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ORIGINAL RESEARCH PAPER

Climate, water and tourism: causes and effects of droughts associated with urban development and tourism in Benidorm (Spain)

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Abstract In this paper, we analyse the relationship between climate, tourism and water in Benidorm (Spain), an international icon of Fordist tourism (mass tourism). In particular, we have studied the causes and effects of the water supply droughts Benidorm has suffered since becoming a major holiday destination. For this purpose, we consulted the local press in Benidorm over the period 1969–2003. Using qualitative and quantitative geographical techniques, we found that the water supply in the area has managed to keep up with rapidly increasing demand, with only occasional imbalances and periods of crisis. We focused in particular on the causes and effects of the water supply crisis of 1978, a moment of great uncertainty in the history of Benidorm as a holiday resort. We also examined the influence of atmospheric conditions on precipitation levels and how these precipitation levels affect the water supply. Our results highlight the importance of intense rainfall episodes associated with easterly winds, which provided large inputs for Benidorm's water supply system (Marina Baja Water Consortium). We also found that the water supply crisis of 1978 resulted in serious economic losses for Benidorm and damaged its image as a holiday destination and that the city is now less vulnerable to variations in the climate, as a result of its search for new water resources (both surface and ground water resources and from other nonconventional sources).

Keywords Mediterranean climate · Mass tourism · Press · Benidorm · Water supply drought

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Introduction

Tourism is one of the world's most important business sectors. The United Nations World Tourism Organization (UNWTO) estimated that income from international tourism in 2011 was US$1,030 billion (740 billion euros) (UNWTO 2012a), and the World Travel and Tourism Council stated that in 2008, the tourism industry provided employment for around 254 million people, producing 9.1 % of world GDP (World Travel and Tourism Council 2012).

The tourism sector is responding well to the current world economic crisis. Indeed according to the latest figures from the UNWTO, even in these unfavourable contexts, tourism only suffered the effects of the economic crisis in 2009, before returning to growth again in 2010 and 2011 in terms of both tourist numbers and income (UNWTO 2012a).

This global trend and the general strength of the tourism market worldwide have been echoed in Europe where the sector began to recover as early as 2010, a positive shift that became even more evident in 2011. Between 2010 and 2011, there was an increase of 29.2 million international tourists in Europe and net income from international tourism came to 54.1 billion euros (UNWTO 2012a).

In Europe, these growth rates have been higher in Central and Eastern Europe and in the Mediterranean countries. Although it is evident that the social crises in rival destinations in Northern Africa and the Middle East have played an important role in this recovery, it is also true that increased numbers of visitors from Russia, Scandinavia and Germany have made a significant contribution. These figures show the importance of tourism and its capacity for healing economic wounds, so emphasizing the need for research in this field.

Water is a vital resource in almost all economic sectors and tourism is no exception (de Stefano 2004; Pombo et al. 2008; Rico-Amoros et al. 2009, 2013; Baños-Castineira et al. 2010). Gössling et al. (2012) divided the use of

water in tourism into two categories, namely direct use (accommodation and daily activities) and indirect use (infrastructure, energy and food). The total daily consumption per tourist is somewhere between 2,000 and 7,500 L of water per day, of which indirect use takes the lion share (see Gössling et al. 2012). At the tourist destination itself, direct use is the most important as it has an immediate effect on the water resources in the area. In this case, most of the water is consumed by accommodation, although this varies significantly between 84 and 2,000 L per tourist per day (Gössling et al. 2012). These variations are due to the type of accommodation (Langumier and Ricou 1995; Gössling 2001; Dworak et al. 2007; EUROSTAT 2009; Rico-Amoros et al. 2009) and to geographical factors (Gössling et al. 2012). On this question, previous research has shown that water consumption varies from one region to the next according to the particular land-use models applied in tourism development (see Rico-Amorós 2004, 2007; Rico-Amoros et al. 2009; Hof and Schmitt 2011). In any case, a lack of water is a serious obstacle for the tourism industry (Rico-Amoros et al. 2009; Gössling et al. 2012). In a study of the use of water by the tourism sector, EUROSTAT (2009) identified a number of specific problems, two of which are particularly relevant for our purposes: (1) demand is at its highest in dry periods (summer), and (2) tourism destinations tend to be concentrated in coastal areas with very limited water resources.

Any study of the relationship between water and tourism must take into account the effects of climatic variability (Scott and Lemieux 2010). In this paper, we focus particularly on the way climatic variability can cause severe water supply problems resulting in socio-economic droughts as defined for the first time by Wilhite and Glantz (1985) and currently identified as water supply droughts (Kallis 2008).

To this end, when analysing the effects of climate change on tourism, recent research has sought to assess the decrease in precipitation in especially vulnerable areas (semiarid and arid areas) and its consequences for the water supply (see Vörösmarty et al. 2000; Brochier and Ramieri 2001; Alcamo and Henrichs 2002; IPPC 2007; EUROSTAT 2009). Climate change could have serious consequences for the Mediterranean Basin, one of the world's most popular holiday destinations, as revealed by Kallis (2008) and García-Ruíz et al. (2011). It is therefore important and advisable (in order to keep ahead of and be prepared for future events) to analyse the different factors that come together to cause a water supply crisis and how these have affected representative tourism destinations. Indeed, EUROSTAT (2009) states that we need to know more about the management of water resources in tourism, especially during dry periods, and the Mediterranean Water Scarcity & Drought Working Group (hereafter MED WS&D WG) was set up in 2004 with this in mind.

It is clear that inefficient water management can increase the possibilities of water supply crises in tourism destinations, especially in unfavourable climatic situations. This can lead to over-exploitation of aquifers (Gómez et al. 2004; Plan Bleu 2000, 2004; MED WS&D WG 2007; Rico-Amorós and Hernández-Hernández 2008; Deyà-Tortella and Tirado 2011), disputes between resident and tourist populations (Medina 1990; Müller et al. 2004), conflicts and competition between the tourism and agriculture sectors for access to water resources (Auernheimer and Gonzálzez 2003; Gómez et al. 2004; MED WS&D WG 2007; Rico-Amorós and Hernández-Hernández 2008; Deyà-Tortella and Tirado 2011; Roson and Sartori 2012) and tensions between sending and receiving areas (Wheeler 1995; Rico-Amorós 2004; Rico-Amorós and Hernández-Hernández 2008). These crises can result in economic losses for the tourist resort (MED WS&D WG 2007; Barceló and Sabater 2010; Tourism Research Australia (TRA) 2010), as a result of substantial falls in the number of tourists visiting a destination (Kent et al. 2002; Tourism Research Australia (TRA) 2010) and shorter stays (Tourism Research Australia (TRA) 2010), and may also dissuade the tourist from returning to the destination in the short term (Tourism Research Australia (TRA) 2010). The aims of this paper are therefore to analyse the relationship between climate, water and tourism and, in particular, to study the way in which climatic variability has affected the supply and management of water in Benidorm and to assess the effects of the drought of 1978, the most serious water supply crisis ever experienced by the city.

In this paper, we have analysed the relationship between climate, tourism and water in a Fordist tourism icon, through the prism of drought. In the first section, "Study area", we contextualize the importance of our research, given the role of tourism in the world and Spanish economies and in Benidorm in particular. In the "Sources and method" section, we describe our sources and the techniques we applied, explaining the reasons for their use, their advantages and limitations. In the "Results" section, we study the natural and anthropogenic causes of water supply droughts, providing an in-depth analysis of the water crisis of 1978, the worst since Benidorm became a tourist resort. Finally, in the "Conclusions" we detail the measures taken to prevent or mitigate water supply droughts in the area and in response to growing demands for potable water. We also highlight the potential impacts of the water supply drought of 1978 on the city of Benidorm.

Study area

Benidorm is situated on the south-east coast of Spain in the region (Europe) and the subregion (Mediterranean and southern Europe) that receives the highest number of tourists in the world. In 2011, Europe received 504 million tourists, 51 % of the world total. A high percentage of these tourists headed for countries in southern and/or Mediterranean Europe (182.2 million) (UNWTO 2012b).

Spain plays a very important role in world tourism because of its geographical position, natural heritage, historical legacy, socio-economic situation and general level of security. In 2011, it was in fourth place in the world in terms of numbers of tourists with 56.7 million visits, behind France (with 77.1 million visits), the USA (62.3 million visits) and China (57.6 million visits), and in second place for income from tourism with US$59.9 billion, second only to the USA (US$116.1 billion) (UNWTO 2012b). These figures illustrate the key role played by tourism in the Spanish economy, accounting for 10.5 % of Spanish GDP in 2010, according to provisional data from the National Statistics Institute (AECIT 2011). Within this vital economic sector, Benidorm occupies a leading position and is one of the best-known examples of the Fordist model of mass beach-resort tourism (see Vera-Rebollo 2001; Bellot et al. 2007; Claver-Cortés et al. 2007; Ivars-i-Baidal et al. 2013).

Benidorm is an excellent example of a Mediterranean holiday resort which enjoyed a boom in tourism from the 1960s onwards (Ivars-i-Baidal et al. 2013). Prior to the arrival of tourism, it was a small town with a modest income from fishing and agriculture. The lack of options on shore encouraged many local men to seek work at sea. This is often cited as the catalyst for the development of tourism in that it brought the men of Benidorm, in what was still a very traditional country, into contact with other people, cultures and ideas and endowed them with a different mentality open to new ideas and new projects for the city. The first tourists to spend their summers in Benidorm arrived as early as the 1860s and 1870s, and the "Virgen del Sufragio" Spa was built in 1893. The first hotels and holiday villas began to appear in the 1920s and 1930s to accommodate visitors from above all inland Spain (Madrid) and inland parts of the province of Alicante (Alcoy). It was not until the early 1950s however that the tourism business really began to play an important role in the life of the town, with the project for the new layout of the Levante Beach (1953) and even more decisively with the Land Use Plan of 1956. Official records show that 462 homes, 352 holiday villas, 663 apartments and 25 hotels (769 hotel rooms) were built between 1954 and 1955 (source: Benidorm Town Council). The real boom in tourism in Benidorm took place in the 1960s, fuelled by the amendments to the Land Use Plan in 1963 and the opening of Alicante airport in 1967, a fact which enabled an "avalanche of foreign tourists", above all British, who arrive to Benidorm. This was manifested in the huge leap in the number of international passengers using this airport, which increased from 232,697 in 1968 to 1,523,241 in 1973 (source: AENA - Spanish airports authority). These new visitors had to be housed in new accommodation resulting in a similar boom in construction in Benidorm over the period 1969 to 1973 in which 4,679 homes, 469 holiday villas, 9,155 apartments and 74 hotels (with 14,478 beds) were built (source: Benidorm City Council).

In 2011, Benidorm was in fourth position in Spain in terms of the number of nights spent in hotels (Madrid 16,411,369, Barcelona 16,146,596, San Bartolomé de Tirajana – Canary Islands 10,856,802, and Benidorm 10,495,788), in sixth position in the number of nights spent in holiday apartments (San Bartolomé de Tirajana 6,832,936, Arona 4,414,383, Tías 4,046,872, Mogán 3,304,195, Adeje 2,708,863 and Benidorm 2,341,659) and in first position in the number of nights spent at campsites (Benidorm 1,626,481, Torroella del Montgrí 1,052,392 and Blanes 769,194) (source: National Statistics Institute). Benidorm has therefore become a landmark holiday destination in the western Mediterranean, generating over 1.2 billion euros a year in income and creating more than 300,000 direct and indirect jobs (Rico-Amoros et al. 2009).

One of the main resources of Benidorm for the success of tourism is its climate. Like so many other European beach resorts, Benidorm is in the southern sector of the medium latitudes in the Mediterranean basin at 38° 32′ N and 00° 08′ W. It is situated between the temperate and tropical zone with a typically "Mediterranean" climate, in which there are significant seasonal variations in rainfall levels characterized by a dry summer period (Linés-Escardó 1970; Perry 1997; Romero et al. 1998; Allen 2001; Mayes 2001; Leroux 2001). This climatic area of transition is also sensitive to changes that take place in the trajectories of extratropical depressions, causing significant interannual variability in precipitation levels (Trigo et al. 2006). As a result, most Mediterranean countries suffer frequent droughts (Trigo et al. 2006). Spain is no exception, and water shortages have always been a question of great concern (Swyngedouw 2003), often being used to further self-seeking political interests (Torregrosa-Martí and Sevilla-Jimenez 2010), that is to get votes.

In climatic terms, the Mediterranean basin is in an area of transition (Laurent et al. 2006), which explains why there are often significant variations in climate in just a few dozen kilometres. These contrasts are accentuated in the specific area we are studying due to its particular orography, as happens in a number of other Mediterranean regions (see Romero et al. 1998; Kent et al. 2002). Specifically, Benidorm is surrounded by a relatively rainy nearby mountain environment (with maximums of around 1,000 mm/year) (see Fig. 1). This means that although Benidorm forms part of the driest region in Spain and one of the most arid in Europe (see Romero et al. 1998; Gil-Olcina 2004), its hinterland has relatively abundant water resources. This enables rainfall to be regulated naturally (aquifers) and by human intervention (reservoirs).

Benidorm's proximity to this quite water-rich mountainous environment has been essential for the tourist development of its coastline. Another favourable aspect was the socio-territorial transformations that took place in the 1960s in the province of Alicante as a result of the emergence of mass

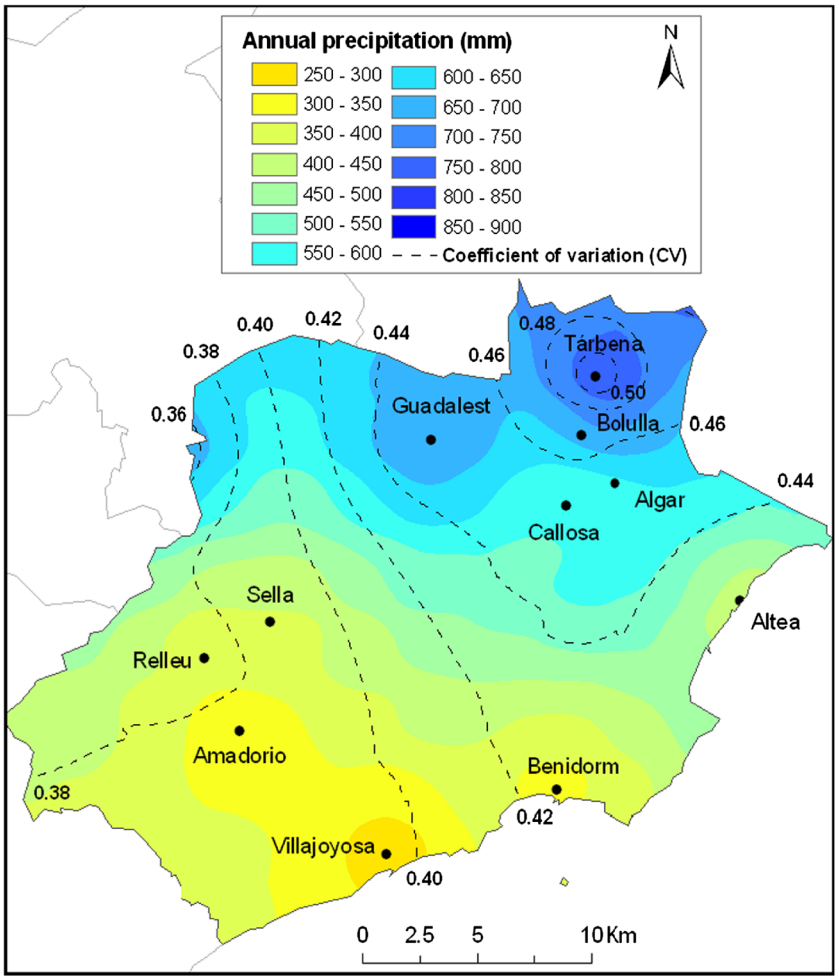

Fig. 1 Annual precipitation and its variation coefficient in the Marina Baja area (Alicante, Spain)

tourism, which quickly began to compete for water resources with other more traditional sectors (Morales-Gil and Vera-Rebollo 1989). A further important factor is that in Spain, the water used to supply the tourism industry is considered part of urban water supply, which has priority over other uses. The result has been that in the Valencia region (to which Benidorm belongs) for example, urban consumption has been guaranteed during periods of drought, while farmers that need to irrigate their fields have suffered the direct consequences of water shortages, incurring often severe financial losses (Rico-Amorós and Hernández-Hernández 2008).

The effective management of available water resources by the Marina Baja Water Consortium (see Torregrosa-Martí 2005a, b; Rico-Amorós et al. 2013) has also been a crucial factor. One example was the agreements reached between the Water Consortium and users' groups from the farming sector. These agreements, under which the irrigation associations exchanged potable water for treated water, unsuitable for drinking, and/or payment, have enabled different users to share water infrastructures and the Consortium to increase urban water supply (see Torregrosa-Martí 2005a, b; Rico-Amorós et al. 2013).

Benidorm's distinctive urban development model has also helped guarantee water supply to the city. This model is characterized by high-rise, high-density buildings allowing for a similarly high concentration of both resident and tourist accommodation. This kind of territorial model allows for a more rational use of water resources as compared with other more disperse forms of urban development (see Rico-Amorós 2004, 2007; Rico-Amoros et al. 2009; Hof and Schmitt 2011).

In spite of all these positive factors, in Benidorm, there have been various periods of imbalance between the supply and demand for water. Water management authorities at different levels (local, regional or national) did not prepare sufficiently for the effects of severe fluctuations in precipitation levels (in other words, variable supply of water) in a tourist area that went through various phases of rapid interannual growth (see Ivars-i-Baidal et al. 2013). These fluctuations can be seen, for example, in one of the main water sources in the area, the aquifer of Algar (see Castaño-Castaño et al. 2000; Torregrosa-Martí 2005b), which receives an average rainfall of 640 mm, with a standard deviation of 293 mm and a coefficient of variation of 45.76 % (source: Marina Baja

Water Consortium). This explains the huge variation in the amount of water entering this aquifer with a minimum annual input of 2 hm^3 and a maximum of 81 hm^3 (Castaño-Castaño et al. 2000).

Sources and method

We understand geography as a science of synthesis (see Sala 2009) that encompasses many and varied fields. The subject we are analysing in this paper, droughts, lends itself to this approach to geography, in that droughts are socio-environmental phenomena (see Kallis 2008) and as such require an integrated analysis.

The main objective of this paper is to analyse the relations between climate, water and tourism in Benidorm, an international icon for mass tourism. In particular, we have analysed water supply crises (droughts related with urban development and tourism), paying particular attention to their causes and consequences. As this is a holistic subject, we have used a wide range of sources and techniques, as was the case in other previous research (Degaetano 1999; Bayés-Bruñol et al. 2003; García-Marín 2008).

During our research, we reviewed all the news items from the local press in Benidorm (printed paper editions) during a representative period (1969–2003) and used the information we gathered to develop a database of climatic risks for tourism (see Fig. 2). Our work is therefore based on the consultation of a direct and climatically relevant documentary source (see Brázdil et al. 2010). Various authors have highlighted the importance of the press even today in the study of natural risks (Barriendos et al. 2002; Pasquarè and Pozzetti 2007), while others have created a database of climatic risks on the basis of information published in the press (see Ruiz-Urrestarazu 1998; Llasat et al. 2009). Drought has also been analysed by consulting press reports (see Heathcote 1974; Pérez-Cueva 1983; Pita-López 1985; Degaetano 1999; Bayés-Bruñol et al. 2003; García-Marín 2008; Tänzler et al. 2008; Ruiz-Sinoga and León-Gross 2012).

We compiled and transcribed (in summary form) all the news reports about tourism and water and manually applied the content analysis technique to the information we had gathered (see Piñuel-Raigada 2002), as did previous researchers (see Tänzler et al. 2008).

We classified the news items about tourism into years and subjects, so enabling us to find out both the concerns expressed about tourism and the general perception as to the impact on tourism of the various water supply crises. This method provided specific information which could not have been obtained from other sources (interesting examples include interviews with business people from the hotel sector in 1978, figures for numbers of tourists provided by tour operators to Benidorm in the 1970s, etc.).

As regards water, the information we have gathered has enabled us to trace the history of water in Benidorm from 1969 to 2003. This information could not have been obtained from other sources either, even after discovering its key aspects. We also made a filtered search for news reports that expressed concern about the supply of potable water in Benidorm, so allowing us to assess public concern about the problem of water in the city, a technique also used in previous papers such as those by Bayés-Bruñol et al. (2003), Hernández-Varela et al. (2003), García-Marín (2008) and Tänzler et al. (2008). In addition and in line with the approach used by Tänzler et al. (2008), we identified critical periods (in our case, droughts) when emergency measures were taken (e.g. potable water restrictions, the exploitation of new water resources, water transfers, etc.). On this question, we should make clear that we are aware that analysing drought is very complex (see Hagman et al. 1984; Wilhite 1993; Kallis 2008), given the wide range of different types (see Wilhite and Glantz 1985; Thurow and Taylor 1999; Marcos-Valiente

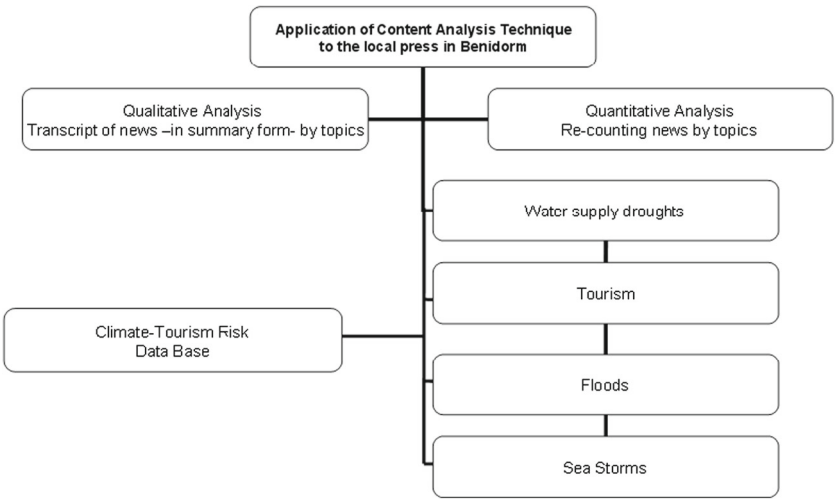

Fig. 2 Database of news items regarding climatic risks for tourism

2001). We also realize that droughts may have more to do with demand than with precipitation levels (Whitmore 2000; March et al. 2013). In fact, the droughts we analysed could be classified as socio-economic droughts (see Wilhite and Glantz 1985) or perhaps even better as water supply droughts (Kallis 2008). In this paper, we have decided to use the latter term, water supply droughts, given that the droughts we have studied here arise above all from imbalances between the urban development linked with the tourism sector and the available water supply. We also acknowledge that the availability of water does not only depend on precipitation but also on human intervention to increase available water supply in response to increased demand, hence the advantage of using supply indicators to identify the severity of drought (see Kallis 2008).

Thanks to the information obtained in the press, we have gained an overview of the situation over time. This kind of research has also enabled us to assess public concern about water, a factor that would have been impossible to estimate by other means (see Ruiz-Sinoga and León-Gross 2012). The general, all-encompassing nature of the information that appears in the press makes it possible to assess the degree of vulnerability and the capacity of the population to respond at different times (Tänzler et al. 2008). This kind of information does have a number of weaknesses however. Firstly, it is often subjective, and secondly, it tends to be qualitative information, which is difficult to convert into quantitative data (Hernández-Varela et al. 2003).

For this reason, we have also consulted other more quantitative information sources. For information on water and the climate, we consulted the Spanish meteorological agency (AEMET), the River Júcar Hydrographic Basin (to which Benidorm and its surrounding area belong), the Marina Baja Water Consortium and Benidorm City Council.

For more information about tourism, we consulted the Spanish Airports Authority (AENA) and analysed the growth in the number of passengers using Alicante Airport between 1967 and 1985, in order to verify or reject, on the basis of a reliable source, the news items regarding the possible repercussions on the number of tourists visiting Benidorm of the worst crisis in the supply of potable water in the city's recent history. On this question, García-Tornel and Morales-Gil (1998) stated that the growth in the number of passengers using the airport was due above all to the huge numbers of tourists channelled by the tour operators towards the Mediterranean area, which resulted in vast numbers of international holidaymakers, above all from Britain, being sent to hotels in Benidorm.

We also visited Benidorm City Council to consult records of the queries made at the Benidorm Tourist Information Office between 1969 and 1980. The figures were broken down according to the nationalities of the tourists seeking information. We felt that this information was relevant to our study of the effects of the water supply crisis of 1978 for various reasons: (1) At that time, AENA did not break down its statistics by nationality; (2) the Benidorm City Council archives had no figures about hotel occupation in the city over this period; (3) we had no access to the records of the Tour Operator TUI (the largest tourism group in Europe) regarding the number of German tourists travelling with them to Benidorm at that time (in 2003, Ian Livesey, director of TUI in the Costa Blanca told us that they did not have this information); and (4) data obtained from the records of the Benidorm Tourist Information Office for this period could be relevant because at that time visits to tourist information offices were probably more generalized than they are today (when much of this information is available online), and it is therefore reasonable to assume that those seeking information were a representative sample of the tourists visiting the city at that time.

In order to analyse the importance of precipitation and water reserves in water supply crises (water supply droughts), we investigated the main components of the system supplying water to Benidorm and its surrounding area (Marina Baja). It is important to bear in mind that the Marina Baja has an urban demand for water of around 24–25 hm^3/year, of which 12–13 hm^3/year comes from Benidorm itself (see Castaño-Castaño et al. 2000; Torregrosa-Martí 2005b). According to the findings of Castaño-Castaño et al. (2000) and Castaño-Castaño and Murillo-Díaz (2001), the main input into the urban water supply system in the Marina Baja (which uses both underground and surface water resources) comes from the underground water reserves in the surrounding mountains and in particular the aquifer of Algar (with an annual average contribution of 32 hm^3/year). These water reserves are regulated to a large extent by the dam on the Guadalest reservoir (Castaño-Castaño and Murillo-Díaz 2001) (see Fig. 3). The system's two main reservoirs, the Guadalest and the Amadorio, make average annual contributions of 8 and 6 hm^3, respectively (Castaño-Castaño et al. 2000) (see Fig. 3). We then correlated these figures with data showing precipitation levels over a representative period, obtained from two reliable sources, namely the meteorological observatories of Guadalest and Callosa d'en Sarrià, both of which are situated in the area that provides most of the water for the Marina Baja water supply network. We also consulted the figures for the amount of water stored in the largest reservoir (the Guadalest) for the same period. It is important to emphasize that the timeframe we used for the precipitation and water reserves data was the agricultural year (September to August), which begins with the period with the most frequent rainfall (autumn) and ends with that of the highest water consumption (summer).

We used a climate teleconnection pattern to analyse the relationship between atmospheric conditions and precipitation. In the case of Spain, previous researchers such as Rodo et al. (1997) and Rocha (1999) used the El Niño-Southern

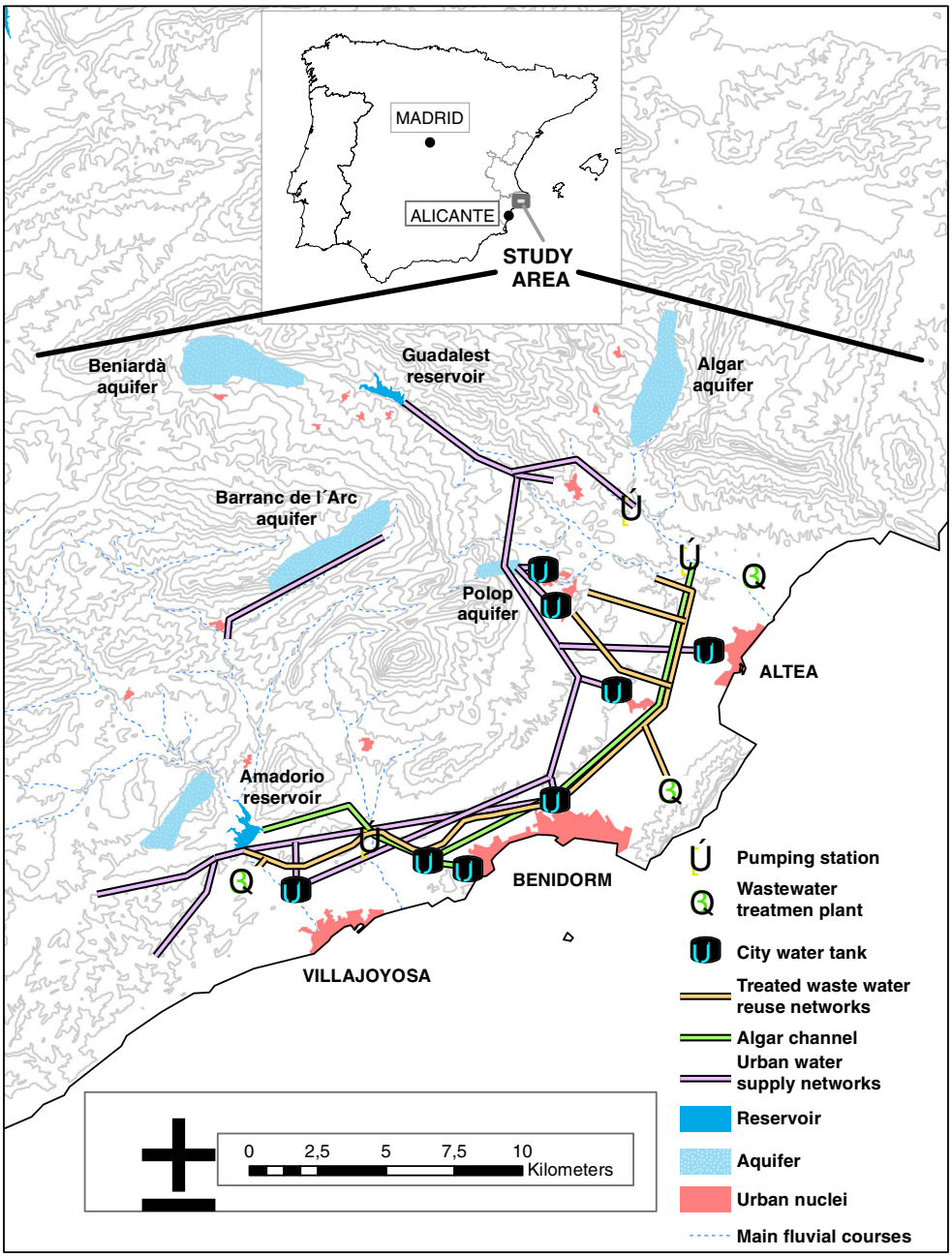

Fig. 3 Topographic framework and main components of the Marina Baja Water Supply System. Source: devised by authors based on Castaño-Castaño and Murillo-Díaz (2001)

Oscillation (ENSO), while the North Atlantic Oscillation (NAO) was applied by Rodo et al. (1997) and Muñoz-Díaz and Rodrigo (2004). In this paper, we decided to use the Western Mediterranean Oscillation (WeMOi) proposed by López-Bustins and Azorín-Molina (2004) and Martín-Vide and López-Bustins (2006), who found that there was a poor relationship between rainfall levels on the east coast of the Iberian Peninsula and the NAO, in particular in the area we were studying. Thus, the WeMOi had to be taken into account.

In order to assess the seriousness of the climatic, hydrological and social situation (as measured by the number of news reports referring to water problems in Benidorm), we normalized the series on an annual scale. In climatology, normalization of series is used to analyse climatic teleconnections and droughts (we applied the Standardized Precipitation Index, an index used to analyse droughts, see Marcos-Valiente 2001; Kallis 2008). The use of normalized or standardized values (z) gives us a better picture of the deviations of the values with regard to their average and improves the results when studying the dependence (e.g. the correlation) between data series of different characteristics. This is why it is used in the hedonic approach to the valuation of heritage resources (see Ministerio de Medio Ambiente, Vivienda y Desarrollo Territorial 2003). García-Marín (2008) also used

normalized values for comparing series with different characteristics. When interpreting the results, we have to bear in mind the following: z values equal to 0 show that there are no differences with respect to the average, negative z values represent below-average values and positive z values above-average (in both cases, the differences are proportionate to standard deviation).

Results

Water supply droughts in Benidorm: natural and anthropic causes

We identified water supply droughts in Benidorm on the basis of reports in the local press, for which purpose we took note of all references to water problems in the city (potable water restrictions, reductions in the pressure in the potable water supply network, the sale of water from water-tank trucks, emergency water transfers or emergency or intensive exploitation of underground water resources). On the basis of these criteria, we identified three periods of water supply drought: 1969–1970, 1976–1985 and 1995–2001, although the last two periods had brief parentheses in 1980–1981 and 1998, respectively. These droughts came to an end due to significant precipitation episodes and an increase in the availability of potable water due to human intervention, although except for the Júcar-Marina Baja water transfer from 1999–2002, the various improvements in the water supply system also depended on these episodes of intense rainfall in the study area to become operative or to refill.

The three periods of drought were brought to an end respectively by the heavy rains of October 1971; those of autumn and winter 1985 and autumn 1986; and those of autumn and winter of 2001 and spring 2002. These natural contributions to water levels were supplemented by various improvements to potable water supply including the construction of pumping stations to pump water from the rivers to the reservoirs (above all the Algar pumping station); the extraction of underground water resources (especially in Beniardà); and the inauguration of water treatment plants after agreements had been reached between water users to exchange treated water for potable water (especially with the inauguration of the Benidorm water-treatment plant).

We quantitatively assessed the importance of rainfall in the area's water reserve levels by comparing the precipitation values with the figures for the amount of water stored in the reservoir in the nearby village of Guadalest. The timeframe used as a reference was the agricultural year (September–August) between 1974 and 2003. The results show a clear relationship between the percentage of water in the Guadalest reservoir and the rainfall recorded at its observatory (annual values), with a correlation coefficient of 0.74 and a coefficient of determination of 54.63.

We also quantitatively verified the importance of the WeMOi in water reserve levels. The ratio between annual precipitation over the same period (1974–2003) and the WeMOi (summer not included) was −0.52 (r) and 27.21 (R^2) and −0.45 (r) and 20.22 (R^2), for the Guadalest and Callosa d'en Sarrià observatories, respectively. These correlation coefficient values are negative, which means that the annual prevalence of Mediterranean air flows on the surface (flows of marine origin) has a substantial influence on annual rainfall levels. On this question, it is important to remember that the wind normally blows in the opposite direction, as the prevailing winds in the middle latitudes are westerly.

It should also be emphasized that precipitations tend to be concentrated within very brief time periods. If we look at the average values, 20 % of rain episodes accounted for 70 % of the total precipitation. Hence, the importance of high precipitation episodes with at least 50 mm/day in the overall annual total, a fact confirmed by our results: using simple regression, we established correlation coefficients for the best fits of 0.63 and 0.85, and coefficients of determination of 39.84 and 71.86 in Guadalest and Callosa d'en Sarrià, respectively. This shows that there is also a relation between the amount of rainfall in days with at least 50 mm/day and the water levels in the Guadalest reservoir, with a correlation coefficient of 0.47 and a coefficient of determination of 27.78. This means that the volume of water stored in reservoirs depends to a large extent on episodes of high rainfall.

As explained earlier, in this paper, we are studying socio-economic droughts and in particular water supply droughts, given that human action is at the root of the droughts in the tourism destination we studied. For this reason, in order to evaluate the importance of the human factor in water supply crises, we decided to assess public concern, which we calculated on the basis of the number of news reports/year that refer to water problems in Benidorm. We then compared the results of public concern with both rainfall and water reserves recorded in the area that provides most of the city's water resources, in order to evaluate the capacity of human response to climatic and hydrological crises. It is important to remember that the rainfall and hydrological levels are recorded over the agricultural year, while public concern is measured according to the calendar year.

If we analyse Fig. 4, we can see a relationship between the three variables with correlation coefficients of −0.45 and −0.36 between public concern/precipitation and public concern/water reserves in the Guadalest reservoir, respectively. There is a clear increase in public concern during the periods of low rainfall and low reservoir levels, especially in the years 1976, 1978, 1979, 1984 and 2000. By contrast, public concern was much lower during the periods with

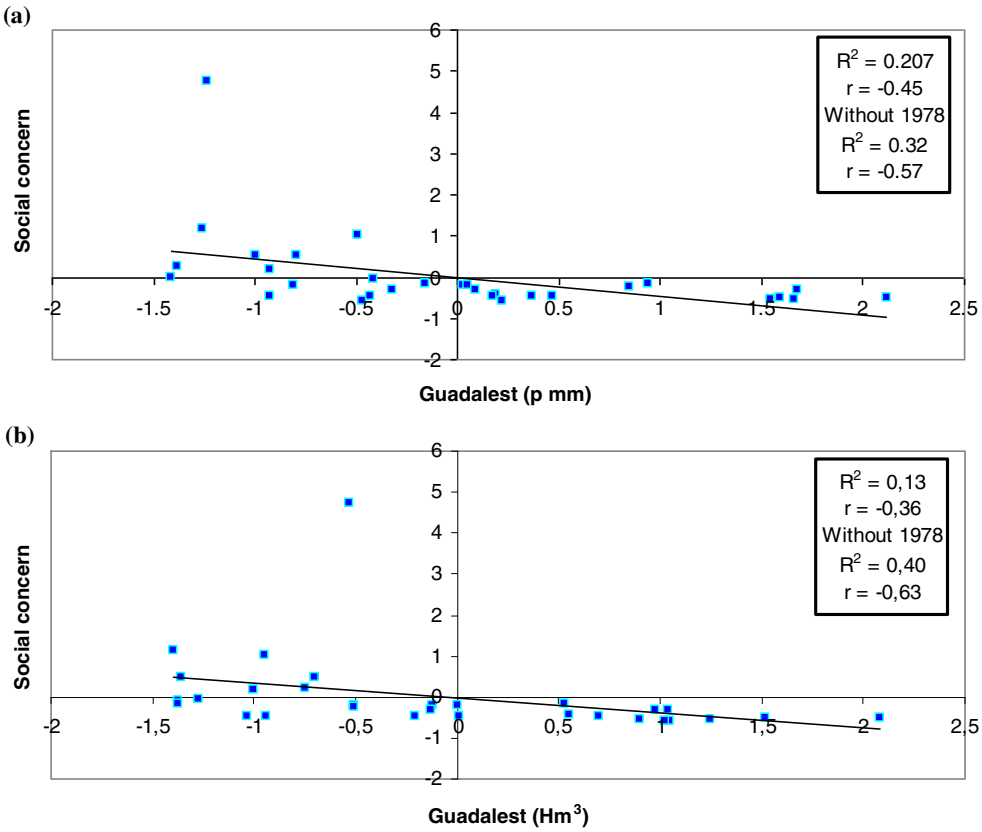

Fig. 4 **a** Public concern and precipitations (mm). Annual *z* values. **b** Public concern and reservoir levels (hm^3). Annual *z* values. Source: local press in Benidorm (*Ciudad* newspaper, 1969–1973, and *Canfali* newspaper, 1974–2003), Marina Baja Water Supply Consortium and Spanish Meteorological Agency (AEMET)

abundant rainfall and water reserves (in particular over the period 1989–1993).

Nonetheless, the number of news reports relating to the water problem has declined over the years. This can be seen by comparing the three most critical periods of low rainfall and reservoir levels and the public concern they created (Table 1) and shows that the city of Benidorm is now less vulnerable to drought. This is clear, for example, if we compare the periods 1976–1979 and 1982–1984. The reduced vulnerability over the period 1982–1984 coincided with the two phases in which the underground reserves from the Beniardà aquifer were tapped (1979 and 1982). The problem was also alleviated by the inauguration of the Benidorm wastewater treatment plant, a last-ditch measure to deal with the potable water shortages of summer 1984. The treated water from this plant helped to increase the supply of water for irrigating crops and of potable water for the population, as farmers agreed to exchange part of their clean water supplies in exchange for treated water.

Table 1 Precipitation, water reserves and public concern (annual *z* values)

Period	*P* (mm)	Hm^3	News
1976–1979 (4 years)	−2.68	−2.30	6.05
1982–1984 (3 years)	−3.56	−3.18	0.92
1999–2001 (3 years)	−2.36	−4	0.31

Source: INM, Marina Baja Water Supply Consortium and *Ciudad* (1974–1977) and *Canfali* (1978–2003) newspapers

The decrease in vulnerability is also clearly visible if we compare 1976–1979 and 1982–1984 with 1999–2001. This was due to three main factors: (1) the potable water supply was made more reliable by connecting Benidorm's supply network with the River Júcar in Cuenca (Spain) during the drought of 1995–2001 (mainly funded by European Cohesion Funds), (2) the approval of Royal Decree 1664/1998 of 24th July 1998 (in particular paragraph 3 of Section C of Article 31), and (3) the emergency application of Royal Decree 8/1999 of 7th May 1999, which amended Article 10 of Law 52/1980 on the Economic Regime governing the Tajo-Segura Water Transfer. This enabled 26.47 hm^3 of water to be transferred from the Alarcón reservoir to the Marina Baja area between April 1999 and January 2002 (source: Marina Baja Water Consortium).

Causes and consequences of the potable water supply crisis in Benidorm in 1978

The most severe water supply drought in Benidorm lasted from 1976 to 1985 (Table 1) and was particularly intense in 1978, in which Benidorm had to deal with the worst situation it had faced since becoming a holiday destination. This

explains why in 1978, the consumption of potable water from the urban supply network fell sharply to the lowest levels for the period 1973–1984 (source: Benidorm City Council).

In order to understand the potable water supply crisis of 1978, we have to look closely at two human factors. The first and most important was the building boom in the city of Benidorm from the 1960s onwards, which took place without any advance planning of water supply needs. This boom was at its height in the period 1969–1973, after the opening of Alicante airport, which led to the arrival en masse of international tourists, above all from Britain. Building was so frenetic that almost half (49.45 %) the houses, apartment blocks and hotels constructed during the period 1952–1983 were built in these 4 years (source: Benidorm City Council). The second factor was the poor management of the reserves in the Guadalest reservoir in 1975, as shown by an analysis of the outflows from the reservoir between July and November over the period 1972–1975: these were 5.8 hm^3 in 1972; 5.9 hm^3 in 1973; 5.7 hm^3 in 1974 and 10.5 hm^3 in 1975 (source: River Júcar Hydrographic Confederation). Under these circumstances, and according to an official question tabled by the Socialist Party to the Spanish government in 1978 (a sign of the severity of the situation), potable water restrictions were first imposed in Benidorm on 13th March (8 h/day) and were increased to 20 h a day on 23rd of August 1978. In fact, on 24th August 1978, Benidorm City Council described the situation as "catastrophic", stating that the city had completely exhausted its supply of potable water. Faced with this situation, local farmers with irrigation rights had begun to transfer some of their reserves of water to the city in the spring of 1978, while during the summer, the hotels had to buy water pumped from local wells or from tanker trucks. The situation was so serious that the Spanish Navy ordered tanker ships (*aljibes* 9, 10 and 11) carrying drinking water to set sail from the Strait of Gibraltar to Benidorm, and the Spanish Air Force also lent a hand from their bases in Murcia, Albacete, Tarragona and Valencia.

Faced with this situation, for a period of 2 months from 3 October 1978, potable water in Benidorm was supplied by two tanker ships from Alicante. According to the minutes of the Benidorm City Council meeting of 9th November 1978, the costs of supplying water in tanker ships were as follows: (1) 28,498,115 pesetas for the building works (1,261,469 constant euros, base 2012); (2) 720,000 pesetas per day for the rent of the ships (31,871 constant euros, base 2012); and (3) 13.5 pesetas per cubic metre (0.60 constant euros, base 2012) for the water sold by the company Aguas Municipalizadas de Alicante.

Evaluating the effects of this potable water supply crisis on Benidorm's tourism sector is a complex task due to (1) the characteristics of a tourism sector dominated by foreign tour operators; (2) the lack of available information; and (3) the prevailing economic, political and social uncertainties arising as a result of the political situation after the death of General Franco (dictator who was the Spanish Head of State from 1938–1975) and the world economic crisis in the late 1970s and early 1980s. An additional problem was the lack of available information given that (1) AENA has no figures regarding arrivals of passengers at Alicante airport by nationality, (2) the Tour Operador TUI could not provide us with data as to the numbers of German tourists visiting Benidorm at that time, and (3) Benidorm City Council had no information about the number of nights spent in tourist accommodation during this period. As a result, all we can hope to achieve is a qualitative approximation as to the repercussions of the water supply crisis of 1978 on the tourism sector in Benidorm.

We will begin by describing the qualitative effects referred to in the local press. In 1978, the press cited the following consequences for the tourism sector: (1) returning home early, (2) cancellation of hotel bookings, (3) the bad image being presented of Benidorm, and (4) that part of the income from the hotel business was being spent on potable water supply in order to avoid imposing restrictions on guests. In the period 1979–1980, there were four news reports in the local press in which it said that Benidorm was receiving lower numbers of visitors as a direct or indirect consequence of the water supply crisis of 1978. A more specific news report was published in the Alicante provincial newspaper, *Diario Información*, on 2 September 1978, stating that the Swedish tour operator Tgaereborg had transferred 1,500 tourists from Benidorm to the Costa del Sol.

A final point of interest was that the Benidorm press has on occasion associated the decline in German tourism with the water supply crisis of 1978, and references to this effect appeared in local newspapers on four occasions between 1978 and 2003. This view has also been repeated in research studies and in particular in papers by Morales-Gil et al. (1999), Rico-Amoros et al. (2009, 2013) and Gil-Olcina (2010).

In order to verify the possible impact of the water supply crisis of 1978 on the number of tourists coming to Benidorm, we analysed the percentages from each nationality of the people making queries at the Benidorm tourist information office between 1969 and 1980, given that as mentioned earlier, we were unable to obtain information from other sources.

Figure 4 illustrates the decline in German, Scandinavian and above all French tourism while the numbers from Holland and Belgium increased substantially. There was also a more moderate rise in domestic and British visitors.

For the two most striking cases (the German and the French market), this decline appears to begin prior to 1978, from 1975 in the case of the German market and since at least 1969 for the French (see Fig. 5). There does not therefore seem to be any relationship between the drop in the number of German tourists and the water supply crisis of 1978, as according to the source we consulted, this decline began earlier. This negative tendency was confirmed by the figures supplied by the Tour

Operador TUI to the local press in Benidorm in 1977, according to which the number of German tourists visiting Benidorm with TUI fell sharply from 17,000 in 1973 to only 8,000 in 1976. The Tour Operator attributed this fall to various factors, namely the energy crisis, political instability in Spain and the lack of complementary tourist activities in Benidorm.

The Spanish Airports Authority, AENA, is another reliable source of information, although there is no breakdown of figures according to nationality. According to data from AENA tracing the history of passenger traffic in Alicante airport between 1969 and 1980, there were four significant slumps, although none of them seem to be in any way related with the water supply crisis in Benidorm. Figures show for example that after a decline in 1976 of 300,000 passengers compared to the previous year, a gradual recovery occurred in 1977 with 50,990 more arrivals, and this was firmly consolidated in 1978 with a huge increase of 282,719 passengers, coinciding with the most severe water supply crisis ever experienced in Benidorm. From 1979 onwards, a new cycle began with a slight fall of 25,011 passengers, a trend that was accentuated dramatically in 1980 with an abrupt drop of 258,233 passengers, in this case as a result of a regressive economic cycle.

Setting aside the various periods of economic recession, we can conclude that the trends in the French and German markets were the result of an array of circumstances related with the massification and banalization of what the city offered to its visitors. This situation was exacerbated by the appearance of new competing destinations in Spain, a priori more attractive than Benidorm. We must therefore conclude that the problems caused by the water supply crisis of 1978 seem to have had less effect on the arrival of tourists with larger spending power (especially from Germany) than that perceived by some sectors of politics and business. It is also important to emphasize that the crisis of 1978 was suffered above all by the resident population and that the hotel sector went to great lengths to ensure a continued supply of potable water for their guests by constructing wells (see Rico-Amorós 2002) and by buying water from tanker trucks.

The type of clientele that chose Benidorm for their holidays was to a large extent the result of four factors: (1) the changes in town planning regulations from 1958 onwards, in which the planners opted for high building density and so-called factory hotels; (2) the fact that many local workers had no professional training; and (3) its limited possibilities in terms of what it offered tourists and the saturation of the resort at certain peak moments, above all of its beaches (according to figures from the Spanish national newspaper *El País*, 150,000 people a day flocked to the beaches of Benidorm in July 1977) and the traffic, in short, the fact that they opted for a standardized model or package. One of the research papers that best captures what Benidorm was really like in the 1970s puts it this way: "the debate between the luxurious garden city proposed in the 1956 Land Use Plan and the reality of hordes of people accommodated in skyscrapers involved two totally contrasting conceptions of life in society between which agreement was impossible" (Gaviria et al. 1977).

As regards the effects of the water supply crisis of 1978 on the numbers of tourists arriving from other countries, we should bear in mind that above and beyond strict economic factors, the arrival of foreign tourists in Benidorm was essentially the result of decisions taken by the British tour operators.

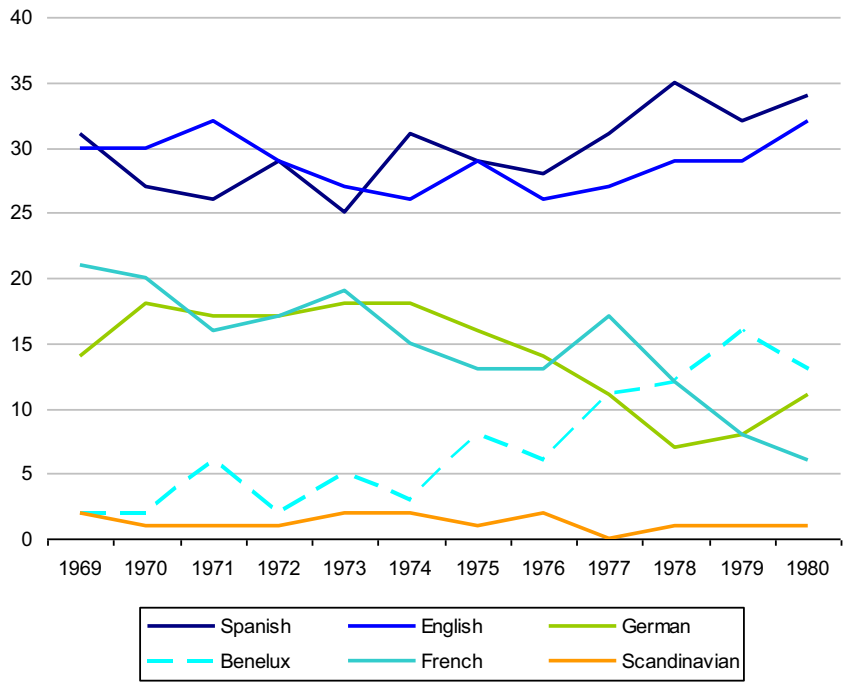

Fig. 5 Percentages by nationality for queries made at the Benidorm Tourist Information Office (1969–1980). Source: Benidorm Municipal Historical Archives

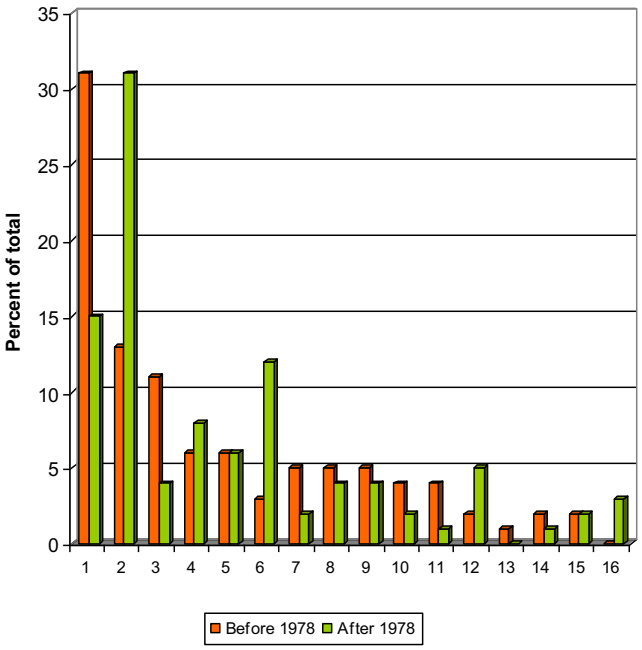

Fig. 6 Tourism issues of greatest concern in the Benidorm local press during the periods before and after 1978. Source: Benidorm local press (*Ciudad* newspaper, 1969–1977, and *Canfali* newspaper, 1978–1985). *1* energy crisis; *2* initiatives to promote the city; *3* type of clientele; *4* lack of state aid; *5* shortcomings in what was on offer to tourists; *6* seasonality; *7* insufficient nontourism infrastructures; *8* general data; *9* saturation; *10* package holidays, tour operators and the importance of Alicante airport; *11* prices of holidays; *12* recovery after economic crises; *13* competition with emerging destinations; *14* lack of professionalism in the hotel sector; *15* news critical of Benidorm; and *16* employment conditions of workers in Benidorm

It seems plausible therefore that the water supply crisis of 1978 was used to put pressure on hotel companies to reduce their prices given the reduction in the quality of the product being offered. The fact is that a fall in the number of tourists visiting the city would also have resulted in financial losses for the tour operators themselves. It is also logical to imagine that for the tour operators, it was easier and cheaper to invest in the improvement of an established tourist resort than to consider promoting new alternative destinations.

Nonetheless, the potable water supply problems in Benidorm may have accentuated to some extent the decline of some of the most demanding market segments. In fact, after the crisis of 1978, there was much greater concern in the local press for the tourist image of Benidorm (Fig. 6).

Conclusions

The diachronic analysis of the local press has proved to be of great value in understanding the water supply crisis suffered by the tourist city of Benidorm and has enabled us to observe how the city's dependence on climate conditions has decreased (elasticity has increased in critical periods) as a result of (1) the more effective use of surface water resources (use of pumping stations in rivers), (2) the exploitation of underground water resources, (3) the optimization of water use in the supply system as a whole (for example, by using treated water in agriculture) and (4) the connection of the Marina Baja supply network (to which Benidorm belongs) with the River Júcar.

In previous research, it was found that the availability of water in the Mediterranean basin is highly dependent on the surface runoff in mountain areas (see García-Ruíz et al. 2011). In our specific case, we have underlined the importance of a nearby mountainous environment, as did Kent et al. (2002) in the case of Mallorca.

Our results show a positive relationship between the volume of water stored in reservoirs and high precipitation episodes. This means that periods of heavy rainfall are essential for ensuring the water reserves in the area. In fact, when analysing the hydrographic area to which Benidorm belongs, Pérez-Cueva (2001) found that rainfall levels must be greater than 30 mm/day in order to become water resources, i.e. surface and underground runoff. From an atmospheric point of view, we have confirmed a relationship between precipitation and the WeMOi index. This index could therefore be used in the study area to plan water supply and demand a year in advance.

As in other holiday destinations (see Smith 1992; Hof and Schmitt 2011), continuous growth has led to water shortage problems. As De Stefano (2004) points out, this is often because the authorities responsible for water management do not normally propose that tourism growth be controlled. In the case of Benidorm, we found (as indicated by De Stefano 2004; Rico-Amorós 2004; Deyà-Tortella and Tirado 2011) that growth in tourism was associated with a search for new resources to satisfy the increased demand and that in times of severe drought, water restrictions have been imposed and water has been transferred from other areas (see Gómez et al. 2004). In Benidorm, as in other parts of Spain (see Rico-Amorós 2004), a traditional water policy (*Política Hidráulica Tradicional*) has prevailed, based on increasing the supply of water in order to respond to increases in demand, a policy which Barceló and Sabater (2010) define as technology-driven. Savings and efficient use have also been promoted (ecosystem-driven, according to the definition by Barceló and Sabater 2010), and in some cases, the two approaches complement each other (Barceló and Sabater 2010). For example in Benidorm, the losses in the drinking water distribution network due to leakages are less than 10 %, whereas in north-west Spain, figures oscillate between 15 and 40 % (Rico-Amorós et al. 2013). In addition, in Benidorm, many hotels have installed small desalination devices to enable them to use salty water from the aquifers. They

also normally use efficient water systems in toilets and bathrooms (Rico-Amoros et al. 2009).

As a result, the seriousness of the water shortage situations in Benidorm depended not only on the lack of episodes of high rainfall but also and fundamentally on the possibilities of the existing water supply infrastructure to exploit other water resources. Finally, as in other Mediterranean areas (see Plan 2004), the problems arising from high water consumption in dry coastal areas were resolved with water transfers from inland rivers, although in the case of Benidorm this only occurred during exceptional drought situations.

Despite the concerns expressed in the local press, we have not observed a clear cause-and-effect relationship between the water supply crisis of 1978 in Benidorm and the decline in tourism from Germany. In this case, we believe that the most important factor shaping the type of clientele that visited the city were the amendments to the Benidorm Land Use Plan from 1958 onwards, in which the city opted for a standard model that would attract primarily British package holidaymakers.

It is true that the crisis of 1978 reduced the revenues from tourism in the city and substantially increased local government costs (in both cases due to the economic burden required to deal with the potable water supply problems). In the mid and long term, the water supply crisis of 1978 may have helped to consolidate the image of Benidorm as a mass tourism destination with problems of saturation and insufficient infrastructure and facilities, which was unattractive to a richer, more demanding kind of tourist.

Should a severe dry period appear in the near future, it would be tackled via the connection between the Marina Baja supply network and the Mancomunidad del Taibilla, previously used between 1999–2002 for the Júcar-Marina Baja emergency water transfer. Although in this case, they would probably also use desalinated water from the Muchamiel desalination plant (see Aguas de las Cuencas Mediterráneas, acuaMED 2007) near the city of Alicante. In fact, in parts of the province of Alicante (Spain) in which there has been a lot of tourism-related urban development, they have been using desalinated water since summer 2003. This water comes from two plants which together provide about 42 hm^3/year (Rico-Amorós and Hernández-Hernández 2008). In this sense, it is important to point out, as did Downward and Taylor (2007) that desalination helps ensure self-sufficiency and independence when combatting climate variability (droughts) and climate change and inspires confidence in potential investors. A potential drawback is that desalination is often expensive in that it is sensitive to increases in energy prices (Kallis 2008), although it remains a useful additional water source, especially in times of drought.

Our research shows that during the period we analysed, Benidorm suffered several water supply droughts to which it responded with increasing effectiveness, so reducing the city's vulnerability to drought. We believe that Benidorm's status as an iconic holiday resort makes it of particular interest as a case study and that the method and techniques applied in this research could also be used to analyse similar situations of water supply droughts in other tourist destinations.

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