BIODIVERSITY AND FARMING: AN EVALUATION OF A VOLUNTARY STEWARDSHIP PROGRAM AND EXPLORATION OF FARMER VALUES

by

Kathleen Goodale

Submitted in partial fulfilment of the requirements
for the degree of Master of Environmental Studies

at

Dalhousie University
Halifax, Nova Scotia
August 2013

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Farming relies on the ecosystem services provided by biodiversity for production. Farming has been, however, responsible for habitat degradation and destruction, and consequently, biodiversity loss. At present, efforts to increase habitat on farmland are largely confined to voluntary programs. The effectiveness of the provincially delivered Agricultural Biodiversity Conservation (ABC) program was measured using a quantitative survey. Follow-up interviews during farm tours further explored qualitatively how farmers value biodiversity and biodiversity conservation on their land. Results from the survey quantitatively link ABC program participation to increased engagement in riparian management and modified harvesting activities. Qualitative results suggest that the motivation for engagement in biodiversity conservation stems from the farmers' interest in preserving the balance between production and 'nature', thereby preserving what they perceive to be the health of their land. These results have implications for the improvement of the ABC program and of future stewardship program design.

LIST OF ABBREVIATIONS USED

AES	Agri-Environmental Schemes
EFP	Environmental Farm Plan
BMP	Best Management Practices
DNR	Nova Scotia Department of Natural Resources
ABC	Agricultural Biodiversity Conservation
NSFA	Nova Scotia Federation of Agriculture
IPM	Integrated Pest Management
FOIPOP	Freedom of Information and the Protection of Privacy Act
NSFA	Nova Scotia Federation of Agriculture

ACKNOWLEDGEMENTS

I would like to acknowledge the financial support from my funders: Sage Environmental Group, the Habitat Conservation Fund and the Department of Natural Resources. Without your support, this research would not have been possible.

To Reg Newell at the Department of Natural Resources, for helping me understand the ABC program, helping with the mail-out of the surveys, and answering my many emails.

To Karen Beazley, my committee member, for providing helpful ideas and feedback throughout the entire project.

To Yoko Yoshida, for teaching me that statistics are not math, and are not as scary as I once thought.

To Kate Sherren, my supervisor, who has helped me grow as a researcher and has been there to help me through all stages of my time at SRES, even so far as to hold meetings at her house during her maternity leave. Kate, your dedication and work-ethic are beyond compare and I am so grateful.

To my friends at SRES, you have been my support group and my cheerleaders. Special acknowledgement goes to my office-mates Ellen Whitman and Stephen Cushing, who have not only helped me through obstacles, but made time in the office fun.

To my partner Dan Conway, for his continued love, support, and above all patience through the ups and downs of this process.

And finally to my parents: Your love and support not only made this thesis possible, but are responsible for making me the person that I am today--I am forever grateful for that. A special thanks goes to my mother, who has been on the brunt end of many late night phone calls and long emails. She still continues to be my number one supporter, is responsible for keeping my spirits up, and always finding the silver-lining. Thanks, Mom.

CHAPTER 1 INTRODUCTION

Humans have been engaged in agriculture for millennia. Farming, by definition, requires that land be devoted to the production of particular crops or livestock. This homogenization of the landscape encourages the growth of a few desired species, but at the expense of many others. Nevertheless, over most of the long history of land management for agriculture, farming and nature have been able to co-exist. More recently, however, the escalating intensity of modern farming world-wide has been responsible for serious negative impacts to global biodiversity (Altieri, 1999; Green, Cornell, Scharlemann, & Balmford, 2005; McLaughlin & Mineau, 1995). The 'Green Revolution' of the mid-twentieth century, in which innovations and intensification of farming practices allowed yields to increase substantially, came at the expense of biodiversity (Krebs, Wilson, Bradbury, & Siriwardena, 1999). The intensification of farming practices has required increased inputs (such as chemical fertilizers and pesticides), increased mechanization and larger land parcels devoted solely to agriculture (Fahrig et al., 2011; McLaughlin & Mineau, 1995). Land that is used agriculturally (either as pasture or crops) now accounts for approximately half of the globe's terrestrial surface (Batáry, Báldi, Kleijn, & Tscharntke, 2011). With the human population expected to reach nine billion by 2050, the demand for food is increasing (Godfray et al., 2010). As the need for agriculture continues to grow world-wide, understanding the relationship between agriculture and biodiversity becomes critical.

Methods of dealing with this growing concern over biodiversity decline have been largely confined to voluntary programs. The Agri-Environmental Schemes (AES) in

Europe and the United Kingdom beginning in the 1980s, are among the earliest examples of voluntary stewardship programs targeting farm biodiversity conservation (European Commission, 2005; Natural England, 2009). In Canada, the history of biodiversity conservation stewardship on farms is much shorter. The Environmental Farm Plan (EFP) program began in Ontario in 1996, and since then different provincial versions of the program have come into operation across Canada. Although participation in the EFP program will have benefits for farmland biodiversity, the target of the program is the mitigation of agricultural pollutants, and not biodiversity conservation specifically (Yiridoe, Atari, Gordon, & Smale, 2010). These voluntary AES (both in Europe and in Canada) promote the adoption of best management practices (BMPs), for example, maintaining vegetation in the riparian zone along a water course to reduce the inflow of sediment and run-off from farms (Lowrance, Dabney, & Schultz, 2002). A literature review of BMPs that benefit biodiversity can be found in the following chapter. Unfortunately, few evaluations of the effectiveness of different environmental stewardship programs have been carried out to date (in Canada or elsewhere), and of those that have been evaluated, results are rarely released or published in academic journals (Ahnström et al., 2008).

Above all, for any of these programs to encourage biodiversity conservation, the voluntary participation of farmers is needed. This thesis explores farmer engagement in voluntary biodiversity conservation in Nova Scotia, Canada. Previous research looking at voluntary biodiversity conservation by farmers has been carried out largely in Europe and the United Kingdom (Ahnström et al., 2008; Morris & Potter, 1995; Willock et al., 1999; Wilson & Hart, 2001). This previous research, guided by the Theory of Planned

Behaviour, has attempted to identify the factors contributing to the engagement of farmers in AES. Under this theoretical framework, the decision to engage in environmental conservation is based on an individual's values, attitudes and situational context (Ajzen, 1991; Beedell & Rehman, 1999; Lynne, Shonkwiler, & Rola, 1988; Mills et al., 2013). All of these may differ by geography. Therefore, the findings of research in Europe may not necessarily generalize to farmers in Nova Scotia. Some research has been carried out in Nova Scotia around EFP adoption, and has found that farmers in their sample with larger property sizes or livestock production were more likely to engage in the EFP program (Yiridoe et al., 2010). This research, however, focused only on situational factors affecting participation (e.g., farm type, farm size and demographics) and has not examined farmer attitudes and values toward conservation. Research from other jurisdictions has suggested that attitude and values are significant factors driving conservation adoption (Ahnström et al., 2008; Mills et al., 2013), and as a result should be considered for farmers in Nova Scotia. This thesis examines one stewardship program, the Agricultural Biodiversity Conservation (ABC) program, as a case study to explore farmer engagement in conservation as well as explore broader farmer values of biodiversity and attitudes towards, and engagement in, biodiversity conservation in Nova Scotia. The ABC program aims to increase biodiversity on farms in Nova Scotia by improving habitat quality, quantity and diversity. The program is voluntary and participation is at no cost to the farmer. This research aims to identify methods of improving stewardship program delivery through the exploration farmer values and attitudes affecting the decision to participate in voluntary biodiversity conservation.

Farmer attitudes and actions have been well researched in Europe, yet very little exploration of farmer values has occurred in Canada, or the Maritime Provinces. Nova Scotia's ABC program was at a five year milestone when this study began; analyzing the impact the program has had on farmer behaviour and investigating Nova Scotian farmer attitudes more generally will help identify methods to improve the program. This research will help to inform the design of other similar programs and help to increase the overall uptake of biodiversity-enhancing activities among farmers. These research interests spurred two research questions:

I. To what extent does ABC program participation seem to impact participation in biodiversity-enhancing activities?

II. What do Nova Scotian farmers' perceptions of biodiversity and biodiversity-enhancing activities mean for voluntary biodiversity conservation programs?

An investigation of the ABC program was carried out to answer question I. This was achieved through a quantitative mail-out survey (described in Chapter 3). From this survey, respondents could elect to participate in follow-up interviews. These interviews took place on the farm's property as a farm tour (described in Chapter 3). Twelve interviews lasting between 40 minutes and 3.5 hours were completed to answer question II. Interview analysis was completed using an inductive approach where themes were first identified and then grouped together (described in Chapter 2). Research findings are discussed in Chapter 4 (survey) and 5 (interviews). These chapters were written with the intention to publish in peer-reviewed journals. Thus, to make them stand-alone documents, some information presented in Chapters 2 and 3 will be repeated in Chapters 4 and 5. The overall implications and significance of the research as a whole is discussed in Chapter 6.

CHAPTER 2 LITERATURE REVIEW

The impact of agriculture on biodiversity is complex. Without suitable habitat nothing can survive. However, activities that are deleterious to one species may in fact cause the propagation of another (Carruthers, 2003). For example, clearing a forest for agricultural production will have significant negative impacts for the original species diversity found in that habitat. Biodiversity will not, however, ultimately disappear. Rather, species composition will shift to those species that prefer more open-field habitat colonizing the area (Carruthers, 2003). Species diversity may increase (or decrease), but this change in species diversity does not necessarily indicate the health of that ecosystem (Turner, Lefler, & Freedman, 2005). That is, colonizing species may be diverse, but they are also often unwanted or invasive species (Luken & Thieret, 1996). As a result, biodiversity becomes a difficult metric to use to measure habitat health, as increased biodiversity may be an indicator of a compromised ecosystem (Turner et al., 2005). These issues are also combined with the added pressure to homogenize the landscape for production; crop species are selected for, and other species selected against (Benton, Vickery, & Wilson, 2003). Generally, it is the native or naturally occurring biodiversity that most often suffers as a result of agricultural production (Green et al., 2005). Bearing this in mind, when the term 'biodiversity' is subsequently used, it is in reference to the native or naturally occurring biodiversity.

There are three broad ways farming has reduced habitat viability: through habitat degradation; through habitat loss; and through habitat fragmentation. All three impacts are intertwined and rarely occur in isolation.

Agriculture is often responsible for the degradation of habitat found both on and off the farm (Green et al., 2005; Smith & Chow-Fraser, 2010). There are different ways this is accomplished: by the contamination of the habitat through pollution, and/or by the manipulation of habitat so that crucial elements needed for the survival of species are removed. Farms sometimes act as a nonpoint source of pollution. Nonpoint source pollution refers to contamination that does not originate from a discrete source (FAO, 1996). For example, untargeted insect species or vegetation can be killed by pesticide drift (Marshall & Moonen, 2002; McLaughlin & Mineau, 1995). If the ground is frozen or rain falls immediately following application, pesticides will also spread from the intended site through run off (Scherr & McNeely, 2008). 'Farm run-off' is water loaded with sediment, and is sometimes contaminated by fertilizers, soil, and farm waste which contain high concentrations of phosphorus and potassium. Run-off diffuses off the farm, often during rain events, and can lead to the eutrophication of nearby watercourses (Lowrance et al., 2002; Magdoff & van Es, 2009). This kind of contamination does not only put aquatic species at risk, but may also pose a threat to humans. In 2000, the town of Walkerton Ontario experienced significant rainfall, and run-off from a cattle farm contaminated the town's drinking water supply, resulting in seven deaths and an estimated 2300 seriously ill residents (Hrudey, Huck, Payment, Gillham, & Hrudey, 2002).

Habitat on productive land itself may also be degraded as a result of agricultural land management. For example, hay fields are often used by nesting birds. When the hay is cut the habitat is rendered unviable due to the loss of cover. Other crops may serve as habitat for different species of birds which feed on pest insects. When those crops are sprayed

with pesticides, the habitat may no longer support those birds because their food source is gone (Fahrig et al., 2011). Habitat degradation can be more subtle. For example, the removal of a single tree species during selective cutting on woodlots will result in the degradation of habitat for those species that require that kind of tree for survival, such as bird species or lichens. Similarly removing dead fallen branches for firewood reduces protected nesting sites for small animals.

Land conversion to agriculture, both historically and today, is responsible for much habitat loss. Since the advent of agriculture the clearing of trees and draining of wetlands has occurred to prepare land for cultivation (Nocera, Parsons, Milton, & Fredeen, 2005). It is currently estimated that one-third of the globe's terrestrial surface is covered by planted crops or planted pasture and another 10-20% is used for heavy livestock grazing (Scherr & McNeely, 2008). Agricultural land will support some species. For instance the red fox (*Vulpes vulpes*) thrives in the mixed habitat offered by farms (DNR, 2012). However, other species cannot cope under the conditions created by agricultural production, resulting in their decline and sometimes extirpation, if not extinction (Fahrig et al., 2011). Land clearing and conversion continues worldwide. The habitat required by some naturally occurring species is reduced, resulting in an overall decline in biodiversity (Green et al., 2005).

The combination of land conversion and habitat degradation reduces the ability of many species to move across the landscape, resulting in habitat fragmentation. Agriculture has expanded substantially during the last 50 years (Scherr & McNeely, 2008). This increase has resulted in decreased habitat connectivity, as patches of habitat become increasingly isolated by lands in production (Burel & Baudry, 2005). Animals

require space or corridors through which to find food, migrate and hide from predators. Agriculture severs the connectivity between patches of habitat for some species, and acts as a barrier to movement for others (Burel & Baudry, 2005). This decrease in connectivity is of particular concern as climate change scenarios predict a shift in species distribution (Bootsma, Gameda, & Mckenney, 2005). If species are unable to reach new areas of suitable habitat they run the risk of local (or in some cases even global) extinction (Merckx et al., 2009).

2.1 Ecosystem Services Provided by Biodiversity

Ecosystem goods and services are indispensible for agricultural production. Daily (1997), as cited in Zhang et.al (2007), defines ecosystem services as "the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life." (p. 253). These services are a by-product of the existence of biodiversity, created by the natural functions of living things in an ecosystem. The functions of both individual species (e.g., food provided by a blueberry bush), and entire ecosystems (e.g., water filtration by a wetland) provide ecosystem services. The Millennium Ecosystem Assessment (2005) describes four categories of ecosystem services that are beneficial to humans: provision (e.g. food and fiber), support (e.g. nutrient cycling and soil formation), cultural (e.g. recreational and spiritual), and regulation (e.g. pollination and flood control) (Figure 2.1). Of these four categories, agricultural production is sustained largely through supporting and regulating services (Moonen & Barberi, 2008; Zhang, Ricketts, Kremen, Carney, & Swinton, 2007).

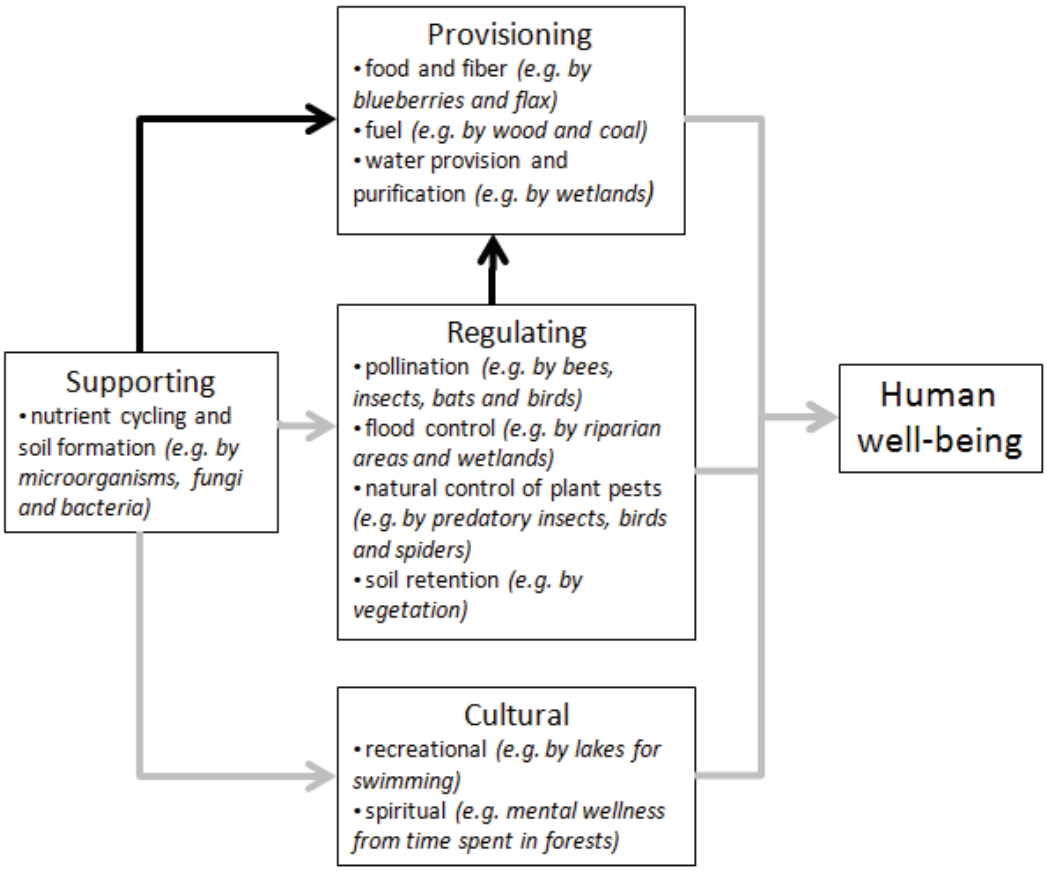


Figure 2.1 Classification of ecosystem services, bolded arrows represent the relationships most significant to agricultural production. (Adapted from Zhang et al. 2007)

Biodiversity is sometimes responsible for disservices to agriculture (Zhang et al., 2007). For example, pest species and increased competition for water from unwanted plants will decrease yields. The disservices created by biodiversity impact management decisions by farmers, as trade-offs occur for both production and/or biodiversity when one is favoured over the other. Many farms, as a result, manage for low species diversity so that production continues unimpeded. Zhang et al. (2007) has argued, however, that disservices are often exacerbated as a result of the loss of natural or native biodiversity levels. For instance, the loss of beneficial predatory insects results in larger populations of pest species. The increased damage from pests, with no natural population control,

fosters the use of pesticides, further damaging the natural insect population. This results in decreased delivery of naturally occurring ecosystem services.

When ecosystem services no longer function naturally the farmer must find a method to artificially recreate these services. Auxiliary inputs replace naturally occurring ecosystem services, for example the use of fertilizer to replace nutrient cycling services and pesticides to replace pest predation. Through the use of these inputs, however, native biodiversity continues to be compromised. This ensures the continued use of auxiliary inputs, resulting in a positive feedback loop where inputs are continually used as a substitute for the missing natural ecosystem services (Altieri, 1999; Zhang et al., 2007). For example, if there is too little naturally occurring soil biodiversity (e.g. bacteria, fungi and microorganisms) as a result of too few crop rotations (Ball, Bingham, Rees, Watson, & Litterick, 2005), then nutrient cycling processes will be hindered, resulting in an increased need for fertilizers. The use of these fertilizers will allow the farmer to achieve the desired yields. However, without naturally occurring biodiversity to provide ecosystem services, and no promotion of soil biodiversity to provide naturally occurring nutrient cycling, this auxiliary input must be used repeatedly.

2.2 Biodiversity Conservation on Farmland

There are two competing theories concerning the preservation and encouragement of habitat on farmland: 'land-sparing' and 'land-sharing'. The differences between the competing theories are discussed below.

Land-sparing refers to the idea that habitat and biodiversity will be more successful if large blocks of land are kept distinct from production. The land that is used for

production is used more intensively to make up for the loss of land to habitat (Green et al., 2005; Matson & Vitousek, 2006). Arguably, this theory represents a conventional approach to farming; that is, farmers consider their land as a place for production and not for habitat (Beedell & Rehman, 1999). Land-sparing is thought to provide more quality habitat for biodiversity--habitat that has not been compromised by agricultural activity (Green et al., 2005).

By contrast, land-sharing, sometimes called 'wildlife-friendly farming', refers to the idea that habitat and biodiversity can be integrated with production. Land that is used for production can also provide habitat for a range of species (Fischer et al., 2008). Habitat is defined broadly: small treed areas within fields, or grassy pathways between rows of crops. The land is used less intensively than in land-sparing strategies, and as a result more land is used to produce the same yields (Phalan, Balmford, Green, & Scharlemann, 2011). Overall, the landscape is more heterogeneous than in land-sparing strategies.

Land-sharing strategies require careful consideration of appropriate methods. Activities that are suitable for one region may not be for another (McLaughlin & Mineau, 1995). For example, coffee farms in Costa Rica and Mexico have had great success in integrating habitat into the coffee crops (Perfecto, Vandermeer, Mas, & Pinto, 2005; Tscharntke et al., 2012). Since coffee plants require shade, coffee plants can be grown in forest patches and as a result, they provide habitat for a number of species while high coffee bean yields are maintained (Tscharntke et al., 2012). However, in other regions such as Nova Scotia, there are no crops that can be grown under such conditions, and therefore alternative land management strategies must be sought. Some of these are discussed in Section 2.3.

Both land-sparing and land-sharing strategies promote biodiversity conservation. It has been argued that the on-going debate between the two factions has, unfortunately, eclipsed the development of real solutions (Fischer et al., 2008)**.** There are benefits and drawback to both approaches, and any given landscape or region should contain a mix of both approaches. Consideration of the regional context should help determine the most effective biodiversity conservation strategy (McLaughlin & Mineau, 1995). In Nova Scotia, farms produce mixed commodities and as a result already have a more heterogeneous landscape. This may suggest that land-sharing strategies may come more naturally**.** Moreover, increasing habitat heterogeneity on the agricultural landscape, even if the habitat patches are small (for example a small wetland in the centre of a crop), will encourage biodiversity (Benton et al., 2003; Fahrig et al., 2011). An additional challenge in Nova Scotia is that the extensification (i.e., expanding the area) of agriculture to offset production losses as a result of land sharing is difficult because of the small amount of suitable soils provincially (Figure 2.2).

The issue of scale must be considered for the successful implementation of any agricultural biodiversity-conservation land management strategy. Not all strategies are appropriate for all farms, and the decisions made on one person's land will have consequences for neighbouring properties. There is a strong argument that using a 'landscape-scale' is most appropriate for biodiversity conservation strategies (Dutton, Edwards-Jones, Strachan, & Macdonald, 2008; Fahrig et al., 2011). For example, a river passes through multiple jurisdictions and private properties. To be able to successfully address the issues of that habitat, a watershed-scaled approach would arguably be most appropriate. The coordination of management at this scale would be, however, quite

challenging. It would require that all land-owners along that river agree to participate, and that their level of participation be equivalent and ongoing. Furthermore, as will be discussed below, farmers are less receptive to management strategies that are dictated to them, reducing the likelihood of success in such large scale strategies. Therefore, while ideally a landscape scaled approach should be used, practically, we must focus on the individual farm, but within a landscape context, and aim to coordinate efforts that could scale up into landscape benefits.

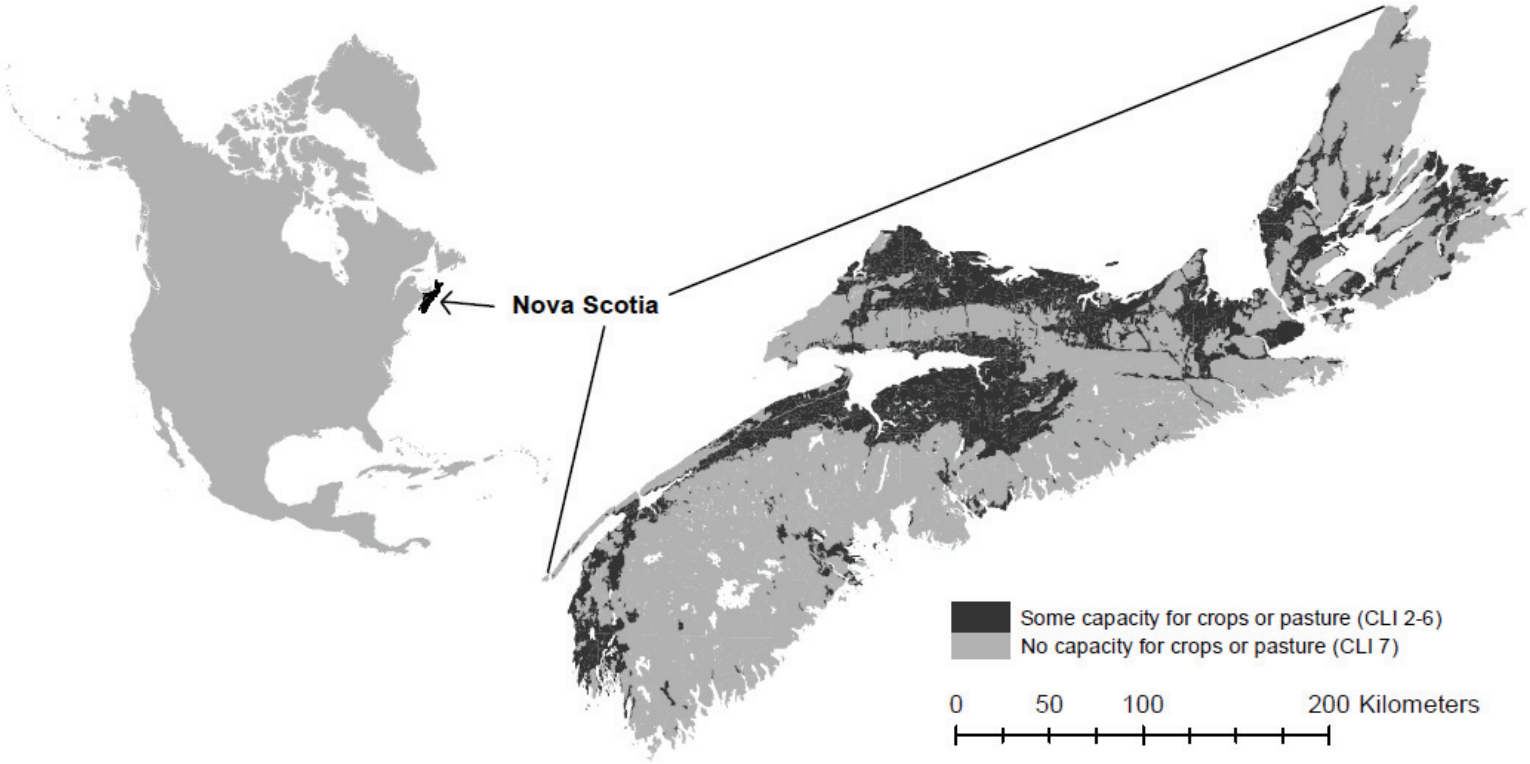


Figure 2.2 Map of arable land in Nova Scotia (Agriculture and Agri-Food Canada, 2012)

2.3 METHODS TO PROMOTE BIODIVERSITY

Despite the academic debates surrounding the driving philosophies of farm management for biodiversity, research has shown that some activities or practices are successful at increasing biodiversity without always reducing productivity at the individual farm scale. The increased recognition of the impact of agriculture on biodiversity has led to the development of activities or best management practices (BMPs) that aim to increase biodiversity on the farm. Research has demonstrated that biodiversity-enhancing activities do not have to come at the expense of yields (Fahrig et al., 2011; Moonen & Barberi, 2008; Scherr & McNeely, 2007), and in some instances where yields are reduced, the farmer may find alternative benefits: costs may be reduced and long term productivity improved (Moonen & Barberi, 2008; Scherr & McNeely, 2007). Increasing naturally occurring biodiversity can be achieved through different methods: reducing intensity, increasing habitat connectivity and diversity, and reducing pollution.

2.3.1 Intensity Reduction

Farm intensification is the result of the drive for the maximization of yields on productive land (Krebs et al., 1999). The pursuit of these high yields has resulted in management strategies, such as the use of auxiliary inputs such as fertilizers and pesticides, that reduce naturally occurring biodiversity (Krebs et al., 1999). Therefore, reducing the farm's intensity of production may help to encourage biodiversity (McLaughlin & Mineau, 1995). Furthermore, by promoting biodiversity it is possible to foster the natural occurrence of ecosystem services, thereby reducing the need for some

inputs and making the farm more self-sufficient. These BMPs will help promote biodiversity, but may in the short term come at the expense of yields.

Reduced till, or no-till practices promote soil biodiversity, which helps to maintain long-term soil health and productivity. Tilling is the practice of turning the soil. Good soil quality improves both crop yields and pasture quality. For soil to be productive, the chemistry must be balanced (i.e., levels of nitrogen and phosphorus must be at acceptable levels), organic matter must be present (i.e., presence of topsoil), and porosity must be maintained (i.e., there must be naturally occurring gaps in the soil matrix), all of which are ecosystem services naturally provided by soil biodiversity (Magdoff & van Es, 2009; Zhang et al., 2007). Modern conventional tilling practices temporarily increase soil porosity, but are also responsible for soil biodiversity losses, resulting in nutrient losses as soils become more susceptible to erosion (Halde, Hammermeister, Mclean, Webb, & Martin, 2011; Magdoff & van Es, 2009; Vieira & Dabney, 2011). No-till**,** also called minimal till or conservation tilling, has been linked to a decrease in erosion and improved soil quality in the long term (Carter, Peters, Noronha, & Kimpinski, 2009). For example, under minimal till, worm populations increase. Worms are a component of soil biodiversity that provide soil porosity. By reducing the intensity of tilling, there is a decrease in worm mortality, thereby increasing natural soil porosity in the long term (Ball, Bingham, Rees, Watson, & Litterick, 2005). This creates a positive feedback loop where the soil is maintained without human intervention. Ball et al. (2005) do, however, admit that the process by which a natural soil regime is re-established is slow, and as a result yields would likely be lowered during the transition from conventional tilling practices to minimal till.

Modified harvesting methods promote the survival of field-dwelling species. Harvesting equipment is often to blame for field species mortality (Humbert, Ghazoul, & Walter, 2009; Perlut, Strong, Donovan, & Buckley, 2008). There are simple methods to decrease mortality rates, such as the use of flushing bars and modifying harvesting techniques. Flushing bars are devices that can be attached to harvesting equipment; chains attached to the bars drag across the ground creating noise and vibrations that alert any animals in the vicinity of the approaching machine (Crowley, 2009). Other simple methods can also be used, such as mowing from the centre of the field outwards, providing an escape route for any animals residing in the field, or raising the cutting blades by 10cm to allow the safe passage of small field fauna (Crowley, 2009; Humbert et al., 2009).

Delayed haying is a method of reducing field bird mortality that does not have to come at the expense of hay yields. Unfortunately, fledgling activity of birds such as the endangered bobolink (*Doluchonyx oryzivorus*) coincides with the timing of hay harvest. This results in high mortality rates as the young birds are not mature enough to be able to flee the machinery. Mortality can be significantly reduced by delaying the hay harvest until after the birds have fledged (Nocera et al., 2005; Perlut et al., 2008). Delaying harvest will result in decreased protein levels, however, thus reducing the nutritional quality of the hay. Nocera et al. (2005) demonstrated that in Nova Scotia, a delay of 1.5 weeks (from June 20th to July 1st) resulted in the crude protein in hay being reduced by 2.1% (still meeting nutritional requirements for non-lactating beef cattle), but increased bobolink fledgling from 0 to 20%. Depending on how this strategy is carried out, there may be a decrease protein yields, but the benefit to the field birds is significant.

The reduction of pesticides will help to promote the survival of non-pest biodiversity, promote beneficial insects, and reduce agricultural pollution. Integrated pest management (IPM) is a popular strategy of pest management among farmers (Brown, 1999). IPM refers to the strategic application of pesticides, so that overall pesticide application is reduced. Pest species are monitored so that pesticide application targets only the species present, preventing unnecessary applications (Kogan, 1998). Some advocates of IPM argue for biological control of pest species through the promotion of their natural predators, an ecological approach to IPM. The principle of this approach is that "...energy and resources [used in farming] are expended to work with ecological processes, not against them." (Brown, 1999, p. 104). Thus, ecological IPM relies on principles of community ecology; polycultures are preferred to monocultures, and choices regarding diversification are based on trophic level interactions (Brown, 1999). Predatory insects are encouraged, so that their prey species (agricultural pests) are reduced. Polycultures reduce vulnerability to pests by producing different crops (SARE, 2004). This relationship may be further exploited if multiple crops are integrated into a single field. The ability of the pest species to spread may be inhibited as the different crop species act as a barrier, and thus yields lost to pests are decreased (SARE, 2004).

Rotational grazing promotes pasture soil biodiversity. Grazing livestock can have a negative impact on soil biodiversity through soil compaction (Magdoff & van Es, 2009). Rotational grazing refers to the practice of dividing pasture land into parcels, or paddocks, and rotating the herd through the sections, thus giving the grasses time to re-establish. Studies in Nova Scotia have demonstrated that rotational grazing preserves soil biodiversity, while increasing forage for livestock (Halde et al., 2011). Rotational grazing

has an additional benefit to livestock parasite control. As the herd cycles through the paddocks, parasites that are deposited in their feces are effectively contained, and thus prevented from cycling through the herd a second time (Stromberg & Averbeck, 1999). There are, however, no guidelines that delineate how long a rotation lasts. Success will depend on the size of the herd, as well as the size and number of paddocks, and may be, thus, difficult for some farmers.

2.3.2 Increasing Habitat Connectivity and Diversity

Conserving and restoring the diversity of habitat will help to maintain and enhance a diversity of species (Benton et al., 2003). Increasing habitat diversity can be as easy as leaving brush piles or coarse woody debris, or hanging bird or bat boxes. This will not only promote bird and bat species, but will also provide insect (such as mosquito) control. Habitat connectivity ensures that habitat corridors exist to promote the movement of species, allowing species the freedom to move from one suitable habitat to the next (Burel & Baudry, 2005). Activities that promote connectivity and habitat diversity will not only help to ensure species survival, but may also help to promote the continuation of ecosystem service delivery from biodiversity.

Both habitat heterogeneity and connectivity can be increased by the promotion of structural and functional corridors. In structural corridors, habitat is physically connected together; whereas functional corridors are not necessarily physically connected together, but still operate as a pathway (Benayas, Bullock, & Newton, 2008; Burel & Baudry, 2005). For example, woodland (or tree) patches or islets are effectively islands of forest within an agricultural system (for example, a patch of trees in the middle of a field). These patches of trees can act as both structural and functional corridors by providing

habitat for some species (such as spiders, beetles, and non-commercial vegetation), and functional corridors for highly mobile species such as insects, or birds (Benayas et al., 2008). Shelterbelts are tree rows (typically a few metres deep, containing a combination of trees and shrubs) that are used to protect wind-susceptible crops. They provide a structural corridor for many species, as the habitat is physically connected together. Hedgerows are a smaller structural corridor that is common to farmland in the United Kingdom and France (Balmford, Green, & Phalan, 2012; Burel & Baudry, 2005). Hedgerows provide connectivity for a variety of insects, including beneficial predatory species which feed on agricultural pests (Merckx et al., 2009).

Wetlands are rich in biodiversity while providing indispensible ecosystem services such as water filtration and storage (Zhang et al., 2007). Constructed wetlands have been used to successfully filter phosphorus-laden waste water from dairy operations (Jamieson, Stratton, Gordon, & Madani, 2002). Wetlands help to maintain soil moisture through periods of drought, and can even in some cases act as a source of water for irrigation (Zhang et al., 2007). Wetlands also act as a functional corridor, as 'stepping stones' through agricultural areas for migratory birds (Smith & Chow-Fraser, 2010). However, if the 'stepping stones' are too far apart, the connectivity is eliminated, and thus the corridor no longer functions. An investigation of marshland isolation in southern Ontario revealed that wetlands that had neighbouring marshland within 4000m, had a significantly higher incidence of marshland nesting birds and overall species richness than those marshlands that were further isolated (Smith & Chow-Fraser, 2010).

The intentional planting of crop edges with native perennial flowers or grasses can increase connectivity for pollinating insects, while increasing the diversity of habitat

found on the farmland. Grassy belts within a crop and at crop margins have been demonstrated in Europe to reduce erosion while creating habitat for invertebrates, including beneficial predatory insects that help to control pest populations (Humbert et al., 2009), and birds (Vickery, Carter, & Fuller, 2002). Also in Europe, planting wildflowers in crop edges has been linked to decreased pest-damage, reduced weed infiltration and increased soil moisture (Smith, Firbank, & Macdonald, 1999). Similar to the planting of grassy strips within crops, intercropping is the planting of different crops in close proximity to one another for mutual advantage (Ball et al., 2005). There are many benefits to this activity: soil structure is maintained by having continuous cover (Ball et al., 2005), the variation in root systems will help to slow water run-off (Magdoff & Van Es, 2009; Smith et al., 1999), and weed and pest control is increased (Balmford et al., 2012; McLaughlin & Mineau, 1995).

2.3.3 Reducing Pollution

Pollution from agricultural operations can have serious consequences for the habitat on farm and nearby. The increasing reliance on inputs and the intensification of farming since the mid-twentieth century have further increased the vulnerability of habitat (McLaughlin & Mineau, 1995). As mentioned earlier, in the example of the disaster in Walkerton, Ontario, pollution from farm run-off has actually posed a direct threat to humans. As a result, much research and policy has focused on mitigating pollution from agricultural areas (Plummer, Spiers, & Summer, 2008). Farms can act as a non-point source of pollution and the pathway by which the pollution travels is frequently by water. Thus, water is a common focus of activities intended to reduce agricultural pollution.

Riparian buffers or fenced setbacks are one popular method of preventing the contamination of water by agricultural run-off, while providing habitat. A riparian buffer is a vegetated strip that covers the area adjacent to a water course. Buffers are responsible for providing many essential ecosystem services such as filtration (Lowrance et al., 2002), bank stabilization (Lee, Smyth, & Boutin, 2004), habitat (for both aquatic and terrestrial animals), and habitat connectivity (Rideout, 2012). A four meter wide grass strip between a field crop and a watercourse, regardless of species composition has been shown to reduce herbicides leaving fields by 66-95% (Burger & Burger, 2005). Riparian areas can also be damaged by livestock through trampling, compaction and the direct input of fecal matter into water courses (Miller, Chanasyk, Curtis, Entz, & Willms, 2010). The exclusion of livestock from watercourses with fencing and riparian areas has been demonstrated to improve water quality (Miller et al., 2010).

Preventing the contamination of water courses from run-off reduces the risk of agricultural pollution, which improves habitat health adjacent to the farm. For example, storing manure on concrete pads prevents the infiltration of nutrients into watercourses (Sharpley, McDowell, & Kleinman, 2001). Slowing the speed of run-off also helps to filter run-off of excess nutrients before the water enters a watercourse. Contour ploughing, ploughing across gradients and parallel to water courses, has been linked to the reduced transport of sediment and nutrients during rain events, thus reducing pollution to nearby ecosystems (Sharpley et al., 2001).

All the activities described above are more inclined toward land-sharing, and all intended for adoption on individual farms. Ultimately, it will be up to the individual farmer to elect to adopt any of those activities.

2.4 Farmer Interest in Conservation

The only way that biodiversity conservation strategies will be successful is if farmers are willing to adopt those practices (Wilson & Hart, 2001). There is a commonly held belief that farmers are not interested in conservation, should it come at the expense of production, and profit is thought to be the chief motivator of land management (Willock et al., 1999). There has been, however, a gradual shift in the academic literature away from this economically-driven model, towards a more multi-factor model (Ahnström et al., 2008a; Beedell & Rehman, 1999; Willock et al., 1999). Regardless of the drivers, 'environmentally-friendly' or conservation farming is gaining popularity. A 2006 survey of Canadian ranchers and farmers revealed that 79% of those surveyed said they were "interested in learning about environmentally friendly farm practices", and 69% of them reported that they were interested in adopting environmentally friendly farming practices (Environics Research Group, 2006, p. 34). Finances will no doubt have an impact on management decisions, but as recent research has shown, it is only one influencing factor of many (Ahnström et al., 2008; Atari, Yiridoe, Smale, & Duinker, 2009; Mobley, Vagias, & DeWard, 2009; Willock et al., 1999).

There are two approaches to promoting conservation among farmers: legislative and voluntary methods. These methods can be thought of as 'sticks and carrots'. Legislation (the stick) enforces environmental standards, and punishes farmers for non-compliance. The benefits of this approach are clear; people are likely to avoid making decisions that would result in their punishment. An example of this strategy can be seen in the Fisheries Act, whereby property owners on watercourses are prevented by law from altering fish habitat or releasing deleterious substances into watercourses (*Fisheries Act*, 1985).

Legislative methods, while effective, do sometimes result in conflict between property owners and public officials (Segerson & Miceli, 1998). Farmers typically believe that they should be the primary decision-makers regarding their property, and thus that the government has no right to dictate how to carry out management on their land (Ahnström et al., 2008). Legislative methods are by definition broad-stroke polices. Legislation must be applicable to the majority for it to have any impact. Therefore, legislation is well-suited to establishing, for example, enforceable pollution levels--something that is broadly applicable to most farms. Issues regarding biodiversity, however, are much more case-specific, and the drafting of legislation to enforce the promotion of expansion of biodiversity across all properties would be difficult, if not impossible.

Voluntary approaches ('carrots') encourage participation by emphasizing the benefits that arise from compliance. Voluntary stewardship programs are becoming increasingly popular in farm environmental conservation (Plummer et al. 2008). Farmers are generally more receptive to voluntary conservation activities, rather than "heavy handed" legislative approaches (Plummer et al., 2008). The nature of voluntary approaches allows the farmer to decide what is appropriate for their land. Since the farmer is familiar with their land, he or she would be more likely to adopt practices appropriate for the land. This is ideal for the promotion of biodiversity, as there will be wide variation in what is appropriate for each farm, allowing that the activities can be tailored to allow for regional differences (McLaughlin & Mineau, 1995). Moreover, under voluntary programs the farmer remains in control as the decision-maker.

The decision to undertake conservation activities is the culmination of an internal evaluation of whether the activity is worthwhile. The Theory of Planned Behaviour

offers some insight into what influences this evaluation (Ajzen, 1991; Lynne, Shonkwiler & Rola, 1988). The decision to act is the culmination of an individual's values, attitudes and evaluation of the merits of an activity, combined with situational variables (Figure 2.3). Values and beliefs are engrained early in life, and as a result, are not easily changed (Lynne et al., 1988). A person's values and beliefs will influence their attitude. For example, a person may have a strong belief in the importance of a comfortable life, and that value will have an impact on that person's attitude toward conservation activities, particularly when they perceive those activities as having negative consequences for what they consider to be "a comfortable life" (Lynne et al., 1988).

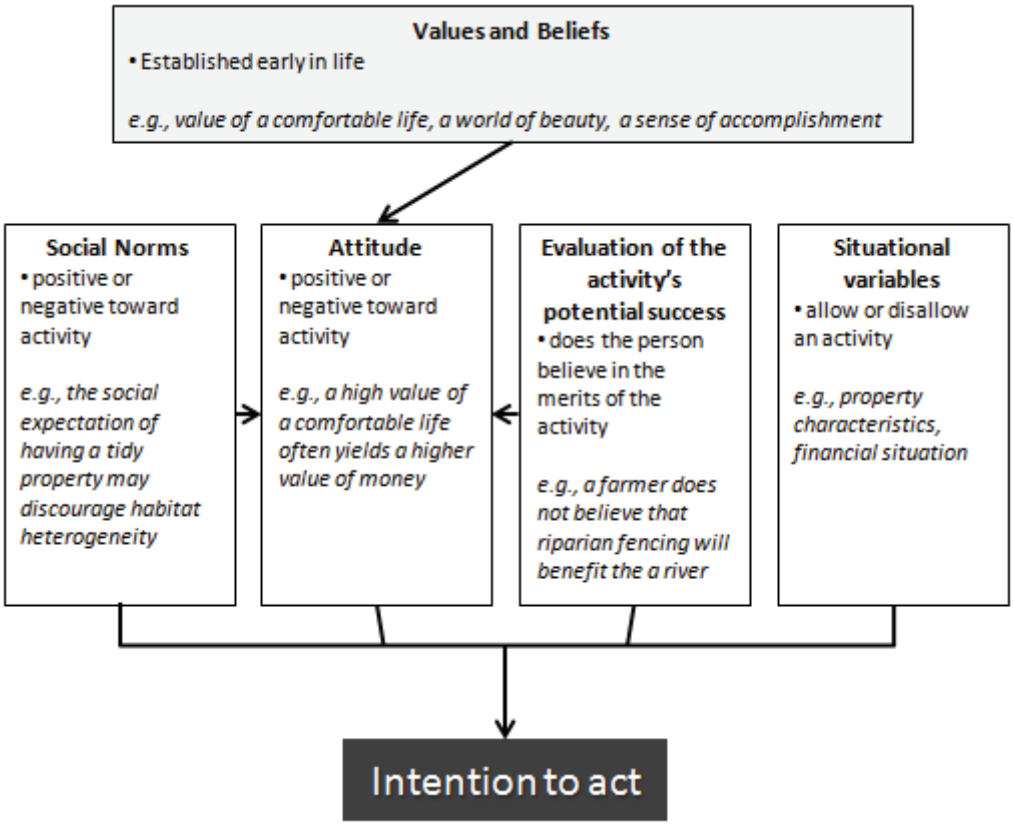


Figure 2.3 The internal evaluation of an individual's intention to act (adapted from Lynne et al., 1988)

Attitude, in combination with situation-specific variables and societal norms, will determine a person's intention to act (Ajzen, 1991). Societal norms will vary depending on where the person lives. For example, farming communities that value homogenous landscapes may be more hostile toward the promotion of 'environmentally-friendly' practices, which in turn would influence the individual's action when it comes to undertaking conservation activities. Situational variables will also have an impact. For example, when a person does not have enough money to undertake an activity, or when the weather prevents the adoption of the activity (e.g., ice formation on a watercourse may prevent the establishment of riparian fencing) a person may be unlikely to undertake the activity. The combination of all these variables determines the decision to act. It is

difficult to influence a person's values or change individual situational variables, but there is some evidence that attitudes can be influenced by things such as conservation programs (Lynne & Rola, 1988). When attitudes are positive toward conservation, it is more likely that conversation efforts will in turn be increased (Lynne et al., 1988).

2.5 Attitude Towards Conservation Among Farmers

A person's attitude is shaped by values and beliefs. These are the product of a person's background, and farmers are likely to hold some in common that are different from other groups of people. Values and beliefs, as previously mentioned, are developed early in life, and are thus not easily changed (Lynne et al., 1988). By understanding farmer values, it provides a basis for the development of conservation strategies that resonate with that group.

Many farmers have a strong link to the land (Ahnström et al., 2008). Farmers work directly with the land and are often keen observers of environmental change and possess a sense of care and connection with the land that is not demonstrated by other populations. This relationship with the land has been identified and described by researchers; Beedell & Rehman (2000) found that when British farmers were questioned about conservation, they often described themselves as "stewards" or "guardians" of the land. There are some characteristics that strengthen this bond. Generationality, or the farmer's 'succession status', impacts on his/her concern for the land, as individuals who come from a long line of farmers tend to prioritize the health of their land (Beedell & Rehman, 2000; Wilson, 1996). The strength of the farmer's link to the land is thought to influence conservation adoption. The 'land ethic' is a term that was first coined by Aldo Leopold in his 1949 seminal book "The Sand County Almanac" (A. Leopold, 1949). The

'land ethic' is something that is thought to drive farmers' ethical connection to the land--where they are bound to protect and nurture the land as part of their role as 'guardians' or 'stewards'. Early research attributed participation in conservation primarily to the farmer receiving economic benefit (Cary & Wilkinson, 1997; Mills et al., 2013; Willock et al., 1999). Later research supports alternative motivations, however, and consistent with this group that identifies as 'stewards', conservation activities are not always embraced for economic reasons (Lynne & Rola, 1988; Willock et al., 1999; Wilson & Hart, 2000). There is a link to the land that inspires some farmers to look after its health, as part of their ethical responsibility (Beedell & Rehman, 2000).

Farmers are more likely to adopt practices when the practices resonate with their own sense of well-being, and reflect their own values (Herzon & Mikk, 2007). Different individuals will have varying conceptions as to what constitutes their 'well-being', and while many farmers may consider themselves 'stewards of the land', their attitude toward individual activities may vary considerably. The different weighing of personal values will result in different personal attitudes. For example, Beedell & Rehman (2000) studied the complex motivations around hedge removal in the United Kingdom. A favourable attitude toward hedge removal, an activity that would have negative environmental consequences, stems from values favouring ease of maintenance, and not necessarily out of interest in getting rid of the on-farm habitat (Beedell & Rehman, 2000).

Social norms and demographic characteristics will also influence the decision to act (Lynne et al., 1988; Wilson & Hart, 2000). Research has shown that the conservation community (e.g., advocacy groups) has little influence on farmer behaviour, rather it is the farming community (e.g., neighbours, and farm groups such as the Nova Scotia

Federation of Agriculture) and family that are the predominant social influence (Beedell & Rehman, 2000). The relationship between values and attitudes toward conservation that are shared by demographic groups will be discussed in the following sections.

2.5.1 Age and Gender

Different demographic groups often have different attitudes towards conservation. Younger farmers are often more receptive to conservation strategies than older farmers (Dietz, Stern, & Guagnano, 1998). This could be the result of a difference in education or knowledge of environmental issues, as conservation issues are linked to the different experiences of age cohorts. Each cohort has lived through a different "slice of history", and will thus have different opinions regarding the importance or validity of certain environmental issues (Kanagy, Humphrey, & Firebaugh, 1994, p. 804).

Generally speaking, females are more interested in conservation than males, but the drivers of those differences are heavily debated (Wester & Eklund, 2011). Some researchers have attributed the higher environmental value held by women to their social role as nurturers or care-givers. This perspective has been criticized, however, as environmental attitudes are thought to develop long before the social roles of motherhood are adopted (Wester & Eklund, 2011). Others attribute the difference to risk assessment, as women are more likely to consider long-term risks and men consider the short-term, resulting in different concepts of value (Wester & Eklund, 2011). Regardless, although the drivers of the differences are contested, it is generally agreed that women will have higher environmental values than men (Wester & Eklund, 2011).

2.5.2 Education

Formal education is linked to increased participation in conservation (Dietz et al., 1998). Increased understanding and knowledge of environmental issues often results in the view that those environmental concerns are legitimate, and thus influence a person to act favourably towards conservation (Mobley et al., 2009). While this knowledge may be linked to formal education, an important distinction to make is that learning can occur from many other sources (Franz, Piercy, Donaldson, Richard, & Westbrook, 2010). Neither farming generally nor environmental issues related to farming are given much weight in most formal curricula (with the likely exception of agricultural schools). It could, in fact, be easily argued that a high degree of formal education (i.e., university undergraduate or post-graduate degrees) is not even a boon for farmers, as more relevant learning would be derived from other sources, such as family members or agricultural college. Thus, the relation between education and participation in conservation for farmers may not be as straightforward as has been demonstrated by other groups.

2.5.3 Farm Characteristics

Farm type, or the commodities produced, may impact the decision to engage in conservation. Although the impact of farm type has not been explored substantially, there is some evidence to support this argument. Wilson & Hart (2000) have found evidence suggesting that farmers with arable crops engage in fewer biodiversity-enhancing activities than farmers with pasture land, and that farmers with larger farms are more likely to undertake biodiversity-enhancing activities. Likewise, Yiridoe, Atari, Gordon, & Smale (2010) found that farmers in Nova Scotia with larger properties who raise livestock are more likely to participate in the EFP program, than farmers with smaller

properties or crops. These differences are attributed to having increased financial flexibility. What is not clear, however, is how generalizable this relationship is to biodiversity conservation, as the EFP targets pollution and not habitat and European farmers (Wilson & Hart, 2000) will be different from other groups.

2.6 Farming in Nova Scotia

Agriculturally productive lands are not widespread in Nova Scotia. Much of the terrestrial features found in the province are characterized by rock and shallow acidic soil (Agriculture and Agri-Food Canada, 2012). Due to this lack of contiguous productive soil (Figure 2.2), the alteration of habitats in productive areas has been vital historically. The draining of the salt marshes along the Bay of Fundy to create arable land by the Acadians in the 17th century is perhaps the earliest and best known example of large scale land management in the province (Nocera et al., 2005). Presently, slightly less than 30% of land in Nova Scotia is considered agriculturally productive. Much of that productive land is not used for agriculture, but is rather urban development and forestry (NS Agricultural Land Review Committee, 2010).

Individual farms in Nova Scotia are, on average, notably smaller and more diverse compared to farms found in the rest of Canada. The average farm found in Nova Scotia is 106 ha, while the national average is almost three times that at 295 ha (Devanney & Reinhardt, 2010, p. 10). The average amount of land dedicated to crops per farm in Nova Scotia is 38.5 ha, which is considerably smaller than the national average of 184.4 ha per farm (Devanney & Reinhardt, 2010, p. 19). There are no Class 1 soils (highest production value) found in the province of Nova Scotia. In fact, there is very little soil that is classified as productive at all (Figure 2.2). Since the areas of productive soil are

smaller, farms often cover a range of soil types and thus many farms, despite their small size, produce more than one commodity. For example, a farmer may have some acreage of productive land devoted to crops such as corn, and the marginal areas dedicated to pasture. The small farm parcel size has also resulted in multiple properties being owned by a single farmer. These properties may or may not be adjacent to one another, resulting in the farmer being responsible for a patchwork of land. The division of the farm into non-contiguous parcels likely has an impact on how farmers conceive of their land as a whole (Sherren & Verstraten, 2012), and may, as a result, impact the farmer's management strategies.

The long history of farming in Nova Scotia has an impact on the characteristics of the farmers. Unlike other parts of Canada, some farms in Nova Scotia have been passed down through as many as nine or ten generations (Scott, 2003). This history may have an impact on the land ethic of Nova Scotian farmers, as generationality is expected to impact farmer interest in conservation (Beedell & Rehman, 2000). However, no research in Nova Scotia has been completed to confirm this hypothesis. Habitat loss in Nova Scotia has been on-going since the arrival of European settlers in the 17th century (O'Neill, Tyedmers, & Beazley, 2006). A range of floral and faunal species from lichens, to insects, to trees such as the eastern white cedar, have been in decline along with notable extirpations such as the woodland caribou and extinctions such as the Labrador duck (Province of Nova Scotia, 2011). As mentioned before, draining coastal marshes was a common practice for preparing agricultural lands, resulting in a significant decline in salt marsh habitat (Province of Nova Scotia, 2012a). Coupled with the draining of coastal marshes, forested land was also cleared for the creation of farms, resulting in decreased

woodland habitat (Sherren & Verstraten, 2012). With nearly 70% of land, including forested land, privately owned and managed in Nova Scotia (Province of Nova Scotia, 2012b), habitat loss in Nova Scotia continues to be an issue as tile drainage of freshwater wetlands and clear-cutting of forested land (primarily for industrial purposes) are widespread.

The coastal climate of Nova Scotia exacerbates some of the environmental concerns that arise from agriculture. When land is cleared of vegetation, the erosive potential of the now exposed soil increases substantially. This is a significant problem in Nova Scotia as agricultural land in the province receives in excess of 1000mm of rain annually (Fuller et al., 2010, p. 268). The frequency and intensity of storms and rainfall patterns in Nova Scotia are projected to increase as a consequence of climate change, and thus there are increasing concerns around erosion and agricultural run-off (Bootsma et al., 2005).

2.7 Agricultural Biodiversity Conservation Program

The Agricultural Biodiversity Conservation (ABC) program is a voluntary stewardship program in Nova Scotia that aims to increase biodiversity on farms through the increase of habitat quality, quantity and diversity. The program was created in 2008, under the auspices of the North American Waterfowl Management Plan's mandate to increase habitat for migratory waterfowl in North America. The program is part of the Eastern Habitat Joint Venture, a joint endeavor to improve and create habitat by groups from Ontario east to Nova Scotia, and in the north-eastern United States. In Nova Scotia, the Eastern Habitat Joint Venture is comprised of the Nova Scotia Environment, Wildlife Habitat Canada, Ducks Unlimited Canada and the Nova Scotia Department of Natural Resources (DNR). The ABC program, while organized by the Eastern Habitat Joint

Venture, is delivered by the DNR. At the beginning of this research, the program had approximately 80 plans for 51 participants, and (as some farmers own multiple properties) (Reg Newell DNR, personal communication, November 2011).

The ABC program relies on farmer engagement and interest in biodiversity enhancing activities. When a farmer elects to participate in the program, a staff member will visit their farm to carry out a biodiversity inventory. Using aerial photography provided by the DNR's Geographical Information Services division, the staff member will walk throughout the farmer's property to determine what ecosystems are present on the farm, what species of note exist (e.g., species at risk or invasive species) and what species could be encouraged to live there. Depending on the size of the farm, this process could take several days. Farmers may choose to accompany the staff member, but more often, the inventory is done by the DNR staff member alone. Once complete, the information gathered during the site visit is compiled into a farm plan that is given to the participating farmer. This plan contains maps of the ecosystems on the property, and descriptions of the condition of the ecosystems and the kinds of species that generally reside there. Most significantly, the plan provides the farmer with a number of suggestions to improve the biodiversity on the land. This improvement is achieved through biodiversity-enhancing activities that improve habitat quality, size, and/or diversity. Once the plan is delivered to the farmer, the DNR's official involvement with the property ceases. There is no formal follow-up, but as the program is quite small both in terms of participants and geographic area, some informal follow-up does occur as individuals cross paths. Additionally, there is no direct access to funding to aid the farmer in undertaking the activities suggested. The exception is the restoration of wetlands, which can be subsidized by Ducks

Unlimited Canada. The DNR employee may thus direct the farmer towards funding bodies, but by and large, it is up to the farmer alone to undertake any of the suggestions made in the ABC plan.

The Environmental Farm Plan (EFP) program is considered a precursor to the ABC program. As mentioned previously, EFP programs are found across Canada, with the Nova Scotia chapter starting in 1997. In Nova Scotia, the EFP is delivered by the Nova Scotia Federation of Agriculture. Like ABC plans, EFPs are created after a farm visit by an EFP expert. The expert will survey the farm and create a plan for the farmer with tailored suggestions specific to the needs of that property (Atari et al., 2009). There are, however, two crucial differences between the EFP and ABC programs. The EFP program targets the mitigation of agricultural pollution, while the ABC program explicitly targets habitat; and, unlike the ABC program where no funding is provided, the EFP program acts as the gate-keeper for both provincial and national government subsidies.

Current ABC program recruitment is generated entirely through word-of-mouth. During early stages of program development some key "farming leaders" were identified and targeted, in an attempt to garner community support for the program (Reg Newell & Glen Parsons, DNR, personal communications, February 2013). Aside from some remarks in Nova Scotia Federation of Agriculture reports (NSFA, 2009), there is no advertising; the only way for farmers to find out about the program is through fellow farmers that have participated. Some EFP planners are familiar with the program, and if a farmer expresses interest in habitat or biodiversity, the EFP planner may chose to direct them towards the program, but this is not formal EFP protocol.

The Agricultural Biodiversity Conservation program is unique to Nova Scotia. Unlike other programs such as the Environmental Farm Plan (EFP) that tackle issues of agricultural pollution, the ABC program specifically targets biodiversity conservation. This program offers no financial incentives for participation. In this research, the ABC program was investigated to determine if there was a quantitative link between participation in the program and engagement in the biodiversity-enhancing activities recommended by the program. Subsequently, semi-structured interviews in the form of farm tours were carried out to explore how farmers in the sample felt about biodiversity and biodiversity conservation on their property. Results will help to improve the ABC program, as well as inform the design of other voluntary stewardship programs. Methods used will be described in detail in the following chapter.

CHAPTER 3 METHODS

There are two stages to this research. The first is an investigation of the Agricultural Biodiversity Conservation (ABC) program (borrowing from program evaluation research design) to determine whether there is any positive change in farmers' knowledge, attitudes and behaviour concerning biodiversity that might be attributed to the program; the second is an exploration of Nova Scotian farmers' attitudes and values of biodiversity on their property. The different methods used in each of these stages are discussed below.

3.1 Stage One: Assessing Program Impact

A program is defined as a group of related activities that are intended to achieve one or several related objectives (McDavid & Hawthorn, 2006). Programs are often created with best intentions, but without clearly defined goals, or without a clear vision of how those goals are to be achieved (Porteous, Sheldrick, & Stewart, 2002). Without pre-existing measures in place to continually evaluate programs, it can be challenging to determine if the program is successful or efficient.

There are different types of program evaluations that serve different purposes. A formative program evaluation refers to an evaluation of whether or not program goals have been achieved as a result of the program. In contrast, a summative program evaluation looks at the economic efficiency of the program (McDavid & Hawthorn, 2006). For this evaluation, the DNR expressed interest in finding out if the ABC program objectives were being met.

Creating a description of program process is crucial in order to understand a program's theory and logic (McDavid & Hawthorn, 2006). This allows the evaluator to

create the research questions that will eventually yield meaningful recommendations (McDavid & Hawthorn, 2006; Porteous et al., 2002). A logic model (Appendix 1) was created to define the program process, and thus identify the links between program goals and methods. Defining the program processes requires coordination between program employees, staff and the researcher, thus opening communication between program stakeholders and the researcher (Porteous et al., 2002). Program structure and relevance also need to be identified at this stage, and agreed upon by both program stakeholders and the researcher. ABC program structure (i.e., the identification of stakeholders, program goals and methods, described in Section 1.1) was mapped through discussions with the DNR and the review of released interim funding reports from the program to the Habitat Conservation Fund. Program relevance, the identification of the problem addressed by the program (i.e., biodiversity declining as a result of farming), was explored by a literature review (Chapter 2).

Program goals may not be defined identically by all stakeholders, including program staff. In the case of the ABC program, the over-arching goal of 'increasing biodiversity' was easily identified. The identification of the program objectives as increasing habitat through diversification, expansion and improvement however, was more challenging, as no quantitative, measurable goals for the program (for instance increasing habitat on NS farmland by 50% by 2016) had ever been set. Moreover, measuring 'increase or improvement in habitat' as a sign of program success is fraught with methodological issues. Depending on the habitat, or the specific activity, measuring the change in habitat would be exceptionally difficult. For many activities it would take too long for any measurable differences to be seen. For example, planting trees will create habitat but it

may be close to 30 years before that habitat is viable for some species. Simply establishing the baseline of 'before', and deciding at what time it is considered 'after' is a significant problem. In addition, choosing an indicator of 'improvement' is also difficult. Should the presence of a species serve as an indicator to measure improvement? Which species? Alternatively, should pollution levels be used? The diversity of ecosystems found on different farms makes it difficult to find a common indicator that could be used broadly and meaningfully. Furthermore, it is not only difficult to decide on what indicators could be used to measure habitat 'improvement', but to establish that that improvement is directly the result of the program rather than some other process. For these reasons, the evaluation focused instead on the change in participants in terms of their attitude, knowledge and action concerning biodiversity, rather than any change in the habitat or biodiversity on their land. Furthermore, it is more often the individual's attitude and values toward activities that are a better predictor of success, rather than the action of the activities themselves (Scherr & McNeely, 2008). Phase one of this research borrowed from formative program evaluation in using a survey to explore ABC program impact.

3.1.1 Survey Design

The evaluation of the ABC program focused on program outcomes. The results of a logic model suggested that the ABC program is intended to change farmers' knowledge, attitudes and behaviour concerning biodiversity. Although these program outcomes are indeed measureable, a program evaluation becomes much more challenging when there is no guidance of what level of change is considered 'program success' (McDavid & Hawthorn, 2006; Porteous et al., 2002). While not ideal, it was decided that any positive

quantifiable change that might be attributed to the program would be of interest (e.g., increased engagement in biodiversity-enhancing activities).

A quasi-experimental or "social science" design was deemed most appropriate (McDavid & Hawthorn, 2006). Since the program is intended to influence participant behaviour, participant involvement in the evaluation was necessary. A survey was chosen as the research instrument because it could assess many different aspects of participants' reported attitudes and values efficiently. Surveys are often used in evaluation design as they also provide quantitative measurement (McDavid & Hawthorn, 2006). Ideal program goals are stated in quantifiable terms (e.g., the achievement of 60 ha of new wetland area on Nova Scotian farmland by 2016). As a consequence program evaluations aim to measure definitive, quantifiable change which can then be used to determine whether or not the program has achieved its goals (McDavid & Hawthorn, 2006). The ABC program did not have goals stated in such a way. To investigate program effectiveness, the intent was rather to measure the change in the farmers who participate in the program, and therefore a method of quantitatively measuring change in human behaviour and attitude was needed. A quantitative survey, in contrast with qualitative methods such as interviews, provides those measures. Other studies examining farmer attitudes and behaviours have also used surveys successfully as a research instrument (Gasson, 1973; Lynne & Rola, 1988; Maybery, Crase, & Gullifer, 2005).

The survey was designed to collect demographic information, measure respondents' knowledge of biodiversity, their attitude toward biodiversity, and their engagement in biodiversity-enhancing activities. If the program is effective, participants would have more knowledge and positive attitudes about, and increased engagement in, biodiversity-

enhancing activities. In the survey itself, no mention of the ABC program was made. If participants were aware that we were measuring program effectiveness, then they might have changed their responses, as people who are happy (or unhappy) with the program might have altered their answers to reflect their personal attitude toward the ABC program. Equally, program participants and staff hold a friendly relationship; there is a chance that respondents would change their answers out of concern for program staff. A breakdown of how each section of the survey was created follows, and a copy of the final survey can be found in Appendix 2.

3.1.2 Knowledge

Increased knowledge of biodiversity has a positive impact on people's attitude toward conservation and engagement in conservation activities (Mobley et al., 2009). Therefore, it was expected that knowledge of biodiversity may impact engagement in biodiversity-enhancing activities. Knowledge, however, could itself be impacted by participation in the ABC program, as the program teaches participants about biodiversity. Thus "knowledge" is both a dependent and independent variable.

Knowledge was measured by two different mechanisms: self-perceived knowledge and tested knowledge. Respondents were asked to identify their familiarity with the term 'biodiversity' on a four-point scale (completely unfamiliar, somewhat unfamiliar, somewhat familiar and completely familiar) and then to answer nine true and false questions. The questions were adapted (with permission) from McFarlane's (2005) study of the public perception of risk to forest biodiversity. True and false questions were tailored to be more relevant to farmland instead of forest biodiversity, but the self-reported familiarity measure was adapted directly from McFarlane's questionnaire.

3.1.3 Attitudes

An attitude is a latent construct; it is not directly measurable because it cannot be directly observed (Raykov & Marcoulides, 2011). Indicators must, therefore, be created that imply a person's attitude. Latent constructs are by nature complex and cannot be accurately measured by a single item (Raykov & Marcoulides, 2011). By increasing the number of indicators, the reliability of the construct measure is increased (Gliem & Gliem, 2003).

Attitudes were conceptualized in a number of different ways: the reported willingness of a person to undergo a financial loss for habitat/biodiversity (reported willingness for absorb costs as a result of the presence of biodiversity); the individual's fondness for the look of or feeling evoked by heterogeneous landscapes (enjoyment of aesthetic of habitat diversity); and the perceived ideal that farming and biodiversity can coexist (Attitude of the impact of biodiversity on production). Sixteen statements were developed for the survey. Groups of those 16 questions measured each construct of attitude. A sample item measuring the enjoyment of the aesthetic of habitat heterogeneity is "I enjoy the look of wild areas". Other studies have had success in using this technique (Dunlap, Liere, Mertig, & Jones, 2000; Fischer & Vanderwal, 2007). Table 3.1 lists the items that measure each attitude.

Table 3.1 Groups of statements assigned to each construct of attitude, + indicating positively and - indicating negatively worded statements

Willingness for financial sacrifice (willingness to undertake financial burden for biodiversity)	1.	It costs too much time/money to do extra projects to increase habitat (living space) on my property (-)
	2.	I am willing to accept some of the costs (financial or production) to have habitat on my land (+)
	3.	Crops lost to browsing animals (e.g. deer grazing) is acceptable (+)
	4.	The financial cost of leaving space for wildlife is something I am willing to accept (+)
	5.	Money and profit are the most important things about farming (-)
Enjoyment of aesthetic of habitat diversity (positive response to the presence of biodiversity)	1.	I don't mind leaving some dead trees on my property (+)
	2.	It is important to me to keep some areas wild on my property (+)
	3.	Wildlife and people can co-exist on farmland (+)
	4.	I like to have trees of a range of ages across my property (+)
	5.	I enjoy the look of wild areas (+)
	6.	I do not want wild animals on my property (-)
Attitude of the impact of biodiversity on production (farming and biodiversity can coexist)	1.	Passing on my land in a healthy condition is very important to me (+)
	2.	Habitat (living space) for wildlife attracts pests (-)
	3.	I enjoy the look of a tidy property (-)
	4.	The health of my land is the best measure of success as a farmer (+)
	5.	The primary function of forests (on farm property) should be for products and services that are useful to humans (-)

Respondents were asked to indicate how much they agreed or disagreed with the 16 statements on a five-point Likert-scale ranging from (1) strongly disagree to (5) strongly agree. A Likert scale is a common measure for attitude (Boynton & Greenhalgh, 2004).It allows respondents to choose a response from a finite set of options, allowing the

responses to be analyzed quantitatively. This is in contrast with alternative measures, such as open-ended questions, which allow the respondent the freedom to answer questions as they wish, but the responses can be quite variable making it difficult to use quantitative analyses. Some of the questions were phrased negatively, and some positively. Thus the respondent could not simply choose the same option each time but instead would need to read and consider each statement (Bryman & Teevan, 2005). The values from the negatively-worded questions were later reversed for analysis. The mean was calculated for the groups of questions corresponding to each attitude for each individual respondent. This provided a score out of five for each construct.

The willingness of a person to undertake a financial loss for biodiversity/habitat was measured by five Likert-scale opinion questions (Table 3.1). The individual's enjoyment of the aesthetic of habitat diversity was measured by six questions (Table 3.1). These two measures capture financial and aesthetic values respectively and each had acceptable internal reliability (Cronbach's alpha of 0.74 and 0.76 respectively). Attitude of the impact of biodiversity on production was measured by five questions. These questions were only grouped after the survey had been printed, resulting in an *ad hoc* combination of questions. A Cronbach's alpha revealed that this construct did not have acceptable reliability (Cronbach $\alpha < 0.6$ [Gliem & Gliem, 2003]), and was thus omitted from further analysis.

3.1.4 Engagement

A list of ten 'biodiversity-enhancing activities' was developed through meetings with the DNR and through literature review (Table 3.2). Not all activities listed are

recommended by the ABC program; while ABC staff likely value all activities in the list, they focus on those neglected by other programs (e.g., EFP).

Table 3.2 Biodiversity enhancing activities identified by literature review

	Activity	Source(s)
Recommended by the ABC program	Habitat creation (e.g., bird/bat boxes, brush piles in unused areas)	Moonen & Barberi, 2008
	Riparian zone management (e.g., fencing of shorelines, wetland and stream buffers)	Lowrance et al., 2002; Zhang et al., 2007
	Tree-planting to create shelterbelts (e.g., hedgerows or tree rows)	Merckx et al., 2009; Vickery, Feber, & Fuller, 2009
	Postponing or modifying harvest/grazing in interest of wildlife habitat (e.g., delayed haying for ground nesting birds, use of flushing bars)	Nocera et al., 2005
	Wetland maintained/created on property	Jamieson et al., 2002; Smith & Chow-Fraser, 2010
	Restoration/conservation of natural areas (e.g., woodlands)	Manning, Fischer, & Lindenmayer, 2006
Omitted by ABC program	No till/reduced tillage	Anderson, 2007; Ball et al., 2005
	Minimizing pesticide use (e.g., decrease use, not using pesticides when ground is frozen or rain expected)	Anderson, 2007; Brown, 1999
	Manure storage to prevent run-off	Sharpley et al., 2001
	Rotational grazing	Mills & Adl, 2006

Respondents were asked to identify their level of engagement with the ten activities from the following options:

1. I have not used it, and have no intention of using it in the future
2. I have not used it, but would consider using it in the future
3. I currently use this practice and am likely to continue using it
4. I currently use this, but am phasing it out
5. I have used this in the past but no longer use it
6. This practice does not apply to my farm

This scale was adapted from Schirmer, Dovers, & Clayton (2012). The different options of engagement level are provided to ensure that one option will resonate with each individual farmer (Gehlbach & Brinkworth, 2011). For example, including the option "this practice does not apply to my farm" takes into account the fact that some activities are commodity or landscape specific.

Respondents were also asked to supply the reasons why they engaged or not in the ten activities listed. This was the only open-ended question on the survey. These responses were transcribed into NVivo 10 (NVivo qualitative data analysis software; QSR International Pty Ltd. Version 10, 2012) for analysis.

3.1.5 Demographics

Demographic factors were identified in the literature review as important factors in a person's attitude toward conservation and in predicting the likelihood of engaging in conservation activities (Section 2.5). Thus, age, education and gender were elicited. Farm characteristics were also included to determine whether different kinds of farms had different levels of engagement in biodiversity-enhancing activities. Respondents were asked to identify their farm types (by checking the appropriate boxes, see Appendix 2) and farm size (by writing in the acreage of their property).

3.2 Identifying the Sample

Isolating the source of any change in program participant's knowledge, behaviour or attitude was a significant challenge. How does one determine if any change was the direct result of the program or another external factor? A 'pre and post' design would have been the most effective, where participants would be tested (given the questionnaire) prior to

participation in the program, and then given the same questionnaire again upon completing the program. In this way the individual people tested remain constant, and the 'treatment' of program participation is 'applied'. This method, however, requires a longitudinal study: the length of time it would take for the program to successfully change knowledge, attitude and behaviour are not clearly defined, and could take numerous years. Moreover, one of the problems with pre-post designs is that respondents might remember their initial answers. A possible substitute was a cohort design, in which two distinct groups are tested and compared: a group of participants and a different group of people who are just entering the program. This design is a useful alternative. Unfortunately, no waiting list for the program existed and so this method was not possible either.

The approach used was a good proxy for a cohort study. While it is (relatively) simple to measure actions, attitudes, and knowledge in a survey, without being able to compare those results to another group it is impossible to measure the impact of the program. In order to attribute change in participants to the program, some kind of baseline or control group had to be used as a comparison. A true control group would be identical to the participant group in all ways except that they did not participate in, nor have any knowledge about the program. Unfortunately, because of the nature of social research, a true control group is not possible (McDavid & Hawthorn, 2006). Finding an identical group, and then preventing them from ever hearing or learning about the program would not be feasible. Therefore, a group of farmers that did not participate in the ABC program that were as similar as possible to the participants in the program were selected as an imperfect comparison group. This comparison group of non-participants was made up of

farmers from the same counties as the program participants. The selection process is described in further detail below.

3.3 Mail-out Process

The survey was delivered by mail. The choice of mail instead of another medium, such as telephone, was because of the Freedom of Information and the Protection of Privacy Act (FOIPOP). Since the ABC program is a provincially delivered program, all of the contact information and the completed ABC plans are protected and inaccessible to anyone but the program employees (*Freedom of Information and Protection of Privacy Act*, 1993). Therefore, no contact details were accessible to the researchers. To adhere to FOIPOP, the DNR agreed to mail out the surveys on the researcher's behalf, preventing any unlawful access to the participants' personal contact information.

The ABC program is quite small with only 51 farmers participating at the beginning of this study. Therefore, a high response rate was needed to achieve a sample large enough for rigorous statistical analysis. A method frequently used by survey researchers to increase participation is the use of multiple reminders (Bryman & Teevan, 2005). Under this method respondents are not only sent the survey, but are also sent follow-up reminders to encourage them to complete the survey (Bryman & Teevan, 2005; Schirmer, 2009). Schirmer (2009) raises some ethical concerns about the use of multiple reminders; she notes that even though mail may not be considered by most as intrusive, respondents may feel harassed by the bombardment of letters. For this reason Schirmer (2009) encourages researchers to send out reminder post-cards at specific time intervals, as well as providing clear information regarding simple ways by which respondents may choose to opt out of the survey. She also recommends ensuring respondents that once a survey is

returned their name is removed from the mailing list, thus stopping any additional mail. To keep the surveys anonymous (in accordance with FOIPOP), numbers were assigned to each respondent by the DNR. These numbers appeared in the top right corner of the surveys. When a survey was returned to Dalhousie University, the researcher recorded the numbers and relayed to the DNR which numbers had been returned. The DNR would then remove the corresponding name from the reminder mailing list.

There is some concern about the use of identifiers in anonymous survey research. When a respondent sees the identifier (in this case a number) it may, either consciously or unconsciously, impact his or her answers (Yang & Yu, 2011). Having no identifiers, however, prevents the researchers from removing names from a mailing list. Not only would respondents be harassed with multiple surveys, but they might return more than one survey. Because the relationship between program staff and program participants is amicable, it was decided that preventing the harassment and alienation of participants was a higher priority than the risks of anonymous identifiers impacting survey responses. Thus anonymous identifiers and multiple reminders were employed (a copy of reminder postcards can be seen in Appendix 3).

The survey was mailed to all participating (n=51) farmers as well as non-participating (n=598) farmers from the same counties. All surveys were sent with a pre-paid return envelope enclosed. A link was also provided to give the respondents the option of completing an online version of the survey (created using Opinio software [ObjectPlanet 2012]). Multiple reminders were employed only for the program participant group as here a high response rate was critical. A breakdown of the mail-out dates follows:

- Initial mailing of survey, to all participants – April 13th 2012
- Second copy of the survey – May 2nd 2012
- First reminder post card – June 1st 2012
- Third copy of the survey (with an additional letter explaining survey importance, and that this was the final survey mailed) – June 15th 2012
- Final post card, reminding respondents to complete the survey and that no additional mail would be sent to them – June 26th 2012

The comparison group of non-participants was assembled through the Nova Scotia Federation of Agriculture's (NSFA) mailing list. The DNR sent the names of the ABC participants to the NSFA, so that they would not receive multiple copies of the survey. Since the comparison group was considerably larger than the participant group (n=589 compared to n=51), a lower return rate was thus acceptable, and they received only a single mail-out. The NSFA mailed the survey on April 4th, 2012.

It was anticipated that there would be some bias in the responses from the comparison group of non-participants. With only a single mail-out it is likely that only those individuals who have some pre-existing interest about biodiversity would take the time to complete the survey and mail it back. This bias, suggesting interest in biodiversity, could be used as an indicator of potential future ABC program participation. In other words, those that are already interested in biodiversity enough to complete such a survey are also likely to opt into the program. This meant that the comparison non-participant group could serve as an alternative to a 'waiting list' for the ABC program, thus creating a quasi-cohort design, where current participants are compared to the closest possible alternative to those who are about to enter the program.

3.4 DATA ANALYSIS

Survey responses were collected until July 31st, 2012. The majority of responses were returned by mail, with only 7% of all responses returned online. All responses were manually entered into Microsoft Excel as they were returned. The Excel file was then imported into STATA 12 software (StataCorp, 2011) for statistical analysis. Descriptive (univariate) statistics were first calculated. Because some of the categories measuring demographic variables were not used very often, some categories were collapsed for analysis: age was collapsed from six categories to three categories and education from eight categories to four. This ensured that there were enough responses in each category for multivariate analysis.

The second stage of analysis focused on bivariate statistics. Chi-squared tests of independence were used to explore the relationship between variables, as virtually all of the variables of interest were either nominal or ordinal levels of measurement. This initial analysis, along with variables identified in a literature review (Chapter 2) provided the basis for a multiple regression model, the third stage.

3.4.1 Multiple Regression Model

The research question (question I, Chapter 1) attempts to link program participation to engagement in biodiversity-enhancing activities (an intermediate outcome of the program identified by the logic model, Appendix 1). There are, however, many factors that may influence the decision to engage in an activity; thus it was important that these alternatives were considered. A multiple regression model allows the impact of program participation to be examined while accounting for the impact of other factors.

For an explanatory variable to have an impact on a response variable, time ordering must be satisfied: the explanatory variables must occur prior to the response variable. Since the ABC program was intended to impact the farmer's knowledge of, action for and attitude about biodiversity, neither the knowledge nor attitude portions could be used as potential explanations for a change in behaviour; they would be changing, theoretically, at the same time as engagement. Demographic factors, however, would occur well before participation in the program, and thus provide the best potential alternative explanatory variables.

The construction of a model of this nature requires careful selection of potential explanatory variables through theoretical reasoning (Agresti & Finlay, 2009). A literature review revealed that individual characteristics often have an impact on conservation engagement (Section 2.5). Women are generally more concerned about the environment than men (Wester & Eklund, 2011), younger individuals are more likely to embrace conservation strategies than older individuals (Dietz et al., 1998; Kanagy et al., 1994) and individuals with more formal education are more likely to undertake conservation activities (Mobley et al., 2009). With only 126 useable surveys, only a few explanatory variables could be selected to produce meaningful results. This is because the number of responses in each combination of explanatory variables (e.g. under the age of 40, female, college educated) would decrease with each added variable, thus reducing the accuracy of the model's prediction. Three characteristics: age, education and gender, were included in the regression model as controls. The average values of each age group, gender group and educational group were used to split each category, so that any over-representation from each of those groups of responses did not skew the regression model results.

There is some evidence that farm characteristics influence engagement in conservation. Wilson & Hart's (2000) study of European farmers determined that farmers with larger properties were more likely to engage in conservation activities. In Nova Scotia, participation in the EFP program has been linked to farmers with larger properties or livestock operations (Atari et al., 2009; Yiridoe et al., 2010). The mixed commodities produced by farms in Nova Scotia (Sherren & Verstraten, 2012), and the number of survey responses resulted in too many different combinations of farm type for analysis. With such a small sample this measure becomes inappropriate for inclusion in the model. Similarly, property size was also omitted as a result of the small sample.

The choice of regression model is largely based on the levels of measurement of each variable (Agresti & Finlay, 2009). In this case, the explanatory variables (participation in the program, age, education and gender) are all either ordinal or nominal levels of measurement. The response variable of engagement in a biodiversity-enhancing activity was measured by a list of six options (e.g. I am currently engaged in this activity and plan to continue, see page 45). While this list does provide the respondent with enough options to allow ease in answering the question, the list of options does not create any kind of discrete ordinal scale. Thus only the options of "I would consider this activity" (2) and "I am currently undertaking this activity" (3) were selected to measure engagement. This decision was also supported by the low response rate in the four categories omitted from analysis.

A logit regression model relies on a binomial response variable, indicating the presence or absence of something. In this case Y=0 indicated no engagement ("I would consider this"), and Y=1 ("I am currently undertaking") indicated engagement in an

activity. Since this variable is binomial (i.e., one or the other and not continuous), the regression line is created by taking the odds of Y=1 happening, divided by one minus the odds of Y=1 happening. As this response variable cannot, by definition, exceed 1, the log of the odds of the response variable transforms the regression line so that this condition is met (Agresti & Finlay, 2009). A logit model is defined by the following equation:

$$log\left[\frac{P_{(y=1)}}{1-P_{(y=1)}}\right] = \alpha + \beta x \quad (1)$$

The equation for this model becomes:

$$log\left[\frac{P_{(y=1)}}{1-P_{(y=1)}}\right] = \alpha + \beta 1 X_{program\ participation} + \beta 2 X_{age} + \beta 3 X_{education} + \beta 4 X_{gender} \quad (2)$$

The model was run for each of the biodiversity-enhancing activities listed on the survey, with the exception of 'minimizing pesticides' and 'rotational grazing' since there was no variability on these measures.

3.4.2 Open-ended Survey Questions

An inductive-approach allows the researcher to generate themes from the responses of participants, rather than determining themes before analysis begins (Kvale & Brinkmann, 2009). Respondents were asked to describe the reasons they chose to engage in any of the biodiversity-enhancing activities listed on the survey. The responses from these open-ended questions were analyzed using NVivo 10 qualitative analysis software. Themes were coded during multiple readings of the text. Responses were coded and then re-coded several times as new themes emerged during each round of coding. The first stage of coding was focused primarily on the content. That is, what were the reasons

farmers undertook (or did not undertake) an activity. After this first cycle of coding, the second cycle analyzed apparent intended meaning (Kvale & Brinkmann, 2009); what was implied in the text? Were farmers hostile toward certain activities, or were they intrigued? Once coding was complete, the nodes were grouped together under broad themes. Major themes were identified about the reasons for adopting activities, and barriers to their adoption.

3.5 Stage Two: Values Elicitation

Values and attitudes are complex, and can be difficult to measure quantitatively (Raykov & Marcoulides, 2011). Thus a qualitative approach is more appropriate for exploring how Nova Scotian farmers value biodiversity and biodiversity enhancing activities on their land (question II, Chapter 1). While the quantitative survey did measure some attitudes identified by the literature, the nature of a survey forces the participant to only provide insight into those practices and attitudes that have been chosen by the researcher (Bryman & Teevan, 2005). An interview, however, allows for freer discussion of attitudes and values, and provides deeper insight into how a farmer values their land and biodiversity. In fact, it is possible that these themes may differ from those first identified by the researcher (Kvale & Brinkmann, 2009).

Interviews can be a powerful tool for collecting rich data concerning people's values, emotions and feelings. Unlike quantitative methods, the flexibility of an interview allows participants freedom to express themselves without the confines of quantitative answer selection (Bryman & Teevan, 2005). Depending on the choice of methods by the researcher, data collected from interviews can be far more complex than that of a questionnaire: the combination of word choice, voice inflection, and choice in subject

matter (or subject avoidance) provides the researcher with a rich tapestry illustrating the participant's values, emotions and feelings (Kvale & Brinkmann, 2009; Ryan & Bernard, 2003).

3.5.1 Go-along Interviews

The 'go-along' interview is a method that has been used to investigate people's relationships with their surroundings. This interview style differs from more conventional interviews as it takes place *in situ*--within the landscape that is the target of research interest--rather than across a table or over a telephone, providing a more intimate way of examining engagement with the land (Evans & Jones, 2011). Go-along interviews may take place along a route pre-determined by the researcher, or may be led by the participant, and are commonly used in planning and urban ethnographic studies (Carpiano, 2009; Evans & Jones, 2011; Garcia, Eisenberg, Frerich, Lechner, & Lust, 2012; Jones, Bunce, Evans, Gibbs, & Hein, 2008).

Go-along interviews reverse the power imbalance of the 'interviewer-interviewee' relationship. Traditional interviews are typically carried out in a formal setting (for example, across a table) where a participant is posed a series of questions by the researcher. This format results in a fundamental power-imbalance whereby the researcher controls the discussion during the interview (Kvale & Brinkmann, 2009). This imbalance may result in the participant hesitating to give answers or in the participant inadvertently manipulating or manufacturing their answers. For example, in an interview of a student by a professor, the student may answer questions fraudulently because they are worried that their honest answer may affect their grade. Likewise, a person with little education may feel inclined to answer questions differently if they perceive the interviewer as

highly educated (Bryman & Teevan, 2005; Jones et al., 2008). In a go-along interview, especially those where the participant acts as the guide, the power imbalance is reversed (Garcia et al., 2012). Furthermore, with the landscape as a common discussion point for both the participant and the interviewer, the participant is no-longer the 'target' of the interview; rather the target is the landscape and how they both interact with it (Kusenbach, 2003). The casual nature of a go-along interview that takes place outdoors, instead of across a table, means participants are more inclined to speak their minds, rather than provide the "right" answers during an interview (Evans & Jones, 2011).

As with any research method, there are some caveats to the go-along interview. An interview that takes place outside is at the mercy of the elements. If the weather does not cooperate there is little that the researcher can do short of rescheduling the interview. The nature of go-along interview also requires mobility on both the part of the participants and of the researcher (Garcia et al., 2012). This may not be possible for some, especially in winter conditions, or if the route chosen is too long for walking. This may be alleviated in some part through the use of a medium of transportation such as a truck or car. Concerns have been raised by some researchers that a lack of consistency in the routes of interviews will impact the generalizability of the research findings (Jones et al., 2008). With interviews on participant farms, however, this is impossible to avoid. Nonetheless, careful considerations must be made during the research design to address these concerns.

3.5.2 Farm Tours

Interview recruitment was carried out through the mail-out survey. Participants in the first study were asked if they would be willing to participate in a follow-up interview.

Forty-four percent of all respondents agreed. Interview candidates were then selected from this pool and contacted by telephone. Despite the initial strong interview interest from the returned surveys, contacting and booking interviews over the summer proved very challenging. It was explained over the phone that the interview would take place at their property in the form of a farm tour (Appendix 4). Candidates were selected based on their answers to the demographic portion of the survey. It was first hypothesized that education level would have a significant impact on a farmer's values about and attitude toward biodiversity and thus candidates were first selected on this basis (Dietz et al., 1998; Mobley et al., 2009). A preliminary analysis of the quantitative study suggested that education was not as important as previously thought. Thus, the recruitment of interview participants was broadened to explore a range of opinions. A stratified sample of different age groups (three farmers were between the ages of 20-40, six between the ages of 41-60, and three between the ages of 61 and 80) and commodity types (Table 3.3), was selected. An attempt was made to talk to farmers who produce some of the most common commodities in Nova Scotia, such as cattle and blueberries (Figure 3.1). Twelve interviews were carried out between August and October 2012. Out of those twelve interviews, three took place in-doors due to inclement weather, and a lack of flexibility to re-schedule.

Table 3.3 Commodities produced by interview participant. Note the total adds up to more than twelve as a result of the combinations of commodities produced on each farm

Commodity Type	Number of farms producing
Hay	7
Cattle (beef)	5
Sheep (meat or wool)	4
Silviculture	4
Blueberries	2
Vegetable	2
Christmas Tree	2
Maple Syrup	1
Other livestock	1

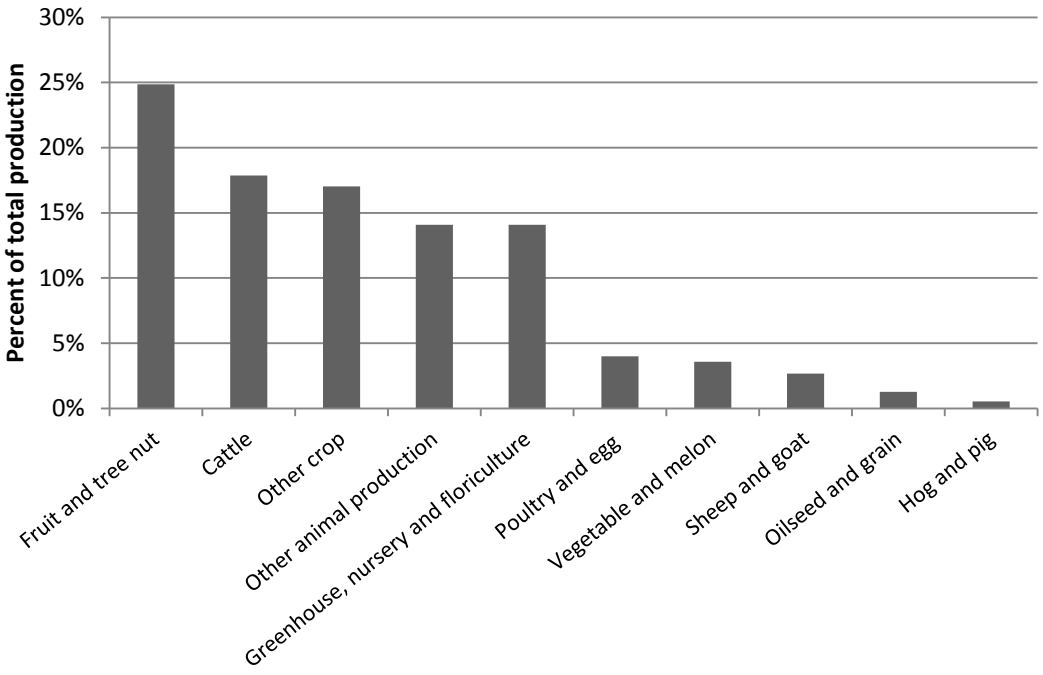


Figure 3.1 Agricultural production in Nova Scotia (Source: Statistics Canada, 2011)

The goal of the interview was to explore the relationship of the farmer with the biodiversity on their land. A semi-structured interview guide (Appendix 5) was created. With the landscape as the key prompt, different themes covered by the interview guide

would arise at different times for each interview making a structured interview inappropriate. With permission from the farmer, the audio of each interview was recorded and photos were taken to help to serve as reminders of the landscape where certain discussions arose. Farmers were asked to first "show a place on their property that they associated with wildlife or biodiversity". Depending on where the participant showed and how the conversation flowed, questions were posed as they came up naturally in conversation. Each interview route was unique to the features of that individual's land; some were carried out walking, and others by driving, but it was the commonalities and differences of the ecosystems shown, the themes discussed, and the broad landscape characteristics (e.g. woodlots, water-courses, hay fields etc.) that were of primary interest.

3.5.3 Data Analysis

Interviews were transcribed by the researcher, directly into NVivo 10 qualitative analysis software. Using an inductive approach, themes were coded as they emerged during multiple readings of the transcripts. This required multiple cycles of coding, as common themes became clear during each reading (Kvale & Brinkmann, 2009; Ryan & Bernard, 2003). The first cycle of coding focused on content analysis: what sites did farmers choose to highlight? What activities have they undertaken? The second cycle focused on the perceived meaning of what was said by the participants: was there implied hostility towards wildlife? What kind of language did the farmers use at different locations on the farm? Each of these stages of coding required multiple readings and constant comparison, as different themes emerged during each visit to the transcripts (Kvale & Brinkmann, 2009; Ryan & Bernard, 2003).

It was important to ensure that the themes identified during analysis were broadly generalizable to Nova Scotian farmers, and not representative of any single individual. Each theme was identified by a node. Once coding was complete, nodes that were present in at least six out of the twelve interviews were considered most important and the rest filtered out. These most common nodes are discussed in Chapter 5. This was done to ensure that the identified nodes were fairly representative of the participant population. The common nodes were then grouped together thematically, identifying the major themes of the interviews. In this final stage, the coding and analysis moved from a descriptive (content and meaning analysis) to a more theoretical (thematic analysis) level (Kvale & Brinkmann, 2009). To avoid the risk of personal bias and ensure some replicability of these themes, a cluster analysis based on word similarity was carried out using the nodes most frequently coded (ignoring 'stop words' such as conjunctions and prepositions). This is represented by a tree illustration (Discussed in Chapter 5, Figure 5.1) that joins the nodes whose interview contents contained the most similar words. The manual grouping, however, was the main method of analysis used to generate results. While the final tree illustration was broadly consistent with the manual grouping, it served as a visual aid to understand the complexity of the themes, rather than any further analytical purpose.

Results from both of these stages (the quantitative survey and the qualitative interview) will help in the development of voluntary environmental stewardship programs. The quantitative survey not only determined if program participation can be linked to increased engagement in biodiversity-enhancing activities, but helped to reveal the attitude toward biodiversity of the farmers in that sample. The interviews built on

these results by qualitatively exploring farmer attitudes and values toward biodiversity and biodiversity conservation on their property. Results from each stage are discussed in the following two chapters, in the form of manuscripts. General implications for the design of voluntary programs based on the results of both stages can be found in the final concluding chapter (Chapter 6).

CHAPTER 4 LINKING STEWARDSHIP PROGRAM PARTICIPATION TO FARMER ENGAGEMENT IN BIODIVERSITY CONSERVATION PRACTICE

Kate Goodale[1], Kate Sherren[1], Yoko Yohsida[2], Karen Beazley[1]

[1]School for Resource and Environmental Studies, Dalhousie University
[2] Department of Sociology and Social Anthropology, Dalhousie University

This chapter was written with the intention of publishing in the *Journal of Nature Conservation*. Therefore there is no conclusion section as per the journal's specifications. To make this chapter a stand-alone manuscript, there will also be some repetition of information from preceding chapters.

4.1 ABSTRACT

Biodiversity and farming are inextricably linked. Naturally occurring biodiversity is responsible for ecosystem services that are indispensible for agricultural production. The intensification of farming during the 20th century has resulted in increased yields, but at the expense of biodiversity. Biodiversity conservation efforts are largely confined to voluntary programs. This research (borrowing from program evaluation methodology) examines the link between farmer engagement in biodiversity conservation and participation in a voluntary stewardship program that does not offer any financial assistance to program participants. This investigation was completed through a quantitative survey measuring respondents' attitudes toward, knowledge of, and management to encourage biodiversity. The quantitative link between engagement in biodiversity-enhancing activities and program participation, suggests that ABC recommendations that give specific instructions, or that are entirely new to the farmer, are mostly likely to be voluntary adopted as a result of participation in the program.

4.2 INTRODUCTION

The modernization and intensification of farming techniques from the mid-twentieth century onward have been partially responsible for the reduction of habitat diversity and quality (Balmford et al., 2012; McLaughlin & Mineau, 1995). Land-clearing for agriculture has further decreased habitat area (Sharpley et al., 2001) and agricultural pollution in the form of run-off and sedimentation has reduced the quality of adjacent habitats (Green et al., 2005), with an overall negative impact for biodiversity. With agricultural land covering half of the globe's terrestrial surface (Batáry et al., 2011), and with rising food demand from a growing world population of increasing financial means (Godfray et al., 2010), there is increasing effort given to identifying the best management practices for balancing production and the integrity of natural areas (Phalan et al., 2011; Tscharntke et al., 2012).

Biodiversity is responsible for the provision of ecosystem services essential to agricultural production (Altieri, 1999). For instance, insects such as bees provide pollination to crops, and wetlands provide water filtration services. Farming intensity has increased at the expense of biodiversity, resulting in a decrease in ecosystem services (Altieri, 1999; McLaughlin & Mineau, 1995). This decrease in naturally existing ecosystem services coupled with an increasing demand for yields has created a greater need for auxiliary inputs such as fertilizers and pesticides. These modern advancements have caused increased yields in the short term. This reliance, however, creates a negative feedback loop whereby biodiversity continues to decrease and increases the reliance on those inputs (Anderson, 2007).

Biodiversity ensures the delivery of ecosystem services through multiple pathways, thus increasing resiliency should one of those pathways fail (Altieri, 1999). While projections vary significantly by region, climate change is expected to impact crucial natural processes such as rainfall, resulting in a shift in species distribution (Bootsma et al., 2005). Managing for biodiversity will help to increase both the quantity and quality of habitat, while potentially increasing farm resilience in the face of climate change (Altieri, 1999; Batáry et al., 2011; Bullock, Aronson, Newton, Pywell, & Rey-Benayas, 2011).

There are two predominant methods employed to reduce the environmental harm produced by farming: legislative ('stick') and voluntary ('carrot') measures. Legislative measures are environmental laws or standards enforced by punishments or fines for non-compliance, and often cause conflict between land-owners and policy-makers (Segerson & Miceli, 1998). There is a sentiment among many farmers that they should be 'in control' of their land, and that governments have little right to dictate how farming is to be carried out (Ahnström et al., 2008). Legislative measures are, most often, blanket solutions, applicable to the majority, motivating the farmer by the threat of punishment--in other words a 'stick'. This makes the drafting of environmental legislation even more challenging, as not only is legislation frequently met with hostility, but creating standards that are generalizable to a wide range of farming properties is often impossible (Plummer et al., 2008).

Voluntary measures, such as environmental stewardship programs, are a more appealing solution for a variety of reasons: they are generally well-received among farmers (Wilson & Hart, 2001), and they allow for a degree of tailoring to the needs of an individual farm. The 'carrot' offered by voluntary programs could be in the form of a

financial incentive, or could simply use the explanation of the environmental benefits to the participant to entice them to participate. These programs appeal to the commonly held farming value of maintaining the health of the land (Ahnström et al., 2008): in a 2000 survey of 1794 Canadian farmers, 79% indicated an interest in learning about environmentally friendly farming techniques, and 68% in adopting environmentally friendly farming techniques (Environics Research Group, 2006). A commonly identified barrier to the adoption of conservation practices, however, is a lack of funding (Environics Research Group, 2006; Wilson & Hart, 2001; Yiridoe, Atari, Gordon, & Smale, 2010). Therefore, it is often thought that monetary incentives are important, if not crucial, in the adoption of voluntary conservation activities (Segerson & Miceli, 1998; Wilson & Hart, 2000)

While some stewardship programs do offer access to incentives, financial enticements are is not always possible, and are perhaps not always necessary (Wilson & Hart, 2000). The Theory of Planned Behaviour states that a positive attitude about strategies coupled with a belief in the benefit or utility in those strategies, increase the likelihood that an individual will take them up (Ajzen, 1991; Lynne et al., 1988). If a farmer believes that a practice is inappropriate for their land or that the cost of the activity outweighs the benefits, they are unlikely to adopt that activity (Wilson & Hart, 2000). Voluntary programs appeal to the farmer's interest in the health of the land, but more importantly, allows the farmer to decide if a practice is applicable to their land. If a stewardship program is well designed and the conservation activities promoted are presented as both environmentally and cost-effective, participants are likely to adopt those conservation strategies, despite a lack of incentives (Wilson & Hart, 2000). The impact of voluntary

stewardship program participation on engagement in biodiversity conservation activity adoption was explored through the case of one stewardship program in the province of Nova Scotia, Canada.

4.3 METHODS

Agriculture in Nova Scotia has a long history of altering the land for human needs when compared to the rest of Canada. It began as early as the 17th century, with land reclamation of salt marshes by the Acadian dyke building (Nocera et al., 2005). Land manipulation has been a crucial component of Nova Scotian farming, as soils are shallow and acidic, with few areas of contiguous fertile soil found throughout the province (Figure 2.2 [Agriculture and Agri-Food Canada, 2012]). As a result, farms tend to be small in size (averaging 261 acres) and produce mixed commodities (Statistics Canada, 2012); fertile land is used intensively (e.g. for crops and horticulture) and marginal land is used for other purposes, such as pasture. This land manipulation has led to declines in both habitat and connectivity (O'Neill et al., 2006), and--as is the experience in other regions of the world--has resulted in an overall decrease in biodiversity. With the diversity of Nova Scotian farms, broad stroke legislative methods for conservation are not ideal. What may apply to one farm may not be applicable to another. Moreover, in a situation where farm characteristics are diverse, conservation strategies that are tailored to the individual farm are more likely to be considered viable by farmers.

The Agricultural Biodiversity Conservation (ABC) program was created in 2008, under the North American Waterfowl Management Plan, through the auspices of the regional Eastern Habitat Joint Venture. The program is delivered by the Nova Scotia Department of Natural Resources, and relies exclusively on voluntary farmer interest in

biodiversity-enhancing activities. Participants are visited by the program staff, who carry out an inventory of the existing habitat and seek opportunities to expand or improve habitat on the participant's land. That information is then compiled into a personalized report that is delivered to the farmer, with a description of the overall ecosystem health, as well as a list of suggested activities (such as maintaining natural areas, planting tree rows as shelterbelts or hanging bat boxes) that could be undertaken to increase habitat quality, quantity or diversity. The program has few staff and only 51 participants during the time of this study. While the ABC program is small, the program's conservation approach is unique: it relies on farmer interest and offers no financial incentives. Few staff are trained to undertake the site evaluations, so plans have only been created for farms in a few counties in the province. When the program was first created, "farming leaders" (respected members of the farming community) were targeted to increase local support for the program. Since that time there has been no further advertising for the program, and participants are largely recruited through word-of-mouth.

4.3.1 Evaluation Methodology

How effective is the ABC program specifically at impacting farmer engagement in the recommended biodiversity-enhancing activities? Bias is an issue: farmers who elect to participate in a voluntary stewardship program are more likely to engage in biodiversity-enhancing activities, despite the lack of any financial incentive, than farmers who do not participate. There are many reasons why a person may choose to adopt conservation activities. Research suggests that demographic factors such as age, gender, and education predict the likelihood that an individual will choose to engage in voluntary conservation activities (Dietz et al., 1998; Mobley et al., 2009). To be able to isolate the

influence of the ABC program, alternative explanations for engagement, such as demographic factors, must be considered and effectively ruled-out.

A formative program evaluation framework was used in the research design. A formative program evaluation tests whether program goals have been achieved as a result of the program. This is in contrast to a summative program evaluation in which efficiency is addressed (McDavid & Hawthorn, 2006). After consultations with the Department of Natural Resources, it was determined that ABC program goals of increasing farmland habitat quantity, quality and diversity are achieved by improving program participants' knowledge, attitudes and engagement in biodiversity-enhancing activities. Measuring the resulting change in habitat would be one method to evaluate program success. Creating the baselines (pre-test conditions) to measure the changes in habitat is, however, problematic. There is much diversity in habitats and ecosystems between farms and the creation of a widely-applicable scale to measure 'change in habitat' would be difficult, if not impossible. Additionally, in many cases the temporal scale of habitat creation is simply too long to effectively measure. For example, tree planting will create habitat, but it may be 30 years before that habitat is considered viable for some species. Such a lag time means that changes made by farmers within the five year history of the program may not yet be evident in such an audit. As a result, the change in the reported behaviour of the program participants, and not the change in habitat, becomes the target of the investigation.

4.3.2 Measures

A quantitative survey was designed to measure program impact on farmer knowledge of, attitude toward and action concerning biodiversity. The final survey contained four parts: knowledge (self-declared familiarity with the term 'biodiversity', followed by nine true and false questions to test that familiarity); attitude (measured by 16 statements with which respondents could rate how much he or she agreed or disagreed on a five-point Likert scale); actions concerning biodiversity (measured by indicating the level of engagement in a list of activities); and demographics.

Attitudes are latent constructs. As attitudes cannot be directly observed, indicators must be constructed as a measurement (Raykov & Marcoulides, 2011). Two facets of attitude were measured using a combination of five-point Likert-scale responses to statements where participants indicated their agreement on a scale from 1 "completely disagree" to 5 "completely agree". 'Willingness to absorb financial costs as a result of the presence of biodiversity' was measured by five statements (Cronbach α=0.74), and 'enjoyment of the aesthetic of habitat diversity was measured by six statements (Cronbach α=0.76). Attitude scores were calculated for each respondent by taking the mean of the grouped Likert-scale answers (Table 3.1). A higher score (out of five) indicates a more positive attitude toward biodiversity.

The 'biodiversity action' based survey questions were drafted through consultations with the ABC program staff and a literature review. The literature review identified the kinds of activities that are recognized by the academic community as successfully increasing biodiversity on farmland (Table 4.2), producing a list of ten biodiversity-enhancing activities. All of these activities are likely to have a positive benefit to

biodiversity, but not all of the ten activities are recommended by the ABC program. Four out of the list of ten biodiversity-enhancing activities are omitted by the program, not because the activities are considered ineffective or unimportant, but rather because the activities are often already the target of other programs. The wording of the questions was reviewed by the Department of Natural Resources (DNR) and the Nova Scotia Federation of Agriculture (NSFA) to ensure the language and the constructs of the questions would resonate with the target farmer population.

Respondents were asked to indicate their level of engagement in the activities from the following options, based on Schirmer, Dovers & Clayton (2012).

1. I have not used it, and have no intention of using it in the future
2. I have not used it, but would consider using it in the future
3. I currently use this practice and am likely to continue using it
4. I currently use this, but am phasing it out
5. I have used this in the past, but no longer use it
6. This practice does not apply to my farm

It was important that the available categories reflected all potential circumstances of respondents. A respondent will be unlikely to answer a question accurately if there is no option available that reflects their situation or belief (Boynton & Greenhalgh, 2004; Gehlbach & Brinkworth, 2011). Similarly, not all activities will be possible on all farms; for example, if a farm does not have any livestock, it will be impossible to undertake rotational grazing. Respondents were also asked to describe the reasons for undertaking any activities in the list that they did do. These open-ended responses were analyzed in NVivo 10 using an inductive approach, where themes were identified and coded, then later grouped to reveal overarching themes about motivation.

To isolate the impacts of the program from other external factors, ideally a pre-post treatment would be employed. This means that a group of farmers entering the program would complete the survey, and then the same group of farmers would complete the same survey after completing the program. Unfortunately, this was not possible as a result of time constraints. The next best solution would be a cohort design, whereby farmers entering the program would be surveyed and compared to farmers that have already participated in the program. This was, however, also impossible as a result of the small size of the ABC program and the nature of recruitment strategies (no waiting list existed for the program). As an alternative, all participants (n=51) of the ABC program were mailed the survey and an identical survey was mailed to all the non-participating farmers on the Nova Scotia Federation of Agriculture (NSFA) mailing list. These farmers (n=589) came from the same counties as the ABC program participants. It is likely that those who are interested in biodiversity would thus be more likely to complete a one-time survey than a random sample of the population, and it can be rationalized that this same group would be the most likely population to participate in the ABC program in the future. The self-selection of survey completions in the comparison group thus served as an alternative to a 'pre-program participation cohort'. Comparing the responses of the self-selected non-participants to a large proportion of the program participants is the closest possible alternative to a cohort design achievable in the circumstances.

To achieve the highest possible response rate from program participants, multiple reminder techniques were employed (Schirmer, 2009). The participant group received, in total, three copies of the survey and three reminder cards over the course of nine weeks from April to June 2012 (See Appendix 2 & 3). The NSFA comparison group received

only a single mail-out, during the month of April 2012. As the comparison group's sampling frame was larger than the DNR's list of ABC participants, the number of surveys returned from a single mail-out provided an adequate sample of that population. A total of 31 useable surveys were returned from the program participants, and a total of 95 surveys were returned from the NSFA comparison group. Thus, the response rate for program participants was 66% and 16% for the NSFA comparison group. These response rates are typical for the mail-out strategies that were used (Schirmer, 2009).

4.3.3 Quantitative Analysis

Survey results were analyzed using STATA 12 statistical analysis software (StataCorp, 2011). The explanatory variable of interest is 'program participation' (that is, whether or not the respondent participated in the ABC program). Engagement in biodiversity-enhancing activities was measured by the indication of the level of engagement with a the list of biodiversity-enhancing activities (Table 3.2) This response variable ('level of engagement') was measured by looking only at the respondents that selected "I would consider doing this" (failure, Y=0) and "I am currently doing this" (success, Y=1). The remaining four options indicating engagement (for example 'I currently use this but am phasing it out') were omitted for two reasons: a lack of responses in those categories, and the lack of any kind of discrete ordinal scale indicating engagement. Because the response variable is binary, logistic regression is an appropriate measurement (Agresti & Finlay, 2009). Age, gender and education were selected as possible alternative explanatory variables: older people are often less receptive to conservation strategies than younger people (Dietz et al., 1998); females show more environmental concern then males (Dietz et al., 1998); and individuals with more formal

education are often more aware of environmental issues, and thus more open to the adoption of conservation strategies (Mobley et al., 2009).

Logit regression takes the log of the odds of Y=1. In this way the regression line is transformed so that Y falls between zero and one. By using the following equation it is possible to determine the slope (β) for each X.

(1)

$$log\left[\frac{P_{(y=1)}}{1-P_{(y=1)}}\right] = \alpha + \beta x$$

The equation for this model becomes:

(2)

$$log\left[\frac{P_{(y=1)}}{1-P_{(y=1)}}\right] = \alpha + \beta 1 X_{program\ participation} + \beta 2 X_{age} + \beta 3 X_{education} + \beta 4 X_{gender}$$

The explanatory variables are either nominal or ordinal levels of measurement, thus dummy variables were constructed. A dummy variable refers to the creation of new variables for each option of a nominal or ordinal variable. The new variable indicates the presence (X=1) or absence (X=0) of that one option. For example, the variable 'education' has four options: 'high school and less', 'college', 'bachelor studies', and 'graduate studies'; thus, four dummy variables are created. In a logit model, the odds of the occurrence of each dummy variable are compared against (or 'selected for') the odds of the occurrence of the option of interest. In this case the variables used in the construction of the model are: X_1 'participation in the program' (selecting for non-participants), X_2 'age' (selecting for the eldest group of farmers), X_3 'education' (selecting for college/technical school), and X_4 'gender' (selecting for women).

4.4 RESULTS

4.4.1 Descriptive Statistics

Important demographic differences between the two populations were noted (Table 4.1). More females were found in the ABC program participant group (37%) than in the non-participant group (20%). ABC program participants also had a more formal education, especially graduate studies, than non participants, whose education was more evenly distributed among the four categories of education. The distribution of age between the two groups was similar. Most respondents were in the 51-60 year category, which is consistent with census data showing the mean age of farmers in Nova Scotia to be 55.4 (Statistics Canada, 2011).

Table 4.1 Distribution of demographic variables of interest

Variables of Interest		Distribution of Responses	
		Participants	Non-Participants
		N=31	**N=95**
Age*	under 50	45.16%	21.05%
	51-60	32.26%	43.16%
	over 61	22.58%	35.79%
Education**	High school and less	9.68%	24.21%
	College/Technical School	9.68%	29.47%
	Bachelor Studies	29.03%	26.32%
	Post Grad Studies	51.61%	20.00%
Gender	Female	36.67%	19.78%
	Male	63.33%	80.22%

* Six age categories were collapsed into three for analysis
**Eight categories of education were collapsed into four for analysis

Respondents were asked to identify from a list which commodities are produced on their farm. In many cases more than one commodity was selected. As a result, the possible combinations of commodities produced were too many for a meaningful analysis. Overall there were few differences in the distribution of production between the

two groups (Table 4.2), thus it is likely that the distribution of farm types between the two groups is similar. Additionally, the distribution of farm size is similar across both groups (Figure 4.1). There is a greater variety of sizes among non-participants, however this is not surprising as the sample size is much larger (n=95 compared to n=31). The median of the size of non-participant farms is also substantially larger than the participants (255 acres compared to 100 acres). This suggests that there are perhaps more small farms in the participant group, which could be an indicator of hobby farmers.

Table 4.2 Distribution of farm types by participation in ABC program

	Participant	Non Participant
Crops	21%	27%
Horticulture	21%	13%
Cattle	17%	24%
Dairy	4%	3%
Other Livestock	14%	15%
Other	23%	18%
Total	*100%*	*100%*

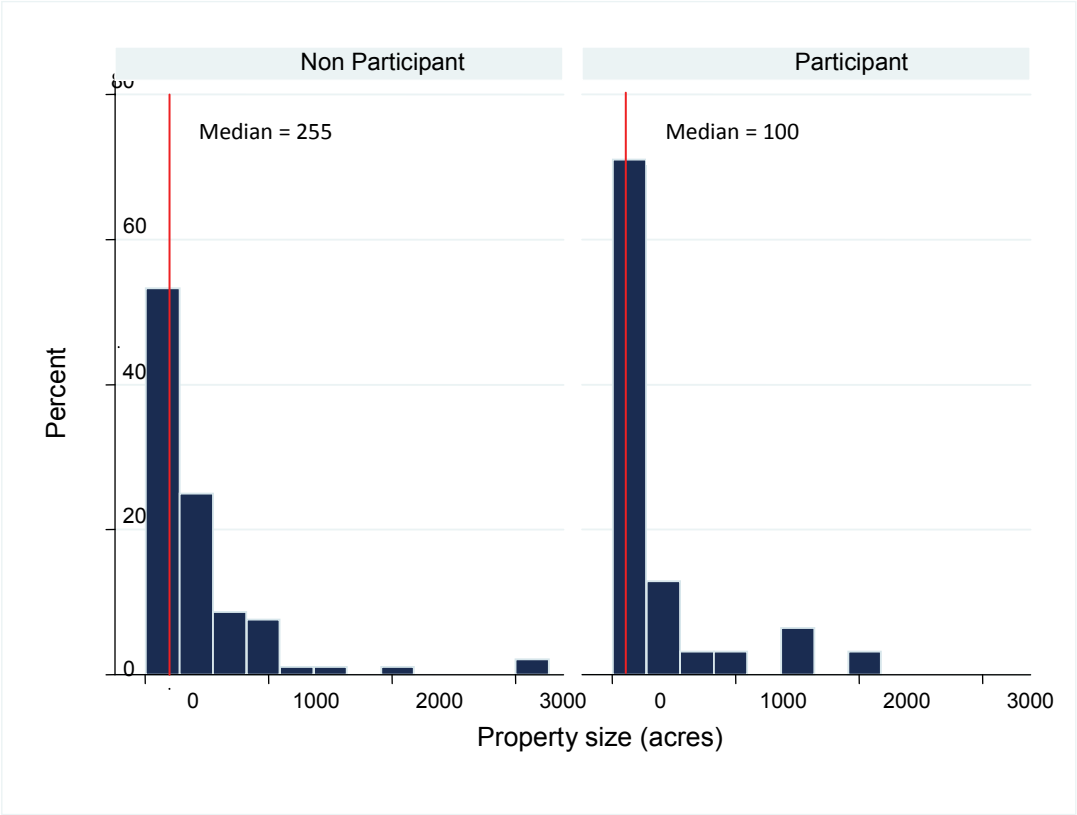


Figure 4.1 Distribution of respondent property sizes in acres

The measures of attitude and knowledge revealed further similarities between program participants and non-participants. Both groups are familiar with the term 'biodiversity'. Participants, however, indicate more comfort with the term than non-participants (all participant respondents were at least 'somewhat familiar' with the term) and a greater proportion of participants selected 'completely familiar' (Table 4.3). Both groups also share positive attitudes toward biodiversity, but the attitudes of program participants are higher and in greater agreement as indicated by a slightly lower standard deviation (Table 4.4).

Table 4.3 Self-identified familiarity with the term "biodiversity" by ABC program participation

	Completely Unfamiliar (never heard of it)	Somewhat Unfamiliar (heard the term, but unsure of the meaning)	Somewhat Familiar (know its meaning, but do not use the term often)	Completely Familiar (use the term often)
Non-Participants	3%	14%	64%	19%
Participants	0%	0%	39%	61%

Table 4.4 Descriptive statistics of attitudes

		Participant (n=31)	Non-Participant (n=94)
Willingness to absorb cost	Mean	3.906	3.572
	Standard Deviation	0.635	0.715
Enjoyment of the aesthetic of habitat diversity	Mean	4.575	4.225
	Standard Deviation	0.479	0.509

Both groups are engaged in biodiversity-enhancing activities. Program participants, overall, are consistently more engaged in activities than non-participants. Figure 4.2 illustrates the differences in responses to the question of engagement in biodiversity-enhancing activities. Notably, participants were more engaged than non-participants in the activities recommended by the ABC program (Figure 4.2). For example, in the 'riparian' activity participants are just over 30% more engaged in the activity than non-participants, while almost 20% more non-participants than participants indicated that the activity was not applicable to their property. By contrast, the distribution of the two groups engagement in activities not included in the ABC was quite similar. For example in 'rotational grazing', program participants selected 'are using the activity' only 5% more than non-participants--a stark contrast to the differences seen in 'riparian'. Non-participants displayed greater aversion to activities than non-participants, as they more

often selected "I would not consider this activity" and "the practice does not apply to my farm". These data suggest that the differences in engagement are the result of program participation, so a logit regression model was used to control for external factors linked to engagement.

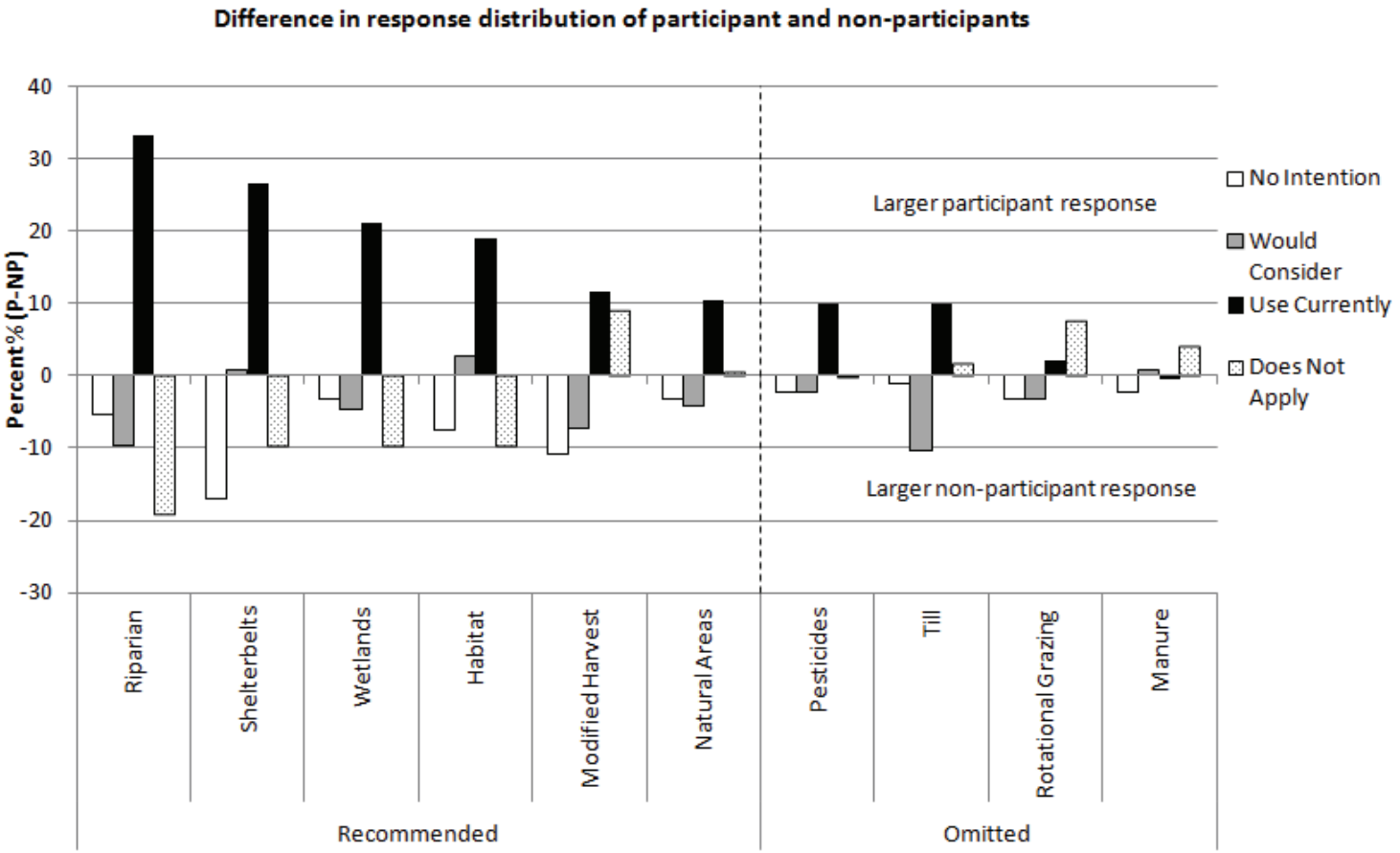


Figure 4.2 Difference in response distribution of participants and non-participants. The percent distribution of participant answers was subtracted from the percent distribution of non-participant answers*

* The options of "I used this in the past but no longer use it" and "I currently use this but am phasing it out" were omitted for two reasons. First, the reasons for activity abandonment are ambiguous; the change in practice could be the result of changing commodities and not as a result of disapproval of the activity. Second, few respondents selected these options.

4.4.2 Qualitative Analysis

Four over-arching themes were identified as the chief motivators for undertaking the activities listed on the survey (Table 4.5): environmental; financial; ethical; and strategic farming. Environmental protection motivators, (such as controlling erosion and run-off), and ethical motivations (for example, the respondent identified the activity as "common sense" or that the activity is carried out because of an enjoyment of nature) were overall the most frequent motivators for both participants and non-participants.

Table 4.5 Themes identified in qualitative analysis of open-ended survey questions

Environmental Protection	**Ethical Motivations**
• to prevent erosion • to reduce pesticides • to minimize run-off	• to help wildlife • for personal enjoyment
Financial Motivations	**Strategic Farming Motivations**
• to save money (reduce inputs) • to increase efficiency • to increase yields	• to control pests (e.g. biological control, bat boxes to reduce mosquitoes) • to prevent wind damage (e.g. shelterbelts)

4.4.3 Bivariate Analysis

A chi-squared test of independence was carried out prior to running the logit model, looking at program participation and engagement in each of the ten activities listed on the survey. The only significant relationship was found under riparian management ($P<0.1$). Despite the lack of statistically significant relationships between program participation and engagement in each activity, overall program participants consistently select "am doing" more often than non-participants (Table 4.6).

Table 4.6 Chi-squared test of independence with program participation and engagement in activity

	Distribution of responses				Test of independence			
	Participant Responses		Non-Participant Responses					
	Would Consider	Am Doing	Would Consider	Am Doing	N	Chi^2	DF	P
Riparian	7%	93%	24%	76%	90	3.66	1	0.056*
Modified Harvest	50%	50%	70%	30%	59	1.99	1	0.16
Shelterbelts	36%	64%	50%	50%	86	1.56	1	0.21
No Till	29%	71%	44%	56%	83	1.47	1	0.23
Wetlands	13%	87%	21%	79%	107	0.96	1	0.33
Minimize Pesticides	4%	96%	7%	93%	92	0.36	1	0.36
Natural Areas	15%	85%	21%	79%	104	0.46	1	0.50
Rotational Grazing	6%	94%	11%	89%	73	0.45	1	0.50
Habitat	23%	77%	26%	74%	102	0.10	1	0.75
Manure	29%	71%	27%	73%	83	0.01	1	0.92

*significant at α=0.1

4.4.4 Multiple Regression

A logit model was constructed to look at program participation and level of engagement, while controlling for age, education level and gender. The model was run for each of the activities, with the exceptions of 'rotational grazing' and 'minimizing pesticide use', as nearly every respondent indicated positive engagement for these activities, thus leaving no variability. Out of all of the activities, program participation was found to be a significant factor ($P<0.05$) in riparian management and modified harvesting techniques (Table 4.7). These two activities are both recommended by the ABC program. Program participation was not found as a significant factor in the activities omitted by the program.

Age was a significant factor in 'no/minimal till', 'wetlands', 'riparian management' and 'shelterbelts' (Table 4.7). Older farmers are doing more on wetlands, till, and shelterbelts, and younger farmers are doing more riparian management. This suggests that age is an important factor in engagement with different activities. Perhaps the activities are perceived differently as a result of vogues in practice and are thus considered more viable by different age groups (Kanagy et al., 1994).

Education was a significant factor in 'habitat creation', 'shelterbelts' and 'manure storage' (Table 4.7). In the activities 'habitat creation' and 'manure storage', respondents who attended high school or post-graduate school were less engaged than college educated respondents. In constructing 'shelterbelts', the respondents with bachelor or post-graduate education were more engaged than college educated farmers.

Table 4.7 Logit regression model, impact of program participation controlling for education, age and gender

		Habitat Creation				No/Minimal Till				Wetlands				Natural Areas			
		N	Coef	Std. Err.	P	N	Coef	Std. Err.	P	N	Coef	Std. Err.	P	N	Coef	Std. Err.	P
Program Participation		**98**	**0.35**	**0.60**	**0.56**	**79**	**0.99**	**0.69**	**0.15**	**103**	**1.11**	**0.81**	**0.17**	**99**	**0.70**	**0.75**	**0.35**
Age	under 50		-1.01	0.69	0.15		-1.35	0.71	0.06**		-2.09	0.88	0.02**		-0.68	0.84	0.42
	51-60		-0.17	0.63	0.79		0.28	0.64	0.66		-0.48	0.80	0.55		-0.62	0.68	0.37
Education	High school and less		-1.85	0.81	0.02**		0.35	0.75	0.64		-1.18	0.77	0.13		-0.78	0.77	0.31
	Bachelors		-1.00	0.82	0.22		1.56	0.77	0.04		0.50	0.86	0.56		-0.38	0.77	0.62
	Post Graduate		-0.92	0.81	0.25		0.82	0.76	0.28		1.47	1.00	0.14		0.94	1.00	0.35
Gender (Female)			-0.83	0.62	0.19		-0.18	0.70	0.80		0.46	0.73	0.53		0.58	0.66	0.38
		Shelterbelts				**Riparian**				**Manure**				**Modified Harvest**			
		N	Coef	Std. Err.	P	N	Coef	Std. Err.	P	N	Coef	Std. Err.	P	N	Coef	Std. Err.	P
Program Participation		**84**	**0.84**	**0.64**	**0.19**	**86**	**2.84**	**1.14**	**0.01****	**80**	**0.84**	**0.69**	**0.23**	**58**	**2.11**	**0.89**	**0.02****
Age	under 50		-2.10	0.79	0.01**		0.08	0.82	0.93		-0.19	0.73	0.79		-0.82	0.87	0.35
	51-60		-1.02	0.67	0.13		1.89	0.90	0.04**		-0.13	0.70	0.85		-0.09	0.76	0.91
Education	High school and less		0.89	0.85	0.29		-0.78	1.10	0.48		-1.27	0.98	0.20		-0.11	0.86	0.90
	Bachelors		1.73	0.86	0.04**		-1.55	1.05	0.14		-1.02	0.95	0.28		-0.39	0.93	0.67
	Post Graduate		3.01	0.95	0.00**		-0.89	1.02	0.39		-1.87	0.94	0.05**		-1.51	1.02	0.14
Gender (Female)			1.75	0.65	0.01**		0.67	0.75	0.37		0.64	0.61	0.30		0.82	0.75	0.27

Note: Rotational Grazing and Minimize Pesticides are omitted, due to a lack of distribution

*significant at α=0.1 **significant at α=0.05

4.5 Discussion

A majority of survey respondents reported engagement in all the biodiversity-enhancing activities, except modified harvest (Table 4.6) in which only 30% of non-participants were engaged. Most respondent farmers, regardless of program participation, expressed interest in conservation. Even though the selection of "I am doing this, and will continue to do this" is consistently lower among non-participants, their frequent selection of "I would consider doing this" suggests that they are interested in the activities. The fact that they would consider the activity implies that they have faith in the success of that activity, thus potentially influencing their behavior in the future (Lynne et al., 1988). Furthermore, both groups demonstrated a positive attitude toward habitat and biodiversity, via a shared willingness to absorb costs as a result of the presence of biodiversity and a positive emotional response to biodiversity (Table 4.4).

Differences in the selection of "this practice does not apply" suggest the two groups perceive biodiversity-friendly practices differently. Literature suggests that being informed about conservation issues is linked to taking action (Mobley et al., 2009). Therefore if a person does not know about a conservation practice, or what practices are relevant to their land, they are less likely to be engaged in those activities, or even consider them as viable (Mobley et al., 2009). Non-participants seemed more ready to rule out practices as not applicable (Figure 4.2). Both groups were geographically and physically similar: from the same counties with similar property sizes and production types (Table 4.2 and Figure 4.1). One might thus have expected that there would be a similar distribution of "does not apply" across the two groups, particularly for site-specific activities such as rotational grazing or riparian management, but this was not the

case. Non-participants, instead, selected this option more frequently than participants. Even activities like "habitat creation", which are applicable to any property regardless of the farm characteristics, still had a higher percentage of non-participants selecting "not applicable" than non-participants. This suggests that there is a difference in how the two groups perceive biodiversity-friendly activities or habitat in general. ABC Participants were more likely to think of the given activities as viable on their property, demonstrating an increased knowledge and grasp of them. ABC non-participants did not consider all the activities as viable for them, but this does not necessarily mean that they oppose activities.

Knowledge of biodiversity could also inform a farmer's perception of biodiversity-enhancing activities. Both groups indicated familiarity with the term biodiversity, but program participants are much more comfortable with the term than non-participants. This familiarity is a likely indicator of increased knowledge of biodiversity conservation issues. Furthermore, the recommendations provided by the ABC program could increase the farmers' knowledge and perception of potential biodiversity-enhancing activities, which would also likely lead to more implementation.

Program participants report more engagement in biodiversity-enhancing activities recommended by the ABC program than non-participants. If the two groups are similar, and if the ABC program has no impact on farmer action concerning biodiversity, it would be anticipated that a similar distribution in engagement level would be seen in both groups among all activities listed on the survey. Program participants, however, report more engagement in activities that are part of the program compared to non-participants, whereas both groups share a similar distribution of engagement in the activities omitted

by the program. This suggests the program impacts participant engagement in biodiversity-enhancing activities. This difference, however, may be attributed to alternative factors, such as demographic differences between the two groups.

A greater proportion of ABC participants attended university, specifically graduate school, than non-participants, which could, upon first glance, seem to bias outcomes (Table 4.1). There is evidence that more educated people are more likely to engage in conservation; certainly knowledge of relevant activities, as previously mentioned, is an important factor leading to engagement in activity (Mobley et al., 2009). Formal education, however, is not necessarily a good indicator of knowledge for the farming population. Knowledge of conservation issues and activities is accessible to farmers in many ways (Mobley et al., 2009). Many farmers learn from alternative sources, such as family members, neighbours, books, the internet, or even stewardship/government programs. It could even be argued that "higher education" (i.e. university bachelor or post-graduate degrees) would be less valuable to farmers than other, more practical, forms of education, such as agricultural college. This seems to be corroborated by the results in the logit models (Table 4.6), as the higher levels of formal education were not always linked to increased engagement. In fact, in 'habitat creation' and 'manure storage' the farmers with a college degree were more engaged than those with a bachelor or post graduate degree.

The dominance of formally educated respondents among the participants (Table 4.1) is likely a side-effect from the recruitment strategies adopted by the program. At the program's launch, 'farming leaders' (respected farmers in a community) were first approached as participants to lend credibility to the program. Since that time, the program

has not been advertised because of a lack of funding and staffing, but has continued to spread by word of mouth, which could be responsible for the bias towards one group of highly-educated farmers: past participants refer their friends, who are likely to be similarly educated (Gilbert, Fiske, & Lindzey, 1998).

Despite the fact that program participants are more engaged in the activities recommended by the ABC program, when controlling for demographic factors, only riparian management and modified harvest are significantly related to engagement. Unfortunately, due to privacy laws (Freedom of Information and the Protection of Privacy Act 1999 c.11) and inconsistent record keeping, we were not able to determine the number of times each activity was recommended throughout the duration of the ABC program's existence. Despite this limitation, discussions with the DNR suggested that both of these activities are among the most frequently recommended by the program. The lack of significance between engagement in the rest of the recommended activities and program participation is perhaps indicative of the kinds of activities that best resonate with program participants.

The quality of the advice provided by the ABC plans may also explain why participants take up some activities and not others. Out of the activities recommended by the ABC program (i.e., shelterbelts, wetland maintenance, natural areas, habitat creation, riparian management and modified harvest), results from the logit model suggest that the latter two activities are taken up more by program participants. This could be because those recommendations were more specific than others. For example looking at the phrasing of recommendations in a few released, anonymized ABC plans, activities concerning natural areas often come in the form of general recommendations, such as

"maintaining woodlot", whereas other recommendations are very specific. For example, both riparian area and modified harvest have specific instructions: "maintenance of a 5m buffer around all watercourses, fencing out cattle in [X] area", "delaying harvest until mid-July, and using flushing bars during haying". The activities are more tangible, the instructions clear, and the benefits to multiple species are clearly argued in supporting text. By contrast, the recommendation of "putting up bat boxes" and "maintaining woodlot" provide some instruction, but are either species-specific (bats) or very generalized (woodlot), and are perhaps thus given a lower priority.

Results from the qualitative analysis revealed that the motivations for undertaking these different kinds of activities varied considerably. The more generalized activities of 'habitat creation' and 'natural area management' were never undertaken for environmental protection (e.g. to reduce pollution and/or erosion, to increase water filtration), but more often for ethical or aesthetic reasons (e.g. for personal enjoyment, because it is '"common sense"). By contrast, 'riparian management' was undertaken more often for environmental protection and not for ethical reasons. Furthermore, some provincial and federal funding can be secured for activities that fall under the 'riparian management' category, such as riparian fence-building. These activities may also help farmers adhere to environmental legislation around agricultural pollution. While these may also help to encourage the adoption of riparian management among farmers, in the open-ended portion of the survey none of the respondents referenced funding or legislation specifically.

These results suggest that the ABC program does, to an extent, influence the behaviour of program participants to take part or to implement recommendations. This is particularly noteworthy since participants do not have access to funding or other

incentives to implement many of the program recommendations. What is of particular interest is that the two activities that share a significant relationship between program participation and engagement are activities in which the farmer would likely absorb some financial losses. Activities related to riparian management include the fencing out of livestock from watercourses, requiring time, energy and financial burdens on the farmer. Delaying the hay harvest results in yields with lower protein counts, resulting in feed that is suitable for beef, but not lactating dairy cows (Nocera et al., 2005). Despite the clear financial burdens that result from engagement in these two activities, participating farmers are still adopting these activities.

While the results suggesting positive program impact are encouraging, it is important to note that observations cannot be generalized to a wider farmer population. The knowledge of biodiversity, attitude toward biodiversity and action concerning biodiversity measured in this study are representative only of participants in the ABC program, and farmers in Nova Scotia who have a pre-existing interest in biodiversity. The intension of this study was not to examine the attitudes, knowledge and action of all farmers in Nova Scotia, but rather to measure the impact of the ABC program on these.

Farmers perceive the health of their land as imperative to farm success, and stewardship programs appealing to this benefit is one way of increasing engagement in some biodiversity conserving activities. The financial situation of a farm will, without a doubt, have an impact on farm management decisions (Wilson & Hart, 2000). Therefore, the social and financial situation of the farmer must be taken into consideration and incentives offered where it is important to incite widespread, large-scale, adoption of conservation. Voluntary stewardship programs may help to increase farmer engagement

in biodiversity conservation at the local scale. Through thoughtful program design resonating with the target farmer population and the delivery of site-specific recommendations that include the provision of the rationale behind those activities, the uptake of voluntary biodiversity conservation among farmers may increase.

CHAPTER 5 BALANCING NATURE AND PRODUCTION: EXPLORING FARMER PERCEPTIONS AND VALUES OF BIODIVERSITY ON THE FARM

Kate Goodale[1], Kate Sherren[1], Karen Beazley[1]

[1]School for Resource and Environmental Studies, Dalhousie University

This chapter was written with the intention of publishing in *Society and Natural Resources.* To make this chapter a stand-alone manuscript, there will be some repetition of information from preceding chapters.

5.1 ABSTRACT

Modern advances in agriculture have led to increased yields, but at the expense of biodiversity. Efforts to increase biodiversity have been confined to voluntary programs. The decision to participate in a voluntary program is based on an internal evaluation of the merits of the program in combination with a person's attitudes toward the program. As attitudes stem from a person's values and beliefs, it is important to understand the values and attitudes of the target population in order to increase participant engagement. In this exploratory research, the values and attitudes of farmers in Nova Scotia toward biodiversity and biodiversity conservation activities on their land is examined. This was carried out through go-along interviews, in which participants gave a tour of their property indicating areas on their land that they associated with wildlife or biodiversity. Using an inductive approach, general themes were identified. Farmers in this sample were generally interested and willing to participate in biodiversity conservation. This willingness to participate, however, stemmed from their interest in the health of their land, rather than interest in biodiversity itself.

5.2 Introduction

There is a link between farming and 'nature'. Ecosystem services, such as pollination and water filtration, are indispensible to production and are the result of a healthy environment undertaking its natural function (Altieri, 1999; Zhang et al., 2007). During the mid to late twentieth century, modernization and intensification in agricultural production led to an increase in yields (Krebs et al., 1999). This intensification through increased mechanization and the use of external inputs, such as commercial fertilizers and pesticides, has had the unintended consequence of decreasing biodiversity globally (Green et al., 2005; Krebs et al., 1999; McLaughlin & Mineau, 1995). With the delivery of ecosystem services compromised along with biodiversity, the reliance on auxiliary inputs has increased which in turn has further decreased biodiversity (Altieri, 1999). Global human population levels are projected to reach nine billion by 2050 (Godfray et al., 2010). Further agricultural expansion and intensification will be needed to produce food and pose a critical threat to global biodiversity levels. Agricultural production must be adapted to prevent the continued loss of biodiversity, and to avoid the negative feedback loop described above from reaching a tipping point, whereby ecosystem service delivery is severely compromised.

The threat of farming to biodiversity has been internationally recognized (Cunningham et al., 2013; Green et al., 2005; Krebs et al., 1999; Rey Benayas & Bullock, 2012), and has resulted in the creation of schemes to entice farmers to adopt more biodiversity-friendly practices. The use of Agri-Environmental Schemes (AES) under the European Commission's Common Agricultural Policy (CAP) began in Europe in the late 1980s. The programs under the AES umbrella target many different things, from

agricultural pollution, to the maintenance of culturally important areas, and finally the promotion of biodiversity (European Commission, 2005; Natural England, 2009). Similar tactics for encouraging environmentally friendly farming were introduced more recently in Canada, and are often controlled provincially. The Environmental Farm Plan (EFP) is a program that has been adopted by many Canadian provinces. Both the EFP and AES entice farmers to adopt management practices through monetary incentives. This could be in the form of cost-sharing (EFP), or through annual payments for program participation (AES). Unlike Europe where the scope of AES are broad, in Canada the target of most programs is narrower and focuses on avoiding agricultural pollution rather than biodiversity conservation. Nova Scotia has one program, the Agricultural Biodiversity Conservation (ABC) program, aimed at increasing biodiversity on farmland. This program differs from the EFP in two ways; it explicitly targets biodiversity conservation, and it does not provide any monetary incentives. Despite this, participation in the program has been linked to increased adoption of biodiversity conservation practices, such as riparian management and modified harvesting techniques (Chapter 4).

Attitudes and values are linked to the decision to participate in conservation. The uniting feature of both the EFP and ABC is their voluntary nature. Farmers are under no obligation to participate, and it is therefore crucial to understand why people participate in order to improve program delivery. The Theory of Planned Behaviour offers some insight into the decision to act (Ajzen, 1991). A person's values, beliefs and situational variables, combined with the evaluation of the activity's merits, influences an individual's decision to undertake that activity (Ajzen, 1991; Lynne & Rola, 1988; Mills et al., 2013). If the core values and attitudes of farmers about conservation practices are understood, it

could help improve program design, increasing its uptake. As Maybery, Crase & Gullifer (2005) argue, "identifying core land stewardship-related values may have important implications for future land conservation attitude and behaviour change" (p. 68).

The way farmers manage their property reflects their values, and conservation practices consistent with those values are more likely to be adopted (Herzon & Mikk, 2007). The American conservationist Aldo Leopold described what he called "a land ethic", whereby an individual is bound ethically to care for the land (A. C. Leopold, 2004; A. Leopold, 1949). Researchers have also described farmers as having a land ethic (Ahnström et al., 2008). For example, when asked about their role on the land, British farmers described themselves as "stewards" or "guardians" (Beedell & Rehman, 2000). 'The land', as described by Leopold, is the entire landscape and all the biodiversity within that landscape, and not just 'the farm' (A. C. Leopold, 2004). This duty to the land reflects their values and their perception of their role as farmers. The land ethic has been identified as a key value that influences farmers' values and attitudes towards conservation broadly (Ahnström et al., 2008). It is not clear, however, how biodiversity is linked to the land ethic espoused by farmers. Since biodiversity is responsible for both services and dis-services to production (Zhang et al., 2007), farmers may not be as interested in the promotion of *biodiversity*, as they are in *environmentally friendly* practices. Ultimately such values and perceptions will impact their decision whether to adopt 'biodiversity friendly' farming techniques.

The values and attitudes held by farmers towards biodiversity will impact their decision to participate in activities aimed at biodiversity conservation. Values affecting the decision to participate in AES schemes in Europe have been well-studied (Burton,

Kuczera, & Schwarz, 2008; Herzon & Mikk, 2007; Mills et al., 2013; Morris & Potter, 1995; Wilson & Hart, 2001). With a shorter history of farm environmental conservation programs in Canada, there has been far less research carried out looking at the attitudes and values of Canadian farmers that drive management decisions. It is likely that there will be some overlap in the values held by European and Canadian farmers; however, because of the different contexts their values are likely to be fundamentally different. Little research has been carried out in Nova Scotia about farmer values and attitudes concerning biodiversity. By exploring the values and attitudes of Nova Scotian farmers concerning biodiversity and their land, this research could help to better inform the design of stewardship programs that are aimed at increasing biodiversity, such as the Agricultural Biodiversity Conservation (ABC) program.

5.3 Methods

Previous survey research (Chapter 4) indicated that many Nova Scotian farmers have positive attitudes about biodiversity conservation. Surveys, however, are subject to response bias and are of limited depth (Bryman & Teevan, 2005). This research takes a qualitative in-depth approach to help triangulate a stronger understanding of farmers' values and attitudes toward biodiversity and biodiversity conservation practices. Interviews are a good way to explore values for this kind of qualitative investigation (Bryman & Teevan, 2005). Given that these values might be more likely to be elicited from cues found in their landscape, the 'go-along' interview method was chosen. This research takes an exploratory approach by investigating first how farmers in Nova Scotia value biodiversity on their land, and second, how they feel about managing for biodiversity on their land.

5.3.1 Go-along Interviews

The 'go-along' interview differs from more traditional interview styles, as it takes place *in situ*. Go-along interviews are best known for their role in urban ethnographic research, in which participants guide the researcher through their neighbourhoods (Garcia et al., 2012; Jones et al., 2008; Kusenbach, 2003). In this case, however, the interviews took place as a farm tour, where farmers were asked to show the areas on their property that they associated with wildlife or biodiversity. With the interview *in situ*, the participant's connection with the land can be explored by directly observing and conversing with the participant in that context (Carpiano, 2009).

Go-along interviews yield rich data, partially because this style of interview breaks down the traditional power imbalance between the researcher and the participant (Bryman & Teevan, 2005; Jones et al., 2008; Kvale & Brinkmann, 2009). In a traditional interview, for example, the participants may perceive the researcher to be more educated than they are, and thus they might be more motivated to give what they think is 'the right answer' rather than what they really believe (Bryman & Teevan, 2005). In the go-along interview, participants are given a different role; they are asked to be a guide. They choose what direction the interview should go--both in terms of a route on the land and in terms of conversation (Jones et al., 2008). When participants are empowered in this way, there is an increased willingness to speak their mind instead of providing answers they think the researcher wants to hear (Evans & Jones, 2011). Additionally, in traditional interviews participants may feel they are the 'target' of the interview. By contrast, participants are more comfortable with the interview *in situ*; even with prepared questions

and prompts from the researcher, the landscape is the target of conversation and not themselves (Kusenbach, 2003).

Outdoor, mobile interviews are complex. Weather can interfere, causing rescheduling or forcing interviews indoors. Audio recording quality can also suffer because of wind or the irregular distance between researcher and participant. The latter issue was addressed by using a foam wind protector over the microphone and by having the participant wear the microphone around their neck during farm tours. The method also assumes that the participant is mobile. While it is likely that an active farmer is ambulatory, the possibility still exists that the participant may not have enough mobility to carry out a walking tour (Carpiano, 2009). This is of special concern as the farming population in Nova Scotia is aging, with the average age of farmers at 56.4 (Statistics Canada, 2011). However, go-along interviews can also be conducted through a driving tour in a truck or all-terrain vehicle (Carpiano, 2009). In this study, there were no mobility issues among the group of participants. Three interviews took place indoors (as a result of inclement weather); four in vehicles (as a result of the farmer having too large a piece of property to cover by foot); and five on foot. All of these conditions were approved by the Research Ethics Board (REB) at Dalhousie University.

A semi-structured interview guide was created (Appendix 5). This guide ensured that the broad topics discussed in each interview were the same, even if the landscapes viewed in each interview were different. The interview began with a discussion around demographic characteristics and context (e.g., how long has the farmer owned the property?). Farmers were then asked to show a place on their property that they associated with wildlife or biodiversity. From there, the order of subsequent questions

and prompts was determined by stimuli that emerged during the tour so that themes from the interview guide (Appendix 5) arose naturally in conversation.

The goal of the go-along interview is to observe and converse with the participant in their own environment. As a result, interviews will inevitably vary from each other to some degree as each participant will exhibit a different relationship with the land, and the prompts for conversation found on the land will differ. In this case, while the initial topic of conversation was about how the farmer felt about biodiversity and biodiversity-enhancing activities, the conversation progressed to other topics such as farming more generally, and the farmer's perception of their land. These topics, while not necessarily directly related to the topic of biodiversity *per se*, were important to consider as they provide insight into the relationship between the farmer and his or her land more broadly--something that will, without a doubt, have some bearing on the decision to engage in conservation.

5.3.2 Recruitment

Recruitment for the interviews took place through a mail-out survey to farmers in Nova Scotia during the first stage of this research (Chapter 4; Appendix 2). The survey was mailed to respondents between April to June 2012. While the survey was anonymous, respondents were asked to indicate if they were interested in participating in follow-up interviews about biodiversity and farming. If respondents were interested, they were asked to provide their phone number and mailing address. Forty-four percent of all respondents indicated an interest in being interviewed (55 out of 126). Although this recruitment strategy resulted in some selection bias (as those who are willing to complete a survey and elect to be interviewed about biodiversity are likely to have pre-existing

interest in biodiversity conservation), the sample nevertheless was representative of farmers who are willing to engage in voluntary conservation--the target population of conservation programs such as the ABC or EFP programs. That said, the results from this research cannot be generalized to all farmers in Nova Scotia.

It was initially hypothesized that education would be a significant factor in influencing a farmer's value of biodiversity (Dietz et al., 1998; Mobley et al., 2009). As a result, the selection of interview candidates was first stratified by education level. Further analysis of the survey revealed, however, that within this self-selected sample, education was not a consistent indicator of engagement in biodiversity-enhancing activities (Chapter 4). Therefore, the recruitment of interviewees took a more exploratory approach, and farmers from different age groups and farming types were contacted.

5.3.3 Population Sample

Although participants likely had a bias toward biodiversity conservation, it is important to remember that the goal was not to create a sample of farmers who were representative of all farmers in Nova Scotia, but rather to explore a range of perspectives. A small group of diverse farmers from different counties was assembled from the many farmers that were interested in being interviewed (Table 5.1). The choice of interviewees was first limited by the availability of the farmers; as the interviews took place over the summer and early fall months, it was challenging to book time with those who were busy in the field. In addition, with only three months to carry out interviews, not all of the respondents who indicated interest could be reached (n=54). Twelve interviews took place overall. Of that sample, three farmers were between the ages of 20-40, six between the ages of 41-60, and three between the ages of 61 and 80. Interviews were carried out

during the months of August to October 2012, and lasted between 45 minutes and 3.5 hours. All farmers consented to being audio recorded, and audio files were transcribed directly into NVivo 10 qualitative analysis software (QSR International Pty Ltd., 2012).

Table 5.1 Number of interviews in each county

County	Number of Interviews
Cumberland	5
Annapolis	2
Lunenburg	2
Hants	2
Kings	1

As a result of a lack of contiguous fertile soil in Nova Scotia, farms typically produce mixed commodities (Agriculture and Agri-Food Canada, 2012). For example, a farmer will grow crops on patches of arable land, and use the marginal land for other purposes such as pasture. Overall, the diverse commodities produced by the interview participants provided an interesting snapshot of the values of different producers (Table 3.3). The commodities that were produced by each individual farm have not been included, as the unique combinations could serve as identifiers for an individual farmer within these relatively small communities.

5.3.4 Qualitative Analysis

Inductive analysis is appropriate for this exploratory research. By contrast with hypothesis testing studies where specific themes are deductively sought, themes were coded as they arose in the transcripts (Ryan & Bernard, 2003). The risk of overlooking potential themes through their delineation ahead of time is then avoided (Bryman & Teevan, 2005; Kvale & Brinkmann, 2009).

An inductive approach to analysis requires constant comparison and multiple cycles of coding (Kvale & Brinkmann, 2009; Ryan & Bernard, 2003). Themes identified in the transcripts were assigned NVivo nodes (i.e., a labeled category) during this process (Ryan & Bernard, 2003). The first cycle of coding focused on content analysis: what locations did the farmers choose to show? What kinds of biodiversity-enhancing activities have they carried out? What kinds of flora or fauna were present on their land? The second stage of coding focused on the interpretation of the farmer's intended meaning: what was the implication of what the farmers said during the interviews? Were they hostile towards wildlife? Were non-commercial plants and animals considered acceptable on the farm? Despite the delineation of 'stage-one and stage-two coding', there was some degree of overlap between the stages. Themes that were identified were constantly compared across interview transcripts to ensure consistency in the coding strategy, as some themes only became apparent after multiple readings of the transcripts (Ryan & Bernard, 2003).

Once the primary stage of coding was complete, nodes were filtered to retain only those themes present in at least half of the interviews. This was done to identify common themes. A matrix was created that displayed the number of times each individual farmer was classified under a node, ensuring that a single farmer was not over-represented in a node because he or she discussed a topic multiple times during the interview (Appendix 6). The most frequently coded nodes were then grouped together into larger themes. In this way, the analysis moved from simply descriptive to more theoretical (Kvale & Brinkmann, 2009). In some instances, an individual may not have appeared under a single node, but once the nodes were consolidated into themes, their responses under

other nodes led to a tally under the broad theme. There were a couple of instances where a farmer did not have a tally under a theme at all, and this was likely the result of the variation between interviews (for instance, landscape perceptions were discussed far less by farmers whose interviews took place indoors). Finally, a cluster analysis of nodes was carried out based on word similarity (after removing 'stop words' such as adverbs) in the interview content coded to those nodes to determine if the themes grouped manually were consistent with other methods of finding themes.

5.4 Results

The results are divided into two sections. The first looks at the primary descriptive stage of content analysis, and the second at the subsequent, more interpretive stage of theoretical analysis.

5.5 Content Analysis Results

The content analysis focused on the specific activities and species mentioned by the farmers, as well as the locations the farmers associated with biodiversity. Overall the farmers in this sample could not list many, if any, activities that they were doing to encourage biodiversity. While this initially suggests that the farmers were not engaged in biodiversity-enhancing activities, many of the farmers were undertaking beneficial activities but for other reasons (this will be further discussed in section 5.5.6). Looking at the activities that were discussed by farmers (Table 5.2), the most referenced category is 'habitat intentionally for animals'. The activities that fall into this group are, for the most part, simple (for example leaving woody debris or brush piles, leaving space uncultivated for wildlife, hanging bird or bat boxes or planting specifically for deer) and often do not take a lot of effort on the part of the farmer. The farmers were, however, aware that the

activity will benefit wildlife in the long run. For example, when one farmer was asked if he carried out activities for wildlife or biodiversity he replied that:

> I don't think I have done anything specific no […] But you know, I'll leave several piles of brush, because I know that is good for the wildlife. So there are little things like that but no [I don't undertake activities]. (Farmer 12)

Table 5.2 Activities mentioned by farmers during interviews

Activity	**Number of interviews** (number of interviews node appeared in)	**References overall** (number of times an item was coded)
Habitat intentionally for animals	**8**	**25**
Silviculture	**8**	**17**
Rotational grazing	**6**	**11**
Fencing out cattle	5	11
Modified harvest	4	7
Planting trees	4	4
Forest management plan	3	6

The areas that the farmers associated with wildlife were similar in each interview, even though the combinations of commodities produced by the farmers were unique. Farmers showed ponds, wetlands, forest/wood lots, and drainage ditches as areas associated with wildlife and/or biodiversity. Although other areas were shown during a minority of interviews (such as crop margins, and grassy pathways), it was these four areas on the farm that were most commonly associated with wildlife and/or biodiversity.

Many different species (both plant and animal) were mentioned by the farmers (Table 5.3). Of the complete list of species mentioned, bear, deer, and coyotes were by far the most referenced. Interestingly these species are among the most common mega-fauna found in Nova Scotia, and perhaps are as a result, most associated with the term 'wildlife'.

These species were often discussed in reference to the question: "are there any kinds of plants or animals that you would like to see more/less of on your property?" Rarely did any farmers list any species that they wanted encouraged. In the discussion of discouraging plants or animals, pest species immediately came to mind for the farmers. The specific 'pest' species discussed, however, were inconsistent. While some farmers took issue with deer for browsing damage, others actively encouraged deer by planting grass for them. Interestingly, species at risk were only mentioned by a minority of farmers, and there was very little talk around species that were more vulnerable as a result of farming practices. (For example, a few farmers discussed how they waited for birds in hay fields to fledge before cutting the hay, while still admitting that some animals are inevitably going to die during the cut.) Rather, it was by and large species that were already co-existing with the farm that were discussed, and not species absent from the farm landscape.

Table 5.3 Species mentioned by interview participants

	Species	**Number of Interviews** (number of interviews node appeared in)	**References Overall** (number of times an item was coded)
Plants	Alder	3	5
	Poplar	2	3
	Soft rush	2	3
Animals	**Deer**	**10**	**23**
	Coyote	**9**	**26**
	Bear	**8**	**13**
	Bald eagles	5	6
	Beaver	3	5
	Crows	1	2
	Bobolinks	1	1
	Fox	1	1
	Geese	1	1
	Racoon	1	1
	Weasel	1	1

5.6 THEORETICAL ANALYSIS RESULTS

The second stage of analysis looked at the apparent intended meaning of the farmers. When an activity or species is frequently discussed, it suggests that the individual has strong opinions, but does not reveal the sentiment behind that discussion. The language and the tone used when discussing these activities and species revealed themes surrounding the farmers' values and attitudes.

The inductive analysis revealed four major themes that came out of the discussion of biodiversity and farming (Table 5.4): the farm and the farmer's relationship with nature; concerns about the future and the reality of farming; landscape perceptions; and motivations to adopt conservation strategies. Not all parts of the themes were explicitly related to biodiversity. Specifically 'landscape perceptions' and 'concerns about farming' are more indicative of the general values and attitudes of the farmers in this sample. These themes, while not overtly related to biodiversity and biodiversity-enhancing activities, will have some implications in values and attitudes concerning biodiversity conservation. These four major themes are not wholly distinct from one another but are connected both in shared language and content. This interconnection was confirmed using cluster analysis (Figure 5.1), and provides some insight into the structure of these connections, and thus how themes are related.

Table 5.4 Filtered nodes manually grouped into themes

Concerns for the future and of the reality of farming	
• Concern about leaving property to good heir • Dislike clear-cuts • Old ways • Their kids	• Critical of government • Critical of Neighbours • Damages by animals • Money as a barrier • Trade-off • Weather barriers
The farm and the farmer's relationship with nature	
• Admiration of nature • Balance • Co-existence with wildlife	
Motivation to adopt conservation strategies	
• For an ecosystem service • It's the right thing to do • Not for wildlife • Pride • Thinking about long term impacts	
Landscape Perceptions	
• Here is a neat spot • History of the area • Outdoor recreation • Property boundaries • Speed of re-growth • That was cut...	

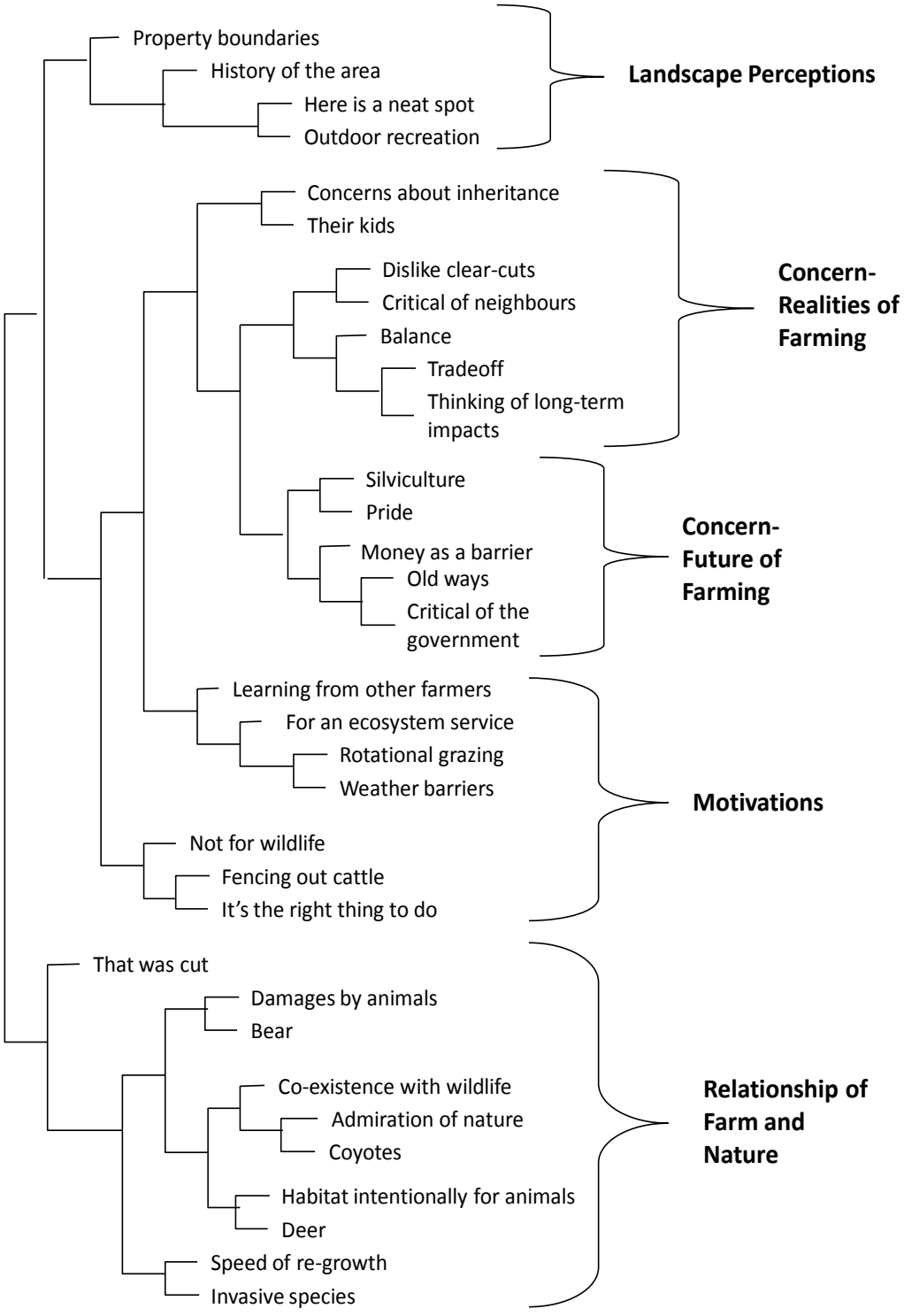


Figure 5.1 Results of the cluster analysis based on word similarity

The cluster analysis does not reveal the nuances within each theme, but does show the nodes which contain the most similar language (Cluster Analysis Tool, Nvivo qualitative analysis software, QSR International Pty Ltd., 2012). The tree diagram displays the groups of nodes that contain the most similar words. For example, the analysis placed the nodes of 'property boundaries', 'history of the area', 'here is a neat spot' and 'outdoor recreation' together on the tree. This group of nodes is consistent with what was manually assigned under 'landscape perceptions'. Overall, the branches of the tree diagram are similar to the manual grouping of nodes (Table 5.4), suggesting that there is some consistency between the two methods of finding themes. Themes are discussed in detail below.

5.6.1 The Farm's Relationship to, and Farmer's Role in, Nature

The farmers' responses suggest they believed that 'the farm' and 'nature' co-exist. This means that some losses, for example livestock casualties or some crop damage, were expected and even inevitable. As one blueberry farmer explained:

> …I don't see them [bears] doing a lot of damage to blueberries; some farmers claim they do, but I don't really see it. Sea gulls can be damaging. No, the problem with farming is that most of the wildlife, if there is an abundance of it, I won't say most, but does cause a lot of problems. But I, uh...we just live with it. (Farmer 5)

While there was clear disapproval of the damage caused by wildlife, there was also some degree of acceptance of wildlife. There appeared to be, however, a threshold at which the damage became unacceptable. In the above quote the farmer stated that wildlife is only a

problem "if there is an abundance of it". This suggests that wildlife is acceptable on the farm, but only when the populations are not 'over-abundant' and, as a result, causing too much damage. Once the relationship between the wildlife population and production becomes unbalanced, either the wildlife must be dealt with, or the farming practices adapted; the balance needs to be re-struck.

While nature was seen to co-exist with the farm, space for wildlife seemed to be confined to specific places on the farm. This was apparent in the locations that the farmers associated with 'wildlife or biodiversity'; mainly woodlots, ponds, watercourses, wetlands, and drainage ditches. These are marginal areas that cannot be used productively. This suggests that leaving space for wildlife on the farm is not necessarily motivated out of interest in wildlife, but instead out of pragmatism (this will be further discussed in Section 5.5.6). Some presence of wildlife on a farm was considered acceptable, however:

> Well we just try to get along with the wildlife. You know I was never a big lover of porcupines, but there's not so many of them around anymore. Other than the coyotes. I mean bears never really cause much of a problem. They're kind of more fearful of humans, and when they get in the green bins that's when they get annoying. But we haven't had much problem with the bears and the sheep you know? Far as birds…we like to see the geese in the fields, and then they're just part of the life, too; you got to leave the animals to have their space. (Farmer 6)

While areas for wildlife were not always discrete from areas of production (e.g., geese gleaning grain in fields), what was of the most interest was that the farm was described as

part of the landscape, and not *distinct* from nature. Farmers spoke about how they see their role in the natural world as one of managers or nurturers of that balance. One farmer described how he is very careful in the management of his woodlot, and does not believe that the woodlot should go its 'natural course', explaining that ″We were put here for a reason you know?" (Farmer 5). Interviews suggested the management of land is part of the farmer's self-identity, and that there is nothing 'unnatural' in land management strategies. That being said, not all types of land management strategies were described as acceptable, particularly those adopted solely for profit, without regard for the long-term health of the land. This will be further discussed in section 5.6.4.

The balance between the farm and nature was frequently discussed. Very few farmers said that they considered *encouraging* wildlife or biodiversity. It seemed as though it was important to most of the farmers in this sample, however, that the wildlife and biodiversity that existed on the farm was healthy and in balance with commercial species. One couple had tried farming in different places around the province before purchasing their current property. When asked about plants or animals that they would prefer to see less of on their land they explained,

> We don't have a huge amount of wildlife; I think that it's fairly balanced? I know that there are deer, but there are also coyotes, and so it's not too out of control. Whereas last year the place we were leasing didn't have a coyote population at all and the deer were out of control. So we like that it's more balanced […] We see things but we don't see so many things that we feel stressed out about it. So that has been nice. It's mostly the cabbage loopers. They're really bad.
> (Farmer 8)

All of the species described in the above quote would typically be considered pest-species on a farm. Deer are notorious for damaging vegetable crops and gardens, coyotes prey on livestock, and the cabbage looper is a species of caterpillar that can damage vegetable crops. These species were, however, acceptable to the farmer when the population was balanced. The farmers in this sample believed that some losses were to be expected. In the above example, the cabbage looper was the only species that was unwanted--because to the farmer, the population was out of balance, and as a result had created an unacceptable amount of damage. This suggests that the balance between production and nature is maintained by the farmers' management strategies (for example, the decision to use pesticides or to plant grassy strips in their crops). Many participants showed me areas on their farms that had been cut back in recent years that were now filled in by primary succession species such as birch or alder. The re-growth was fast, and constant maintenance was required for the farmer to be able to continue to use that area of land productively, suggesting that the balance between natural growth and cleared productive land needs to constantly be maintained.

In all the interviews, the farmers' admiration for wildlife was clear. Even those participants who were inclined to value production over habitat described encounters with wildlife that were exciting or inspiring (even if species are potentially dangerous or threatening). As one sheep farmer explained:

> …I'm even quite accepting of coyotes, which is probably sacrilege for a sheep farmer to be saying, but I mean you've got to admire an animal like that, that's been so damn successful and when they're howling at my fence line I think, as long as they don't kill too many I'll live with it. (Farmer 12)

There is a social expectation that farmers should hate coyotes because of the threat to livestock and the potential danger to the farmer and his or her family. Despite this expectation, some farmers, including the farmer in the above quote, had a certain admiration for the coyote. Even in the cluster analysis (Figure 5.1) the node 'coyote' was grouped with the nodes of 'co-existence with wildlife' and 'admiration of nature'. This demonstrates how 'nature', even if perceived as a potential pest, was often accepted by the farmers interviewed. So long as they perceived the population as being "balanced", they were content to "live with it".

5.6.2 Landscape Perceptions

Landscape perceptions were the themes that arose directly from walking *in situ.* Some of the features of the land that prompted discussion included ecosystems (such as wetlands, rivers and forests) or specific items on the land, which could be naturally occurring or as a result of human intervention (such as a specific tree or a significant site such as a family graveyard). The nature of the methodology resulted in the discussion sometimes straying from biodiversity explicitly. The themes that arose from these digressions, however, revealed important nuances of relationship between the farmers and their land and their perceptions of their identity as farmers. Some of the items discussed by the farmers, while at first glance seem unrelated to biodiversity, are cultural ecosystem services. For example, farmers spoke about a sense of well-being produced by the presence of a river, or the use of a pond for ice skating in the winter. As these services are at least partly the products of healthy ecosystems, the farmers' value of these are likely to have some bearing on biodiversity conservation strategies, and therefore should not be omitted.

The farmers conveyed a deep sense of connection and belonging to the land, and this seemed to be pronounced in those who came from a long family history of farming. Their sense of belonging to the land was evidently reinforced by the history of the area and their connection to that history. Many of the participants showed me parts of their farm that brought up memories of their childhood, or of their parents or grandparents. One farmer, for example, pointed out a tall white pine that his father used to climb to hunt deer, admitting that “it will be a sad day when that tree has to come down” (Farmer 5). The majority of the farms I visited had been in the families for generations, some as far back as the original land grants before Canadian Confederation in 1867. Even farmers without a long family history on a property, who purchased their property themselves, pointed out many of the historical features of their property. History was important to the farmers, and seemed to form part of their identity as a Nova Scotian farmer. One farmer described old photographs from the 1930s of the river that runs through his property. Some of the buildings and trees present in the photo are still standing today, but it is clear the land-use has changed considerably since then. When discussing how much land-use and commodities produced have changed over the years, the farmer joked, "…there's all kinds of things that went on on that river, that nobody knows about except a few old fools" (Farmer 4). This suggests that not only did the farmers consider themselves stewards of their land's health, but also stewards of the history of their land.

A frequent narrative that arose was that of lamenting the loss of the farms of the past. With increasing pressure to produce, many of the farmers in this group discussed how the modern farm was different than the farms of their childhood. They contended that modern farms must be larger and more efficient than ever, and it has changed the farmer's

role. One farmer described his grandfather using only a single field for hay, and cutting that hay by hand with scythes. Now he must use multiple fields to feed a much larger herd, and with machines it takes no time to cut that area where his grandfather once cut. Interestingly, the increased ease of work in comparison to his grandfather seemed to create a decreased sense of pride in that work. The farmers expressed resentment towards this pressure to ramp up production, and lamented the less-intensive farming techniques of the past. Where a dairy farmer could once get away with "20 head of cattle" now he or she must have "80 in order to break even" (Farmer 10). The farmers' lamenting the past also extended to ecological changes. Many of the rivers that pass through these farmers' properties are naturally tidal. However, over the years some of these tidal rivers were dammed for hydro or flood management purposes. One farmer described how he used to watch the river change levels over the course of the day; that stopped 30 years ago when the river was dammed:

> Environmentally that was probably the wrong thing to do, but it's probably the wrong thing to do to take out now, because you have a whole 30 year ecosystem above it that's based on fresh water, and it's a tremendous fresh water resource that we have. So our way, as a farmer's perspective, I think the harm was done, but no sense in harming it again--to me it doesn't make any sense. And we would have to protect this land again with dykes and stuff, and that's probably not going to happen. (Farmer 4)

Many farmers described a pride in land ownership. Even though participants were never asked to show their property boundaries, many of them felt compelled to point out where their land extended to and, perhaps more importantly, which parts of the land they

were not responsible for. The choice to point out the property boundaries reflects the sense of pride the farmers had in being landowners. One farmer described how happy he was when he and his wife were finally able to buy their first piece of property--despite having worked on the family farm for a number of years. Actually *owning* the land they were working on was very important: "So that's when we started farming, we bought this. We were working on our own [and] finally we had our own ground. Don't mean a thing to the young fellah″ (Farmer 11). The pride in ownership was also reflected by their pride in their management of the land. Many farmers pointed out different areas on the farm that they had cleared themselves, suggesting that they are proud of their accomplishments: "Look in here, Kate, doesn't that look pretty? I thinned that out in the 80s, and all them yellow birch that I left there are all 25, 30 years old now" (Farmer 1). Farmer 1's description of a managed part of his land as "pretty", also suggests that he values the aesthetic of a well-managed land.

The farmers did not describe the farm as a place exclusively for production. In addition to pointing out areas of production on the land, they pointed out areas that were used recreationally. Ponds, for example, were used by the families for fishing and ice skating in the winter. The majority of farmers allowed hunting on their land, even if they did not hunt. Some farmers pointed out places on their land that were particularly important to them (described by the node "here is a neat spot", Table 5.4). These were special spots on the farm that the farmer thought of as particularly beautiful or special in some other way. Often these places provided a vista of the entire property. Some farmers described how these specific places on their farm gave them a sense of peacefulness or

tranquility; after a long day they would drive to these spots on the property to help them relax:

> Yeah, I'll tell ya sometimes, when work gets kind of hard on or bothering you, and the pressures on […] I just like to come back here and shut the truck off and listen to the water going over the bridge. (Farmer 5)

The landscape thus contributes to farmer well-being.

5.6.3 Concerns About the Future and the Realities of Farming

Pride in land ownership and land management had a profound impact on how the farmers thought about the reality and the future of farming, which in turn has implications for biodiversity conservation. The pride in land ownership seemed to inspire in farmers a deep sense of responsibility and stewardship. As was mentioned before, interviews revealed nostalgia for the farms of the past and a sense that it was difficult to 'keep up' with increasing pace of modern production. Many also expressed a pessimistic attitude about farming trends and a sense of inevitability that "the death of the family farm" (Farmer 5) had already occurred. So, while the farmers had a general desire to leave the property to an heir within the family, they were reluctance to 'condemn' their children to the farming life. As one farmer explained:

> Well, they [his children] show a little interest, they're in 4H, and they have some animals in that. So, whether they'll want to farm or not, we're not really pushing it. But, you know where the quality in the food comes from, you know, compared to buying it in the stores. So, whether they'll have that opportunity…there may not be enough work for them to stay out here. (Farmer 6)

This quote demonstrates how the hope that their children will be interested in taking over the farm is mixed with concern about the future of farming. This attitude towards the next generation of farmers was slightly different among farmers over 60. While older farmers were hopeful that their children, or in some cases grandchildren, would take over the farm, they also told negative stories of farms passed to the next generation: farms that were run into the ground, woodlots completely clear cut, and land that had been carefully managed over a lifetime sold-off without thought to legacy. There was a clear emphasis on the importance of hard work and pride in the lifetime achievement of managing farmland. Some of the farmers, however, felt that their sense of stewardship, responsibility and pride was not shared by the next generation. One farmer spoke about a friend whose son inherited his land, which resulted in the farm being eventually sold:

> It's so sad to think that he worked all his life...Worked hard and everything, and that's [his house] all he's got left. Doesn't even have a tractor to plough snow, he's asked me to plough for him. He's probably two years older than me. (Farmer 5)

A couple of farmers even equated a farm being sold (to another farmer or to their family) to a farm destroyed. The farmers expressed the belief that there needs to be ongoing land-management on the farm, and if that management is not maintained the farm will deteriorate. One farmer articulated this belief about the management of his woodlot, although the same sentiment could easily be extended to the rest of the farm:

> Working at a woodlot is a lifetime, and it's not just when I'm done, but to keep it in good shape; you know, somebody else has got to take it on and continue to maintain it, and keep it in good health. (Farmer 1)

There was general mistrust among the farmers of anyone else attempting to manage their land, whether through government regulations ("ridiculous regulations" as described by farmer 5), or by the next generation that might work the farm. They described maintaining the 'balance' between production and nature as something that takes a lifetime to learn. As a result farmers, especially older farmers, felt that they were the best authority to speak for the land as they held the health of the land as their highest interest. One farmer described how terrible it would be to lose his property to someone that did not share his vision and work-ethic:

> This is my life. I put my life into this, and I put effort into what I believe is making it better, more healthy, making it more profitable sometimes. Sometime this will be a profitable piece of land, and in ways it is now. (Farmer 1)

This farmer suggested that profit is important but that money was not the only way that profit can be measured; this suggests profit can also be measured as a sense of well-being and pride that results from the good management of the land.

There were also reported concerns surrounding the day-to-day operation of the farm. The farmers were critical of both the provincial and federal governments, as they felt that there has not been enough financial compensation for farmers. Moreover, they believed that there has been a lack of recognition of the amount of hard work that is dedicated to working a successful farm and that people who are not farmers themselves do not understand the reality of farm work. So while there was desire to undertake 'environmentally friendly' practices because it is something that they feel would better the land, the reality of farming has created barriers to doing so. These barriers will be further

discussed in the 'motivations for adopting management strategies' section (Section 5.5.6) to follow.

Criticisms of improperly managed clear-cuts were raised by the majority of farmers. Most of the farmers were themselves harvesting wood from their woodlots on a small scale. Many of them had found themselves in situations where neighbours (crown or private) have cleared land without any consultation. Two major themes that came out of this discussion surrounding clear-cuts: a concern that 'the balance' will be upset, and a criticism of the land-management style of clear-cutting. The farmers have observed that 'the balance' of different plant and animal populations is upset when a forest is cleared. For example, the displaced animal population may be forced onto the surrounding farmland, thereby upsetting the delicate balance the farmer has worked so hard to maintain. Additionally, the motivation for clear-cuts was often thought to be only for short-term gain, and this lack of forward thinking was sharply criticized by many of the farmers. One farmer criticized a neighbour who decided to clear-cut his property:

> We're not tree huggers or anything, but let's face it, when you start destroying…like the one guy here who owns that whole area across at the back. We were here about two, three years and he completely clear cut everything […] Clear cut it so there wasn't a tree standing. Gone. Why? Money. That's all. He needed money to pay some bills, and that was it. Anyway, that forced a lot of the wildlife out of there and they started coming this way, so it's not right. I don't care what anyone says, when you start doing that then you start creating a major imbalance all the way around. And as long as they're going to clear cut around us,

> they're going to build, they're going to take away habitat, then, they're [wildlife] going to migrate to where they're safe, so where is that going to be? (Farmer 7)

Not all the farmers in this sample believed that clear-cutting was an inherently bad practice, however. Some of the farmers admitted that it was the only way to actually earn any substantial profit from their woodlot, and if it is carried out with care it was not necessarily the worst thing someone can do to their land. These concerns reported by the farmers suggest that having to undertake some, perhaps, undesirable practices is part of the reality of farming: to keep up with modern production standards, the farmers must, in some circumstances, clear forest to increase their pasture or crops, viz:

> I had a really good lamb crop, and I bought another flock, and just started feeling the pinch for good grass, 'cause my pasture isn't brilliant. And then I kind of tried to sort of clear the areas where I think it's the easiest to do and there will be less insult [to the land]. So, for instance, the three acres I'm clearing by my pasture, it was clear cut 25 or 30 years ago, we estimate, so there was no big trees left in there, and it was just kind of scrubby birch and poplar, and we thought it would be easy to cut. And I'm not destroying anything that's been around for like 200 years and that kind of thing. So that was an easy decision.(Farmer 12)

Similarly, the management style of the large-scale forestry operations is also criticized. The farmers felt as though the primary driver of that industry is profit, and that there is little or no concern for the 'health of the land'. Additionally, they described a complete disregard for the community that resides within those areas that are cut by forestry companies. One farmer described how an international company cut a parcel of

crown land near his community. The only benefit that the community had from that operation was when one of the workers decided to "buy a coffee on the way to work", and now a forest that could have once provided the entire community with social, natural and financial capital is gone.

There was also some criticism of forestry, and in some cases woodlot owners, for not taking the time to consider the value of a forest in terms of habitat. For example, one couple explained how they thought an inventory of the plant species that live in the forest should be completed prior to any large-scale cutting. They agreed that it was unlikely that a forestry company would take the time to carry out that kind of review:

> …When I look at these big logging operations, they don't go and look at all the little plants that grow on the ground. You would have to do it over a period of what? At least one season, going every month at least to see what is there, and if there is anything rare. I mean it's just not going to happen […] I don't know how the ordinary woodlot owner would bother. Now they might know mayflowers and they might know a lady slipper but they'd have to be there when they're in bloom or you wouldn't even know. (Farmer 2)

There was some concern from this couple that woodlot owners are not able, or perhaps unwilling, to carry out an inventory before harvesting begins. They explained that this lack of foresight stems from a lack of knowledge on the woodlot owner's behalf, and a lack of resources to be able to carry out such practice. The importance of having an inventory was not described by other farmers. The ideal of planning for the long-term health of the land was, however, a recurring theme.

5.6.4 Motivations for Adopting Management Strategies

Farmers often adopt conservation practices or 'environmentally friendly' practices because "it is the right thing to do" and not necessarily because they want to promote wildlife or biodiversity. Interviewees considered it "common sense″ for farmers to care for their land and to keep that land “healthy” and “in balance”. Therefore, intensive practices, such as extensive tilling or not rotating crops, are frowned upon. By ensuring the health of the land, their future as a farmer was secured. Most of the farmers in this sample described concern that the land would suffer as a result of increasing the scale of production. For example, one farmer criticized his neighbour for planting corn during consecutive years. The farmer explained that his neighbour thinks he would be better off by making his land more profitable by producing more, but the farmer argued that "he is only mining the soil" by not rotating crops and relying on auxiliary inputs. This narrative often comes back to lamenting the end of the family farm, and concern that they will be unable to meet the demands of farming in the future. The farmers discussed how all of their management strategies revolve around planning for the future. This planning may have been recorded formally in the form of a forest management plan or an environmental farm plan, or it may be an informal mental list, but the farmers described how they always consider the long-term impacts of any management decision. Furthermore, many of the farmers discussed how sustainable farming, with long-term goals, provided more satisfaction than a higher profit gained by short-term thinking. This may also explain in part why farmers are loathe to sell their farms; their management plans, whether formalized or not, would take many years to carry out, and when the farm is sold, they feared that all of that planning would be wasted. Farmer 4 explained this long-term philosophy in reference to the way his woodlot is harvested:

> But he [the farmer] has to do the work, so he kind of looks way ahead. […] next year or two or three years down the road he might have someone that wants a particular log that he can get out of that tree, so he's not going to cut it today. He's going to leave it there until he knows he needs it. You can't do that on a large commercial scale. (Farmer 4)

The farmers seemed to recognize that nature's time scale is different from that used by humans, and thus their management strategies included long-term benefits that may not ever be realized in their time. The long-term health of the land was their stated goal: the land should be left in better health than when the farmer began to work it. As one farmer explained: "Well we're only passing through, Kate, you know, so…" (Farmer 5). This suggests that the farmer understood that the farm and nature existed before him, and will continue to exist after him. For these farmers, they felt that it was up to them to do their best to preserve and improve the land's health during their lifetime. As Farmer 1 explained, the management of his woodlot and Christmas trees has been ongoing his entire life:

> The health is…[important]…I like the woods, we want it to be healthier and to be in better shape than what it was when we started our first management plan in the 70s.[…] Father and I worked on the [first] management plan. At that point it took a lot of clean-up work in the forest; a lot of balsam fir was starting to fall out. It had reached an age where it had started dying so we had to start working at that. Well it took us 20 years to really get a handle on that and get control of it, but we didn't go at it all over night. You know, we did projects in it each year, and, [have had] four management plans now, every ten years we get a new one, a new

> management plan. And the government used to help us do them at one time, but they won't help you do them anymore, it costs 1500 dollars just to do one now. (Farmer 1)

There was a common sentiment that this kind of long-term planning is a vision not shared by the government (provincial and federal) or even by some farmers. This seems especially to be the case when farmers are pressured to continually increase production. Many environmental best management practices (BMPs) are costly to the farmer, so while the willingness to adopt was there, the ability to adopt was limited. For example, consider building a fence to exclude cattle from a watercourse. The fence itself is one cost, but a pump would also have to be bought so that there is a new accessible water source in the pasture. This makes adopting the BMP very expensive, and decreases the ability of farmers to adopt the practice. Many of the participants argued that the reason some other farmers do not adopt conservation practices was that "environmentally friendly farming" cannot be done at a commercial scale, as there was no government support and no financial benefits. Despite these barriers, the farmers still displayed interest in biodiversity conservation. It was as a symbol of ethical farming that such practices held appeal. This is also demonstrated by the cluster analysis (Figure 5.1) which placed the nodes 'fencing out cattle' alongside 'not for wildlife' and 'it's the right thing to do'. These farmers carried out this activity not for wildlife, but rather as something that simply makes sense to do because it they saw it as beneficial to the land.

As well as for ethical reasons, the motivation for the farmers in this sample to increase farm habitat heterogeneity was often pragmatic. Places for 'wildlife' on the farm were described by most of the farmers as places that were not being used productively;

already marginal for production, they were bequeathed to wildlife. In other words these areas were not necessarily left *for* wildlife but for other reasons: out of necessity (e.g., unproductive land such as a rocky outcrop); out of interest in gleaning ecosystem services (e.g., bird boxes to encourage birds that eat pests and mosquitoes, using a wetland to filter waste water); or for another service benefiting production (e.g., using a wetland for irrigation). For instance, one farmer described a large artificial wetland that he had built on a piece of wet marginal land on his property. The primary reason for having the wetland put in was pragmatic: he needed a causeway built across the wet area so that he could access another part of his land. This wetland now serves as habitat, but also provides him with water for irrigation. As indicated by the hostility towards shortsighted practices, however, the farmers do not seem to be interested in sacrificing the health of their land for the sake of pragmatism or profit.

5.7 Discussion

Interviews revealed that farmers in this sample share a common value of pride in land ownership. That pride seems to foster a sense of stewardship that drives these farmers to care for the health of his or her land and serves as a motivator to adopt 'environmentally friendly' practices. This land ethic has also been demonstrated in other interviews of farmers in the Maritimes (Scott, 2003).This pride also includes an emphasis on independence. These farmers are not only dedicated to maintaining the health of the land, they also value their independence to manage their land as they see fit. The values of independence and land stewardship are consistent with other research (Gasson, 1973; Mills et al., 2013). In fact, it could be argued that these values, and not financial profit, are the drivers of much of the farmers' behaviour (Chapter 4). While interview

participants agreed that financial gain was important, it was not considered the most important measure of a farm's success. Many of the farmers in this sample were highly critical of management strategies (such as clear-cutting) that are carried out without consideration of the long-term impacts, exclusively for financial gain. Management that emphasized long-term thinking and maintaining the health of the land, including environmental best management practices, were much more socially acceptable among this group of farmers. They were motivated to undertake some conservation strategies because they were good for the land, which in turn made them 'good farmers'. This is in contrast with much of the literature surrounding conservation adoption among farmers, which has traditionally found that profit and monetary incentives were chief motivators in conservation adoption (Cary & Wilkinson, 1997; Mills et al., 2013; Willock et al., 1999).

Modern farming has put a strong emphasis on increasing production and profit, and farmers in this study were resentful of that shift. They were unable in some cases, however, to satisfy their desire to engage in more environmentally friendly practices because they were less profitable. With the growing emphasis on increasing production and scale, the farmers lamented the loss of small-scale family farms of the past that were, in their opinion, much more sustainable. This suggests that the farmers value low-impact farming techniques. Alternatively, this nostalgia for farms of the past could also be the result of an aging farm population. Seven out of twelve interview participants, and the vast majority of the farming population in Nova Scotia are over the age of 50 (Statistics Canada, 2011). This age group, therefore, holds a shared history of farming, resulting in a common, nostalgic, narrative of what farming 'was' and therefore 'should be' (Kanagy et al., 1994).

Given the recruitment strategy, one must use caution in generalizing these results to other groups. Those who chose to complete and return a survey, and then subsequently agree to be interviewed about biodiversity and farming likely have strong opinions on the topic--negative or positive--and more likely positive since they have essentially gone through two screening processes. The sentiments expressed by the farmers in this study are, therefore, unlikely to be representative of all farmers in Nova Scotia. The farmers in the study represent a population of farmers that are likely to be more concerned about biodiversity than others. Although one must use caution in generalizing to other groups, the broad values of pride in land stewardship and balance have been described in other research (Gasson, 1973; Mills et al., 2013), and thus suggests that the results are somewhat transferrable to a broader farming population. In other words, this research confirms the presence of broad values that seem to be shared by farmers in Nova Scotia. It is important to note that these values will be manifested slightly differently for various social groups, and as a result, their impact on the decision to engage in biodiversity conservation will vary.

'Good farmers', according to participants in this study, are interested in conservation; in maintaining the balance between production and nature. The farm exists within nature, and nature plays a role on the farm. They felt there was a social expectation that they (and others) should carry out management practices that consider the health of their land and the long-term impacts of their practices. This is an interesting finding as it implies that humans and nature can coexist in the same landscape. By contrast, among many western populations people often consider themselves as distinct from nature (Vining, Merrick, & Price, 2008) and that nature exists elsewhere from the 'human landscape'. People who are

more connected with nature are more receptive to conservation strategies and more likely to adopt them (Vining et al., 2008). As was also found by Scott (2003), Nova Scotian farmers see multi-functionality in the landscape: the farm is an area of production, recreation, nature and important history. Their role as stewards and value of balance inspires a land ethic (A. C. Leopold, 2004). Nevertheless it should be kept in mind that the farms studied produced mixed commodities. With no large patches of contiguous fertile soil, farmers are forced to adapt their management strategies. This results in farmers leaving patches of marginal land uncultivated, even if they are not interested in biodiversity. Multi-functionality of landscape has also been described as desirable by Australian farmers, and has been linked to conservation behaviour among that population (Maybery et al., 2005). The farmers' role as observers, managers and nurturers of their land, results in an inherently close relationship with the land and, therefore, by extension 'nature'.

For the farm and nature to successfully coexist, the ‘balance’ between the two entities must be maintained. Balance was discussed in nearly every theme that arose in the analysis of the interviews. The farmers understood and accepted that some losses will be made to wildlife. They also recognized that there is, however, a tipping point where this relationship becomes unbalanced, and therefore, no longer acceptable. The tipping of the scales may be the result of an imbalance in nature, or an imbalance in farming method. The fulcrum that balances nature and production varies by individual. Some will place a stronger emphasis on maintaining nature, whereas others favour production (Ahnström et al., 2008; Morris & Potter, 1995). The nature of the recruitment for this research likely resulted in a group of farmers who lean toward the 'nature' side of the spectrum. Despite

individual preferences, however, the value of maintaining the balance between production and nature is likely important to many farmers. This value could help to inform conservation programs. Not all farmers may be knowledgeable of the biodiversity issues and opportunities on their property or recognize the values provided by biodiversity. Providing such information, and framing it in terms of balance (i.e., maintaining the health of productive and non-productive areas on the farm), could help engage farmers in biodiversity conservation (Mobley et al., 2009).

The identification of farmer values related to biodiversity and wildlife can help inform methods or programs for biodiversity conservation on farm land (Ahnström et al., 2008; Maybery et al., 2005). There are two predominant methods to deliver biodiversity conservation strategies: legislative and voluntary (Plummer et al., 2008). Legislative methods are 'one-size fits all' policies that enforce compliance under the threat of punishment. Enforcement of environmental legislation has been historically unpopular with farmers (Segerson & Miceli, 1998). As farmers value their independence and are skeptical of other people managing their land, the negative attitude toward legislative methods comes as no surprise (Ahnström et al., 2008; Gasson, 1973). This research has confirmed that this negative sentiment extends to Nova Scotian farmers as well, as the farmers interviewed were quite critical of government intervention and legislation. Voluntary methods, on the other hand, which emphasize the benefits arising from compliance and rely entirely on the farmer to make the decision to engage (Plummer et al., 2008), are much more acceptable. The Environmental Farm Plan (EFP) and the Agricultural Biodiversity Conservation (ABC) programs are examples of voluntary stewardship programs in Nova Scotia. While these programs offer some advice and

guidance to participating farmers, it is still the farmer who remains in control of the management of their land. Results from this research suggests that farmers in Nova Scotia might be much more receptive to voluntary programs that appeal to their value of independence and pride in land stewardship.

5.8 Conclusion

It has been argued that it is possible to encourage people to participate in biodiversity conservation by appealing to their values. This research explored how twelve farmers in Nova Scotia felt about biodiversity and biodiversity conservation. From the four themes identified during analysis, three predominant values shape the management strategies of farmers in Nova Scotia: pride in land stewardship, independence and balance. The strong sense of stewardship, independence and pride in their land management makes them less receptive to strategies that dictate and instead are more receptive to voluntary strategies. They perceived the relationship between the farm and biodiversity as all about maintaining 'balance', not necessarily encouraging or increasing biodiversity. Regardless of the reasons for undertaking biodiversity conservation practices, however, if farmers are doing them, then biodiversity will benefit. They understood that biodiversity or 'nature' exists on the farm, and has a role to play on the farm, but when populations become unbalanced they felt intervention is needed. Programs should capitalize on the farmer's appreciation of balance. Programs that set out to *increase* biodiversity may not be well received among farmers, but the message that the health of their land is in jeopardy, may better resonate with the farming population and help to encourage the uptake of biodiversity conservation.

CHAPTER 6 CONCLUSIONS

Biodiversity decline as a result of agricultural production is a global issue, and the pressure on farms to produce has amplified with the demand for food (Altieri, 1999; Green et al., 2005; McLaughlin & Mineau, 1995). Different strategies to encourage the adoption of more biodiversity-friendly farming practices have been studied and implemented in some regions, but there are no 'one size fits all' solutions. The species found in one area will vary from another, as will the commodities produced, climate, soil type and topography. Therefore, the most successful strategies rely on region-specific programs that can target the biodiversity issues specific to a given area.

There are many factors that play into farmers' decisions to engage in on-farm biodiversity conservation activities (Figure 6.1). Since biodiversity issues are complex and region specific, blanket legislation is often inappropriate or inadequate. This is reflected by the development of many voluntary conservation programs, such as AES in Europe and the Nova Scotian ABC program. The Theory of Planned Behaviour offers some insight into the decision to act (Ajzen, 1991). An individual's values, attitudes, and evaluation of the merits of the activity, combined with situational variables, lead a person to intend to act (Ajzen, 1991; Lynne et al., 1988). These factors can be collapsed into two categories: willingness to adopt, and the ability to adopt (Figure 6.1). The individual drivers of adoption differ by farmer--what may be an important limiting factor on one farm, may not be in another. To ensure the success of biodiversity-friendly farming programs, it is important to have a thorough understanding of the target population and the biodiversity issues of that region, so that programs can be tailored to the needs of both (i.e. farmer and region).

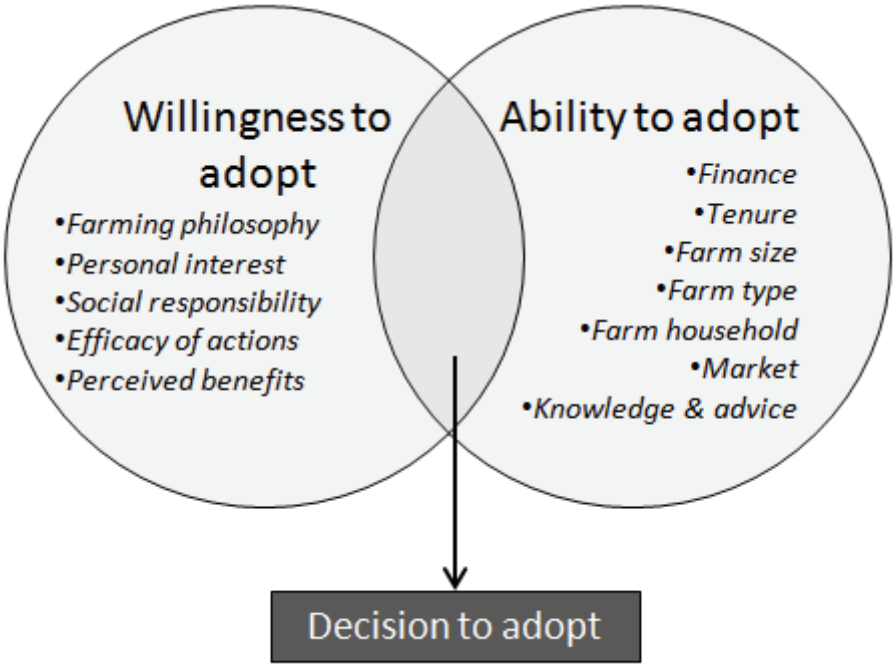


Figure 6.1 Decision to adopt conservation activities (simplified from Mills et al. 2013's analytical framework for understanding the link between farmer attitudes and environmental management)

The aim of this research was to identify methods of improving stewardship program delivery through the exploration of farmer values and attitudes affecting the decision to participate in voluntary conservation. Farmer interest in and value of biodiversity and biodiversity conservation was explored in a Nova Scotian context in two stages. First, the link between participation in the DNR's ABC program and engagement in biodiversity-enhancing farming activities was quantified. The second stage explored farmer attitudes and values concerning biodiversity and biodiversity-enhancing activities on their land. Some general conclusions from the two phases can be made.

The survey indicated a strong willingness to engage in biodiversity-friendly practices on the part of both ABC program participants and non-participants. The data from this research is self-reported, so it is difficult to make any definitive statements about

engagement levels. The results do, however, provide insight into the motivations and willingness to engage in biodiversity-friendly activities of the farmers in this sample. Interestingly, many of the farmers interviewed said that they were not undertaking any activities *for* biodiversity. Yet, many of the management strategies used on their land, simply as part of their farming practice, would be considered 'biodiversity-enhancing', such as the maintenance of brush piles, or leaving vegetation in drainage ditches. The interviews suggest the interest in conservation does not necessarily stem from interest in any specific species, or even 'wildlife' broadly. Rather, concern stems from how farmers consider the farm to be a part of nature, and that the management of that land (not just the areas of production) is crucial to maintain the overall health of their land (i.e., their values are affecting their attitude and engagement in biodiversity-enhancing activities--Figure 6.2). Observations from the survey and the interviews suggest that there is a value among farmers that maintaining the health of their land is expected as part of their role as a farmer. The common values of balance, independence and stewardship among farmers were consistent with what others have observed (Ahnström et al., 2008; Gasson, 1973; Mills et al., 2013). These values influence the likelihood that a farmer will elect to engage in biodiversity conservation activities--activities that if chosen and implemented well--will positively impact their land's health.

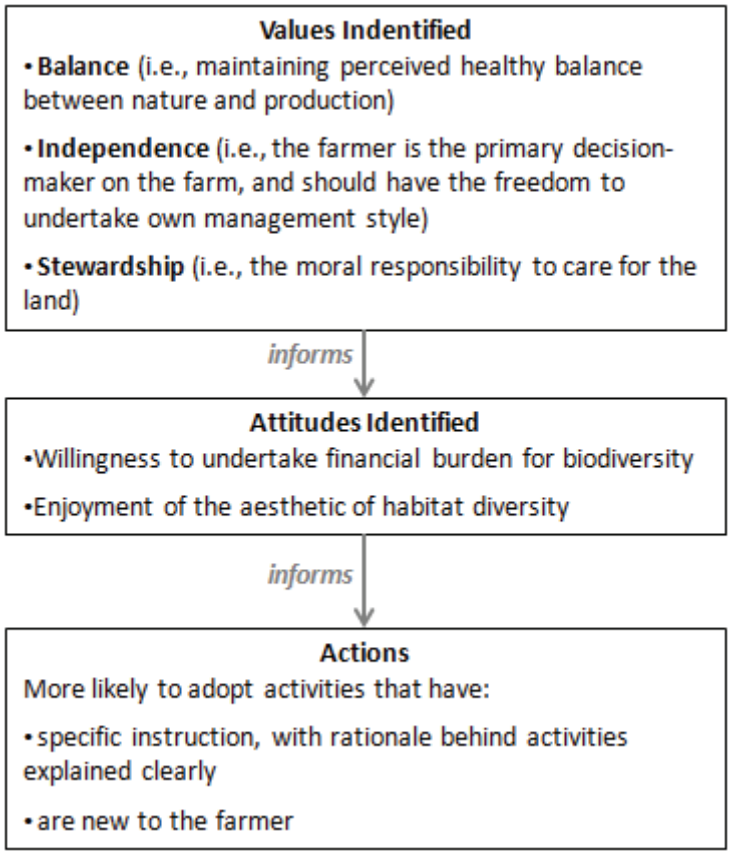


Figure 6.2 Values and attitudes identified

Very few farmers selected the option "I would not consider this" when presented with a list of biodiversity-enhancing activities. Moreover, a high willingness to adopt was apparent by selection of "I am currently doing this" and "I would consider doing this" by the majority of farmers. Despite this apparently high willingness to adopt, some barriers to adoption were identified by respondents. When respondents were asked to explain why they did or did not engage in an activity, responses suggested that they had interest in the activities, but were unable to adopt as a result of different contextual factors (Figure 6.1), including finances, knowledge of the appropriate activities, and how to carry out those

activities. Many farmers also pointed to a lack of financial support from the government as a reason for not adopting.

Money is not the only, nor even the primary, driving factor of decision making in farming. It has been thought that the financial 'bottom line' is the most important factor that influences decision-making in farming management (Cary & Wilkinson, 1997; Mills et al., 2013; Willock et al., 1999). Participation in the ABC program is statistically significantly linked to engagement in riparian management and modified harvesting techniques, demonstrating a quantifiable link between engagement in biodiversity-enhancing activities and participation in a stewardship program that is both voluntary and incentive-free. Finance can certainly be a barrier to conservation adoption; however, it is only one factor among many that influence a farmer's management strategy (Figure 6.1). In fact, during interviews, many of the farmers were deeply critical of practices that were undertaken chiefly for profit, and it was rather the long-term impacts of activities that carried more weight in their management decisions. Financial incentives would likely help to increase the uptake of voluntary conservation programs, but are not crucial. Moreover, results from the survey suggest that there is even a willingness to make a financial sacrifice for biodiversity. Farmers in this sample are not interested in turning a profit at the expense of the health of their land. These findings alone do not necessarily translate to biodiversity conservation action. They are, however, suggestive of the ways that these farmers make decisions on their land. By appealing to these identified values of stewardship, balance and independence (Figure 6.2) during the design of stewardship programs, it may be possible to increase farmer participation, and thus increase biodiversity conservation overall on farmland.

Encouraging naturally occurring or native biodiversity may have a positive impact on agricultural production. The loss of biodiversity as a result of agriculture has resulted in decreased ecosystem service delivery. This loss in important services such as nutrient cycling has increased farmer reliance on auxiliary inputs to replace those lost services (Altieri, 1999). By encouraging biodiversity it is possible to foster ecosystem service delivery, making farms more self-sufficient. Furthermore, under climate change scenarios, it is anticipated that a shift in species distribution will occur (Bootsma et al., 2005). If there are multiple species and ecosystems responsible for ecosystem services, when one of those becomes compromised as a result of climate change, there is enough redundancy to ensure continued service delivery, thus increasing the long-term resilience of farms under climate change.

6.1 RECOMMENDATIONS

These research findings have implications for the development of stewardship programs that target biodiversity on private farmland. Recommendations can be made to improve the ABC program, with potential application to other similar programs in similar contexts.

6.1.1 Future Design of Conservation Programs

There are many factors that need to be considered in conservation program design (Figure 6.1). Many of these factors are heavily influenced by the context in which the program operates: the region's commodities, ecosystem and the values and constraints of the target population. For these reasons it is imperative that program creators take the time to understand the target population, and the regional context.

Appealing to the common values of the target population will increase engagement. Farmers value independence, balance and stewardship, therefore program design should appeal to these. This research suggests that farmers would be more likely to consider adoption of biodiversity-conserving activity if the rationale behind the activities is explained to them in a way that reflects their values (i.e. to maintain the balance between nature and production on the farm). Likewise, by providing farmers with the final decision considering adoption and ways to customize practices to particular circumstances, their role as the primary decision-maker on the farm is maintained--appealing to their independence. This is consistent with the dislike for regulation often found by other researchers; farmers are more willing to adopt voluntary strategies (Plummer et al., 2008).

Biodiversity is also responsible for the delivery of cultural ecosystem services. For example, a sense of well-being provided by walking through a forest or recreational activities such as swimming or ice skating. Services such as these were often discussed by the farmers interviewed as an integral part of the lifestyle being a farmer. Biodiversity was often not, however, discussed in relation to these services. These services are at least partially provided by the presence of biodiversity, a connection that was not always made by the farmers. Thus, by highlighting the importance of biodiversity in maintaining these cultural ecosystem services that are so valued, it would perhaps increase farmer interest in biodiversity conservation.

6.1.2 Recommendations for the ABC Program

This research suggests that the ABC program is successful at influencing participant engagement in some biodiversity-enhancing activities: riparian management and

modified harvest. The impact of participation in the program was not, however, a significant predictor of all recommended biodiversity-enhancing activities. To determine the true impact of the program on all the activities recommended, some follow-up is needed. This could be accomplished in detail by site visits, or even through telephone calls. It is important that records are maintained of which activities have been recommended and to whom. This will provide base-line data for the continued evaluation of the program, as well as provide some insight into the kinds of activities relevant to different areas and commodity types. Analysis of such data could give further insight into the likelihood that farmers will adopt other activities, and thus inform farmer extension work.

The ABC program, despite the small size and limited number of participants, is having a positive impact on farmer adoption of some biodiversity conservation activities. Therefore, it is recommended that program delivery be expanded if possible. There are two ways this could be achieved: first by expanding the program through more staff training; or, secondly, by delivering program materials through another medium. The first method would likely require an increase in program funding, which may not be available. The second method, however, may include more cost-effective ways of delivering biodiversity-conservation material to farmers, such as courses, mail-outs or digital tools. Extension programs in the United States are increasingly using mobile technology for the delivery of materials (Dvorak, Franke-Dvorak, & Price, 2012). The information that is provided by the ABC program using traditional methods could be delivered to farmers by using a mobile platform, such as an 'app' (i.e. application). This would help to expand a

program that is limited by man-power, but is otherwise successful at influencing engagement in biodiversity-enhancing activities.

6.2 Future Research

This study has been able to demonstrate that there is an interest in biodiversity conservation among the farmers in this sample. Their 'ability to adopt', however, needs to be further researched (Figure 6.1). While this research has discussed some of the factors in this category (i.e. knowledge of activities, cost of activities and a lack of support), without further research, the adoption of biodiversity conservation more broadly may be hindered. It would be beneficial to determine the specific farm and farmer characteristics that facilitate, or inhibit, adoption.

Larger-scale research is also needed. The results from this research are encouraging, as the farmers in Nova Scotia who responded to the survey and who were interviewed seem to be generally interested in biodiversity conservation. It is important, however, to acknowledge the bias in the sample of farmers examined; both those who participate in the ABC program and those who are willing to take the time to complete a survey and subsequently take part in a go-along interview about biodiversity and farming are more likely to have greater pre-existing interest in biodiversity conservation than other farmers. Therefore, it would be useful to carry out similar research, but targeting a broader farming population. The use of multiple reminders on a randomly selected group of Nova Scotian farmers would not only increase response rate, but would allow more general conclusions about engagement in biodiversity conservation and values concerning biodiversity, to be drawn.

The efficacy of individual biodiversity-enhancing activities must also be determined. For biodiversity levels to be successfully improved in Nova Scotia, the activities that are recommended to farmers must have a confirmed positive impact. There are some examples of this research being carried out in Nova Scotia, specifically around water filtration by wetlands (Jamieson et al., 2002) and soil biodiversity (Mills & Adl, 2006). There are, however, many other activities that have been executed successfully in other regions, but have not yet been tested or adapted to suit the needs specific to Nova Scotian farms. For example the planting of wildflowers in crop margins has had demonstrated success in Europe at controlling weed incursion and promoting biodiversity without major losses in yields (de Snoo, 1999; Moonen & Marshall, 2001). An activity such as this, however, cannot be recommended in Nova Scotia until the biophysical research is carried out to determine the kinds of techniques and species that could successfully reproduce those results in a Nova Scotian context.

The issue of biodiversity decline as a result of farming is a global issue and with a growing global population, research concerning environmentally friendly farming practices must continue. This research has demonstrated that there is some interest and a qualified willingness among the farmers in this sample to adopt some biodiversity-enhancing practices. The motivation behind this willingness to adopt typically stems from concern for the health of their land, rather than the 'desire to conserve biodiversity'. This suggests that the strategy of conservation programs to appeal to the farmer's interest in *biodiversity* is perhaps misplaced. Instead programs should focus on what appeals to farmers, that being *the health of their land.* The adoption of biodiversity-enhancing activities, even at a small scale, will help to improve biodiversity, fostering a system

whereby food production can be continued while fostering biodiversity on and off the farm. Regardless of the sentiment behind the decision to adopt, if farmers are willing to adopt more sustainable practices, it will contribute to striking a balance between biodiversity and agricultural production.

REFERENCES

Agresti, A., & Finlay, B. (2009). *Statistical Methods for the Social Sciences* (4th ed.). Upper Saddle River, New Jersey: Pearson Prentice Hall.

Agriculture and Agri-Food Canada. (2012). *Canada Land Inventory: Soil Capability for Agriculture*. Retrieved from http://sis.agr.gc.ca/cansis/nsdb/cli/index.html

Ahnström, J., Höckert, J., Bergeå, H. L., Francis, C. A., Skelton, P., & Hallgren, L. (2008). Farmers and Nature Conservation: What is Known About Attitudes, Context Factors and Actions Affecting Conservation? *Renewable Agriculture and Food Systems*, *24*(01), 38. doi:10.1017/S1742170508002391

Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior And Human Decision Processes*, *50*, 179–211.

Altieri, M. A. (1999). The Ecological Role of Biodiversity in Agroecosystems. *Agriculture, Ecosystems & Environment*, *74*(1-3), 19–31. doi:10.1016/S0167-8809(99)00028-6

Anderson, R. L. (2007). Managing Weeds With a Dualistic Approach of Prevention and Control: A Review. *Agronomy for Sustainable Development*, *27*(1), 13–18. doi:10.1051/agro:2006027

Atari, D., Yiridoe, E. K., Smale, S., & Duinker, P. N. (2009). What Motivates Farmers to Participate in the Nova Scotia Environmental Farm Plan Program? Evidence and Environmental Policy Implications. *Journal of Environmental Management*, *90*(2), 1269–79. doi:10.1016/j.jenvman.2008.07.006

Ball, B. C., Bingham, I., Rees, R. M., Watson, C. A., & Litterick, A. (2005). The Role of Crop Rotations in Determining Soil Structure and Crop Growth Conditions. *Canadian Journal of Soil Science*, *85*(5), 557–577.

Balmford, A., Green, R., & Phalan, B. (2012). What Conservationists Need to Know About Farming. *Proceedings of the Royal Society/Biological Sciences*, *279*(1739), 2714–24. doi:10.1098/rspb.2012.0515

Batáry, P., Báldi, A., Kleijn, D., & Tscharntke, T. (2011). Landscape-Moderated Biodiversity Effects of Agri-Environmental Management: A Meta-Analysis. *Proceedings of the Royal Society/Biological Sciences*, *278*(1713), 1894–902. doi:10.1098/rspb.2010.1923

Beedell, J. D. C., & Rehman, T. (1999). Explaining Farmers' Conservation Behaviour : Why do Farmers Behave the Way They do? *Journal of Environmental Management*, *57*, 165–176.

Beedell, J., & Rehman, T. (2000). Using Social-Psychology Models to Understand Farmers' Conservation Behaviour. *Journal of Rural Studies*, *16*(1), 117–127. doi:10.1016/S0743-0167(99)00043-1

Benayas, J. M. R., Bullock, J. M., & Newton, A. C. (2008). Creating Woodland Islets to Reconcile Ecological Restoration, Conservation, and Agricultural Land Use. *Frontiers in Ecology and the Environment*, *6*(6), 329–336. doi:10.1890/070057

Benton, T. G., Vickery, J. A., & Wilson, J. D. (2003). Farmland Biodiversity: Is Habitat Heterogeneity the Key? *Trends in Ecology & Evolution*, *18*(4), 182–188. doi:10.1016/S0169-5347(03)00011-9

Bootsma, A., Gameda, S., & Mckenney, D. W. (2005). Impacts of Potential Climate Change on Selected Agroclimatic Indices in Atlantic Canada. *Canadian Journal of Soil Science*, *85*, 329–343.

Boynton, P. M., & Greenhalgh, T. (2004). Selecting, Designing, and Developing Your Questionnaire. *British Medical Journal (Clinical research ed.)*, *328*(7451), 1312–5. doi:10.1136/bmj.328.7451.1312

Brown, M. W. (1999). Applying Principles of Community Ecology to Pest Management in Orchards. *Agriculture, Ecosystems & Environment*, *73*(1), 103–106.

Bryman, A., & Teevan, J. (2005). *Social Research Methods*. Don Mills ON: Oxford University Press.

Bullock, J. M., Aronson, J., Newton, A. C., Pywell, R. F., & Rey-Benayas, J. M. (2011). Restoration of Ecosystem Services and Biodiversity: Conflicts and Opportunities. *Trends in Ecology & Evolution*, *26*(10), 541–549. doi:10.1016/j.tree.2011.06.011

Burel, F., & Baudry, J. (2005). Habitat Quality and Connectivity in Agricultural Landscapes: The Role of Land Use Systems at Various Scales in Time. *Ecological Indicators*, *5*(4), 305–313. doi:10.1016/j.ecolind.2005.04.002

Burger, W., & Burger, L. (2005). Conservation Buffers. *Wildlife Trends*, *5*(2), 2–8. Retrieved from http://www.fwrc.msstate.edu/pubs/fieldborder.pdf

Burton, R. J. F., Kuczera, C., & Schwarz, G. (2008). Exploring Farmers' Cultural Resistance to Voluntary Agri-environmental Schemes. *Sociologia Ruralis*, *48*(1), 16–37. doi:10.1111/j.1467-9523.2008.00452.x

Carpiano, R. M. (2009). Come Take a Walk With Me: The "Go-Along" Interview as a Novel Method For Studying The Implications Of Place For Health And Well-Being. *Health & Place*, *15*(1), 263–72. doi:10.1016/j.healthplace.2008.05.003

Carruthers, R. I. (2003). Invasive Species Research in The United States Department of Agriculture-Agricultural Research Service. *Pest Management Science*, *59*(6-7), 827–834. doi:10.1002/ps.616

Carter, M. R., Peters, R. D., Noronha, C., & Kimpinski, J. (2009). Influence of 10 Years of Conservation Tillage on Some Biological Properties of a Fine Sandy Loam in The Potato Phase of Two Crop Rotations in Atlantic Canada. *Canadian Journal of Soil Science*, *89*, 391–402.

Cary, J. W., & Wilkinson, R. L. (1997). Perceived Profitability and Farmers' Conservation Behaviour. *Journal of Agricultural Economics*, *48*(1-3), 13–21. doi:10.1111/j.1477-9552.1997.tb01127.x

Crowley, M. (2009). *Healthy Lakes and Wetlands For Tomorrow: A Landowner Stewardship Guide For Species At Risk In Nova Scotia*. Mersey Tobeatic Research Institute. Retrieved from http://www.speciesatrisk.ca

Cunningham, S. A., Attwood, S. J., Bawa, K. S., Benton, T. G., Broadhurst, L. M., Didham, R. K., … Lindenmayer, D. B. (2013). To Close the Yield-Gap While Saving Biodiversity Will Require Multiple Locally Relevant Strategies. *Agriculture, Ecosystems & Environment*, *173*, 20–27. doi:10.1016/j.agee.2013.04.007

De Snoo, G. R. (1999). Unsprayed Field Margins:Effects on Environment, Biodiversity and Agricultural Practice. *Landscape and Urban Planning*, *46*, 151–160.

Devanney, M., & Reinhardt, F. (2010). *An Overview of the Nova Scotia Agriculture and Agri-Food Industry*. Retrieved from http://www.gov.ns.ca/agri/AO0102-2010-NS-Ag-Overview-w-Appendices.pdf

Dietz, T., Stern, P. C., & Guagnano, G. A. (1998). Social Structural and Social Psychological Bases of Environmental Concern. *Environment and Behavior*, *30*(4), 450–471.

DNR. (2012). *Wildlife & Birds of Nova Scotia*. Retrieved from http://novascotia.ca/natr/wildlife/wns/wns7f.asp

Dunlap, R. E., Liere, K. D. Van, Mertig, A. G., & Jones, R. E. (2000). Measuring Endorsement of the New Ecological Paradigm : A Revised NEP Scale. *Journal of Social Issues*, *56*(3), 425–442.

Dutton, A., Edwards-Jones, G., Strachan, R., & Macdonald, D. W. (2008). Ecological and Social Challenges to Biodiversity Conservation on Farmland: Reconnecting Habitats on a Landscape Scale, *Mammal Review, 38*(2), 205–219.

Dvorak, J. S., Franke-Dvorak, T. C., & Price, R. R. (2012). "Apps"--An Innovative Way to Share Extension Knowledge. *Journal of Extension*, *50*(6).

Environics Research Group. (2006). *National Survey of Farmers and Ranchers: Ecological Goods and Services*. Toronto, ON.

European Commission. (2005). *Agri-environment Measures: Overview on general principles, types of measures, and application* (pp. 1–24). Retrieved from http://ec.europa.eu/agriculture/publi/reports/agrienv/rep_en.pdf

Evans, J., & Jones, P. (2011). The Walking Interview: Methodology, Mobility and Place. *Applied Geography*, *31*(2), 849–858. doi:10.1016/j.apgeog.2010.09.005

Fahrig, L., Baudry, J., Brotons, L., Burel, F. G., Crist, T. O., Fuller, R. J., … Martin, J.-L. (2011). Functional Landscape Heterogeneity and Animal Biodiversity in Agricultural Landscapes. *Ecology letters*, *14*(2), 101–12. doi:10.1111/j.1461-0248.2010.01559.x

FAO. (1996). Control of Water Pollution From Agriculture. *FAO Irrigation and Drainage Papers*. Retrieved from http://www.fao.org/docrep/W2598E/W2598E00.htm

Fischer, A., & Vanderwal, R. (2007). Invasive Plant Suppresses Charismatic Seabird – the Construction of Attitudes Towards Biodiversity Management Options. *Biological Conservation*, *135*(2), 256–267. doi:10.1016/j.biocon.2006.10.026

Fischer, J., Brosi, B., Daily, G. C., Ehrlich, P. R., Goldman, R., Goldstein, J., … Tallis, H. (2008). Should Agricultural Policies Encourage Land Sparing or Wildlife-Friendly Farming? *Frontiers in Ecology and the Environment*, *6*(7), 380–385. doi:10.1890/070019

Fisheries Act (R.S.C., 1985, c. F-14). Government of Canada. Retrieved from http://laws-lois.justice.gc.ca/eng/acts/F-14/

Franz, N., Piercy, F., Donaldson, J., Richard, R., & Westbrook, J. (2010). How Farmers Learn: Implications for Agricultural Educators. *Journal of Rural Social Sciences*, *25*(1), 37–59.

Freedom of Information and Protection of Privacy Act (1993, c.5, s.1). Office of the Legislative Counsel, Nova Scotia House of Assembly. Retrieved from http://nslegislature.ca/legc/statutes/freedom.htm

Fuller, K. D., Gordon, R., Grimmett, M., Fillmore, S., Madani, A., VanRoestel, J., … George, E. St. (2010). Seasonal and Crop Rotational Effects of Manure Management on Nitrate–Nitrogen Leaching in Nova Scotia. *Agriculture, Ecosystems & Environment*, *137*(3-4), 267–275. doi:10.1016/j.agee.2010.02.012

Garcia, C. M., Eisenberg, M. E., Frerich, E. A, Lechner, K. E., & Lust, K. (2012). Conducting Go-Along Interviews to Understand Context and Promote Health. *Qualitative Health Research*, *22*(10), 1395–403. doi:10.1177/1049732312452936

Gasson, R. (1973). Goals and Values of Farmers. *Journal of Agricultural Economics*, *24*(3), 521–542.

Gehlbach, H., & Brinkworth, M. E. (2011). Measure Twice, Cut Down Error: A Process for Enhancing the Validity of Survey Scales. *Review of General Psychology*, *15*(4), 380–387. doi:10.1037/a0025704

Gilbert, D. T., Fiske, S. T., & Lindzey, G. (1998). *The Handbook of Social Psychology* (4th ed.). New York: Oxford University Press.

Gliem, J. A., & Gliem, R. R. (2003). Calculating, Interpreting, and Reporting Cronbach's Alpha Reliability Coefficient for Likert-Type Scales. *2003 Midwest Research to Practice Conference in Adult, Continuing, and Community Education*, 82–88.

Godfray, H. C. J., Beddington, J. R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F., … Toulmin, C. (2010). Food Security: the Challenge of Feeding 9 Billion People. *Science*, *327*(February), 812–818.

Green, R. E., Cornell, S. J., Scharlemann, J. P. W., & Balmford, A. (2005). Farming and the Fate Of Wild Nature. *Science*, *307*(550), 550–555. doi:10.1126/science.1106049

Halde, C., Hammermeister, A. M., Mclean, N. L., Webb, K. T., & Martin, R. C. (2011). Soil Compaction Under Varying Rest Periods and Levels of Mechanical Disturbance in a Rotational Grazing System. *Canadian Journal of Soil Science*, *91*, 957–964. doi:10.4141/CJSS2011-026

Herzon, I., & Mikk, M. (2007). Farmers' Perceptions of Biodiversity and Their Willingness to Enhance it Through Agri-Environment Schemes: A Comparative Study From Estonia and Finland. *Journal for Nature Conservation*, *15*(1), 10–25. doi:10.1016/j.jnc.2006.08.001

Hrudey, S. E., Huck, P. M., Payment, P., Gillham, R. W., & Hrudey, E. J. (2002). Walkerton : Lessons Learned in Comparison With Waterborne Outbreaks in the Developed World. *Journal of Environmental Engineering and Science*, *1*, 397–407. doi:10.1139/S02-031

Humbert, J.-Y., Ghazoul, J., & Walter, T. (2009). Meadow Harvesting Techniques and Their Impacts on Field Fauna. *Agriculture, Ecosystems & Environment*, *130*(1-2), 1–8. doi:10.1016/j.agee.2008.11.014

Jamieson, T. S., Stratton, G. W., Gordon, R., & Madani, A. (2002). Phosphorus Absorption Characteristics of a Constructed Wetland Soil Receiving Dairy Farm Wastewater. *Canadian Journal of Soil Science*, *82*(1), 97–104. doi:10.4141/S01-042

Jones, P., Bunce, G., Evans, J., Gibbs, H., & Hein, J. R. (2008). Exploring Space and Place With Walking Interviews. *Journal of Research Practice*, *4*(2), 1–9.

Kanagy, C., Humphrey, C., & Firebaugh, G. (1994). Surging Environmentalism: Changing Public Opinion or Changing Publics. *Social Science Quarterly*, *75*(4), 804–819.

Kogan, M. (1998). Integrated Pest Management: Historical Perspectives and Contemporary Developments. *Annual Review of Entomology*, *43*, 243–70. doi:10.1146/annurev.ento.43.1.243

Krebs, J. R., Wilson, J. D., Bradbury, R. B., & Siriwardena, G. M. (1999). A Second Silent Spring? *Nature*, *400*, 611–612. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/21237033

Kusenbach, M. (2003). Street Phenomenology: The Go-Along as Ethnographic Research Tool. *Ethnography*, *4*(3), 455–485. doi:10.1177/146613810343007

Kvale, S., & Brinkmann, S. (2009). *InterViews: Learning the Craft of Qualitative Research Interviewing* (2nd ed.). Thousand Oaks: Sage Publications Inc.

Lee, P., Smyth, C., & Boutin, S. (2004). Quantitative Review of Riparian Buffer Width Guidelines From Canada and the United States. *Journal of Environmental Management*, *70*(2), 165–180. doi:10.1016/j.jenvman.2003.11.009

Leopold, A. (1949). *A Sand County Almanac*. New York: Oxford University Press.

Leopold, A. C. (2004). Living With the Land Ethic. *BioScience2*, *54*(2), 149–154.

Lowrance, R., Dabney, S., & Schultz, R. (2002). Improving Water and Soil Quality With Conservation Buffers. *Journal of Soil and Water Conservation*, *57*(2), 36–43.

Luken, J., & Thieret, J. W. (1996). Amur Honeysuckle, its Fall From Grace: Lessons From the Introduction and Spread of a Shrub Species May Guide Future Plant Introductions. *BioScience*, *46*(1), 18–24.

Lynne, G. D., & Rola, L. R. (1988). Improving Attitude-Behavior Prediction Models With Economic Variables: Farmer Actions Toward Soil Conservation. *Journal of Social Psychology*, *128*(1), 19–28.

Lynne, G. D., Shonkwiler, J. S., & Rola, L. R. (1988). Attitudes Behavior and Conservation. *Journal of Agricultural Economics*, *70*(1), 12–19.

Magdoff, F., & van Es, H. (2009). *Building Soils for Better Crops: Sustainable Soil Management* (3rd ed.). Waldorf, MD: Sustainable Agriculture Research and Education.

Manning, A. D., Fischer, J., & Lindenmayer, D. B. (2006). Scattered Trees are Keystone Structures – Implications For Conservation. *Biological Conservation*, *132*(3), 311–321. doi:10.1016/j.biocon.2006.04.023

Marshall, E. J. ., & Moonen, A. . (2002). Field Margins in Northern Europe: Their Functions and Interactions With Agriculture. *Agriculture, Ecosystems & Environment*, *89*(1-2), 5–21. doi:10.1016/S0167-8809(01)00315-2

Matson, P. A., & Vitousek, P. M. (2006). Agricultural Intensification: Will Land Spared from Farming be Land Spared for Nature? *Conservation Biology*, *20*(3), 709–710. doi:10.1111/j.1523-1739.2006.00442.x

Maybery, D., Crase, L., & Gullifer, C. (2005). Categorising Farming Values as Economic, Conservation and Lifestyle. *Journal of Economic Psychology*, *26*(1), 59–72. doi:10.1016/j.joep.2003.10.001

McDavid, J., & Hawthorn, L. (2006). *Program Evaluation & Performance Measurement: An Introduction to Practice*. Thousand Oaks: Sage.

McFarlane, B. L. (2005). Public Perceptions of Risk to Forest Biodiversity. *Risk analysis*, *25*(3), 543–53. doi:10.1111/j.1539-6924.2005.00623.x

McLaughlin, A., & Mineau, P. (1995). The Impact of Agricultural Practices on Biodiversity. *Agriculture, Ecosystems & Environment*, *55*(3), 201–212. doi:10.1016/0167-8809(95)00609-V

Merckx, T., Feber, R. E., Riordan, P., Townsend, M. C., Bourn, N. A. D., Parsons, M. S., & Macdonald, D. W. (2009). Optimizing the Biodiversity Gain From Agri-Environment Schemes. *Agriculture, Ecosystems & Environment*, *130*(3-4), 177–182. doi:10.1016/j.agee.2009.01.006

Millennium Ecosystem Assessment. (2005). *Ecosystems and Human Well-Being: Biodiversity Synthesis*. Washington DC.

Miller, J., Chanasyk, D., Curtis, T., Entz, T., & Willms, W. (2010). Influence Of Streambank Fencing With a Cattle Crossing on Riparian Health and Water Quality of the Lower Little Bow River in Southern Alberta, Canada. *Agricultural Water Management*, *97*(2), 247–258. doi:10.1016/j.agwat.2009.09.016

Mills, A., & Adl, M. S. (2006). The Effects of Land Use Intensification on Soil Biodiversity in the Pasture. *Canadian Journal of Plant Science*, *86*(5), 1339–1343.

Mills, J., Gaskell, P., Reed, M., Short, C., Ingram, J., Boatman, N., … Lobley, M. (2013). *Farmer Attitudes an Evaluation of Outcomes to On-Farm Environmental Management. Report to Department for Environment, Food and Rural Affairs*. Gloucester UK. Retrieved from http://socialsciences.exeter.ac.uk/media/universityofexeter/research/microsites/centreforruralpolicyresearch/pdfs/10570_FarmerAttitudesFinalReportIF01114.pdf

Mobley, C., Vagias, W. M., & DeWard, S. L. (2009). Exploring Additional Determinants of Environmentally Responsible Behavior: The Influence of Environmental Literature and Environmental Attitudes. *Environment and Behavior*, *42*(4), 420–447. doi:10.1177/0013916508325002

Moonen, A., & Barberi, P. (2008). Functional Biodiversity: An Agroecosystem Approach. *Agriculture, Ecosystems & Environment*, *127*(1-2), 7–21. doi:10.1016/j.agee.2008.02.013

Moonen, A. C., & Marshall, E. J. P. (2001). The Influence of Sown Margin Strips , Management and Boundary Structure on Herbaceous Field Margin Vegetation in Two Neighbouring Farms in Southern England. *Agriculture, Ecosystems & Environment*, *86*(1), 187–202.

Morris, C., & Potter, C. (1995). Recruiting the New Conservationists : Farmers ' Adoption of Agri-Environmental Schemes in the U.K. *Journal of Rural Studies*, *11*(1), 51–63.

Natural England. (2009). *Agri-Environment Schemes in England 2009: A Review of Results and Effectiveness*. Retrieved from http://www.naturalengland.org.uk/ourwork/farming/funding/aesiereport.aspx

Nocera, J. J., Parsons, G. J., Milton, G. R., & Fredeen, A. H. (2005). Compatibility of Delayed Cutting Regime With Bird Breeding and Hay Nutritional Quality. *Agriculture, Ecosystems & Environment*, *107*(2-3), 245–253. doi:10.1016/j.agee.2004.11.001

NS Agricultural Land Review Committee. (2010). *Preservation of Agricultural Land in Nova Scotia*. Retrieved from http://www.gov.ns.ca/agri/elibrary/nsalrc/AppendixF-AgriculturalProfiles-NS.pdf

NSFA. (2009). *Environmental Performance of the Agricultural Sector in Nova Scotia 2009: a Report Card*. Truro, NS.

ObjectPlanet Inc (2012). *Opinio Survey Software.* Oslo, Norway.

O'Neill, D. W., Tyedmers, P. H., & Beazley, K. F. (2006). Human Appropriation of Net Primary Production (HANPP) in Nova Scotia, Canada. *Regional Environmental Change*, *7*(1), 1–14. doi:10.1007/s10113-006-0021-1

Perfecto, I., Vandermeer, J., Mas, A., & Pinto, L. S. (2005). Biodiversity, Yield, and Shade Coffee Certification. *Ecological Economics*, *54*(4), 435–446. doi:10.1016/j.ecolecon.2004.10.009

Perlut, N. G., Strong, A. M., Donovan, T. M., & Buckley, N. J. (2008). Regional Population Viability of Grassland Songbirds: Effects of Agricultural Management. *Biological Conservation*, *141*(12), 3139–3151. doi:10.1016/j.biocon.2008.09.011

Phalan, B., Balmford, A., Green, R. E., & Scharlemann, J. P. W. (2011). Minimising the Harm to Biodiversity of Producing More Food Globally. *Food Policy*, *36*, S62–S71. doi:10.1016/j.foodpol.2010.11.008

Plummer, R., Spiers, A., & Summer, R. (2008). The Contributions of Stewardship to Managing Agro- Ecosystem Environments. *Journal of Sustainable Education*, *31*(3), 55–84.

Porteous, N. L., Sheldrick, B. J., & Stewart, P. J. (2002). Introducing Program Teams to Logic Models: Facilitating the Learning Process. *Canadian Journal of Program Evaluation*, *17*(3), 113–141.

Province of Nova Scotia. (2011). *Species at Risk List.* Retrieved from http://www.gov.ns.ca/natr/wildlife/biodiversity/species-list.asp

Province of Nova Scotia. (2012a). *Historic Wetland Loss in Nova Scotia.* Retrieved from http://www.gov.ns.ca/nse/wetland/historic-wetland-loss-ns.asp

Province of Nova Scotia. (2012b). *Private Land Conservation.* Retrieved from http://www.gov.ns.ca/nse/protectedareas/privateconservation.asp

QSR International Pty Ltd. (2012). *NVivo qualitative analysis software.*

Raykov, T., & Marcoulides, G. A. (2011). *Introduction to Psychometric Theory*. New York: Routledge Taylor & Francis Group.

Rey Benayas, J. M., & Bullock, J. M. (2012). Restoration of Biodiversity and Ecosystem Services on Agricultural Land. *Ecosystems*, *15*(6), 883–899. doi:10.1007/s10021-012-9552-0

Rideout, E. (2012). *Setbacks & Vegetated Buffers in Nova Scotia A review and analysis of current practices and management options*. Retrieved from http://sterlinglab.ca/setbacks-and-vegetated-buffers-in-nova-scotia?format=pdf

Ryan, G. W., & Bernard, H. R. (2003). Field Methods Techniques to Identify Themes. *Field Methods*, *15*(85), 85–109. doi:10.1177/1525822X02239569

SARE. (2004). *Opportunities in agriculture: Diversifying cropping systems*. Sustainable Agriculture Network. Retrieved from http://www.sare.org/bulletin/diversify

Scherr, S.J., & McNeely, J. A. (Eds.). (2007). *Farming with nature: the science and practice of ecoagriculture*. Washington: Island Press.

Scherr, S.J., & McNeely, J. A. (2008). Biodiversity Conservation and Agricultural Sustainability: Towards a New Paradigm of "Ecoagriculture" Landscapes. *Philosophical Transactions of the Royal Society/Biological sciences*, *363*, 477–494. doi:10.1098/rstb.2007.2165

Schirmer, J. (2009). Ethical Issues in the Use of Multiple Survey Reminders. *Journal of Academic Ethics*, *7*(1-2), 125–139. doi:10.1007/s10805-009-9072-5

Schirmer, J., Dovers, S., & Clayton, H. (2012). Informing Conservation Policy Design Through an Examination of Landholder Preferences: A Case Study of Scattered Tree Conservation in Australia. *Biological Conservation*, *153*, 51–63. doi:10.1016/j.biocon.2012.04.014

Scott, J. (2003). *Farm and Community Viability: Report on Interview Results.* GPI Atlantic. Retrieved from http://www.gpiatlantic.org/pdf/agriculture/farmviab.pdf

Segerson, K., & Miceli, T. J. (1998). Voluntary Environmental Agreements: Good or Bad News for Environmental Protection ? *Environmental Economics and Management*, *36*, 109–130.

Sharpley, A. N., McDowell, R. W., & Kleinman, P. J. A. (2001). Phosphorus Loss From Land to Water : Integrating Agricultural and Environmental Management. *Plant and Soil*, *237*, 287–307.

Sherren, K., & Verstraten, C. (2012). What Can Photo-Elicitation Tell Us About How Maritime Farmers Perceive Wetlands as Climate Changes? *Wetlands*, *33*(1), 65–81. doi:10.1007/s13157-012-0352-2

Smith, H., Firbank, L. G., & Macdonald, D. W. (1999). Uncropped Edges of Arable Fields Managed for Biodiversity Do Not Increase Weed Occurrence in Adjacent Crops. *Biological Conservation*, *89*, 107–111.

Smith, L. A, & Chow-Fraser, P. (2010). Impacts of Adjacent Land Use and Isolation on Marsh Bird Communities. *Environmental Management*, *45*(5), 1040–51. doi:10.1007/s00267-010-9475-5

StataCorp. (2011). *Stata Statistical Software: Release 12*. College Station, TX: StataCorp LP.

Statistics Canada. (2011). *Census of Agriculture, Farm and Farm Operator Data* (p. catalogue no. 95–640–XWE).

Statistics Canada. (2012). *Number of Farms, Farm Area, And Average Farm Size By Province, With Percentage Change Since 2006, Canada and the Provinces, 2011*. Retrieved from http://www.statcan.gc.ca/daily-quotidien/120510/t120510a001-eng.htm

Stromberg, B. E., & Averbeck, G. A. (1999). The Role of Parasite Epidemiology in the Management of Grazing Cattle. *International Journal For Parasitology*, *29*(1), 33–39. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/10048817

Tscharntke, T., Clough, Y., Wanger, T. C., Jackson, L., Motzke, I., Perfecto, I., … Whitbread, A. (2012). Global Food Security, Biodiversity Conservation and the Future of Agricultural Intensification. *Biological Conservation*, *151*(1), 53–59. doi:10.1016/j.biocon.2012.01.068

Turner, K., Lefler, L., & Freedman, B. (2005). Plant Communities of Selected Urbanized Areas of Halifax, Nova Scotia, Canada. *Landscape and Urban Planning*, *71*(2-4), 191–206. doi:10.1016/j.landurbplan.2004.03.003

Vickery, J. A., Feber, R. E., & Fuller, R. J. (2009). Arable Field Margins Managed for Biodiversity Conservation: A Review of Food Resource Provision for Farmland Birds. *Agriculture, Ecosystems & Environment*, *133*(1), 1–13. doi:10.1016/j.agee.2009.05.012

Vickery, J., Carter, N., & Fuller, R. J. (2002). The Potential Value of Managed Cereal Field Margins as Foraging Habitats for Farmland Birds in the UK. *Agriculture, Ecosystems & Environment*, *89*, 41–52.

Vieira, D. A. N., & Dabney, S. M. (2011). Modeling Edge Effects of Tillage Erosion. *Soil and Tillage Research*, *111*(2), 197–207. doi:10.1016/j.still.2010.10.007

Vining, J., Merrick, M. S., & Price, E. A. (2008). The Distinction between Humans and Nature : Human Perceptions of Connectedness to Nature and Elements of the Natural and Unnatural. *Human Ecology Review*, *15*(1), 1–11.

Wester, M., & Eklund, B. (2011). “My Husband Usually Makes Those Decisions”: Gender, Behavior, and Attitudes Toward Tte Marine Environment. *Environmental management*, *48*(1), 70–80. doi:10.1007/s00267-011-9676-6

Willock, J., Deary, I. J., McGregor, M. M., Sutherland, A., Edwards-Jones, G., Morgan, O., … Austin, E. (1999). Farmers’ Attitudes, Objectives, Behaviors, and Personality Traits: The Edinburgh Study of Decision Making on Farms. *Journal of Vocational Behavior*, *54*(1), 5–36. doi:10.1006/jvbe.1998.1642

Wilson, G. A. (1996). Farmer Environmental Attitudes and ESA Participation. *Geoforum*, *27*(2), 115–131.

Wilson, G. A, & Hart, K. (2000). Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. *Environment and Planning A*, *32*(12), 2161–2185. doi:10.1068/a3311

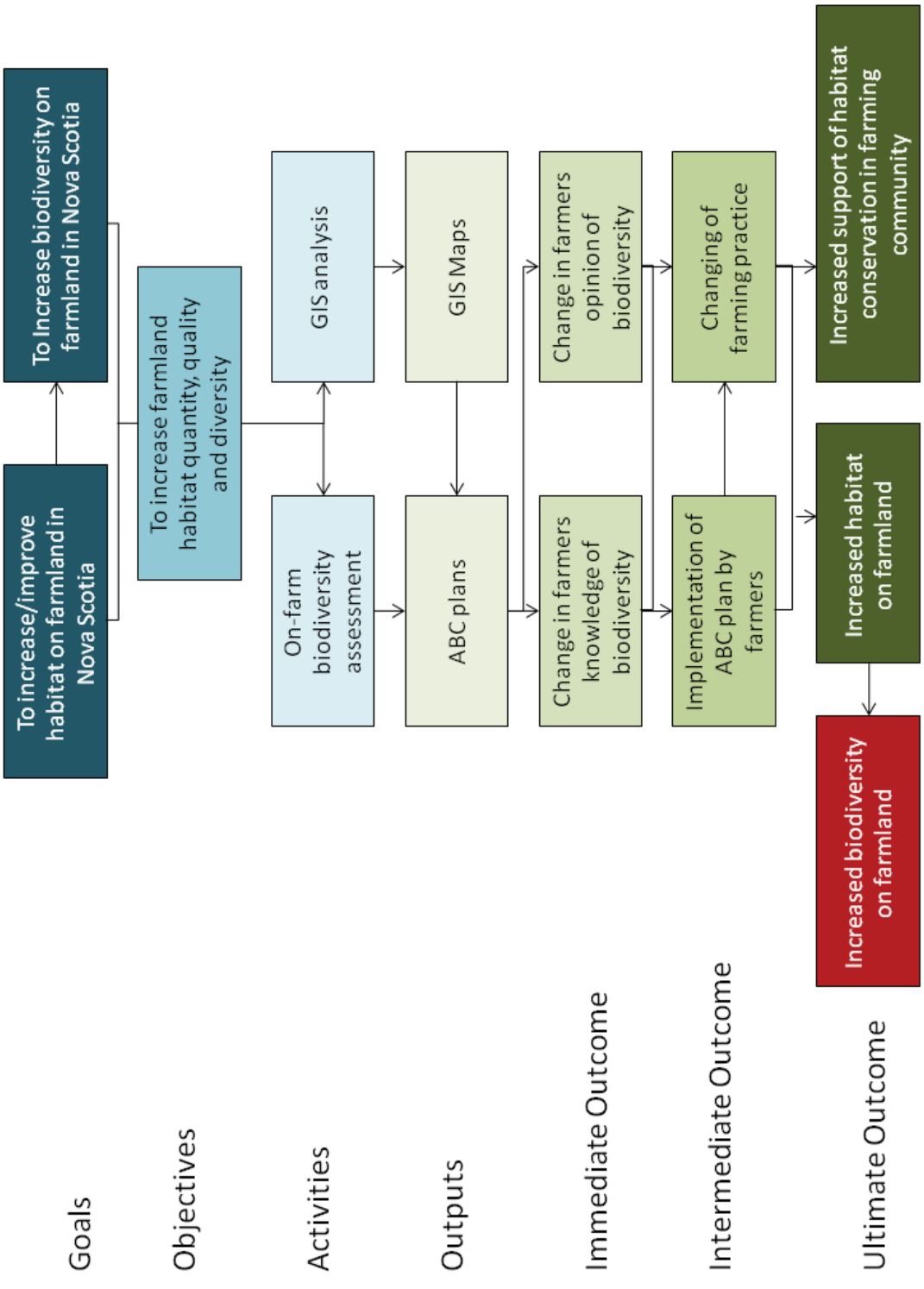
Wilson, G. A., & Hart, K. (2001). Farmer Participation in Agri-Environmental Schemes : Towards Conservation-Oriented Thinking? *Sociologia Ruralis*, *41*(2), 254.

Yang, M.-L., & Yu, R.-R. (2011). Effects of Identifiers in Mail Surveys. *Field Methods*, *23*(3), 243–265. doi:10.1177/1525822X11399401

Yiridoe, E. K., Atari, D., Gordon, R., & Smale, S. (2010). Factors Influencing Participation in the Nova Scotia Environmental Farm Plan Program. *Land Use Policy*, *27*(4), 1097–1106. doi:10.1016/j.landusepol.2010.02.006

Zhang, W., Ricketts, T. H., Kremen, C., Carney, K., & Swinton, S. M. (2007). Ecosystem Services and Dis-services to Agriculture. *Ecological Economics*, *64*(2), 253–260. doi:10.1016/j.ecolecon.2007.02.024

APPENDIX 1: LOGIC MODEL



APPENDIX 2: SURVEY

Biodiversity on Farms

How do you feel about it?

I am a graduate student at Dalhousie University and for my thesis research I am investigating how farmers in Nova Scotia feel about biodiversity on their land. You have been chosen to participate because you are a farmer in our study areas of Lunenburg, Annapolis or Cumberland counties. We do not have your contact details; this survey is being sent via the NSDNR.*(or NSFA depending on group)

This questionnaire should be filled out by the farm primary farm decision maker and should only take around 20 minutes.

Please try to answer all of the questions by either ticking a box, or circling the appropriate number. If there are any questions that you do not wish to answer, leave them blank and move to the next question. Partial responses are still useful to me.

All of your answers will remain anonymous. Your name will never appear with your answer, and only a summary of everyone's answers will be made public.

If you prefer, the same questionnaire is also available online at
http://tinyurl.com/farmsurvey2012

If you prefer to complete the questionnaire on paper, please return your completed survey using the postage paid envelope provided.

If you do not wish to complete the survey and want to avoid being sent any reminders please mail the blank copy of the survey or call me at the number below and your name will be removed from the mailing list.

Thank you for taking the time to read this and to consider helping me out in my research. If you have any questions regarding the survey, or about the survey findings please contact me at the details below, or my supervisor, Dr Kate Sherren, at kate.sherren@dal.ca or 902 xxx-xxxx.

Kate Goodale
goodale@dal.ca or 902-xxx-xxxx

School for Resource and Environmental Studies, Faculty of Management, Dalhousie University

Section I. Your Knowledge of Biodiversity

We are trying to understand how familiar farmers are with the term biodiversity, and how familiar they are with biodiversity as it relates to farming.

Please check the box indicating what you feel best answers the question:

1. How familiar are you with the term "biodiversity"?

Completely Unfamiliar (never heard of it)	**Somewhat Unfamiliar** (heard the term, but unsure of the meaning)	**Somewhat Familiar** (know its meaning, but do not use the term often)	**Completely Familiar** (use the term often)
☐	☐	☐	☐

2. Please tells us whether you agree or disagree with the following statements about biodiversity

	True	False	Unsure
Only native (naturally occurring in the area) organisms contribute to biodiversity	☐	☐	☐
Biodiversity only refers to animal life	☐	☐	☐
Wetlands (e.g. swamps, marshes) are particularly rich in biodiversity	☐	☐	☐
Successful farms cannot have biodiversity	☐	☐	☐
Aquatic animals (animals that live in water) do not contribute to biodiversity	☐	☐	☐
Fencing out cattle around water-ways helps preserve biodiversity	☐	☐	☐
Genetics has nothing to do with biodiversity	☐	☐	☐
There is a crucial link between biodiversity and habitat	☐	☐	☐
Wetlands filter water	☐	☐	☐

Section II. Your Opinion of Farm Biodiversity

We are hoping to better understand how farmers feel about biodiversity. Please indicate how you feel by circling the number that best describes your agreement or disagreement with each statement

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
It costs too much time/money to do extra projects to increase habitat (living space) on my property	1	2	3	4	5
I don't mind leaving some dead trees on my property	1	2	3	4	5
The health of my land is the best measure of success as a farmer	1	2	3	4	5
It is important to me to keep some areas wild on my property.	1	2	3	4	5
I am willing to accept some of the costs (financial or production) to have habitat on my land	1	2	3	4	5
Wildlife and people can co-exist on farmland	1	2	3	4	5
Crops lost to browsing animals (e.g. deer grazing) is acceptable	1	2	3	4	5
Habitat for wildlife attracts pests	1	2	3	4	5
I like to have trees of a range of ages across my property	1	2	3	4	5
I enjoy the look of wild areas	1	2	3	4	5
The primary purpose of forests (on farm property) should be for products and services that are useful to people	1	2	3	4	5
I do not want wild animals on my property	1	2	3	4	5
Passing on my land in a healthy condition is very important to me	1	2	3	4	5
I enjoy the look of a tidy property	1	2	3	4	5
The financial cost of leaving space for wildlife is something I am willing to accept	1	2	3	4	5
Money and profit are the most important things about farming	1	2	3	4	5

III. Biodiversity Related Practices

What is your personal experience with each of the following conservation practices?

	I have **not** used it, and have **no intention** of using it in the future	I have **not** used it, but would **consider** using it in the future	I **currently** use this practice and am likely to **continue** using it	I **currently** use this, but am **phasing it out**	I have **used** this in the past but **no longer use it**	This practice **does not apply** to my farm
Habitat creation *(e.g. bird/bat boxes, brush piles in unused areas)*	□	□	□	□	□	□
No till/reduced tillage	□	□	□	□	□	□
Wetland maintained/created on property	□	□	□	□	□	□
Restoration/conservation of natural areas *(e.g. woodlands)*	□	□	□	□	□	□
Tree-planting to create shelterbelts *(e.g. hedgerows or tree rows)*	□	□	□	□	□	□
Minimizing pesticide use *(e.g. decrease use, not using pesticides when ground is frozen or rain expected)*	□	□	□	□	□	□
Riparian zone management *(e.g. shoreline management, fencing of shorelines, wetland and stream buffers)*	□	□	□	□	□	□
Manure storage to prevent run-off	□	□	□	□	□	□
Rotational grazing	□	□	□	□	□	□
Postponing or modifying harvest/grazing in interest of wildlife habitat *(e.g. delayed haying for ground nesting birds, use of flushing bars)*	□	□	□	□	□	□
Other *(please describe)*	□	□	□	□	□	□

III. Biodiversity Related Practices (continued)

There is a possibility of using some of what you write in this section for publishing purposes. Would you be willing to let me use any direct quotes from this section?

□ **No** □ **Yes**

For any of the practices which you stated at left that you have undertaken, we would be grateful to hear briefly below why you undertook them.

Habitat creation

No till/reduced tillage

Wetland maintained/created on property

Restoration/conservation of natural areas

Tree-planting to create shelterbelts

Minimization of pesticide use

Riparian zone management

Manure storage to prevent run-off

Rotational grazing

Postponing or modifying harvest/grazing in interest of wildlife habitat

Other

IV. You and Your Farm

To better understand your answers in the previous sections, it is important that we know a little about you and your farm. Please answer the questions as best you can, if there are any questions that you do not wish to answer, or feel uncomfortable answering leave the question blank. **Remember that all answers are anonymous, and your name will never appear with your answers.**

1. How old are you? under 30 ☐ 31-40 ☐ 41-50 ☐ 51-60 ☐ 61-70 ☐ over 70 ☐

2. You are: male ☐ female ☐

3. What is the highest level of formal education that you have completed:

☐ Grade 9 or less
☐ Some high school
☐ High school graduate
☐ Technical school or Community college
☐ Some university
☐ University degree (Bachelors)
☐ Some graduate study
☐ Graduate university degree (Masters or PhD)

4. Did you farm register a profit in 2011? ☐ yes ☐ no

5. What is the approximate size of your property? _____ acres

6. Which category best describes your farm? what commodities do you produce? (check all that apply)

☐ Field Crops
☐ Field Crops and Cattle
☐ Cattle
☐ Horticulture
☐ Milk
☐ Other Livestock
☐ Other

I will also be carrying out interviews of farmers to explore their values related to biodiversity and their experiences. These interviews will be conducted during the summer months on the farmer's property at their convenience. These interviews are **completely voluntary, and farmers who choose to participate can opt out of the interview at any time.**

☐ No I am not interested in being interviewed ☐ Yes I am interested in being interviewed

If **yes**, please provide your contact information below:

Name:_____ Address:_____
Signature:_____ _____

Thank you for your participation, any information that you have disclosed in this questionnaire will not appear with your name at any time.

Telephone Number: _____

APPENDIX 3: REMINDER POSTCARDS

Biodiversity and Farms

Two weeks ago you were sent a survey seeking your input about biodiversity and farming. If you have already returned the survey, I would like offer my sincere thanks.

If you still have the survey, I encourage you to complete and return it as soon as possible.

Receiving your input will help me and future researchers learn about how farmers understand biodiversity, and will help to inform future projects about biodiversity and farming.

If you did not receive the survey, or it has been misplaced, or if you have any questions or if you do not wish to participate, please contact me at 902-XXX-XXXX or goodale@dal.ca

Sincerely,

Kate Goodale
Master of Environmental Studies Candidate
School for Resource and Environmental Studies
Dalhousie University

DALHOUSIE UNIVERSITY *Inspiring Minds*

NSFA 1895 FEDERATION OF AGRICULTURE

NOVA SCOTIA Natural Resources

FINAL SURVEY REMINDER

Biodiversity and Farms

I have been seeking your input on a survey about biodiversity and farming since early April. If you have already returned my survey, I would like to offer my sincere thanks.

If you still have the survey, I encourage you to complete and **return it by June 30th.** Alternately, you can complete the survey online at http://tinyurl.com/farmsurvey2012. Your input will help me understand about how farmers feel about biodiversity, and will inform future farm biodiversity projects and programs.

If you prefer not to complete the survey, you will not receive any further reminders. Thank you for your considering my request.

If you wish to reach me, please contact me at 902-XXX-XXXX or goodale@dal.ca

Sincerely,

Kate Goodale
Master of Environmental Studies Candidate
Dalhousie University

DALHOUSIE UNIVERSITY *Inspiring Minds*

NSFA 1895 FEDERATION OF AGRICULTURE

NOVA SCOTIA Natural Resources

APPENDIX 4: TELEPHONE SCRIPT

This script is intended to be used as a guide so that all participants are informed of the same information regarding interviews.

Hello [name of participant], my name is Kate Goodale and I am calling to thank you for taking the time to complete my survey about farming and biodiversity. Do you remember the survey? [if not, prompt with: It was about biodiversity and farming, it asked you some questions about the kinds of projects that you do on your farm for wildlife, and about how you feel about having wildlife on your property. It was sent out by the Department of Natural Resources/Federation of Agriculture]. I know that you are busy, and you taking the time to finish the survey has been really helpful for my research. A summary of the research findings will be available via the NSFA online newsletter.

You indicated on your survey that you were interesting in being interviewed. I'm calling to find out if you are still interested, are you still interested? [If yes, continue, if no: Thanks so much for your time. If you change your mind, please call me at 902-xxx-xxxx]

I'm planning on doing something a bit different for this interview. What I would like to do is have you show me around your property, instead of having the interview sitting across a table. Does this sound like something that you would be interested in? If you would prefer we could have the interview indoors, but since we are talking about wildlife and farming a tour of the property would be very useful to me in my research.

The interview would last about an hour, but if you would like to end it early for any reason you are free to do that. Also if you decide later that you want to be removed from the study, that is also fine, you just have to get in touch with me to do it.

When would be a good time for you to do the interview? Do you have an email address where I could send you a bit more information, and a copy of the consent form? [otherwise, the consent form will be sent by post]

Thank you so much for agreeing to participate in an interview. I really appreciate the time that you are dedicating and it will help me so much in my research.

APPENDIX 5: INTERVIEW GUIDE

These questions are intended to be used as a guide. Because this qualitative research project takes a grounded theory approach, any questions by the researcher will be open-ended and meant only to engage the participant in thoughtful conversation. Due to the semi-structured nature of the interviews, as well as the variation in interview locations not all questions could be asked in an identical manner. There are some questions that may apply to one participant, but not to another.

Preamble

Thank you so much for agreeing to participate in this interview. As you know, you have been chosen for an interview because you expressed interest on my survey that I sent you in the spring. I am hoping that you will be able to tell me a bit about your land, and the wildlife on it by showing me around. I expect that the interview will last no more than an hour, but you can choose to end it at any time if you wish. This is a confidential interview. I invite you to speak as openly and honestly as possible. You are welcome to talk about any issues that you think are important in relation to the wildlife on your farm, in whatever detail you feel is needed. There are no right or wrong answers or topics. Your insights will help me to better understand how farmers feel about biodiversity on their land, and I am really interested in what you have to say. If you feel uncomfortable with any of the questions, you do not have to answer them.

I would like to audiotape our conversation. This way I won't have to take notes and it will be easier to have a conversation. Do you give your permission from me to tape record our meeting? I will not use anything you say without your permission. Are you willing to wear a microphone?

Demographics

note: some of the demographics will have been established during the survey, these questions are intended to be supplementary to that information

How long have you owned this land? [prompt: more than 10 years? has it been in your family for a long time?]

Who owned the land before you? [prompt: family? someone different?]

How long has this land been a farm?

Do you know what this land was before it was a farm? [prompt: was it a forest? a swamp? too long to know?]

Give me a tour of some of the significant places for wildlife on your property.

For each location, ask "Why is this significant to you [prompt: why did you chose this place?]" *depending on how the participant responds to this question the path of the interview will change. Questions for different possible topics brought up by the participant can be found below. These questions could also be used as prompts about the places that the participant chooses to show.*

Interaction with wildlife

Do you think that wildlife is a net benefit or a net loss on your farm? [prompt: overall would you say that wildlife is a good thing or a bad thing on your farm? what is good about wildlife on your farm? what is bad about the wildlife on your farm?]

Is there a kind of plant or animal that you would like to see more of on your property? Does that play into the decisions that you make?

Is there a kind of plant or animal that you would not like to see more of on your property? Does that play into the decisions that you make?

Do you allow hunting or trapping on your property? [prompt: do you personally hunt?, has anyone ever hunted on your land?]

Biodiversity Related Practices

These questions will be asked in each interview, perhaps multiple times should the farmer show more than one habitat project during the tour.

When you make decisions about land use on your property do you consider what your neighbours are doing? Do your neighbour's actions regarding wildlife have any impact on the decisions you make on your property?

There are always tradeoffs that need to be made in farming, how do you choose what kind of "habitat projects" or "best management practices"? [prompt: how do you decide on other farming practices?]

What kind of habitat projects or best management practices have you undertaken on this farm, can you show me?

Have you noticed any changes to the land since doing those things?

How did you hear about that project?

Are you happy with the outcomes?

Are there any projects that you would like to do but cannot? Why not?

Are there any projects that you would not do? Why not?

Conclusion

Thank you for taking the time to talk with me. It has been a pleasure to learn more about your farm and the wildlife on it. If you have any questions, comments or concerns about the interview feel free to contact me at any time. As you know the information that you have provided will help to inform my research about how farmers in Nova Scotia feel about biodiversity on their land. I will get in touch with you about reviewing your transcript if you would like, as well as specific quotes that I might want to use in publications. Even though the interview is complete, you can choose to have your data removed at any time. If you are interested in the publications that results please get in touch with me and I can have those provided to you.

As a token of my thanks for the time that you have spent talking to me I have a $10 Irving gift certificate for you.

If the interview, for whatever reason, happens in a more formal setting (i.e. across a table) a more structured approach will be necessary. A script for this circumstance is provided below:

Preamble

Thank you so much for agreeing to participate in this interview. As you know, you have been chosen for an interview because you expressed interest on my survey that I sent you in the spring. I am hoping that you will be able to tell me a bit about your land, and the wildlife on it. I expect that the interview will last no more than an hour, but you can choose to end it at any time if you wish. This is a confidential interview. I invite you to speak as openly and honestly as possible. You are welcome to talk about any issues that you think are important in relation to the wildlife on your farm, in whatever detail you feel is needed. There are no right or wrong answers or topics. Your insights will help me to better understand how farmers feel about biodiversity on their land, and I am really interested in what you have to say. If you feel uncomfortable with any of the questions, you do not have to answer them.

I would like to audiotape our conversation. This way I won't have to take notes and it will be easier to have a conversation. Do you give your permission from me to tape record our meeting? I will not use anything you say without your permission.

Demographics

note: some of the demographics will have been established during the survey, these questions are intended to be supplementary to that information

How long have you owned this land? [prompt: more than 10 years? has it been in your family for a long time?]

Who owned the land before you? [prompt: family? someone different?]

How long has this land been a farm?

Do you know what this land was before it was a farm? [prompt: was it a forest? a swamp? too long to know?]

Biodiversity/Wildlife Values and Practices

1. There are always tradeoffs that need to be made in farming, how do you choose what kind of "habitat projects" or "best management practices"? [prompt: how do you decide on other farming practices?]
2. Do you think that wildlife is a net benefit or a net loss on your farm? [prompt: overall would you say that wildlife is a good thing or a bad thing on your farm? what is good about wildlife on your farm? what is bad about the wildlife on your farm?]
3. What kind of habitat projects or best management practices have you undertaken on this farm?
    a. Have you noticed any changes to the land since doing those things?
    b. How did you hear about that project?
    c. Are you happy with the outcomes?
4. When you make decisions about land use on your property do you consider what your neighbours are doing? Do your neighbour's actions regarding wildlife have any impact on the decisions you make on your property?

5. Are there any projects that you would like to do but cannot? Why not?
6. Are there any projects that you would not do? Why not?
7. Is there a kind of plant or animal that you would like to see more of on your property? Does that play into the decisions that you make?
8. Is there a kind of plant or animal that you would not like to see more of on your property? Does that play into the decisions that you make?
9. Do you allow hunting or trapping on your property? [prompt: do you personally hunt?, has anyone ever hunted on your land?]

Conclusion

Thank you for taking the time to talk with me. It has been a pleasure to learn more about your farm and the wildlife on it. If you have any questions, comments or concerns about the interview feel free to contact me at any time. As you know the information that you have provided will help to inform my research about how farmers in Nova Scotia feel about biodiversity on their land. I will get in touch with you about reviewing your transcript if you would like, as well as specific quotes that I might want to use in publications. Even though the interview is complete, you can choose to have your data removed at any time. If you are interested in the publications that results please get in touch with me and I can have those provided to you.

As a token of my thanks for the time that you have spent talking to me I have a $10 Irving gift certificate for you.

APPENDIX 6: MANUALLY GROUPED NODES MATRIX

Nodes and Themes	Farmer											
	1	2	3	4	5	6	7	8	9	10	11	12
Concerns for future												
Concern about leaving property to good heir	2	1	0	0	1	0	2	0	1	0	1	0
Dislike clear-cuts	1	9	0	1	3	1	3	1	0	0	2	0
Old ways	1	6	1	1	2	7	0	0	4	4	1	0
Their kids	2	1	0	1	2	1	0	0	3	0	2	0
TOTAL	**6**	**17**	**1**	**3**	**8**	**9**	**5**	**1**	**8**	**4**	**6**	**0**
Concerns reality of farming												
Critical of government	3	5	1	1	5	0	0	0	7	0	0	0
Critical of Neighbours	2	3	0	1	0	1	3	0	4	1	6	3
Damages by animals	5	1	2	1	5	0	1	0	3	4	3	0
Money as a barrier	3	2	1	0	1	0	0	1	3	6	1	0
Trade-off	1	0	0	2	1	1	0	4	1	0	3	5
Weather barriers	0	0	1	0	1	0	2	0	0	3	2	2
TOTAL	**14**	**11**	**5**	**5**	**13**	**2**	**6**	**5**	**18**	**14**	**15**	**10**
Farm's relationship with nature												
Admiration of nature	5	4	1	5	2	1	0	1	0	1	2	2
Balance	2	0	0	0	2	1	6	2	2	1	1	2
Co-existence with wildlife	0	3	0	2	5	1	0	2	0	0	1	0
TOTAL	**7**	**7**	**1**	**7**	**9**	**3**	**6**	**5**	**2**	**2**	**4**	**4**
Landscape												
Here is a neat spot	1	0	1	4	1	0	0	0	0	0	1	1
History of the area	4	3	1	4	4	0	1	0	1	2	1	6
Outdoor recreation	1	3	1	5	0	0	0	0	0	0	2	1
Property boundaries	1	0	0	2	1	1	0	0	0	2	3	0
Speed of re-growth	0	1	0	0	1	1	0	0	0	4	1	0
That was cut...	2	0	0	0	1	1	0	0	0	2	1	1
TOTAL	**9**	**7**	**3**	**15**	**8**	**3**	**1**	**0**	**1**	**10**	**9**	**9**
Motivation												
For an ecosystem service	1	0	4	0	2	0	0	2	2	0	1	0
It's the right thing to do	2	0	2	4	3	1	0	0	0	0	0	1
Not for wildlife	0	0	0	1	0	0	1	0	1	1	1	1
Pride	7	2	0	1	0	0	0	0	1	0	2	0
Thinking about long term impacts	7	3	3	1	1	2	1	3	6	1	0	0
TOTAL	**17**	**5**	**9**	**7**	**6**	**3**	**2**	**5**	**10**	**2**	**4**	**2**

APPENDIX 7: COPYRIGHT PERMISSION LETTERS

Figure 2.1 Classification of Ecosystem Services

ELSEVIER LICENSE
TERMS AND CONDITIONS

Aug 19, 2013

This is a License Agreement between Kathleen Goodale ("You") and Elsevier ("Elsevier") provided by Copyright Clearance Center ("CCC"). The license consists of your order details, the terms and conditions provided by Elsevier, and the payment terms and conditions.

All payments must be made in full to CCC. For payment instructions, please see information listed at the bottom of this form.

Supplier	Elsevier Limited The Boulevard,Langford Lane Kidlington,Oxford,OX5 1GB,UK
Registered Company Number	1982084
Customer name	Kathleen Goodale
Customer address	XXXXXXXXXXXX Halifax, NS XXX XXX
License number	3198800239655
License date	Jul 30, 2013
Licensed content publisher	Elsevier
Licensed content publication	Ecological Economics
Licensed content title	Ecosystem services and dis-services to agriculture
Licensed content author	Wei Zhang,Taylor H. Ricketts,Claire Kremen,Karen Carney,Scott M. Swinton
Licensed content date	15 December 2007
Licensed content volume number	64
Licensed content issue number	2
Number of pages	8
Start Page	253
End Page	260
Type of Use	reuse in a thesis/dissertation
Portion	figures/tables/illustrations

Number of figures/tables/illustrations	1
Format	electronic
Are you the author of this Elsevier article?	No
Will you be translating?	No
Order reference number	
Title of your thesis/dissertation	BIODIVERSITY AND FARMING: AN EVALUATION OF A VOLUNTARY STEWARDSHIP PROGRAM AND EXPLORATION OF FARMER VALUES
Expected completion date	Aug 2013
Estimated size (number of pages)	
Elsevier VAT number	GB 494 6272 12
Permissions price	0.00 USD
VAT/Local Sales Tax	0.0 USD / 0.0 GBP
Total	0.00 USD

Figure 6.1 Decision to adopt conservation activities

July 30th 2013

Countryside and Community Research Institute
University of Gloucestershire
Oxstalls Lane
Gloucester
Gloucestershire
GL2 9HW

I am preparing my Master of Environmental Studies thesis for submission to the Faculty of Graduate Studies at Dalhousie University, Halifax, Nova Scotia, Canada. I am seeking your permission to include a manuscript version of the following paper(s) as a chapter in the thesis:

Figure 1.1 Analytical framework for understanding link between farmer attitudes to environmental management and subsequent farmer behaviour and outcomes, Final Report: Farmer attitudes and evaluation of outcomes to on-farm environmental management, p. 2

Canadian graduate theses are reproduced by the Library and Archives of Canada (formerly National Library of Canada) through a non-exclusive, world-wide license to reproduce, loan, distribute, or sell theses. I am also seeking your permission for the material described above to be reproduced and distributed by the LAC(NLC). Further details about the LAC(NLC) thesis program are available on the LAC(NLC) website (www.nlc-bnc.ca).

Full publication details and a copy of this permission letter will be included in the thesis.

Yours sincerely,

Kathleen Goodale

Permission is granted for:

a) the inclusion of the material described above in your thesis.

b) for the material described above to be included in the copy of your thesis that is sent to the Library and Archives of Canada (formerly National Library of Canada) for reproduction and distribution.

Name: JANE MILLS Title: SRA MS

Signature: ___ Date: 5/8/13