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Global patterns in mangrove recreation and tourism

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ABSTRACT

The use of mangroves as a travel and tourism destination has not received much attention, but provides a high-value, low impact use of these important ecosystems. This work quantifies and maps the distribution of mangrove visitation at global scales using keyword searches on user-generated content of the popular travel website, TripAdvisor. It further explores the use of user-generated content to uncover information about facilities, activities and wildlife in mangrove tourism locations world-wide. Some 3945 mangrove "attractions" are identified in 93 countries and territories. Boating is the most widespread activity, recorded in 82% of English-language sites. Birdlife is recorded by visitors in 28% of sites, with manatees/dugongs and crocodiles/alligators also widely reported. It is likely that mangrove tourism attracts tens to hundreds of millions of visitors annually and is a multi-billion dollar industry.

1. Introduction

Mangrove forests and communities are distributed worldwide in tropical and warm temperate coastal areas. Their location has often placed them "in the way of" development and large areas of mangroves have been lost in recent decades to aquaculture, agriculture and urban expansion [1–3]. By contrast, mangroves are now recognised as being among the most important ecosystems in the world for the array of ecosystem services they provide [4], including provisioning services such as fisheries enhancement [5,6], and regulating services such as carbon storage and sequestration [7–9]; and coastal protection [10,11].

Although often listed in reviews, the importance of mangroves for cultural services, including their use in recreation and tourism has received relatively little scrutiny. Ghermandi and Nunes' [12] comprehensive review of 253 valuations for coastal recreation found only 11 mangrove valuations (4.6%), with beaches (25.5%), coral reefs (22.2%) and mixed ecosystems (41.4%) dominating the work. Despite this limited attention, the recreational use of mangroves it is widespread [e.g. 13]. The most popular mangrove sites attract hundreds of thousands of visitors per year (Appendix A Table A1,) and may generate millions of dollars in visitor expenditure. Also noteworthy is the popularity of mangrove tourism among local communities, including in locations where international tourism is limited, such as Iran and Bangladesh [14–16].

Mangrove recreation activities include hiking and boating – often centred around wildlife-watching – and fishing. While many visitors are participants in single day or part-day trips, a few undertake extended stays for recreational fishing and overnight boating trips. Mangroves may not be a primary drive for destination choice, but they offer a popular attraction, which can influence destination choice, and their popularity appears to be growing [13].

Three factors – the scattered nature of locations; the considerable variety of activities undertaken; and the mixed user-base, with significant domestic components – combine to make large-scale assessment of mangrove tourism a particular challenge.

One possible entry point for such work may be the use of user-generated content (UGC) from the internet. There is now a growing interest in using such information as a means to assess recreation and tourism broadly [17] and more specifically in the field of nature-based tourism [18–20]. Such approaches are also being developed at global scales: Wood et al. [21] used online photographs to study global use of protected areas, while Spalding et al. [22] have used both online photographs and crowd-sourced web-platform data in the modelling and quantification of coral reef tourism values. In mangrove settings, Richards and Friess explored the finescale use of Flickr to determine user activities in mangroves in Singapore [23].

TripAdvisor is the world's largest travel website. Founded in 2000, by the end of 2016 it was used by 390 million unique visitors every

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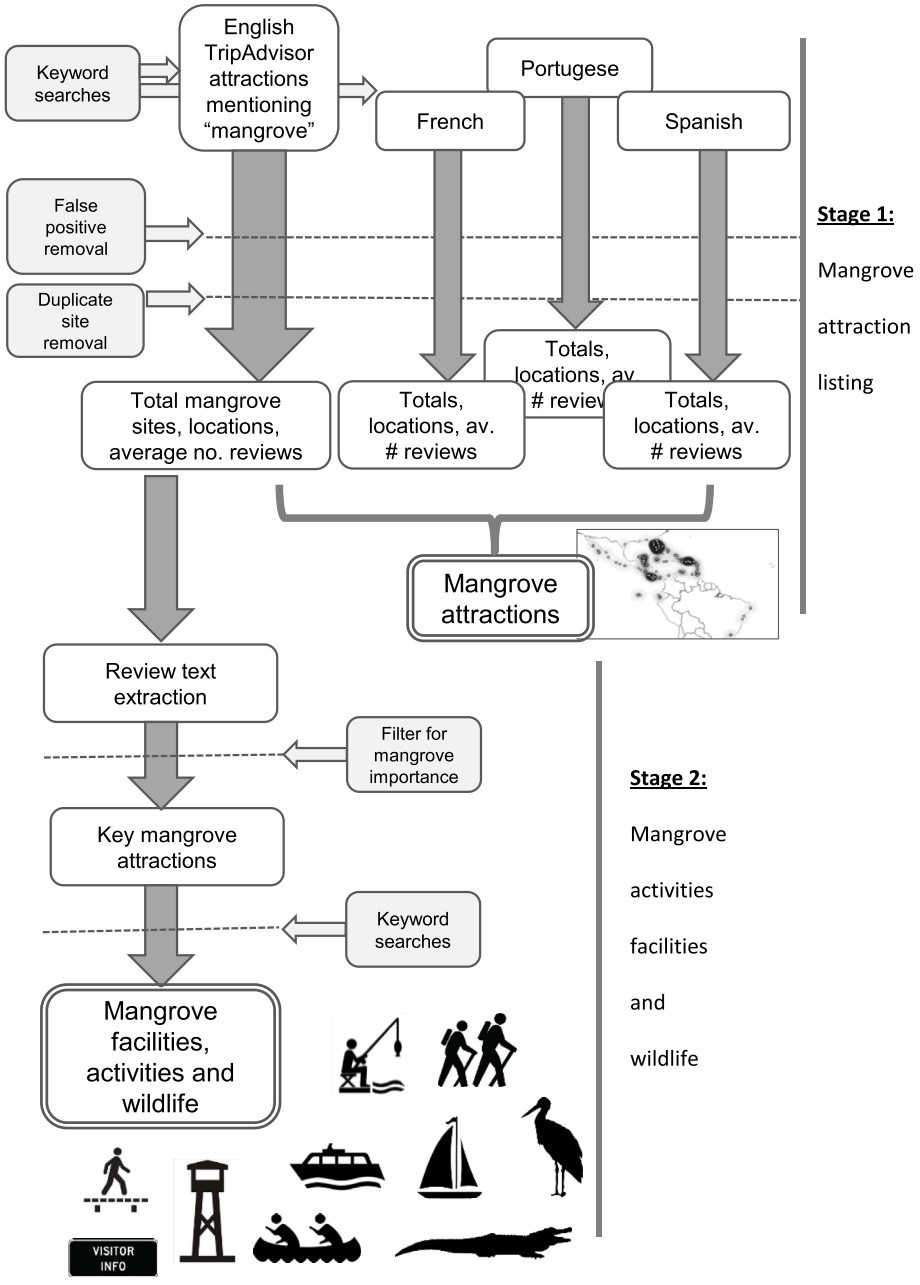

Fig. 1. A schematic outline of the various elements undertaken in this research. See text for details.

month [24]. It hosts user-generated content and reviews of destinations world-wide, and different language and nationality versions offer access to information in multiple settings. Among the destinations it reviews are some 730,000 "attractions" – destinations and services that are neither accommodation or restaurants, which are dominated by places to visit and operators in those places. The global, multi-lingual reach and widespread use of TripAdvisor offers a potential opportunity to overcome some of the difficulties of studying geographically dispersed activities such as mangrove tourism.

The current work reviews the geographic spread and relative importance of mangrove tourism world-wide using UGC extracted from TripAdvisor. It further explores the use of the same platform to investigate key features of attractions in terms of facilities, activities and charismatic wildlife.

2. Methods

The work had two elements: a search for all mangrove attractions globally; followed by a more targeted search of English-language sites to explore additional information about activities and facilities in these attractions. An outline of these two elements or stages is laid out in Fig. 1, with further details outlined below.

2.1. Stage 1. mangrove attraction listing

The first stage of this work was to extract (or scrape [25]) information on all attractions (ie. excluding accommodation and restaurants) containing the word 'mangrove' either in the attraction name or in any written review, and then to assess associated data. This was undertaken firstly in English, and then repeated on French, Portuguese and Spanish TripAdvisor websites using keywords in those languages. (The different "language" websites in TripAdvisor access all reviews in

every language but search terms will only search the pages/reviews in that language.) Although there are many other language websites, brief assessments suggested a rapidly diminishing return on efforts to expand beyond these four.

The definition of an attraction in TripAdvisor includes a broad array of groups and categories, including locations (for example protected areas, natural sites, landmarks, museums, shopping malls, spas and casinos), tours, operators, events, and activities [26]. Each of these has a geographic locator. From the context of understanding the distribution of mangrove tourism it was clear that this work would need to capture a variety of these classes, but that there would likely be geographic overlap. For example, a popular national park with mangroves would also be recorded by multiple separate tours being offered in that park. As the intention was to explore the location and intensity of tourism it was decided to keep all such information as independent data points.

The initial text extraction was done using a commercial, automated online data collection tool (http://www.mozenda.com). For the English language pages, all attractions with the word “mangrove”, either in the attraction name or in reviews, were selected. This was undertaken by world-region to avoid data capping in the extraction process. Data extracted included attraction name, address, geographic co-ordinates, TripAdvisor page URL, total number of reviews, and number of reviews mentioning mangrove.

The process was repeated for four language websites using equivalent search terms (‘mangrove’ for the French domain; ‘manglar’ for the Spanish; and ‘mangue’ for the Portuguese).

Under this approach any attraction mentioning mangrove, even in only one review, will have been selected. This work generated lists of attractions which then required further cleaning to complete missing fields, and to remove duplicate entries. Additionally, an intensive process of verification was undertaken to remove false-positives. These included attractions where the keyword mangrove did not apply to the attraction under review, misidentification of mangroves and incorrect location of attractions. These processes were refined on the English language attractions before being applied to the other languages (see Appendix A). The cleaning process removed between 10% (Portuguese) and 17% (English) of attractions from the original search.

This process produced a basic listing of mangrove attractions for four of the main language websites on TripAdvisor, with some basic details of location, number of reviews, and average ratings for each.

2.2. Stage 2. Facilities, activities and wildlife

Following on from the first review and filtering, a second stage was undertaken for English language attractions to assess the utility of using UGC to uncover further details about attractions, including facilities, activities and wildlife. A pre-existing programme in R, rvest [27], was modified to read the URL addresses for each attraction, paginate within each attraction to fetch all reviews over multiple pages, loop to the next relevant attraction/URL and return each review's ID, title, rating, date and a portion of the review text. A limit was set at 910 reviews per attraction, while the coding extracted the text for these, up to a limit of 60 words. Many reviews are shorter than this, while the extraction of full reviews would have required considerable additional coding and was considered unnecessary for this exploratory work.

Extracted data were checked for blank fields and review ID's were used to recognise and eliminate duplicate reviews.

As noted earlier, many attractions are not solely focused on mangroves, and review comments may relate to other habitats. As the intention of this phase of the work was to look at activities and facilities within mangrove components of attractions it was decided to further filter the initial listings to attempt to isolate those attractions where mangroves were more likely a key feature. To guide this, attractions which gave little attention to mangroves in reviews were excluded. After a series of trials, it was determined to exclude attractions where less than 3% of review texts mentioned the term mangrove, unless the term mangrove was mentioned in the attraction name. Although a relatively low bar, this process led to the removal of a further 39%, leaving 2005 key mangrove attractions. Setting a higher level, by contrast, appeared to lead to losses of some key attractions.

The reviews of these key mangrove attractions were then searched through an Access database for keywords that would give some indication of features of these attractions. This was an iterative process, both in the initial identification of keywords, and in the developing of a series of search terms which would ensure the exclusion of false positives (e.g. statements such as “there was no information centre”) or misappropriation of non-mangrove activities and facilities to the mangroves (see Appendix A). Initial efforts sought to identify three classes of keywords – facilities, activities, and wildlife. UGC information was not expected to provide a comprehensive or consistent review of features, and that this approach would not work for certain components. For example, with wildlife it was expected that reporting would be largely restricted to iconic and charismatic features or species. The intention here was to explore within this framework, and to look in particular at the geographic distribution of those elements which do appear to be well-reported. Where keywords were highly likely to be linked to mangroves (e.g. boardwalk), the presence of the keyword alone was considered sufficient to be counted for an attraction to be included, but in other instances (e.g. bird) where the target might well be linked to other habitats or activities outside of mangroves, the search was constrained only to count those words where they co-occurred with the word mangrove in the same review.

The final list of activities, facilities and wildlife which the authors felt were generating valuable data included four facilities (boardwalks, information centres, lookout towers and information boards), and eight main activities including hiking and boating (with a further 5 subclasses of boating activities); and six main classes of wildlife.

3. Results

The final cleaned list of attractions with mangroves includes 3945 attractions in 93 jurisdictions (countries and overseas territories) from across the 4 language websites of TripAdvisor that were searched (Fig. 2). Between them these attractions have over one million reviews (Table 1).

These numbers are likely to be an underestimate as they depend on the presence of a keyword in at least one review. In our full list of attractions across languages, less than 4% of reviews mention mangroves, and so there will be many attractions with mangroves, particularly those with fewer reviews, that are simply not recorded.

While English entries predominate, the importance of other languages is significant, with over 700,000 reviews and adding 782 unique attractions that have no English listing).

As mentioned, attractions include a range of locations and tour operators, which were kept as separate entries. Some of these may operate or occur in similar or overlapping locations. Likewise, the reported locations from TripAdvisor may not overlap directly with the mangroves where the activity takes place, as they may refer to headquarters or starting points of boat trips and so on (Fig. 3).

In looking at larger-scale patterns, Table 2 shows that by far the largest number of attractions in this study are in North America. Although this region includes Mexico, attractions and reviews are dominated by the USA (largely Florida). The Caribbean and South America are also important, with over 600 attractions each, covering multiple jurisdictions, although one country again is dominant: Brazil hosts some 495 attractions. Central and West Africa have only 28 attractions in 9 countries, however it may be noteworthy that mangroves are regularly mentioned in reviews (6%, the highest for any region).

The second stage of the study, based on English-language reviews, focused on 2005 key mangrove attractions, which formed the basis of keyword development and searches. A number of keywords were

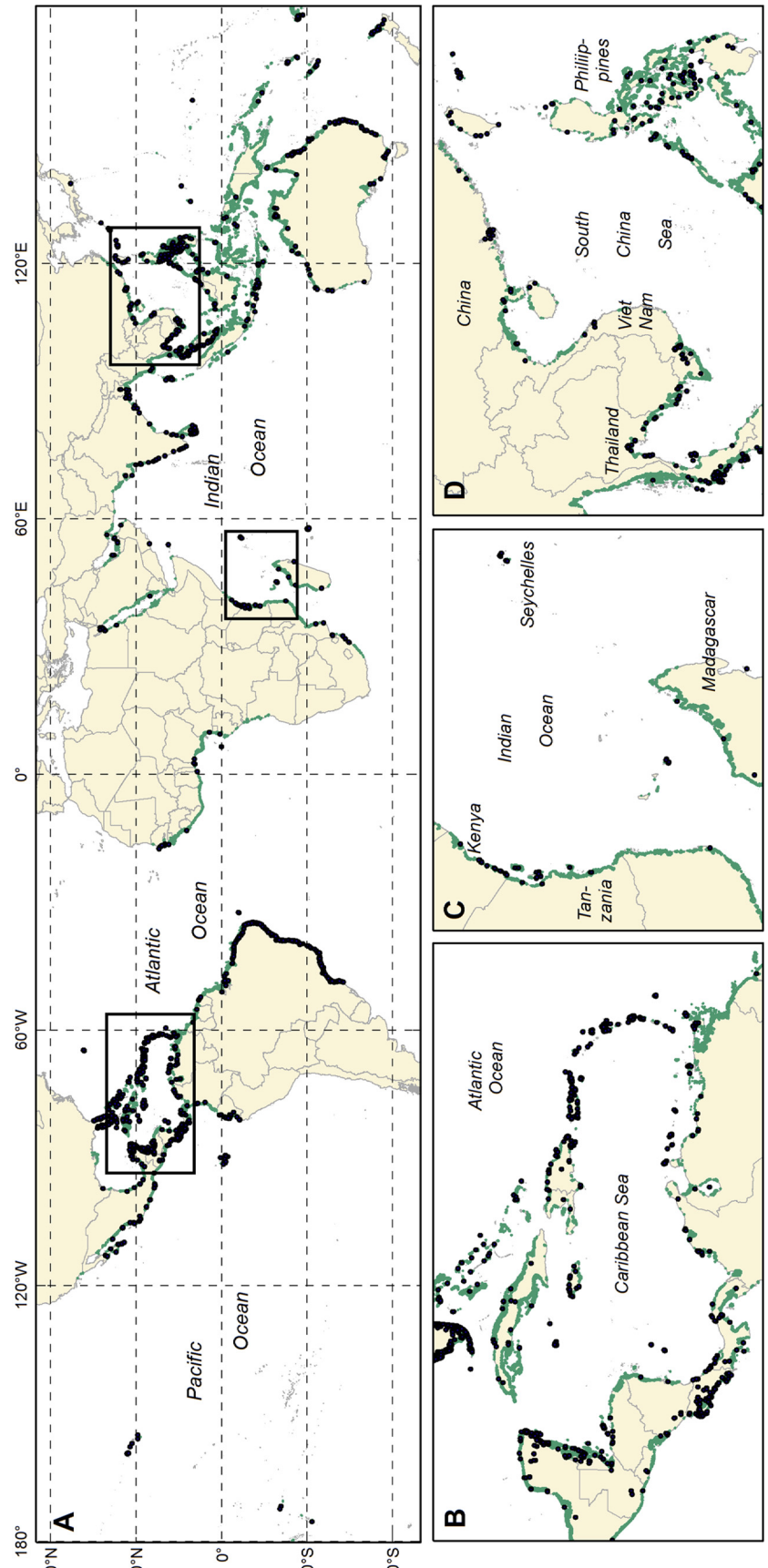

Fig. 2. Map showing location of all 3945 mangrove attractions, with the distribution of mangroves in pale green behind (A). Lower panels show the Caribbean (B), East Africa (C), and East Asia (D). See Appendix A for additional maps. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Table 1
TripAdvisor attractions with connections to mangroves. Data current at end-2015. The total column excludes duplicate attractions which were recorded in more than one language website.

		English	French	Portuguese	Spanish	TOTAL
Initial TripAdvisor search results	Initial no. of attractions	3942	674	633	537	5786
	Initial no. of reviews		254,381	416,889	325,613	1,592,966
"Cleaned" results from TripAdvisor	No. of attractions	3182	567	564	459	3945
	No. of reviews (all/any language)	735,590	177,260	316,089	209,414	1,014,317
	No. of reviews mentioning mangrove (all/any language)	29,551	2538	3987	1762	37,027
	No. of jurisdictions with mangrove attractions	91	62	25	40	93

utilised that provide an indicator of some of the activities, facilities and wildlife receiving attention in mangrove forest attractions (Table 3).

The keyword search process will only find a subset of attractions, and so the numbers are conservative and only give known occurrence, rather than absence. Perhaps the most notable activity is boating, mentioned in some 82% of the key attractions. While not all attractions give details on the activity, the presence of canoeing and kayaking in almost half of the total boating attractions shows the clear popularity of these activities.

Further analysis of these data could enable, for example, exploration of geographic patterns in these features. For illustration, Table 4 shows a regional breakdown of the wildlife observations (See also Appendix A).

4. Discussion and conclusions

This work highlights the scale and geographic extent of mangrove tourism and recreation – almost 4000 attractions in 93 countries and territories – and provides initial insights into the potential to use UGC to investigate more deeply into the uses and activities in these attractions. These attractions have over one million individual reviews. Over two-thirds of these attractions are found through the Americas and the Caribbean, however Southeast Asia also has over 500 attractions.

Unlike the somewhat mixed messages around tourism impacts

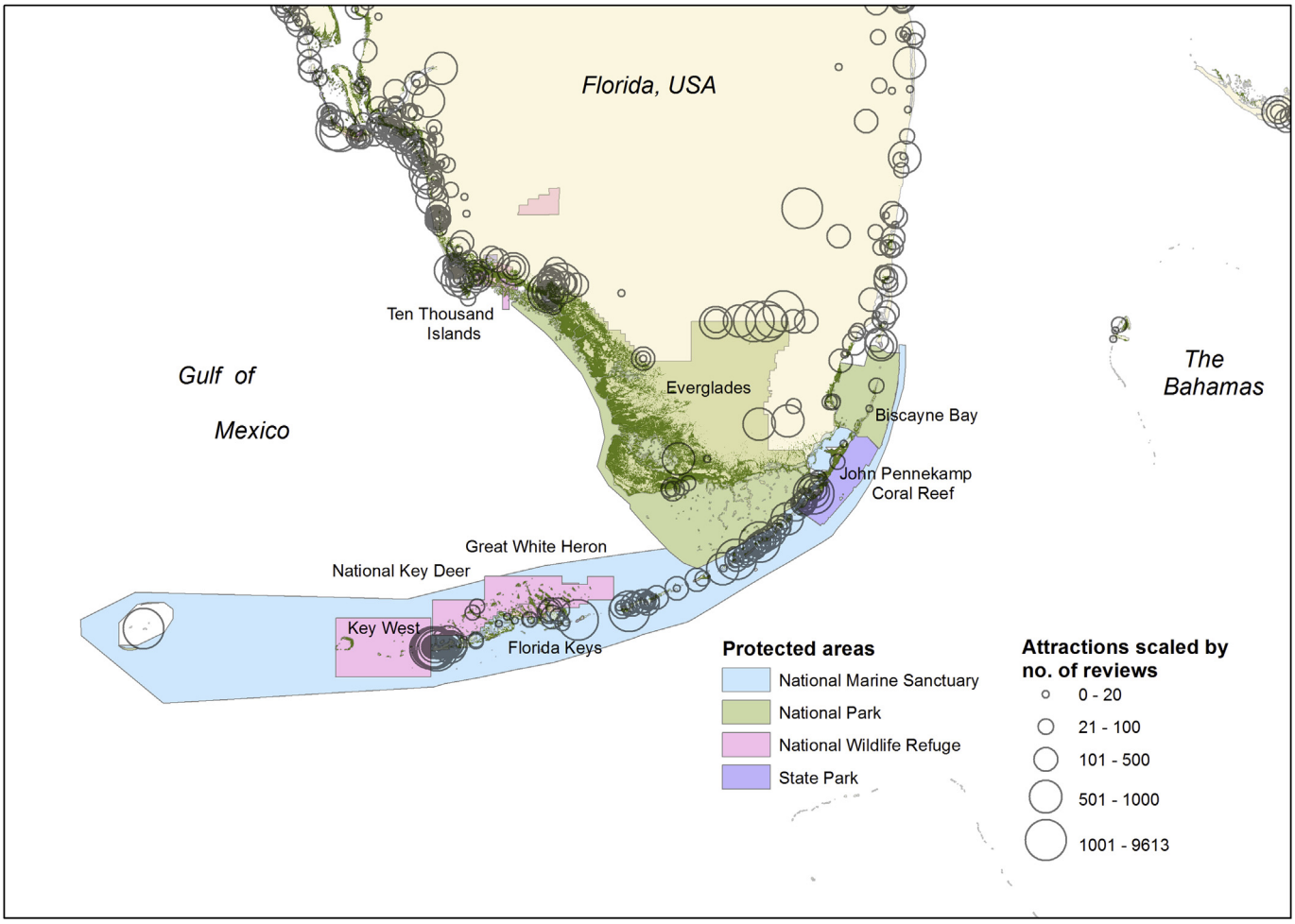

Fig. 3. The spatial relationship between attractions and mangroves: in southern Florida numerous operators and locations are listed around the complex mangrove coastlines, and attractions include places such as the many protected areas shown on the map, but also operators who take clients to one or more of these locations. Many operators are located quite far from the mangroves (dark green), such as those located along the northern boundary of the Everglades National Park. Expanding the analysis of UGC data in this local context may also serve to inform managers of the relative importance of mangroves in particular locations. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

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Table 2
Mangrove attractions by broad geographic region.

Region	No. jurisdictions with mangrove attractions	No. of mangrove attractions	No. of reviews of mangrove attractions	No. reviews mentioning mangrove
Caribbean	26	654	189,524	8527
North America	2	1101	243,888	13,769
Central America	7	390	69,367	2220
South America	8	614	284,192	4303
Central and West Africa	9	28	1694	101
East Africa	8	96	12,472	540
Middle East	7	45	17,538	349
South Asia	3	121	18,455	842
Southeast Asia	9	527	108,842	4804
East Asia	3	52	2851	84
Australia	2	279	57,229	1386
Pacific	9	38	8265	102
Grand Total	**93**	**3945**	**1,014,317**	**37,027**

Table 3
List of the facilities, activities and wildlife noted for key mangrove attractions on English-language TripAdvisor pages, together with statistics of numbers of attractions and jurisdictions associated with each.

	Number of attractions	Proportion of attractions	Number of jurisdictions	Dominant jurisdictions
Facilities				
Boardwalk	234	12%	33	USA, Australia
Viewing Tower	140	7%	30	USA, Mexico, India
Information Centre	33	2%	13	USA
Information Boards	27	1%	9	USA, Australia
Activities				
Boating[a]	1634	82%	78	
Airboat	54	3%	2	
Canoe & kayak	784	39%	59	USA, Puerto Rico, Thailand
Stand Up Paddleboarding	274	14%	32	USA, Costa Rica, Puerto Rico
Fishing	282	14%	37	USA, Australia, Malaysia
Hiking	266	13%	43	USA, Australia, Puerto Rico
Wildlife				
Birdlife	566	28%	56	USA, Mexico, Australia Costa Rica
Bioluminescence	69	3%	10	Puerto Rico
Fireflies	39	2%	10	Malaysia, Philippines
Monkey	134	7%	24	Malaysia, Costa Rica, Thailand
Proboscis monkey	19	1%	3	Malaysia, Brunei, Indonesia
Manatee/Dugong	332	17%	14	USA, Mexico, Belize
Crocodile/Alligator	193	10%	23	USA, Mexico, Costa Rica, Australia

[a] Most references to boating were unspecified, but where there were specific mentions of boat type these are shown.

associated with ecosystems such as coral reefs e.g. [28], mangrove visitation appears to have minimal negative impact. By contrast, benefits are widely reported, including generating income and employment, with some locations recording reductions of potentially unsustainable activities around timber extraction or over-fishing [29–31].

Quantitative values for mangrove use intensity or value cannot be directly determined from these data, however it is possible to consider such values alongside other data. The relative importance of mangroves in relation to other features of interest, will vary considerably between attractions. Thus, for example, the Florida Everglades National Park

Table 4
Wildlife attractions by region. Note that there were no specific wildlife observations in the Pacific region.

	Alligators and crocodiles	Birdlife	Biolunin-escence	Fireflies	Manatees and Dugongs	Monkeys	Proboscis monkeys
Caribbean	8	74	55	3	10	5	
North America	86	264	9	2	294	6	
Central America	36	48	2		18	34	
South America	2	16			1	5	
Central and West Africa		6					
East Africa	1	11				4	
Middle East		11			2		
South Asia	17	27				8	
Southeast Asia	18	56	3	34	1	72	19
East Asia		4					
Australia	25	49			6		
	193	**566**	**69**	**39**	**332**	**134**	**19**

(Fig. 2) typically hosts one million visitors per year, but this site includes many habitats and a broad range of activities and it is not possible with current data to know the role of mangroves in driving such numbers. There are, however, a number of locations where mangroves are likely to be the sole or core attraction. (Table A1 Appendix A) includes some basic statistics on visitor numbers to some of these: ten of these are attracting visitor numbers in excess of 100,000 per year (totalling 3.29 million). Unfortunately, even with these mangrove-focused sites there appears to be no clear correlation between reported visitor numbers and the number of TripAdvisor reviews, and so it is not possible to use the latter to extrapolate any reliable estimates of global total visitors. Even so, it seems likely that mangroves are attracting tens to hundreds of millions of visits per year world-wide.

The monetary value of this tourism is likely to be considerable: Kuenzer and Tuan [32] used a travel-cost method to look at the value of Can Gio mangroves in Vietnam and estimate a total value of $104,400,000 per year. Two other studies, both using willingness to pay approaches predicted much lower values of “over $1,000,000” per year for Matang Forest in Malaysia [14] and $700,000 per year for Hara Biosphere Reserve in Iran [16]. Given both the paucity of such studies, and the variability in approaches, it is not possible to generate median values for tourism per unit area of mangrove, or indeed to attempt to extrapolate the values mentioned here to the other sites identified world-wide. It would nevertheless, be reasonable to suggest that mangrove tourism and recreation is a multi-billion-dollar industry.

The potential for bias in social media has already been discussed in relation to platforms such as Twitter and Instagram [33–35]. TripAdvisor has received much less research attention [36], but its large and multi-lingual user-base may help to remove some degree of dominance by single countries or language groups. In the current work under-reporting may be more likely where visitors do not speak any of the four languages included in this synthesis, and future work would benefit from assessing other language websites within TripAdvisor, notably across the range of Asian languages.

The high utilisation of mangroves by domestic and local visitors may be an important feature of mangrove forests, and this too, could lead to bias. Examples of high domestic use include 98% of visitors to the Bangladeshi Sundarbans [15] and 85% in Can Gio, Vietnam [32]. Motivations for local visitors may be broader than typical recreational activities, with religious practises being recorded in both Kenya and Bangladesh [15,37]. It would seem likely that engagement in TripAdvisor by local communities may be lower than that from international travellers, but it does occur (we list 10 attractions and 300 reviews from Bangladesh, around half of which were from Bangladeshi reviewers). Despite these concerns, the use of UGC and social media more generally, is a valuable tool, likely far better at capturing local engagement than other research approaches such as hotel-based surveys or airport exit surveys.

A further important direction for work of this nature might be to utilise image-based searches alongside text-based searches as a [38] and to consider including regionally popular platforms to capture local and domestic use in better detail.

The exploration of activities, facilities and wildlife in this work provides valuable, albeit partial, further insights into the uses of mangroves. While the presence of a keyword is a good indicator that a particular facility, activity or wildlife feature may be present, the absence of such a word may not be indicative of absence, particularly if attractions have not received many reviews. With wildlife observations in particular, it needs to be emphasised that UGC will largely focus attention on iconic or charismatic species. Such species or dramatic wildlife phenomena are nonetheless a particular draw for tourism to mangrove forests, and where this is the case they are likely to be mentioned in reviews. Beyond particular species or phenomena, wildlife watching in general, and birdwatching in particular, are clearly a key component of many attractions: some 28% of attractions were identified as containing the word “bird*” in the same review as the word mangrove.

Future studies might consider trying to use these approaches to better quantify the importance or value of particular species in attracting visitors, which might in turn generate powerful arguments for conservation and management [39]. The potential for UGC to reveal further details at local scales may also be important – certain wildlife features, such as the spectacular arrival of thousands of scarlet ibis for the evening roost in Caroni Swamp in Trinidad and Tobago, are well recorded in TripAdvisor. While these may be insufficient for generating a global picture, UGC could nonetheless be utilised at national or even site-levels to track elements of popularity and use.

The geolocation of attractions also enables the discernment of geographic patterns: canoeing and kayaking, for example, are abundant and popular world-wide, while the popularity of standup paddleboarding is far more concentrated in Northern and Central America and the Caribbean (Map A3, Appendix A).

One initially unexpected result was the relatively low figure for fishing, picked up in only 14% of key attractions. Fishing in general is widely reported in TripAdvisor, and some particularly valuable fisheries take place in or adjacent to mangrove areas [40,41]. One reason for this relatively low figure could be the focus of reviews on the activity, while failing to mention the term “mangrove”. This might be exacerbated by a failure of some fishers to understand the relevance of mangroves to their catch [42,43]. A further reason could be that much mangrove fishing is undertaken by local recreational fishers who do not regularly report to TripAdvisor, and these fishers may also be reluctant to share their preferred fishing locations on a public platform.

Further work might also consider more nuanced aspects of popularity, of both places and activities. TripAdvisor ratings give a simple route to such insights, but more analytical text tools from the field of opinion-mining and sentiment analysis might greatly enhance such work by considering emotions through machine learning around word patterns [44–46].

The appearance of mangrove forests as a tourist attraction is not new, with detailed records, notably from the Caribbean, dating back to the 1970s [47], although it seems likely that it has been an area of growth over the past two decades [13] alongside more general trends in nature-based tourism [48,49]. The term mangrove first occurs in the English-language attractions of TripAdvisor in 2002, and the rapid growth of reviews undoubtedly broadly tracks the similar overall growth of the platform, however future studies should be able correct for this growth and to use UGC data to follow recent patterns of use of mangrove (or other) attractions over time.

Mangrove ecosystems provide a leading exemplar of the potentially high value to be obtained from multiple ecosystem services [50], and these values in turn provide a critical argument for both protection and restoration. This study shows that, alongside provisioning and regulating services, mangroves are of considerable importance for recreation and tourism. Site-specific studies have already drawn attention to high visitor numbers and monetary values. There are also likely to be many linked benefits, in terms of health and well-being, employment, alternative livelihoods and social enhancement. It would be valuable for future studies to further quantify these values.

By raising awareness of the broad distribution and popularity of mangrove recreation and tourism, this work should encourage key decision-makers in government and the private sector to consider its value within the wider aspects of planning and natural resource management. It further raises awareness of the potential for developing cultural benefits from mangroves in other locations. For those already engaged in mangrove tourism and recreation, including at individual locations, it should encourage or help to leverage connection, sharing and learning from other practitioners. Given the extent and diversity of mangrove utilisation described here there would also be value in reviewing activities and approaches, successes and failures, and from this to develop ideas for best-practises in mangrove tourism and recreation, encouraging sustainable use and compatibility with other aspects of

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mangrove utilisation.

In utilising UGC to assess the distribution and intensity of a cultural ecosystem service, this work also demonstrates a novel research approach with considerable potential. It would be valuable to extend such approaches to other aspects of nature-dependent tourism and recreation. Future work should focus on utilising a broader spread of languages and perhaps strengthening the approach using elements of sentiment analysis, or non-linguistic approaches such as image-recognition.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.marpol.2019.103540.

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