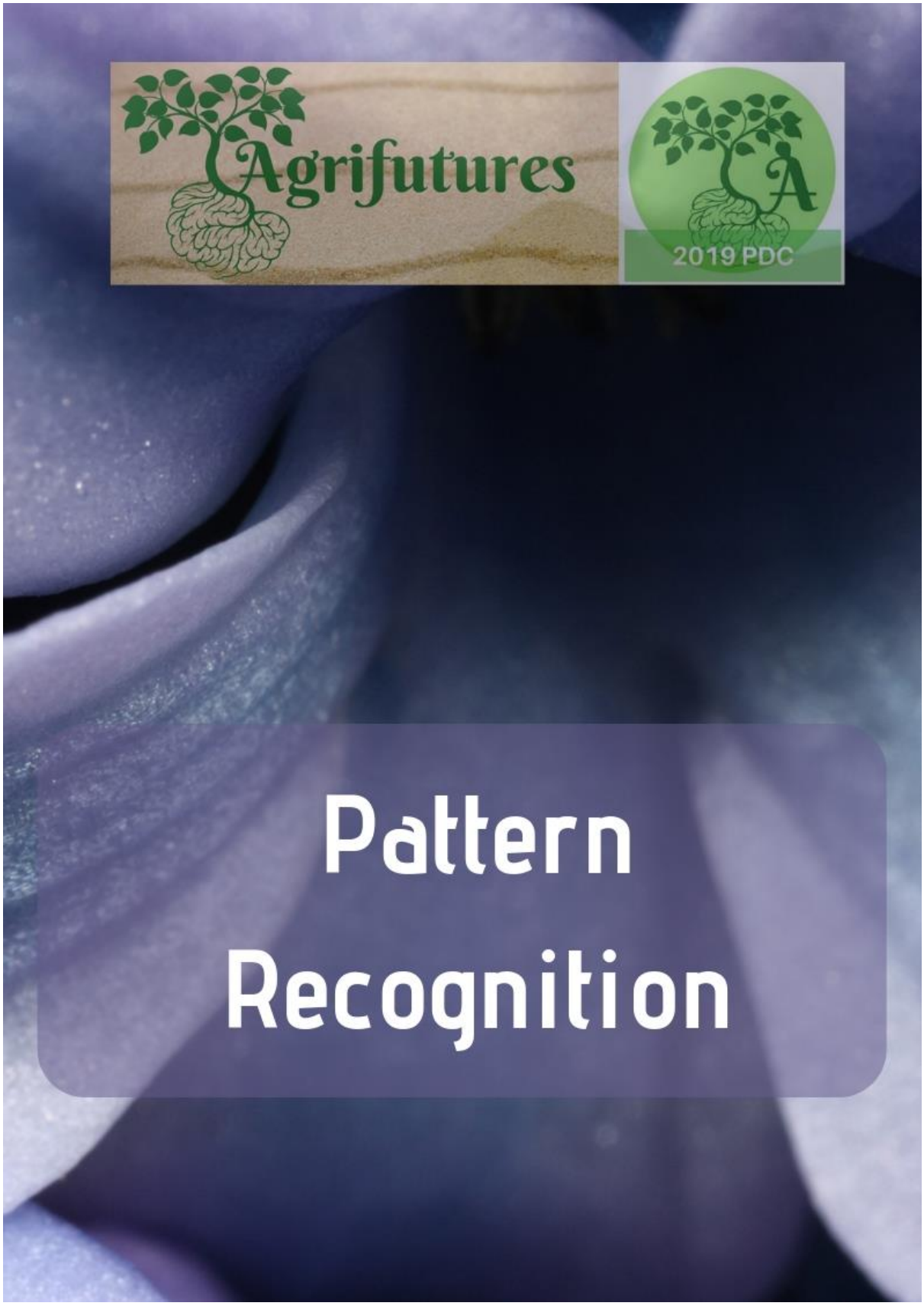
Agrifutures
2019 PDC
Pattern
Recognition

Pattern Recognition

Rhythms of nature

Processes on Earth are shaped by a wide range of cosmic forces that have had a profound impact on living things. We intuitively recognise this and gauge the passing of time and seasons in accordance with the natural changes in the environment, which since the dawn of humanity have had a profound impact on our lives.

The two most obvious influences are the sun and moon, but there influence is a result of the orbit and spin of the Earth and other players operate behind the curtain of our awareness, such as the planetary giant Jupiter which exerts a protective gravitational influence by attracting rogue meteorites that could collide with Earth into its orbit instead.

Other major planetary influences are from Mars and Venus, which are not only are next planetary neighbours, but due to their similarities to Earth have always had a major role in astrology and can impact life processes on Earth via their relative positioning and alignment with other planets.

There is perhaps no more subtle and intuitive barometer of planetary influences on Earth than own aware bodies. Countless examples exist throughout societies of an awareness of the movement of planetary objects and their impact upon our behaviour and consciousness. Some of the more obvious examples of this is the term lunatic used to describe the influence of the lunar cycles on our moods and behaviour, with the full moon associated with a sense of restlessness , anxiety and heightened energetic awareness, while the new moon one of tranquillity, rest or repose.

And yet even the phase of the moon only demonstrates how much of the moon's surface is reflecting the light of the sun from our vantage point and does not reflect its gravitational strength, which is how most satellites exert their influence.

Perhaps on considering the wider cosmos we can greater appreciate the subtle forces that run through all processes on Earth and through that appreciate be more conscious and aligned in our actions. Such thinking was certainly the inspiration of development of biodynamics by Rudolf Steiner, who wove an appreciation of the cosmos into the form of organic gardening he envisioned.

Rudolf Steiner was hailed as an esoteric visionary with an appreciation of how to capture cosmic energies and through conscious manipulation transfer those energies to enhance the life energies of a landscape to enhance its production. He development a range of preparations to focus the intent and spirit of biodynamic practitioner towards tangible actions aligned at restoring the health of the landscape and by doing so help direct the deeper spiritual capacities of people and use that capacity to mediate alignments between cosmic energies and natural energies that support the growth and flourishing of cultivatable plants.

Steiner's perspective characterised that of other prophetic contemporise of his time and represented a striving to capture a primal spiritual connectivity of humanity that was waning throughout the world due to the rapid advance of industrial modernisation.

Patterns in Nature

A natural pattern occurs when there is an exchange of energy between two elements, resulting in a recognisable form developing in one or both elements. Once you know what to look for you will see patterns everywhere in nature, and understanding why patterns form and how they function helps you understand how natural systems work. This "pattern recognition" can be used to recognise microclimates, predict movement of water across the landscape, manage pests and predators, form compatible plant guilds, and assemble compatible productive elements and much more. These patterns appear at every scale, from the microscopic to the galactic. They are found in all dimensions, including time, and can combine with other patterns to create even more complex structures.

Pattern understanding is a complex topic involving many variables and categories of patterns that can be go down many rabbit holes. In this context, the focus will be patterns that typically contribute to the establishment of stable systems will be explored, that can help inform how to organise elements within that system and how recognition of those patterns can help inform progressive changes in that system.

As a starting point we will explore some of the more common patterns expressed in nature that we can incorporate into the design of systems.

- **Spirals:** Spirals are a common growth pattern that is found widely in nature and also features heavily in human imagery from the earliest history. Spirals are expressed in everything from the circulation of global air currents to seashells, whirlpools and fingerprints, and even the structure of DNA. Spirals are commonly expressed in growth of shells and ferns and cones and flowers in a mathematically regular form called the Fibonacci sequence. Our own Earth spirals through space as it orbits around the sun and moves through space, as does our galaxy the Milky Way. Spiralling inward concentrates energy and material, while spiralling outward disperses energy and material. Thus, a spiral is a balanced, efficient form of energy transfer, and so they are often found in nature where anchoring, transportation or harmonic flows are needed.

- **Streamlines:** Streamlines are often associated with the flow of air or water. A streamlined form is one that offers the least resistance to fluid flow, and is designed to minimize friction and loss of energy. Streamlines are long almost strait flows that form through parallel movement along a course. This is commonly observed within weather and ocean currents, which on larger scale resemble spirals, but on a smaller scale have the appearance of streamlines. Similarly in the flow of water along the stones on the bottom, the flow could be described as streamlines.

- **Waves:** Waves are disturbances that carry energy as they move. Wave motion transfers energy from one point to another. Waves can pulse through a medium (such as a sound wave) and are transmitted by the sequentially compression and expansion of a medium, normally spreading out as a ripple from a point of origin. Another type of wave is called a sine wave which is transmitted as an oscillating s-shaped current, with a measurable pitch and frequency. Examples of this include all types of electromagnetic waves, which include x-rays, gamma rays, ultraviolet, infra-red and visible light.

- **Lobes:** A lobe is a roundish, flattish part of something, an extension of an element that typically protrudes, hangs or projects from the edge of the element. A lobe can be two- or three-dimensional, and may be segmented or fissured. Examples in nature include the edges of saltpans, the leading edge of cooling magma from a volcano, and the parts of a human brain.

- **Torus:** A torus is a closed, three-dimensional vortex. Their function is the accretion and expulsion of material or energy, usually at the poles. Perhaps the best example is that of a black hole in space. The torus is the ring of material around the hole, being drawn into the vortex, while material is ejected at the poles. The Earth's magnetic field acts in a similar, if less destructive, way.

- **Foams:** Foams are formed by pockets (or bubbles) of gas becoming trapped in a liquid or solid. Foam and bubble patterns occur widely in nature, for example on the edges of water bodies, by insects, and sea creatures. There are two main types. In a closed-cell foam, the gas forms discrete pockets, with each completely surrounded by the solid material, while in open-cell foam, the gas pockets connect with one another.

- **Meander:** A meander is the sinuous bending of a water course, normally around a circular shape that alternates between clockwise and counter-clockwise courses. The length of a meander is influenced by elevation and substrate type, with a general pattern of shorter and more frequent meanders further up a catchment with a smaller width of river and a longer and wider meander further down with wider rivers. This predictable relationship between river width and wavelength of bends can be incorporated to great effect within pathways within garden designs, or in artificially created water courses.

- **Clouds:** The cloud pattern can be incorporated into the undulating edges of ponds to increase surface area, to the edges of clusters of trees to blend their edges (and increase surface area) and many other boundaries between two types of systems. It represents an informal way to harmonise edges between systems.

- **Tessellations:** Tessellations are a pattern that repeats itself over space, usually to finer and finer detail, in association with the transfer of energy. This pattern has been used to create telecommunication devices and the storage of information within computer chips to make most use of the space they take up. Within a landscape design a tessellation pattern can be used to connect smaller paths to larger ones, or create a series of ponds and dams on a property.

- **Scatter Patterns:** Scatters are apparently random placements at a smaller scale, but on a larger scale shows a more organised repeating pattern grouping similar elements and positioning them in space within the context of a larger background system. In a woodland system this takes the form of a grass/herb meadow interspersed with clusters of trees. The trees group to create micro-environments around themselves more favourable to other trees.

- **Branches:** Branches are one of the most common patterns in nature. They concentrate energy and then disperse it, so are useful when there is a need to disperse, collect or

distribute materials. Think of the tributaries of a river collecting water and distributing it to the main channel, or the human circulatory system, dispersing blood to all parts of the body. The size of the branch has a significant effect on its ability to move material. Smaller branches have high pressure and slower flow; which is the opposite for larger conduits. Smaller branches have their advantages though, as they allow the branch to change direction more easily, without causing turbulence or interrupting flow, while they can provide easier penetration into other media to allow for the exchange of material.

- **Cracking and Nets:** The lateral stress between two elements may express itself in a variety of patterns such as the cracking of bark, honey combs or the shell of a tortoise. Many of these patterns may be used within the context of a permaculture design. Cracking and fracture patterns are great ways of adding a bit of unusual contrast within garden designs, through the layout of paths or placement of paving stones. Net patterns are efficient ways to organise a repeating pattern into a defined space (such as the hexagonal shape of the honey comb) and these layouts can be used to create order in highly structured environments.

- **Stripes and spots:** These are patterns that often serve to camouflage and are produced by a biological mechanism two counter-acting chemical mechanisms, one that activates and one that inhibits pigment development. Both are active in striped and spotted animals.

Patterns in Natural Communities

In natural ecosystems there are a wide variety of interactions between plant and animal species that create patterns such as distribution of herbivores, defences and growth of plants and territories of predators. The observation and recognition of these patterns provides useful information to a permaculture designer that is sensitive to their environment.

Some of the more important ecosystem patterns are those of zonation, succession and stratification, which describe recognisable forms in how living things assemble within ecosystems.

- **Zonation:** This describes where living things are horizontally placed relative to each other within an ecosystem. For example in a rocky shore there is a gradient of species distribution with those more tolerant of longer periods immersed in salt water and adapted to withstand the strong water currents placed closer to the ocean and those that are more adapted to withstand drying out and being exposed out of water located further up the beach. In a similar way living thing in other ecosystems follow similar gradients.

- **Stratification:** Another pattern is the horizontal orientation of species within a system. In an ocean, for example, there are fish species adapted to living in deep water and those adapted to live closer to the surface. Or in a forest there are canopy trees, sub-canopy trees, shrubs and ground cover. The placements of species along these gradients allow species to share a habitat without being in direct competition with one another. This allows for more efficient utilisation of resources and allows for beneficial collaborative relationships to develop between species. This moderates environmental conditions towards greater levels of stability and abundance that in turn positively re-enforces the living things within their niches.

- **Succession:** This pattern describes how living things within an ecosystem change over time, passing through a sequence of communities from early pioneers species that are adaptable and resilient to a more complex array of specialist species that require a more stable and protective environment to survive. The overlaying patterns behind these changes are towards species with higher specialisation, more diversity of species and species becoming increasingly more inter-dependent upon one another.

Application of Patterns

We can take inspiration from these patterns and apply them to our permaculture designs in order to create effective systems. It is this patterning that permits our elements to flow and function in beneficial relationships. The constant observation of patterns within productive systems will inform necessary changes to the design of that system. In this way effective "pattern recognition" is essential to create a sustainable productive system, that is adaptable, varied and offers a number of financial returns to support the livelihood of the farmer.

We use our pattern understanding to integrate what already exists in the landscape with the functions we want to accomplish on that landscape. Pattern and function go hand in hand. Either one without the other is not harmonious. Integrating both is the heart of pattern understanding. Patterns of growth and flow constantly surround us and are expressed in breath-taking diversity throughout the world. By harmonising with the most appropriate patterns of the landscape the permaculture designer fits their design in with the changes within the surrounding ecosystem and positions their system in anticipation of those changes to bring the most stable, diverse and abundant yield of resources.

There are several different ways in which patterns – either repetitions of the same pattern or completely different ones – can interact.

- Tessellation: The intersection of tiles in a matrix. The patterns intersect and interlock as though on a grid – there is no overlapping or any gaps between them. The drawings of MC Escher often depict tessellations.

- Nesting: shape but different sizes fit inside each other. Nesting is an efficient use of space. Examples include Russian dolls, stacked bowls in the kitchen, and the rings on a tree trunk.

- Superimposition: This involves the placing of instances of the same pattern or different patterns over one other An example would be the placement of one spiral over another going in the opposite direction, as seen in the petals of some flowers and the whorls of leaves in many types of plants.

Tessellation, Nesting and superimposition are all strategies for developing complex and compact designs and can be used for analyzing complex landscapes (e.g. seeing how ridges and valleys tessellate).

A common pattern explored in permaculture is the boundary or edge between two different systems. The creation of complex boundary, or edge, conditions is a basic design strategy for creating spatial and temporal niches. Again, this mimics what is observed in nature – organisms often inhabit boundary zones because resources accumulate there (e.g. debris along a fence line), the resources of two or more media systems are available and often form a third media by their

combination (e.g. turbulence creating an emulsion of oil and water), or the boundary is itself a unique and rich niche (e.g. tidal pools). It is no coincidence that estuaries and coral reefs are the most productive parts of the ocean, primarily due to the complex interaction between land and water.

Where different media come together there is also the potential for stress conditions to occur. For instance, friction, shear or turbulence, violent chemical reactions, powerful diffusion forces or social disruption are all examples of stress at a boundary. These boundaries are a place for things to happen or for events to locate. In permaculture we often refer to them as ‘edges’. Patterning is the way we frame our designs. In response, boundaries are often adapted to mitigate or take advantage of these stresses. While interactions at boundaries can have positive or negative effects, in general plants and organisms at boundaries have mutually beneficial interactions. But it is worth considering edge harmonics and species compatibility when planning your boundaries to get an efficient system.

Parts of the systems that move across boundaries are sometimes called ‘translating elements’. These can store resources in one part and pass on resources to be used by the adjoining system. Plants, people and pipes are some different types of translating elements. We can also divert or modify flows across boundaries, by the use of obstacles. For example, rocks and logs can divert the flow of water in a stream, creating turbulence that disrupts the otherwise smooth laminar flow of water.

Most boundaries benefit from media moving across them, which is why impermeable boundaries create stress in a system. It is important to design boundaries with relief valves or translators in them to ease pent-up energy.