USDA National Agroforestry Center

Inside Agroforestry

VOLUME 23 ISSUE 1

Helping Wildlife

Helps You!

NAC Director's Corner

A commentary on the status of agroforestry by Susan Stein, NAC Director

I am so excited and honored to be leading USDA's National Agroforestry Center and our knowledgeable staff, to support the increased adoption of agroforestry which, as we all know, can play a critical role in increasing the sustainability of agriculture and forestry practices.

This issue of Inside Agroforestry is focused on one of the many landowner objectives that agroforestry can support – wildlife. Enhancing wildlife habitat is something many landowners identify as an important motivator for establishing an agroforestry practice on their farm. My original reason for getting a Masters in Forestry was to learn how to integrate trees into farming systems in order to reduce siltation and enhance water quality for people and wildlife. In the many years since then, the need for this and other forms of agroforestry has only grown greater. Why? For one, working lands across the country and, hence, the local wildlife that depend upon them, are disappearing or being altered by increased housing density. As forests disappear, even those small patches that remain or are planted can become critical habitat for some wildlife species and, if placed appropriately, can help to provide a pathway for wildlife to travel across the landscape. For another, as production pressures on remaining agricultural lands increase, so do the nitrogen, phosphorous and other contaminants contained in run-off. The water-cleansing capabilities of forest buffers, in addition to the shade provided, can help to maintain water quality and water temperature, critical to the survival of many native aquatic species.

This issue of *Inside Agroforestry* describes opportunities for incorporating wildlife habitat into in a range of agroforestry practices, from shade grown coffee for birds, to riparian buffers that include pawpaws and hazelnuts for mussels and native hedgerows for pollinators. I hope that this issue inspires you to think about new ways to incorporate wildlife habitat into your future agroforestry plantings.

Sincerely,

Susan Stein

Presidential Memo on Pollinators

On June 20, 2014, the President released a Memorandum, "Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators." This memo emphasizes the importance of pollinators to American agriculture and acknowledges the significant loss that has occurred in the last few decades.

The memo also directs the heads of executive departments and agencies to take several import steps to help pollinators. These steps were described in a White House Fact Sheet.

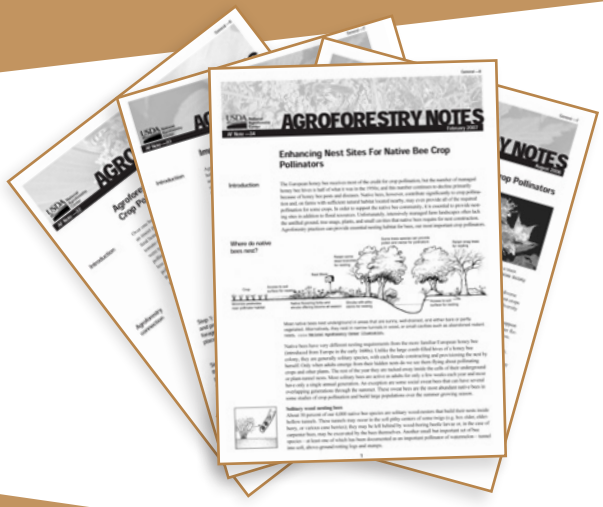
The memo:

- Directs the Federal Government to use its research, land management, education, and public/private partnership capacities to broadly advance honey bee and other pollinator health and habitat;
- Establishes a new Pollinator Health Task Force, co-chaired by United States Department of Agriculture and the Environmental Protection Agency, to develop a National Pollinator Health Strategy. The Strategy will include: a coordinated research action plan to understand, prevent, and recover from pollinator losses, including determining the relative impacts of habitat loss, pesticide exposure, and other stressors; a public education plan to help individuals, businesses, and other organizations address pollinator losses; and recommendations for increasing public-private partnerships to build on Federal efforts to protect pollinators;
- Directs Task Force agencies to develop plans to enhance pollinator habitat on federal lands and facilities in order to lead by example to significantly expand the acreage and quality of pollinator habitat, consistent with agency missions and public safety; and
- Directs Task Force agencies to partner with state, tribal, and local governments; farmers and ranchers; corporations and small businesses; and non-governmental organizations to protect pollinators and increase the quality and amount of available habitat and forage.

Related Publications

Updated Brochures

Four popular publications have been updated and re-released through partnerships with the Arbor Day Foundation and Scott Josiah, Nebraska State Forester. These publications cover four important topics: Productive Conservation, Marketing Specialty Forest Products, Hybrid Hazelnuts, and Edible Woody Landscapes for People and Wildlife. The last has particular relevance to this issue of Inside Agroforestry. The publications are intended for a general audience and can be useful in both rural and community settings. These publications are available to download or order through the NAC website at http://nac.unl.edu/publications/morepublications.htm.



Technical Resources for Pollinators

NAC has four technical publications that were developed with cooperation from the Xerces Society and the Agricultural Research Service (ARS). These publications (found in the Agroforestry Notes series) are for those who are thinking about the pollinators in their landscapes:

- Agroforestry: Sustaining Native Bee Habitat For Crop Pollination (AF Note #32)
- Improving Forage For Native Bee Crop Pollinators (AF Note #33)
- Enhancing Nest Sites For Native Bee Crop Pollinators (AF Note #34)
- Pesticide Considerations For Native Bees In Agroforestry (AF Note #35)

These resources give more detailed information on species considerations, habitat needs, and landscape design and are available to download from the NAC website: http://nac.unl.edu/publications/agroforestrynotes.htm.

Technical Resources for Wildlife Corridors

Other resources are available to assist in planning wildlife corridors, including information about management techniques, design guidelines, and landowner outreach:

- Riparian Buffer Design Guidelines for Water Quality and Wildlife Habitat Functions on Agricultural Landscapes in the Intermountain West
- Conservation Corridor Planning at the Landscape Level: Managing for Wildlife Habitat

These publications can be found by going to http://nac.unl.edu/research/publications.htm

Payments for Ecosystem Services, Working Lands, and Agroforestry:

Opportunities and Constraints

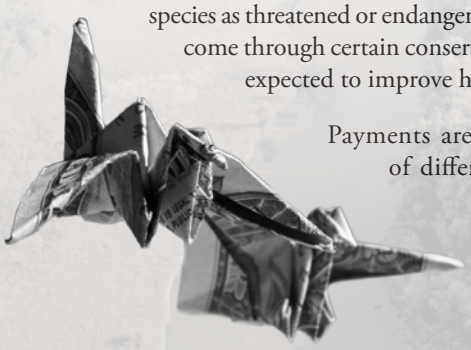
Kate MacFarland, Assistant Agroforester, United States Forest Service

Agroforestry is often used to increase the benefits landowners can get from any one acre. Economic, ecological, and social outcomes are enhanced. These ecological benefits are especially important due to the increasing demands being put on agricultural landscapes to not only produce food and fuel, but to provide wildlife habitat, clean water, carbon sequestration, and other similar benefits, or, ecosystem services.

Agricultural landscapes are particularly targeted for increasing wildlife habitat, since barriers to targeting other land use types (like cities) are too high. Many agricultural landscapes currently provide connectivity to existing habitat or could do so more effectively with minor changes. Landowners understand this; wildlife habitat provision is frequently seen as a reason to incorporate agroforestry practices into agricultural systems.

In recent years, payments for ecosystem services (PES) and ecosystem services markets (ESMs) for habitat are motivating landowners to manage their land for wildlife. Payments for ecosystem services are a way for businesses and other entities to pay for the benefits that agricultural lands provide (or could provide).

Types of payments for ecosystem services related to biodiversity and habitat vary. Some of these payments are mitigation markets (which can be for a single wildlife species or multiple species). These mitigation markets are intended to replace habitat that is destroyed elsewhere. These are developed because replacing certain kinds of destroyed endangered species habitat is required by law. Other habitat markets are voluntary; lack of habitat is identified as a factor that is reducing the viability of a particular species and market developers rely on the willingness of the public to pay to increase habitat protection. Sometimes voluntary markets develop as a result of concern over potential listing of a species as threatened or endangered. Still other payments come through certain conservation practices that are expected to improve habitat conditions.



Payments are managed by a range of different entities and have different buyers, sellers, and intermediaries, and as a result have different requirements for landowners (who act as suppliers or sellers). In some cases, traditional government conservation programs (like EQIP for wildlife and pollinators) pay for a service. Generally, these programs provide cost share for installing or creating the ecological structures to create habitat, not the ecosystem service itself. Other payments operate as a market, with buyers and sellers negotiating a price. Intermediaries who negotiate, manage, and validate the provision of ecosystem services are important parts of these systems.

> Some markets require the land to be entirely devoted to the service…

Payment for Ecosystem Services are highly variable with respect to their compatibility with working lands. Some of this variability corresponds to the species being protected; an animal that needs undisturbed ground-cover during the growing season is not compatible with row crop agriculture. Some markets require the land to be entirely devoted to the service and harvesting from the land is restricted. Others are more compatible with working lands, with seasonal restrictions on grazing or other disturbances.

Some limits also stem from a concern over "double dipping," when the landowner is paid twice for the same action. A concept that is important to many buyers of ecosystem services is *additionality*, the idea that without payment, the landowner wouldn't have made the change. Many buyers do not want to pay landowners for something they would have done without incentive. This can preclude harvesting from that area in particular (e.g. CRP). If you harvest a product from the protected area, the assumption is you did not change your practices solely for conservation, but also to profit from the product.

It is important to investigate how a landowner's existing operation is or is not compatible with a potential payment and decide whether the landowner is interested in adjusting their operation accordingly. Think about the time frame under which the agreement would exist; some PES time frames are longer than landowners are comfortable agreeing to. How will these agreements affect landowners if they decide to sell the land?

Different payments have different degrees of compatibility with various land management practices related to agroforestry, such as farming adjacent to the payment area, grazing in the payment area, harvesting non-timber forest products from the payment area, or harvesting timber from the payment area.

For more information on ecosystem services visit
http://www.fs.fed.us/ecosystemservices/

Agroforestry Riparian Buffers:

A Look on the Wild side

By Katie Commender, USFWS
Partners for Fish & Wildlife Volunteer
Abingdon, VA

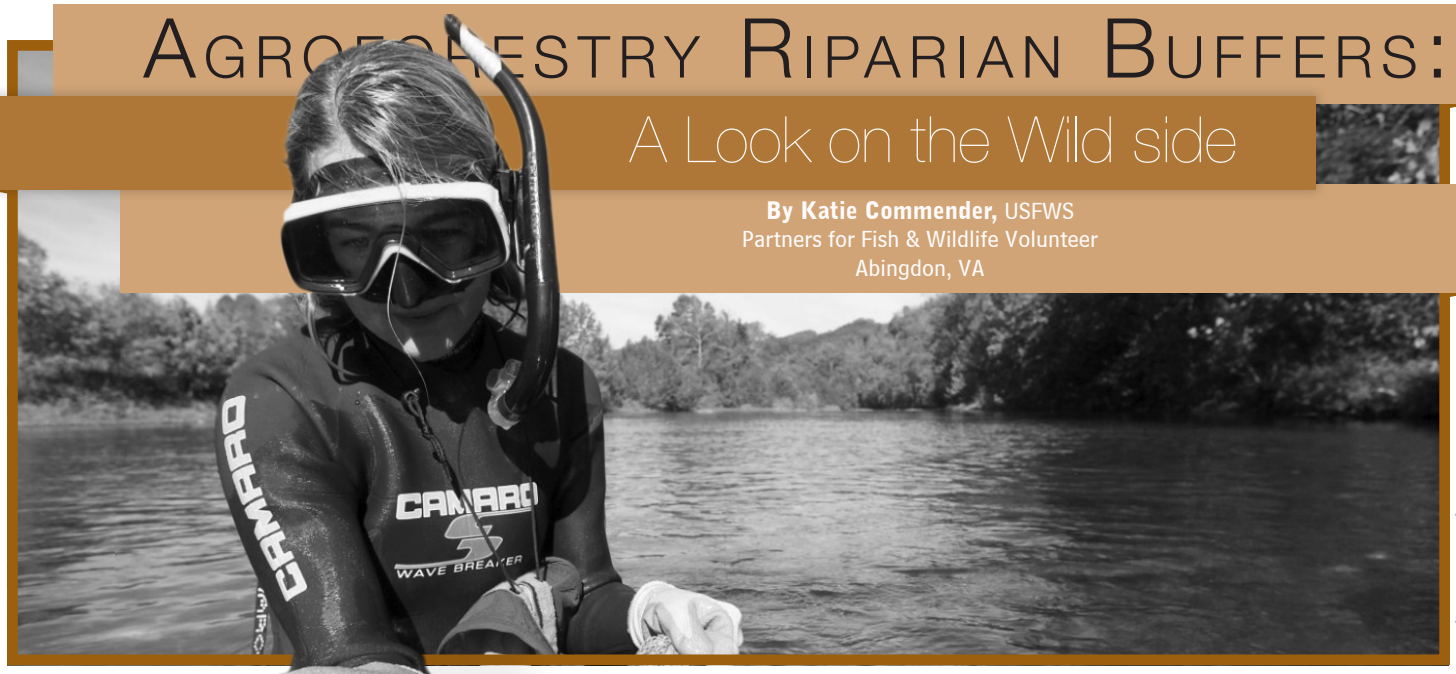


Photo courtesy of Jack Looney

It's been a long, downhill spiral for many fish and mussels in the southeast.

Of the 85 mussel species historically found in the Upper Tennessee River Basin (UTRB), 11 are now extinct and 31 are federally listed. Water pollution, dam construction and invasive species introductions have shared a combined role in this drastic decline. A variety of restoration approaches are needed in order to improve aquatic habitat and prevent more species from becoming extinct. One, rather unorthodox, method that the US Fish & Wildlife Service's (USFWS) Partners for Fish & Wildlife (PFW) program is implementing in the UTRB is the establishment of fruit and nut producing trees and shrubs, like pawpaws and hazelnuts. Initiated in 2013, in partnership with Appalachian Sustainable Development, this agroforestry riparian buffer program was designed to increase landowner adoption of riparian buffers. It has since brought about the protection of 8 acres of riparian land, with 25 additional acres slated for the next two years. While traditional single-use buffers take land out of production, multifunctional agroforestry riparian buffers provide an alternative fruit and nut crop to farmers. As many farmers rely on floodplains for agricultural or livestock production financially, simply taking this land out of production is not economically feasible. Alternative, profitable crops, like fruits and nuts, thus become essential to the economic viability of these buffers.

We can see that fruits and nuts can economically benefit landowners, but what benefits could they possibly have for threatened and endangered (T&E) fish and mussel species? The simple answer- a lot. When planted in a riparian area along an impaired waterway, pawpaws and the like can perform a variety of functions. Picture their root systems underground, anchoring into the stream bank and creating a living retaining wall. This wall also helps to reduce erosion and sediment inputs, and maintain stream channel stability by dissipating stream flow energy. With soil as the largest contributing pollutant to our water, these intricate root systems are of dire importance. When excess soil enters a stream, a myriad of implications ensue. Suspended sediment can lead to gill erosion, decreasing the amount of oxygen aquatic biota can intake. Within the streambed itself, sediment embedded between rocks reduces aquatic habitat that is critical for breeding and cover. Tree and shrub roots can diminish these effects and give aquatic T&E species a fighting chance.

As we surface from the root system, we find ourselves standing in a vegetated floodplain. During rain events, this vegetation slows down runoff water that transports upland sediment, nutrients, waste and pesticides. In doing so, the buffer absorbs and retains these inputs before they ever enter the stream. Excess nutrients, such as phosphorus, can lead to an increase in aquatic plant growth, such as algal blooms. When the algae decompose, oxygen levels in the stream decrease and aquatic insects being to perish. Without adequate oxygen levels and food, T&E fish and mussel species die. When waste then enters the watershed, it is broken down by bacteria, further consuming available oxygen.

See **Mussels** Page 9

Photo by Katie Commender

Agroforestry Riparian Buffer at the Stone Creek Outdoor Classroom & Park in Lee County, VA

Photo by Jack Looney

Cumberlandian moccasinshell found in Wallen's Bend, Clinch River, in Hawkins County, TN.

on Agricultural Lands:

Creating Wildlife Habitat through Agroforestry

Gary Bentrup
Research Landscape Planner
United States Forest Service

The 2014 Farm Bill reduces conservation program spending by $6 billion — the first decrease in conservation funding by a Farm Bill since the inclusion of conservation incentives in 1985. These funding cuts will impact habitat enhancement on private lands, typically accomplished through Farm Bill incentive programs such as the Conservation Reserve Program (CRP) and the Wildlife Habitat Incentives Program (WHIP). CRP lands alone will shrink from 32 million acres in the previous Farm Bill to 24 million acres by 2017 (NWF 2014). So the question becomes: What other options can produce economic benefits for ranchers and farmers while also providing wildlife benefits?

One key option in the toolbox is agroforestry — the intentional combination of agriculture and forestry to create an integrated and sustainable land-use system for the benefit of both landowners and wildlife. This integrated approach is essential, given that nearly 51 percent of land use in the U.S. is dedicated to agricultural production (Nickerson et al. 2011). Farms and ranches are therefore a critical piece in the conservation puzzle, as actions taken on these working landscapes have an impact on wildlife and the health of ecosystems.

Agroforestry and Wildlife

The types of wildlife that can benefit from such agroforestry practices will vary with region and ecotype and depend on the landscape context and size of the area and the types, spatial configuration, and age of the plantings. Alone or in combination, agroforestry approaches can provide multiple benefits to wildlife.

Protect Aquatic Habitats.
Agroforestry practices provide living cover, which intercepts sediment, nutrients, and other materials in surface runoff and in shallow subsurface water flow, preventing them from getting into streams, lakes, or wetlands. Riparian forest buffers can also reduce bank erosion and in-stream sedimentation, and help maintain water temperatures for cold water fisheries.

Since 1999, over 1,100 acres of riparian forest buffers and other restoration measures have been implemented

In the Tucannon River in Washington, for example, spring Chinook salmon (*Oncorhynchus tshawytscha*) runs hit a low of 54 fish in 1995 and juvenile salmonids were absent in lower reaches of the river. Since 1999, over 1,100 acres of riparian forest buffers and other restoration measures have been implemented, reducing summer water temperatures by about 10 degrees Fahrenheit (Smith 2012). Young salmon are now using areas of the river that were previously too warm for them, and returning Chinook adults have increased in number to 1,239 in the year 2012 (Gallinat and Ross 2013).

Stabilize Habitat.
Croplands are subject to frequent disturbances that can impact shelter and food sources for wildlife. Agroforestry practices offer more constant habitat in these shifting landscapes, and the woody structure and associated understory increase niche diversity. For example, often surrounded by an ephemeral sea of annual crops, multi-row windbreaks (created with woody species such as bur oak, Osage orange, black walnut, and hackberry) can provide valuable year-round habitat for over 108 bird species and 28 species of mammals in the Midwest (Johnson and Beck 1988).

Restore Forest.
Only 4 percent of longleaf pine forests remain in the eight states of the southeast coastal plain, a preferred forest type of the redcockaded woodpecker (RCW) (*Picoides borealis*) (Franklin 2008). RCWs require large tracts of mature pine stands, with an open understory free of mid-story hardwoods. Silvopasture — the practice of combining forestry and rotational grazing — can create this habitat condition by using livestock to control understory vegetation. Annual income from livestock and long-term income from timber production give silvopasture an economic advantage over traditional forestry as a means to restore longleaf pine forests — land expectation values estimated at approximately $1,800 more per acre over an 80-year rotation when compared to traditional forest plantation management (Stainback and Alavalapati 2004).

Manage Pesticide Risks.
Current farming methods rely heavily on pesticides, which can have harmful effects on sensitive wildlife, particularly insects, amphibians, fish, and other aquatic species. Windbreaks, hedgerows, riparian buffers, or alley cropping can help contain drifting pesticides. Tree and shrub layers provide a large surface area over which particles

of pesticides may adhere, and also provide wind-speed reduction at the application site, reducing the movement of pesticides off their target. In addition, woody species incorporated directly into cropping systems can reduce pesticide use by providing essential habitat for beneficial predators of crop pests. An alfalfa-walnut alley cropping system in eastern Missouri, for example, supported twice as many predators and parasitic hymenoptera and half as many pest herbivores as did alfalfa alone (Stamps et al. 2002).

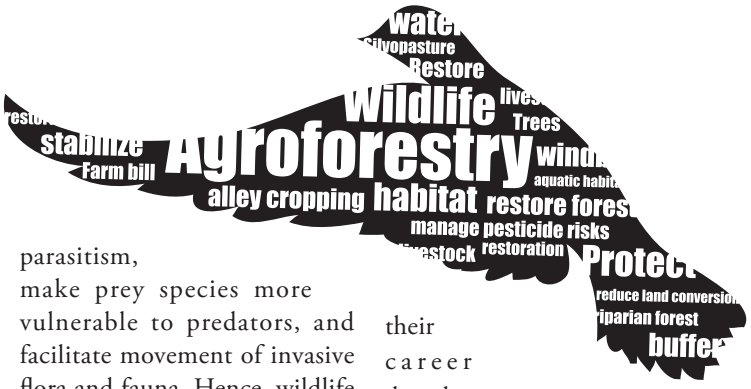
Restore Connectivity.

Agroforestry can decrease the impacts of habitat fragmentation by reducing habitat isolation if plantings are well planned and connected with other habitats. For example, in the Tensas River basin in northern Louisiana, a study documented corridor use by the threatened Louisiana black bear (*Ursus americanus luteolus*). In an area dominated by extensive crop fields, bears used riparian forest buffers, ranging in width from 15 to 250 feet, to travel between hardwood patches (Anderson 1997).

Reduce Land Conversion. Between 1982 and 2010, about 24,125,400 acres of agricultural land were converted to developed uses — an area approximately the size of Indiana (USDA 2013). Such conversion can transform farms and ranches into fragmented and extensively modified urban or suburban patches, much to the detriment of wildlife. Agroforestry can reduce such conversion by diversifying short- and long-term income sources, giving landowners economically sustainable alternatives to selling their land for development. For example, the Travis family has saved their northern Illinois farm by using their 26-acre woodlot for forest farming (NAC 2006). "Harvesting and selling wild onions known as ramps from our woodlot generates almost 70 percent of our total farm income," says landowner Marty Travis.

Balancing Economics and Ecology

For all the benefits agroforestry practices can have, they may also prove detrimental to certain wildlife populations if they are located, designed, and managed inappropriately. For example, the creation of poorly designed edge habitat may benefit generalist species over specialists, promote parasitism, make prey species more vulnerable to predators, and facilitate movement of invasive flora and fauna. Hence, wildlife biologists should be involved in agroforestry projects to ensure the systems are designed to achieve desired wildlife goals and minimize potential negative impacts.



From California's Central Valley croplands to southeastern pasturelands to New England woodlots, wildlife biologists are assisting private landowners and other resource professionals in implementing agroforestry systems that accomplish wildlife stewardship while producing economic services. Biologists from governmental agencies, nonprofit organizations, and consulting companies are using their expertise to benefit game and non-game wildlife as well as imperiled species. Indications are that this is a growing field, so wildlife biologists of the future may want to consider incorporating agroforestry into their career development. As one student who recently completed an agroforestry class at Virginia Tech states, "It changed the way I look at problem-solving. Instead of insulating factors, taking a holistic approach is very real-world applicable and valuable."

With increasing demands from society for limited resources, agroforestry will likely be one source of solutions as people find it increasingly necessary to achieve multiple social, economic, and ecological objectives on the same plot of land.

Adaptation of an article first published in The Wildlife Society News June 16, 2014:

http://news.wildlife.org/twp/a-win-win-on-agricultural-lands/

Photos by NAC

Riparian Forest Buffers: Streamside plantings of trees, shrubs, and grasses serve as buffers that reduce water pollution and bank erosion, protect aquatic environments, and enhance wildlife habitat.

Alley Cropping: Widely spaced rows of high value trees such as black walnut and pecan create alleyways for crops, an additional source of cash flow for landowners, and provide habitat for birds and other wildlife species

Windbreaks: Rows of trees and shrubs planted in agricultural fields can reduce wind speed and the aerial spread of pesticides. In addition they can improve crop yields, reduce soil erosion, improve water-efficiency, and protect live-stock.

Silvopasture: This agroforestry approach combines forestry, forage, and livestock production on the same field. The trees are managed for wood and, at the same time, provide shade and shelter for livestock as well as wildlife habitat.

Shade Coffee

Benefits for wildlife and growers

Edwin Mas
Plant Materials Specialist
National Resource Conservation Service

Kate MacFarland
Assistant Agroforester
United States Forest Service

Shade coffee production and other types of coffee production systems that retain trees can benefit wildlife. Shade coffee production in Puerto Rico has experienced a resurgence during recent years, after having previously undergone a dramatic period of deforestation to convert to coffee production under full sun. Shade coffee production combines coffee shrubs and shade trees that form a secondary forest. Shade coffee production provides environmental benefits such as soil erosion control, water quality and quantity improvement, and wildlife habitat. It can also provide socioeconomic benefits such as the production of other sustainable forest products, and the reintroduction of traditional jobs and cultural activities for local coffee pickers.

What do these systems look like?

Coffee shrubs require certain environmental and ecological conditions to perform at their best in terms of vigor, growth and berry production. These conditions are achieved by planting coffee in locations with the most suitable environmental conditions. In Puerto Rico, not all coffee plantations are located in areas that are ecologically suitable for coffee growth. Therefore, recreating favorable coffee growing conditions may be beneficial for both coffee production and for the environment.

For example, the optimum growth temperature for arabica coffee varies from 60° to 65° F. With these conditions, coffee shrubs grow adequately, developing vigorous and healthy branches and leaves.

> Forest-based pollinators have been shown to increase coffee yields by 20% within one kilometer of the forest.

The temperature in Puerto Rico's coffee zone fluctuates between 55° to 85° F. One method to maintain ideal coffee-growing temperatures is to manage shade on the plantation. Healthy coffee plantations also require adequate moisture, in terms of both rainfall and relative humidity. Coffee shrubs require 70 to 100 inches of rain per year and a relative humidity of 70 to 85%. Shade trees help to reduce potential evapotranspiration by modifying solar radiation. The amount of solar light in shade coffee plantations can be managed by pruning shade trees.

Benefits to Wildlife

A number of studies have compared species richness and composition in shade grown coffee and neighboring forest reserves (Bhagwat et al. 2008). Arthropods and birds use shade coffee plantings as habitat. Migratory birds use shade coffee more than resident birds, but researchers have found that the number of species of birds in coffee plantations with structurally and floristically diverse canopies is similar to the number of species in natural forest habitat and is higher than other agricultural landscapes without trees.(Perfecto et al. 1996). However, edge species are favored and heavily pruned plantations can exclude birds that depend on other forest layers.

Shade coffee plantations can serve as corridors between forest fragments for mantled howling monkeys (*Alouatta palliate*) in Nicaragua (Williams-Guillen et al. 2006). Shade grown coffee is especially important to wildlife in places and periods where deforestation is common; in these landscapes, shade grown coffee provides an important refuge. Researchers have suggested that both birds and orchids have survived periods of deforestation in Puerto Rico due to the presence of shade coffee plantations (Perfecto et al. 1996). These areas can also be seed sources for replanting many tree species.

Photo by Edwin Mas

Coffee beans grown in a shade coffee system ripen on plant.

Photo by Rich Straight

Coffee grows beneath plantains in this shade coffee system.

Benefits to Growers

Coffee growers also benefit from the pollinator habitat that shade coffee provides. These systems provide habitat for not only avian wildlife, but also pollinators. Forest-based pollinators have been shown to increase coffee yields by 20% within one kilometer of the forest. This pollination can also improve coffee quality; the frequency of small, misshapen seeds ("peaberries") is reduced by 27%. Between 2000 and 2003, pollination services from two forest fragments (46 and 111 hectares) translated into $60,000 (U.S.) per year for one Costa Rican farm (Ricketts et al. 2004).

Forests also can provide habitat for native coffee pest predators, particularly the coffee borer beetle. In Costa Rica, birds reduced coffee borer infestation by about 50%. These bird species were more common on coffee plantations with higher forest cover. On average, forest elements doubled bird pest control, from 2 to 4% of berries saved. These trees were largely privately owned and voluntarily maintained, rather than being part of a protected area. The prevented borer damage represented a significant gain in income for coffee producers (Karp et al 2008).

Producing coffee in agroforestry systems allows growers to reduce their risk by growing other products as well. Overstory species can provide fruits, fuel, and construction materials for use at home or to be sold in the market (Perfecto et al. 1996).

Bhagwat, S. a, Willis, K. J., Birks, H. J. B., & Whittaker, R. J. (2008). Agroforestry: a refuge for tropical biodiversity? Trends in ecology & evolution, 23(5), 261–7. doi:10.1016/j.tree.2008.01.005

Karp, D. S., Mendenhall, C. D., Sandí, R. F., Chaumont, N., Ehrlich, P. R., Hadly, E. a, & Daily, G. C. (2013). Forest bolsters bird abundance, pest control and coffee yield. Ecology letters, 16(11), 1339–47. doi:10.1111/ele.12173

Perfecto, Ivette, Robert A. Rice, Russell Greenberg and Martha E. van der Voort. (1996). Shade Coffee: A Disappearing Refuge for Biodiversity. BioScience, 46(8), 598-608.

Ricketts, T. H., Daily, G. C., Ehrlich, P. R., & Michener, C. D. (2004). Economic value of tropical forest to coffee production. Proceedings of the National Academy of Sciences of the United States of America, 101(34), 12579–82. doi:10.1073/pnas.0405147101

Williams-Guillen, K. et al. (2006) Resource availability and habitat use by mantled howling monkeys in a Nicaraguan coffee plantation: can agroforests serve as core habitat for a forest mammal? Animal Conservation, 9, 331–338.

Mussels

Continued from page 5

Topped off with pesticides, the elimination of aquatic species multiplies. As this process ensues, the need for establishing agroforestry riparian buffers becomes increasingly apparent.

From floodplain to treetop, riparian buffers support a world teeming with life. The federally listed Indiana bat roosts within the tree cavities and loose bark. Mammals, such as bears, use the corridor below for travel and forage, amphibians hibernate under logs, and reptiles come ashore to breed and nest. The tree canopy above buzzes with bees as they land from one flower to the next, setting the stage for a bountiful season of fruits and nuts for all to enjoy. Chirping baby birds impatiently await their next meal, while a bald eagle perched above scouts for prey. Meanwhile, under the surface of the water, the federally listed Yellowfin madtom fish and birdwing pearly mussel enjoy the shade of the canopy above. Mimicking an umbrella, the canopy shades the water and reduces the temperature that can further exacerbate algal blooms and their associated implications.

If we take a look on the wild side, we encounter a biologically diverse riparian ecosystem swimming, hovering and buzzing with life. From the canopy above to the water below, agroforestry riparian buffers enhance and protect the aquatic and terrestrial habitat needed for wildlife to thrive. At first glance, the pawpaw may seem meager, but as you walk along the floodplain, a new perspective is gained, and the mighty fruit tree rises to the top.

Diverse native hedgerows deliver healthier crop systems

Nancy Lee Adamson, Pollinator Conservation Specialist, Xerces Society/NRCS ENTSC
Rachael F. Long, Farm Advisor, Univ. of California Cooperative Extension

Pollinators and many beneficial insects feed on nectar or pollen as adults. The flowering native shrubs in the hedgerows provide not only vital nutrients, but also habitat and protection from pesticides.

Hedgerows (sometimes also called shelterbelts) with diverse native plants supply food and shelter for a wide range of wildlife while also protecting watersheds, and improving air quality, among many other benefits. Hedgerows with a mix of native flowering shrubs, small trees, wildflowers, and grasses form permanent shelter typically bordering crops, often on land that is least suited to crop farming, in natural borders, or surrounding riparian areas. Diverse native hedgerows provide a haven for wildlife in farmlands, and ensure a supply of beneficial insects and insectivorous birds for controlling pests in adjacent (and successive) crops. They may also produce harvestable fruits or herbs, and provide a renewable source of firewood.

Syrphid Fly

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Diverse native plant hedgerows directly contribute to pest management on farms, but farmers sometimes worry that natural areas near crops may attract pests or entice pollinators away from crops. Here we highlight research in California's Yolo County to inform that concern.

Beginning in 1999, Drs. Lora Morandin and Claire Kremen from the University of California at Berkeley and Rachael Long from the UC Cooperative Extension Service compared beneficial and pest insect populations in diverse native hedgerows, weedy (semi-managed) field borders, and adjacent croplands. They found that native plant hedgerows exported beneficial insects (including predators of pests) into adjacent crop fields.

The California researchers found that diverse native hedgerows support more beneficial insects relative to pest species throughout the growing season. Plants with beneficial insects in greatest abundance were in flower at the time of sampling, a reminder that having plants in bloom through the season is vital for ensuring the presence of beneficial insect populations.

Pests were much more abundant in semi-managed weedy field borders, particularly during summer months, than in the native hedgerow plantings. Beneficial and pest populations varied greatly by plant species. Growers should be sure to choose species that are locally appropriate and adapted to site conditions. Local NRCS and Cooperative Extension staff may have plant recommendations specific to your region—plants to support beneficials known to be most effective in helping to control locally significant pest populations.

The hedgerow plants observed in this study included west coast natives with successive and overlapping

Parasitic Wasp

© 2004 Regents of the University of California

Background Photo by Lora Morandin

Lady beetle

bloom periods from March to December, including California lilac (*Ceanothus griseus*), coffeeberry (*Rhamnus californica*), California buckwheat (*Eriogonum fasciculatum*), toyon (*Heteromeles arbutifolia*), elderberry (*Sambucus mexicana*), and coyote bush (*Baccharis pilularis*). Every region hosts locally native shrubs appropriate for specific site conditions to enhance flower availability through the growing season. These California hedgerow plantings were also bordered by native grass strips designed for suppressing weeds and providing overwintering habitat for beneficial insects. Current hedgerow planting recommendations include diverse native wildflowers (see publication #8390 at http://anrcatalog.ucdavis.edu and http://www.xerces.org/pollinator-conservation/agriculture/pollinator-habitat-installation-guides/).

Note that the key to successful hedgerow plantings is enhancing diversity on farms. Diverse hedgerow plantings support a greater diversity of insects and spiders throughout the growing season. Successful biological control of crop pests by natural enemies does not mean eliminating pest populations, only reducing the pest populations below an economic threshold (the level of herbivory that affects economic returns). If we expect predators to help control pest populations when they spike, we cannot eliminate all their prey. Beneficials are susceptible to the same pesticides that target pest species. When growers harvest crops or treat their crops with pesticides, hedgerows adjacent to crops (if protected from pesticides) are essential refuges for predators and pollinators, ensuring healthy populations are able to recolonize or pollinate adjacent and succeeding crops.

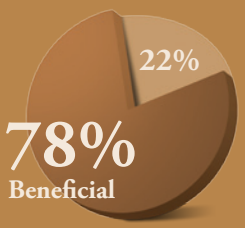
Examples of Beneficial Insects

Predators of Pests	Examples of Prey
Lady beetles	Aphids, mealybugs, mites, whiteflies, scale, psyllids
Lacewings	Aphids, mealybugs caterpillars, scale, whiteflies, insect eggs
Predatory bugs, minute pirate, big-eyed and assassin bugs	Aphids, thrips, scale, caterpillars, beetles, mealybugs, whiteflies
Parasitoid wasps	Insect eggs, caterpillars, aphids, scale, flies, plant bugs, beetles
Parasitic flies	Caterpillars

Photo by Antonio Pecchia. Modifications made.

Did you know?

Of 10,323 insects collected in the hedgerows during the growing seasons over 2 years, 78% were beneficial insects and 22% were pests.



Source: Morandin, L., Long, R. F., Pease, C., & Kremen, C. (2011). Hedgerows enhance beneficial insects on farms in California's Central Valley. California Agriculture, 65(4), 197–201. doi:10.3733/ca.v065n04p197

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December 12, 2014
Forest Botanicals: Deep and Tangled Roots
Webinar
http://cc.readytalk.com/cc/s/registrations/new?cid=sodq9sgrbjol

December, 8-12 2014
ACES Conference: A Community on Ecosystem Services
Washington, DC
http://www.conference.ifas.ufl.edu/aces

February 4-7, 2015
PASA Farming for the Future Conference
State College, PA
http://conference.pasafarming.org

February 26-28, 2015
Ninth Anniversary Minority Landowner Magazine Conference
Houston, TX
http://minoritylandowner.com

For more upcoming events, visit our website calendar:
http://nac.unl.edu/events/index.htm

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The USDA National Agroforestry Center (NAC) is a partnership of the Forest Service (Research & Development and State & Private Forestry) and the Natural Resources Conservation Service. NAC's staff is located at the University of Nebraska, Lincoln, NE. NAC's purpose is to accelerate the development and application of agroforestry technologies to attain more economically, environmentally, and socially sustainable land use systems by working with a national network of partners and cooperators to conduct research, develop technologies and tools, establish demonstrations, and provide useful information to natural resource professionals.

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