Accessing centuries of documentation - Resources to improve access to Swedish rock art documentation and metadata

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Abstract
The archive of rock art documentation maintained by SHFA provides a valuable resource to archaeologists and others who study rock art. The archive includes images of rock art documentation, sites, and the documentation process, from the 17th century to the more recent high resolution 3D recording and visualizations. In the last few years, GRIDH, in collaboration with SHFA, have begun to improve access to the archive through a Django-based solution and new digital resources. In this paper, we introduce the images in the archive, provide details on the new digital resources, and reflect on how the new website will impact data availability and rock art research.

Keywords
Research infrastructure, digital resource, archaeology

1. Introduction

As part of developing core methods for visualising large digital archives, the Gothenburg Research Infrastructure in Digital Humanities (GRIDH) have developed new web resources to display and share SvensktHällristningsForskningsArkiv's (SHFA) digital archive of rock art documentation. SHFA is a research infrastructure at the University of Gothenburg which curates and manages the digital archive of rock art documentation from Sweden and several other countries.

The idea to establish a database to provide digitalised documentation of the rock art in Sweden to the public and the academic community has been around since the early 1990's and the idea gained momentum after the rock carvings in Tanum were inscribed on the UNESCO world heritage list in 1994. Third-party funded projects, including EU funding, studied rock art documentation, developed methods, and began to digitalise older recordings. In 2007, Riksbankens Jubileumsfond granted money which matched funding by the Swedish National Heritage Board (Riksantikvarieämbetet). This funding allowed for the kick-off of SHFA the following year with Ulf and Catarina Bertilsson, Kristian Kristiansen, and Gerhard Milstreu. An inventory study was conducted by Åsa Fredell in 2008 to get an overview of the amount of data that needed to be digitized, where this material was stored, and which rock art sites these covered.

Since then, SHFA has digitised ca. 80000 documents of different kinds of rock art documentation including Indian ink drawings, rubbing, tracings, photographs and more. Where these documents represent portions of a single panel they are aligned and merged into a single image for upload to the SHFA database. In addition, SHFA staff's own documentation projects

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were conducted with a special focus on 3D methods including laser scanning and photogrammetry.

Since the documentation of rock art is an ongoing process, the original projected data that needed to be digitised has grown considerably. In addition, third-party funded projects that SHFA collaborated with generated new documentation in Spain, Portugal, Italy, Denmark, and more which is also aimed to be provided to the public.

To provide this material, a website was established in 2009 based on an older system which categorised entries by originator of the documentation. The data was published under a CC-BY-NC-ND license, which, while being an open access license, is the most restrictive Creative Commons license. To account for the increased amount of material and demand, it was decided to transform the old database into a more modern, topographically sorted system that provided metadata through its folder structure which was completed in 2021. This was used as the start for the current backend, which was developed by GRIDH in 2022, for a new website that was launched in Summer 2023. The digitized documentation is now provided under a less restrictive CC-BY license.

2. General description

The SHFA resource is comprised of a Django backend and a web-based user interface. The image metadata is stored in a database but uploaded and edited in GRIDH's implementation of a Django-based platform – *Diana*. Recorded metadata includes unique identifiers to maintain links to each image, as well as fields that provide researchers with detailed information about the site location, image credits, image attributes, and interpretations of the motifs visible in each image.

The frontend offers content in both Swedish and English, as well as displays in light and dark mode. The main page provides users with a header containing links to documentation followed by a 2-column layout containing a search panel with three search options and a gallery of sample images. In the desktop version, the search panel is visible on the left and the gallery on the right; however, in the mobile version, the search frame is at the top and the gallery below it. The size of each panel is adjustable.

Users are provided with a search guide, description of the archive, and external links to the SHFA homepage and SHFA news page in the header. The search guide details instructions for the three search options as well as the available keywords and datings, and descriptions of the available image types. The about page provides information on the images in the database, the progress of migrating from the previous system, and guidance on how to cite the images.

The search frame has a form input, the *simple search*, where users can input free-text and all content in the API is searched and items where an explicit match is found, or the search term is a substring of the record entry are returned. This search input is also accompanied by buttons which allow users to trigger example searches. The example searches familiarise users with the new interface layout as well as a range of rock art and image styles. Below the simple search are *map display* (visible by default) and *advanced search* components with buttons that toggle between them. The map displays markers of all sites, with the default view randomised on loading. The advanced search allows users to search specific fields – site, author, institution, image type, keywords, and dating. Each input accepts free-text or the user's selection from the autocomplete suggestions. Clicking on a map marker will also trigger a search for the site.

Once a search is executed, the map zooms to the extent of all sites included in the search results. For further information on the sites, hovering over markers on the map will display pop-ups with site identifiers from the relevant heritage registers or the placename stored in the database. Search results are returned and paginated in the gallery with 25 images per page. Hovering over an image thumbnail in the gallery also displays the site identifiers or placename.

The metadata panel is only visible once an image thumbnail is selected and displays the IIIF image at the top; however, the image can also be viewed in full screen mode. This image can also be downloaded using the button overlayed on, or to the left of, the image. Below the image, all the available metadata is displayed. For sites in Sweden, the site description is fetched from Fornsök,

the Swedish National Heritage Board's search service for ancient and cultural remains, with a link directly to the site entry in Fornsök.

3. Technical description

3.1. Backend

The image metadata is stored in a PostgreSQL database and the site metadata, including geometry, is linked based on the site identifier and stored in a PostGIS database. GRIDH use *Diana*, their Django-based database coordination system, to make the data accessible to the frontend using by generating REST APIs. The primary returned fields can be described as follows:

- "id": incremental numeric identifier
- "uuid": unique 32-digit alphanumeric identifier
- "iiif_file": storage location of the higher resolution display image which is generated using the International Image Interoperability Framework (IIIF)
- "site": site identifiers and the site location information
- "collection": collection of images based on a common institution, region, or creator
- "author": name(s) of image creators
- "institution": affiliation(s) of image creators
- "year": year image was taken or created
- "rock_carving_object": group of panels or region an image belongs to
- "type": descriptive image type (e.g., photo, 3D visualisation, night photo, etc.)
- "keywords" & "dating_tags": archaeologists' interpretation of the images and motifs

Diana also offers an accessible frontend solution to allow users to upload new data to the database and take advantage of auto-filled data based on existing entries in the database to an extent.

3.2. Frontend

The SHFA frontend uses the Vue3 framework [1] and features a 3-column layout using the Split.js library. The leftmost column showcases the map and search functionalities, the middle column is an image gallery using the Vue Masonry library, and the right-most panel shows a high quality (IIIF) version of the selected image and relevant metadata. The panels from left to right become more specific and enable a workflow where the data can be filtered down from a regional scale to a specific site.

The frontend fetches the images and metadata using the API generated from the Django backend, but the site description is fetched from Fornsök using HTML parsing. The website's language can be toggled between English and Swedish through a button in the top right-hand corner. The Swedish-English text is manually generated using i18n [2] for the general website texts and keywords in the metadata panel. However, the remaining text is stored in the database. The map uses OpenLayers [3] with a colour-corrected OpenStreetMap layer as a basemap and site markers in a WebGL point layer with the interactive pop-ups.

The simple search function searches the site identifiers, carving, keyword, dating, location, image type, author, and institution fields and returns images where the entered text matches a substring of the data in any of the searched fields. Clicking on one of the suggested search buttons adds the text to the search bar and automatically triggers the search. The advanced search function has separate inputs for each field and supports free-text as well as clicking on one of the autocomplete suggestions which are generated using the entered text as a search query to the relevant API. The advanced search function allows users to narrow their search results by searching for a value in multiple fields, e.g., laser scans from the site Tanum 1:1. Clicking on a marker on the map or the 'Search in map view' button also triggers a search for images by site.

Search results are then grouped by image type and the image types are returned in the order defined by the archaeologists at SHFA which highlights the documentation over images of the site or documentation process. Results are displayed as image thumbnails in the gallery panel with a section header indicating the image type group. Clicking on an image in the gallery opens the image and metadata panel.

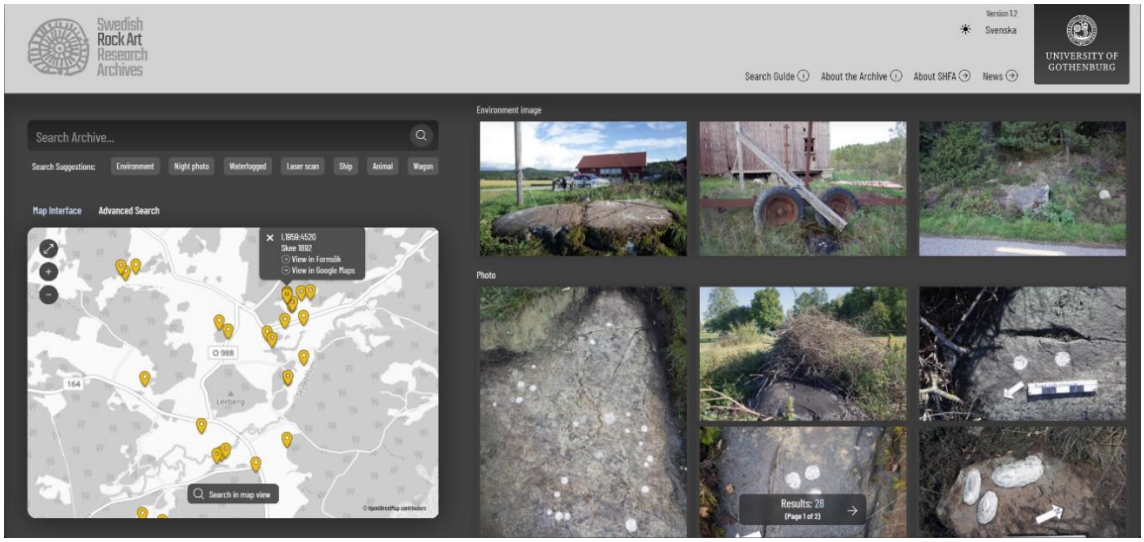

Figure 1: Example of the main page for shfa.dh.gu.se on a widescreen display

The website is responsive, meaning that the layout is preserved across various screen widths and heights. Individuals can access the platform across all browsers and devices while maintaining the same user interface. As demonstrated in Figure 1 and 2, all elements are available on various screen sizes, but the elements are rearranged to improve the ease of use for users. The website's analytics are handled through the open-source library Matomo [4] with custom composables that track searches performed.

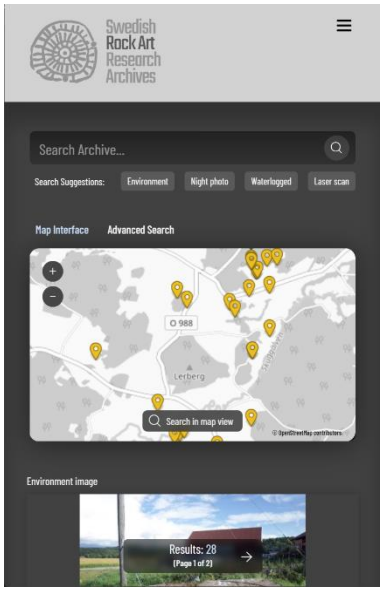

Figure 2: Example of the main page for shfa.dh.gu.se on a narrow display

The IIIF image and controls are rendered with OpenSeadragon [5]. The available metadata is returned below the image in a table. Headers are only returned if data is present in the field. A reference for each image is constructed from the author, year, image type, site identifier, and image id fields with the date accessed calculated from a JavaScript Date instance [6] and

returned language determined by an if/else statement. The keyword and dating lists are concatenated as dating information is not available for all images or motifs. Links to the IIIF images and sites can be shared by copying the URL in the address bar.

4. SHFA data and research

While there have been over 11,000 visits to the site in the four months since it became public, it is still difficult to estimate the short-term impact on research in such a timeframe. However, there is data gathered for the old website of the SHFA which can be discussed, with some limitations that must be considered. The data of the use of the website over the last six years only includes visits to the website which did not include any user information. That means it is impossible to say whether the contacts were established by academic users, members of the general public, or other originators. There is also no information about unique users. Gathering user statistics including academic affiliation and more is inherently difficult, because it would require, for example, to establish a login which in turn might diminish the user base because people do not want such information collected or simply because it would make the use of the website much more cumbersome.

A better metric for the impact on research is the use of rock art documentation provided by the SHFA in academic publications. However, even this is not free from problems. The SHFA provides documentation under a creative commons license that requires the user only to acknowledge the originator of the documentation, but not the SHFA as provider. That means SHFA relies on the circumspection and kindness of authors to mention in text, figure descriptions, or acknowledgments where the images they used came from. However, a representative sample of publications were gathered that allow some insights. Between 2017-2022 the SHFA supported 98 academic publications with peaks in 2018 and 2022. Peer reviewed publications outweigh considerably non peer reviewed publications (85%). To assess the quality and rank of publications, the University of Gothenburg uses the ranking provided by the The Norwegian Directorate for Higher Education and Skills. This system ranks publications into three levels (0-2) with the higher number indicating a higher rank. Most publications that were supported were level 1 followed by level 2 publications. The number of supported publications increased clearly in 2022, including the number of level 2 publications.

The SHFA also supports many BA, MA, and PhD theses. Although, it is again difficult to ascertain any concrete numbers. Safer ground provide research projects undertaken by the SHFA driven by and in support of its infrastructure. Currently, the SHFA is involved in six different projects including the Riksbankens Jubileumsfond program “Maritime Encounters”, the Swedish Research Council project “Modelling Bronze Age societies”, and the Swedish Research Council national research infrastructure “InfraVis”. SHFA also supports external projects such as the Swedish National Heritage Board supported project “Digitala bilder för forskning och publik” by Prof. Fredrik Fahlander (Stockholm University).

In 2022, the Riksbankens Jubileumsfond infrastructure for research project “Rock art in three dimensions” ended successfully. The project created the first working image recognition model to successfully semi-automatically identify Scandinavian rock art motifs. In addition, over the course of the project two different ways to better visualize 3D rock art documentation were developed and eventually bundled up into an individual app called Topographic Visualization Toolbox which is open source (https://tvt.dh.gu.se/) [7], [8]. Furthermore, two prototypes for mobile apps including augmented reality technologies were programmed to provide information about rock art at home and on-site both [9]. The infrastructure not only supported 20 scientific publications directly and indirectly linked to researchers in the project, but the work also laid important groundwork for the newly launched website and database of the SHFA.

In addition, the SHFA contributed to the national discussion around important cultural heritage including the UNESCO world heritage area “Rock art in Tanum”. This particularly concerns preservation issues through the tradition to paint the rock art in on touristic sites. There

is a long debate about this practice and SHFA co-organised, for example, the “Ren sten” (Clean stone) conferences together with Vitlycke Museum, Riksantikvarieämbete and others to drive the debate forward [10] Preliminary results of a new pilot study indicates that the paint actively contributes to the erosion of the images on the rocks [11].

Overall, the increased user-friendliness of the relaunched SHFA database and especially the website is expected to further be a strong driver for high impact research. A less restrictive CC licence and the suggested citation for each image will allow easier use of the material and the newly implemented map feature makes it easier to find local and transrregional comparative rock art. The future implementation of features like viewers for 3D meshes and point clouds will allow users to explore and download material directly, which increases accessibility and researchability of these documentations. This will not only support new publications, but also new research projects advancing our knowledge about those making rock art, and how to protect and communicate rock art. The upload of international material from Norway, Denmark, Italy, Spain, and Portugal from the database to the website will make the new web resources a research resource and a hub for a wider international audience of researchers supporting their work.

5. Discussion and Conclusion

Providing rock art documentation and associated metadata digitally and under a creative commons license using web-based distribution has had many positive aftereffects. Sites are often widely distributed and comparable sites might be separated by several hundred kilometres. Furthermore, the sites are immovable making them disparate even if they are located within a couple of metres from each other. Analogue documentation is only a partial remedy to this situation, because it is generally 1:1 in size and large spaces are necessary to compare the data which may in addition be stored in different locations. The wide availability of digitised rock art documentation has empowered research by increasing the opportunities to compare data not only of different sites, but also subsequent documentations of the same site. In addition, providing data outside of Sweden has enhanced to possibilities for international, diachronic comparative studies which have the opportunity to provide new insights into Bronze Age mobility, travel, exchange networks, and ideologies across Europe. The larger amount of available data also means that more evidence is available for researchers to test their hypotheses. This has rejuvenated rock art research which has experienced an increased research output in monographs, articles, theses, and new projects making important contributions to method development, computational studies including Big Data, and it also allows deeper analysis of social roles that were understudied so far, for example the carvers in Bronze Age societies [10], [11]. By digitising and disseminating rock art documentation through a web-based resource, the data is accessible to the public as well as researchers, allowing for engagement with rock art from multiple perspectives.

The resources developed by GRIDH offer a solution to create future resources where the primary components are images and geospatial data. Using a backend solution that provides the research partners with an adaptable user interface makes uploading data easier for those with a technical background. As viewing the rock art in-person requires a visit to the site, offering a website optimised for both desktop and mobile use makes it easier to view the existing documentation while at a site. User feedback is also considered as we continue to make improvements to the frontend. Data is continuously added to the SHFA website and as migration continues to the new resources, additional data types, such as 3D meshes, will be made available.

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