

STRANGE ATTRACTORS IN THE HIGH MOUNTAINS

ABSTRACT

ESPEN ULEBERG

UNIVERSITY MUSEUM OF CULTURAL HERITAGE, UNIVERSITY OF OSLO

A number of sites in the Norwegian high mountains are included in this study. Dateable artefacts and C14-datings can yield a relatively precise time for an activity on a site but do not supply information on the length of time involved. The allocations demonstrate the various interpretations of the landscape. Hunters and pastoralists have placed their sites differently in the landscape; dependent on how they interpreted their surroundings.

Some sites have been visited on a number of occasions. A certain site must have had specific traits that made it preferable for a hunter or a pastoralist. It is not possible for us to comprehend these preferences even though they are the main variables in the system. The strange attractor is a representation of the system and the attractor is reflected by the distribution of sites in the landscape. The concept of a strange attractor is used to focus on movement and flexibility within the system.

Stone Age sites are remains from movement and action in a continuous landscape. The static, dotted site map tends to conceal this, and leads to see the Stone Age landscape filled with a fixed number of closed units. The density of artefacts at any given place is in relation to the number of events that took place there. The varying density in the artefact distribution shows centres and less used areas. This shift from centre to periphery and movement in the landscape can be inferred from the static plot maps through a concept from chaos theory, namely the strange attractor.

The study area is in the Lærdal Mountains, between 1,100 and 1,500 m above sea level (Fig.1). The distance to the coast is around 250 km to the east and only 50 km to the west. The area is above the treeline which is around 900 m a.s.l., The only large game in the area is the reindeer, and scatters of quartzite flakes on the surface gives an impression that not much has changed since the Stone Age. The traditional interpretation of the sites is that they were used by hunter/gatherers living most of the year on the coast or in other lower

lying areas, acting as specialised reindeer hunters in the mountains in the autumn (Johansen 1978).

The treeline is lower now than in the Stone Age. The effect of a colder climate and isostatic uplift is increased by human impact, especially the shieling in the 19th century. The existence of an earlier debated birch forest above the pine tree limit has been demonstrated through the finds of birch tree trunks in the moors. At 8700-8500 BP the pine treeline was probably around 1,200 m a.s.l. and the birch forest may have been as high as 1,400-1,450 m a.s.l. The tree limit stayed at this level till 5000 BP, and the subsequent decline was slow. (Aas og Faarlund 1995). Almost all of the Stone Age sites were therefore situated in the forest; some of them even in the pine forest. This suggests that moose and deer have been more important than the reindeer.

The last remains of the ice cover were melted not long after 9000 BP, and the oldest site in the Lærdal Mountains is dated to 8510 ± 110 BP. There are no organic material preserved at the sites, but bones from Stone Age sites in the nearby Hardangervidda area show the presence of reindeer in the mountains in Southern Norway from 8500 BP onwards. Bones from moose and possible deer in addition to bird (Indrelid 1994:237-40), show that the subsistence was more varied, and supports the idea that the sites were not situated above the treeline.

C14-results combined with dateable artefacts from several sites show repeated visits. The lack of cultural layers and frost perturbation makes it hardly possible to document

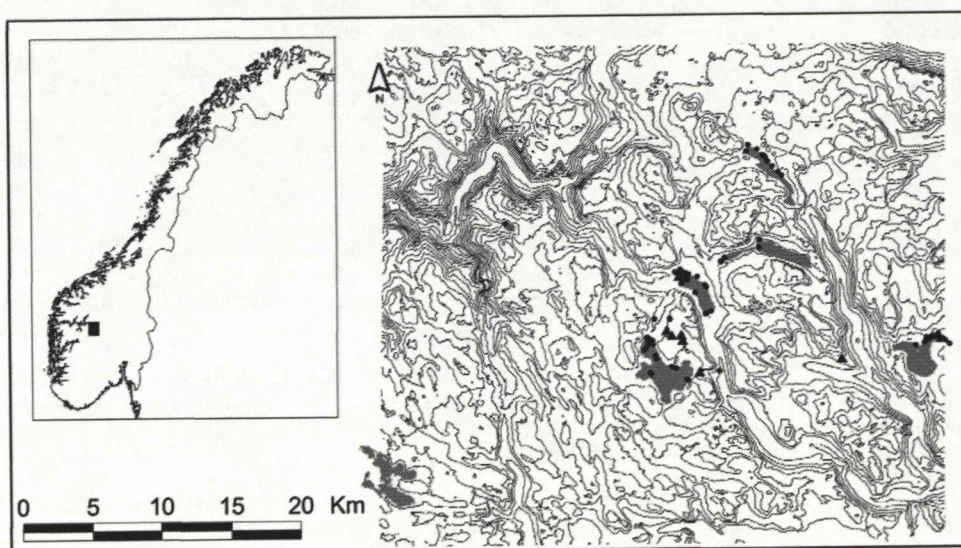


Figure 1

any time sequence at the sites. What can be said with certainty is that the lakesides have attracted activity at several points in time.

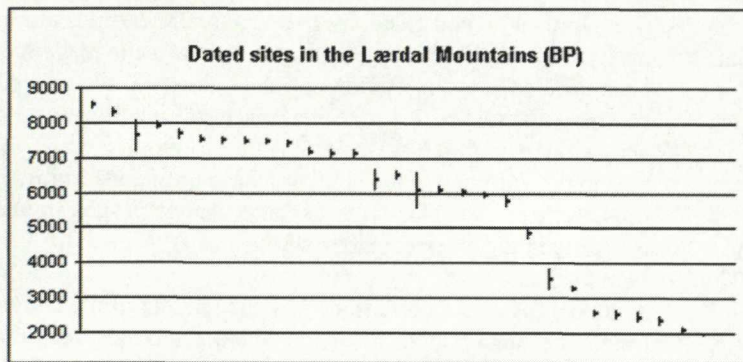


Figure 2

Two C14-datings or two dateable artefacts show two separate events, and it is not possible to say anything about what may have happened between these two points in time. A combination of a series of C14-datings from the high mountains shows longer periods with no activity at all. There is a noticeable gap in the period 6000 - 3500 BP, the last part of the Mesolithic period and the early Bronze Age (Fig.2). Dateable artefacts from this period indicate that the area was used, but the activity in the Neolithic and Early Bronze Age is not visible in the C14-samples. One explanation could be the use of fossil fuel. The tree species was not determined for the C14 samples from The Lærdal Mountains, so that old tree trunks, pine found in the bogs, might have been used as firewood. On the other hand, the same hiatus is visible in other high mountain areas where the dated material was twigs and branches (Bang-Andersen 1986), corroborating that the mountain areas in Southern Norway were less used in this period.

The hiatus has been explained by bad climate - that more precipitation followed by ice-covered ground in the winter would give worse conditions for the reindeer. When the reindeer population was reduced, the mountain areas would not be attractive for hunters (Moe et al. 1978). However, there does not seem to be sufficient data to support the idea that a climatic change caused the virtual abandonment of the interior areas. Longer and not simultaneous periods of no or less activity in different parts of Southern Norway implies that it was not only the natural environment but a cultural change that decided this development (Uleberg 2003).

NON-LINEAR SYSTEMS

The culture landscape is dependent on a beholder, but it is not necessary that the landscape be physically restructured. The landscape is structured through its description. It is the user of the landscape who, on basis of the cultural and historical context, ascribes importance to certain elements. The same landscape has differing contents for people with differing backgrounds (Meløe 1989). The subsistence pattern will outline what the individual sees and looks for in a landscape. The economical basis and individual experience decide the description of the cultural landscape. In this way, a description of

a group's ecological niche will also be a description of the group's cultural landscape.

In this way, it is possible to have many landscapes within one geographical unit. These different, co-existing, landscapes are dependent on a subject to exist. The cultural landscape becomes a dynamic unit where changes happen in local environments and over short time spans (Welinder 1992:107). The system is dependent on individual decisions, and initial conditions and small variations can be decisive for the development. It is possible to use a model that presupposes that the system is changing. Small changes and initial conditions can be given great importance in non-linear systems theory. The non-linear systems theory can show that unpredictable random variation can be produced in a deterministic system. The system can contain quick changes and

shift between chaos and order. The apparently random variation is connected to orderly recurring patterns, where the system can change states from order to chaos and order can re-emerge from chaos (Spencer-Wood 2000:115-116).

One way of delineating the underlying dynamics of a system is by producing the attractor of the system. Simple systems converge towards simple attractors. A pendulum is a simple system. It moves back and forth, and stops eventually over a point. It has a point attractor. Other systems can have more complex attractors like a circle or a torus. Chaotic systems, nonlinear systems, also converge towards an attractor, but this attractor is even more complex, and is called a strange attractor. The path is deterministic, but totally aperiodical. The movement converges, but two paths that are close to each other will diverge and follow quite different developments (McGlade 1995:119-120).

A strange attractor cannot be described beforehand. One way of describing a strange attractor is by studying the Poincaré section, which is a slice through the attractor. From an m -dimensional attractor, this can be obtained from the intersections of a continuous trajectory with an $(m-1)$ -dimensional surface in the phase space. If the system is periodic, with period n , the section will contain a sequence of n dots repeating indefinitely. If the evolution is chaotic, the set will be a collection of points with no obvious repetition. The Poincaré section can be obtained by sampling the system occasionally, and not necessarily continuously (Tsonis 1992:83). It will not be possible to describe a model that can be tested, but it gives another way of thinking about the material. Important variables in the model are landscape and find density. Chronology gets less attention, so that finds from all periods can be incorporated in the same model.

Thinking of the artefact distribution as a strange attractor helps to move away from the site map's scatter plot to an understanding of interaction and movement. The small variations in the system can be visible in the pattern made by the artefacts in the landscape. In this way the archaeological recordings can be seen as a Poincaré set where the system is sampled occasionally. Stone Age men and women moved in a continuous landscape, performing activities, some of which

Statistic and Quantitative Methods

resulted in physical remains, and some of these are preserved and documented by archaeologists. Each artefact is from an event in prehistory. At sites with one or only a few artefacts, there have been one or a few events. At sites with many artefacts and constructions, there have been several events, perhaps in a short period of time, perhaps spread out over a longer time span. There is a connection between the density of artefacts and the importance of the specific site, the place. Areas with high artefact density have been visited often, areas with lower density more seldom. This approach reduces the need to explain each site on its own, and strengthens the notion that all remains are parts of the same basic system.

THE LÆRDAL SITES

There is a large difference in site density around the lakes in the Lærdal mountain area. Lake Eldrevatn has by far the largest number of sites. The Lakes Kvevotni and Flævatn have none. The other surveyed lakes have several sites. When the area is seen as a whole, there is no clear chronological difference among the lakes. All that have dateable sites have finds or C14-datings from all periods from the Mesolithic to the Bronze Age. The possible differences between the lakes Kvevotni and Flævatn and the other sites can give information about what people saw as a good allocation. The two lakes were earlier two series of smaller lakes and rivers. The lowest of these lakes were at 1,458 m a.s.l. The birch tree line was probably at 1,400-1,450 m a.s.l. These lakes have therefore always been above the treeline. All the other surveyed lakes were below the treeline. This suggests that a good allocation was a place near a lake below the treeline.

The density of sites around Lake Eldrevatn combined with C14-datings and dateable artefacts show that this has been an attractive area in several periods. The lake has attracted activity throughout the Stone Age. In addition to the definable sites, some with constructions, there are scattered finds along most of the lakeside. Sometimes exactly the same place has been used several times, although there does not seem to be anything that makes that particular place special. Some of the sites around the lake have finds from all periods, while an area in the West and in the Southeast have only finds from the Mesolithic period. This suggests that a change in subsistence is visible in the artefact pattern when seen at this scale.

A good allocation is determined by the reading of the landscape. The hunter looks for good hunting grounds, and the pastoralist looks for good pastures. Human activity at a place can give a positive feedback. The place will be prepared for living there. Human activity also leads to a concentration of debris, which again can give better grazing condition, and increase the possibility that a certain place can be seen as a good place to settle. The difference between the early hunter-gatherer sites and the Late Neolithic pastoral sites in the Lærdal Mountains is not very clear. The larger sites are all placed near the lakes that were used for shieling, even in modern times (Uleberg 2003). In the nearby Nyset-Steggje mountains areas, where lakes are not dominating the landscape in the same way, a shift in allocation from the early hunter sites to the pastoral sites of the late Neolithic is more clear (Prescott 1995). The situation changes when the scale is changed from the whole mountain area to one single lake. The mapping of artefacts along the lakeside makes it possible to discern a shift in the reading of the landscape from the hunters of the Mesolithic to the pastoralists of the Neolithic period.

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