Content analysis of nature documentaries in China: challenges and opportunities to raise public conservation awareness

Haonan Wei[1,2], Violeta Berdejo-Espinola[1,2], Yunjie Ma[3], and Tatsuya Amano[1,2]

[1]School of Biological Sciences, The University of Queensland, Brisbane, Queensland 4072, Australia

[2] Centre for Biodiversity Conservation and Science, The University of Queensland, Brisbane, Queensland 4072, Australia

[3]Beijing University of Technology, Beijing, China.

Correspondence

Email: haonan.wei@uqconnect.edu.au

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Abstract

1. In the Anthropocene, the general public is a key part of biodiversity conservation since several aspects of their daily life are inevitably linked to major threats to biodiversity. It is thus important to improve their conservation awareness. While a growing body of research has demonstrated the potential of English-language nature documentaries to raise public conservation awareness, little attention has been paid to the potential of non-English-language nature documentaries.
2. Here, we assessed the challenges and opportunities for nature documentaries broadcasted in China in 2021 to raise public conservation awareness by investigating their thematic, geographical, and taxonomic coverages using a content analysis approach.
3. We found that terrestrial biomes, mammals, and birds were overrepresented in nature documentaries in China, while only a quarter of documentaries explicitly covered human destructive impacts on nature. To further promote public conservation awareness, there is an urgent need to cover under-represented realms/biomes (e.g., freshwater realm and deep-marine biome), taxa (e.g., invertebrates, plants, and fungi), and anthropogenic threats in future documentaries. Nevertheless, nature documentaries in China also showed a relatively good coverage of threatened species and biomes under human influence (e.g., cities and farmlands), which have increasingly been shown to be important for conservation.
4. We also found that domestically-produced, Chinese-language nature documentaries provided unique information on biodiversity and ecosystems in China, such as local biomes and endemic species, highlighting their role in raising conservation awareness in China and worldwide. However, only 9% of them provided English subtitles/versions. Making Chinese-language nature documentaries accessible to the global community by translating them into other languages would help us increase international awareness of biodiversity in China.
5. The methodological approach of this study is easily applicable to nature documentaries produced in other parts of the world. By better understanding the content coverage of nature documentaries globally, we can address knowledge gaps in their thematic, geographical, and taxonomic coverages and maximise their contribution to raising conservation awareness.

Keywords:

Biodiversity conservation, China, content analysis, general public, nature documentaries

1. Introduction

It has increasingly been recognised that biodiversity conservation is not only about nature, but also about people (Wright et al., 2015; Fernández-Bellon & Kane, 2020; Silk et al., 2021). Many aspects of people's daily life, such as food consumption (Ramankutty et al., 2008), water and energy use (Jones, Pejchar, & Kiesecker, 2015), tourism activities (Anderson et al., 2015), and purchasing animal-based products ('t Sas-Rolfes et al., 2019), are inevitably linked to major threats to biodiversity including habitat loss, overexploitation, and the introduction of invasive species (Ramankutty et al., 2008; Schultz, 2011; Cowling, 2014; Aitchison, Aitchison, & Devas, 2021). Therefore, the general public play a vital role in biodiversity conservation. The importance of engaging the general public in conservation, particularly in relation to sustainable consumption of food and other materials, has been highlighted as a target to be met under the Kunming-Montreal Global Biodiversity Framework adopted by the Convention Biological Diversity in 2022 (Convention Biological Diversity, 2022).

Rapid urbanisation has reduced natural areas within urban environments, leading to less opportunities for the general public to experience nature, widely known as "the extinction of experience". This could result in disaffection with the natural world and destructive behaviours, which might underlie current environmental issues (Miller, 2005; Soga & Gaston, 2016). The need to reconnect people with nature and raise their awareness on the ongoing biodiversity crisis has never been more urgent to generate public conservation efforts (Wright et al. 2015). Nature documentaries provide mediated experience of nature and have been shown to promote conservation awareness and efforts among the general public (McCormack et al., 2021). For example, nature documentaries increase social support for conservation organisations through donation and volunteering (Jones et al., 2019), drive policy change to protect wildlife and nature (Aitchison, Aitchison, & Devas, 2021; Boissat, Thomas-Walters, & Veríssimo, 2021), and promote the end of illegal wildlife trade (Liu, Huang, & Ma, 2018) and irresponsible wildlife shows at theme parks (Boissat, Thomas-Walters, & Veríssimo, 2021). Compared to other conventional ways of experiencing nature in urban settings, such as visiting parks or zoos, nature documentaries have two key differences. Firstly, they are highly accessible regardless of time and place (e.g., during the COVID-19 pandemic) (Boissat, Thomas-Walters, & Veríssimo, 2021; Riley Koenig, Koenig, & Sanz, 2019). Secondly, nature documentaries can provide a more comprehensive

representation of species diversity, particularly threatened species that are not suitable for captivity, like killer whales (Boissat, Thomas-Walters, & Veríssimo, 2021).

Earlier studies on the role of nature documentaries in raising conservation awareness have focused almost exclusively on English-language documentaries (e.g., Wright et al., 2015; Fenández-Bellon & Kane, 2020; Aitchison, Aitchison, & Devas, 2021; McCormack, Martin, & Williams, 2021; Nielsen et al., 2021). This leaves a huge knowledge gap on the role of non-English-language nature documentaries in conservation. Nature documentaries that are available solely in languages other than English are expected to play a similar, or even more important role in raising conservation awareness, given that many biodiversity hotspots occur in countries where English is not widely spoken (Myers et al., 2000). Further, there has been a marked recent increase in the amount and breadth of non-English-language nature documentaries, for example in China (Wu, 2020), Japan (Ohara, 2020), and Spain (Alberich Pascual & Aguirre Salmerón, 2015).

To address this knowledge gap, our study aims to assess the role of non-English-language nature documentaries as a medium for nurturing conservation awareness among the general public. We focus on nature documentaries in China, a mega-biodiverse country that harbours four of the world's 36 biodiversity hotspots (Mi et al., 2021). Although a growing number of nature documentaries are being produced in China (Wu, 2020), limited research exists on this topic. Most of the earlier studies are descriptive in nature (Chu, 2017; Lv, 2018), or lack a focus on conservation as a main theme. For example, some studies focus only on specific types of nature documentaries, such as environmental films (Liu et al., 2018), while others focus on film aesthetics (Ji, 2017; Deng, 2018), the art of translation (Wang, 2018), or culture transmission (Yang & Zhao, 2011). There have been limited attempts to date to conduct a large-scale and in-depth content analysis of nature documentaries in China, particularly in terms of their potential to promote both national and global conservation awareness.

The objectives of this study are thus threefold:

1. Developing a comprehensive list of nature documentaries that are available on major platforms in China.
2. Investigating the thematic, geographical, and taxonomic scopes of nature documentaries in China.

3. Comparing the scopes of nature documentaries between domestically produced, Chinese-language documentaries and imported, mostly English-language documentaries.

2. Methods

We identified all nature documentaries that were broadcasted in 2021 on four different widely-used video platforms in China. Next, we collected and analysed data on the coverage of themes, geographical locations, biomes and realms, species taxonomic groups, conservation status, and their threats in each documentary identified.

2.1. Definition of nature documentaries

We defined nature documentaries as any film or television show that provides facts about natural and semi-natural environments, including artificial natural environments like zoos, wildlife parks, or botanic gardens. However, this definition was not limited to only those nature documentaries with a clear conservation agenda, since nature documentaries without clear conservation messages, like Planet Earth II, have also been shown to raise conservation awareness and stimulate audience engagement (Fernández-Bellon & Kane, 2020). Note that in China, there are both domestically-produced, Chinese-language documentaries and imported, mostly English-language documentaries.

2.2. Identifying nature documentaries in China

Publicly accessible nature documentaries in China are mainly available through two sources, the traditional national television broadcaster, China Central Television (CCTV) (https://tv.cctv.com), and online video streaming services including Youku (https://www.youku.com), Tencent Video (https://v.qq.com), and bilibili (https://www.bilibili.com). The four platforms differ in the way they can be viewed (Fig. 1). Shows on CCTV are firstly live broadcasted on the television (TV) and then stored on its official website for on-demand streaming, while the three online streaming services only provide on-demand streaming. In terms of accessing nature documentaries, all shows on CCTV are freely accessible to anyone, while online streaming services charge a fee for certain shows. We thus identified nature documentaries available in 2021 on these four

major platforms.

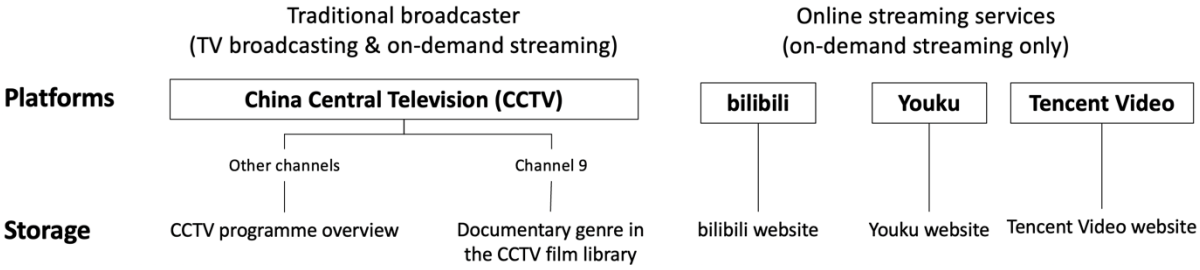

Fig. 1. Major platforms for nature documentaries in China and methods for accessing them.

Traditional national broadcaster – CCTV

A total of 17 channels are listed on the CCTV's official website, and each channel broadcasts several TV programmes, which are comprised of multiple shows (Fig. 1). Those shows were stored in two types of storage, CCTV film library (片库) and CCTV programme overview (栏目大全) (Fig. 1). In particular, the CCTV film library stores and classifies shows in four genres: drama (电视剧), cartoon (动画片), documentary (纪录片), and special shows (特别节目). As Channel 9 solely broadcasts documentaries, all domestically-produced documentaries on Channel 9 are therefore stored under documentary (纪录片) genre in the CCTV film library, whereas imported documentaries on Channel 9 are only live-broadcasted and not stored anywhere for on-demand streaming. Thus, we could not include imported documentaries broadcasted in Channel 9 in this study. The CCTV programme overview, on the other hand, stores shows classified other than the four genres above, which can be accessed on each programme's webpage under each channel. Given the broad definition of nature documentaries used in our study (see 'Definition of Nature Documentaries' above), we explored not only those stored under the documentary genre in the CCTV film library, but also shows stored in the CCTV programme overview.

The documentary genre in the CCTV film library allows filtering by theme and year. We first screened all shows stored under each of the five potentially relevant themes: 'Nature (自然)', 'Cultural and History (人文历史)', 'People (人物)', 'Exploration (探索)', and 'Society (社会)'. Then, we identified the shows that met our definition of nature documentaries based on the description of each show provided by the official website. We conducted the second screening round by only filtering year 2021 to make sure we did not miss any nature documentary in the first round.

The CCTV programme overview, on the other hand, provides a list of CCTV programmes. We first identified all potentially relevant CCTV programmes based on their title and official description. TV programmes are frequently broadcasted (e.g., five shows per week or even one per day); thus, we only investigated a subset of shows from each CCTV programme. We sampled a show every two months (i.e., February, April, June, August, October, and December 2021), with each sampled show being in the middle of all shows broadcasted in the month (henceforth 'sampled shows'). We then assessed the sampled shows based on their titles and descriptions and only used shows that met our definition of nature documentaries, since some CCTV programmes are exclusively dedicated to nature-related themes while others only partially cover nature-related themes. Due to the differences in sample size and the nature of broadcasting platforms, we analysed nature documentaries on the CCTV programme overview and those on all other platforms (i.e., CCTV film library and three online streaming services) separately.

Video streaming platforms

We also filtered documentaries by theme and year on all three online streaming services. For bilibili, we screened documentaries under six potentially relevant themes: 'Animal(动物)', 'Culture (人文)', 'Exploration (探索)', 'Nature (自然)', 'Society (社会)', and 'Technology (科技)'. For Tencent Video, we explored five potentially relevant themes: 'Culture (人文)', 'Exploration (探索)', Nature (自然)', 'Society (社会)', and 'Technology (科技)'. For Youku, we screened five potentially relevant themes: 'Exploration (探索)', 'Nature (自然)', 'People (人物)', 'Society (社会)', and 'Technology (科技)'. We screened all documentaries under these themes and identified those that met our definition of nature documentaries by reading the title and the description of each documentary provided by their official website. On each online streaming services, we also conducted the second screening round by only filtering year 2021 to avoid missing any potentially relevant documentaries.

The identification of all nature documentaries was conducted between March and April 2022 by H.W. As some documentaries were stored on more than one platform, we removed duplicated records after combining all nature documentaries identified on the four platforms.

Data Collection

To investigate the thematic, geographical, and taxonomic coverage of nature documentaries in China, we (H.W. for all documentaries on the CCTV film library and the three online streaming services, and Y.M. and H.W. for all documentaries on the CCTV programme overview) watched all nature documentaries identified and recorded the following information: film title (in Chinese and in English (either already available or being translated by H.W.)), episode number, episode name, country of production, storage platform (CCTV, Youku, Tencent, or bilibili), year of production, length (min), copyright (production company), the availability of English- language subtitle/version, region (Arctic, Antarctic, Asia, Africa, North America, South America, Europe, or Oceania), country, province/autonomous region/state, specific location, spatial scale (see *Geographical location* below for more detail), theme (see *Theme* below), realm and biome (see *Realm and biome* below), species information (including species group, species common and/or scientific name, kingdom, class, and the International Union for Conservation of Nature (IUCN)'s conservation status of the species) (see *Species* below), and threat (see *Threat* below) covered by each documentary. The details of data collection are described in the following sections.

Theme

To categorise nature documentaries' themes, we adopted the four phases in the modern framing of conservation, proposed by Mace (2014): 'Nature for itself', 'Nature despite people', 'Nature for people', and 'People and nature'. 'Nature for itself' is centered on pristine views of nature, predominately depicting species, habitats, and wildlife ecology, and it generally misses any sign of people. On the other hand, the other three phases all involve people, but to varying extents and aspects. With the rising awareness of the ongoing biodiversity crisis, 'Nature despite people' prioritises anthropogenic threats faced by species, including habitat loss and degradation, overexploitation, invasive species and so forth, followed by the relevant conservation interventions to bring species back from the brink of extinction. The focus of 'Nature for people' is on ecosystems, rather than species, highlighting the significance of ecosystem services provided by nature, for example, the maintenance of human well-being, the provision of food and pest control, and the prevention of natural disasters. In contrast to the potentially overly utilitarian perspective of 'Nature for people', 'People and nature' reflects a two-way interaction between humans

and nature (e.g. nature benefits people while people, in return, show their respect to nature) and emphasises a shared human-nature environment in either positive way (e.g. the coexistence of wildlife and humans in urban ecosystem) or in a negative way (e.g. the competition on fish stocks between fishing industry and endangered species feeding on fish as their major food source). The four frames together show the changing views of nature and conservation in a hierarchical order, ranging from having a basic understanding of species in nature to living in a shared human-nature environment.

We assigned 'Nature for itself' to the nature documentaries that only featured species, 'Nature despite people' to those that covered threats to and/or conservation intervention for species, 'Nature for people' to those that mentioned ecosystem services, and 'People and nature' to those that focused on a two-way interaction between nature and people. In some cases, a nature documentary involved more than one framing, in which case the framing in a higher hierarchical order was chosen as the theme covered by the documentary. For instance, the nature documentary series 'Song of Life' emphasises coexistence, co-prosperity, and mutual reverence between human and nature ('People and nature' framing), while also depicting rich local biodiversity and species' ecological interactions ('Nature for itself' framing). In this case, we categorised it as 'People and nature'.

Geographical location

We recorded spatial attributes (region, country, province/autonomous region/state, and specific locations) of each documentary based on the oral description of focal areas. We also assigned one of the four spatial scales to each documentary: local (covering a single location), national (spanning multiple locations within a country), regional (including multiple countries within the same region) or global (spanning multiple regions). For instance, if a nature documentary mentioned that butterflies travel from tropical Africa to the Arctic, the documentary was categorised as "global" with the two regions being recorded as well.

Species

If any information on a species other than its name, such as its ecology, taxonomy, traits, or threats, was mentioned in a documentary, we recorded the scientific and/or common name

(whichever is available) of the species regardless of the duration of its appearance on screen. We did not include species that are extinct and domesticated (e.g. feral cat, domestic horse, cultivated crop), used in laboratory experiments, or mentioned at the end of the documentary as a species of focus in the next episode. If only the common name of the species (e.g. water deer) was mentioned, we identified its scientific name (e.g. *Hydropotes inermis* for water deer) based on the Global Biodiversity Information Facility (GBIF) database (GBIF, 2022). If only the group of the species was known (e.g. elephants), but not the name of the exact species (e.g. African savanna elephant, African forest elephant or Asian elephant), the name of the species group was recorded.

Next, we converted the recorded scientific names into the scientific names used by the IUCN Red List of Threatened Species (IUCN, 2022) using the package 'taxize' (Chamberlain & Szocs, 2013) in R version 4.2.2 (R Core Team, 2019). This process also allowed us to derive information on species' kingdom and class. We also used the package 'rredlist' (Chamberlain, 2020) to derive each species' IUCN conservation status. Scientific names that did not match names on the IUCN database were manually checked and adjusted using species synonyms based on GBIF database (GBIF, 2022). Those species that we still failed to find scientific names that matched the IUCN species names were excluded from the analysis of taxonomic coverage. We also compared the proportion of species in each taxonomic group covered in nature documentaries, with the proportion of all species in each group, recognised by the Catalogue of Life (COL) (Bánki et al., 2022). For this we grouped the species where we found the IUCN species names into nine common taxonomic groups: chromista, fungi, plants, invertebrates, mammals, birds, reptiles, amphibians, and fish. The same groupings were applied to the species listed by the COL. For species' conservation status, we used the proportion of threatened species in each taxonomic group based on the IUCN Red List as a comparison (extinct species were excluded for consistency).

Realm and biome

To record the realms and biomes covered in nature documentaries, we used the IUCN Global Ecosystem Typology classification framework (https://global-ecosystems.org/) (Keith et al., in press). Realm and biome represent the top two levels of the typology's hierarchical classification system. The typology has four core realms (Terrestrial, Marine, Freshwater, and Subterranean) that include both natural and human-modified ecosystems (e.g., cities, farmlands, or reservoirs). Along with the core realms, there are six transitional realms

(Marine-Terrestrial, Subterranean-Freshwater, Freshwater-Marine, Marine-Freshwater-Terrestrial, Subterranean- Marine, and Terrestrial-Freshwater), representing the interfaces among the four core realms. Examples of transitional realms include wetlands (Terrestrial-Freshwater realm), mangroves (Marine- Freshwater- Terrestrial realm), coastlines (Marine-Terrestrial), and underground streams (Subterranean-Freshwater). Under these realms, 25 biomes are recognised, which are defined by common ecological drivers (e.g., light penetration) that maintain a group of major ecological functions.

We identified the IUCN realm and biome featured in each nature documentary. If a species' habitat was mentioned the identification of the relevant realm/biome was straightforward (e.g., tropical rainforest corresponds to the Tropical-subtropical forests biome). However, on most occasions, habitats were only shown visually or in the form of focal species. In such a case, all potentially relevant realms and biomes were identified from the visual description of the habitat, species' distribution, and/or information on suitable habitat types for species provided by the IUCN. For example, if a documentary did not mention any habitat but only the name of a species, we visited the species' profile on the IUCN Red List of Threatened Species website (https://www.iucnredlist.org/search) and used the list of suitable habitat types for the species to then identify potentially relevant realms/biomes that matched the visual description of the habitat for the species. Potentially relevant realms and biomes could be further refined if the country of focus was also mentioned. In this case, we only used realms/biomes found in the country of focus based on a list of realms/ biomes provided by the IUCN Global Ecosystem Typology.

Threat

To understand how documentaries describe anthropogenic impacts on biodiversity and ecosystems, we used the threat classification provided by the IUCN (IUCN, 2022) and recorded whether documentaries mentioned any type of threats to biodiversity, including the historical, ongoing, or future drivers of biodiversity loss. In particular, the IUCN lists 12 types of threats: 'Residential & commercial development', 'Agriculture & aquaculture', 'Energy production & mining', 'Transportation & service corridors', 'Biological resource use', 'Human intrusions & disturbance', 'Natural system modifications', 'Invasive & other problematic species, genes & diseases', 'Pollution', 'Geological events', 'Climate change & severe weather', and 'Other options'. When a threat to a species was mentioned in a broad sense (e.g., habitat loss), we again visited the species' profile on the IUCN Red List of

Threatened Species website (https://www.iucnredlist.org/search), checked the list of potential threats facing by that species, and assigned all specific types of IUCN threats that could cause the general type of threat discussed (e.g., habitat loss can be caused by 'Residential & commercial development', 'Agriculture & aquaculture', 'Natural system modifications', etc.).

3. Results

Considering a single episode as a documentary, we identified a total of 313 nature documentaries broadcasted in 2021 from which 285 nature documentaries where broadcasted on the CCTV film library and three online streaming services, and 28 nature documentaries from the CCTV programme overview sampled shows (Supplementary Data S1). Of the 285 documentaries, 171 were produced in China and in Chinese language (henceforth, domestic documentaries), and 114 were produced outside China and mostly in English language (henceforth, imported documentaries). The 28 documentaries identified on the CCTV programme overview were edited and produced domestically in Chinese language, using either domestic footage only, imported footage only, or both domestic and imported footage. Despite the differences upon the usage of footage, those documentaries were analysed together given their limited sample size.

Hereafter we first report the result of content analysis of the 285 documentaries, and summarise the analysis of the 28 documentaries identified on the CCTV programme overview in Section "TV shows".

Theme

Theme representation varied greatly between domestic and imported documentaries (Fig. 2). 'People and nature'—the most modern framing of conservation—was the most prevalent theme (43%) in domestic documentaries, followed by 'Nature for itself' (29%) and 'Nature despite people' (27%). In contrast in imported documentaries, 'Nature for itself' was the most prevalent theme (57%) followed by 'Nature despite people' (26%) and 'People and Nature' (11%). The 'Nature for people' framing was least covered in both domestic and imported documentaries.

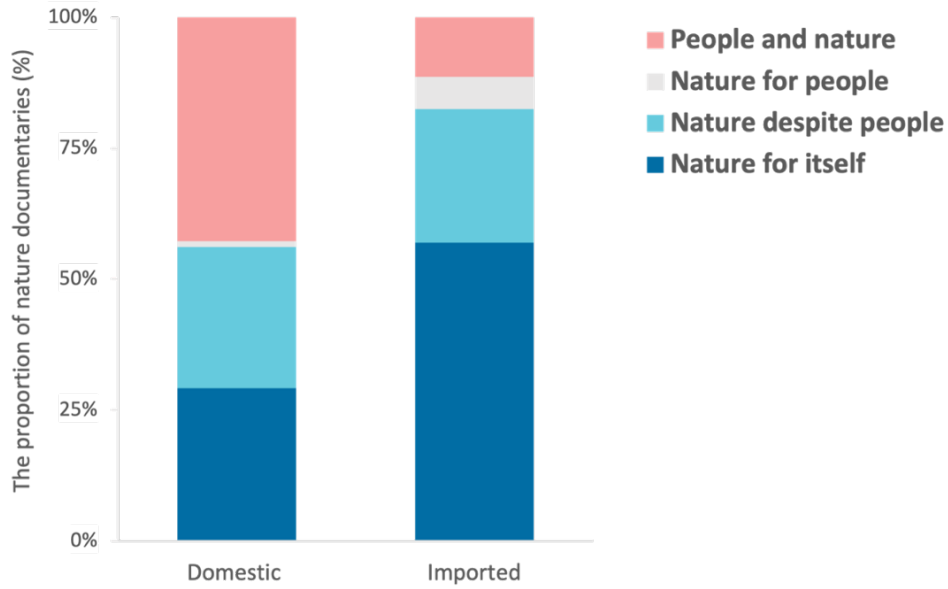

Fig. 2. The proportion of domestic (n=171) and imported nature documentaries (n=114) by thematic coverage. The thematic coverage was defined using the four framings of biodiversity conservation, proposed by Mace (2014).

Geographical representation

There was a stark contrast between domestic and imported nature documentaries with regard to their geographical representation (Fig. 3). The geographical scope of the 171 domestic documentaries was heavily skewed towards 'local' scale (94%), followed by 'national' (4%), 'regional' (1%), and 'global' (1%). In comparison, 'global' scale was the most prevailing level of scale (49%) among imported documentaries, followed by 'local' (31%), regional (14%), and national (6%).

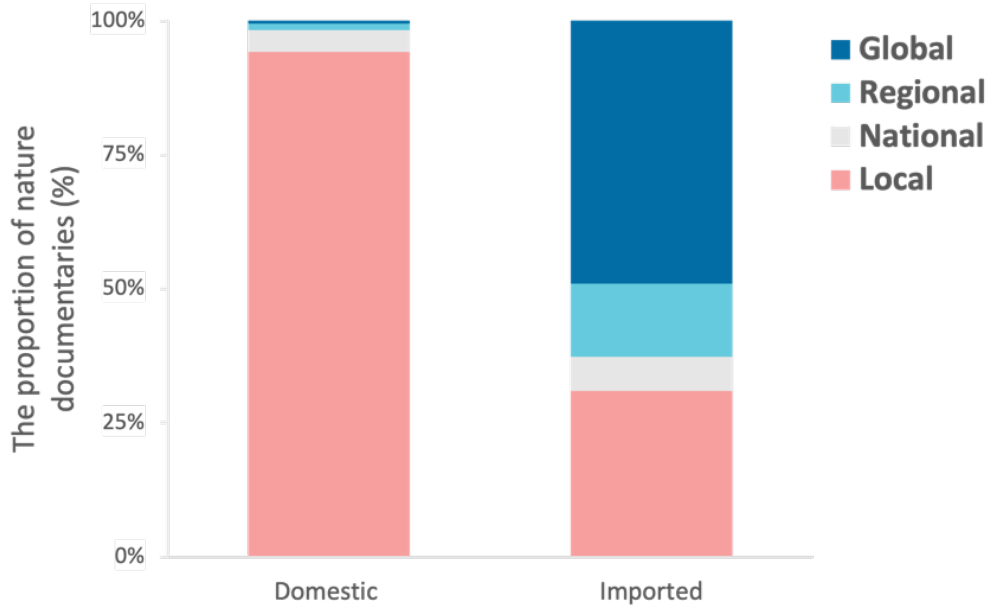

Fig. 3. The proportion of domestic (n=171) and imported nature documentaries (n=110) by geographical scope. Of the 114 imported documentaries, the geographical scope of four documentaries could not be identified.

Realms and biomes

Nine (four core and five transitional realms) out of the 10 realms classified by the IUCN Global Ecosystem Typology were covered by the 285 nature documentaries identified in this study (Fig. 4). In both domestic and imported documentaries, the most prevalent realm was 'Terrestrial' covering 68% and 32% of documentaries, respectively. The second most common realm was 'Terrestrial-Freshwater' (13%) in domestic and 'Marine' (21%) in imported documentaries, respectively. 'Marine' realm, on the other hand, only constituted 6% of the coverage in domestic documentaries. Of the four major realms, 'Subterranean' was the least common realm in both domestic and imported documentaries. The representation of transitional realms was highly skewed towards 'Terrestrial-Freshwater' (13%) in domestic documentaries. In contrast, for imported documentaries, transitional realms representation was primarily dominated by Marine-Terrestrial (12%), followed by Terrestrial-Freshwater (9%), and Marine- Freshwater-Terrestrial (4.5%).

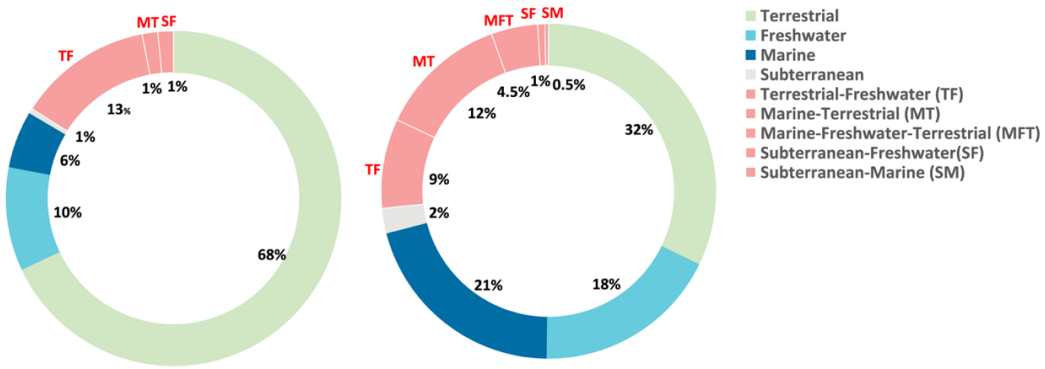

Fig. 4. The realm representation between domestic (left, n=197 times of appearance in 171 documentaries) and imported nature documentaries (right, n=289 times of appearance in 114 documentaries). Each realm is shown in a separate colour, except from the five transitional realms, which are all shown in pink, with labels provided for identification. The definition of realms is based on the IUCN Global Ecosystem Typology (v2.0) (Keith et al., in press).

Out of the 25 IUCN Global Ecosystem Typology biomes, 20 biomes were shown in the nature documentaries (Fig. 5). The coverage of biomes also varied among the origin of documentaries. The domestic documentaries were dominated by 'Polar/alpine (cryogenic)' biome (30%), while 'Tropical-subtropical forests' (12%) and 'Savannas and grasslands' (12%) were the two most prevalent biomes in imported documentaries (Fig. 5). 'Savannas and grasslands' (2%), on the other hand, was the second least common type of terrestrial-related biome in domestic documentaries. With regards to marine-related biomes (shown in dark blue in Fig. 5), 'Deep sea floors' was least covered in both types of documentaries, with even being absent in domestic documentaries. For both domestic and imported documentaries, biomes under human influence accounted for a considerable proportion (e.g., 'Intensive land-use' covered in 8% and 6% of the domestic and imported documentaries, respectively). The representation of transitional biomes was highly skewed towards 'Palustrine wetlands' (11%) in domestic documentaries, while imported documentaries showed a relatively even representation of transitional biomes.

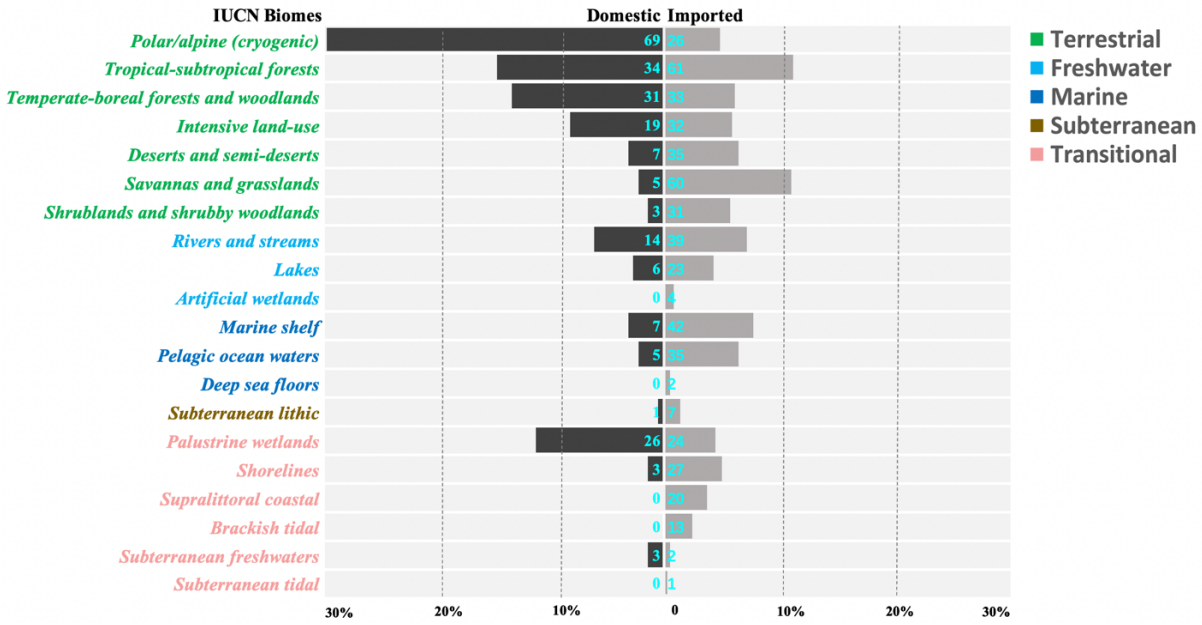

Fig. 5. Biome representation in domestic (dark grey bars, n=233 times of appearance in 171 documentaries) and imported nature documentaries (light grey bars, n=517 times of appearance in 114 documentaries). The colour of the biome name on the y axis indicates the realm to which the biome belongs, with 'Terrestrial' in green, 'Freshwater' in light blue, 'Marine' in dark blue, 'Subterranean' in brown, and all transitional realms in pink. The identification of biomes is based on the IUCN Global Ecosystem Typology (v2.0) (Keith et al., in press).

Taxonomic representation

The coverage of taxonomic groups in nature documentaries differed greatly from the actual proportion of species in the wild (Fig. 6). Kingdom Animalia, mostly mammals (50% for domestic and 53% for imported) and birds (35% for domestic and 22% for imported), accounted for almost all the species featured in both domestic (96%) and imported (98.5%) documentaries. Kingdom Animalia also accounted for the majority of species listed by the COL (70.3%), but invertebrates (66.7%), rather than mammals (0.3%) and birds (0.5%), were the dominant group of the kingdom in wild species. Reptiles were the third common taxonomic group in both domestic and imported documentaries, with 6% and 10.5%, respectively, but their proportion in wild species was quite small (0.6%). A considerable number of wild species belong to Kingdom Plantae (19.1%), Kingdom Fungi (7.4%), and Kingdom Chromista (3.2%), but these kingdoms were hugely under-represented in both domestic (4%, 0%, and 0% respectively) and imported documentaries (1%, 0%, and 0% repressively).

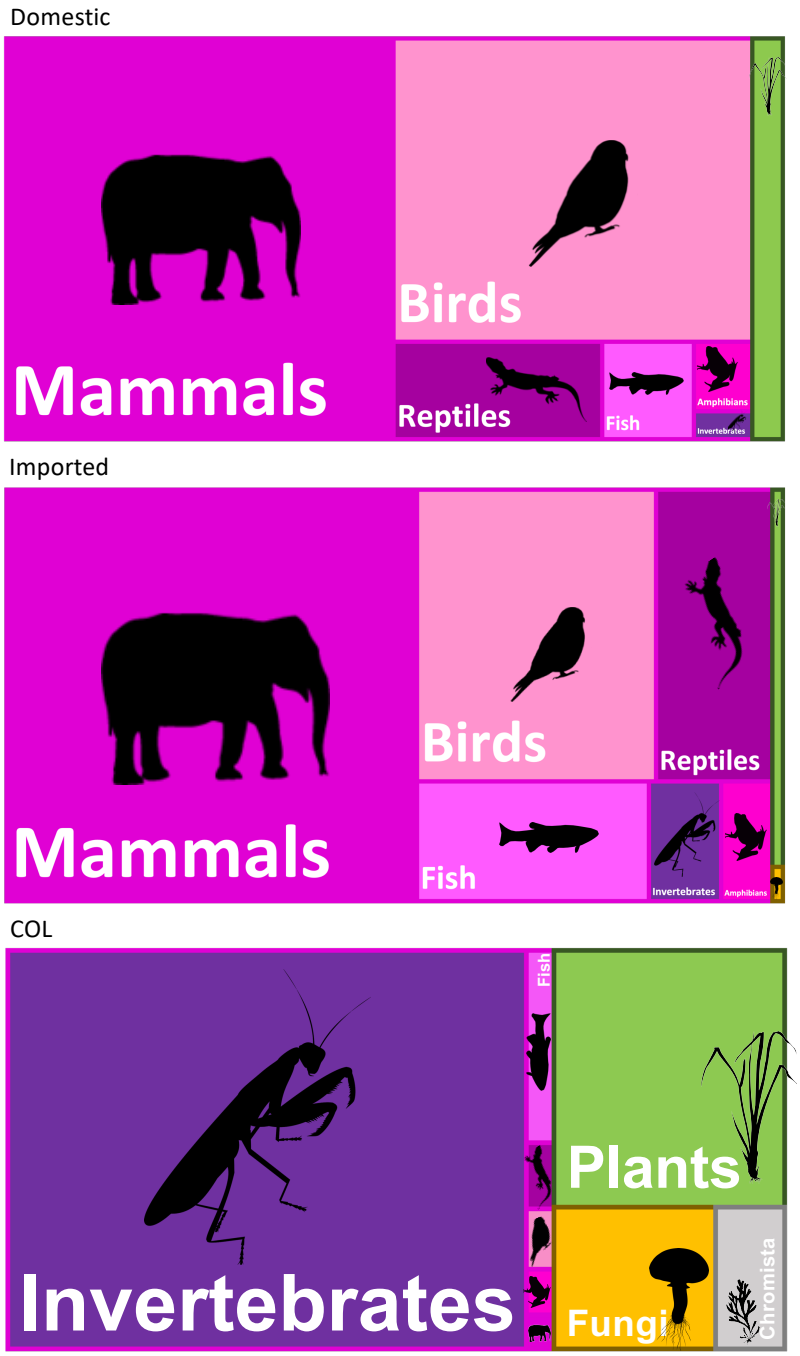

Fig. 6. Taxonomic group representation in domestic (top, n=383 number of species in 171 documentaries) and imported nature documentaries (middle, n=885 number of species in 171 documentaries), and the Catalogue of Life (COL) (bottom, n=1,975,129 of species from four Kingdoms, Animalia, Plantae, Fungi, and Chromista, accessed on Dec 20, 2022). The area of each taxonomic group represents the proportion of species in the group. Taxonomic groups in the same kingdom are shown in the same colour palette, with pink-related colours for animalia, green for plantae, yellow for fungi, and grey for chromista. Silhouettes from phylopic.org. Credit: Melissa Broussard (License: Attribution 3.0 Unported; no changes

made), Ghedo and T. Michael Keesey (License: Attribution-ShareAlike 3.0 Unported; no changes made).

Threatened species representation

For both domestic and imported documentaries, most of the species featured were Least Concern (LC, 52% and 57%, respectively), followed by Vulnerable (VU, 8% and 19%) and Endangered (EN, 15% and 13%) (bar charts at the bottom of Fig. 7). The proportion of species with different conservation status was similar for 149,334 extant species currently evaluated by the IUCN; LC (52%) was the most common status, followed by Data Deficient (DD, 14%), VU (11%) and EN (11%).

LC was also the most common conservation status in all taxonomic groups, except fish in domestic documentaries (pie charts in Fig. 7). The proportion of LC species in each taxonomic group covered in nature documentaries was generally similar to the proportion of LC species in the wild. On the other hand, threatened species (CR, EN and VU combined) were clearly over-represented for mammals, reptiles, and fish in both domestic and imported documentaries, compared to their proportion in wild species.

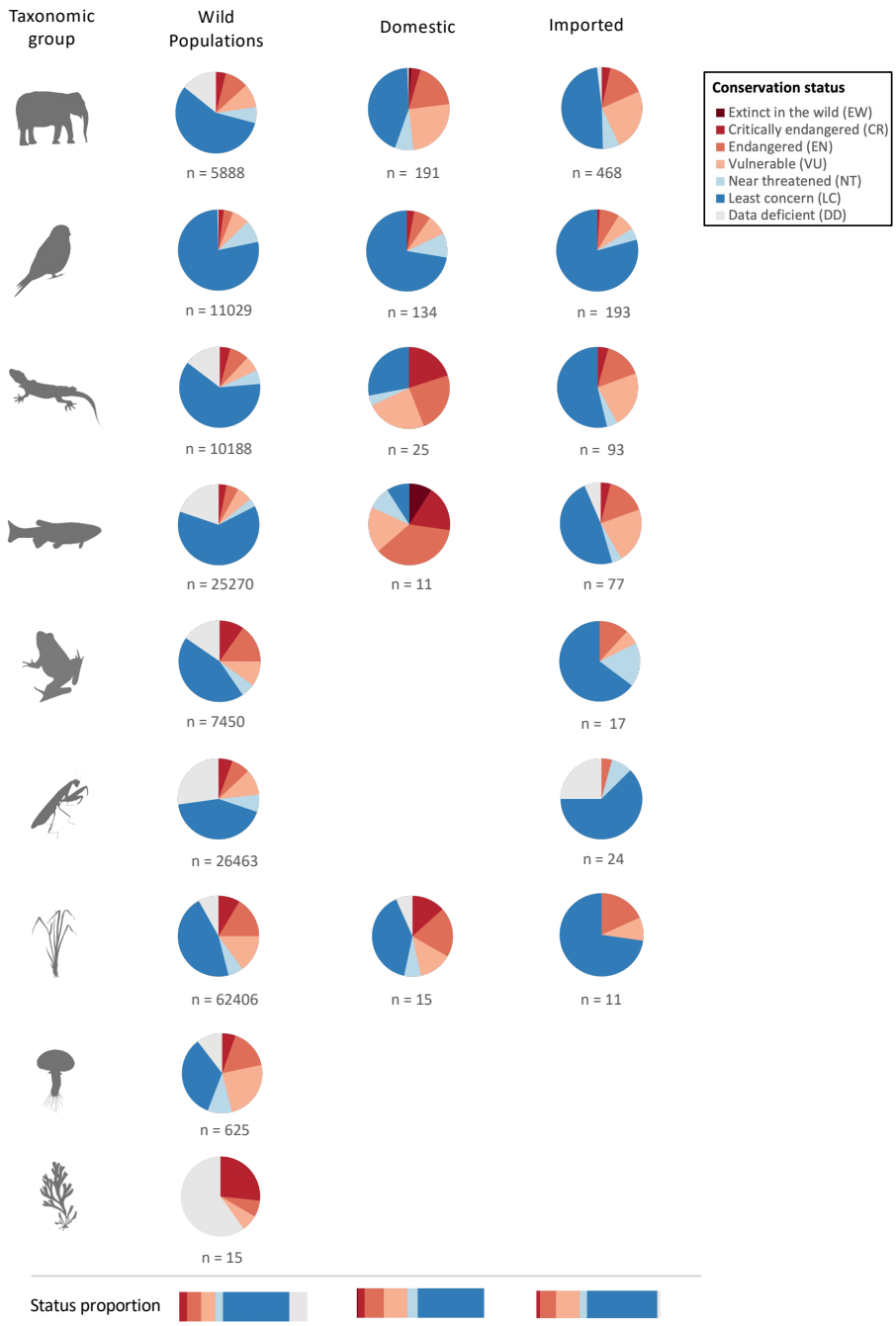

Fig. 7. The proportion of species with different conservation status assessed by the IUCN (n=149,334, left, accessed on Feb 23, 2023) and those covered by domestic (n=376, middle) and imported nature documentaries (n=883, right) in each taxonomic group (from the top, mammals, birds, reptiles, fish, amphibians, invertebrates, plants, fungi, and chromista). The proportion of all species with different conservation status is shown with the bar charts at the bottom. Extinct species were excluded. Pie charts are shown only for the groups with records of at least 10 species. Silhouettes from phylopic.org. Credit: Melissa Broussard (License: Attribution 3.0 Unported; no changes made), Ghedo and T. Michael Keesey (License: Attribution-ShareAlike 3.0 Unported; no changes made).

Threat representation

Only 27% and 32% of the domestic and imported documentaries, respectively, explicitly discussed threats to biodiversity. Ten out of the 12 types of threats identified by the IUCN (IUCN, 2022) were discussed in the documentaries identified in this study (Fig. 8). Broadly, the proportion of the types of threats discussed was similar between domestic and imported documentaries. For instance, 'Biological resource use' was the most frequently featured, constituting 38% and 31% of the total threat coverage by domestic and imported documentaries, respectively. 'Agriculture & aquaculture', 'Climate change & severe weather', and 'Pollution' were also commonly discussed in both domestic and imported documentaries (Fig. 8). However, when compared to the proportion of threat types faced by actual species, 'Agriculture & aquaculture' still seemed to be particularly under-represented in nature documentaries (Fig. S1). Further, the representation of 'Residential & commercial development', 'Natural system modifications', and 'Invasive & other problematic species, genes & diseases' was also scant.

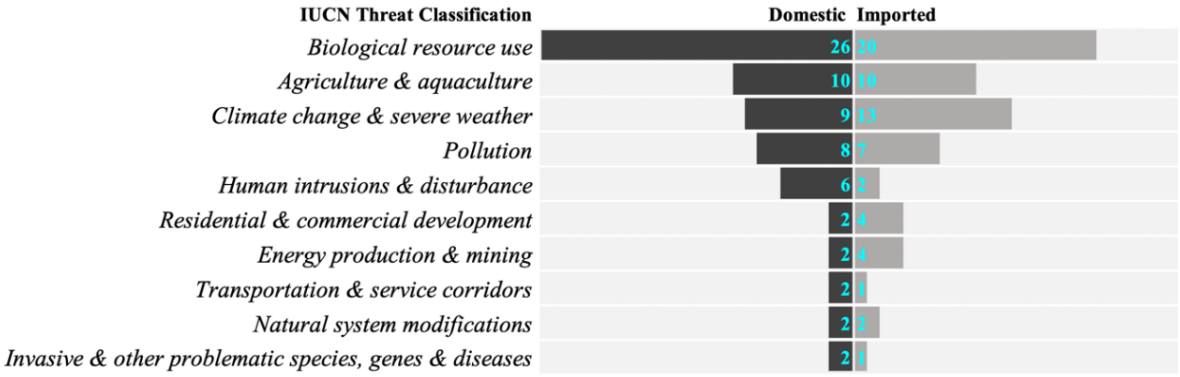

Fig. 8. Threat representation in domestic (dark grey, n=69 times of appearance in 171 domestic nature documentaries) and imported nature documentaries (light grey, n=64 times of appearance in 114 imported nature documentaries). The categorisation of threats is based on the classification provided by the IUCN (IUCN, 2022).

TV shows

Among the 28 nature documentaries found on the CCTV programme overview, 'Nature for itself' was the most common theme (76%), and the local scale was the most prevailing geographical scope (72%) (Table S1). They were dominated by 'Terrestrial' realm (51%) (Fig. S2), particularly by the three types of terrestrial-related biomes: 'Tropical-subtropical

forests' (16%), 'Temperate-boreal forests and woodlands' (16%), and 'Savannas and grasslands' (14.8%) (Fig. S3). Mammals (51%) and birds (28%) again accounted for the majority of taxonomic representation (Fig. S4), and the proportion of threatened mammal species covered was evidently higher than its actual portion in the wild (Fig. S5). In term of threat representation, only four of the 28 documentaries explicitly mentioned anthropogenic threats to biodiversity.

4. Discussion

By screening four major video platforms in China, we have identified 313 nature documentaries that were released in 2021, and assessed the thematic, geographic, and taxonomic coverage of those documentaries. This has allowed us to identify both opportunities and challenges for nature documentaries to raise public conservation awareness within and beyond China.

Thematic representation

The four phases in conservation represent changing views of nature and conservation through time, with the most classic view 'Nature for itself' (before the 1960s), followed by 'Nature despite people' view (1970s to 1980s), 'Nature for people' view (by the late 1990s), and the latest 'People and nature' view (from 2005 onward). As this study focused only on nature documentaries in 2021, we expected the highest representation to be 'People and nature', the most modern framing of conservation. Indeed, domestic documentaries tended to be people oriented, with 71% of the documentaries involving humans from different aspects, including 'Nature despite people', 'Nature for people', and 'People and nature'. This may be explained by philosophical traditions in China, which often stress the interconnectedness of the human-nature relationship (Hassoun & Wong, 2015; Chu, 2017). In particular, the Daoist philosophy, the unity of nature and human (天人合一), emphasises 'spiritual harmony and holistic unity between human beings and the external environment' (Chu 2017). In contrast, 'Nature for itself' was the most common theme in imported documentaries and in documentaries found on the CCTV programme overview, which also used imported footage, indicating that their theme was more inclined towards pristine nature. The difference in thematic coverage between domestic and imported documentaries may indicate that documentaries on pristine nature are deliberately imported to complement the people-oriented nature of domestic documentaries. Thus, with varied

views of nature and conservation being covered, nature documentaries available in China seem to enable audiences to reconnect with nature from different aspects.

Geographical representation

Domestic documentaries tended to focus on the local scale, while imported documentaries tended to have a global focus. Th difference in the focus of the spatial scale highlights the complementary role of domestic and imported documentaries in informing people living in China about nature. Specifically, Chinese domestic documentaries inform people about local biodiversity and ecosystems in this mega-diverse country, while imported documentaries provide people with important information at the global scale, such as biodiversity and its crisis in other continents. Indeed, there is an urgent need to inform the general public about biodiversity at multiple spatial scales. Human activities in a country can have a destructive impact not only on local species in the country, but also on distant species, for example through international economic trade (Liu et al., 2022; Nijman et al., 2019) and greenhouse gas emission (Ekholm et al., 2010). The results of this study showed that domestic and imported documentaries together successfully covered biodiversity at a range of spatial scales, inspiring viewers to appreciate not only national biodiversity but also global biodiversity and potentially gathering global conservation effort.

Realm and biome representation

The marine realm and marine-related transitional realms were clearly under-represented in domestic documentaries. Given the rich marine biodiversity in China (Song, 2011; Huang et al., 2015; Fu et al., 2022), this is concerning and indicates a lack of awareness on marine ecosystems. Within the marine realm, 'Deep sea floors' was severely underrepresented in both domestic and imported documentaries. This is also a serious issue, as there is growing concern about the impact of deep-sea mining on marine biodiversity (Simon-Lledó et al., 2019). Due to the physical barrier, people tend to pay less attention to marine environments (in particular deep sea) as opposed to terrestrial ecosystems. The freshwater realm was also much less covered than the terrestrial realm in all types of documentaries, although freshwater species tend to be more threatened than terrestrial species and require more attention for their conservation (Reid et al., 2019). Therefore, creating and importing more nature documentaries on these under-represented realms and biomes can fulfill this gap and raise public conservation awareness.

Realm/biome representations in nature documentaries are not all daunting. For example, the dominance of 'Polar/alpine (cryogenic)' biome among domestic documentaries well represents the geographical distribution of biodiversity in China. 'Polar/alpine (cryogenic)' biome is primarily found in southwest China (Keith et al., in press), where the Qinghai-Tibetan Plateau—one of the most important biodiversity hotspots in China—is located (Xue et al.,2021; Mi et al., 2021). Thus, domestic documentaries help to inform people about the rich biodiversity of this region. Some domestic and imported documentaries also covered biomes under human influence, including cities and farmlands, which have increasingly been shown to be important for conservation (Lepczyk et al., 2017; Jackson et al., 2020; Kristancic et al., 2022).

Taxonomic representation

For both domestic and imported documentaries, mammals and birds are clearly over-represented, compared to invertebrates and plants. This is a typical pattern in people's interest in conservation (Castillo-Huitron et al., 2020; Kacprzyk et al., 2023) and also found in the availability of biodiversity information (Troudet, 2017). In particular, many mammal species, such as elephants, lions, and apes, are considered as charismatic species, which can explain their highest proportion of taxonomic representation in nature documentaries.

In contrast, invertebrates, plants, and fungi were highly under-represented in nature documentaries. This is a major concern, as these taxonomic groups not only constitute the majority of species in the wild, but also provide fundamental ecosystem functions and services, such as the provision of primary production (Long, Fegley, & Peterson, 2013; Gustafsson, Norkko, & Austin, 2019) and temperature regulating by plants (Yazaki, Hirano, & Sano, 2016; Diao et al., 2022), carbon storage by plants and fungi (Orwin et al., 2011), nutrient cycling by fungi (Baird & Pope, 2022), the decomposition of dead organic matter by fungi and invertebrates (Graca,2001; Tiegs et al., 2013) and pollination by invertebrates (Bawa, 1990; Ollerton, Winfree, & Tarrant, 2011). There is a clear need for these under-represented, yet critically important taxonomic groups to be more widely featured in future nature documentaries.

Threatened species representation

Overall, both domestic and imported documentaries showed a slightly higher coverage of

threatened species, compared to the proportion of threatened species assessed by the IUCN. In particular, both types of documentaries provided a good coverage of threatened mammals, reptiles, and fish, well beyond their actual proportions in the wild. Threatened mammals were also frequently featured in documentaries on the CCTV programme overview. Collectively, those findings are promising, as it is generally believed that people need to pay more attention to threatened species. It is also worth noting that Least Concern species were widely covered in both domestic and imported documentaries. Despite of their lower risk of extinction, LC species are still an integral part of biodiversity, and the conservation status of certain LC species can even be upgraded in the future (IUCN, 2022). Therefore, to prevent LC species from declining further and becoming threatened in the future, it is also important to widely disseminate those nature documentaries that feature LC species.

Threat representation

Only about 30% of both domestic and imported documentaries explicitly mentioned anthropogenic threats to biodiversity, and that percentage was even lower among the documentaries on the CCTV programme overview. Human activities have been causing profound negative impacts on Earth's land surface and ocean (Brondizio et al., 2019), and biodiversity continues to face a variety of threats, such as land use change, land degradation, climate change, invasive species, and overexploitation (Schultz, 2011; Cowling, 2014; Ramankutty et al., 2008; Aitchison, Aitchison, & Devas, 2021). The mismatch between the coverage of nature documentaries and the magnitude of threats to biodiversity indicates an urgent need for future nature documentaries to focus more explicitly on threats and create changes in people's behaviour to promote conservation. In particular, although 'Agriculture & aquaculture' is the most common threat faced by species, it was underrepresented in both domestic and imported documentaries. In fact, over a third of the global ice-free land surface was used for agricultural production at the expense of large-scale habitat loss (Machovina, Feeley, & Ripple, 2015; Ramankutty et al., 2008), and one-third of the global food production for human consumption is either lost or wasted (Nicastro & Carillo, 2021). Similarly, some other common threats, such as 'Residential & commercial development', 'Natural system modifications', and 'Invasive & other problematic species, genes & diseases' were also underrepresented. These threats are also a high priority for future nature documentaries.

Global importance of domestic documentaries in China

We found that domestic nature documentaries provided a wide range of important information on unique biodiversity in China, such as threatened endemic species (e.g. Chinese Alligator *Alligator sinensis*), threatened species with restricted geographic range (e.g. Hainan white pine *Pinus fenzeliana* and Chinese crocodile lizard *Shinisaurus crocodilurus*), widely-distributed threatened species that require global conservation efforts (e.g. Siberian Tigers *Panthera tigris tigris*), and rare species in an extreme environment that have rarely been featured in previous nature documentaries (e.g. Sclater's Monal *Lophophorus sclateria*, found often at Mt. Gaoligong, a western of part of China with an altitude above 3,000 meters (Luo et al., 2011)). Domestic documentaries also covered important local biomes in China (e.g., polar/alpine (cryogenic)) that were relatively underrepresented in imported nature documentaries.

This highlights the potential importance of Chinese domestic documentaries in raising conservation awareness not only in China but globally. Nevertheless, only 9% of the domestic documentaries identified in this study provided English-language subtitles/versions, making them virtually inaccessible to international audiences. Making existing and new Chinese-language nature documentaries available to the global community by translating them into other languages would be an effective way to raise awareness about biodiversity in this megadiverse country and further promote global biodiversity conservation.

5. Conclusions

As we live in a highly urbanised society, watching nature documentaries has become an efficient way of experiencing nature, and many studies have shown the potential of nature documentaries to raise conservation awareness among the general public. While most studies have only assessed English-language nature documentaries, our study investigated nature documentaries in China including both domestically-produced, Chinese-language documentaries and imported, mostly English-language documentaries. We found the potentially important role of Chinese domestic nature documentaries in promoting biodiversity conservation not only in China but also globally, while identifying gaps and bias in the coverage of existing documentaries. The findings of this study can help producers of future nature documentaries to identify priority areas of focus, namely under-represented

realms/biomes (e.g., freshwater realm and deep-sea biome), and taxa (e.g., invertebrates, plants, and fungi), and anthropogenic threats (in particular 'Agriculture & aquaculture').

One limitation of this study is that we focused only on whether a variable of focus (e.g., theme, biome, taxa) was mentioned or not, without considering the length of its mention in each documentary, assuming that the number of mentions was correlated with the total length of mentions. Future research can also evaluate the length of mentions for each variable, as time on screen can have a profound impact on people awareness/attention (Fernández-Bellon 2020; Kacprzyk et al., 2023).

The methodological approach of this study could be replicated to understand the thematic, geographic and taxonomic coverage of nature documentaries in other countries. By better understanding the coverage of nature documentaries around the world, we should be able to assess the potential importance of domestically-produced, often non-English-language nature documentaries, and guide the future production of nature documentaries to maximise their contribution to raising conservation awareness globally. Such studies will help to ensure that it is less a question of 'does it work?' and more question of 'how to make it work' when it comes to using nature documentaries to raise public awareness of conservation.

CONFLICT OF INTEREST

No conflicts of interest

AUTHORS' CONTRIBUTIONS

H.W., V.B-E, and T.A. conceived the ideas and methodology; H.W., V.B-E, and Y.M. collected the data; H.W., V.B-E, and T.A. analysed the data; H.W. wrote the first draft; All authors significantly contributed to improving the draft and gave final approval for publication.

DATA AVAILABILITY STATEMENT

All data are available as Supplementary Data S1.

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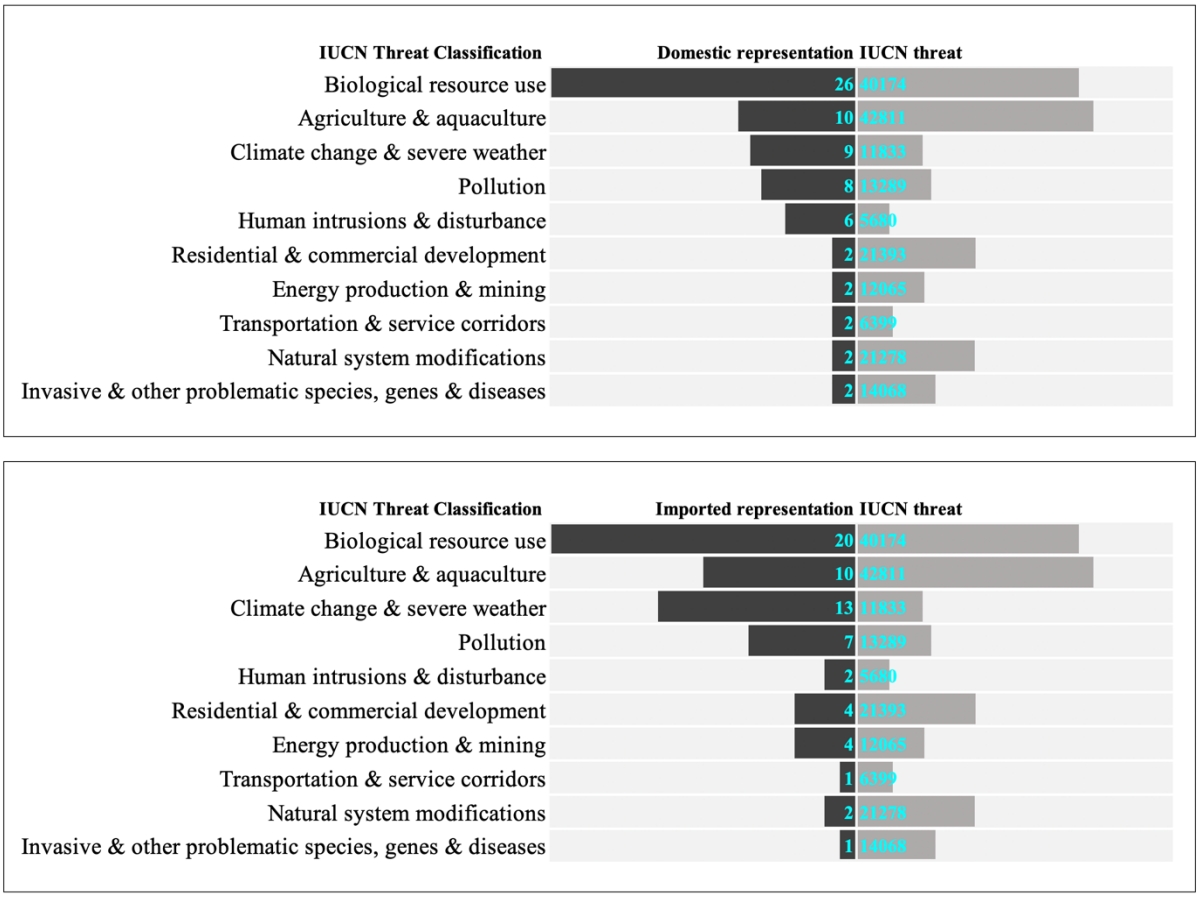


Fig. S1. The representation of threats covered by each type of nature documentaries (dark grey) and those faced by species assessed by the IUCN (light grey, n = 192,924 times of appearance of threats faced by 149,334 extant species assessed by the IUCN, on Feb 23, 2023). The categorisation of threats is based on the classification provided by the IUCN (IUCN, 2022).

Table S1. The thematic, geographic, and taxonomic representation in the 28 nature documentaries identified on the CCTV programme overview.

Variable	*Category*	*Subcategory*	*Times of appearance*	*Percentage (%)*
Theme	Nature for itself		22	78
	Nature despite people		5	18
	Nature for people		0	0
	People and nature		1	4
	Total		**28**	**100**
Geographical scope	Local		20	71
	National		2	7
	Regional		0	0
	Global		6	22
	Total		**28**	**100**
IUCN Realms/Biomes	Terrestrial		**26**	**51**
		T1. Tropical-subtropical forests	12	16.0
		T2. Temperate-boreal forests and woodlands	12	16.0
		T3. Shrublands and shrubby woodlands	1	1.3
		T4. Savannas and grasslands	11	14.8
		T5. Deserts and semi-deserts	1	1.3
		T6. Polar/alpine (cryogenic)	4	5.3
		T7. Intensive land-use	4	5.3
	Freshwater		**7**	**13**
		F1. Rivers and streams	6	8.0
		F2. Lakes	2	2.7
	Marine		**6**	**12**
		M1. Marine shelf	4	5.3
		M2. Pelagic ocean waters	5	6.7
	Subterranean		**1**	**2**
		S1. Subterranean lithic	1	1.3
	Terrestrial-Freshwater (TF)		**4**	**9**
		TF1. Palustrine wetlands	4	5.3
	Marine-Terrestrial (MT)		**7**	**13**
		MT1. Shorelines	6	8.0
		MT2. Supralittoral coastal	2	2.7
	Total		**51**	**100**
Taxonomy	Mammals		89	52
	Birds		48	28
	Reptiles		11	6
	Fish		5	3
	Amphibians		0	0
	Invertebrates		8	5
	Plants		7	4
	Fungi		1	1
	Chromista		1	1
	Total		**170**	**100**
IUCN Conservation status	Extinct in the wild (EW)		0	0
	Critical endangered (CR)		5	3
	Endangered (EN)		14	10
	Vulnerable (VU)		27	18
	Near threatened (NT)		8	5
	Least concern (LC)		92	63
	Data deficient (DD)		1	1
	Total		**147**	**100**

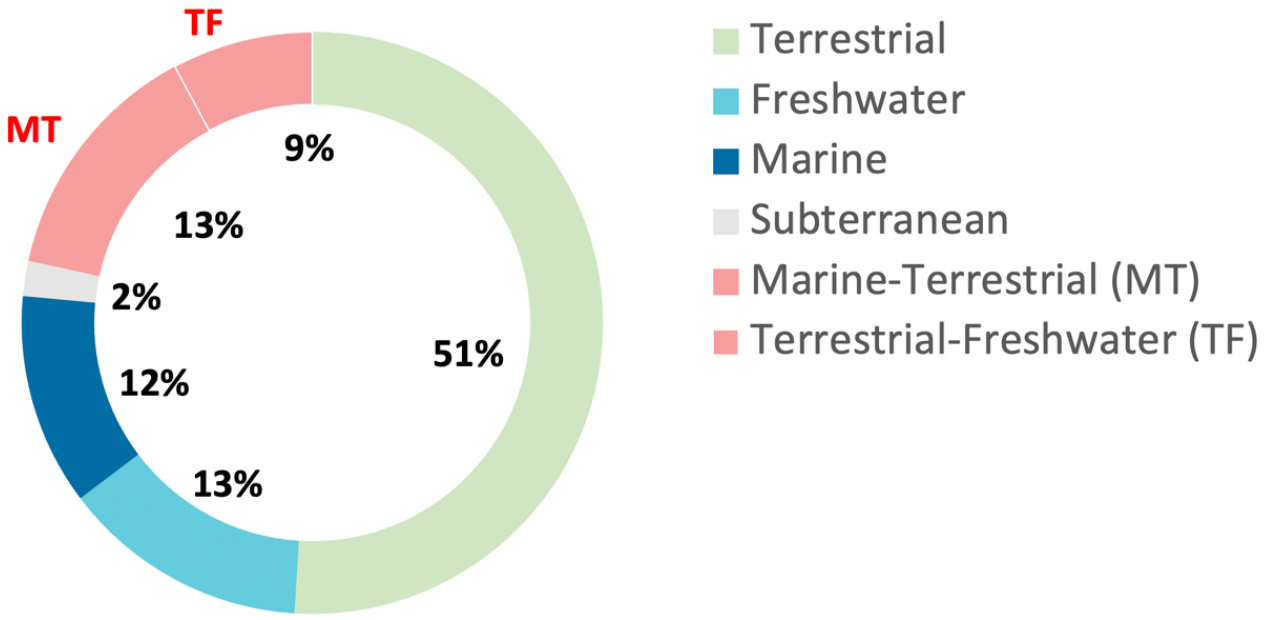


Fig. S2. The realm representation in 28 nature documentaries on the CCTV programme overview (n= 51 times of appearance). Each realm is shown in a separate colour, except from the five transitional realms, which are all shown in pink, with labels provided for identification. The definition of realms is based on the IUCN Global Ecosystem Typology (v2.0) (Keith et al., in press).

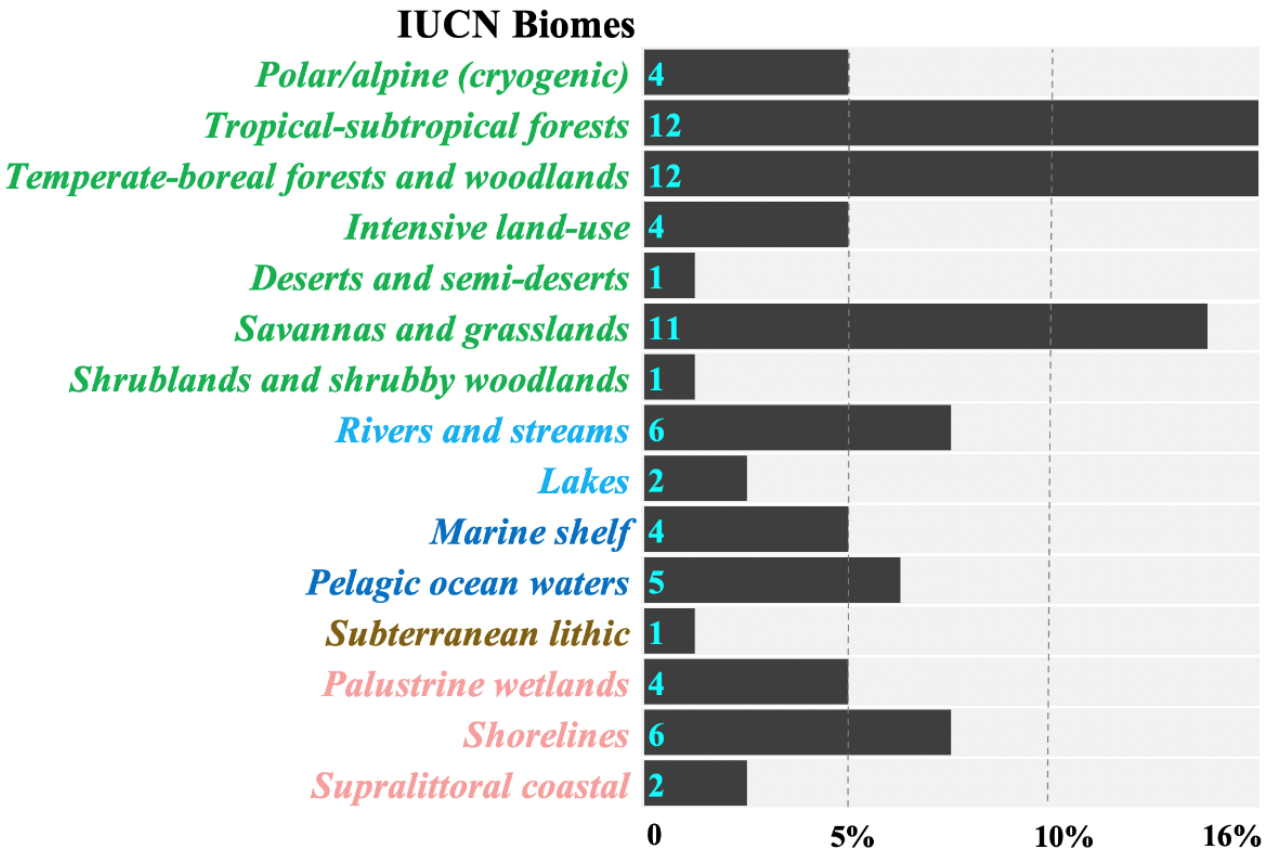
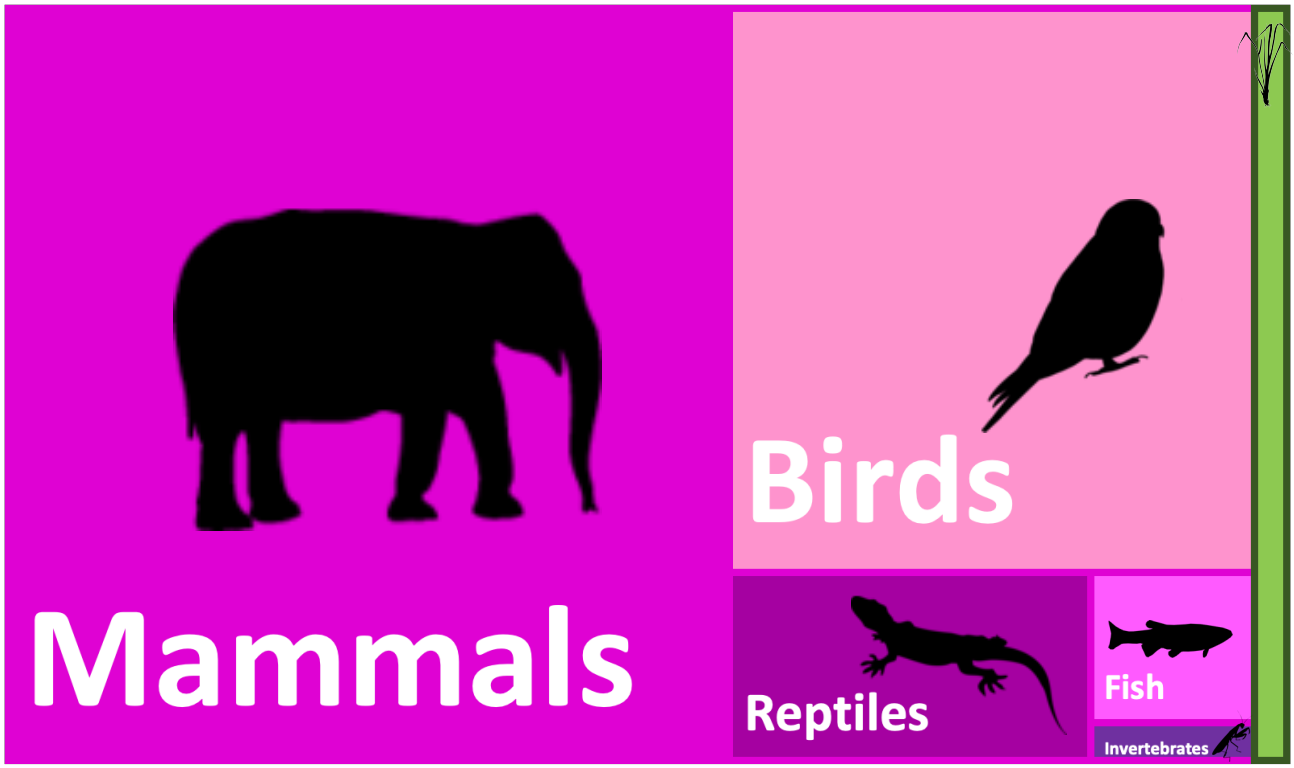


Fig. S3. Biome representation in 28 nature documentaries on the CCTV programme overview (n= 75 times of appearance). The colour of the biome name indicates the realm to which the biome belongs, with 'Terrestrial' in green, 'Freshwater' in light blue, 'Marine' in dark blue, 'Subterranean' in brown, and all transitional realms in pink. The categorisation of biomes is based on the IUCN Global Ecosystem Typology (v2.0) (Keith et al., in press).

Documentaries on CCTV programme overview



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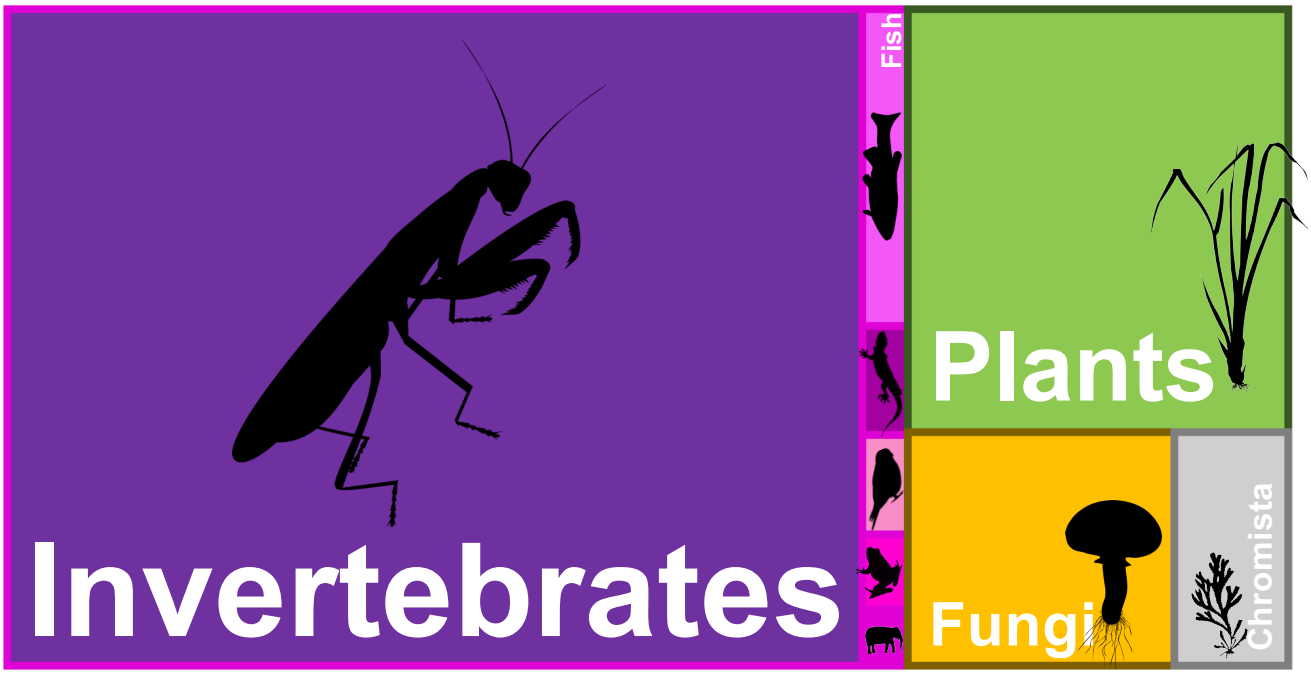

Fig. S4. Taxonomic group representation in 28 nature documentaries on the CCTV programme overview (top, n=156 number of species) and the Catalogue of Life (COL) (bottom, n=1,975,129 of species from four Kingdoms, Animalia, Plantae, Fungi, and Chromista, accessed on Dec 20, 2022). Taxonomic groups in the same kingdom are shown in the same colour palette, with pink-related colours for animalia, green for plantae, yellow for fungi, and grey for chromista. Silhouettes from phylopic.org. Credit: Melissa Broussard (License: Attribution 3.0 Unported; no changes made), Ghedo and T. Michael Keesey (License: Attribution-ShareAlike 3.0 Unported; no changes made).

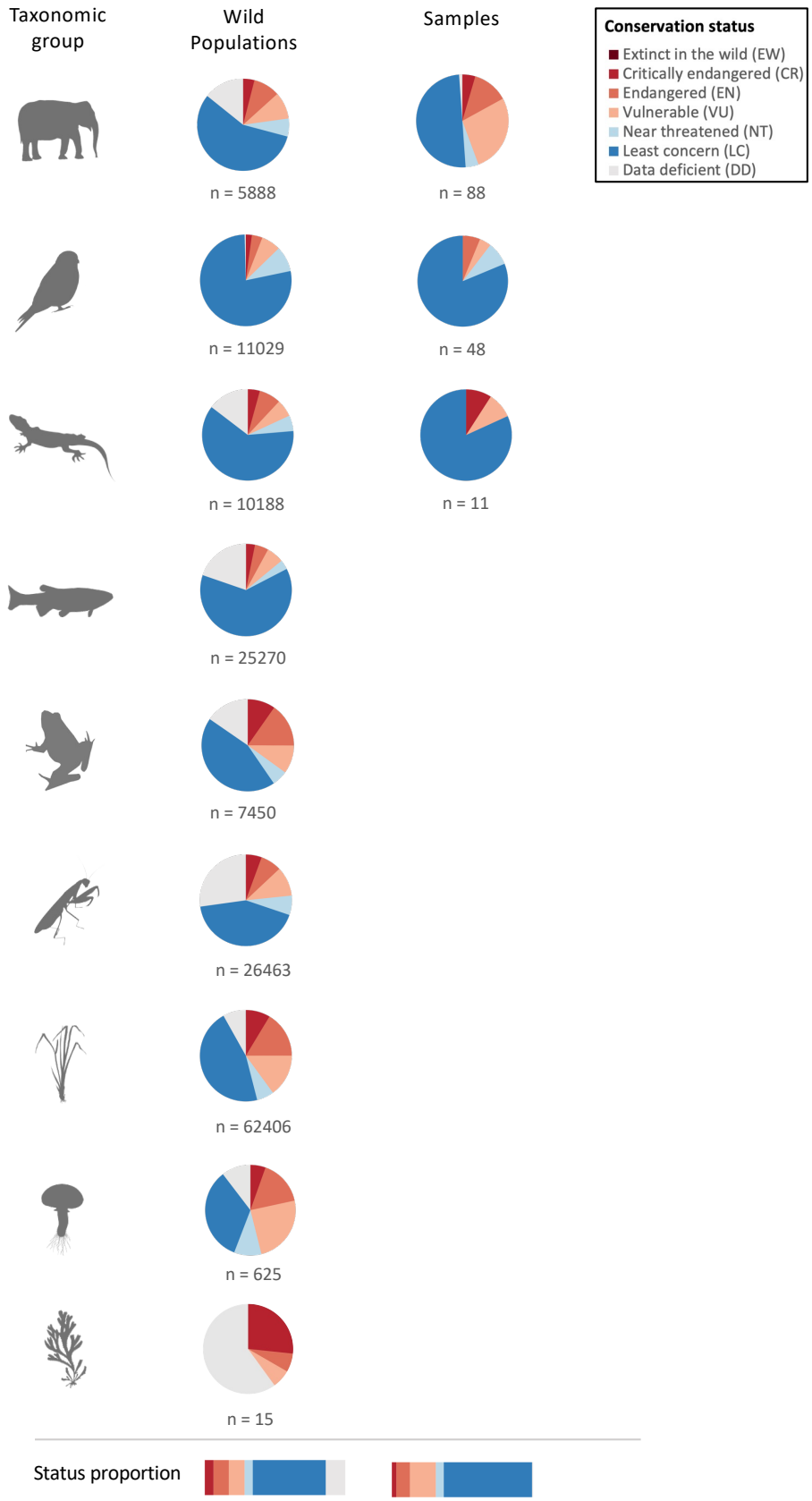

Fig. S5. The proportion of species with different conservation status assessed by the IUCN (n=149,334, left, on Feb 23, 2023) and those covered by nature documentaries on the CCTV programme overview (n=147, right) in each taxonomic group (from the top, mammals, birds, reptiles, fish, amphibians, invertebrates, plants, fungi, and chromista). The proportion of all species with different conservation status is shown with the bar charts at the bottom. Extinct species were excluded. Pie charts are shown only for the groups with records of at least 10 species. Silhouettes from phylopic.org. Credit: Melissa Broussard (License: Attribution 3.0 Unported; no changes made), Ghedo and T. Michael Keesey (License: Attribution-ShareAlike 3.0 Unported; no changes made).