Archaeological report of the wreck of Arado 196-3

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Introduction

This report is based on the work carried out as part of a heritage evaluation and archaeological survey for Blekinge County Administrative Board of the wreck of an Arado 196-3 plane off the coast of Karlskrona, Sweden. The wreck has been known by divers but until now had not been subject to any archaeological investigations or surveys to evaluate its condition. Work was carried out by the MARIS research institute at Södertörn University and a report produced describing the wreck’s condition and heritage values as well as recommendations for the management of this resource. In this publication we will develop the findings of the fieldwork and present a more detailed description of the wreck site as well as its historical background.
Historical background

Even though planes were used during the First World War it was during the Second World War that aeroplanes started to be produced and used on a larger scale with fast developing types of bomber, reconnaissance and fighter planes. Although not directly involved in the war, Sweden was still affected by the conflict despite declaring itself neutral. In some ways it was its neutrality that directly forced the country into the conflict, especially as a place of refuge. Between 1939 and 1945 over 300 foreign planes landed in Sweden, either as emergency landings due to damage or forced down by the Swedish military after having illegally entered Swedish airspace. The Arado Ar 196-3 investigated here was one of these planes.

On 11 February 1943 just before 4pm a plane was spotted by the Swedish navy between the islands of Hanö and Tärnö outside the Swedish Blekinge coast. The aircraft was identified as a German Arado plane with registration DH + ZF and a Swedish cruiser fired shots from a 57mm anti-aircraft gun in order to warn the plane it was within Swedish airspace. This did not stop the Arado which carried on towards land and further shots were fired which finally forced the plane to land. When the Captain of the Swedish cruiser called the plane the pilot reportedly tried to take off again but was forced to stop by further warning shots. The plane was searched and all documents on board were confiscated. The pilot Uffz. Ludwig Hammer was brought onto the Swedish cruiser whilst the observer, Officer Helmut Abramowski stayed on the plane as it was towed into the harbour at Karlshamn.

Interrogations were subsequently carried out at the air force flight school in Ljungbyhed by the head of the flight school, Åge Lundström. The two Germans insisted they had entered Swedish airspace by mistake on their way from Denmark to the island of Bornholm but as the Germans had been observed throwing a bag from the plane before they landed there were suspicions of espionage. Lundström claims in his report from the interrogation that he tried to gain more information from the Germans by suggesting that a camera had been found. Lundströms writes that this “made the lieutenant confused and that he then said he...
had no wish to discuss the matter further. The officer, however, smiled knowingly.” The bag was never found and despite the recovery of a photo journal from the plane showing that four photographic plates had been produced it was impossible to assert when these had been taken as no dates were written down. The reports of the events in the War Archives state how after the interrogation the Germans remained in Ljungbyhed as guests in the homes of several of the staff at the flight school, something that today seems somewhat curious but which in the records is not recorded as anything out of the ordinary. The two Germans were then returned to German authorities via a German transport train from Norway at the ferry terminal in Helsingborg.

The aircraft was an Arado 196-3, a German single engine seaplane, built at the S.N.C.A. de L’Ouest factory in St. Nazaire in France in 1942. This was one of several factories that built Arado aircrafts. Approximately 20 planes of this type were built at this factory and approximately 500 in total were constructed. This particular aircraft was given the identification number 1006 and was approved by the German Luftwaffe to be used at their seaplane training school in Rügen. The Arado 196-series was developed to replace earlier seaplanes within the Kriegsmarine to operate from their ships. The 196-series was produced on a large scale and was the most common German seaplane during World War II and an important part of Germany’s air arsenal.

![Figure 3: The Arado plane in storage in Karlskrona after it was forced down by Swedish military in 1943. Photo: Bo Widfeldt Collection.](image-url)
After the Arado-plane was confiscated by Swedish military it was stored in Karlskrona until it was sold to a private company in 1945. The plane was originally given the Swedish identification SE-AOU. Records show that it was sold to AB Kontinentagenturen/Continent-Agenturen (records display several different spellings). It is possible that during its time in Karlskrona it was also owned briefly by Aktiebolaget Industri diesel but this is unclear from the documents found.\(^\text{xiii}\) The plane was then bought by a John Turner, who was seconded from the Green Howards Regiment to join the British-Norwegian Intelligence Service in Sweden and Norway from 1943 until the end of the war. In March 1945 a new plane was required to provide supplies to a group of observers stationed in remote areas of Lapland as they were obtaining information about the retreat of the 21st German Lapland Army from Finland into Norway. Using the company AB Kontinentagentur the Arado 196 plane was bought and as the plane was needed for operations in Lapland urgently it was paid for by John Turner himself with private funds.\(^\text{xiv}\)

![Figure 4: the Arado plane during its service in Norway. Photo: Bo Widfeldt Collection.](image)

In May 1945, after the official end to the war, the Russian Legation in Stockholm wanted to impound the plane but John Turner instructed Pilot Björneby to fly the plane from Stockholm to Fornebu in Norway to avoid this. Records show that the plane was handed over from the authorities to Kontinentagenturen at Lindarängens airport in Stockholm on the 26 May. After a test flight the plane took off at 11:50, destination Karlstad. It never made it to Karlstad, however, but was instead flown illegally to Fornebu in Norway.\(^\text{xv}\) The pilot was fined 250 Swedish Kronor for flying the plane out of Sweden illegally. The fine was paid by John Turner.\(^\text{xvi}\) Photos of the plane painted in the colours of the Royal Norwegian Airforce demonstrate that the plane was then used in Norway. In the autumn of 1946 the plane was sold to Swedish company AB Ahrenbergsflyg and was given a new Swedish identification SE-AWY.\(^\text{xvii}\) It was mostly used as part of the Swedish forces target practice for searchlight surveillance.

On 19 April 1947 the plane crashed during navy target practice. The plane was deregistered in September 1947 with AB Ahrenberg as its last owner. The aircraft had been the target for two searchlights from 20:55 until 22:05 when a red flare was shot from the plane indicating that the searchlights should be turned off, all according to plan. After flying around for approximately 10 minutes in order for the pilot’s eyes to adjust to the dark, the plane went in to land. According to the accident report it was a dark night making it difficult for the pilot to differentiate between land and water during the descent. Coming down at 140–150 km/hour the pilot aimed for the landing lights that had been placed on the water surface. In the accident report one can read the following:

Suddenly both pilot and mechanic noticed that the plane was flying too low and the mechanic shouted to the pilot to lift, which the pilot also did, but in the same moment one of the floats hit the water causing the plane to turn over and sink. The pilot managed to get out of the plane, most likely through a side window, and swim to the surface. The mechanic struggled to get out but finally managed and swim to the surface. They found one of the floats floating on the surface but as it seemed like it was about to sink they swam towards land. A rescue boat picked them up. Both pilot and mechanic were wearing parachutes and life vests but had to remove the former when they became heavy from the water.\(^\text{xviii}\)

**Archaeological investigations**

**Methods**

The site was located using multibeam and search by divers. Loose sediments were removed and a visual evaluation was carried out. The wreck site was then recorded through video filming and photogrammetry, a non-invasive technique in which an area and the objects within it are measured and plotted using high resolution digital cameras. By combining several photographs, three dimensional points of the sites and objects are measured creating 3D images which can be printed out in a 3D printer. Approximately 900 still images were taken of the Arado wreck site in order to create a 3D-reconstruction. The visibility during documentation was limited to approximately 1.5 metres. One of the advantages of this technique is that the finished 3D image makes it possible to zoom in and out and therefore gain both detail as well as a clear overview of the wreck, something not possible at the site where visibility is often poor. The 3D image therefore gives a
1. Right horizontal stabilizer
2. Vertical stabilizer and rubber, mainly covered in silt
3. Left horizontal stabilizer
4. Attachment for the catapult
5. Exit for a trailing radio aerial
6. Base of the cockpit
7. Wing attachment
8. Struts for the floats
9. Area of the part of the cockpit (largely under the right wing)
10. Flap
11. Attachments for the 20-mm cannon
12. Right wing, broken off from its attachment and lying upside down
13. Mad plate connected to cannon
14. Cowling flap wire
15. Air intake ducts
16. Propeller
17. BMW 132K 9-cylinder radial engine
better overview of the site than when diving. The 3D images are a useful tool when investigating the wrecks as well as for communicating the results and findings.

The fieldwork and documentation was carried out by Professor Johan Rönnby (Södertörn University/MARIS), Ingemar Lundgren, diver and photographer (Ocean Discovery) supported by Joel Hallström and Tomas Kamm on the dive- and survey boat Gnarli (MMT/Deep Sea Productions).

Findings

The wreck is located at latitude 56°08.817N longitude 15°36.257 E. The main wreck site measures approximately 9 x 5 metres (E-W). The wreck of the Arado 196-3 was discovered in 2006 by divers and the site has since been used for diving expeditions. No archaeological investigations or surveys had been carried out at the wreck site before this study.

Back of plane

Looking at the images of the aircraft wreckage it immediately becomes clear that the metal skin (made of a magnesium-rich aluminium alloy called hydronium) and fabric once covering the plane has been destroyed in the water but the shape of the plane and its different parts can be seen from the steel and aluminium frame still present (tubes, ribs and stringers). We had been informed by divers that the plane was lying upside down. As the visibility was very limited during the dive it was hard to get an overall picture of the wreck site and one observation that caused initial confusion was that part of the wreck was protruding 1.5 metres from the ocean floor, right at the back of the plane. At first we assumed it was the vertical stabilizer and rudder and that the divers had mistaken the plane’s position. As soon as we looked at the 3D-images, however, it became clear that the part of the plane sticking up was not the rudder but in fact the right horizontal stabilizer. The plane lay on its left side with the front of the plane towards the east. The vertical stabilizer and the rudder were both covered in sediment but parts of them were still visible. The left horizontal stabilizer was broken and lay partially underneath the fuselage. The body of the plane measures approximately 5 metres and an opening in the steel frame in the middle of the plane suggests there could have been an opening here although none has been spotted on historical photographs of the plane.
Cockpit

Along the right side of the plane in line with the cockpit the metal plate of the wing attachment was still visible. Most of the cockpit appears to be covered by the right wing which has broken off and lies upside down across the fuselage of the plane. There is an opening at the underside of the plane in the base of the cockpit which allowed some glimpses of its interior. Wires and what could be parts of the rudder pedal assembly could be seen. It is clear that under where the cockpit was located the floor of the fuselage is more reinforced than in other parts in order to hold the heavier weight here than in the rest of the plane.

Wing

The left wing could not be seen and confirms accounts recorded during its crash of the left wing being broken off. The accounts of the plane ‘turning around’ as it hit water are also confirmed by the wreck even if previous accounts from divers that the plane was located upside down proved to be not fully correct. The construction within the right wing of ribs and stringers were very clear as the skin has disappeared, showing features such as the attachment for guns even if no guns were fitted at the time of the crash.

Front of plane

Immediately in front of the fuselage were the remains of the engine and one of the propeller blades. The engine has sunk into the sediment which is not surprising considering it is the heaviest part of the plane and therefore most likely to be the first part of the plane to hit the seafloor. Despite being relatively fragmented the majority of the components could still be identified and are located in situ. The engine is a BMW 132K 9-cylinder radial engine, 960PS (706kW, 947hp) which differs from the other engines of the 132 type in that it had two air intakes at the front of the engine to increase performance. The right air intake could still be seen on the engine whilst the left was covered in sediment demonstrating how the engine was also lying on its left side.
Figure 7: The round shape of the engine and several of its components as well as one of the propeller blades can still be made out at the wreck site. Photo: Ingemar Lundgren, Ocean Discovery.

Figure 8: Even if large parts of the engine are covered in sediment it is possible to see the shape and many of its components. Photo: Ingemar Lundgren, Ocean Discovery.
Figure 9: This example of a BMW 132K shows what the engine would have looked like before the crash. Photo: Stina Hedvall, Swedish Air Force Museum.

Figure 10: Pipes connected to the engine can still be made out at the wreck site. Photo: Bo Widfeldt Collection (left) and Ingemar Lundgren, Ocean Discovery (right).

Figure 11: A circular wire wraps around the engine body, most likely part of the cowling flaps located here used to control cooling airflow for the engine. Photo: Ingemar Lundgren, Ocean Discovery.

One of the three propeller blades is sticking up from the ocean floor with the other two most likely buried in sediment. The visible blade is bent backwards towards the engine and the fuselage of the plane. This suggests that the propellers were spinning at a low rate at the moment of impact with water. This is consistent with the plane coming in for landing, slowing down the engines. This also demonstrates that it was a very still evening with not much wind interfering with the landing which would otherwise have required more speed. The lack of wind is also likely to be a contributing factor to the crash as it would have been harder to see the calm water and differentiate it from land in the dark night.

Figure 12: Propeller in the foreground and one of the two air intakes for the engine, specific to the BMW 132K-type, in the background. Photo: Ingemar Lundgren, Ocean Discovery.

There is a small round opening on the underside of the fuselage between the cockpit and the stabilizers. It is likely to have been the mounting hole for the rear attachment lug for the catapult which was used if the plane was launched from a ship. Just behind and below the right wing root a bent tube can be found. It is likely to have been the exit for a trailing radio aerial which could be reeled out during flight to get better range for the radio.

Figure 13: Objects on the wreck show use of trailing radio aerial (left) and attachment for catapult (right). Photo: Bo Widfeldt Collection.

The floats were not located during the archaeological survey but directly south of the fuselage there are several metal rods which are likely to be the struts for the floats. Information provided by divers suggests that parts of the floats are located approximately 30 metres from the main wreckage but this has not been confirmed.
Preservation and originality

The seabed at the wreck site consists of dark, loose sediment which covers part of the wreck, especially the left side of the plane facing downwards. This side appears to be better preserved than the right side which is almost fully exposed. The impression from the visual evaluation is that the plane is in poor condition and that several of the more delicate parts of the plane have already disappeared. It is, however, still possible to increase our knowledge of the structure of the plane and its different components. Aircraft are made to be light which makes them more sensitive to decay than many other types of wrecks. Aircraft can also contain magnesium in many of their light alloy parts which is particularly sensitive to water. Parts of the plane have therefore perished, such as the fabric cover and metal sheeting. The fact that the cover of the plane has almost entirely disappeared, however, means the internal sections of the plane are exposed and makes it easier to gain an understanding of its construction and its technical components. It is therefore possible to gain information and an understanding from studying the wreck, especially with some background knowledge. The fact that the plane crashed in water helped to dampen the impact and led to less direct damage than for plane crashes on land. The wreck site does not appear to be particularly sensitive to diving activities.

Despite the Arado Ar 196 plane being produced on a large scale and that it was the most commonly used seaplane in the German Kriegsmarine throughout World War II there are very few of these planes preserved today:

- Ar 196 A-3 is on display at the Museum of Aviation and the Air Force in Plovdiv, Bulgaria
- Ar 196A-5 (Werknummer 623 167) is stored at the Smithsonian National Air and Space Museum, Washington, USA
- Arado 196 A-5 (Werknummer 623 183) is owned by the National Aviation Museum, Pensacola, Florida, USA but is currently on loan to Nordholtz Naval Airbase, Germany

There are also parts of airplanes of this type preserved such as at the Flyghistorisk Museum in Sola, Norway as well as some known wreck sites for example in Jonsvatnet, Trondheim, Norway.

Discussion and conclusion

Despite its position as a neutral country during the Second World War Sweden was affected by the conflict. Between 1939–1945 over 300 foreign aircraft landed or were forced down within Swedish territory. The wreck investigated here was one of these planes, a German Arado 196-3 forced down in southern Sweden on 11 February 1943. Although our resources have been limited we have managed to piece together the aircraft’s history between 1943 until its crash in 1947 through records, literature and the physical wreck itself.

The wreck of the Arado 196-3 is, despite being in poor state of repair, a valuable source of information. Despite many of its parts being fragile they are located to great extent in situ which makes it possible to get an overview of the plane and its different components. The fabric cover and metal sheeting that would have covered the plane originally has been almost completely destroyed after a long period in water but this also makes it possible to see the aircraft’s inner components. The frame of the fuselage and the wings are still almost completely intact and the engine and part of the propeller can still be seen.

The wreck can inform us about the technology of seaplanes of the 1930s and 1940s in general and about the Arado 196 aircraft in particular. When you look at the frame you are struck by its focus on lightness, a necessity for efficiency and speed. Heavier materials were used only where absolutely necessary, such as the steel tube truss in the fuselage, the firewall behind the engine and highly loaded fittings. We can see how the planes were originally equipped with fixed guns in the wings and how these had been subsequently removed. Other equipment mirrors the history of communication such as the trailing radio aerial, a technology which was phased out and replaced after the war (except for communication between aircraft and submarines). The attachment for a catapult gives indications of how these planes were used at sea where they were launched off ships. Although the floats themselves are not still present at the wreck site the struts that once held these floats in place also show technological development of seaplanes, which the development of the different Arado-types were a part of.

The wreck can also make us understand something about how it was to use these planes. The size demonstrates how little space was provided for the pilot as well as the Radio Operator/Gunner. This understanding has also been aided by comparing the wreck with historical photographs. Although both crew members survived the accident of this particular plane, the wreck also clearly demonstrates the danger involved...
when flying these planes, particularly during the war, although the outcomes were often much more severe than on this occasion.

We can also say something about the accident as the propeller indicates that the plane was coming in for a slow landing in calm conditions. The broken off left wing and missing floats confirm statements made in the accident report following the accident. The finding that the plane is lying on its side also confirms statements in the accident rapport that the plane turned over when it sank even if previous indications by divers suggested it had turned over completely and was lying upside down (which the right wing is).

The wreck of the Arado 196-3 airplane and its location in Swedish territorial water also highlight a part of Swedish and European history which is not very well known and which has so far received very little attention from researchers. By studying the wreck of the Arado 196-3 we therefore gain information about the technology, construction and history of this particular aircraft but we also have the opportunity of learning new aspects of the more general history of the Second World War.

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