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ORIGINAL ARTICLE

European inland waters
The history of seafaring, shipping, and shipyards at the Lake Balaton

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Abstract – Maritime history and development of waterways is often perceived as a mostly marine issue including activities linked directly to the oceans and seas and their coastal zones. However, inland waters and waterways constitute an important landscape-forming factor in terms of transport, wetland formation, watercourse regulations and flood prevention, agriculture, forestry, fishery, settlement structures, tourism and a number of related services. Lake Balaton in western Hungary is a unique environment regarding its geology, biodiversity, water resources (including springs and thermal waters) and rich cultural heritage. Inland navigation has greatly contributed to the development of settlement structures and trades in the region already from Roman times, but only with the appearance of steamboats and the internationally renowned shipyards the shipping of goods and personal transport reached a larger volume. Since Lake Balaton is a shallow lake, producing ships (both sailing boats and larger vessels) was a technical challenge. The largest shipyard around the lake was in the town of Balatonfüred with some ancillary facilities in Siófok. With the continuous development of railway traffic first on the southern and later on the northern shore successively replaced the goods transport on the lake and changed the system of its water level control through the Sió-channel. In this study, we analyse the development of inland navigation on lake Balaton and its influence on trade and settlement structures and cultural heritage in the region, the connections to international inland waterways through the Sió canal and the River Danube and the changes of ship building industry during history. The article is based on a number of studies on the history of Lake Balaton and a specific focus is put on the industrial era and how international influences have been instrumental in this development.

Keywords – inland waterways, European Landscape Convention, Lake Balaton, Festetics family, Sió Canal, European waterway

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INTRODUCTION

When studying maritime history, development of navigation and ship building industry, mainly coastal communities and maritime activities related to the oceans are concerned. However, the inland waterways (rivers, canalised rivers, artificial canals and navigable lakes) form an important component of the European landscape, representing valuable natural and cultural heritage. Landscape as well as heritage, following The European Landscape Convention and the Faro Convention, need to be understood as historically based phenomena to be used as instruments for democracy and sustainable development (Council of Europe, 2000; 2005). This requires however, research to improve the society's ability to work in a concrete manner with landscape and heritage issues on all levels, and an interdisciplinary approach is necessary (Council of Europe, 2018, p. 96). An important starting point in this endeavour is to capture the historical development, the key components, and the patterns of influences that has governed the development of settlement structures in the vicinity of waterways, inland navigation, trade, ship building industry, and formation of cultural landscapes as results of anthropogenic activities. Here an important geographical area is presented, centrally positioned on the European continent – the Lake Balaton.

Lake Balaton in Hungary (Fig. 1) is the largest lake in Central Europe with an area of 600 km² and a catchment area of 5,775 km² that includes all rivers, streams, and marshes. The length of the lake is 78 km, the total length of the coastline is 235 km, and the average width 7.7 km, the water mass is about 2 billion m³ while the average depth is only 3.4 metres. Its deepest point is the bottom of the ditch of the Tihany Strait, the so-called "Tihany Fountain", where the lakebed is about 11 - 12.5 metres deep (Balatonland, 2020). The actual water depth varies however, due to water level fluctuations and sediment transport. The lake was formed geologically on sedimentary rocks deposited in the Mesozoic, which are

associated with the formations that make up the material of the Alps (Rónai, 1969).

Figure 1. The location of Lake Balaton in Hungary[1]

Geologically, it is a shallow-water trench-lake of tectonic origin, a series of depressions in the north-eastern-south-western direction in the south-eastern foreland of the Transdanubian Mountains. Thus, the lakebed is a polygenetic pool formed as a result of intermittent subsidence in space and time (Fig. 2). Lake Balaton does not consist of a single bed, but of at least 3-4 sub-basins, which may have been formed approximately 17-15 thousand years BP on sedimentary rocks deposited in the Mesozoic.

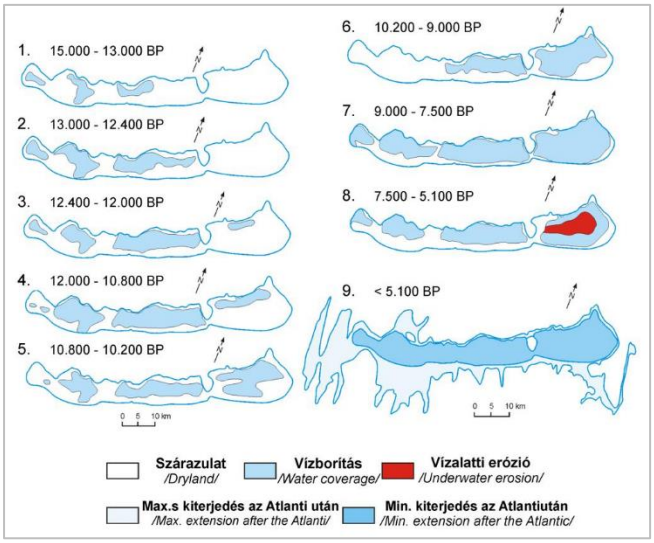

Figure 2. Development of Lake Balaton based on pollen statistical analysis and geophysical measurements based on studies of Cserny & Nagy-Bodor 2000). 1= Dryas-I.; 2= Bölling; 3= Dryas-II.; 4= Alleröd; 5= Dryas-III.; 6= Preboreal; 7= Boreal; 8= Atlantic; 9= Subboreal, Subatlantic. (Visnovitz, 2015)

The basin of Lake Balaton is part of a series of depressions in the north-eastern-southwestern direction in the southeastern foreland of the Transdanubian Mountains. The lakebed is a polygenetic pool formed as a result of intermittent subsidence in space and time. These "drawer basins" were separated by sills that were "broken down" and opened together by water erosion (rippling). This can be dated to 5,000 years BP. Thus, there can be up to 10 kyr BP between the formation of the lakebed and the permanent, uniform water cover. Today, the water level of Lake Balaton shows a regulated state, but throughout its history, mainly due to climatic and / or human influences, its water level has shown significant changes several times (Kutics, 2020).

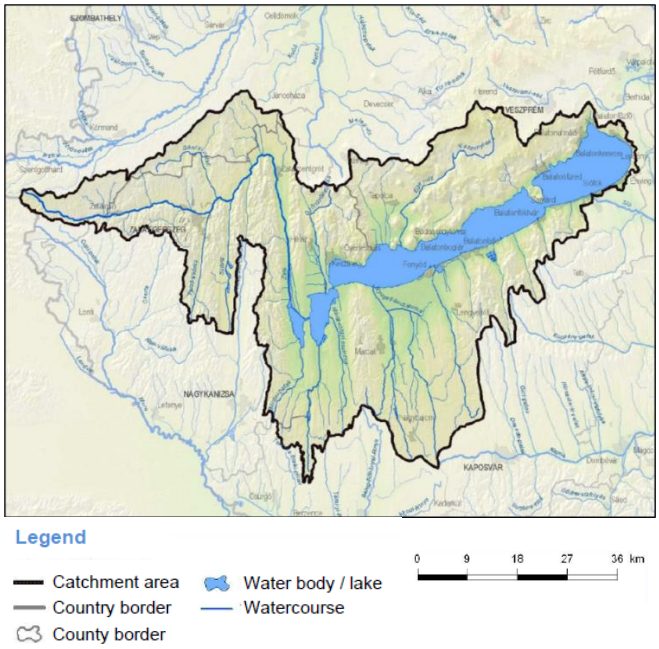

Figure 3. The catchment area of Lake Balaton[2]

Over the years, many renowned researchers have been working to describe the lake and its immediate surroundings, which has proven to be a multidisciplinary task involving many disciplines (Lóczy 1913; Cholnoky, 1936; Cserny, 2002).

The water level of Lake Balaton is regulated by the Siófok drainage sluice. The drainage capacity of the structure is theoretically 80 m^3 / sec, but due to the riverbed condition of the Sió canal it is only 50-60 m^3 / sec. The reconstruction of the drainage sluice has been partially completed in recent years, but the renovation of the ship's sluice and the reorganization of the Sió canal do not tolerate further postponement. Investment in the new triple structure ensemble (Balatonkiliti riverbed dam, Siófok ship sluice, Siófok drainage sluice) has been decided. The shoreline of the lake is 235.6 km long, of which 128.1 km is natural shore and 107.5 km is protected by shore protection. The length of the permanently built shore protection is 85.23 km, and the length of the section with temporary protection (rock reventment) is 22.7 km. There are 20 ports and about 140 boat ports in the 43 coastal settlements of Lake Balaton. According to the

[1] http://magyarorszag.terkepek.net/

[2] http://www2.vizeink.hu/files/Reszvizgyujto_VGT_Balaton_13.pdf

2016-2017 survey, the area of reeds outside and within the legal shoreline is 1662 ha in total, it is recommended to maintain this reed surface with ecologically adaptive design and professional reed management (Central Trans-Danubian Water Management Directorate, 2020).

The inland waterways do not only represent heritage properties that are or could be highly valued in society, but they also represent potentials for developing sustainable infrastructures for both cargo and passenger traffic. Lake Balaton together with the Sió canal and the Danube, obviously holds such potentials not the least in developing sustainable and attractive transportation systems within the destination industry. However, regarding the possibilities of future development, water level fluctuations, evaporation, sedimentation and water replenishment solutions will have to be taken into consideration in view of climate change.

shallow, it stretches over a large geographical area and an early interest arouse for using the lake for shipping of goods and persons, not excluding military purposes. As early as Roman times, about 2,000 years ago, wealthy Romans established themselves in the province of Pannonia, around Lake Balaton through the construction of private estates (Sági and Zákonyi, 1989). Pannonia was one of the provinces of the Roman Empire. It was bordered on the north and east by the Danube, on the west by Noricum, first a Celtic kingdom and then a Roman province, and its southern border stretched about 30 to 50 km south of the Sava River. Its western border - due to the need to protect the Amber Road, shifted westwards over time and thus became more permanent. Its territory is present-day Eastern Austria, the Devian-Bratislava area of Slovakia, northern Slovenia and the south-western part of the Carpathian Basin, i. e. the western part of Hungary (Transdanubia), northern Croatia, part of northern

Figure 4. Roman provinces of Illyricum, Macedonia, Dacia, Moesia, Pannonia and Thracia (Droysen, 1886)

EARLY HISTORY

Due to the proximity of the Bakony and the Alps, it is the cleanest air area in Hungary. Even though the lake is very

Serbia (Macsó district and Vojvodina area) and the northern part of Bosnia and Herzegovina (Fig. 4). During the 4th century the Romans transported stone blocks by boat from a quarry in the north across the lake for the construction of the

southern fortification Valcum, which is today's Fenékpuszta near Keszthely (an archaeological site today).[3]

This fortress was one of the supply depots established in the hinterland of the province of Pannonia, far from the border (limes). At the time of its construction, the fortress still had a bright future, since it could have become a well-fortified real city with a harbour, next to an extremely important road, and later even an episcopal seat, and so on. However, history changed the circumstances so that not even the exact name of this place was recorded, or at least the research has until recently been unable to identify how and how many purposes these buildings were raised. According to recent research work thanks to new excavations, the fortress was a 15-hectares large, high-walled structure with 4 gates and reinforced with 44 round outer towers, with an irregular square floor plan, with side lengths nearly approaching 400 metres. To date, we know of 27 stone buildings of various sizes and floor plans, including those serving representational, economic, cultic and other purposes. In the centre of the area enclosed by the walls, and at the intersection of the passageways, stood an arch of triumph. (Heinrich-Tamáska et al. 2012).

Ferry routes across Lake Balaton were established already in Roman times. The ferry was initially a larger sailing ship that could only carry a few people. The crossing was not important at first, as the Tihany peninsula often became an island due to fluctuating water levels. However, the military route of the Romans stretched on the north shore, close to the water, the protection of which was essential for them. Roman engineers created a drainage system around today's Siófok (in fact the ancient predecessor of Sió canal) that was able to drain the water of Lake Balaton into the Danube. With this, they were able to ensure even water levels, so Tihany was no longer an island, and the northern military route became always usable (Bíró, 1996; Némethy et al. 2016). After the founding of the Tihany Abbey in 1055, the next significant step in the development of ferry transport occurred, as the abbey estate has undergone significant improvements. It became necessary to sell and exchange crops for other products, and since the estates of the Tihany Abbey were not only on the peninsula, it was also an important goal to reach the estates on the south coast. At the tip of the peninsula, going up from the ferry port, a ferry village called Újlak was established on the hillside in the 12th and 13th centuries. In Szántód, a huge, flat area at that time called Szántódpuszta, another ferry village was also founded. The ferry was a huge wooden ship that could use oars and a large sail to get people on foot or in a chariot to the other shore. The ferry usually rested in the sheltered bay of Tihany. Those who wanted could easily get through from Tihany, but the traffic from Szántód had to wait. Those who wanted to get through Szántód reported at the ferryman, who informed his comrades of Tihany with smoke signals. More developed ferries were used according to archival material, that indicates that four ferries served Lake Balaton during the period from 1795 to 1815 thanks to the aforementioned development by the Festetics family (Bíró, 1996).

During the 5th century, the influence of the Roman Empire was significantly weakened in the area, despite the prosperity of the economy. This was followed by some turbulent centuries and during the years 895-907 the Hungarians invaded the Carpathian Basin eventually reaching Lake Balaton where the Grand Duke Árpád settled in the Balaton Highlands. (Bodrossy, 2001)

The Hungarians dominated the area from the 10th century onwards, but after the emergence of the Ottoman Empire in the late 13th century, conflicts escalated and fighting soon broke out in south-eastern Europe. The Ottoman Empire based in present-day Turkey expanded rapidly, encompassing at most the Middle East, Asia Minor, northern Africa, the Caucasus, and south-eastern Europe. In the early 1520s, the Ottomans attacked the southern Hungarian border fortress system with great vigour and successfully broke through it. This was followed by an attack on the interior of the country in 1526, which led to the defeat of Mohács and the subsequent disintegration of the United Kingdom of Hungary. At that time, the Ottoman troops withdrew from Buda, and after the unsuccessful siege of Vienna in 1529, no occupying force remained in the central part of the country. After the outbreak of the Hungarian Civil War in 1541, the Ottoman Empire took advantage of the political turmoil and occupied Buda. With this, the Kingdom of Hungary was divided into three parts: the Royal Hungary, the Eastern Hungarian Kingdom (from 1570 the Principality of Transylvania) and the territory of the Ottoman occupation. The occupied territories were administered from Buda. The Peace of Adrianople (1568) established the border between the Habsburg Monarchy and the Ottoman Empire in the line of Lake Balaton, which did not change until the end of the occupation (Fig. 5).

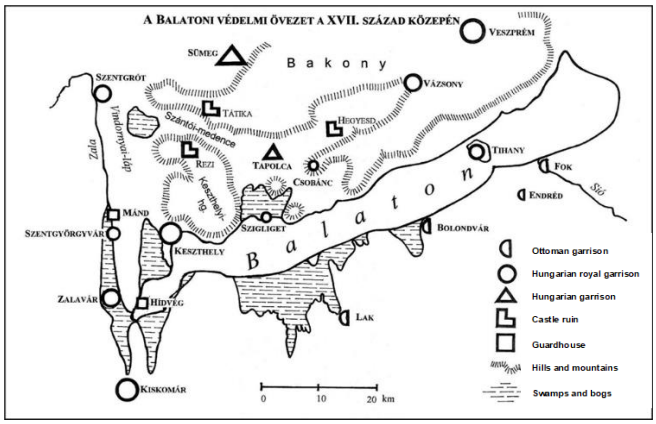

Figure 5. The Balaton protection zone in the middle of the 17th century (Végh, 2016).

The lake, which was much larger in extent in those times than it is today (Fig. 5), was a natural barrier between spring and autumn for the Ottoman troops who were making forays. In

[3] http://fenekpusztacastrum.pe.hu/

order to bridge this gap, the Ottomans used boats (pinnaces) as early as the 1550s, which were equipped with oars, sails and small-caliber guns and were suitable for the transport of about 30 soldiers. The Ottoman warships were stationed first in Bolondvár, then in the port of Siófok, which was built in the first years of the 17th century. In response to the Ottoman step, the Christian army sent warships to the border castles on the north shore, such as Keszthely, Szigliget. and Tihany and Fonyód on the south shore. In the aforementioned border castles - due to the small size of these garrisons – only a few boats could operate, which were brought to their destination by carriages from both sides of the Danube. The most important, and almost exclusive task of the Ottoman and Christian navy was to secure the transport for their garrisons between the northern and southern shores of Lake Balaton. Their importance was therefore secondary compared to the fleets that were in operation on the major rivers of the occupied territories (Danube, Tisza, Drava). Regarding the seafaring on the Lake Balaton, there is only sporadic information about its extent from this time, but the lake's strategic importance during the 16th and 17th centuries became clear when the opposing powers, the Ottoman Empire and the Habsburg Empire, had their warships and naval bases established on Lake Balaton (Végh, 2016; Némethy et al. 2016). On the Ottoman side, the widespread use of warships took place only after the last campaign of Sultan Suleiman I (1520-1566), the main result of which was the capture of Szigetvár. After the loss of the Szigetvár, which was protected to the very end by Miklós Zrínyi, the Hungarian border castle chain in Somogy county also collapsed, so the conquerors could finally set foot on the southern shore of Lake Balaton.

Figure 6. Reconstruction of a pinnace from the 16th – 17th century (Végh, 2016)[4]

Next to the castle of Lak, which also fell into their hands at that time, the conquerors already erected a fortress called Bolondvár (Fool's Castle) in the inner area of today's Balatonszemes, and another one at the Sió sometime in the early 1600s. The last two Turkish border castles probably had a fleet from the very beginning, which posed a constant threat to the soldiers of the Hungarian border castles and fortresses and to the population of the settlements on the other side. The backbone of the opposing parties' lake fleet were the pinnaces, which in the 17th century were mostly called Sajka, by a word borrowed from the Ottoman-Turkish language. The type of ship used on the Danube and its tributaries and later on Lake Balaton, was this fast-moving warship, 17-23 metres long, 2.5-3.5 metres wide, without a deck, equipped with oars and a triangular sail (Végh, 2016). The crew consisted of 33 people under the command of a *voivode* or a Turkish side a *reis*, but they used even smaller vessels, so-called paddle-boats or half-pinnaces with fewer oars. Two cannons were placed in the noses of the pinnaces used on the Hungarian side, and a small-caliber cannon was placed in the rear. The Ottoman ships differed from their Hungarian counterparts in that they had only one single cannon in the bow. Although the pinnaces were basically designed for river conditions, for practical reasons, both the Ottoman and Habsburg armies used this type of ship on Lake Balaton. Ottoman pinnaces organized on Lake Balaton could certainly have been made in the 1530s by one of the various types of shipyards along the Danube River including shipbuilding workshops in Szendrő, Zvorniki, Pozega, Osijek or the increasingly important Belgrade shipyards (Đulderan, 1983). The Ottoman global traveller Evliya Çelebi (1611-1684) wrote in his travel guide *Seyahatname*, about the boat traffic on Lake Balaton composed of between 40 and 50 vessels that carried traders and goods between the coasts of the lake (Végh, 2016). The Pest workshop, which also accommodated shipbuilders in Visegrád, was only able to significantly increase its capacity by the second half of the 16th century, but the decline in the number of craftsmen employed there suggests some decline in the first decades of the 17th century (Hegyi, 2007). It can be assumed, therefore, that most of the Ottoman ship fleet at Lake Balaton later came from workshops processing the timber of the oaks near the Danube, the Sava and the Drava. This is supported by the information from 1644 that the Ottomans had brought ships to Lake Balaton "from below" i. e. from the Danube (Végh, 2016). The boats towed on the Danube were certainly transported by carts to the southern shore of the lake, as Sió, which drains the excess water from Lake Balaton, was made navigable later, only by the river regulations.

Until the second half of the 19th century, there was no significant shipping or seafaring on Lake Balaton. The Englishman John Paget, who was an experienced traveller, wrote in 1839 the following:[5]

"It is difficult for an Englishman to imagine a fine inland lake of this kind, totally useless for the purposes of commerce or pleasure. I believe there is not a single trading barge, and certainly not one sailing-boat on the whole lake! /.../ Their rivers and lakes seem to be of more use to them when frozen than when fluid; for, on observing to a gentleman of this

[4] https://missiles.blog.hu/2016/04/15/a_balatoni_hadiflotta_a_torok_korban

[5] Paget, 1839, p. 265

neighbourhood how extraordinary it was that they did not use the lake as a means of communication, 'Oh!' he exclaimed, 'we do in winter; we drive from one end to the other of it, as if it were a road'".

Paget had a few years earlier married the Hungarian baroness Polyxena Wesselényi Bánffy, and he was actively involved in projects to improve agricultural practices in the Hungarian-Transylvanian area, and he also participated in the Hungarian war of independence in 1849 (Bökös , 2017, pp. 87-98). However, the lake Balaton was, in spite of Paget's observations, served by some larger sailboats in the 18th century, and there were three ferry crossings. Most of these activities were run by the Croatian-Hungarian royal family Festetics, the most prominent noble family in the Balaton region, which did a lot for the development of the region in. The Festetics are of Croatian origin, to be precise, Turopolys. Their first known ancestor, John, is mentioned in the late 16th century. The family received a noble coat of arms from Matthias II. Pál Festetics first settled in Hungary in the middle of the 17th century (Bíró, 1996).

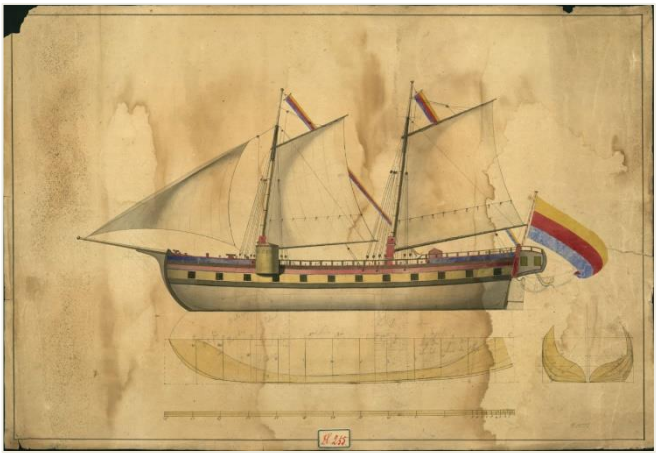

Figure 7. The salt-carrier galley Kristóf – drawing by Antal Bori around 1800. Plan-repository of the Hungarian National Archive, retrieved from Festetics family documents No. 255.

Figure 8. Model of the salt ark Kristóf at the Balaton Museum in Keszthely. Photo: Sándor Némethy

The first large cargo sailboat on Lake Balaton, the ship called Kristóf (Figs. 7 and 8), was launched in 1753. The "salt ark", that is, the salt-transporting galley, could ride in oars during the windless silence, transporting salt from Balatonkenese to Keszthely, and carrying wood, wine and other products backwards. In the 1790s, György Festetics (1755-1819) began large-scale shipbuilding. It was then that the Italian engineer Antal Bori (1764-1835) moved to Fenékpuszta (now the outskirts of Keszthely) as a "trained shipbuilder" in Trieste and established a shipbuilding plant with Italian carpenters (Török, 2012). The largest sailboat on Lake Balaton, the other salt ark, Phoenix was probably designed by engineer Sámuel Sebestyén, and he also compiled the budget in January 1796. Sebestyén's drawing is from the year 1796. We know his plan for a ship to be built in Keszthely only from the literature, in the archive of the Festetics Castle Museum the versions of the plans drawn by Antal Bori were kept and now the original drawings are stored in in the Plan-repository of the Hungarian National Archive. According to the minutes of the meeting of the Directorate, a model of Phoenix was also made, which was placed in the library of the Festetics family at the end of 1797. The Phoenix (Figs. 9 and 10) was built in 1796 under the direction of Antal Bori and was launched on July 15, 1797.

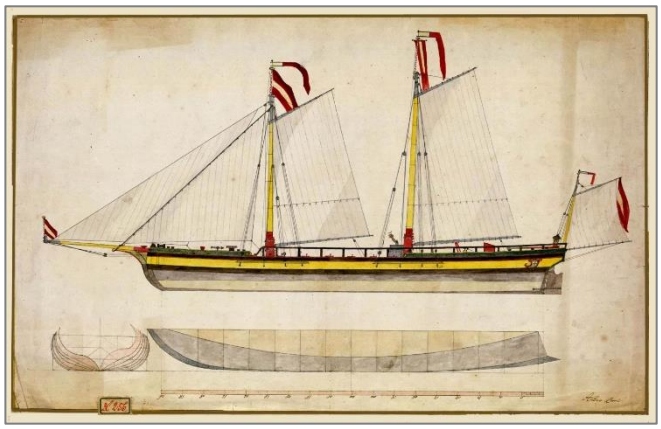

Figure 9. The galley Phoenix – drawing by Antal Bori around 1800. Plan-repository of the Hungarian National Archive, retrieved from Festetics family documents No. 256.

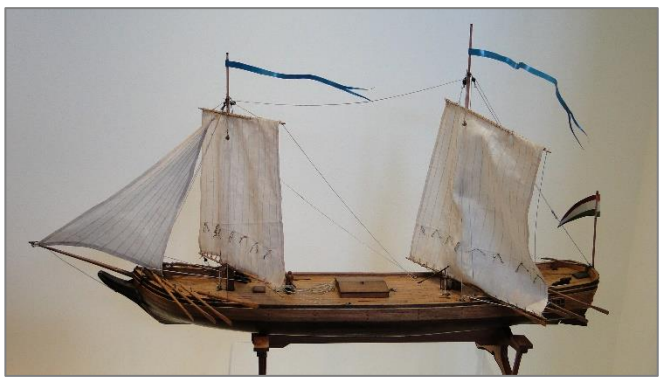

Figure 10. Model of the galley Phoenix exhibited at the Balaton Museum, Keszthely. Photo: Sándor Némethy

According to a ship inventory dated August 7, 1798, known from the literature, the Phoenix was a 32-metres-long, 6-metres-wide, two-masted, 16-oars boat. It got its name from the writer József Takáts (1767-1821), the educator of László Festetics, who in one of his poems likened the ship to the resurrected phoenix, suggesting that it was made using parts of the dismantled ship Kristóf. Often Antal Bori himself steered the ship, which was used not only for cargo but also for passenger transport, and ceremonies with prominent guests were held on board.
The Festetics family played a key role in the development of the Balaton region in terms of agriculture, animal husbandry and particularly horse breeding, agricultural education, regional development, local industry and crafts and ship building industry and development of trade and transport – mostly on the lake Balaton. In line with their interest, the Festetics family financed the construction of several boats and ferries. The inventory of 1798/1799 mentions a sailing mail ship under the hands of Antal Bori, and four old ships and a mail ship in the hands of ferrymen. The inventories of 1803 and 1804 list a "service boat" and a mail ship among the "ship-devices," and the inventories of 1807-1808 list a "larger mail ship" and a "smaller mail ship". In 1812, instead of the "larger mail ship" that was sold, another smaller mail ship was built (Török, 2012).

At the beginning of the 19th century, the road network around the lake was rather undeveloped and transport by horse-drawn vehicles took far too long. Ferries were therefore the preferred and economically justified option. Boat traffic on Lake Balaton thus constituted the predominant mode of rational transport for a relatively short period in the 19th century, as railways began to be built between eastern and western Hungary during the second half of the 19th century. Thus, boat traffic along Lake Balaton soon became, as it is today, more focused on leisure.

THE ERA OF STEAMBOATS

The river Danube has an ancient history as an important infrastructure on the European continent, and with the technological development during the 19th century, the opportunities with improved transportation of cargo and passengers became vital. In 1813, King Francis I of Hungary and the Czech Republic issued a decree to encourage navigation in the Habsburg Empire, promising a patent for rivers to those who present a usable steamer. After several failed attempts, the first small, short-lived steamboat, the first Danube steamer Carolina anchored in the port of Pest on September 2, 1818. Carolina (named after the monarch's wife) was built in 1817 by Antal Bernhard, a citizen of Pécs - a tenant of the Osijek ferry customs - in the village of Sellye near the river Dráva. The ship was made of good quality Slavonian oak, 13.37 meters long, 3.16 meters wide, and had a draft of 1.02 meters. Its machinery was also partly made by Bernhard, powered by a pendulum-free, reciprocating steam engine with 24 horsepower (18 kW). Bernhard was the first to use a piping system to generate steam and even patented his controlled paddle drive wheel system. Carolina also preceded its age with its steam winch, which was used for towing.

The ship made its first test voyage on March 21, 1817, and on its second test voyage, towing a raft loaded with 4880 kg cargo, it reached a speed of 3.4 km / h upwards and 17 km / h downwards on the Danube.

Already in May 1817, the boat was presented in Vienna. The presentation was followed by an official exam on July 21, which was successful in all respects.

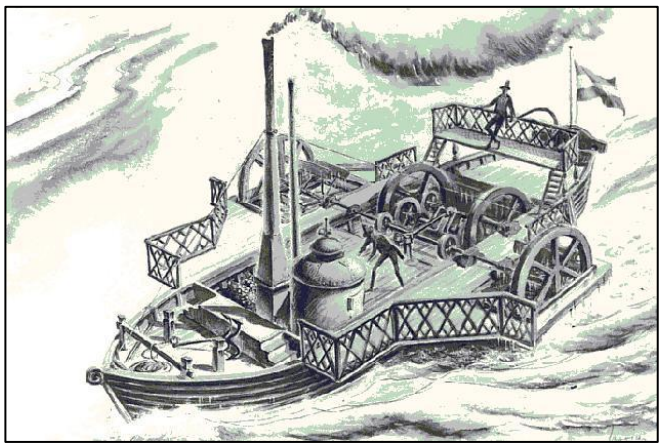

Figure 11. The first Danube steamer Carolina (Czére, 1997)

The low wood consumption of the boiler and its double safety device were highlighted (boiler explosions were common at the time). The low draft of the ship was a definitive advantage on the river Danube, full of stumps, reefs and other obstacles. The ship was first intended to be used as a tug, but its performance was not enough, so it carried passengers between Pest, Buda and Óbuda. The ship and its barge were able to complete two voyages a day and was used only during the sailing season because the bridge was cheaper, so it had few passengers. Therefore, Carolina did not take part in the transport of Budapest the following year either, its owner took it back to the river Drava, where it was seen as a wreck in 1824. Thus, to satisfy the requirements of the royal decree, more powerful ships were needed.

The problem was solved by two Englishmen, who came to Vienna and declared that they could meet all the requirements of the royal decree. John Andrews and Joseph Pritchard established in 1830 the Danube Steamship Company (originally Danube-Dampfschiffahrts-Gesellschaft, DDSG) for passenger and cargo service between Budapest and Vienna (Sutter Fichtner, 2009). Andrews and Pritchard received the royal privileges and permission to design and commission a new steamboat. By now, most people understood that the previous failures were caused by machine faults due to faulty construction. Andrews and Pritchard therefore decided to order a strong, well-proven steam engine from one of Europe's best machine factories, Boulton & Watt in England. The company was a partnership, set up in 1775 between the English manufacturer Matthew Boulton and the Scottish engineer James Watt (Britannica, 2021). Watt had improved the older Newcomen engine by introducing a separate condenser to increase fuel efficiency, thereby providing business opportunities by producing steam engines for diverse uses within the growing industrialisation.

Pritchard had good experience with this manufacturer, as he equipped his boat, Léman manufactured for Lake Geneva in 1826 with the same steam engine. The investment in steamboat traffic, however, required extensive financial resources that the English could not obtain on their own. They therefore set up a limited company whose share capital was set at 100,000 forints and which was to be covered by the income from an issue of 500 shares of 200 forints each. On January 24, 1829, they sent out a mass letter to persons perceived to be in power, such as aristocrats and significant businessmen in the Habsburg monarchy, to receive the desired amount. The initiative was a success, and on March 13, 1829, at the first general meeting of the DDSG, the company received promises of both continued financial as well as strong political support. (Sutter Fichtner, 2009, p. 80) The DDSG thus became a determining factor for a century in the economic and social integration of the Danube region. The most influential person who supported the development of steamboat traffic on the Danube was Count István Széchenyi, who decided to expand steamboat traffic to the Black Sea and from there on to Odessa and Istanbul. To find out about geographical, social and economic conditions along the Danube, he made a trip on the river in 1830 to the Black Sea. His travel diary contains preserved valuable and critical observations regarding the people's poor living conditions and social conditions as well as the technically underdeveloped boat traffic (Czére, 1997). Count Széchenyi was himself a shareholder and supported the company with significant sums. In the 1840s the DDSG had expanded comprising 41 vessels with annual transportation figures amounting to 850,000 passengers and ca. 200 000 tons of cargo. Besides shipping the company became engaged in waterways, railroads and mining, and up to the World War I. it was the world's largest inland shipping company (Sutter Fichtner, 2009, p. 80).

Figure 11. Model of the Kisfaludy paddle steamer at the Balaton Museum in Keszthely. Photo: Sándor Némethy

After the successful development on the Danube, Count István Széchényi began work on preparing steamboat traffic on Lake Balaton as well, as he was the most active contributor to the launch of the Kisfaludy paddle steamer, but also to the founding of the Balaton Steamship Company on April 5, 1846. However, the idea originally popped out of Lajos Kossuth's head, who in 1842 put forward his ideas for the development of the lake in Füred, and later he also drafted the statutes of the Balaton Steamship Company. In a letter from 1846, Széchenyi argued for steamboats instead of outdated sailboats in the country's largest lake. In April 1846, the first general meeting of the Lake Balaton Steamboat Society was established and István Széchényi was elected president. The hull of the very first steamboat, the Kisfaludy, named after the poet Sándor Kisfaludy, was manufactured at the Óbuda shipyard in Budapest while the 40-horsepower machine was imported from John Penn & Sons in England. John Penn had started his company in 1799, initially focused on agricultural engineering up to the 1830s when Penn's son, also named John Penn, started specialising in marine steam engines with oscillating cylinders (Science Museum Group, 2021). The Kisfaludy (FIG. 11) was constructed as a side paddle steamer with a capacity of 200 passengers, which was a considerable amount for that time. The ship operated regularly from 1846 to 1887. The boat's first-class saloon was designed according to guidelines from Mrs. Széchényi (i. e. Countess Crescence Seilern-Aspang), with white and gilded interior panels, mahogany poles and mirrors. There was also a dining room and library on the boat. By the middle of the 19th century, tourism was concentrated almost exclusively in Balatonfüred and Kisfaludy transported travellers mainly to and from Balatonfüred.

The construction of the southern railway opened more extensive connections between Lake Balaton and other parts of the country. The town of Siófok on the south coast became a popular tourist destination that contributed to an increasingly rapid regional development. Organised boat traffic resumed in 1852 after the war of independence in 1849. After 1863, Kisfaludy only transported passengers between Balatonfüred and Siófok; and eventually was taken out of service in 1887 (Bíró, 1996).

Before the Kisfaludy was taken out of service, Lake Balaton's first propeller-driven steamer Balaton was built. The passenger carrier, which could accommodate 50 people, was recorded as "Zala-Somogy", but was also mentioned as Balaton in the very first news. The ship was ordered and owned by the newly formed shipping company Zala-Somogy Steam Ship Society (Bíró, 1996). The company went bankrupt in 1876 and the boat was moved to the Danube and continued a truly adventurous life. After several rebuilds, name and ownership changes and over 100 years of service, the boat was moved back to Lake Balaton in early 1981. Today, fully renovated, in a worthy environment, the ship operates as a museum in the port of Balatonboglár, introducing visitors to its own history and the history of steamboat transport on Lake Balaton. The ship serves as a venue for cultural events, permanent and temporary exhibitions, thematic programs from early spring to late autumn. The propeller, the original drive shaft, the new helmsman's position, the old uniform, the mini steam engine and the playing bow are just some of the interesting things of the Balaton Screw Steamer Monument Ship.

Following the closure of Kisfaludy and Balaton, the shortage of steamboats caused a decline in the development of the Balaton region, but there was widespread interest in reviving steamboat traffic. In October 1888, The Lake Balaton Steamboat Shipping Corporation was formed to secure the transport of passengers and goods on the lake, and construction of a new paddle steamer began (Bíró, 1996). The new boat, the Kelén, made its maiden voyage on July 1, 1889, and the name was soon changed to Baross (Fig. 12). The large boat could carry up to 450 passengers and was in use until 1922 when it was taken out of service and dismantled.

Figure 12. Model of the Baross paddle steamer at the Balaton Museum in Keszthely. Photo: Sándor Némethy

On May 27, 1890, Lake Balaton's second propeller-driven steamer, Rohan, was launched. The boat's role was to secure the transport needs until two new, larger propeller steamers were completed, and in 1905 she was transferred to the Danube (Hajok Anno, 2021; Bíró, 1996).

THE SIÓ CANAL - THE DREAM OF A EUROPEAN WATERWAY

In step with the establishment of industrial society in the 19th century, Lake Balaton's function as an infrastructure needed to be further developed, which could also solve another problem: the need to be able to regulate the water level in the lake.

Lake Balaton has always been a shallow lake and its water level changes often caused floods mainly on the southern coast and the western part of the lake, where natural wetlands were formed. The significant water level variations and the periodically high-water level meant that larger settlements along the lake were formed only on higher hills such as at Tihany and Szigliget, along the northern shore of the lake.

An important incentive for the canal construction was the railway line between Budapest and the Adriatic Sea, built from 1858 and onwards, drawn along the southern shore of Lake Balaton. To protect it from floods and ice damage, the need for water regulation became more urgent. The first wooden lock was therefore built at Siófok in 1863 and became decisive for the region's further development. (Reference) The 120.8 km long Sió Canal, solving water regulation and communication needs, consists partly of a natural watercourse, and runs between the coastal town of Siófok on the southern shore of Lake Balaton to the river Danube near the town of Szekszárd. The waterway runs through a number of Hungarian counties and has two major tributaries in the form of Kapos from the south and Sárvíz from the north.

The Sió Canal (Fig. 13), together with Lake Balaton, forms a drainage basin that covers close to 14,730 km². The riverbed falls on average 14.5 cm per kilometre, the width varies from 20 to 30 metres, and the depth range between 0 and 8.8 metres depending on the water supply through the lock at Siófok and the tributaries Kapos and Sárvíz (Fig. 13). The water level in the canal is thus not uniform. In the upper part near Lake Balaton, a significant amount of water can come when the lock at Siófok is open, while the amount of water in its lower part on the Danube mainly depends on the inflow from the Kapos River and Sárvíz.

The Sió Canal thus becomes not only a system for water regulation of Lake Balaton, but also the only possibility of a navigable waterway between Lake Balaton and the river Danube, so the lock and the canal itself were further modernized in several stages from 1891 to 1941 when development work was interrupted due to WWII. Work resumed after the war and was completed in 1947, making the waterway between Lake Balaton and the Danube usable so that barges of up to 1,200 tons could pass as well as ships of similar size. The lock is 83.5 m long and 12 m wide and can handle a level difference of 2.5 m between the Sió Canal and Lake Balaton (Kutics and Kravinszkaja, 2020).

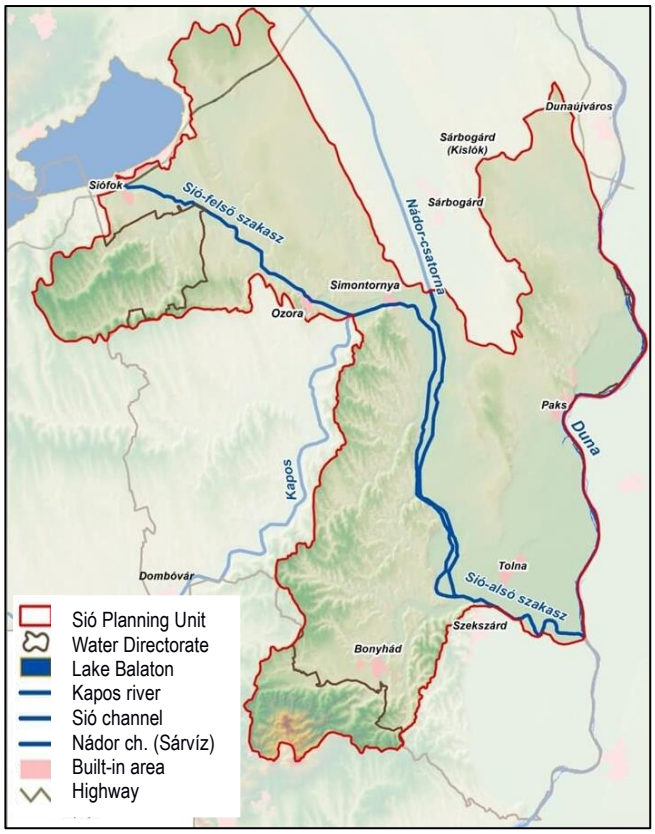

Figure 13. Map of the Sió channel and its catchment area Source: www.kdtvizig.hu 2021.

The prerequisite for being able to use this waterway is, however, that there is enough water in the system, which has become a constant problem. During long dry summers, the lake's water level decreases so that the lock to the Sió Canal cannot be opened. Despite this, the Sió Canal was used periodically between 1947 and 1990 for the transport of boats and barges from the shipyard in the northern coastal town of Balatonfüred to the river Danube. Over the past three decades, the system has become obsolete and in 2018 a remodelling project begun. The purpose is to create opportunities for further water storage in the lake by raising the water level by 10 cm, in order to mitigate the effects of climate change. The project also includes renovating the water drainage system and increasing capacity, which would also facilitate a more continuous use of the Sió Canal. The project is expected to be completed in 2022 and can thus secure an important and culturally and historically interesting Central European waterway (Kutics and Kravinszkaja, 2020).

VESSELS FROM THE 1890S ON THE LAKE BALATON

The boats that operated on Lake Balaton were manufactured at the shipyards in the Óbuda district of Budapest. Given the shallow water of the lake, special requirements were placed on draft and reliability. Not all ships can be described here, but some of the most typical passenger boats are discussed below.

The twin boats Kelén and Helka

In 1891, by order of The Lake Balaton Stem Boat Shipping Corporation, two identical propeller steamers were built at the Schoenichen – Hartmann shipyard in Óbuda (Budapest), which were named Kelén and Helka. The vessels, which were finally assembled in Siófok, are of the same size and shape and are built with an iron hull and wooden superstructure. Kelén was launched on April 17, 1891, while Helka came into service on June 28 of the same year (Hajók Annó, 2021).

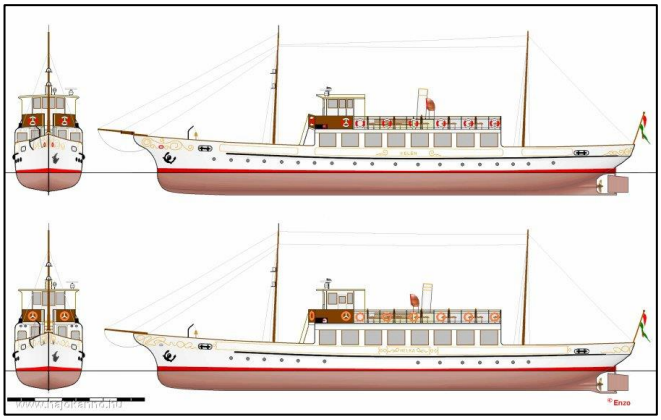

Figure 14. The twin boats Kelén and Helka. Drawing of the recent condition of the boats (Hajok Anno 2021)[6]

During this time, the development of shipping on Lake Balaton began to gain momentum, which also meant that the ports were modernized with stone quays instead of the older wooden structures. Kelén and Helka were in service until the Second World War but were then close to being completely destroyed. When Kelén was in port in Révfülöp, on March 27, 1945, German soldiers placed explosives in the engine room. The Hungarian crew intervened, however, and lowered the boat to the bottom of Lake Balaton in a gentle way by opening the bottom taps and thus preventing destruction. Helka, on the other hand, had been blown up two days earlier in Balatonfüred (Bíró, 1996).

After the Second World War, both ships were lifted and restored in 1946. After several renovations (1964, 1991), the Kelén was fitted with a diesel engine and is today in operation as a traditional ship. Helka was modernized in 1964 and in 1980 she was placed on land at a crossroads as a café and restaurant in Balatonfüred, but after renovation she was put back into service in 1996 and is in operation in the same way as the twin boat Kelén.

The screw steamer Jókai

At the beginning of the 20th century, it was necessary to increase transport capacity due to the increasingly intensive passenger traffic. In 1913, therefore, a larger screw steamer was built at the Óbuda shipyard for final assembly in Siófok. Jókai was launched on June 28, 1913 (Bíró, 1996).

The ship was in use until March 23, 1945 when the retreating German troops blew up the boat in the port of Balatonfüred. The ship was salvaged four years later, and after renovation was able to resume passenger traffic from 1948 until the autumn of 1963. After a new renovation where she was equipped with a diesel engine, she was in use from 1964 until her relocation to the river Tisza in 1980, to function as a floating hotel and restaurant. After almost being scrapped, she was bought in 1998 by Vanyolai Shipping Corporation, who rebuilt her into a similar design as the twin boats Helka and Kelén (Hajok Anno 2021).

Shipyards at Balatonfüred

From the end of the 19th century the coastal town of Balatonfüred became developed both as a tourist resort and a centre of shipbuilding. The shipyard was founded in 1881 by Richard Young, a shipbuilder from England who started the build sailing boats in 1881 at his workshop in Balatonfüred leading to the first sailing competition in Hungary in 1882 (Balatonfüredi Yacht Club, 2021). Around fifteen years earlier the first Hungarian sailing Club had started under the name the Royal Balaton-Füred Yacht Club in 1867, inspired by sailing activities in England and specifically the Royal Thames Yacht Club. It was reported by The Hunt's Yachting Magazine, in May 1 1867 (pp 228-229):

"In Hungary a nobleman who has justly earned amongst us the name of a thoroughly practical and enthusiastic yachtsman, Count Edmund Batthyany, has introduced this fascinating sport amongst his countrymen; and with praiseworthy energy and perseverance, founded and

[6] http://hajokanno.balatonihajok.hu/helka.html

established a Yacht Club upon the English model, within an almost incredible space of time. Count Batthyany's claim to be a yachtsman does not depend upon the mere fact of being owner of a fine and well-known schooner, he has won his spurs worthily and practically; we have ourselves sailed matches, and on board the craft we found it hardest to beat, and which has carried her flag in triumph thro' many a hard fought day, and not a few ocean battles either, have seen the gallant Count in woollen Guernsey, canvas trousers, and orthodox scarlet racing cap, working his way as a sailor should, through the hawse pipes, on to the quarter deck, and if we mistake not the Hungarians will find a second Yarborough in their distinguished countryman. This Club – entitled the Royal Balaton Füred Yacht Club, has been instituted under the special patronage of Her Majesty the Empress of Austria, Queen of Hungary; The Commodore is Count Edmund Batthyany – schooner Flying Cloud, 75 tons, and Lissa, 5 tons; Vice Commodore, Count Bela Szèchenyi; Trustees, Count John Waldstein and Count Edmund Szèchenyi; Cup Bearer, Stephan de Birly, Esq.; Reasurer M. Mikalovies, Esq.; Secretary, Paul Rost, Esq. The distinguishing flags of the club are, Ensign – Red, having as Jack in the upper dexter canon a green cross proper and saltier, bordered white, with the crown of Huganry in the centre. Burgee – Red, a green cross proper, bordered white, with the Hungarian crown in the centre.

So energetically supported has Count Batthyany been in the formation of this Club, that scarcely a month has passed from the first intimation, 'ere the number of members to which the limit extends were made up. The laws and regulations, together with the sailing rules, are based upon those of the Royal Thames Yacht Club.

The headquarters of the Club, and from which it derives its title, are situated at Balaton Füred, the fashionable watering place of Hungary, standing upon the magnificent Platten Zee, or Lake of Balaton, which lies S.W. of Buda Pesth. This noble lake extends forty-six miles N.E. and S.W., with a width of from three to eight miles in a N.W, and S.E. direction; and with the lovely scenery which surrounds it, and the grand expanse of clear sailing room constitutes the most charming and romantic cruising waters in Europe."

Richard Young took the tradition to another level through his shipbuilding activities and background from England and created the first Hungarian sailing association under the name The Balaton Sailing Association in 1884, and in the following year changed to The Stefánia Yacht Association. (Wikipedia, Young Richárd, 2021)

Young stayed on until 1888 and he turned his workshop into a shipyard, initially building sailboats and motorboats in wood. (Wikipedia, Young Richárd, 2021) During the 20th century the demand for steel vessels increased, and a new factory was built between 1939 and 1941 including new construction halls, a hauling station and a port, in total the site provided work for about 230 people.

A consequence of the Second World War was the creation of conditions for salvaging and restoring all the boats sunk by German troops. After many repairs, the first "own" construction of the yard was a motorboat Csongor, completed in 1948. In 1948, the first small diesel tugboat Badacsony and a few barges of 250 tons and a number of barges of 300 tons, specially built for gravel transport, were also launched (Bíró, 1996).

As part of the 'compensation supplies' following the liabilities of war damages after World War II, 330-ton dredges, smaller motorboats for the police, customs and military, tugboats of 150 horsepower were delivered to Czechoslovakia and 15 gravel barges to Yugoslavia (Wagner, 2006). The shipyard was nationalized as all other companies in 1948 as the Communists wanted to have full control of the country. In 1950 the shipyard was reorganized under the name Balatonfüred Boatyard. During the short period 1948–1950, several minesweepers were built for the navy on the Danube. Consequence of the communist era under Soviet Union, as a result of that they took over after the German occupation, Hungary suffered between 1946 and 1948 an extensive Sovietization by threats and terror, and the People's Republic of Hungary was proclaimed in 1949. The Soviet Union demanded substantial damages from the countries it liberated from the German occupying powers. As a result, the shipyard in Balatonfüred, among other places, was required to deliver ships and other equipment to the USSR for several years to come. At the same time, they got to take part in the planned economy that the USSR partially introduced in Hungary, which contributed to many orders for ships, boats, etc. being ordered at the shipyard, which gave them high employment for decades to come. When 'Die Wende' took place in 1989 and communism was overthrown in Hungary and other states in the Eastern Bloc, orders for equipment from the USSR also ceased. This contributed to a significant reduction in employment at the shipyard and many workers lost their jobs.

The shipyard was continuously modernized and expanded during the 1950s, and the workforce amounted to almost 600 men with a design unit consisting of 15 people. With this, the factory was ready to perform more and larger tasks. In 1952, they built the largest passenger ship to date for Lake Balaton with a capacity of 600 passengers and named after the Greek poet Beloiannisz (Bíró, 1996; Wagner, 2006).

For Hungarian shipping, the construction of river barges and tugs began at the shipyard in Balatonfüred, and the units to the Danube were taken through the Sio Canal. After the construction of river barges of 250, 300, 400 tonnes, series production began of 75 meter long and 10-meter-wide barges for transport of goods with a capacity of 1000 tonnes, as well as barges for bulk transport of 1000 tonnes (Wagner, 2006). The series construction of tugboats of 800 hp for the Danube was also of great importance to the shipyard. The principle applied was that a tugboat could tow a barge up to 1000 tons. (Wagner, 2006). After the icy floods of 1956 on the Danube River near the town of Baja, the national water authority ordered special icebreakers, which should be possible to be used – from an economic point of view – throughout the year. This gave birth to a "stomping" icebreaker construction, i.e. vessels equipped with two eccentrically placed auxiliary engine flywheels, one in the bow and one in the stern. The efficiency of the stomping and rocking icebreaker is significantly better than when the ship repeatedly moves forward and then reverses. These units can then be used for

towing after the ice has passed. In addition to these models, the shipyard also delivered icebreaker tugboats for the port, marking boats for deploying beacons such as buoys and dots, as well as houseboats and dredgers (Wagner, 2006).

In the early 1950s, the shipyard also had an export order for ten coastal boats for Poland. Meanwhile, the production of sailing vessels continued in parallel. Since 1953, new types have been developed, for example larger boats with aluminium hulls and with a sailing area of 50, 75, 80 and 125 m^2 respectively (Wagner, 2006). The hull was built at the Danube shipyard in Vác while the rigging and other equipment were mounted at the Balatonfüred shipyard. Despite these modern vessels, the construction of wooden boats continued at the factory.

A major industrial restructuring process from 1962 affected the shipyard, which lost its independence and became part of the Hungarian Shipyards and Crane Factory (MHD, Wagner, 2006). Here, unmotorized barges and regular barges were manufactured to an increasing degree for foreign customers, as well as ferries for inland waters. From 1985, the shipyard ended up in a particularly difficult financial situation due to a shortage of raw materials, but above all due to delivery delays from subcontractors. As a result, the shipyard was forced to manufacture everything from excavators, hotel furniture, support constructions for mines, and swivel elements to floating cranes.

Figure 15. The new ferry Kossuth Lajos. (Hajok Anno, 2021).

The crisis became more and more obvious and generated losses e. g. during the construction of the so-called Link Spaun pontoons that were delivered for Norwegian customers, as well as other products such as 16-tonne floating crane pontoons, passenger ships for 60 people, telescopic loaders, etc. Because of the increased tourism industry, a major order was the complete rebuilding of the ferry Lajos Kossuth, increasing the ship's cargo capacity from 24 to 33 cars (Fig. 15). The number of employees in the yard had then reached 920 persons (Wagner, 2006). Although the Balatonfüred shipyard was prepared to produce high-quality products to meet Western requirements, the market situation deteriorated, which meant that sales of the shipyard's products became more or less impossible. The situation was catastrophic and after a number of different more or less short-lived reconstruction attempts, the shipyard operations ceased, and the area became a leisure boat harbour and a museum of the previous shipyard operations.

Examples of the shipyard's production

The passenger boats Csongor and Tünde that could take on 130 passengers needed to be adapted to the shallow conditions of Lake Balaton, implying little draft and relatively small passenger capacity. The frame and beams were of angular steel, while the hull carvel constructed with wood and with internal diagonal steel bands as reinforcement, and with wooden decks. Both boats were powered by diesel engines of 150 horsepower (Hajók Anno, 2021)

In 1929, the motorboat Sió was built with a capacity of 50 passengers. In addition to motorboats for passenger transport, series production of recreational sailboats of various classes started. In addition, larger sailboats were constructed, the class of so-called Schärenkreutzers as the yacht Hungaria exemplified, built in 1928 for the Olympic Games in Amsterdam. In 1935 the motorboat Boglár was built, suitable for 80 passengers, followed by the motorboat Badacsony in 1936 with seats for 30 people and in 1938 two larger ships, Szent István and Szent Miklós with capacities of 100 passengers each. The latter two ships were, unlike the previous ones, made entirely of steel (Hajok Anno, 2021).

In addition to the ships that served passenger traffic, two or three smaller motorboats were manufactured per year with both outboard engines and built-in machines. The serial production of larger sailboats and lighter yachts of the dinghy type was still in progress. The shipyard also produced some sailboats with sail areas of 50 and 75 m² for Lake Balaton (Wagner, 2006).

Lake Balaton's ferries connect the south and north shores through the narrow strait between Szántód and Tihany. The ferries in use today were built by the shipyard at Balatonfüred. The ferry Komp II (later István Széchenyi) was launched in 1961, then the ferry Komp III was built in 1964 (later Kossuth Lajos) and in 1968 Komp IV (later Sándor Kisfaludy) was delivered. The vessels were equipped with Voith-Schneider units for propulsion which combine operation and steering. They were used here for the first time in Hungarian shipbuilding history, which became great news. The ferries have the dimensions 35 × 10 meters and space for 375 passengers, 6 buses or 20–24 cars. In 1976, the ferry

Gábor Baross, which is 8 metres longer, was launched and the superstructure is located on one side of the ship to achieve a better use of the ship's surface (Hajok Anno, 2021).

DEVELOPMENT OF WATERWAYS INFRASTRUCTURE

Lake Balaton as a natural component of the waterways system composed of Sió canal, and the Danube, have had important functions throughout history as presented in this article. The opportunities at hand for continued development of this system are well established as well as highly motivated. In 2006 The European Conference of Ministers of Transport (ECMT, 2006, p.74) noted that in spite of large increases in transport demands nearly all of such volumes were absorbed by land bound systems and most significantly road based. This was due to the failure of inland waterways to attract new traffic flows, in spite of its potential capacity to increase through the total of 28 000 km of internationally classified inland waterways in Europe. In 2016 The Innovation & Networks Executive Agency of the European Commission (INEA, 2016, pp. 5-6) stated that this imbalance between road transports and inland waterways were still predominant, and the prediction for 2030 was that the road freight transport was projected to increase by around 40%. This constitutes a severe problem since the EU transport policy has as its main aim the development of more energy efficient systems. Therefore, one of the key goals the European Commission has formulated for 2050 is that a 50% shift of intercity cargo and passenger transports from road to rail and waterborne transport, should take place.

The United Nation Economic Commission for Europe stated in 2019 the need for "Increased coordination in the development of modern, sustainable and resilient European waterway network". (UNECE, 2019, p. 44) They further notes that due to the impact of climate change the whole logistic chain including the inland water transport has to focus on this impact, where the development of European waterways shall ensure the resilience of the IWT systems. One proposed action by the UNECE is to encourage initiatives on waterway construction, maintenance and rehabilitation (UNECE, 2019, p. 45). While the focus on European waterways for natural reasons address its potential for more energy efficient transports, its ability to address other important societal functions are also noted. The European Commission identified the intrinsic nature of rivers and waterways as complex dynamic ecosystems used by a multitude of stakeholders and delivers societal goods for free. (European Commission, 2018, p. 44) By doing so waterway systems have an economic value often overlooked, and there is a need to clarify this indirect market value when developing high-efficient transport systems. This has also been described by Dutch researchers where they state that "IWT infrastructure cannot be based on freight transport developments only" (de Leijer, et al., 2015, p.29). They note that other important functions are recreational crafts, tourism, flood protection, agricultural irrigation, wildlife habitats, nature conservation, real estate development, housing boats, to name some such functions. These perspectives are specifically relevant in the context of Lake Balaton and the Sió canal.

To mitigate the effects of short-, medium- and long-term extreme weather events on Lake Balaton and its catchment area, several factors must be taken into consideration (Némethy and Molnár, 2014; Kravinszkaja and Varga, 2020). Exploiting water storage opportunities in the lake based on water balance analyses is required both for flood protection and extreme water level fluctuations caused by drought and high evaporation, the available equipment is inadequate (sluice gates, the condition of the upper section of the Sió canal). Revision of the lake's water level control regime is required, the increase of the permissible control (maximum) water levels by 10 cm (60 million m^3 of water; Kravinszkaja and Varga, 2020).

CONCLUSIONS

Inland waterways such as lakes, rivers, canalised rivers, and constructed canals have always played an important role as infrastructures for different transportation needs, and this is specifically obvious when looking into the history of shipping and seafaring on Lake Balaton. The British influence has likewise been important for the development under the era of industrialisation including the introduction of steam driven vessels and shipyards, but also the growing area of tourism and leisure activities such as yachting.

All these perspectives that become clear from the historical overview, presents at the same time qualities and opportunities in the continued development of local and regional economies around the lake. The destination industry has for a very long time been a significant part of societal development at Lake Balaton, and the challenges now is to gear these activities towards sustainable solutions building on the heritage components of ancient and recent times.

The strategies and models for enabling this will be the primary subject for the coming establishment of the Balaton Ecomuseum, integrated with cross-disciplinary research projects to be formulated within the network of European Ecocycles Society.

Extreme water level fluctuations on Lake Balaton must be prevented both for the safety of inhabited areas and the protection of ecosystems in the littoral zone.

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