



Covid-19 and *Sargassum* blooms: impacts and social issues in a mass tourism destination (Mexican Caribbean)

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Abstract

When the COVID-19 pandemic reached the Mexican Caribbean in late March 2020, this world-renown tourist destination had already been struggling with *Sargassum* influxes for 5 years. The nature and magnitude of these two impacts are not directly comparable, but both have contributed to profoundly transforming the region. As extreme COVID-19 containment measures were implemented nationwide, the tourism industry contracted by 98% as over 23 million visitors failed to arrive in 2020 and 400 daily flights stopped landing at Cancun Airport. *Sargassum* accumulations on Caribbean beaches, and their collection, containment and removal had been a challenging socioeconomic issue in the Caribbean region years before the COVID-19 pandemic shut down the tourist industry. We explore Beck's concept of a risk society as an approach to these socioenvironmental impacts. We analyze five premises about risk society, combining them with a mainly ethnography methodology involving 61 informants. We present the results in terms of impacts. Using the concept of trajectory based on pandemic event chronology, we review the main stages of the pandemic during the research period (May to July 2020) and how the studied population worked to prevent virus infection and spread. We employ narratives to analyze risk perception both of the *Sargassum* influx and the pandemic. The discussion highlights the importance of moving beyond nature/society dichotomies and dualisms. In summary, the profound transformations caused by these impacts provide a unique opportunity for the Mexican Caribbean to reconstitute itself in a way that encompasses the world risk society concept, perhaps in a more socially and environmentally resilient incarnation.

Keywords COVID-19 · Caribbean · Tourism · *Sargassum* · Risk · Uncertainty

Introduction

In coastal marine ecosystems, pollution, eutrophication, coastal urbanization, conflicts for space and accelerated privatization of natural resources are exacerbating socioenvironmental vulnerability and risks (Barragán 2012; Ruiz et al. 2019). This urbanizing anthropogenic pressure increases coast and shore exposure to storms, hurricanes and red tides; it may even influence the frequency of massive algal blooms.

Species of the genus *Sargassum* constitute some of the primary macroalgae found in the tropical Atlantic. Two of the most widely known species are the holopelagic *Sargassum fluitans* and *Sargassum natans*, both commonly found in the Sargasso Sea in the North Atlantic. Since 2011, these and other *Sargassum* species have formed part of massive algal blooms that have affected areas far from the Sargasso Sea and have recently formed a new *Sargassum* accumulation zone in the South Atlantic; the causes behind these blooms remain unclear (Renn 2008; Gaille 2018; Chavez et al 2020). In the Caribbean Sea, these blooms have caused enormous beach cast events throughout the region at scales far beyond any events in social memory. Even prior to these events, *Sargassum* formed part of the common lingo for marine trash or solid waste driven by currents and wind. It is now classified as an invasive and destructive marine plant since it has become an ongoing nightmare for tourism throughout the Caribbean Basin (UNEP 2018).

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To date, the most alarming *Sargassum* influxes in the Mexican Caribbean have occurred between March and September in 2015, 2018 and 2019, although it is difficult to quantify their magnitudes (Robertson et al. 2015; Senado de la República Comisión de Ciencia y Tecnología 2019). It has become an ongoing phenomenon largely affecting tourist activities and dependent businesses and workers. The accumulation of enormous quantities of *Sargassum* on beaches and in bays and reefs has ecological, economic and organizational impacts. Managing accumulated *Sargassum* casts on tourist beaches has also become a major social and financial challenge. They are particularly difficult to manage because the factors driving this over-proliferation of *Sargassum* are multiple and respond to marine wind patterns, currents, cloud cover and atmospheric pressure, all of which are dynamic and none of which are limited by national boundaries. Researchers are still very much unsure as to what is causing the blooms (Israel et al. 2010; Dreckmann and Senties 2013; Djakouré et al. 2017; Hu et al. 2015), and these uncertainties form part of the world risk society and modern reflexivity (Beck 2009).

Manifold theories have been proposed to explain the blooms' causes, ranging from marine pollution, hydrocarbon spills, agroindustry use of pesticides and herbicides, and mining in large river basins such as the Amazon, Orinoco and Congo, among other causes. There is a possible relationship between bloom occurrence and the massive movement of nutrients (minerals, nitrogen, phosphates, etc.) from land masses into the South Atlantic (Wang et al. 2019). Blooms in the Caribbean Sea may also be caused by sand dust from the Sahara Desert blown into the South Atlantic in combination with climate change impacts (Martin 2016; Chavez et al. 2020). Oils spills, such as the Deepwater Horizon event in 2010, may also play a role (Powers et al. 2013). Marine winds and currents then move the resulting *Sargassum* floating mats until they wash up on coasts (Hinds et al. 2016; Djakouré et al. 2017). Satellite monitoring systems can accurately predict their movements and provide early warning of the arrival of *Sargassum* floating mats (Chavez et al. 2020). This does not, however, reduce the challenge to national governments of containing and managing them (Adet et al. 2017). Their sheer scale makes collection on the open sea a daunting socio-technological and socioecological venture, especially when considering the potential effects on marine trophic chains, and consequently on marine ecosystems and habitat equilibrium.

The social reality of the blooms is manifest most clearly on coasts in the form of local and regional economic impacts (Adet et al. 2017; Djakouré et al. 2017; Torres 2019), as well as health impacts from the chemical composition and heavy metal content of this biomass (Chavez et al. 2020). Very limited research has been done on the effects coastal *Sargassum* accumulation has on economies and human

health, emphasizing the need for long-term, multidisciplinary studies.

The *Sargassum* blooms in the Caribbean Sea during the previous decade have highlighted the brief history of a world-renowned tourist brand: the Mexican Caribbean. Stretching along the eastern coast of the Yucatan Peninsula, completely within the state of Quintana Roo, this region provides 9% of Mexico's gross domestic product and is home to a series of major tourist destinations. Primary among them is the world's single largest tourist attraction, the city of Cancun. What began in 1972 as a small fishing village with barely 100 inhabitants has become a city of over 850,000 inhabitants providing services to a tourist industry centered around over 38,000 hotel rooms, mostly along the Cancun coast (SEDETUR 2018). The 25-km-long coastal area known as the Cancun Hotel Zone contains approximately 200 Great Class and five-star hotels with a low-season (April–June, September–November) occupancy rate of about 60% and a high-season (December–March) rate of about 87% (SEDETUR 2018).

South of Cancun is the region known as the Riviera Maya, which stretches along 120 km of coast. In 1984, the region had a population of 500 inhabitants, mostly fishermen. In 2019, its 600,000 inhabitants service the visitors to approximately 44,881 hotel rooms (SEDETUR 2019). The principal cities in the region are Playa del Carmen and Tulum. The former has the highest population growth in Mexico through immigration from around the world. Tulum has 2530 hotel rooms in the city itself, and hundreds more in the multiple hotels lining the coast to the north and south (SEDETUR 2019). Not as populated as other areas in Quintana Roo, Tulum has struggled to maintain a growth model focused on low impact tourism, but appears to be doomed to the fate of Playa del Carmen. For example, the iconic Tulum archeological site, with ancient Maya temples poised on cliffs above turquoise waves, receives one million visitors annually, a figure that took the famous Chichen Itza archeological site in neighboring Yucatan over 20 years to attain (INAH 2012).

Usage pressure on the public and private beaches along the Caribbean coast of Mexico is immense and constant. Very few places along Quintana Roo's northern and central beaches are free of massive tourism use. For example, the hundreds of thousands of people who live in the state's cities and towns (most of whom are directly or indirectly involved in the tourism) only have access to 35 beaches along the 200-km section of coast which has the highest per person daily tourist spending (US \$164/day) (SEDETUR 2019). In other words, even the few areas not subject to mass tourism experience local tourism, applying yet more pressure to coastal resources.

This economic powerhouse of leisure tourism came to an abrupt halt on March 23rd, 2020, the day the SARS-COV2

(COVID-19) pandemic was officially acknowledged, and preventative measures begun in Quintana Roo. For all social actors on the coast, the resulting social drama has exceeded the impacts of hurricanes, tropical storms and even the H1N1 influenza epidemic in 2009. The precautionary measures recommended by the World Health Organization (WHO), and implemented by federal and state governments, in response to the global health risk of COVID-19 succeeded in paralyzing a booming regional economy and isolating millions of people in long-term lockdown. The effects rippled outward from Quintana Roo, crippling national and international businesses (golf clubs, marinas, car rental, equipment rental, realtors, restaurants and hotels) and plunging millions of people into financial crisis. When the COVID-19 pandemic first hit the Mexican Caribbean in March 2020, tourism activity plummeted 97%; of 2.8 million expected visitors only 86,000 arrived (Forbes LATAM Real Estate 2020). Just during the 2-week Easter Vacation in 2020 COVID-19-related financial losses exceeded USD 1 billion. Millions of people stopped working, among them approximately 6000 commercial fishers. International markets closed borders, and fish and shellfish had no access to markets. Prices consequently plummeted, and capture and processing focused on fisheries such as groupers, live lobster (*Panalirus argus*) and octopus (*Octopus maya*) halted completely as Europe and China stopped importing (SAGARPA, 2020). Activity in the sector stopped for 3 months and reactivated slowly beginning June 1st, although there were still no buyers or consumers due to social confinement measures.

The situation generates myriad questions, including What social impacts have *Sargassum* blooms had in the Mexican Caribbean? How has COVID-19 affected the region in conjunction with the blooms? Is there a theoretical tool to help us in interpreting empirical results generated by these questions? The present study is an exploratory qualitative study aimed at understanding the social repercussions of *Sargassum* influx in the Mexican Caribbean in tandem with the unprecedented COVID-19 pandemic. The article is divided into five sections. The first is a theoretical debate based on Beck (2009) that synthesizes five premises on the concept of world risk society (Beck 2009). Beck offers an opportunity to rethink and rewrite reflexive modernity, marking a distance from the conventional notion of industrial modernity. In his famous quote, "...the more we try to colonize the future with the risk category the more it escapes our control" (Beck 2009: 221), he uses the concept of manufactured risks and underlying anxieties. He poses the risk society in the context of a "glocal" perspective (Robertson 1992). The second section focuses on materials and methods. The third explains the results of a questionnaire applied to tourist industry workers during a portion of the COVID-19 lockdown (May to July 2020) and includes narratives from the interviewees about their experiences with COVID-19 and

the *Sargassum* influx on tourist beaches, their main work scenario. The fourth section is a general discussion considering Beck's five premises, which recognizes the concept of glocal risks but cautiously applies it to future epistemologies and the nature/society dichotomy. Finally, the fifth section presents conclusions and invites a reframing of the Mexican Caribbean as a tourist destination.

The world risk society in reflexive modernity: a general approach to understanding and overcoming dual impacts

Innumerable are the critical positions developed by social scientists to address risk and disasters in society. Beck's 1999 *World Risk Society* is widely recognized as the advent of a deeply influential approach in the social sciences (Burgess et al. 2018). The Mexican Caribbean under the two recent impacts of *Sargassum* influxes and the COVID-19 pandemic fits well into Beck's world risk society concept (Beck 2009) because both are unfolding on regional, national and global scales, and, in the case of COVID-19, it is a reality still under social construction both regionally and nationally. The risk society concept is now used by social scientists to explain the consequences of modernity. According to Beck, we need to rewrite, redefine and reinvent the script of modernity (hence the world risk society concept) rather than refuting its presence or evading it by affixing "post" to the great historical, theoretical and epistemological narratives. In other words, we need a new sociological imagination to address social conditions and transformations (economic, ecological, political, cultural, etc.) in response to new events like the COVID-19 pandemic and the appearance of *Sargassum* blooms as a major element of marine pollution.

Beck (2009) treats the world risk society as the second (reflexive) modernity, a way of distinguishing it from the first (industrial) modernity, even though the consequences and impacts of industrial society are still both manifest and latent. For the purpose of this exploratory study, we adopt five of Beck's premises which guided our approach to the socioenvironmental impacts of Covid-19 and *Sargassum* blooms: (1) Neither destruction nor confidence/security, rather, real virtuality; (2) Control and a lack thereof as expressed in fabricated uncertainty; (3) Simultaneous global and local reconstitution, as in risk "glocality"; (4) Distinction between knowledge, latent impact and symptomatic consequences; and (5) Hybrid, human-made world in which the nature/culture duality has been lost (Beck 2009: 233).

Some of these premises were generated during epistemological engagements between Beck and other sociologists within the modernity-postmodernity debate. For example, the second contrasts the control society vs. Foucault's (1982)

perspective and incorporates the debate of Giddens with the concept of fabricated uncertainties (Giddens 1990). It is also involves fabricated uncertainty as a double reference; for example, as science opens ever more spheres of action it also creates new kinds of risks (e.g. collecting *Sargassum* on the open sea, new Coronavirus strains). The third uses Robertson's idea of risk glocality in a global culture (Robertson 1992). Each of Beck's proposed premises helps to understand the concept of risk and uncertainty. For him, risk characterizes a peculiar intermediate state between security and destruction in which the perception of the risks that threaten us determines our thinking and action (premise one).

The sociology of risk is a science of potentialities and probability judgments. Therefore, the risks “are” a kind of virtual reality, a real virtuality: “...just thinking of the risk in terms of reality or, better even, as something that will become real (a virtuality) can be understood as a social materialization” (Beck 2009: 215). Beck's position is based on the apparent incompatibility between Van Loon's constructionism and realism: “...Just by thinking of risk in terms of a construction we can understand its undefinable ‘essence’. Risks cannot be understood outside of their concrete mediations, be they scientific, political, economic or popular” (Van Loon in Beck 2009: 215).

As the concept of risks becomes an all-encompassing context with which to perceive the world it provokes alarm that creates an atmosphere of impotence and paralysis. Doing nothing and demanding too many transformations have pushed the world into a series of indomitable risks (e.g. uncontrollable *Sargassum*). The concept of indomitable risks is associated with premise three (glocality of risks) in that they ignore physical borders and are universalized like air, wind, water and food chains. This concept underlies the worldwide ecology movement and drives discussion of global risks (sea level rise, biodiversity loss, anthropogenic climate change). As a result, says Beck, these risks have created a world in which the foundations of the established logic of risks are undermined and invalidated because there are now only difficult-to-control risks rather than calculable risks. In the world risk society, the logic of control collapses from within, and therefore it is a (latent) political society (the prevention and control of biodiversity loss, prevention and control of coronaviruses, and so on).

The world risk society concept is pertinent in a world where the clear distinction between nature and culture is lost: “Nature is ineluctably polluted by human activity. Confronted with this threat, people experience that plants breathe and that they live from water, just like fish that live in water” (Beck 2009: 230). This quote illustrates premise five and highlights the fact that these risks are hybrids created by humans because they include and combine the political and ethical, mathematics, mass media, technologies, and cultural definitions and perceptions. Most important of all,

if the intent is to understand the cultural dynamic in various disciplines these aspects and realities cannot be separated since this is the way the “hybrid society” observes, describes and criticizes its own hybrid nature. This is how modernity becomes reflexive, in other words, it is how society worries about its undesired consequences, about risks and their implications for its foundations.

Materials and methods

Study area

The portion of the Yucatan Peninsula in Mexico covers approximately 181,000 km² and is inhabited by about 5,107,261 people (INEGI 2020). Located in Mesoamerica, the Peninsula separates the Gulf of Mexico from the Caribbean Sea. The 1633 km of coastline in Mexico account for 14.4% of its coastline. A little over half (860 km) of this coastline is on the Caribbean Sea and completely within the state of Quintana Roo (Fig. 1).

The study area included five areas within Quintana Roo: Riviera Maya, Cancun, Isla Mujeres, Holbox Island and Cozumel Island. Almost two million people live in the area, but every year over 23 million tourists arrive by air and 8 million more on cruise ships (Carnival, Norwegian Cruises, MSC and Royal Caribbean). In 2019, the sun/sand/sea tourism prevalent in the region generated USD 23.6 billion and was supported by an infrastructure including at least 107,000 hotel rooms (SEDETUR 2019). After oil, mass tourism was the second most important economic contribution to Mexico's economy. In 2019, Mexico was classified as the sixth largest tourist destination worldwide, the fifteenth most attractive for foreign business and forty-fifth in terms of tourist spending or overnight spending (SECTUR 2018; SEDETUR 2019).

Figures available at the time of writing showed worldwide tourism industry losses caused by COVID-19 to have reached USD 4.3 trillion (UNCTAD 2021), and it is probable this will double in 2021–2022. Long-term industry prospects will depend on the effectiveness and availability of vaccines, and the virus's evolution. Until the pandemic is controlled, mass tourism destinations like the Mexican Caribbean can only hope to survive by taking measures such as redefining themselves over the short-term as biosecure destinations.

Research design

Social analyses were done of data collected via questionnaires. The questionnaires contained eighteen items addressing COVID-19 and its effects on informants, and twenty-two items addressing the *Sargassum* theme. Informants were

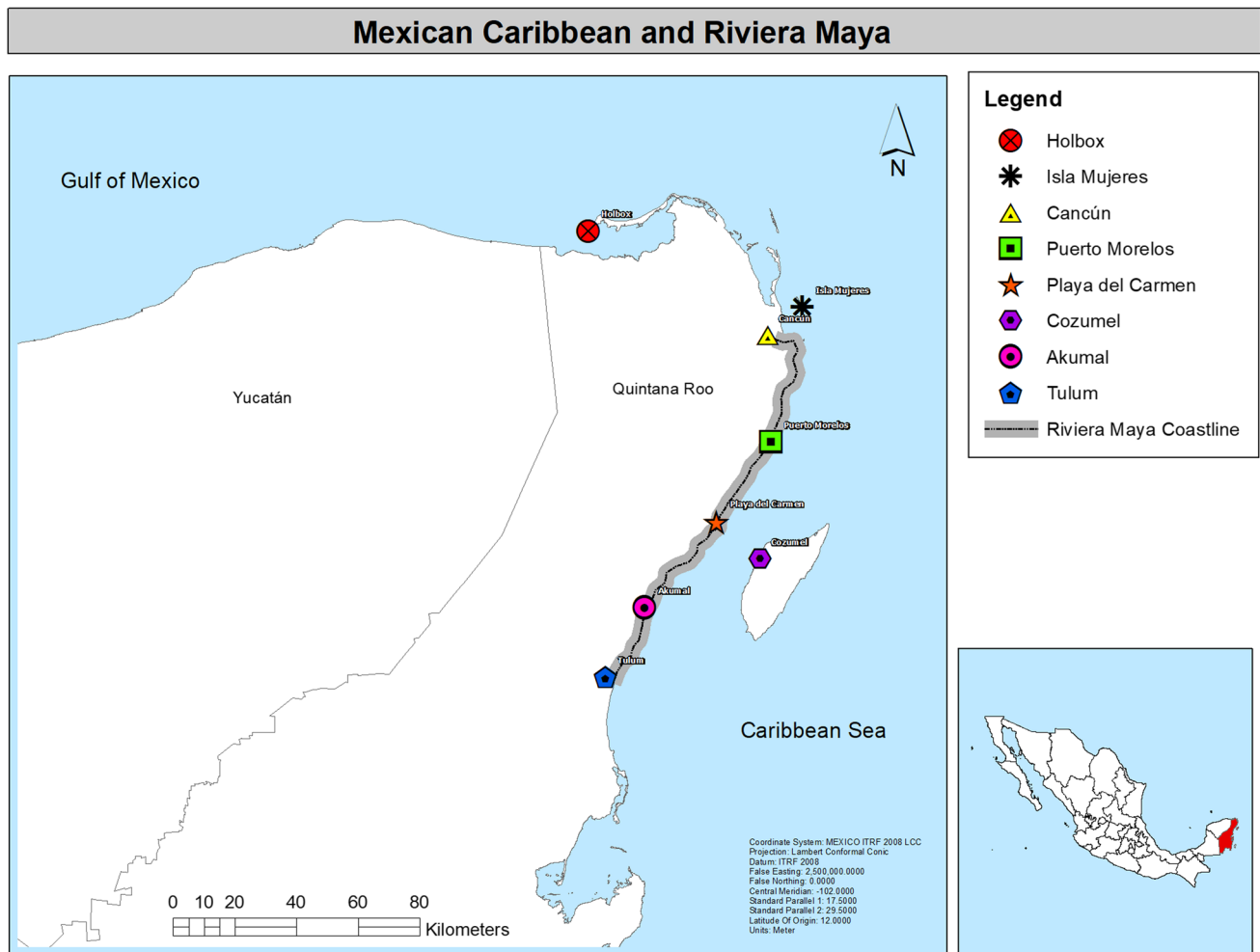


Fig. 1 Study area in state of Quintana Roo, Mexican Caribbean; beach-cast *Sargassum* at tourist beaches in Riviera Maya. Source: Elaborated by Adriana Ortiz Servin, March, 2022

selected based on their tourism-related activities (maids, cooks, waiters, receptionists, maintenance, fishers, nature guides, reef tour sales, taxi drivers, supervisors, therapists, food and beverage managers, laundry and small business owners) and place of residence (considering *Sargassum* beach casts and the COVID-19 quarantine) (Table 1). A non-random, convenience or non-probabilistic, sampling technique was applied considering ease of access to the informant and her/his openness to express their habits, opinions and point of view (Saldaña 2013). A total of 61 informants were interviewed via digital media (mainly WhatsApp®) from May to July 2020, during the COVID-19 lockdown in Quintana Roo. Responses were precodified, and the data entered into spreadsheets for descriptive analysis (Microsoft Excel®). The ethnography technique was crucial to maintaining the study under the umbrella of Beck’s approach, in that it kept it from being merely a description of the “context” of or “about” (Hampshire et al. 2014) the socio-environmental impacts in question, or just talking to people

with sensitive issues. In our ethnography when the people expressed the sentiments, perception or situations directly related from the crisis of pandemic and *Sargassum* blooms, we use false names, just to provide a sense of gender of our informants. Using ethnography allows the study to move beyond nature/society dichotomies and dualisms.

Results

The results are presented in terms of impacts in two dimensions: institutional and principal stakeholders (i.e. tourism workers). In the institutional dimension, we employed the trajectory concept, based on the regional pandemic event chronology. Using secondary sources, we present the main stages of the COVID-19 pandemic in Mexico during the study period (May to July 2020) and how the population responded to prevent virus infection and spread. In the principal stakeholders dimension, we used narrative as the

Table 1 Sociodemographic indicators of interviewers of Mexican Caribbean. Source: Questionnaires applied from May to July 2020

Variab/indicators	Percentage
Gender	
Male	62.3
Female	37.7
Civil status	
Married	50.9
Unmarried	49.1
Age range	
19–35	47.1
36–55	37.7
56+	15.0
Education level	
High school	50.9
University	39.6
Graduate school	11.3
Place of origin	
Rural Yucatan	77.3
Cities in Quintana Roo	13.2
Other states of Mexico	9.4
Current place of residence	
Cancún	32.0
Riviera Maya	47.1
Maya Zone	9.4
Maya Coast	11.2
Years in tourism industry	
1–5	52.8
6–10	24.5
10–20	13.2
21+	9.4
Return to same job post-quarantine	
Yes	77.4
No	22.6

primary information source, as a resource to analyze risk perception of both the *Sargassum* influx and the pandemic.

COVID-19 pandemic trajectory: the institutional dimension of risk society in Mexico (premises one and two)

On March 31st, 2020, 1 month after announcing that Mexico was in Phase 1 of COVID-19 containment, the federal government of Mexico declared a “National Health Emergency” in response to COVID-19. The first confirmed COVID-19 case in Mexico was identified on March 9th, with the infected person dying on March 18th due to diabetes-related complications. By April 1st, Mexico had entered Phase 3, with 1215 people confirmed infected

with COVID-19, and 29 COVID-19-related deaths; at this time, Mexico was ranked 45th in terms of number of infections worldwide. By May 1st, it ranked 23rd worldwide and had 1859 reported deaths. Despite increasing infection and mortality rates (93,435 cases, 10,167 deaths), on June 1st, the federal government decreed that essential economic activities (41 activities from all sectors) could resume, with clear exceptions for the educational, sports, religious and recreational-cultural sectors. Ten days before, the federal government had designed preparatory measures and published “Specific Technical Guidelines for Reopening of Economic Activities”, which also took effect on June 1st. Between June and August 2020, “stay-at-home” public health policies were implemented, and the population was exhorted to adopt basic precautions such as wearing masks, regularly washing hands, social distancing and avoiding crowded places, among others. These were implemented for all business sizes (micro, small, medium and large) and sectors, and included teaching and learning centers of all educational levels, leisure and recreation areas, beaches, museums and cultural centers, among many others. This situation was popularly deemed the “new normal”, and by this point the country had been “locked down” for 71 days (the present study period).

The “new normal” constituted a new social, labor, educational, cultural and economic stage for Mexico, with new COVID-19 containment and monitoring measures. The Federal Ministry of Health implemented an “Epidemiological Risk Traffic Light” system to be updated weekly and divided into Northern, Central and Southern Mexico. As of August 30th, 2020, all of the 32 states in Mexico were classified as high-risk (orange) or medium-risk (yellow), with none at low-risk (green). Both infection and mortality rates were expected to increase in the coming months.

At this point (August 30th, 2020), Mexico had 595,841 confirmed cases and 64,158 reported deaths, the second highest rates in Latin America, after Brazil. The virus was present throughout Mexico, and the seventeen coastal states were on full contagion alert from April to mid-August. Most (64%) confirmed deaths at this time had been men, and the average age of those who died was 63 years (Secretaría de Salud, Dirección General de Epidemiología 2020). The scenario was equally grim on the Yucatan Peninsula with just over 3000 COVID-19-related deaths in the three states on the Peninsula as of August 24th, 2020: in Quintana Roo, there were 9806 confirmed cases and 1312 deaths; in Yucatan there were 13,596 confirmed cases and 1229 deaths; and in Campeche there were 5351 confirmed cases and 727 deaths (Secretaría de Salud, Dirección General de Epidemiología 2020).

Stakeholder perspective of COVID-19 impact: simultaneous global and local reconstitution, the “glocality” risk (premise three)

From March to June 2020, during a 71-day lockdown, the Mexican Caribbean experienced the most severe economic paralysis of its short history as a tourist destination, with profound regional and national impacts. “Drastic” was the most common adjective used by informants when asked how the pandemic had affected them and what their greatest fear was at the time. They observed that more than 100,000 people lost jobs in hotels, restaurants and small businesses, and that tourism activity was down by 98%. This translated into layoffs, loss of rent, meagre sales, no tourists, business closures and declines in clientele. In other words, “zero income”, a “rock-bottom economy” and “zero tourist arrivals” (Mariela, Beatriz and Juan, Riviera Maya, hotel managers, June 10th, 2020).

The greatest fear expressed by those interviewed during lockdown took the following general order of importance:

“...Dying, getting sick, getting infected, losing a relative, loved one or friend; risk to loved ones’ health; lack of control of the pandemic and that it lasts longer, prevents going to work; being left without the possibility of supporting a household; not eating; no money; reductions in income; surviving, fear that tourist jobs will not revive; falling out of the work routine, being unable to pay debts acquired pre-pandemic; being unable to pay for water, electricity, rent” (Juana, Carlos, Joel, Malena and Ricardo, Cancún-Riviera Maya, restaurant and hotel employees, June 8th, 2020).

“Uncertainty as to the lock-down end date” was expressed as their worst fear, mainly because it was subject to inconsistent dictates by health and governmental authorities via the Traffic Light. Quintana Roo was completely closed to the public on March 26th, 2020, and partially reopened on June 1st with a 30% capacity allowed for tourism activities and beach areas. A generalized fear of contagion kept many tourists away, which made tourism workers very worried:

“...I can’t be locked up, and I can’t get used to the new normal. It already affects coexistence between people; some measures may even be absurd economically because there are no jobs and no income and the months run on without an early end date; I can’t do other activities to earn some extra money to meet expenses” (Marcos, Veronica, Gaspar, Lourdes and Miguel, Riviera Maya, hotel employees, June 10th, 2020).

“... I have stopped working as a tourist guide because of the shutdown and closure of the island to tourists. Now that the island has opened to tourism again, few

tourists have arrived, and there hasn’t been much work in terms of tours...” (Joel, Holbox, hotel manager, May 28th, 2020)

In addition to the economic impact there were collateral emotional impacts:

“...skepticism; anxiety, stress; fear of hunger; isolation; family instability; uncertainty; easy at first, difficult as the days go by; no access to [fresh] air, sun, beaches for good health” (Graciela, Akumal, maid, July 28th, 2020).

Lack of worker income was a standard condition among informants:

“...How do I pay my rent, electricity, water, food and my acquired debts, if I don’t have a salary?” (Imelda, Playa del Carmen, hotel receptionist, July 29th, 2020).

Latent impact and symptomatic consequences of the pandemic (premise four)

Paralysis of tourist activities affected workers differently. A small portion (18.8% of informants) were prohibited from working but were still paid from 60 to 100% of their income during the lockdown, slightly more (24.5%) were paid from 15 to 50% of their income. Most (56.7%) completely lost all income from wages or selling tourist services. Beach closures had the most significant impact on tourism workers and the small, medium and large businesses that make the Mexican Caribbean brand possible and functional. The impact of COVID-19 containment measures produced both positive and negative perspectives. The negatives included:

“... Instability; I cannot be locked up; I need to get used to the new normal; unable to go out on the street; They closed the interstate borders, and I couldn’t go see my relatives, I cannot work because all the hotels were closed; They prohibited sale of alcoholic beverages...” (Luis, Carolina, María, Jorge and Cristina, Riviera Maya, food and beverage managers, June 23rd, 2020).

Use of face masks and social isolation were two conditions that the informants said had impacted them the most:

“... Excessive cleaning of all staff and places that are already very clean; use of a mask affects me by preventing good oxygenation due to my high blood pressure.” (Jaqueline, hotel maid, Akumal, June 27th, 2020).

Confinement or quarantine garnered negative responses in 60.4% of informants and positive ones in 39.6%. Informants with a positive perspective stated the shutdown allowed them to acquire new knowledge and gain experience working with

new hygiene and safety protocols. Another positive comment was that the relative absence of people in marine habitats had allowed nature to “rest” and “recover”. A crucial question was whether the informants believed companies would require new hygiene protocols for tourists and training for employees: 92.5% said yes, and 7.5% said no.

Stakeholder perspective of Sargassum influx impact: hybrid, human-made world in which the nature/culture duality has been lost (premise five)

Massive *Sargassum* influxes in the Mexican Caribbean have proved a dire challenge for mass tourism hoteliers and restaurateurs, among many other sectors of the economy (UNEP 2018). Although the phenomenon began earlier, the first *Sargassum* influx in the region dates to June to September 2015 when these macroalgae, mixed with seagrass, began casting onto beaches in large quantities (Fig. 2). At that time, more than 200,000 metric tons of *Sargassum* were collected and removed from Caribbean beaches. Even larger influxes occurred in 2018 and 2019, affecting over 100,000 workers; it took more than 9000 collectors (women and men) to remove over one million metric tons of *Sargassum* from the beaches. The white sand beaches that are the main attraction of the Mexican Caribbean lost their charm under mounds of smelly seaweed, and the normally inviting tepid turquoise waters had turned a dark turbid brown.

Regional mass media developed a narrative about the influxes, referring to “the plague” from Brazil, echoing the belief that pollution from the Amazon River had triggered excessive *Sargassum* growth in the Atlantic Ocean. It was

“[t]he natural disaster that came to stay”, “[t]he marine debris that came to evict tourists from the beaches from March to September”. *Sargassum* beach casts on Caribbean beaches were actually occurring beyond just May to August, and lasted much longer in 2018 and 2019.

Compared to the social confinement implemented in response to COVID-19 in Quintana Roo (March 26th to August 30th), the 2020 *Sargassum* influx was of secondary importance. Nonetheless, *Sargassum* collectors worked from 9 to 14 h a day (06:00–18:00 or 20:00 h) collecting from four to five tons/person/day (Questionnaire May 2020).

We took advantage of the COVID-19 questionnaire to include various items addressing the *Sargassum* influx. The informants’ narrative allowed an analysis of their social perception of the phenomenon. Overall, most of the informants (66%) stated that the 2020 *Sargassum* influx would be like those of 2018 and 2019, only 26.4% were unsure and just 7.5% responded “maybe”. Both women and men among the informants (39.6%) had collected *Sargassum* from beaches. Almost all of them (98%) had done so in 2018 and 2019, but only 2% had in 2016. Just under half (49.1%) of those who collected *Sargassum* had been paid for their work at a daily wage of USD 12 (Questionnaire June 2020). A small portion (26.4%) had used protective equipment such as gloves and masks while collecting it. When asked if *Sargassum* collectors should be required to use protective measures when working, 75% of the informants said “yes” and 24.5% said “no”. Those who believed protective gear was necessary argued that *Sargassum* has:

“... Toxic substances; It causes infections due to the dirty water it leaves behind. There is garbage inside

Fig. 2 A) Collectors of *Sargassum*, pandemic period, Akumal Beach, May 2020. B) Transporting the *Sargassum* in Puerto Morelos Beach, March, 2021. C) Tourists, Collectors and machine in Playa del Carmen beach, April, 2019. D) Mountains of *Sargassum* in the dunes, Akumal Half-Moon Bay, August, 2019. Images courtesy: A) Hotel Akumal Caribe, Pedro Cab May. B) Karina Marrufo and Iveth Meraz García, Puerto Morelos. C and D) Nidia J. Echeverría, Riviera Maya fieldwork



the Sargassum; the bad smell is powerful and toxic. Sargassum itches and can irritate the skin differently for each person. It leaves welts on the skin. Exposure during an entire working day can be dangerous to the health; it produces a worm, and is disgusting and may cause some damage. The odors are a sign of vapor emission that damages the lungs by accumulation, and the constant handling of saltwater damages the skin, also the sun's rays reflect off it due to the heavy metals in it. Sargassum seems to have bad gases; there is a lot of ignorance about the associated pathogens; about its smell, and the itchiness it causes on the skin; many bacteria live in Sargassum..." (Raúl, Julio, Paulina, Pedro and José, Riviera Maya, reef tour sales, nature guides and fishers, July 27th, 2020).

When asked if the tourists who visited the Mexican Caribbean between May and July had been upset by the *Sargassum* accumulation, 92.5% of the informants said "yes". One of the items asked: "Is it necessary to clean up accumulated *Sargassum* from beaches given the COVID-19 social confinement measures (social distancing, hygiene measures, beach use schedules)?" Most of the informants (86.8%) stated the beaches should be kept free of *Sargassum* even in the absence of visitors, while fewer (13.2%) thought it unnecessary. However, most agreed that *Sargassum* should not be allowed to accumulate on beaches:

"... It affects the coexistence between visitors and the sea; the beach must be clean, COVID or no, love enters through the eyes, tourists can't see a photo of ugly beaches even if we are in total confinement, no safe distance is needed for 'memes', and then it goes viral on the web, make beauty viral, not ugly beaches; Sargassum does not cause contagion of the virus, but the smell it gives off is very annoying to tourists; it accumulates and begins to rot; It smells horrible; build-up causes a very unpleasant aroma; it must be cleaned to attract tourists; for the destination's image; it is essential to keep our beaches clean; so that when the beaches open, tourists want to return; like tourists, we use the beaches and what better than to have clean ones; because it is turtle nesting season; because a clean beach guarantees health; because of the damage the accumulation generates in the coastal ecosystem; for hygiene and the correct reactivation of the destination and its promotion; because Sargassum begins to rot and generates a terrible smell..." (Enrique, Samuel, Lorena, Paulina, Karla, Juan and Mario, Riviera Maya, taxi drivers, cooks and waiters, July 27th, 2020). *"...To avoid the damage it produces in the ecosystem, millions of species die in excess, affecting the plant and animal [food] chains, from microscopic to large species, it also visually affects tourists, which will*

result in losses of millions in the tourist destination and especially [affect] its fame as a nature destination that is in a protected environment. It could become a destination like Acapulco..." (Rodrigo, biologist, Chetumal, July 7th, 2020).

In terms of the *Sargassum*'s impact on fishing operations, 67.9% of the informants stated they were affected because fish die tangled in the macroalgae, and it affects marine habitats and reefs. Fewer (30.2%) thought fishers were unaffected because fishing grounds are far offshore. Most of the informants (81.1%) stated there might be a commercial or industrial use for *Sargassum*, while fewer (18.9%) thought not.

Discussion

Glocal risks, beyond dichotomies between nature and society after Covid-19 and Sargassum blooms

Mexico has experienced health and environmental crises before. For example, the H1N1 influenza epidemic began in Mexico in April 2009 and was declared a worldwide pandemic on June 11th of the same year. That year, it claimed 1172 lives in Mexico and hundreds of thousands worldwide (WHO 2020). In the narrative of tourism workers, H1N1 seemed more economically disastrous than infrastructure destruction in Cancun by hurricanes. As the pandemic spread, hundreds of thousands of tourists canceled vacation plans. The brunt of the crisis was born by workers who were furloughed, forced to take unpaid "vacations", returned to their hometowns or emigrated northward to the US border. In the Mexican Caribbean, the 2009 H1N1 pandemic directly affected various tourism segments (theme parks, archeological sites, lagoons) for 30 days, but had long-term effects for at least 2 years (Córdoba et al. 2009). The economic and social fallout of the H1N1 pandemic pales in comparison to the short-, medium- and long-term impacts the COVID-19 pandemic is likely to have, and which tourism workers are not yet able to conceptualize. As of summer 2020, they predicted its impact would take several years (four to five minimum in stakeholder perceptions) to recover from the COVID-19 pandemic once it ends. Its immense scale also highlights that the measures implemented to address COVID-19 far surpass those applied by the government (Ministry of Health, Ministry of Tourism) in previous disasters (*Sargassum* influx).

The combination of the COVID-19 pandemic and *Sargassum* blooms dimensions has generated a double economic impact that has become a structural crisis (Krugman 2008; Stiglitz 2012, 2019) which will exacerbate growing human pressure on natural ecosystems in the context of the five major causes of deterioration identified globally: land-use

change and habitat loss, resource over-exploitation, climate change, pollution and invasive species (OECD 2019). Periodic *Sargassum* influxes have been regularly undermining the regional economy without completely shutting it down. The COVID-19 pandemic is a worldwide health crisis that has been paralyzing regional, national and global economies. In the Mexican Caribbean, it caused the abrupt cessation of almost all tourist and fishing activities, constituted a massive social disruption due to social confinement measures and generated culture shock among the population. For example, the incidence of “community pneumonia” cases boomed, and the sudden need for additional burial space to accommodate the surge in deaths generated a fear of dying without proper burial. This is especially important among members of ethnic groups and peasants accustomed to burying their dead in the cemeteries of their villages of origin since cemeteries are very scarce in the Riviera Maya (Fraga, personal observation based on fieldwork in the Riviera Maya region).

As impacts, COVID-19 and *Sargassum* influxes are incomparable. However, an analysis can be done of the contextual situation confronting our world risk society. As shown in the informant narratives, *Sargassum* can have substantial health implications, but prolonged contact with macroalgae does not induce massive mortality. The overlap of the COVID-19 pandemic and *Sargassum* influxes has added two dimensions to the reflexive modernity that is the economic, social and ecological nightmare of the Mexican Caribbean.

Sargassum influxes were already scaring tourists away from the beaches due to the overpowering stench and the noise and disruption caused by its removal using heavy machinery 13 to 14 h a day (observation in situ, March 2020; Fraga et al. 2019). By late 2019, influxes were becoming “normalized”, occurring seasonally 7 months a year (March to September). They had wrought a gradual and (in)visible impact in the political and economic imagination as to the (im)possibility of their mitigation and management, a true institutional dimension of risk society with many dilemmas or absences in the face of the *Sargassum* blooms. Effective handling of the blooms and their fallout must still overcome dilemmas such as a lack of official statistics on the *Sargassum* situation, an inability to develop commercial uses for beach-cast *Sargassum* due to an absence of data on the heavy metals it may contain and the need for more research on its biochemical elements (Robledo et al. 2021). There is also a shortage of financial resources to support social and economic evaluation of the *Sargassum* situation in tandem with local communities (e.g. starts-ups or family coops to pilot commercial uses, Fraga et al. 2019).

In March 2020, the COVID-19 pandemic arrived suddenly in the Mexican Caribbean, only allowing time for the population to lock down at home. Both the pandemic and the *Sargassum* influxes were uncontrollable, inexplicable and threatening environmental risks and disasters that required several “protocols” in different human and natural arenas (environmental and economic, social and cultural, political and legal). They are a product of our hybrid society since both are highly complex and thus difficult to understand, and they are anthropogenic risks that neither wreak total destruction nor provide confidence/security; in other words, both are elements in a real virtuality (Beck 2009). For example, the pandemic engendered local responses such as curfews and social confinement in response to a risk to world society; the world risk society had to be educated about hygiene and total cleanliness while waiting at home (Rose 2020).

Mexico’s social structural problems exacerbated the issues caused by COVID-19, exposing it as being fragile, vulnerable and unequal, and clearly lacking the sanitary conditions needed to face a pandemic. Mexico joined the Organization for Economic Cooperation and Development (OECD) in 1994 as an emerging country and is currently the 15th largest economy in the world. However, it is 63rd in terms of social backwardness, and post-pandemic Mexico can expect a substantial increase in the population in extreme poverty (Salas et al 2020). The pandemic has revealed a Mexico requiring more health-focused public policy. For instance, the Mexican Caribbean needs more than mass tourism, it needs infrastructure appropriate for the care of the population that supports the tourism sector. Most workers live in towns lacking hospitals, schools and cemeteries apt for addressing health crises such as epidemics and pandemics.

Sargassum influxes pose less critical health challenges than COVID-19, though public policy has yet to focus on the inadequate sanitary conditions of collectors and the skin problems and toxic exposure they experience. Every year more than 11,600 people collect *Sargassum* in the Mexican Caribbean, mostly without proper protective gear and sanitary measures. Both society and government have approached the *Sargassum* situation from a perspective of protecting the Mexican Caribbean as a tourist destination, prioritizing beach clean-up and, in the case of workers, exploiting it “to have work, making arrival of the *Sargassum* a financial opportunity” (Juan, Paulina, María, Carlos and Pedro, Akumal, *Sargassum* collectors, May 2020). This perspective ignores the phenomenon’s socioenvironmental consequences and remains tied to a nature/society dichotomy.

Understanding the intertwined socioenvironmental impacts of the COVID-19 pandemic and *Sargassum* blooms in the Mexican Caribbean will require a perspective unfettered by this dichotomy. Overconsumption of the Mexican Caribbean was abruptly stopped by the pandemic (Urry 2010), and the massive uplift and transformation it caused triggered efforts to reshape society along a defensive strategy, but still in defense of the paradisiacal tourist destination (Crick 1992; Macias and Pérez, 2009; Sosa and Jiménez 2011). The pandemic and *Sargassum* blooms in the Mexican Caribbean are forcing a redefinition of the destination as it accepts the reality of periodic blooms and makes a socioterritorial transition needed to raise biosecurity standards. This is a society transforming in response to glocal risk, with as yet unforeseen consequences. It is manifest in the fear and uncertainty expressed in the narratives of the interviewed tourism workers and fishers. The informants emphasized that even though they still remained hidden (at the time of the interviews), there would be tremendous, short-, medium- and long-term consequences such as increased hunger, crime and drug trafficking. The narratives collected in the present study highlight how society in the Mexican Caribbean is facing new ways of building a hybrid society with high levels of fabricated uncertainties, and with scientific, political and corporate entities in the lead (Fig. 3). The question now is what possibilities will be available to the multiple interested parties (e.g. tourists, the tourism sector, government,

collectors of *Sargassum*) as they work at rebuilding and redefining their destination post-COVID?

Conclusions

The combined impacts of the COVID-19 pandemic and *Sargassum* influxes in the Mexican Caribbean aptly illustrate Beck’s world risk society (Beck 2009). Mexico adopted strategies and mechanisms to protect its population and mitigate the effects of COVID-19 by implementing social measures. Uncertainty surrounded the first 60 days of social confinement, and 5 months later both the healthy and the sick had become aware of a culture of fabricated uncertainties. Simultaneously, *Sargassum* blooms in the Caribbean Sea and later beach casts are likely to continue. On a practical level, research and technological innovation may allow entrepreneurs to utilize the *Sargassum* biomass and to coordinate natural cycles with economic cycles (Vos et al. 2016; OECD 2019; Marx et al. 2021, Robledo et al 2021); however, it remains a source of uncertainty. As it faces different sources of uncertainty, society in the Mexican Caribbean has before it an opportunity to diversify away from mass scale sun/sand/beach tourism towards a more resilient manifestation that implicitly acknowledges world risk society.

Beck’s five premises effectively guided our exploration of socioenvironmental impacts in the Mexican Caribbean, but other epistemologies need to be applied in the exploration of complex social realities and virtualities. His approach is appropriate for examining world risk society, but more exploration of the empirical world is also needed to adapt to continued uncertainty. Both the COVID-19 pandemic and *Sargassum* blooms have been unpredictable and very challenging to measure because they are uncontrollable, in reality and virtually (e.g. their effects in the mass tourism industry). Responses to both have emphasized the need to greatly expand interdisciplinary approaches to better understand the environmental and historical roles of human beings and the environment as products of culture and adaptation and innovation, in other words, the very condition of multilinear, multipurpose and multifunctional evolution (Jentoft 2019). Attaining some form of this critical vision will require interactive governance and governability of multiple interested parties (Koiman et al. 2004), which allows scientists and academics from the global North and South to interact more broadly (Djaba et al. 2021).

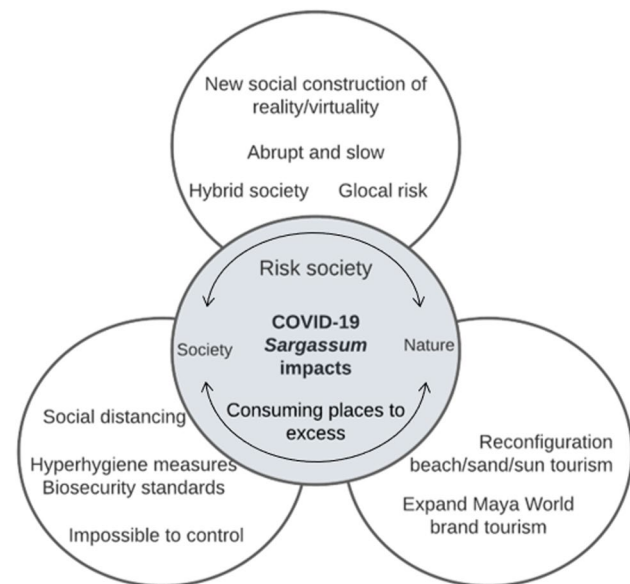


Fig. 3 The COVID-19 pandemic and *Sargassum* influxes in the Mexican Caribbean: moving beyond dichotomies and dualisms. Source: Elaborated based on world risk society theoretical approach and ethnographies, 2020

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Declarations

Conflict of interest The authors declare no competing interests.

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