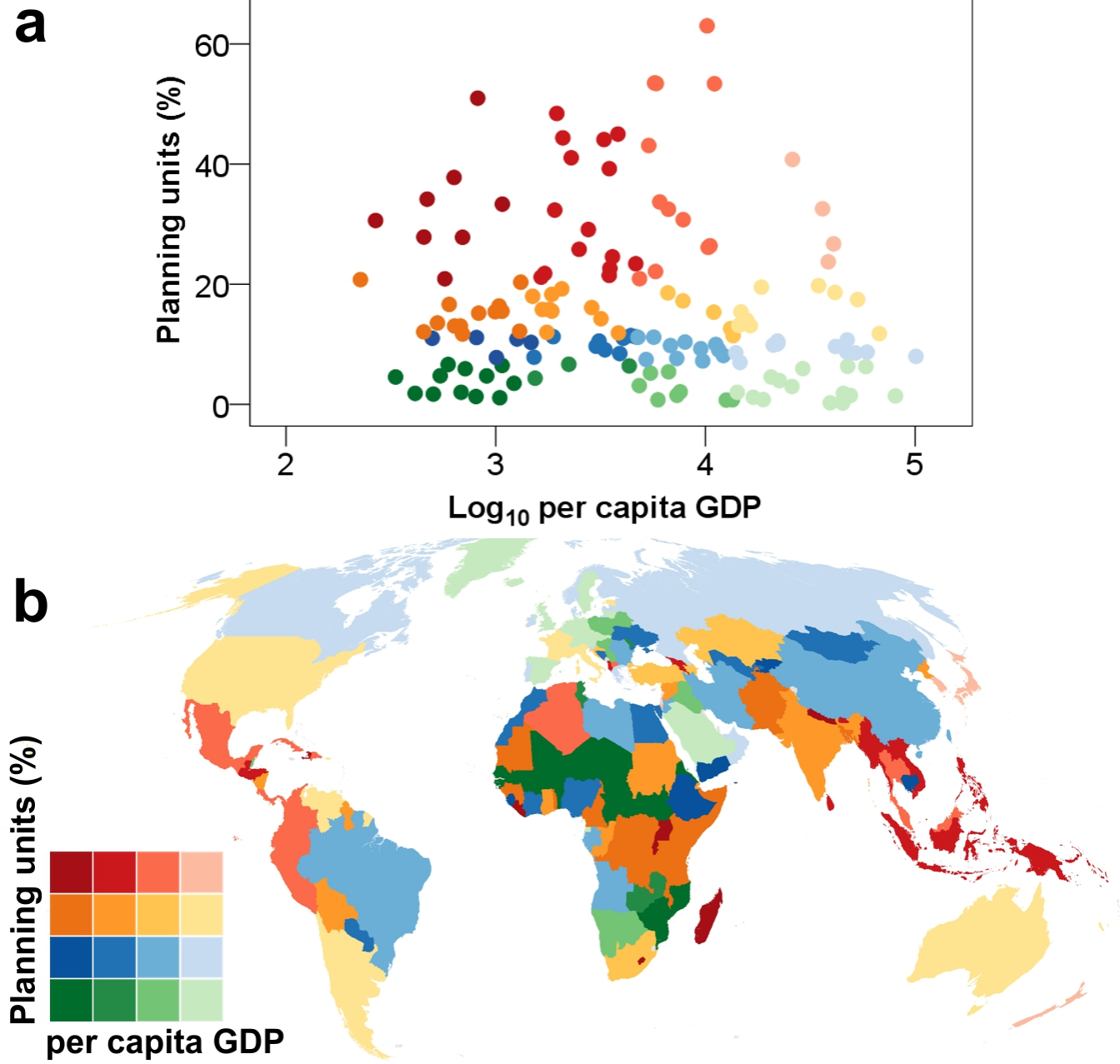
i.e. to meet Target 11 would require doubling PAs to cover 28% of land!

## Results: land needed

## % planning units requiring additional conservation areas

i.e. poorer countries need proportionally greater expansion of PAs

Costa Rica, Ecuador & Dominican Republic require new conservation areas in >53% planning units



## Discussion

- Doubling the PA network by 2020 is v unlikely
- Other “effective area-based conservation measures” needed
  - e.g. locally managed marine or forest areas
  - indigenous and community-conserved areas
  - sacred sites
  - sustainably managed forestry or fisheries
- To meet Aichi Target 11 we need
  - substantial & better-targeted expansion of PAs
  - alternative area-based approaches
  - improved prioritisation
  - international coordination
  - greater resourcing





## CONSERVATION TARGETS

### A mid-term analysis of progress toward international biodiversity targets

Derek P. Tittensor,<sup>1,2\*</sup> Matt Walpole,<sup>1</sup> Samantha L. L. Hill,<sup>1</sup> Daniel G. Boyce,<sup>3,4</sup> Gregory L. Britten,<sup>2</sup> Neil D. Burgess,<sup>1,5</sup> Stuart H. M. Butchart,<sup>6</sup> Paul W. Leadley,<sup>7</sup> Eugenie C. Regan,<sup>1</sup> Rob Alkemade,<sup>8</sup> Roswitha Baumung,<sup>9</sup> Céline Bellard,<sup>7</sup> Lex Bouwman,<sup>6,10</sup> Nadine J. Bowles-Newark,<sup>1</sup> Anna M. Chenery,<sup>1</sup> William W. L. Cheung,<sup>11</sup> Villy Christensen,<sup>11</sup> H. David Cooper,<sup>12</sup> Annabel R. Crowther,<sup>1</sup> Matthew J. R. Dixon,<sup>1</sup> Alessandro Galli,<sup>13</sup> Valérie Gaveau,<sup>14</sup> Richard D. Gregory,<sup>15</sup> Nicolas L. Gutierrez,<sup>16</sup> Tim L. Hirsch,<sup>17</sup> Robert Höft,<sup>12</sup> Stephanie R. Januchowski-Hartley,<sup>18</sup> Marion Karmann,<sup>19</sup> Cornelia B. Krug,<sup>7,20</sup> Fiona J. Leverington,<sup>21</sup> Jonathan Loh,<sup>22</sup> Rik Kutsch Lojenga,<sup>23</sup> Kelly Malsch,<sup>1</sup> Alexandra Marques,<sup>24,25</sup> David H. W. Morgan,<sup>26</sup> Peter J. Mumby,<sup>27</sup> Tim Newbold,<sup>1</sup> Kieran Noonan-Mooney,<sup>12</sup> Shyama N. Pagad,<sup>28</sup> Bradley C. Parks,<sup>29</sup> Henrique M. Pereira,<sup>24,25</sup> Tim Robertson,<sup>17</sup> Carlo Rondinini,<sup>30</sup> Luca Santini,<sup>30</sup> Jörn P. W. Scharlemann,<sup>1,31</sup> Stefan Schindler,<sup>32,33</sup> U. Rashid Sumaila,<sup>11</sup> Louise S.L. Teh,<sup>11</sup> Jennifer van Kolck,<sup>3</sup> Piero Visconti,<sup>34</sup> Yimin Ye<sup>3</sup>

<sup>1</sup>United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), 219 Huntingdon Road, Cambridge CB3 0DL, UK. <sup>2</sup>Department of Biology, Dalhousie University, 1355 Oxford Street, Halifax, NS B3H 4R2, Canada. <sup>3</sup>Department of Biology, Queen's University, Kingston, ON K7L 3N6, Canada. <sup>4</sup>Ocean Sciences Division, Bedford Institute of Oceanography, Post Office Box 1006, Dartmouth, NS B2Y 4A2, Canada. <sup>5</sup>Centre for Macroecology, Evolution and Climate, Natural History Museum, Copenhagen, DK-2100, Denmark. <sup>6</sup>BirdLife International, Wellbrook Court, Cambridge CB3 0NA, UK. <sup>7</sup>ESE Laboratory, Université Paris-Sud, UMR 8079, CNRS-Université Paris-Sud, 91405 Orsay, France. <sup>8</sup>PBL Netherlands Environmental Assessment Agency, Post Office Box 303, 3720 AH, Bilthoven, Netherlands. <sup>9</sup>Food and Agricultural Organization of the United Nations, Viale delle Terme di Caracalla, 00153 Rome, Italy. <sup>10</sup>Department of Earth Sciences-Geochemistry, Faculty of Geosciences, Utrecht University, Post Office Box 80021, 3508 TA Utrecht, Netherlands. <sup>11</sup>Fisheries Centre, The University of British Columbia, 2202 Main Mall, Vancouver, BC V6T 1Z4, Canada. <sup>12</sup>Secretariat of the Convention on Biological Diversity, 413, Saint-Jacques Street, Suite 500, Montreal, QC H2V 1A9, Canada. <sup>13</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>14</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>15</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>16</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>17</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>18</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>19</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>20</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>21</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>22</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>23</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>24</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>25</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>26</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>27</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>28</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>29</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>30</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>31</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>32</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>33</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada. <sup>34</sup>Centre for Biodiversity and Conservation, 100, University Avenue, Toronto, Ontario M5S 1A5, Canada.

October 3, 2014