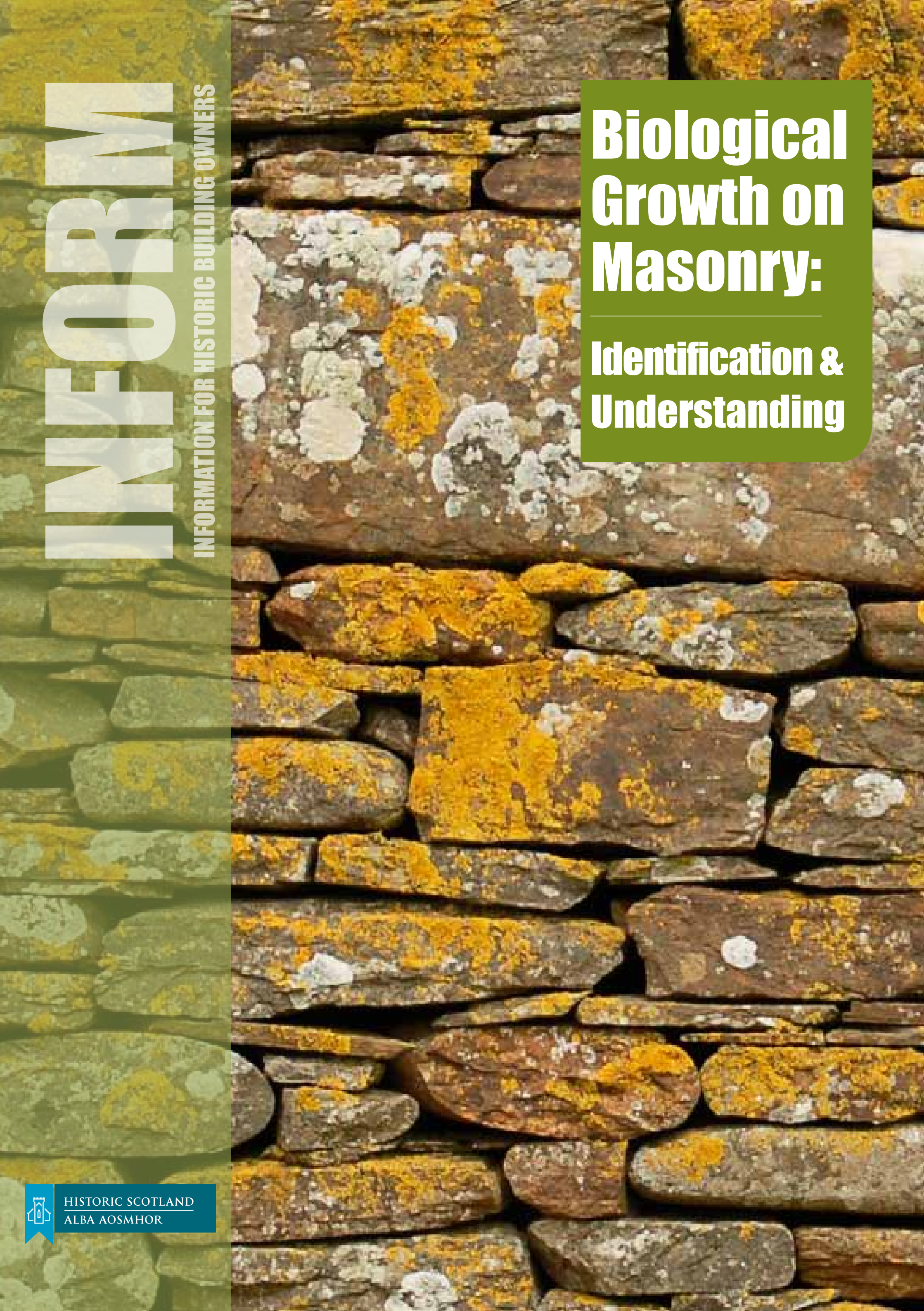
INFORM

INFORMATION FOR HISTORIC BUILDING OWNERS

Biological Growth on Masonry:

Identification & Understanding



HISTORIC SCOTLAND
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Introduction

This INFORM guide provides a brief overview of the types of biological growths that are commonly found on Scottish buildings and historic structures, and gives advice on their monitoring and management.

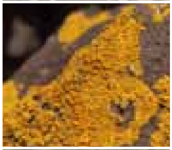
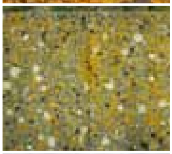
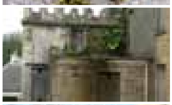
Biological growths found on masonry include algae, fungi, lichens, mosses and higher plants (e.g. grasses, ivy, bushes and trees). Biological growth on building exteriors is inevitable, but not necessarily problematic in terms of either aesthetics or preservation. In fact, much biological colonisation is harmless and goes undetected, and the presence of biological growth is not necessarily responsible for damage, which may be the result of other problems affecting a structure.

Types of biological growths

Many biological growths are benign and may sit on a stone surface without causing damage, or may even act as a protective barrier to wind and rain. However, some growths can damage underlying stone and mortar. Woody plants will open up joints and may dislodge stones leading to structural problems. Grasses can clog gutters and down-pipes, and blocked drainage may increase moisture levels in masonry, encouraging the establishment of algae or mosses that might not otherwise grow there.

The table opposite will assist in the identification of biological growths and where they are likely to flourish. Many surfaces are colonised by a variety of different organisms living together, known as a biofilm.

Fig. 1 *Grey-green crustose lichen with blood-red fruiting bodies growing on granite in Aberdeenshire.*

Biological growth	Colour	Appearance	Examples	Habitat	Effect on masonry
Algae	Usually green, occasionally black, red, orange or yellow	Mats, films, patches or streaks lacking defined borders.		Seen on wood, stone, soil, glass, plastic, etc. Favours areas which are often moist. Requires relatively high light levels.	Unless growth is heavy, algae are normally benign, but may be slippery on paving stones.
Cyanobacteria (previously known as blue-green algae)	Blue-green, grey or green	Similar to above.		As above, but in areas away from direct sunlight, or in enclosed spaces adjacent to artificial lights.	Unless growth is heavy, algae are normally benign, but may be slippery on paving stones.
Fungi *	Yellow, orange, rust red, brown or black.	May appear as a film or spots that resemble general soiling. Large specimens may exhibit long strands (hyphae) or large, fruiting bodies.	 	Most common on organic substrates but also colonises masonry. Requires moisture, but no sunlight. Often associated with algae.	Normally benign, although some species cause pitting of marble and limestone surfaces.
Lichens	White, grey, orange, red, black, yellow, or green	Variable surface crusts or leaf-like structures growing away from the surface with well-defined borders. Slow growing to several cm in diameter.	 	Stone, wood and soil. Often found in conditions that are too hostile for other organisms. Most species have a low tolerance to air pollution and are most common in rural sites.	Normally benign, although rare instances of blistering and pitting are known.
Mosses	Green or reddish	Leafy with a primitive root, often growing as a small clump loosely attached to the surface.	 	Found on wood, stone and soil. Requires a very damp environment, sunlight and some soil.	Can cause pitting and retains moisture on affected surfaces.
Higher plants		Leafy and some have woody roots.	 	Often found on chimneys, guttering and joints in upper levels of buildings.	Woody root growth can penetrate walls and dislodge stonework leading to structural damage.

**NB* *The identification and treatment of dry rot is beyond the scope of this guide.*

Biological attachment to stone

Organic growth is favoured on rough, porous surfaces such as sandstone. Surface roughness encourages biological attachment to the stone, while high porosity retains moisture necessary for organisms to survive. Hard stones that are not very porous, such as granite and whin, are generally more resistant to biological colonisation.

The chemical nature of masonry may control what types of biological growths colonise the surface. For example, orange coloured Trentepohlia algae and cyanobacteria (blue-green algae) tend to favour alkaline conditions as found on limestone, marble, concrete and mortar. Green algae are less sensitive to pH levels and may be found on a wide variety of masonry types. Individual lichen species are particularly sensitive to surface acidity and air pollution, and many species will only colonise masonry under very specific conditions.

Fresh mortar is particularly alkaline and may act as a biocide, killing off nearby biological growths (Fig. 2). Over time mortar alkalinity levels decrease to a level that some organisms can tolerate, but as mortar often remains more alkaline and porous than most stone, different species may be found growing on mortar and adjacent masonry.

Fig. 2 *Inhibited biological growth due to alkaline conditions caused by new mortar.*

Potential effects on masonry

The vast majority of biological growths found on masonry are not damaging, particularly at low levels of colonisation, and a stable biofilm may provide a preservative effect to stone surfaces. The main effect of biocolonisation on stone is aesthetic, resulting in colour change that does not necessarily require corrective treatment, and may in some cases even enhance the appearance of historic buildings.

In general, algal growth on masonry is superficial and does not penetrate or cause physical damage. However, a thick algal layer located within the joints between stones may create an environment that encourages the establishment of woody plants that may be damaging. Some species of algae produce excessive amounts of slime that may expand and contract upon wetting and drying, which may cause flaking or spalling of a stone surface. These slime layers may also be slippery on paving stones, causing a safety hazard (Fig. 3).

Fig. 3 *Slime producing algae may result in slippery surfaces.*

Fig. 4 *Rare example of damage to sandstone masonry caused by lichen growth.*

Fungi are one of the most common organisms that colonise building stone, although they may be almost imperceptible to the naked eye, requiring specialist microscopic identification. Fungal strands (hyphae) may penetrate stone surfaces to obtain nutrients and secrete small amounts of acid, which may cause some superficial damage, particularly to marble or limestone. Fungal biofilms may be dormant for extended periods of time, but may be reactivated when environmental conditions are favourable for their growth.

Lichens are a symbiotic intergrowth of algae and fungi. Lichens also have hyphae that anchor them to stone surfaces and secrete acid compounds that may dissolve mineral grains. Lichens are slow growing and rarely cause significant damage to masonry. Lichens may provide some protective benefits by both blanketing the stone, as well as interacting with the outer stone surface to reduce moisture ingress. In rare cases, some species may cause bleaching, blistering or pitting of a stone surface (Fig. 4).

Mosses are simple plants, consisting of a leaf region and a primitive root which attaches to the stone. They occur mostly in cracks and crevices, and on wetted slopes such as roofs. Moss retains water extremely well, and this can keep a masonry surface in a persistently wet state, which exacerbates stone decay. When moss becomes dislodged, it can clog up guttering leading to drainage problems.

Woody plants can cause substantial damage to masonry as their roots penetrate joints and cracks. Such root growth can dislodge masonry allowing water penetration and leading to eventual structural problems if the growth is ignored.

Monitoring and management

Biological colonisation of building stone is a natural process, but excessive growth may indicate a serious problem with a structure. Monitoring biological growths over time will help to determine if the growths are in fact responsible for any damage to the stone or if they are responding to changes in the environment that may be damaging the building. When new or enhanced biological growth is observed, inspect the building to identify whether the biological growth is a symptom of a maintenance problem, such as blocked guttering, damaged pointing or other drainage issues (Fig. 5). Resolving such problems not only prevents further colonisation, but should also cause the existing growths to die off. Reducing the sheltering effects of nearby vegetation can also help dry out areas of a building that are persistently damp and therefore may be susceptible to enhanced moisture-related deterioration. Thus it is possible to decrease the appearance and effects of most biological colonisation without treating the growths directly.

Fig. 5 *Guttering clogged by plant growth.*

Removal of biological growths from historic masonry buildings and structures should only be done when their damaging effect has been confirmed, and then only methods least likely to cause any additional damage should be used. It is important to note that several lichen and moss species are considered endangered and may be protected by law.

Stonecleaning for purely aesthetic reasons is not encouraged, but cleaning may be necessary in order to undertake a conservation survey or to address damage to a building. Consent is normally required to carry out cleaning on listed buildings, scheduled monuments and structures within conservation areas. Any cleaning treatment involves some risk of damage, and the end result may be unpredictable and may not be entirely effective. Whilst stonecleaning may reduce the appearance of surface biological growths, it is unlikely to render the surface uninhabitable. Spores of some species may survive the cleaning process, and re-establishment of organisms on the cleaned stone surface can occur within a matter of months. Re-growth of green algae may even accelerate following cleaning (Fig. 6). Some lichens partially penetrate the stone surface and may leave behind “ring marks” after removal. Stonecleaning is also likely to roughen the surface of stone and increase surface porosity, creating even more favourable conditions for biological growth than before.

Fig. 6 *Rapid re-colonisation by algae of a recently cleaned sandstone building.*

When biological growths are found to be damaging and require removal or management, the following courses of action may be considered:

Washing and brushing

In dry conditions, surface growths may be removed by lightly scraping or bristle brushing and then gently washing down the area. Wooden scrapers should be used in preference to metal ones – natural bristle brushes are best and, on no account, should wire brushes be used as these can damage the stone surface.

Copper strips

A traditional approach to growth control is to set narrow, thin-gauge copper flashing strips into the length of horizontal mortar joints in masonry at approximately one metre centres. When surface water run-off takes place, this produces a mildly toxic biocidal wash. However, such run-off may cause light green surface staining that can be difficult to remove, particularly on pale-coloured stone.

Ultraviolet light

In some cases, particularly on small indoor areas where humidity is high, UV light can be used to control algae or cyanobacteria. However, this type of treatment is rarely carried out, and is not widely available. For specialist cases, it may offer a solution to growths that other treatments cannot. UV light kills photosynthetic growths and has none of the risks associated with chemical biocides, but bacteria and fungi deep in the stone may not be killed by this method. UV light is not suitable for whole building façades, as the application requires a particular small-scale set-up.

Biocide compounds

Chemical biocides are compounds applied to stone to kill off biological growths. Most biocides will kill a range of growths. However, organisms vary widely in their susceptibility to biocides, and some produce spores that are resistant to biocides, re-colonising a stone surface soon after treatment. Some biocides will kill growths on contact but have no long-term effect, and others are designed to remain active within the stone and inhibit re-colonisation for some time after treatment. The effective life span of a biocide varies from several months to years, depending on the type.

Due to their toxic nature, only five main types of compounds have been approved by the Health & Safety Executive for use as biocides: quaternary ammonium compounds, amines, chlorophenols, phenoxides and metals (i.e. copper). The HSE should be contacted directly for more information before using any chemical biocide. Be aware that biocides that are relatively safe for people to apply (i.e. 'low mammalian toxicity') may be toxic to birds, fish or aquatic invertebrates. Run-off into water courses could be a problem.

Before applying any biocide treatment, it is highly recommended that the relevant Historic Scotland Technical Advice Notes are read, as they provide important background information.

The effects of biocides on masonry itself are rarely considered, but they could be potentially damaging if applied incorrectly or may have as yet unknown long-term consequences for stone deterioration. It is generally best to use treatments which are pH neutral. Acidic treatments should not be used on marble or limestone, as they will dissolve the stone surface, and strongly alkaline treatments may cause iron staining on some stone types. Treatments that may leave behind damaging salt residues (e.g. chloride containing bleaches) should be avoided. Test biocides on a small, inconspicuous area before general application.

Personal protective equipment (PPE) is required when working with most biocides. Read the manufacturer's instructions and 'Technical Data Sheet' for the product (available free on request from all chemical manufacturers) to ensure the correct safety precautions are taken.

Conclusion

A variety of biological growths can be found on historic masonry structures. Much biological colonisation is harmless and will not require corrective treatment. Excessive growth may be an indicator of another problem with the structure such as ineffective rainwater goods or damaged pointing, and may be best controlled with proper maintenance of the site. Any removal or cleaning of growths should only be considered if damaging effects can be confirmed, and then only methods least likely to cause additional damage to the stone should be used.

Further Reading and Contacts

Biological Growths on Sandstone Buildings: Control & Treatment, Technical Advice Note (TAN) 10 (1997) (Available for purchase or digital view from the Historic Scotland Technical Conservation website www.historic-scotland.gov.uk/conservation)

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