



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



## Beachgoer perceptions on health regulations of COVID-19 in two popular beaches on the Brazilian Amazon

Luci Cajueiro Carneiro Pereira<sup>a,\*</sup>, Rosigleyse Corrêa de Sousa Felix<sup>a</sup>, Ana Beatriz Brito Dias<sup>a</sup>, Rubem Manoel Coelho Pessoa<sup>a</sup>, Brenda Ribeiro Padilha da Silva<sup>a</sup>, Carlos Alessandro da Costa Baldez<sup>b</sup>, Rauquীরio Marinho da Costa<sup>a</sup>, Taynara Sousa da Silva<sup>a</sup>, Luciane Ferreira da Silva Assis<sup>a</sup>, José A. Jimenez<sup>c</sup>

<sup>a</sup> Instituto de Estudos Costeiros, Universidade Federal do Pará, Alameda Leandro Ribeiro, s/n, Aldeia, 68600-000, Bragança, Pará, Brazil

<sup>b</sup> Faculdade de Matemática, Universidade Federal do Pará, Alameda Leandro Ribeiro, s/n, Aldeia, 68600-000, Bragança, Pará, Brazil

<sup>c</sup> Laboratori d'Enginyeria Marítima, Universitat Politècnica de Catalunya-BarcelonaTech, c/Jordi Girona 1-3, Campus Nord ed D1, 08034, Barcelona, Spain

### ARTICLE INFO

#### Keywords:

Pandemic  
Beach activities  
Summer peak  
Amazon coast

### ABSTRACT

The sandy beaches of the Brazilian Amazon coast have enormous touristic potential and attract thousands of visitors each year, principally in July, at the beginning of the summer vacation period. In 2020, beach going was affected worldwide by the Covid-19 pandemic, but how did the pandemic affect recreational beach use on the Amazon coast in the Brazilian state of Pará? Given this, the objective of this work is to identify public perception in compliance with health safety established by authorities due to COVID-19 pandemic in two popular beaches on the Brazilian Amazon. Recreational patterns on the beaches of this region were analyzed from the user's perspective in July, through semi-structured interviews and direct observations. Recreational activities were prohibited on the beaches located within protected areas. At other locations, however, including Ajuruteua and Atalaia, the beaches were reopened on July 1 st, and both sites received thousands of visitors in July, despite the fact that interviewees believed the pandemic to be dangerous, and considered the situation in Pará state to be at least as bad or worse than in previous months. Agglomerations were verified on both study beaches and social distancing and other protective measures were limited. The increase in the new cases recorded in August was due to the relaxation of restrictions on social, recreational, and economic activities by the local authorities in July 2020, including the reopening of public access to beaches. As Pará state has been hard-hit by the pandemic, prohibitions on recreational beach use should clearly not have been lifted during this period. A number of management measures were presented in this study. These measures should contribute to the prevention of the spread of the virus during the upcoming public holidays, as long as the pandemic continues.

### 1. Introduction

Four pandemics - SARS, in 2002, "Bird flu" (2009), MERS (2012), and now COVID-19, which began in 2019 - have occurred during the first two decades of the twenty-first century has already been four (began in 2019 until now). The first outbreak of the new coronavirus (COVID-19) was recorded in China (Wuhan), and in a just few months, it had spread worldwide via human-to-human transmission (Wen et al., 2020). Worldwide, the COVID-19 pandemic has resulted in 82,401,834 confirmed cases and 1,801,280 deaths so far, based on the data available

up to December 31st. In an attempt to stem the advance of the disease, governments around the world have implemented preventive measures such as lockdowns, strict social distancing, and travel bans, which have resulted in estimated economic losses of hundreds of billions of dollars, in particular in the tourism sector, which was severely affected (Ormaza-González and Castro-Rodas, 2020; Zielinski and Botero, 2020).

The World Tourism Organization (WTO) announced that travel restrictions during the peak of the summer season in the Northern Hemisphere had an ample impact on this economic sector (UNWTO, 2020). Arrivals of tourists declined by 81% in July and 79% in August, and

\* Corresponding author.

E-mail addresses: [cajueiro@ufpa.br](mailto:cajueiro@ufpa.br) (L.C.C. Pereira), [rosigleyse@ufpa.br](mailto:rosigleyse@ufpa.br) (R.C. Sousa Felix), [beatrizbritodias@gmail.com](mailto:beatrizbritodias@gmail.com) (A.B. Brito Dias), [rumcop19@gmail.com](mailto:rumcop19@gmail.com) (R.M.C. Pessoa), [brenda.ribeirops@gmail.com](mailto:brenda.ribeirops@gmail.com) (B.R.P. da Silva), [baldez@ufpa.br](mailto:baldez@ufpa.br) (C.A. da Costa Baldez), [raucosta@ufpa.br](mailto:raucosta@ufpa.br) (R.M. Costa), [taysousasilva120@gmail.com](mailto:taysousasilva120@gmail.com) (T.S. Silva), [lucianeferreirasilva6@gmail.com](mailto:lucianeferreirasilva6@gmail.com) (L.F. Silva Assis), [jose.jimenez@upc.edu](mailto:jose.jimenez@upc.edu) (J.A. Jimenez).

<https://doi.org/10.1016/j.ocecoaman.2021.105576>

Received 15 November 2020; Received in revised form 14 February 2021; Accepted 17 February 2021

Available online 25 February 2021

0964-5691/© 2021 Elsevier Ltd. All rights reserved.

between January and August, there were 700 million fewer visitors than during the same period in 2019. This led to a loss of US\$730 billion, more than eight times higher than the loss recorded following the economic crisis of 2009 (Gössling et al., 2020).

Tropical countries, such as Brazil, offer ideal climatic conditions for beach tourism throughout most of the year, and this sector is often responsible for a considerable proportion of national revenue (Gössling et al., 2020). Beach tourism in Brazil has been impacted profoundly by the pandemic since March, when the first cases were confirmed in the country (Sukheja, 2020). Unfortunately, Brazil has been one of the countries most affected by the COVID-19 pandemic, with 7,563,551 confirmed cases and 192,681 deaths up to December 31st (WHO, 2020).

In July, when the first signs of a “possible” decline in COVID-19 cases were detected, local authorities in coastal zones, including both state and municipal governments, came under pressure to reopen beaches, although in many cases, even stricter measures to control the disease were implemented (Valente et al., 2020).

The Brazilian Amazon coast is located within the equatorial zone, where beach tourism peaks in July (Pereira et al., 2014; Sousa et al., 2017a). The Brazilian state of Pará is part of this region, and most of its coastal municipalities depend on the tourism sector, in particular beach tourism, which has been the most affected by the COVID-19 pandemic. The local beaches are located within one of the largest continuous tracts of mangrove forest found anywhere in the world (Kjerfve and Lacerda, 1993), which is within or adjacent to many conservation units (Pessoa et al., 2019). In July, the local beaches located within conservation units remained off-limits to beachgoers, with potential visitors being inspected by the local authorities at access points and redirected, as necessary (Limão, 2020). In Pará, a number of state and municipal decrees were implemented for the planning of the re-initiation of activities, with the aim of responding to the economic crisis caused by the pandemic.

Worldwide, the reopening of public access to beaches has been a crucial moment for the strengthening of governance through the promotion of cooperation among local governments, society, and academia (Prideaux et al., 2020). As beaches continue to attract thousands of visitors, even in countries where the number of COVID-19 cases is still increasing, such as Brazil, there is a clear need to evaluate the strategies adopted to guarantee the safety of beachgoers, through the physical distancing of visitors and the management of risk perceptions. In this study, risk perception was used to determine the cognitive (knowledge and the understanding of risks), experiential (personal experience), and social, cultural, and individual factors (including the gender, age, education, and knowledge level of the beachgoer), as suggested by Cori et al. (2020) and Dryhurst et al. (2020).

In the present study, we provide a scientific perspective on the key issues for the management of beach tourism during the pandemic, by analyzing the public health and safety measures adopted by local authorities (through the evaluation of municipal decrees), beachgoer perceptions (using questionnaires), and the reality of recreational activities (by direct observation and photographs) of two popular beaches on the Brazilian Amazon coast during the peak month of July 2020. Based on the data obtained, the present study evaluates whether, and to what extent this planning was safe for local beachgoers, considering public perception in compliance with health safety established by authorities, and suggests management strategies as guidelines for the control of the spread of the virus during the upcoming public holidays, as long as the pandemic lasts.

## 2. Materials and methods

This section includes data on the evolution of the COVID-19 pandemic in the coastal zone of Pará state, the Study area and (iii) the Methodology used in this study.

### 2.1. Evolution of the COVID-19 pandemic in the coastal zone of Pará state

The coastal zone of Pará has five sectors (Pará, 2020b). An overview of the evolution of the COVID-19 pandemic in these five sectors is presented below, based on data recorded according with data obtained from the Oswaldo Cruz Foundation (FIOCRUZ) and the Brazilian Institute of Scientific and Technological Communication and Information on Public Health, ICICT (FIOCRUZ/ICICT, 2020). The seven-day moving averages of daily confirmed new cases and deaths per 100,000 inhabitants - between March 01<sup>st</sup> and October 31<sup>st</sup> 2020 - were shown in [Supplementary Material - S1A-I](#).

#### A) Western Marajó Sector (Sector 1)

The Western Marajó sector includes 11 municipalities (with 422,332 inhabitants, IBGE, 2020), with COVID-19 infections being recorded in nine of these municipalities already in April. The highest number of new daily cases per 100,000 inhabitants was recorded in June (31.39 new cases). In July, the number of daily cases began to decline, but in August new daily peaks were recorded (>20 new cases per 100,000 inhabitants, [Supplementary Material S1A](#)).

#### B) Eastern Marajó Sector (Sector 2)

The Eastern Marajó sector has 124,924 inhabitants (IBGE, 2020) distributed in six municipalities. During the first months of the COVID-19 pandemic, the number of cases recorded daily in these municipalities peaked in July, reaching 36.25 new cases per 100,000 inhabitants, with cases declining between August and October ([Supplementary Material S1B](#)).

#### C) Continental Estuarine Sector (Sector 3)

This sector of the Pará coast comprises 10 municipalities, with 2,337,788 inhabitants, including the metropolitan region of Belém (with 1,499,641 inhabitants, IBGE, 2020), the state capital. Belém had the largest number of COVID-19 cases in Pará, with up to 878 cases being recorded in a single day (34.54 new cases per 100,000 inhabitants), in May ([Supplementary Material S1C](#)). In June and July, the number of cases in this municipality decreased, although there was a slight increase in the first half of August, which may have been related to the reopening of beaches, restaurants, shopping centers, and other services, that had been suspended by state decree number 800, of May 31st, 2020. This decree established the RETOMA PARÁ project to provide a safe economic and social recovery in the state of Pará through the application of social distancing measures and specific protocols for the gradual reopening of economic and social activities.

#### D) Fluvial Maritime Sector (Sector 4)

This sector has a population of 241,537 inhabitants (IBGE, 2020) distributed in 10 municipalities, where the first COVID-19 infections were confirmed in April, with the number of daily cases increasing in subsequent months, peaking at 35.25 new cases per 100,000 inhabitants in June 2020 ([Supplementary Material S1C](#)). A lower daily peak was recorded in August, with 13.01 new cases per 100,000 inhabitants.

#### E) Atlantic Coast Sector (Sector 5)

The Atlantic Coast sector includes the oceanic beaches most visited by tourists in the state of Pará, including the beaches of Atalaia, in the municipality of Salinópolis, and Ajuruteua, in Bragança, which are the focus of the present study. The 10 municipalities of this sector, which have a total of 433,302 inhabitants (IBGE, 2020), reached a peak in the daily number of cases in May and June. Bragança (128,914 inhabitants)

and Salinópolis (40,922 inhabitants) were the municipalities most affected during this period, with respectively daily peaks of 47.83 and 47.76 new cases per 100,000 inhabitants in May (Supplementary Material S1H-I). A lower peak was recorded in Bragança in August (9.09 new cases per 100,000 inhabitants), which may have been related to the reopening of Ajuruteua beach.

## 2.2. Study area

The study area is located on the Amazon coast, at the northeastern extreme of the state of Pará. The coastline of this area is highly irregular and indented, being formed by innumerable islands, bays, and estuaries, located within one of the most extensive continuous tracts of mangrove forest found anywhere in the world (Souza-Filho et al., 2005). This coast has semidiurnal macrotides (4–6 m), moderated wave energy ( $H_s < 2.0$  m during high tides), strong tidal currents (up to 1.5–2.0 m s<sup>-1</sup>), and levels of annual rainfall up to 3,000 mm (Pereira et al., 2013). Its beaches are visited by thousands of tourists during the annual vacation period (July) and bank holidays (Pereira et al., 2016).

The two study beaches, Ajuruteua and Atalaia (Fig. 1), are adjacent to two conservation units, the Caeté-Taperaçu Marine Extractive Reserve (Ajuruteua) and the Atalaia Natural Monument, and are also among the most popular beaches of the whole Amazon coast (Sousa et al., 2011; Pessoa et al., 2019). Both beaches have picturesque natural scenery, which supports a range of recreational activities, such as bathing, walking, surfing, and kiteboarding, and a range of installations for the enjoyment of the local cuisine. These beaches are located in the sector 5 (see 2.1 item), specifically in the Bragança (Ajuruteua) and Salinópolis (Atalaia) municipalities.

Ajuruteua beach is more rural, 2.5 km long and up to 300–350 m wide during the low spring tide, with rudimentary public services and infrastructure (Pereira et al., 2007). Atalaia beach is semi-urban, 12 km long and 300–400 m wide during the low spring tide, and has better infrastructure and services (Pinto et al., 2011). At Atalaia, private vehicles are allowed access to the beach zone, although this has an impact on the recreational carrying capacity of both beaches (Sousa et al., 2011).

## 2.3. Methodology

To identify public perception in compliance with health safety measures established by authorities due to COVID-19 pandemic, both sites were surveyed over the final weekend of July 2020. This period represents the maximal visitation peak on these beaches, because it is the last weekend of the summer school vacation (Sousa et al., 2011). The field surveys were conducted simultaneously on both beaches, and semi-structured questionnaires were applied to 254 beachgoers (131 at Atalaia and 123 at Ajuruteua). The questionnaire was divided into two parts (Part I: beachgoer profile and Part II: opinion and perception), with a total of 19 questions, which are shown in Supplementary Material - S2. The application of these questionnaires was taken in printed format conducted *in loco* by two experts between 8 a.m. and 6 p.m. The interviewees were chosen by random sampling.<sup>1</sup>

Data obtained from the questionnaires were plotted in an electronic spreadsheet to be represented in the Florence Nightingale Graphic<sup>2</sup> and to be used in the software IBM SPSS Statistics v. 25. Normality and homogeneity tests were not applied in this study since the discrete nature of the data could lead to a loss of information between integers and

<sup>1</sup> The interviewers adopted all protective measures suggested by the Center of Disease Control (CDC) guidance.

<sup>2</sup> The Florence Nightingale's graphic is a polar coordinate system, where the radar chart is divided into equal-sized segments that represent each category of the data. Every segment extends from the center in proportion to the value it represents. Thus, larger colored areas represent higher values.

make it difficult to establish a normal distribution (Üçkardeş et al., 2013). Given this, non-parametric tests were performed on the dataset, selected accordingly to the rating scale for each parameter (dependent variable - ordinal or nominal). The Mann-Whitney *U* test was applied at 95% confidence level ( $p < 0.05$ ) to evaluate the ordinal questions (age, education, length of visit and level of knowledge), comparing the answers of the beachgoers from both beaches. In addition, the chi-square test of independence ( $\chi^2$ ) was used to evaluate nominal questions (gender, residence, accommodation, state of infection, recreational place, public health measures, pandemic status, government strategies, commercial establishment, feel protected, self-isolation, respect to measures, prevention measures).

A checklist (Supplementary Material - S3) was applied to determine whether the beachgoers and commercial establishments (bars and restaurants) had adopted adequate sanitary measures to avoid the spread of COVID-19. At both beaches, a series of photographs taken from the same photograph point at different times throughout the day was also used to confirm whether the measures established in the municipal decrees (Supplementary Material - S4A, B) were adopted or not.

## 3. Results

The results are divided into three parts: beachgoer profiles and beachgoer perceptions (both questionnaires), and reality of the study area (direct observations and photographs).

### 3.1. Beachgoer profiles (part I)

There were no significant differences ( $p > 0.05$ ) related to gender, age, education, and status of infection in both beaches (see Table 1). Similar proportions of male (Ajuruteua: 49%; Atalaia: 51%) and female (Ajuruteua: 51%; Atalaia: 49%) beachgoers were recorded in both beaches. The majority of beachgoers on both beaches (Ajuruteua: 45%; Atalaia: 54%) were 21–39 years old, with a large proportion having a high-school (HS) or college/university (UN) degree (Ajuruteua: HS: 53%; UN: 41% and Atalaia: HS: 55%; UN: 34%).

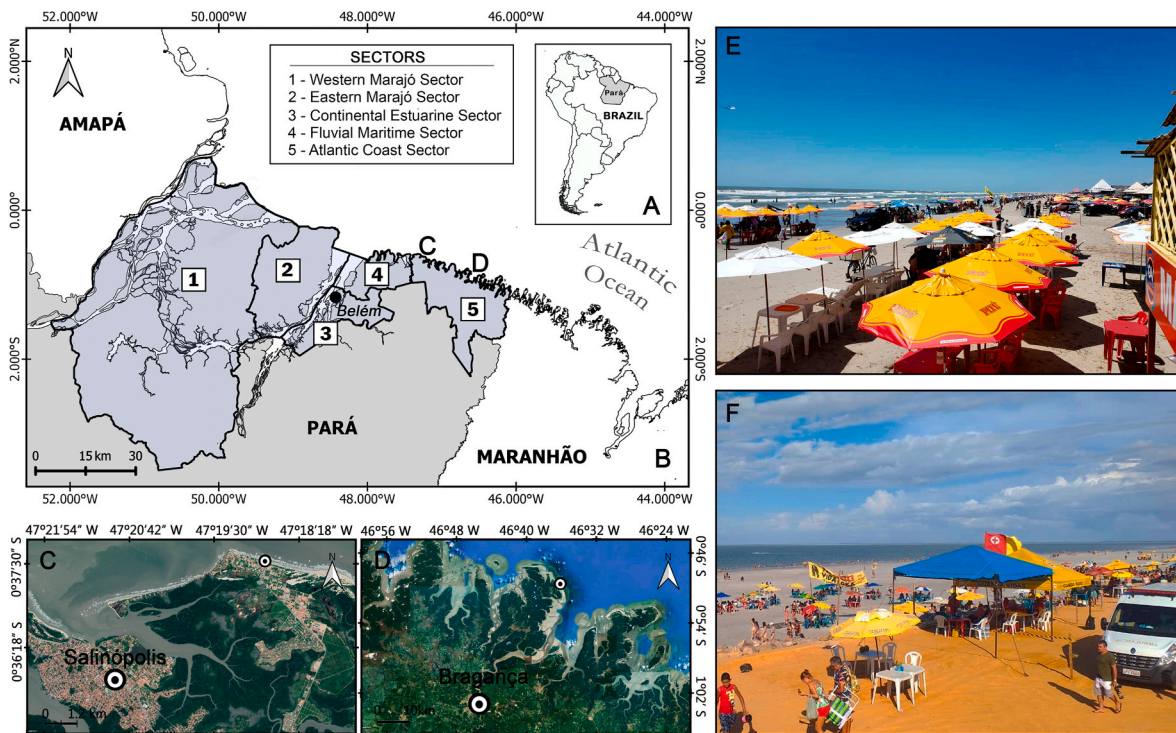
The majority of the beachgoers at Ajuruteua beach were resident in Bragança (35%), Belém (33%) and other 14 municipalities, while those at Atalaia beach were predominantly from Belém (39%) and 34 other municipalities in Pará and other Brazilian states (Fig. 2A–B), showing that Atalaia is more popular than Ajuruteua ( $\chi^2 = 62.206$ ;  $p < 0.05$ , Table 1). The individuals interviewed on both beaches included administrators, lawyers, merchants, businessmen, nurses, students, civil servants, educators, marketing promoters, and other professions.

In general terms, during the interview, the beachgoers selected their respective beaches in search of leisure, tranquility and well-preserved natural environments. At Ajuruteua, beachgoers also reported going to the beach due to a lack of crowds (although agglomerations have been observed in bars when were observed groups of more than 8 persons, see 3.3 item), the desire to take advantage of the day or weekend, and the proximity of the beach to their home (35% of them live in Bragança city, Fig. 2A). At Atalaia, many of the interviewees reported going to the beach to work, as well as for leisure, the enjoyment of the local scenery, and because it is crowded and offers better infrastructure and services than other regional beaches.

At Ajuruteua, a majority of the visitors (43%) returned to their homes every afternoon, whereas at Atalaia, most visitors stayed at hotels (28%) or in the homes of friends or family members (49%) because most of them (93%) live in other municipalities far from Salinópolis ( $\chi^2 = 25.304$ ;  $p < 0.05$ , Table 1; Fig. 2A–B). Given this, the vast majority (86%) of the beachgoers at Ajuruteua stayed at the beach for less than 48 h (returned home each day), while most of those at Atalaia (76%) stayed for more than 48 h ( $U = 12.756$ ;  $p < 0.05$ , Table 1; Fig. 2A–B).

Related to the status of infection, 23% of the interviewees at both beaches confirmed having tested positive for the new coronavirus. For the majority of the beachgoers (Ajuruteua: 91%; Atalaia: 81%), July





**Fig. 1.** Map of South American showing Pará state (A), the five coastal sectors of Pará State (B), the municipalities of Salinópolis (C) and Bragança (D), and the beaches of Atalaia (E) and Ajuruteua (F).

**Table 1**

Significant effects (*p*-values) of beachgoer profiles and beachgoer perceptions, knowledge and personal opinions on choosing one of the two beaches (Ajuruteua or Atalaia) to visit during the COVID-19 pandemic.

Parameters	Chi-square ( $\chi^2$ )	<i>p</i> -values	Mann-Whitney <i>U</i>	<i>p</i> -values
Gender	0.142	<i>p</i> > 0.05	***	***
Age	***	***	7.774	<i>p</i> > 0.05
Education	***	***	7.283	<i>p</i> > 0.05
Residence	62.206	<i>p</i> < 0.05	***	***
Accommodation	25.304	<i>p</i> < 0.05	***	***
Duration of visit	***	***	12.756	<i>p</i> < 0.05
Status of infection	5.595	<i>p</i> > 0.05	***	***
Recreational places	222.544	<i>p</i> < 0.05	***	***
Level of knowledge	***	***	8.500	<i>p</i> > 0.05
Public health measures	25.604	<i>p</i> < 0.05	***	***
Pandemic status	5.032	<i>p</i> > 0.05	***	***
Government strategies	27.113	<i>p</i> < 0.05	***	***
Commercial establishments	22.530	<i>p</i> < 0.05	***	***
Feel protected	5.158	<i>p</i> > 0.05	***	***
Self-isolation	40.631	<i>p</i> < 0.05	***	***
Respect to measures	15.468	<i>p</i> < 0.05	***	***
Prevention measures	23.386	<i>p</i> < 0.05	***	***

\*\*\* Not applicable.

2020 was the first time since the start of the pandemic that they had visited the study beach, but 19% of the interviewees at Atalaia had already visited other beaches ( $\chi^2 = 222.544$ ; *p* < 0.05, Table 1; Fig. 2A–B).

### 3.2. Beachgoer perceptions (part II)

The perceptions of the beachgoers on the COVID-19 pandemic were divided into three principal aspects: i) Levels of knowledge; ii) Opinions on the strategies adopted by the local authorities, and iii) Risk perception.

#### 3.2.1. Level of knowledge

Most of the beachgoers (Ajuruteua: 90%; Atalaia: 85%) commented that they have moderate to sufficient knowledge about the COVID-19 pandemic, with their principal sources of information being the television, radio, and internet. For the majority of the interviewees at Atalaia, the new coronavirus is a highly infectious virus (60%), while at Ajuruteua, only 16% of the interviewees believe that the new coronavirus is highly infectious ( $\chi^2 = 25.604$ ; *p* < 0.05, Table 1; Fig. 2A–B). With respect to their choice of beach, the interviewees were asked whether they had taken public health and safety measures into account, and whether this was a relevant factor. Only 18% of the interviewees at Atalaia and 24% at Ajuruteua responded positively to this question. For all the other beachgoers, the fact that the beach is an open space, together with the initiatives of the local authorities to reopen access to these spaces was sufficient to encourage their visit.

#### 3.2.2. Opinions on the pandemic situation and the strategies adopted by local authorities

Despite no significant differences (*p* > 0.05) considering the following aspect, the perceptions of the beachgoers on the socio-political scenario of the COVID-19 pandemic in Brazil, and specifically in the state of Pará, varied visually between the two study beaches (Fig. 2A–B). The situation at Ajuruteua was evaluated as positive by 37% of the interviewees, whereas at Atalaia, the beachgoers were more negative, classifying the current situation as critical, unstable, uncontrollable, worsening, and with contamination increasing.

At Ajuruteua, 46% of the interviewees believe that the public health and safety strategies adopted by the local authorities were positive, whereas at Atalaia only 21% were of the same opinion ( $\chi^2 = 27.113$ ; *p* < 0.05, Table 1; Fig. 2A–B). When the beachgoers were asked whether they chose the respective beach due to the health and safety measures adopted by the local authorities, such as social distancing, a majority responded positively, given that public transport access to the beaches had been prohibited to avoid crowding. They also responded that the beaches would be safe, as long as social distancing is respected, given

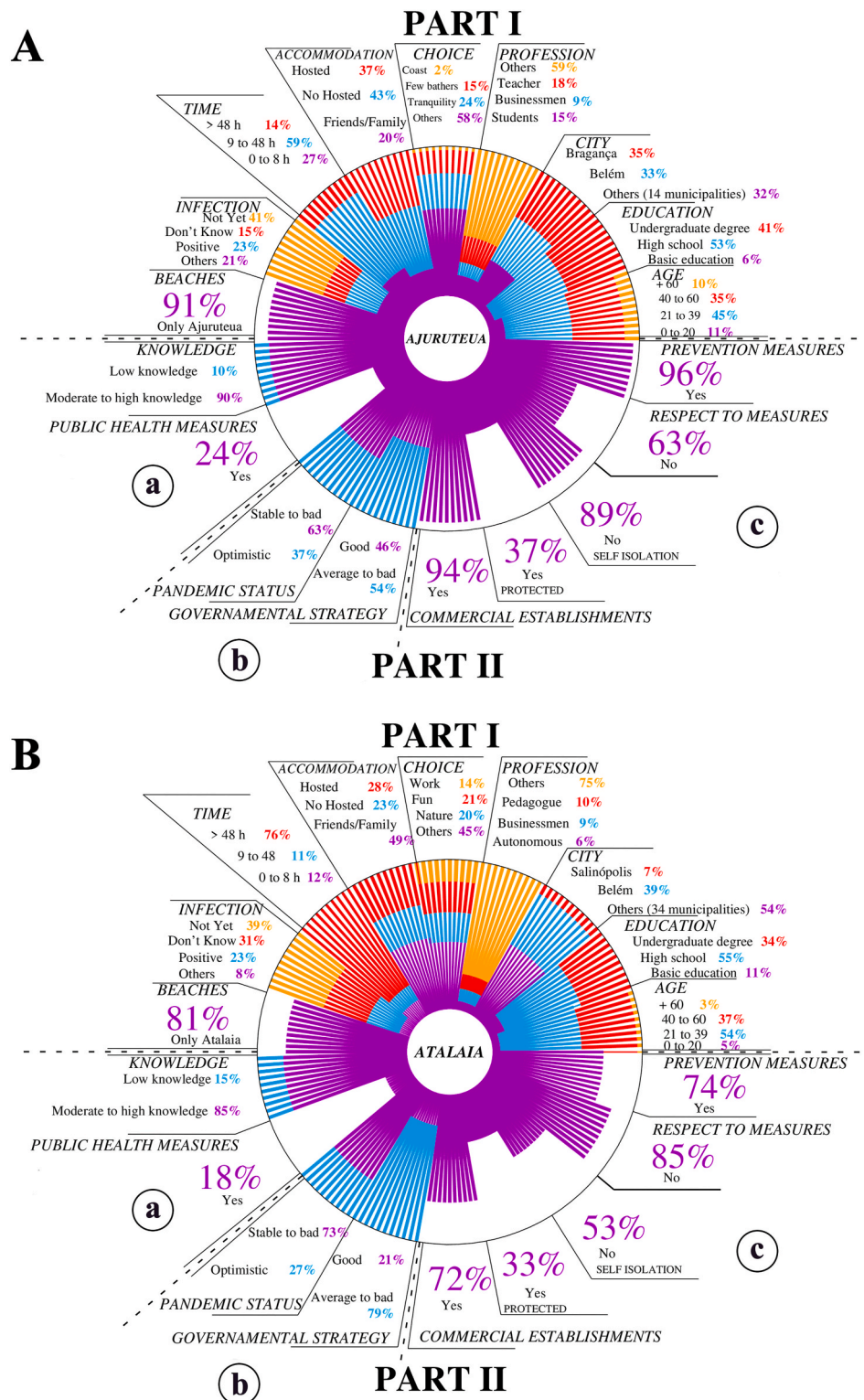


Fig. 2. User profile (Part I) and opinion (a) and perception (b, c) (Part II) of the interviewees in Ajuruteua (A) and Atalaia (B) beaches.

that they are open environments, where the risk of infection is minimal. Many beachgoers commented that it was not the ideal time to relax the quarantine or for the recreational use of the beaches, with the need to maintain the lockdown.

### 3.2.3. Risk perception

A significantly higher ( $\chi^2 = 27.113$ ;  $p < 0.05$ , Table 1) proportion (more than 70%) of the beachgoers interviewed had visited commercial

establishments ( $\chi^2 = 22.530$ ;  $p < 0.05$ , Table 1), although 63% of the interviewees at Ajuruteua and 85% at Atalaia confirmed that the public health and safety measures (the use of face masks, alcohol gel, and social distancing) were not being adopted adequately by these establishments (Fig. 2A–B). More than 60% of the beachgoers at both beaches felt unprotected from the pandemic. At Ajuruteua, beachgoers claimed that “there is no protection anywhere”, given that the virus is everywhere, and visitors are not immune or free from possible contamination.



However, the situation at Ajuruteua appeared to be better than that at Atalaia, where crowding was observed frequently.

Regarding quarantine regulation after the summer school period, the answers varied between the two study beaches ( $\chi^2 = 40.631$ ;  $p < 0.05$ , Table 1; Fig. 2A and B). Curiously, almost all (89%) of the beachgoers at Ajuruteua responded that they would not respect quarantine regulations on returning to their homes. At Atalaia, by contrast, on 53% responded that they would not respect quarantine regulations on their return (Fig. 2B). The interviewees responded that they were unable to respect the isolation period of 10–14 days as they needed to work, although they would continue to adopt the standard safety measures such as the use of face-masks, alcohol gel, and social distancing.

One other interesting point at Ajuruteua was that 63% of the interviewees commented that the other visitors did not respect the sanitary rules. For example, many beachgoers only used masks or alcohol gel when they arrived at the beach, subsequently abandoning these measures. At Atalaia, 85% of the interviewees commented that the other visitors did not respect the sanitary rules, indicating that most of the people on the beach did not use masks and tended to agglomerate in crowds (Table 1, Fig. 2A and B).

The answer about preventive measures varied between the two study beaches ( $\chi^2 = 23.386$ ;  $p < 0.05$ , Table 1). At Ajuruteua, 96% of the interviewees (Fig. 2A) confirmed using preventive measures, such as face-masks, hand-washing, and alcohol gel. At Atalaia, 26% of the interviewees (Fig. 2B) confirmed that they were not adopting preventive measures although the principal measures declared by the interviewees were the use of masks, alcohol gel, and social distancing.

### 3.3. Reality of the study area

The photographs taken during the study period revealed the spatial-temporal distribution of beach usage, with Sunday being the peak day. The largest numbers of beachgoers were observed between 10 a.m. and 4 p.m. (Fig. 3A and B). Atalaia beach (Fig. 3B) was more crowded than Ajuruteua (Fig. 3A), as indicated by the number of beach umbrellas and tables observed within the intertidal zone. Beachgoers were also more widespread at Atalaia beach, where they were distributed throughout the intertidal zone, whereas at Ajuruteua the majority of the beachgoers were distributed in the proximity of the bars and restaurants.

Horizontal occupation patterns were also different between beaches. At Ajuruteua beach, the access of vehicles has been prohibited since 2011 by municipal law (n° 4.148/2011), and the majority of the beachgoers are concentrated near the principal beach access points (Bragança, 2011). At Atalaia, vehicles are allowed on the beach, and this was reflected in a more uniform horizontal occupation pattern in the southeastern sector of the beach. The photographs also revealed a lack of social distancing (1.5 m) among the beachgoers on both beaches.

The results of the checklist indicated that some of the sanitary measures were not respected. The use of PPEs (masks, face shields, gloves, and alcohol gel) was one of the principal measures adopted by the employees of the establishments located on both beaches. In general, however, the beachgoers themselves ignored these measures, mainly in Ajuruteua. In addition, the periodic sanitation of tables and chairs, as established in the municipal decrees (Supplementary Material - S4), was not observed at the local bars and restaurants. Similarly, family groups of more than 10 (Atalaia, decree no. 028/2020) or 8 (Ajuruteua, decree no. 136/2020) beachgoers were recorded both beached, despite being prohibited by the respective municipal decrees.

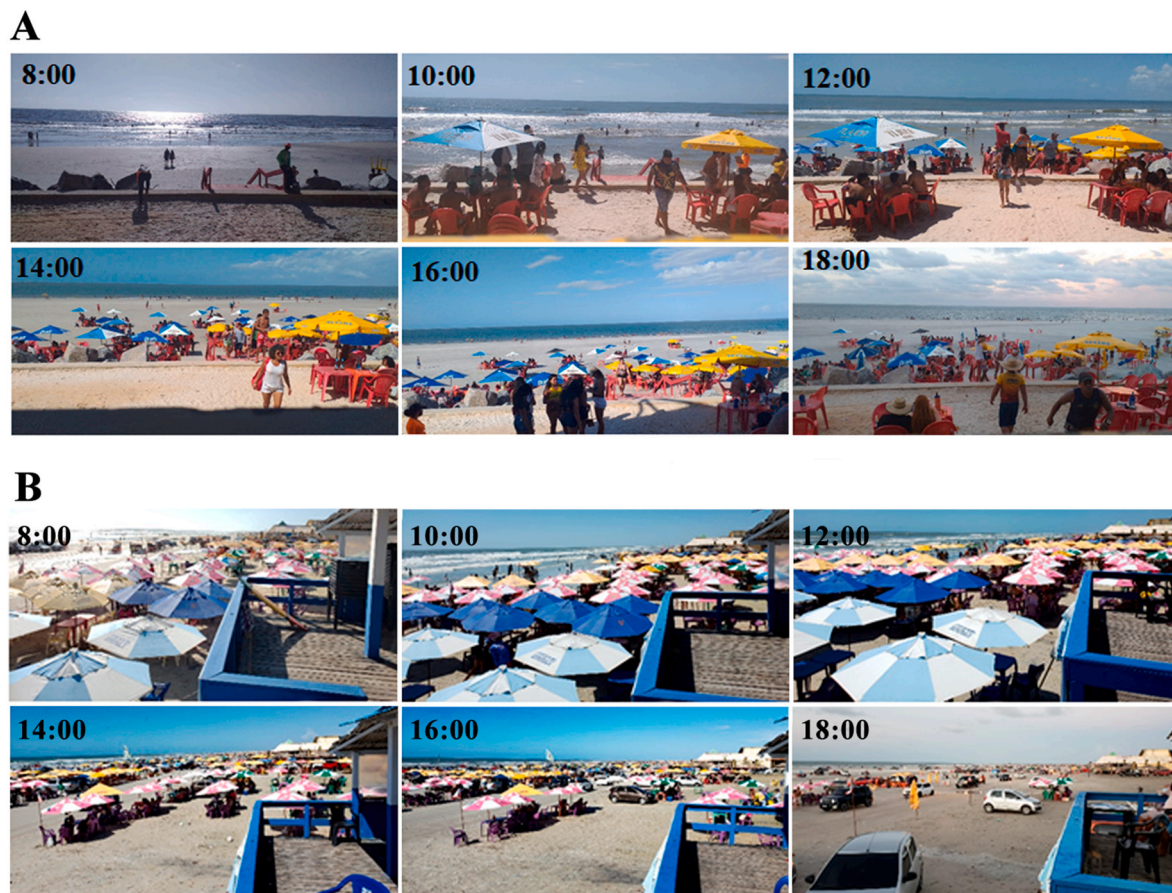


Fig. 3. Photographs taken on the last Sunday of the July 2020, every 2 h, between 8 a.m. and 6 p.m. in Ajuruteua (A) and Atalaia (B) beaches.

#### 4. Discussion

The pandemic COVID-19 in Brazil peaked in May–June 2020, but in July, local governments began to permit the reopening of locations for leisure and tourism, including the study area. Local governments emitted decrees establishing isolation measures to ensure the safety of beachgoers.

At Ajuruteua, decree n° 136/2020 allowed the public access to the beaches as long as health and safety measures were respected by beachgoers including inside public service establishments ([Supplementary Material - S4A](#)). Another safety measure adopted by local authorities was the restriction of access to the beach by public transport. This measure may have contributed in particular to the visitation pattern, where most visitors were day trippers, with a much smaller percentage of non-local residents when July 2020 was compared with the same month in previous years ([Sousa et al., 2011](#); [Pessoa et al., 2019](#)), reflecting the restrictions of the period. Thus, the public transport access to the beaches had been prohibited to avoid crowding.

At Atalaia, the decree No 028/2020 ([Supplementary Material - S4B](#)) also established safety measures, but public transport was permitted contributing to a longer visitation time and a higher percentage of non-local residents compared to Ajuruteua. With respect to other beaches in Pará state, one potentially important measure imposed was the prohibition of recreational activities on the beaches located within Conservation Units, as that of the Pesqueiro. These measures certainly helped to prevent the spreading of the virus in traditional communities located within Conservation Units. Pesqueiro is located in Sector 2, where there were no peaks in new cases and deaths in August ([Supplementary Material - S1A](#)).

Regarding beachgoer' perceptions, the measures adopted by the local authorities for the reopening of the beaches were understood by interviewees as public health and safety initiatives, and one of the reasons cited for the selection of the beaches for recreational activities was the perception that these locations are ample outdoor areas at which the risk of infection was negligible, despite the fact that many of the individuals interviewed did not feel completely safe.

Comparing both study sites, beachgoers at Atalaia were better-informed on the virus, and they respected the public health measures more systematically, whereas beachgoers that did not perceive risks, as observed in the majority of beachgoers at Ajuruteua, were more likely to ignore the preventive measures. The interviewees at Ajuruteua were more positive with respect to the evaluation of the pandemic situation and governmental strategy, but cooperate less with government recommendations to adopt quarantine behaviors or safety measures. Studies of risk perception during the COVID-19 pandemic showed that beachgoers with less knowledge about the virus were the individuals who perceived less risk and who were less likely to adopt preventive behaviors ([Cori et al., 2020](#), [Gerhold, 2020](#) and [Kuper-Smith et al., 2020](#)), cooperating less with government recommendations ([Dryhurst et al., 2020](#); [Bruin and Bennett, 2020](#); [Wise et al., 2020](#)).

In the opinion of the beachgoers, the public health and safety measures adopted by the local authorities were not effective. Given this, it would be necessary to adopt more effective and regulatory strategies to guarantee the safety of beachgoers, including a long-term response to prolonged pandemic, such as that of COVID-19. The principal concern for beach management during a pandemic is the consistency of the data that confirm a positive relationship between risk perception and the likelihood of adopting preventive measures. One of the strategies used in Europe – for example – was to isolate groups of beachgoers from one another, by demarcating specific areas of the beach with ropes or acrylic sheets, and establishing separate booths ([Benaim, 2020](#); [Meisenzahl, 2020](#)), although these measures became ineffective during peak periods, when agglomerations were recorded on many beaches.

In the study area, local governments emitted decrees establishing isolation measures to ensure the safety of beachgoers ([Supplementary Material - S4A, B](#)). One of these measures was to arrange the tables to be

arranged at a distance of 2 m from one another. These spacing were far from the reality observed on the study beaches, in particular at Atalaia, where the intertidal zone was also occupied by vehicles ([Fig. 3](#)). In this context, any management initiative would have to focus on the need to disperse beachgoers over a much wider area of the beach.

Leaflets providing information on the risks of contagion and emergency alerts by cell phone are other measures that could easily be taken by local authorities, as recorded in other beaches worldwide ([Wise et al., 2020](#)). [Palacios and San-Martín \(2020\)](#) showed that the period of social detachment provoked by the current pandemic represented an opportunity for local authorities and (medium and small) entrepreneurs in the tourism sector to join forces to create clean and organized beaches that would guarantee the health and safety of visitors. This could include delivery or takeout food services to reduce the number of beachgoers frequenting bars and restaurants, as also reported by [Wen et al. \(2020\)](#), especially considering that agglomerations of individuals observed in these establishments during the present study, and the fact that many of the interviewees did not feel protected in these environments.

The findings of the present study provided the basis for the formulation of a number of management measures that could be adopted by local authorities responsible for the administration of the beaches of the Amazon coast, in order to limit the spread of the new coronavirus. The management measures are shown in [Table 2](#).

Limiting the spread of the new coronavirus during bank holidays is extremely important, while the pandemic lasts because an increase in COVID-19 cases were recorded in some municipalities in the first half of August 2020 (including Belém and Bragança, [Supplementary Material - S1](#)), which was almost certainly a result of the relaxation of restrictions on social, recreational, and economic activities by the local authorities in July 2020, as shown in [Supplementary Material - S4A,B](#). The number of new cases did not peak in Salinópolis, because 93% of the interviewees came from other cities. As Pará state – which has 8,690,745 inhabitants ([IBGE, 2020](#)) – has been hard-hit by the pandemic with more than 160,000 cases and over 5,300 deaths until June 30th ([Pará, 2020a](#)), prohibitions on recreational beach use should clearly not have been lifted during this period.

In this context, we believe that the adoption of the measures suggested here, based on the results of the present study, would allow local authorities to control the spread of the virus on the beaches of Pará during the upcoming public holidays. These measures consider the typical cultural and social dynamics of the recreational activities on the Amazon coast ([Sousa et al., 2017b](#); [Pessoa et al., 2019](#)).

#### 5. Conclusion

The results of the study indicate that the beachgoers at Atalaia are

**Table 2**

Management measures that could be adopted by the local governmental authorities during the COVID-19 pandemic.

<b>ISOLATION STRATEGIES</b>
- Controls on visitor numbers
- Distancing of tables
- Dispersal of visitors on the beach
- Self-isolation
<b>ECONOMIC STRATEGIES</b>
- Implementation of alternative business strategies for small enterprises
<b>MANAGEMENT STRATEGIES</b>
- Information strategies by the creation of a website to help the public plan their trip and find out what is available before leaving home
- Cellphone alert to provide relevant information to visitors and beachgoers on the risks of the pandemic and protective measures on the beach
- Distribution of leaflets to provide relevant information to visitors and beachgoers on the risks of the pandemic and protective measures on the beach
- Establishment of a beach management council that integrates local stakeholders



better informed on the virus, and that they adopt preventive measures more systematically, whereas at Ajuruteua, the interviewees cooperated less with government recommendations to adopt quarantine behaviors or safety measures. In general, however, beachgoers at both sites presented a low perception of risk. In the opinion of the beachgoers, the health and safety measures adopted by the local authorities are ineffective, given the peak in infections and deaths recorded in some coastal municipalities following the July vacation period, which may be also related to the relaxation of restrictions on other social, recreational, and economic activities. It is thus necessary to implement more effective management strategies and regulatory measures to guarantee the safety of beachgoers including long-term initiatives designed to respond to a prolonged pandemic, such as that of COVID-19. Based on these findings, a number of guidelines are presented here to ensure social distancing and public information, as well as economic and management strategies for the current scenario. These measures should contribute to the prevention of the spread of the virus during the upcoming public holidays, as long as the pandemic continues.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Acknowledgments

This study was financed by CNPq, through a Universal project (431295/2016-6). Pereira LCC (309491/2018-5) and Costa (311782/2017-5) would also like to thank CNPq for research grants. We are also indebted to Stephen Ferrari for his careful revision of the English text.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ocecoaman.2021.105576>.

### References

- Benaim, R.D., 2020. With plexiglass barriers, Santorini hopes and prepares for tourists to return. Available online. <https://weather.com/health/coronavirus/news/2020-05-11-with-plexiglass-barriers-santorini-prepares-for-tourists-to>, accessed 11<sup>th</sup> November 2020.
- Bragança, 2011. Lei Municipal nº 4.148 de 14 de junho de 2011. Proíbe acesso, circulação e permanência de qualquer tipo de veículo automotor de passeio nas áreas de Ajuruteua. Bragança, PA.
- Bruin, W.B., Bennett, D., 2020. Relationships between initial COVID-19 risk perceptions and protective health behaviors: a national survey. *Am. J. Prev. Med.* <https://doi.org/10.1016/j.amepre.2020.05.001>.
- Cori, L., Bianchi, F., Cadum, E., Anthonj, C., 2020. Risk perception and COVID-19, 2020. *Int. J. Environ. Res. Publ. Health* 17 (3114). <https://doi.org/10.3390/ijerph17093114>.
- Dryhurst, S., Schneider, C.R., Kerr, J., Freeman, A.L.J., Recchia, G., van der Bles, A.M., Spiegelhalter, D., van der Linden, S., 2020. Risk perceptions of COVID-19 around the world. *J. Risk Res.* 1–13. <https://doi.org/10.1080/13669877.2020.1758193>.
- FIOCRUZ/ICICT, 2020. MonitoraCovid-19. Rio de Janeiro, 2020. <https://bigdata-covid19.iciet.fiocruz.br/>, accessed 11<sup>th</sup> November 2020.
- Gerhold, L., 2020. COVID-19: Risk Perception and Coping Strategies. <https://doi.org/10.31234/osf.io/xmpk4>. PsyArXiv. March 25.
- Gössling, S., Scott, D., Hall, C.M., 2020. Pandemics, tourism and global change: a rapid assessment of COVID-19. *J. Sustain. Tourism* 29 (1), 1–20. <https://doi.org/10.1080/09669582.2020.1758708>.
- IBGE, 2020. Censo cidades. Available. <https://cidades.ibge.gov.br/brasil/pa/braganca/panorama>. (Accessed 11 November 2020).
- Kjerfve, B., Lacerda, L.D., 1993. Mangroves of Brazil. In: Lacerda, L.D. (Ed.), *Conservation and Sustainable Utilization of Mangrove Forests in Latin America and Africa Regions*. Mangrove Ecosystems Technical Reports, vol. 2. ITTO TS-13, Okinawa, pp. 245–272, 1.
- Kuper-Smith, B., Doppelhofer, L., Oganian, Y., Rosenblau, G., Korn, C., 2020. Optimistic beliefs about the personal impact of COVID-19. *PsyArXiv Prepr.* <https://doi.org/10.31234/osf.io/epcyb>.
- Limão, A.C., 2020. Destino disputado do veraneio no PA, Algodão proíbe entrada de turistas por tempo indeterminado. G1 PA Available. <https://g1.globo.com/pa/p-ara/noticia/2020/06/19/destino-disputado-do-veraneio-no-pa-algodoal-proibe-entrada-de-turistas-por-tempo-indeterminado.ghtml>, accessed 11<sup>th</sup> November 2020.
- Meisenzahl, M., 2020. These plexiglass boxes from an Italian designer might be the way to reopen beaches safely. <https://www.businessinsider.com/plexiglass-beach-isolati-on-boxes-for-coronavirus-reopening-2020-5>, accessed 11<sup>th</sup> November 2020.
- Ormaza-González, F., Castro-Rodas, D., 2020. COVID-19 impacts on beaches and coastal water pollution: management proposals post-pandemic. *Preprints* 2020, 2020060186. <https://doi.org/10.20944/preprints202006.0186.v1>.
- Palacios, M.A., San Martín, T.V., 2020. Cuarentena para las playas ecuatorianas. Una oportunidad de adaptarlas a los nuevos paradigmas post-Covid-19. In: Botero, C.M., Mercadé, S., Cabrera, J.A., Bombana, B. (Eds.), *O turismo de sol e praia no contexto da Covid-19: cenários e recomendações*. Publicação no marco da Rede Ibero-americana de Gestão e Certificação de Praias – PROPLAYAS, pp. 46–49.
- Pará, 2020a. Secretaria de Saúde pública do Governo do Pará. Coronavírus no Pará. Available. <https://www.covid-19.pa.gov.br/#/>, accessed 11<sup>th</sup> November 2020.
- Pará, 2020b. Lei nº 9.064 de 25 de maio de 2020. Institui a Política Estadual de Gerenciamento Costeiro (PEGC/PA) (Belém, PA).
- Pereira, L.C.C., Guimarães, D.O., Costa, R.M., Souza-Filho, P.W.M., 2007. Use and occupation in Bragança Littoral. *Brazilian Amazon. J. Coast. Res.* SI50, 1116–1120.
- Pereira, L.C.C., Oliveira, S.M.O., Costa, R.M., Costa, K.G., Vila-Concejo, A., 2013. What happens on an equatorial beach on the Amazon coastal when La Niña occurs during the rainy season? *Estuar. Coast Shelf Sci.* 135, 116–127.
- Pereira, L.C.C., Vila-Concejo, A., Costa, R.M., Short, A.D., 2014. Managing physical and anthropogenic hazards on macrotidal Amazon beaches. *Ocean Coast. Manag.* 96, 149–162.
- Pereira, L.C.C., Vila-Concejo, A., Short, A.D., 2016. Coastal morphodynamic processes on the macro-tidal beaches of Pará state under tidally-modulated wave conditions. In: Short, A.D., Klein, A.H.F., Org (Eds.), *Brazilian Beach Systems*. Springer, Switzerland, pp. 95–124.
- Pessoa, R.M.C., Jiménez, J.A., Costa, R.M., Pereira, L.C.C., 2019. Federal conservation units in the Brazilian Amazon coastal zone: an adequate approach to control recreational activities? *Ocean Coast. Manag.* 178, 1–10.
- Pinto, K.S.T., Pereira, L.C.C., Vila-Concejo, A., Gorayeb, A., Sousa, R.C., Costa, R.M., 2011. Effects of the lack of coastal planning on water quality and land use on a macrotidal beach (Atalaia, Pará) in the Amazon region. *J. Coast. Res.* SI64, 1401–1405.
- Prideaux, B., Thompson, M., Pabel, A., 2020. Lessons from COVID-19 can prepare global tourism for the economic transformation needed to combat climate change. *Tourism Geogr.* 22, 667–678. <https://doi.org/10.1080/14616688.2020.1762117>.
- Sousa, R.C., Pereira, L.C.C., Costa, R.M., Jiménez, J.A., 2017b. Management of estuarine beaches on the Amazon coast through the application of recreational carrying capacity indices. *Tourism Manag.* 59, 216–225.
- Sousa, R.C., Pereira, L.C.C., Silva, N.I.S., Oliveira, S.M.O., Pinto, K.S.T., Costa, R.M., 2011. Recreational carrying capacity of three Amazon macrotidal beaches during the peak vacation season. *J. Coast. Res.* SI64, 1292–1296.
- Sousa, R.C., Pereira, L.C.C., Trindade, W.N., Souza, I.P., Jiménez, J.A., 2017a. Application of the DPSIR framework to the evaluation of the recreational and environmental conditions on estuarine beaches of the Amazon coast. *Ocean Coast. Manag.* 149, 96–106.
- Souza-Filho, P.W.M., Paradella, W.R., Silveira, O.F.M., 2005. Coastal observing system and the role of the remote sensors in the Northern Brazilian coast monitoring. *Amazon. Revista Brasileira de Cartografia* 57 (2), 79–86.
- Sukheja, B., 2020. Brazil's health ministry revise date of first coronavirus death to March 12. <https://www.republicworld.com/world-news/south-america/brazil-revise-date-of-first-coronavirus-death-to-march-12.html>, accessed 11<sup>th</sup> November 2020.
- Üçkardeş, F., Aslan, E., Küçükönder, H.A., 2013. Fast approach to select the appropriate test statistics. *Academic Journal of Agriculture* 2 (1), 55–61.
- UNWTO, 2020. New data shows impact of COVID-19 on tourism as UNWTO calls for responsible restart of the sector. <https://www.unwto.org/news/new-data-shows-impact-of-covid-19-on-tourism>, accessed 11<sup>th</sup> November 2020.
- Valente, J., Souza, L., Tokarnia, M., 2020. Saiba como cada estado está retomando as atividades econômicas no país. <https://agenciabrasil.ebc.com.br/saude/noticia/2020-06/saiba-como-estados-brasileiros-est%C3%A3o-retomando-a-atividade-economica>, accessed 11<sup>th</sup> Nov 2020.
- Wen, J., Wang, W., Kozak, M., Liu, X., Hou, H., 2020. Many brains are better than one: the importance of interdisciplinary studies on COVID-19 in and beyond tourism. *Tour. Recreat. Res.* 2020, 1–4. <https://doi.org/10.1080/02508281.2020.1761120>.
- WHO, 2020. WHO coronavirus disease (COVID-19) dashboard. <https://covid19.who.int/>, accessed 11<sup>th</sup> November 2020.
- Wise, T., Zbozinek, T., Michelini, G., Hagan, C.C., Mobbs, D., 2020. Changes in risk perception and protective behavior during the first week of the COVID-19 pandemic in the United States. *PsyArXiv Prepr.* <https://royalsocietypublishing.org/doi/10.1098/rsos.200742>.
- Zielinski, S., Botero, C.M., 2020. Beach tourism in times of COVID-19 pandemic: critical issues, knowledge Gaps and research opportunities. *International Journal of Environmental Research and Public Health Int. J. Environ. Res. Public Health* 2020 (17), 7288. <https://doi.org/10.3390/ijerph17197288>.