

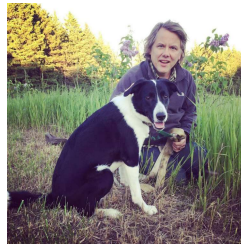
The rejuvenation of hedgerows in North America: exploring new directions for socio-ecological connectivity and rural livelihoods

The screenshot shows a digital poster with the following sections:

- Introduction:** A video thumbnail showing a person in a field.
- Results and Discussion:** A circular sunburst chart with 12 segments in various colors, representing different categories of hedgerows.
- Hedgerows in The Ontario Landscape:** A photograph of a hedgerow landscape.
- The North American Hedgerow Society:** A photograph of people working in a field.
- Methods:** Text describing the selection of 20 papers from the IALE 2020 program.
- Hedgerow Management: Rejuvenation by Hedgerowing:** Text and a bar chart discussing the benefits of hedgerowing.

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Waterloo Institute for Social Innovation and Resilience



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Virtual Remote Conference • May 11-14
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INTRODUCTION

[VIDEO] <https://www.youtube.com/embed/qFWpUDQAT8Q?feature=oembed&fs=1&modestbranding=1&rel=0&showinfo=0>

Introduction

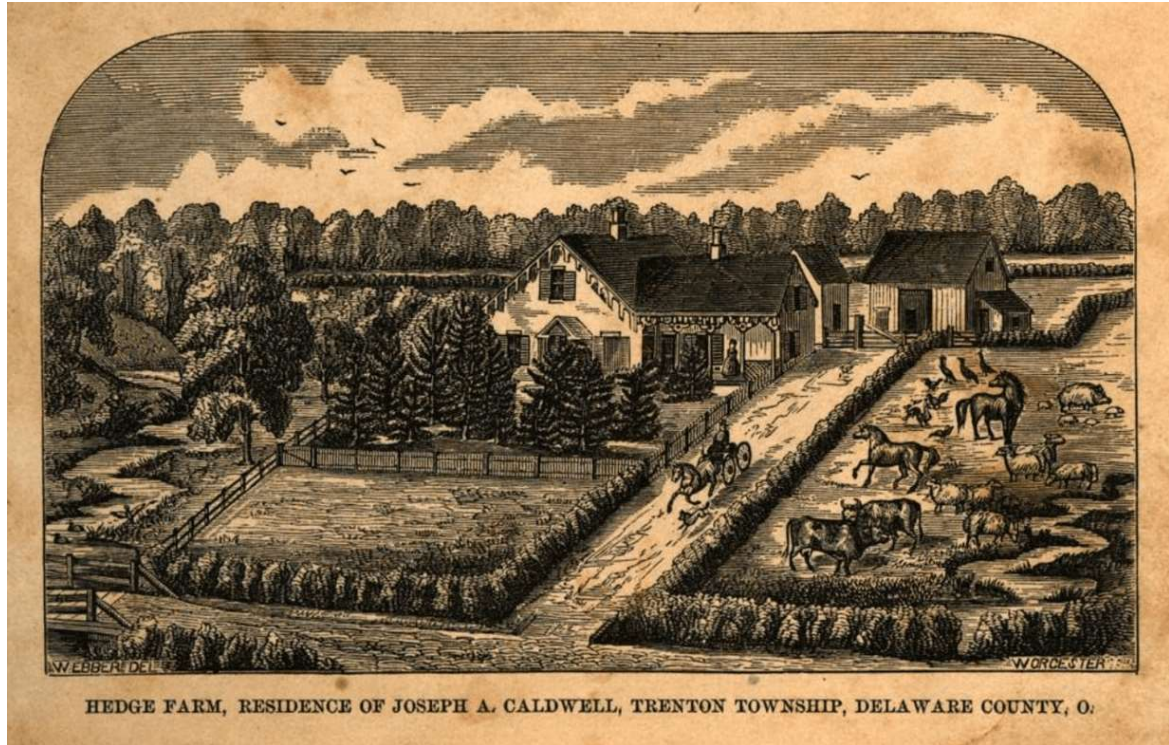


Fig 1: Hedge Farm, Delaware County, USA from *A Treatise on Hedging* (Caldwell 1870)

Hedgerow History

It's likely that 'hedgerow' construction and management has existed in many cultures as the simplest form of fencing: readily available, often thorny shrubs placed or sometimes dug in around settlements to keep people and livestock in and predators out (Müller 2013). Indigenous peoples such as the Masai still use acacia *Acacia nilotica* thorn dead hedgerows in the construction of 'enkang' today (Adams, N. pers.com). In North America First Nations peoples such as the Gwich'in of the North West Territories constructed 'surrounds' or blinds similar in structure to 'dead hedgerows', for use in hunting caribou and other game, and these were often maintained from year to year by tribal elders (Benson 2019). 'Natural' woody hedgerows (Forman and Baudry 1984, Boutin et al. 2001a) were created in North America through field clearances by the earliest settlers, who also brought with them hedgerow planting and management practices that were reaching their apogee in England with the Parliamentary Inclosure Acts of the 1700-1800s (Pollard et al. 1974). The 'birthplace' of the North American hedgerow was likely in Delaware and eastern Pennsylvania in the late 1700s where experiments with imported and native hawthorn (*Crataegus* spp.) took place, with a second burst of enthusiasm in the Midwest in the 1850s (Bourcier 1984) with the extensive planting of Osage orange *Maclura pomifera* hedgerows.

The wide availability of wood for post-and-rail fencing may have limited hedgerow planting in North America, and those planted were removed because they were seen as a loss of potentially cultivated area and as a reservoir of invasive weeds and pests (Boutin et al. 2001b). With increased field sizes which led to higher wind speeds and subsequent soil loss and plant desiccation, the usefulness of hedgerows and windbreaks for protection against soil erosion and to mitigate variations in soil moisture content was rediscovered (Boutin et al. 2001b). Hedgerow planting increased in the late 20th Century, for instance in Southern Canada in the mid-1980s more than 2500 km of coniferous windbreaks were created (Pesant 1994).

The Rejuvenation of Hedgerows

Interest in woody linear features such as hedgerows, windbreaks and shelter belts has been more recently rejuvenated with the advent first of agroforestry as a concept of integrated land use that combines elements of agriculture and forestry in a sustainable production system. While the term was first coined in 1977 agroforestry has been practiced for thousands of years (Smith 2010a).

Global research interest in the agroforestry field has significantly enhanced since 1990, with the USA, India and Germany leading the field in research output but significant interest in developing countries (Liu et al. 2019). Traditional agroforestry systems include fruit trees, olives, shelterwood and grazing, pollards and pannage and, in the European context hedgerows (Smith 2010a). In North America, windbreaks or shelterbelts have been a key practice since European settlement, and are recognized by the USA and Canada as one of the main categories of agroforestry (Thevathasan et al. 2018, USDA 2019).

Shelter belts and windbreaks are sometimes called fencerows or hedgerows because formal definitions of these, although they exist, are not consistently applied. For instance hedgerows have been defined in the UK (Department for Environment Food and Rural Affairs 2007) and regular management has become an intrinsic part of their ecology and indeed socio-ecology. No such management interventions have evolved in North America, despite their introduction with European settlement. Taken together, however, these linear woody features provide a range of ecosystem services which make them indispensable in existing and novel agricultural landscapes (Smith 2010b, Wolton et al. 2014).

Focus on ecosystem delivery is around regulatory services such as soil erosion, pollination, shelter provision and air quality improvement (Wolton et al. 2014) Often over-looked aspect of these linear woody features is their cultural service value (Milcu et al. 2013) and socio-ecological context where they can contribute to feelings of 'sense of place' which has an important role in fostering sustainability practices and human wellbeing (Ainsworth et al. 2019, Masterson et al. 2019). Hedgerows have been recognized for their aesthetic and cultural value in Europe where the hedgerow networks are a defining feature of Bocage landscape (Burel and Baudry 1995, Brady 2006), and while comparisons with North America have been explored (Oreszczyn 1999, 2000), there is no comprehensive assessment of cultural attitudes to woody linear features in North American landscapes. Hedgerows and hedged landscapes are often seen differently depending on the land-user (Burel and Baudry 1995), which is of critical importance where landscapes are being designed and managed through participatory approaches: an educated citizen with a strong sense of place is a powerful conservation tool (Lindenmayer and Hobbs 2008).

Hedgelaying, Rural Skills and Livelihoods

Management, particularly through hedgelaying has been an historically important rural skill in bocage landscapes and is still recognized as an important tool in maintaining them in good condition (Staley et al. 2015). Hedgerows are composed of living shrubs and trees and if the hedge is to retain its ability to deliver the full range of services, a balance needs to be found between allowing shrubs to grow and keeping the hedge from becoming a line of trees, developing gaps and eventually disappearing. Hedgerows can be cut to slow their growth but annual cutting can limit flower production and the development of fruits, berries and seed. Annual cutting also stresses and eventually kills the plants. Evidence has shown cutting every two to three years and increasing the cut height by a few inches each time can maintain the health of the hedge (Staley et al. 2016). As a hedgerow grows, the shrubs thicken and become gappy at the base, so at some point it will be necessary to rejuvenate the hedge. The hedge could be coppiced (felled), however with the shrubs removed it cannot function as a fence. The practice of hedgelaying evolved to rejuvenate a hedge while still maintaining a stock-proof structure ('Hedgelaying', Figures 2-6). Hedgelaying is a catch-all term used to describe the rejuvenation of a hedge from the base by cutting and 'laying-over' of the shrub. There are many different styles of hedgelaying throughout the world, with at least 16 styles in the UK alone. In some styles wooden stakes are positioned at intervals along the hedge and long 'binders' are woven in across the top to give the hedge strength

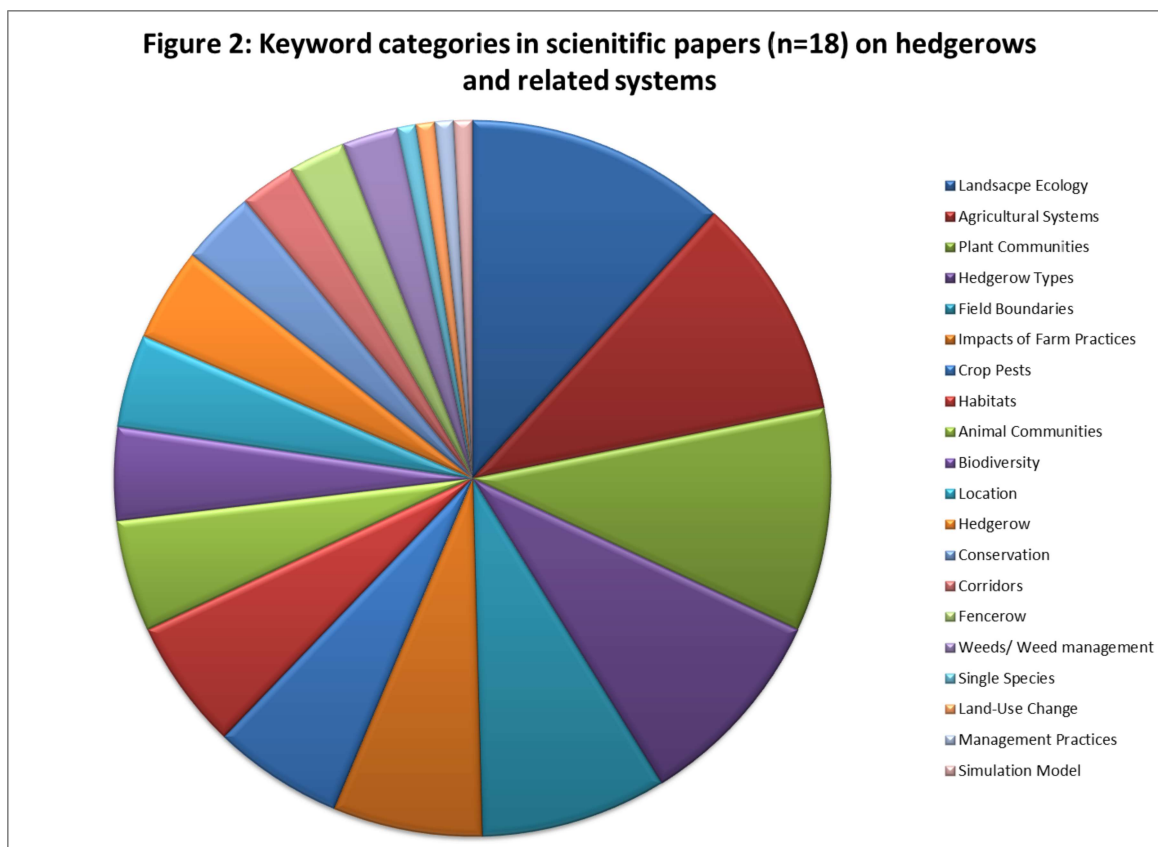
In an age of mechanization, hedgelaying is still practiced in this traditional way throughout Europe, and there is growing interest amongst small farmers and homesteaders in North America. With more and more of the world's population living in cities, meeting sustainable development goals and climate change targets involves exploring options for maintaining rural economies. Hedgelaying is one of a number of rural skills and crafts which lend themselves to the concept of Livelihood as place-based work envisioned as a solution to living within ecological limits to growth (Quilley and Zywert 2019). In the era of the Anthropocene, the future of the planet has an urgent need for sustainability transitions which may require radical, systemic shifts in deeply held values and beliefs, patterns of social behavior, and multi-level governance and management regimes (Westley et al. 2011). Here we explore whether the literature on hedgerows is reflecting these socio-ecological aspects and illustrate the approach through two innovative case-studies.

METHODS

In this paper we review 79 scientific papers on hedgerows from the 1700s to the present day and discuss emerging themes and directions. Papers were selected and retrieved where possible from Google Scholar using the search terms 'hedgerow', 'hedge', 'fencerow', 'shelterbelt', 'windbreak', 'North America', 'USA' 'Canada' in the title and abstract. Keywords from each paper were, if presented, collated and categorized.

We also report here on two initiatives which seek to foster and build upon the rejuvenation of interest in hedgerows through working with socio-ecological and agroforestry themes: (i) Hedgelaying in the Ontario Landscape initiative at the University of Waterloo which has initiated hedgerow planting and management workshops to better understand how we might responsibly nurture socio-ecological novelty within settled regions and (ii) the recent inauguration of the North American Hedgerow Society following hedgelaying workshops in Ithaca where there is significant interest in hedgerows as an agroforestry tool at the Cornell University and amongst local small-scale farmers in New York State and nearby Vermont.

RESULTS AND DISCUSSION



Results

Of the 82 papers, 28 (34%) have been analysed to date (May 2020), of which 19 included keywords. There were 76 individual keywords appearing 118 times, which were collated into 20 categories (Figure 1). Categories were formed where keywords were nominally or thematically similar. The highest scoring categories (Figure 1) were Landscape Ecology (11.8%), Agricultural Systems (10.2%), Plant Communities (10.2%), Hedgerow Types (9.3%) and Field Boundaries (8.4%). There was only a single keyword each for management practices and agroforestry. The 28 papers originated primarily from Canada (Canada 24; US 3; North America 1).

Discussion

We present here a preliminary analysis of the 34% of papers retrieved through Google Scholar. Early indications show that most research relating to hedgerows, fencerows, shelterbelts and windbreaks focusses on their role at the intersection of landscape ecology and agricultural systems, exploring the historical and current impacts of agriculture on ecological systems and particularly on plant communities (e.g. (Boutin et al. 2002, De Blois et al. 2002), and the function that woody corridors play (if any) on dispersal in fragmented landscapes (e.g.(Bhar and Fahrig 1998, Corbit et al. 1999, Sykes and Hannon 2001)). Only one paper (Boutin et al. 2001b) included management practices as a keyword, which related to fertilizer and pesticide use, and the removal of wood by the landowner which created gaps allowing for the increase in weed abundance in the hedgerow.

There were no keywords relating to socio-ecological research e.g. “socio-ecological systems”, “culture”, “aesthetics” although one of the papers without keywords is explicit in its exploration of hedgerow cultures, and concludes that the ecological value of hedgerows is connected to cultural feelings towards landscapes with implications for the structure, function and ecological value of hedgerows but also for knowledge transfer between cultures, here between England and Canada (Oreszczyn and Lane 2001). Attitudes towards hedgerows in the landscape have been explored in Europe (Burel and Baudry 1995, Brady 2006). These studies suggest that a better understanding of the socio-ecological aspects of hedgerows, their management and hedgerow landscapes could provide important insights for local and regional planning, for meeting objectives under the Sustainable Development Goals and the Paris Agreement on Climate Change and for a more systemic and holistic understanding of landscape dynamics. The authors here present two initiatives which are beginning to explore socio-ecological aspects of hedgerows, hedgelaying and rural skills.

HEDGELAYING IN THE ONTARIO LANDSCAPE



Fig 3: A European buckthorn (*Rhamnus cathartica*) hedgerow in Caledon, Ontario, layed by attendees at a hedgelaying workshop run by the Ontario Rural Skills Network. (<https://www.ontarioruralskillsnetwork.com/>) Hedgelaying couldt be considered as an alternative control method for this non-native invasive shrub.

In 2013 a team from the University of Waterloo, together with partners in southern Ontario and funded by the Social Sciences and Humanities Research Council, began working together using hedgerows and hedgelaying to examine landscape planning and management practices within Toronto's Greater Golden Horseshoe, with reference to broader themes including place-making, collective stewardship, agro-ecology and resilience (Ruttonsha et al unpublished). A week of hedgelaying demonstrations and talks were staged in 2016 with visiting hedgerow ecology and hedgelaying specialists including James Jones and Nigel Adams from Hedgelinek in the UK and Jef Gielen from the Netherlands. Three pilot hedgerow plantings were undertaken at public and private properties in Caledon Township (Jones et al. n.d.). From 2018 the project continued and expanded to explore the uses of hedgerows, hedgelaying and rural skills in socio-ecological contexts. Working from the family-run Mount Wolfe Farm in Caledon, rural skills such as green woodworking, blacksmithing, scything and basket weaving were offered to the farm's Community Supported Agriculture (CSA) shareholders and other community members.



Fig 4: Members of the CSA at Mount Wolfe Farm attend a hedgerow planting and 'weave in' their own story or pledge to the newly planted hedge as part of *The Hedgerow Rite*

In the fall of 2018, a hedgerow planting at Mount Wolfe Farm was used as an opportunity to explore sense-of-place and nature connection through storytelling and ritual using *The Hedgerow Rite* (<https://thehedgerowrite.wordpress.com/>)(Jones et al. n.d.). In the fall of 2020 the Hedgelaying In The Ontario Landscape Project will continue as part of a PhD studentship focusing on the role of Rural Skills and Crafts in Rural Livelihoods.

THE NORTH AMERICAN HEDGEROW SOCIETY



Fig 5: Attendees at the 'Hedgelaying North America' Workshops at Wellspring Forest Farm, Ithaca, USA in November 2019 get to grips with laying willow stools

In the fall of 2019, the authors assembled delivered a series of public workshops and accompanying talks and webinar to promote hedgerows and their hedgelaying at Wellspring forest Farm in Ithaca, New York State. The workshops were led by professional hedgelayer Nigel Adams from the UK and hedgerow socio-ecologist Jim Jones from the University of Waterloo. Nigel and Jim are both members of the UK's 'Hedgelinek' group and undertook similar demonstrations for the Hedgelaying In the Ontario Landscape Project in 2016.



Fig 6 and 7: Hedgerows layed at Wellspring Forest Farm, in the South of England style (TOP) and Midland 'Bullock' Style (BOTTOM)



At these workshops the North American Hedgerow Society was informally launched with a mission to promote the planting and traditional management of 'hedgerows' in North America; deliver education on the many services healthy hedgerows provide such as pollination, erosion protection, flood mitigation and carbon sequestration; to foster an emerging network of hedgerow advocates, practitioners and businesses related to hedgerow planting and the traditional skill of 'hedgelaying'; promote scientific research into all aspects of hedgerow management; and to celebrate the emergence of new hedgerow landscapes and local hedgerow groups and societies through hedgerow-related arts and crafts. The NAHS website is www.nahedgerowsociety.org (<https://www.nahedgerowsociety.org/>) (currently under construction)

HEDGEROW MANAGEMENT: REJUVENATION BY HEDGELAYING

Hedgelaying

There are at many different recorded 'styles' of hedgelaying throughout Europe (Mueller 2013). Here we show the method called the South of England or Southern Counties Style.



Fig 8: The hedge should ideally be at least 2.5m (8.2') tall for laying with regular and closely spaced (c. 30cm/1') plants. To allow access to the base of the hedge, sparingly remove lower branches with loppers. Don't go mad!



Fig 9: Using a sharp billhook or small axe cut down into the stem of the plant approximately 4/5 of the way through. Begin the cut up the stem at a height about 3-4 times the width of the stem. The cut stem- called a pleacher-is gently guided over to a 35 degree angle.



Fig 10: Remove the 'heel' of the pleacher either with your billhook (with practice) or a small saw. This allows the next pleacher to be layed without hindrance. There is enough 'hinge' left in the shru to allow free transport of nutrients so that the layed stem (now called a pleacher) continues to thrive.



Fig 11: Cut one pleacher at a time and build up the hedge with pleachers lying as parallel to each other as possible. In South of England style shown here, pleachers are crossed so that brush appears on both sides of the hedge.



Fig 12: Once all pleachers are layed, stakes (approx. 5-6' x 2") are driven through at intervals of approximately 1' 6" apart (closed fist to elbow is a good measure) down the centre line of the hedge, helping to support the structure. Then binders (approx. 10-5' x 1.5") are woven alternately around the stakes (see Picture 8). Stakes and binders here are both hazel.



Fig 13 & 14: The finished hedge should be 4' high. The tops of stakes are sawn off and any excess brush above the binders is cut back, and the sides are trimmed to leave a neat finish. With trimming every 1-3 years and a small (c.5cm) increase in height at every cut, it may be 20-30 years before the hedge needs laying again.



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ABSTRACT

In North America, hedgerows were planted by early European settlers who wanted to recreate their homeland landscapes, and to manage and protect soils. While in Europe hedgerow networks remained a key landscape feature, by the twentieth century in North America they had all but disappeared, primarily due to the modernization and intensification of agriculture. The North American hedgerow today is variously described as a fencerow, shelterbelt or windbreak with a variety of structures and uses but usually little or no management is regularly undertaken.

There has been a resurgence of interest in hedgerows in North America in the late 20th and early 21st Century which has come from two schools, agroforestry and socio-ecology, both resting on evidence for the growth of ecosystem services delivered by hedgerows. Agro-foresters are interested in hedgerows as living fences, in flood plain management and hydrology, pollination, carbon sequestration, crop pest management through natural enemies. Socio-ecologists value the use of hedgerows and the management practice of hedgelaying in creating a sense of place and improving human wellbeing.

In this paper we review the North American literature on hedgerows from the 1700s to the present day and discuss emerging themes and directions. We also report on (i) the Hedgelaying in the Ontario Landscape initiative at the University of Waterloo which has initiated hedgerow planting and management workshops to better understand how we might responsibly nurture socio-ecological novelty within settled regions and (ii) the recent inauguration of the North American Hedgerow Society following hedgelaying workshops in Ithaca where there is significant interest in hedgerows as an agroforestry tool at the Cornell University and amongst local small-scale farmers in New York State and nearby Vermont.