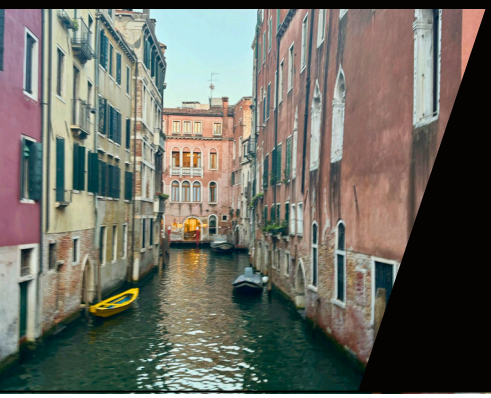

Sinking Cities: The Detriment of Cruise Ships to the City of Venice, Italy

Sophie Hof

When compared to modern-day societies, historical locations require resilient adjustments to combat contemporary advancements. Whether these advancements are positive or negative, they are an unavoidable part of society. Venice, Italy, a city once the greatest ocean port in medieval Europe, now struggles to balance rising sea levels with a declining economy (Foot, et. al, 2023). According to Laura Carbognin, a marine biologist from the National Research Council of Italy, over the past 20 years Venice has subsided (or 'sunk') 12 centimeters into the surrounding Adriatic Sea. However, a sinking Venice is nothing new. The city has endured more subsiding in past generations, which has caused severe damage to the city's urban heritage and a seven-time increase in flood frequencies (Viviano, 2009). Naturally, many Venetians are fleeing the city in fear of its rapid submersion, causing the population and economy to sink with the town. Moreover, in 2015, Transparency International published its Corruption Perception Index, in which Venice ranked financially lower than several developing countries.

Considering what Marcus Aurelius, a Roman Emperor and philosopher, believed, "all things are concurrent causes of all others," there must be a main factor harming Venice. To narrow the search for the cause, Climatologist Davide Zanchettin from the Ca'Foscari University of Venice, believes the sinking of Venice and its economic struggle is linked to lagoon erosion, mass tourism, and pollution (2007). However, Zanchettin fails to mention the modern culprit that has increased such complications: cruise ships. Due to shoreline erosion, substantial amounts of tourism, and heightened contribution to pollution, commercial cruise ships damage Venice's stability and should be banned from docking in the city.

Venice is located in the Venetian Lagoon, which stretches between the shorelines of the Po and Piave Rivers (Bock, 2012). According to Morgan Gelinas, a Venetian aquatic wellness inspector, "In the shallow and muddy lagoon, cruise ships create high water velocities and intense resuspension, possibly leading to serious environmental consequences for large parts of the Venice Lagoon'' (2013, pg. 64). To clarify, Venice is surrounded by loose and muddy seabeds, meaning the transit of large vessels, such as cruise ships, can disrupt the aquatic floor, weakening its support for the city. Moreover, Donna Bilkovic, a marine scientist from the Institute of Virginia, explains the loosening of Venice's seafloor can disturb submerged aquatic agriculture surrounding it (2019). Plants act as a natural shoreline barrier by mitigating

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mitigating the seabed disruption caused by boat wake, making it a crucial form of protection for the city. However, this defense mechanism is destroyed when boat wake is amplified to the level of a cruise ship. Compared to the average wake of a recreational boat, five to seven meters in width, cruise ships take the lead with a standard wake ranging from 100 to 250 meters (Gilman, 2011). This intense emission is too powerful for delicate plants. Additionally, depression wake, the value of water decent caused by boat wake, can reach significant dimensions up to 2.45 m, translating into an eight-foot wave hurling towards the city (Scarpa, 2019). This concentrated wave energy is particularly destructive in Venice's confined waterways, where buildings line narrow canals, amplifying wave force not seen in open water. Therefore, if vacation vessels were banned from the city, shorelines would maintain support for the city, mitigating the sinkage of Venice.

Opposing this proposal, Robert Schuster, a geology professor from the University of Alabama, claims, "boat wakes are an important source of erosive energy in many sheltered coastal and estuarine environments" (2020, pg. 2). To restate, many shallow bodies of water lack wave production. In other words, these areas typically experience minimal natural water disturbances. Schuster believes boat wake should be used as a strategy to prepare plants and sheltered seabeds for intense water disturbances. Although this idea is accurately displayed by Bangladesh's natural root bridges, which have been forcefully strengthened by the brutal increase in natural rainfall, Schuster fails to recognize other crucial aspects that prevent cruise ship wake from being beneficial to shorelines (Watson, 2020). The amplitude of wake that Schuster is implementing does not compare to a cruise ship's emission. In a study developed by the Institute of Atmospheric Sciences and Climate, cruise ships were found to have a ten-time production of wake when compared to a 20-foot fishing boat (Contini, 2010). Although it is beneficial for low amounts of boat wake to strengthen aquatic vegetation barriers, cruise ship values are irrational when it comes to categorizing them with recreational vessels. Therefore, cruise ship wake is deemed harmful when it comes to strengthening plants that surround shorelines. Although it would be impossible to remove all forms of boat-related wake from the Venice Lagoon, eliminating cruise ships would decrease the damage caused to vegetation barriers and shorelines.

Similar to boat wake, the mass number of tourists that arrive on cruise ships is a main cause of Venice's suffering. Initially, citizens may see a large number of annual visitors as a benefit for the city's economy. New customers for restaurants, more people to use water taxis, and plenty of families to stay in local hotels. However, scientists are finding that such a high number of visitors is causing a strain on the city's local accommodations and sewage systems. Between 500 and 600 cruise ships dock yearly in Venice (Venezia Autentica, n.d). Although this may not seem like a substantial amount, according to Petros J. Katsioloudis, a travel agency director for Green Ships, this data averages 2.45 cruise ships daily with a combined minimum of 5,711 passengers (2010), making Venice the 13th busiest cruise terminal in the world (Ahmed, 2022a). Unfortunately, this concern is not showing any signs of fading. Even in October 2020, during a time with restrictive travel rules, 36 cruise ships arrived 84 times each, bringing a total of 191,000 passengers to Venice in just one month (Avoid Crowds, 2020).

Another aspect to consider is Venice's local population-to-tourist ratio. According to the World Population Review, the city's residential population has dropped to less than 50,000. Meanwhile, Venice receives 36 million tourists each year (2023). Maintaining a balance between a tourist haven and a suitable living location for locals is a battle Venice is constantly fighting, which puts intense pressure on the city's accommodation toward locals (Eaglescliffe, 2022). Ana Trancoso González, an art historian and culture manager from the University of Sevilla, Spain, claims that Venice's market has suffered while, "Trying to be at the service of tourism and obviating the needs of the locals" (2018, pg. 23). This has led to the replacement of essential local amenities, like grocery stores and markets, with hotels and souvenir shops. Although this development is beneficial for visitors, it creates numerous complications for locals, such as limited grocery options and overpriced housing. According to Joanna Simmons, a journalist from Warwick University, "Property prices are sky high, with owners converting what could be family homes and lower income rentals into lucrative vacation accommodation" (n.d, pg. 4). Maintaining an affordable lifestyle in Venice is becoming extremely difficult due to the accommodations made for tourists. In addition to sea level stability complications, the city is unable to prioritize its local's needs. Therefore, lowering the population and causing the economy to plummet.

Additionally, Venice's ancient architecture makes it clear that the city was not built to withstand millions of annual visitors. Due to the problematic systems beneath the city, it is difficult to resolve the constant sewage problems. Many of the structures, from the 16th century, are outdated, which, according to Rudmer Hoekstra, a civil engineer from the Netherlands, "creates several threats towards the town and the health of millions of tourists'' (2023). In fact, Venice's ancient networks do not consist of pipes. Installing such infrastructure today would require elevating the entire city by half a meter, an engineering feat made impossible by the city's continued descent. Moreover, even if houses are now equipped with updated plumbing systems, most of the wastewater from the systems will still end up in the city's canals. The tides then carry it out to sea and replace it with cleaner water, perpetuating a fragile and polluted system (Venezia Lines, n.d). The constant spew of sewage into the bodies of water that surround Venice is a health concern. According to Marco Ostoich, from Veneto Regional Prevention and Protection Agency, being exposed to contaminated water can cause health effects, such as gastrointestinal illnesses, nervous system complications, reproductive effects, and even cancer (2006). Although Venice is a beautiful city to visit, it is overwhelmed by tourism, making it a deteriorating and unsustainable location for people to live and visit. To finalize, the majority of tourists that visit Venice arrive on cruise ships. Therefore, eliminating this form of transport to the city would minimize the local accommodation and sewage complications tourism brings to Venice.

However, many citizens of Venice rely on tourism to make a comfortable income. Since there are a majority of hotels and attractions designed for visitors, several locals find employment in relation to them. As stated by Mr. Secci, a Venetian, "Since I can remember, tourism has been our only economy," (Momigliano, 2020, pg. 3). Removing the ability for travelers to take cruise ships to the city would drastically lower the number of customers for locals to gain capital from. Although Venice's economy urgently needs aiding, this is not the correct method to utilize. In the past 25 years, hotel stays in the city have dropped by two-thirds (Sharp, 2017). This is strictly caused by the cruise ship industry. Rather than staying in the city, cruise ship passengers stay in private rooms that are provided on the boats docked in the lagoon. Additionally, many tourists visit Venice while on a whirlwind trip around Italy. They often disembark, buy a few souvenirs, and leave within hours (Simmons, n.d) This form of visitation brings no benefit to Venice's economy.

Another modern development that is causing the rapid sinkage of Venice relates to the colossal amount of pollution cruise ships emit into the city. According to the Italian Senate, every ship emits the same amount of pollution as 14 cars daily, deeming them the main cause of atmospheric pollution in Venice (Contini, 2011). The atmosphere plays a huge part in controlling rainfall and temperature, which influences erosion patterns and the sea level. When atmospheric pollution increases, erosion intensifies, and sea level fluctuations become more severe. However, the atmosphere is not the only natural aspect being harmed by ships. According to Venice's 2009 congressional report, wastes such as hazardous sewage, oil-contaminated substances, and ballast water were all constantly discarded into the Venice Lagoon (Katsioloudis, 2010). To put the substantial amount of water pollution into perspective, The National Bureau of Transportation Statistics, found that a 3000-passenger cruise ship can generate 210,000 gallons of sewage and 25,000 gallons of oily bilge water in the span of seven days (Ahmed, 2022b). Additionally, this data does not account for the increased average passenger capacity of cruise ships, nor the copious gallons of sewage created by visitors during their time off the ships and in the city. Moreover, such a large amount of pollution directly creates another factor that causes erosion to Venice's shorelines. Plant barriers cannot withstand poor water conditions caused by cruise ships. Therefore, water pollution causes them to lose their support towards surrounding shorelines.

High levels of pollution also put a strain on Venetians. Living in an environment plagued by polluted water and air is both unhealthy and undesirable, which is the main reason why Venice's population is decreasing. With the descending population, is the sinking economy. Fewer citizens create a decline in a region's workforce, supply variation, and association with modern-day technology (Wilmoth, 2022). To conclude, cruise ships create a large amount of atmospheric and aquatic pollution, which amplifies the damage to Venice's sinking shoreline, descending population, and plummeting economy. To prevent further harm to the environment and locals, cruise ships should be banned from docking in Venice, Italy.

Considering intensive research, the harms to Venice's physical and economic stability are clearly being caused by an outside object: cruise ships (Antoninus, para. 40, 1902). As a result of shoreline destruction, significant tourism pressures, and considerable contribution to pollution, cruise ships should be banned from docking in the city. This application will preserve Venice for a longer duration, making it a historic wonder that is here to stay.

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