ODRŽIVO RONJENJE NA OLUPINI NA OTOKU ŽIRJU
SUSTAINABLE WRECK DIVING ON THE ISLAND OF ŽIRJE

Branimir Dunkić¹, Goran Crnica², Mihovil Ugrina³

¹Veleučilište u Šibeniku, Trg Andrije Hebranga 11, bdunkic@vus.hr
²Veleučilište u Šibeniku, Trg Andrije Hebranga 11, gcrnica@vus.hr
³Veleučilište u Šibeniku, Trg Andrije Hebranga 11, ugrina@vus.hr

Sažetak
Namjena ovoga rada je analizirati trenutno stanje na otoku Žirju s obzirom na njegov turistički potencijal i razvoj, da bi se revitalizirala atrakcija podvodne olupine zrakoplova iz Drugog svjetskog rata. Bombarder strovalnik, Junkers JU 87 R-2, pronađen je blizu otoka Žirja 2014. godine. Stavlja se poseban naglasak na usporednu analizu, u kojoj se otok Žirje uspoređuje sa sličnim mjestima u svijetu koja nude takvu vrstu turističke atrakcije. Ovaj rad ne treba samo dati uvid u privlačnost spomenute turističke atrakcije, nego i razjasniti, može li se, te kako se može takva atrakcija promovirati na održiv način. Anketa među roniocima i promicateljima kulturno povijesne baštine treba dovesti do rješenja održive konzumacije spomenute olupine zrakoplova od strane nautičkih turista i ronioca.

Ključne riječi: kulturno dobro, Junkers JU 87 R-2, ronjenje na olupinama, otok Žirje

Abstract
The purpose of this paper is to analyse the current situation on the island of Žirje in terms of its tourism potential and development, so as to revitalise the underwater wreck site of the World War II dive bomber plane wreck, the Junkers JU 87 R-2, which was found near the island in 2014. Special emphasis is put on a contrastive analysis, in which the island of Žirje is compared to similar sites in the world. This paper shall not only give insight into how attractive the mentioned site is, but whether and how it can be promoted in a sustainable manner. An interview among divers and cultural heritage promoters shall give solutions for the sustainable consumption of this plane wreck site by nautical tourists and divers.

Key words: cultural heritage, Junkers JU 87 R-2, wreck diving, the island of Žirje
1. Introduction

Scientific papers about diving, wreck diving and sustainability are relevant for nautical tourism. In comparison to the scientific search engine, Google Scholar, The Portal of Scientific Journals of Croatia, also known as “Hrčak”, which is searched by many Croatian scientists, teachers and students, has only a relatively small number of scientific papers about diving, wreck diving and sustainability. When the island of Žirje is compared to other islands, it can be concluded, that there is also a relatively small amount of information about the island available.

Geographical and historical information are usually the first type of information a tourist searches for. The average tourist usually searches the internet for information about his tourist destination. Usually the attractiveness of the tourist destinations is presented on specially designed webpages. These webpages analyse in a few steps the preferences of the potential tourist and offer illustrated images with descriptions of the chosen destination together with a list of prices.

But this is not the case with the island of Žirje. In comparison to other tourist destinations, the island of Žirje is scarcely described even by official web page of the National Tourist Board of Croatia.

The discovery of the dive bomber Junkers Ju - 87r2 in the year 2014 led to an increase of scuba divers on the island of Žirje. The island of Žirje has become a famous wreck diving site among divers who are interested in World War 2 war machinery. Whoever searches the internet for wreck diving in Croatia, will most probably stumble upon images of the Stuka dive bomber next to the island of Žirje.

Wherever tourists arrive in larger numbers, the sustainability of the environment or the tourist attraction itself is endangered. As this paper tries to give solutions for the sustainability of Žirje, the first step is to give information about the geographic and historical facts that led to the forced water landing of the Stuka dive bomber pilot during World War 2.

The island of Žirje, as well as the homonymous settlement of Žirje, is about 22 km southwest of the town of Šibenik, it is 11.7 km long, 2.5 km wide, and it stretches over an area of 15.8 km². As the coastline is indented, it has a total length of 41.8 km. Žirje is one of five inhabited islands in the Šibenik archipelago. As only 94 inhabitants (2011) live on the island, there is more than enough space for any visitor. On the northern side of the island, there are four larger bays: Mikavica, Muna, Koromašna and Japlenišće. On the southern side of the island, there are six larger bays: Velika Nozdra, Mala Nozdra, Tratinska, Velika Stupica, Mala Stupica and Kabal. The island of Žirje is also surrounded by five smaller islets: Mikavica and Koromašna on the northern side; Škrovada, Škrovadica and Bakul on the southern side.

The island terrain consists of limestone. The hill peak Kapić is with a height of 131 metres the highest point on the island and enables a spectacular panorama view. The island is covered by macchia. In the central part of the island, there is the only settlement, Žirje, as well as a fertile field surrounded by a hilly terrain. The inhabitants of Žirje grow grapes, olives, plums and cherries. The surrounding sea is rich in fish, crabs, lobsters and corals.

The island of Žirje has several significant historical and archaeological sites.

There is a prehistoric archaeological fortification site (gradina) on the hill of Kapić.

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1 http://croatia.hr/hr-HR (2017.) http://croatia.hr/hr-HR/Odredista/Otoci/Otok/Zirje/ZHNcNTU1LHBcMjE2
There are remains of Ancient Roman architecture and fractures of ceramics from the second to the third century B.C. when the island of Žirje is mentioned as *Surium*.

There were two fortifications which were part of the Byzantine fortification system, built by the emperor Justinian I the Great (Flavius Petrus Sabbatius Iustianus; 482-565; ruled 527-565), so as to control and enable ship traffic.

During medieval times, the island of Žirje is mentioned as *insula Azuriorum* or *Zuri*.

Since 1059 the island belonged to the property of the Benedictine monastery of St. John in Rogovo (benediktinski samostan sv. Ivana u Rogovu), which is mentioned in a document written by the Croatian King Krešimir IV (hrvatski kralj Petar Krešimir IV).

In the 14th century, the towns of Zadar and Šibenik interfered into confrontations so as to proclaim the island of Žirje as their property.

In the year 1460 Žirje had its own rectory.

The parish Church of St. Mary (župna Crkva sv. Marije), which is mentioned since the 15th century, was restored and enlarged at the end of the 18th century. In the bay Muna, there is the little Church of Our Lady (Gospina crkvica), which is said to be erected by the humanist Juraj Šižgorić; it was abandoned in the 18th century. On the island there is another church, St. John's Church (crkva sv. Ivana), which was consecrated in 1616, the Chaple of the Holy Cross (kapela Svetog Križa) in the bay Mikavica and St. Mary's Monastery (samostan Svete Marije), which was destroyed in the first half of the 16th century.3

During history, fishery was developed, as well as coral mining to a smaller degree.

The number of islanders reached its peak of 780 inhabitants in the year 1921. Since that time the number of residents is decreasing and has reached a number of under one hundred inhabitants.

During the Austro-Hungarian period in Dalmatia, Žirje became a strategic point of defence. Two main coastal defence locations were used for a placement of heavy 150 mm and 190mm cannons (Skoda).

During World War Two the island was occupied by the Italian Army. After the capitulation of Italy, the German Army Forces controlled the island until retreat in 1944.

After World War Two the island became an important strategic point for the JNA (Yugoslav People's Army). At the beginning of the Serbian aggression towards Croatia in 1991, the Croatian Army managed to take control over the cannons (Ansaldo 90 millimetre) of the JNA, which contributed to a successful defence of the town of Šibenik.

The introduction shows that the island of Žirje has been a strategic point since ancient Roman times. Therefore, it has numerous artefacts of historical importance, its geographic position enriches the island with an abundant flora and fauna.

2. Wreck diving on the island of Žirje

The potential development of wreck diving on the Island of Žirje dates back to the 1970s. The Department for Underwater Archaeology of the Šibenik City Museum (Muzej Grada Šibenika) found remains of a ship and ship cannons near the little islet of Gušteranski. Artefacts of antique amphorae were also found.

An antique ship and a huge quantity of amphorae were found in the bay of Koromašina (island of Žirje). The wreck site is protected with a steel mesh covering and left for future archaeological research.4

One of the recent significant discoveries is the wreck of an Italian World War 2 dive bomber, Ju 87 R - 2 Stuka, which was found on the location N 43° 39 17.6, E 15° 38 03.9 P-4932.5

![Picture 1: Location of the plane wreck](Source: maps.google.com)

According to an announcement published on the official web-page of the Ministry of Defence of the Republic of Croatia, a military bomber plane, type Ju 87R-2 was found by divers of the Department of Underwater Archaeology of the Croatian Conservation Institute and divers of the dive club ZG-SUB from Zagreb, which is a rare finding. Of 5709 Stukas produced during World War 2, only two are preserved and exhibited in museums in London and Chicago.6 In Norway and Greece two more plane wrecks are found, however in a much worse condition. Two similar planes, type Ju 87 B1 and B2 were found at the Cote D' Azur in France. One of those wrecks was raised and transferred to the Auto and Technic Museum in Sinsheim, where it is exhibited. (Lino von Gartzen/Klaus Fischer, 2009) 7

3. Facts about the dive bomber Junkers Ju - 87 Stuka

The Ju – 87 Stuka (German: Sturzkampfbomber) was a dive bomber, a plane that was designed to attack enemy targets on the ground or at sea with a special flight technique that enabled the pilot to hit the target with a precision bomb attack. The pilot would fly the plane at high altitude when approaching the target and would roll the plane onto one side, turning it into back flight, then he would dive down like an eagle towards the target at a speed of even over 650 kilometres per hour. While diving, a horribly loud siren was activated, that had a special frightening effect on the enemy. This siren is known as the "Jericho-Horn". The

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famous sound of Stuka’s “Jericho Horn” is today often used in action movies as a sound effect when a plane crash occurs.

While attacking, a Stuka pilot would aim his plane at the target, release the bomb on a low altitude and rescue himself with an abrupt manoeuvre upwards. As a great number of pilots would lose their consciousness during this manoeuvre, a special automatic system would bring the plane back into horizontal position. There was also a specific protection mechanism that prevented the bomb from hitting the plane after release in a diving manoeuvre.

The Ju - 87 Stuka was probably the most famous dive bomber of World War II, especially in the earlier stages of the war. The plane was designed to play a significant role in tactics known as Blitzkrieg. As the Stuka’s bomb attacks were much more accurate than standard bombers, the Stuka dive bombers were tactically used as flying artillery. The pilots would attack the enemy targets and supply lines to inflict heavy casualties before the attack of ground forces.

Although the dive bombers were mostly used by the German air forces (Luftwaffe), the idea of creating a dive bomber was originally American. Stukas made their combat debut as part of German contingent to the Spanish civil war – the Condor Legion. They first flew in action in 1936, when a single experimental Ju 87 was secretly deployed to fight alongside nationalist forces. In the first stage of World War 2, JU 87 Stukas were successful in Blitzkrieg operations in Poland, France, and Soviet Union as well as in the Mediterranean war theatre. Stukas were especially effective in attacks on naval targets. The Stuka’s main drawback was its slow flight speed, which made it vulnerable to enemy fighter planes and anti-aircraft defence fire.

4. Facts about the Stuka found on the island of Žirje

Igor Miholjek, Head of the Department of Underwater Archaeology stated for HRT, Croatian Radio Television, that there were three dive bomber planes of the type Ju 87R within the 239th Squadron - Group 97 (239. Squadriglia, 97 Gruppo Bombardamento a tuffo). There is evidence, that the mentioned dive bombers attacked torpedo boats belonging to the Second Torpedo Boat Division, as well as the Hydroplane Squadron (hidroeskadrila) of the Royal Yugoslav Navy on 12th April 1941. In that attack, one of the Ju 87R-2 dive bombers was damaged by anti-aircraft defence fire from the Royal Yugoslav Army. The pilot of the damaged dive bomber had to initiate a forced water landing. There is still no evidence whether the pilot survived, but the plane sank behind the southern side of the island of Žirje. It has been lying on the bottom of the sea floor for over 70 years. It is preserved in an excellent condition. The only greater damage occurred to the engine of the plane, it was ripped off, but it was found near the wreck site 10 years before the discovery of the plane.

Picture 2: Dive bomber Ju 87 R – 2

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5. Methodology and Analysis

A total number of 50 people were asked a set of nine specific questions:

1) How satisfied are you with the island of Žirje?
2) Have you heard about the plane wreck next to Žirje?
3) How interesting is the plane wreck to you?
4) Do scuba divers have a negative impact on the environment?
5) Can you recommend a solution against negative impact on the environment?
6) Are you a tourist?
7) Are you a nautical tourist?
8) Are you a diver?
9) Do you work in the tourism branch?

The data for the questionnaire was collected on the island of Žirje and in the town of Šibenik in June 2017. The questionnaire was comprised of questions related to the general opinion about the island of Žirje and about the possible negative impact on the environment of the island. Question number 5 (see above) had the purpose to find solutions against possible negative impact on the environment. The authors of this paper conducted the interviews personally either on the island of Žirje or in the town of Šibenik. As shown in Chart 1 (see below: Table 1), 78% of questionees were either very satisfied or satisfied with the island.

Table 1: Charts showing the satisfaction with the island of Žirje perceived by islanders and tourists

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9 Vojnapovijest.vecernji.hr - Kod otoka Žirja pronađena olupina Junkersa Ju 87 „Stuke“ iz II. svjetskog rata (2017)
22% of questionees, who reported to have a neutral opinion about the island, were questioned in the town of Šibenik, but these people had a neutral opinion about the island, because they had never been on the island of Žirje. Chart 2 (see above: Table 1) shows that all of the questionees, who either visited or lived on the island, were either very satisfied or satisfied with the island of Žirje.

About 74% of questionees, who were on the island of Žirje, had heard about the plane wreck next to the island.

As can be seen in Chart 3, about 60% of all questionees said that the plain wreck is very interesting; 22% said that the plain wreck is interesting; 18% said that the plain wreck is not interesting to them.

Table 2: Charts showing the interestingness of the plane wreck and opinion whether divers contribute to the degradation of the island environment

29% of divers and 38% of non-divers share the opinion that divers contribute to the degradation of the island environment. About 56% of all questionees, divers as well as non-divers, had at least one suggestion on how to prevent degradation of the island environment or on how to prevent the demolition of the plane wreck.

While the questionees were asked to give a solution for the environmental degradation of the environment or the plane wreck, they felt the need to express even other opinions about other issues on the island. Table 3 (see below) gives a selection of problem solutions given by the questionees.

Table 3: A selection of problem solutions in Croatian and English language

<table>
<thead>
<tr>
<th>Croatian</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potrebno je postaviti kante za smeće po otoku.</td>
<td>Waste bins need to be placed on the island.</td>
</tr>
<tr>
<td></td>
<td>Signs need to be placed.</td>
</tr>
<tr>
<td>Potrebno je postaviti znakove.</td>
<td>Signs with restrictions and rules of behaviour are necessary.</td>
</tr>
<tr>
<td>Potrebni su natpisi sa zabranama i pravilima ponašanja.</td>
<td>Rules of behaviour need to be explained.</td>
</tr>
<tr>
<td>Potrebno je objasniti pravila ponašanja na otoku.</td>
<td>Signs, like those in national parks, need to be placed everywhere on the island, in the settlements, on the beach, in the forest.</td>
</tr>
<tr>
<td>Potrebno je obilježavanje kao u nacionalnim parkovima na svim mjestima na otoku, u mjestu, na plaži, u šumi.</td>
<td>A service for the protection of the island and the settlement needs to be introduced.</td>
</tr>
<tr>
<td>Potrebna je služba za zaštitu otoka i mjesta. Treba uvesti podvodne zaštitare.</td>
<td>Underwater security staff needs to be introduced.</td>
</tr>
<tr>
<td>Potrebna je kontrola ronioca od policije.</td>
<td>Divers need to be controlled by the police.</td>
</tr>
<tr>
<td>Potrebno je obilježavanje kao u nacionalnim parkovima na svim mjestima na otoku, u mjestu, na plaži, u šumi.</td>
<td>A detailed briefing is necessary before a dive.</td>
</tr>
<tr>
<td>Stuka bi se trebala bolje zaštititi, trebala bi se izvaditi.</td>
<td>Cleaning of the underwater world should be a part of diver education.</td>
</tr>
<tr>
<td>Treba ograničiti ronjenje na nekim mjestima.</td>
<td>The Stuka should be protected better, it should be lifted out of the water.</td>
</tr>
<tr>
<td>Treba provoditi zakon.</td>
<td>Diving should not be allowed on some places.</td>
</tr>
<tr>
<td>Provođenje zakona je primarna pretpostavka za održivost.</td>
<td>The law needs to be enforced.</td>
</tr>
<tr>
<td>Treba kažnjavati kršitelje zakona.</td>
<td>Law enforcement is a primary precondition for sustainability.</td>
</tr>
<tr>
<td>Trebalo bi školsku djecu voditi više na otoke.</td>
<td>Those who violate the law should be punished.</td>
</tr>
</tbody>
</table>

World War Two findings are generally interesting to a wide group of people. It is common practice that such artefacts get transferred to museums if that is possible. It is known from many examples worldwide that scuba diving tourism is immensely attracted by such findings. The local dive centres, restaurants and other community members have an economic benefit from such sites. On the other hand, museums generally provide the best protection for historic vehicles, aircraft, as well as other war machinery. Not only that the enclosed museum spaces protect the metal parts from corrosion and other destructive elements, but they also enable a much larger audience to explore such items of history without belonging to the diving community or without special permissions. According to the International Centre for Underwater Archaeology in Zadar (Međunarodni centar za podvodnu arheologiju u Zadru), which is under the auspices of UNESCO (United Nations Educational, Scientific and Cultural Organization), diving at underwater archaeological sites and museums is allowed only with a written permission of the Conservation Office (Konzervatorski odjel) in charge or within the organisation of a local diving club with a license from the Ministry of Culture of Croatia.\(^{10}\)

The authors of this paper interviewed Mr Željko Šižgorić (former Head of the Community Board of Žirje) about the discovery of this Stuka plane and about the impact of this finding on the local community of Žirje. Mr Željko Šižgorić was personally involved in the accidental discovery of the wreck. He found the engine of that plane 10 years before the plane itself was discovered. What Mr Šižgorić accidentally found was a Junkers Jumo 211D liquid cooled inverted V12 engine. Mr Šižgorić explained that the discovery of the Stuka had a huge impact regarding the promotion of tourism on the island of Žirje. According to him more than 600 internet links and news articles related to the plane wreck were shared. The consequences of this Stuka wreck discovery had only positive influence on the promotion of the island of Žirje as a tourist destination. The number of diving tourists is continuously increasing since the

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\(^{10}\) International Centre for Underwater Archeology in Zadar. (2017)
plane wreck discovery. The local community of the island of Žirje has a generally positive opinion about the discovery of the plane wreck. The local people are satisfied with the profile of guests, who treat the island in a respectful way. The scuba divers seem to be ecologically and culturally conscious. Some people are expecting further improvements of the promotion of this specific archaeological site, as well as of other historical heritage on the island.

Mr Šižgorić pointed out, that there are significant historical archaeological, and military artefacts found or still situated on the island, but there is no museum on the island that could present and preserve the heritage of the island of Žirje.

Mr Marin Cvitan, owner of the scuba diving club POSEIDON, gave an interview to the authors of this paper, in which he gave a surprising perspective on the case. Mr Cvitan is in possession of one of five concessions for the wreck site of the Ju-87r2 dive bomber. Mr Cvitan reported that about 300 divers visit this wreck every year within his scuba diving club. Mr Cvitan noticed a degradation of the plane wreck itself, he reported that it was evident that the damage on the plane increased since its discovery. As probable reasons for the damage Mr Cvitan, as well as other inhabitants on the island, mentioned illegal divers. Some of the illegal divers cut smaller parts from the plane and took them as souvenirs. Mr Cvitan suggested that according to his personal as well as professional opinion, the best solution for the preservation of the plane wreck would be to lift it out of the sea and to store it in a museum. If the trend of degradation of the wreck should continue, the only possible outcome would be the complete devastation of the wreck within the next few years.

The scuba divers from the dive club POSEIDON reported that other dive sights suffered severe environmental and material damage by divers who were either unconscious of sustainable principles of diving or even willing to perform illegal activities.

On a similar wreck site, two similar planes, type Ju 87 B1 and B2, were found at the Cote D' Azur in France. One of those wrecks was raised and transferred to the Auto and Technic Museum in Sinsheim in Germany, where it is exhibited. The exhibition of the plane wreck was chosen as the best option for the preservation of the plane wreck. In this case sustainability of the environment around the wreck was not an issue, however the cultural value of the plane wreck seemed to be reason enough to invest money and time into the preservation of the plane wreck.

In a position paper Susan L. Pepe wrote that her paper has focused on one key issue, sustainable scuba diving. She concluded, that if divers are informed about how their actions have an impact on the environment, and how those actions may affect the future of the sport, it is likely scuba divers will gain in the scuba diving sustainability, even if it is only for their own self-interest.11

6. Conclusion

Considering the gathered information about the strategic position of the island of Žirje, next to which the historic Stuka dive bomber was found, the island has a long historical and military tradition. The island is interwoven with various historical artefacts, from prehistoric times to modern times. The history of the island and its natural beauty make it attractive for tourism. A significant increase in the number of tourists can be expected, if the number of tourists rises to a critical point, problems of sustainability will occur.

11 Caution diver below! A case for enhanced environmental education and policies to raise awareness of sustainable scuba diving; Pepe, Susan L.. State University of New York Empire State College, ProQuest Dissertations Publishing, 2010
To raise the awareness of sustainability, this paper offers a list of solutions defined by the inhabitants of the island of Žirje. Among the main needs for the island of Žirje, the placement of waste bins and signs for restrictions, as well as signs for rules of behaviour are mentioned. A need for security staff or park rangers is mentioned. Enforcement of law is mentioned as a primary precondition for sustainability.

A comparison of the Stuka dive bomber to other Stuka dive bombers shows, that a preservation of World War 2 planes is common practice. The Stuka, exhibited in the Automobile and Technic Museum in Sinsheim, is an example that can serve as a model of how to preserve a plane wreck, as well as how to exhibit it in a sustainable manner.

All interviewed wreck divers agree, that the best protection for the Junkers Ju – 87R2, found next to the island of Žirje, is to place it into a museum as soon as possible.

References

10. Caution diver below! A case for enhanced environmental education and policies to raise awareness of sustainable scuba diving
11. Caution diver below! A case for enhanced environmental education and policies to raise awareness of sustainable scuba diving; Pepe, Susan L.. State University of New York Empire State College, ProQuest Dissertations Publishing, 2010 Attained from: https://scholar.google.hr/scholar?q=%22Scuba+diving+is+a+popular+recreational+activity%22&btnG=&hl=hr&as_sdt=0%2C5&as_ylo=2010&as_yhi=2010