

Hiding in plain sight: The biomolecular identification of seal use in Romanesque medieval manuscripts

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Medieval manuscripts not only represent an irreplaceable documentary record, but are also a remarkable source of art historical and craft information. The medieval manuscript collection of Clairvaux Abbey and Clairmarais is of global significance with over 1,300 documents; amazingly 28 of these documents can still be found in their original bindings with chemises (outer cover) almost intact. The chemises are described in library catalogues as boar/deer skin, however, under magnified examination the distribution of the hair follicles on the covers was found not to match either animal. The remaining hair is damaged and the condition of the skin is poor, compared to that of the primary leather covers preventing a standard visual identification.

To try to identify the animal origin of the chemises we applied non-invasive proteomic and genomic (biocodicological) analyses to seven documents from the Clairvaux/Clairmarais collection. Proteomic analysis identified the skins as belonging to pinnipeds with DNA sequences further resolving the species of origin for six of the documents, revealing five chemises as being produced from harbour seal (*Phoca vitulina*) skin and one from harp seal (*Pagophilus groenlandica*) skin.

Further DNA analyses comparing the sequence data recovered from the documents with that of contemporary populations, found that four of the harbour seal skins could be genetically assigned to Scandinavian and Scotland and the harp seal to Greenland. This suggests an important trade in seal skins as a commodity, possibly at the Champagne fairs, although the monks may not have been aware which animal the skins were from.

The skins currently appear to be brown in colour, but it is highly unlikely that Cistercians would have covered their books with brown skins: as brown was characteristic of the Benedictine order. The Order of Cistercians is known for its white choir robes and objects and therefore it is a possibility that pinniped skins were chosen for the chemises due to their light coloration.

In summary the biocodicological study of these rare bindings has aided not only in the understanding of the extent of trading networks that the Cistercians monasteries were involved in but also the original physical appearance of the manuscripts.