



THE PERMACULTURE ACTIVIST

No. 32

\$5.00

Animals & Aquaculture

**Chicken Tractors
Free Bees
Grass Farming
Goat Dairy
Constructed
Wetlands
Draft Animals
and More...**



WHEW!!

This issue of *The Permaculture Activist* has taken many long and difficult months to reach your hands. A spring has never been more welcome than this one. 1994 was the year my marriage ended in divorce. For the third time in five years the magazine has a new address, and I have a new home. In moving to western North Carolina, I have committed myself to a bold social and cultural experiment called Earthaven, the first permaculture planned village in North America (see pg. 40).

The community which supports Earthaven includes many talented individuals, among them my good friends Arjuna da Silva, a genius with blue pencil and Macintosh, and Andrew Brown, both of whom contributed significantly to the labor of this delivery. Special thanks are due also to Chuck Marsh for his unrelenting love and support during an especially difficult transition. This budding publishing collaborative promises a much higher quality product with greater reliability for you the reader and greater ease of production for us.

Recognizing the demands of a busy life and the current economy of this magazine, we are changing our publishing frequency and subscriber-year from quarterly to a 3/year basis. In 1995, the months of issue will be April, July, and November. Next year and subsequently, the months of issue will be February, June, and October. Between magazines, we will issue short supplements to subscribers to keep our calendar listings and other fast-changing information up to date, as we began doing in April, 1994 with #30-A. Supplements will be designated with the number of the previous magazine issue and an "A," eg. 32-A.

Though postal rates have risen recently, we will keep our yearly subscription rate at \$16, where it has remained since 1990. The cover price of individual issues of *PCA* will rise to \$5.00. Thus we reckon the value of a year's supplements and three issues of the magazine to be \$19.50, creating a long-overdue financial reward for our loyal subscribers.

Those with subscriptions paid in advance will see their expiration number reduced in the following manner:

- 3-5 issues paid ahead, reduce 1 issue;
- 6-9 issues paid ahead, reduce 2 issues;
- 10 + issues paid ahead, reduce 3 issues.

We will adjust the records after this issue is published, limiting the impact on everyone. Subscription expiration numbers will still be measured in magazines. Supplements will be pegged to magazine expiration, ie. if your subscription now expires with #35, you would see that change to #34 (to find out your current status, check your mailing label. It is calibrated in the old system.), and you would receive two magazines (#33, #34) and three newsletters (32-A, 33-A, 34-A) after this one, taking you through calendar year 1995.

As we have since 1990, we will continue to publish magazine issues with themes from permaculture subjects, eg. Water, Creativity,

Structures, Forest Farming, etc. The next issue (#33) will address the subject of Cities and their Bioregions; #34 will treat Village Design.

Permaculture is entering a period of sustained expansion in which it will become more and more visible and effective in the public arena. We foresee a strong demand for information permaculturists have to offer about sustainable and regenerative systems. By

contributing news and views of your own work and of the greater transition which society is now undergoing, you can help us make permaculture design part of the solution to the challenges of our times. We welcome your written comments and suggestions about *The Permaculture Activist*. Your interest and support are vital to our continued health and growth.

Peter Bane

Animals in Permaculture... The First Steps

Kay Barnes

Permaculture is incomplete without the animal presence. Animals offer the human spirit great comfort, pleasure, and companionship. Further, they are natural nutrient cyclers: they may feed us while their manures feed plants and the soil.

Permaculture is an ethical system, and animal use in permaculture is first and foremost based on the understanding of that animal's role in the great design of the universe: its needs, yields, and characteristics. Appropriate and adequate food, fresh water daily, and shelter and confinement that is appropriate, pleasant, and spacious are all paramount considerations to be met prior to working animals into your design. Knowledge, compassion, and tolerance are critical attributes for those wishing to undertake this highly rewarding, responsible, and time-consuming lifestyle.

Which Animals?

Incorporating rare and endangered species of animals should be reserved for advanced permaculture settings. First establish the well-known and adaptable farm animals. They are very forgiving and tough survivalists. If you are successful and find you have a flair and special love for these creatures, branch out slowly and carefully, contacting organizations working to save rare and endangered species for assistance with your next venture.¹

A few farm chickens can be raised in a small mobile chicken house on wheels—complete with nests for layers—and hauled wherever need dictates. Used in this way, chickens are superb at lightly tilling your garden and any areas you would like de-bugged, de-slugged, de-weeded, or manured.²

A couple of goats or sheep or small horses can do away with the noise and pollution of the lawnmower. The animals, assisted by you with a swing-blade, can maintain a charming, wildish, grassy lawn or meadow graced with ellipses or scatterings of pioneer plants (weeds) and wildflowers attracting bird, butterfly, and bee—creatures and habitat much threatened by America's fanatic fetish for manicured lawns.

Two or three common farm ducks or weeder geese will be a pleasure to watch in the little pond you design for your garden or back yard. They will be delighted to reduce the grub and bug population. Be especially aware of their need for safety, and design accordingly.

Dogs can be excellent early warning systems heralding friend or foe, and they keep rabbits and deer away from the garden's edge. Even the dog

who first chased down your newly adopted family member may be successfully trained, with time, patience, and consistency in voice and handling commands, to be its friendly protector.

Security

I cannot emphasize enough how important safe zones are for your animals. The trauma of arriving home after work and finding the torn, blood-soaked little bodies of your precious animals killed by a pack of neighborhood pets is an experience one wants to avoid. Safe zones may be incorporated into eye-pleasing designs with showy, thick, thorny fruit-bearing hedges or dense berry bushes. While your hedgerows are growing, install secure fencing to keep out wandering predators. The fences will eventually disappear into the thicket.

Preparation and Care

An animal in your care puts demands on your time and patience. Plan food, shelter, water, and confinement areas in advance to require the least maintenance. Animals are wonderful creatures of habit and can be conditioned to independence as well as remarkably labor-saving behavior. But it takes knowledge and familiarity with that animal, time, and consistent and clear behavior on your part during the animal's conditioning.

Start small as with any earthcare system. Introduce a few animals at a time, preceeding their arrival with a complete awareness of their niche in the ecosystem and a home design appropriate for their ultimate safety and comfort.

Spirituality in Permaculture

When the interaction between human and animal is close and meaningful, animals in permaculture fill the deepening void so many of us feel today. Because our society ranges far from the soil, trees, sun and wind, the plants and animals of our Earth home, our spirituality suffers greatly. But it can be recaptured with animals in permaculture sharing our dream design.

Notes

1. For example, American Livestock Breeds Conservancy. (see pg. 5)
2. Andy Lee. *Chicken Tractor: The Gardener's Guide to Happy Hens and Healthy Soil*. (see review pg. 40)

Kay Barnes tends three acres, a horse, a goat, and a small flock of chickens. She would be delighted to hear from those successfully (or unsuccessfully) raising animals in permaculture. Write her at 8943 White Rd, Primm Springs, TN 38476.

The Permaculture Activist

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The Permaculture Activist is an independent publication serving the permaculture movement in North America. Our primary goal is to provide information useful to people actively working to establish permaculture systems "on the ground."

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For each issue mailed to subscribers, 25¢ is placed in a Tree Tax Fund maintained by *The Permaculture Activist*. From time to time these funds are distributed to individuals or groups working in reforestation and forest preservation. Recipients are selected based on need and demonstrated effectiveness in their work. To apply for funds, contact the Publishers and include a short description of your project and proposed use of funds. We have approximately \$500 available per year.

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permaculture© per'ma•cul•ture. 1. permanent agriculture, the requirement for a permanent culture. 2. An ethical philosophy of earthcare and peoplecare supported by the distribution of surplus goods: wealth, labor, attention, information. 3. the condition of abundance in nature marked by cooperation, diversity of species, occupation of essential ecological niches, and stability over time, in contrast to the condition of competition, scarcity, monotony, and imminent decay which predominates under hierarchical social conditions.

Livestock, Genetic Diversity, and Sustainable Agriculture

Caroline Christman, Donald Bixby, and Phillip Sponenberg

Those concerned with the future of our environment should take an active interest in the role livestock play in creating and supporting a sustainable food supply. The authors, all staff at the American Livestock Breeds Conservancy, argue that the economic and cultural future of farming is inextricably bound with the fate of minor, rare, and endangered breeds of animals, as well as our rich, but threatened heritage of plant varieties. Livestock are critical to the economic and ecological health of diversified family farms, while in the dominant industrial system they have become a symbol of gross excess and needless cruelty. Concerned consumers need to put their money where their mouths are by supporting farmers to raise animal products in sustainable ways.

Though livestock species themselves may never become extinct, almost 100 American breeds are in decline or danger of being lost. These breeds represent much of the genetic diversity remaining in livestock species. Without the genetic differences represented by a variety of breeds, there would be little opportunity to select and improve livestock to fit changing conditions in the future.

In the past, North American farms provided habitat for a wide variety of livestock breeds. There were regional varieties and types, some with colorful names (such as Iowa Blue chickens) and others which lacked even the status that a name can provide (such as "native" sheep). Different climatic regions required animals adapted to various conditions, and so geography itself acted as a selector to maintain genetic diversity. Livestock production and services were an integral part of agriculture.

But diversity in all livestock species is now threatened by several trends in modern agriculture, including the separation of livestock production from agriculture, the increasing uniformity of breeds towards the highest producing types within a species, and public ignorance and apathy which has resulted in a lack of support for the farm community.

The protection of livestock genetic diversity, represented by a variety of distinct breeds, is different from the preservation of wild animals. To be saved, endangered domestic breeds must be used within a social and economic context. Diversity is both essential to and dependent upon the revival of farming in the U.S. What happens across the country today very much affects the agricultural heritage—animals and plants—passed on to the next generation.

Livestock in Sustainable Agriculture

In today's "politically correct" world, animal agriculture has a bad name. Books, such as Jeremy Rifkin's *Beyond Beef*, blame livestock for much of the global environmental crisis, and implore readers to become vegetarians as a way to save Mother Earth. Indeed, modern livestock production systems create many environmental problems, some of which are due to the removal of livestock from the farm.

Rifkin is wrong in his blanket condemnation of animal agriculture. More of the blame lies with modern livestock production systems, which concentrate large numbers of animals that

consume high quality grains (grown and transported specifically for use as animal feeds). (Ed. note: Mile upon mile of land is devoted to these crops, most often grown with the heavy use of fertilizers, pesticides, and herbicides which pollute not only our groundwater, but our rivers, lakes, and oceans. Continuous cultivation of these high-input crops robs valuable nutrients from the soil, while constant tillage leads to soil erosion.) Manure, nature's best fertilizer, has become so concentrated that it poses a serious threat to groundwater. Concerns about safety, animal welfare, and the health of workers have also attracted public attention.

Traditionally, livestock have been an integral part of agriculture and a recovery of this relationship presents the best alternative to the management of today's problems. The use of livestock also presents a number of opportunities for sustainable farmers who want to increase their economic diversity.

Sustainable agriculture is, by definition, designed to operate in natural balance, with an emphasis on efficient use of renewable resources. Livestock complement the production of crops, and animal services provide alternatives to high chemical and energy inputs.

Livestock Uses and Products

The uses of livestock can be roughly divided into services and products. The products are relatively well-known: meat, milk, fiber, leather, manure, and other by-products. Services—such as grazing, brush clearing, and pest control—are less well known to the current agricultural generation.

The best-known agricultural product is food. Livestock produce a significant part of our food supply, specifically cheese, eggs, milk, and meat. Livestock transform forage nutrients, unavailable to humans, into foods of high quality for human consumption. Livestock can be raised in areas poorly suited to field crops and, therefore, need not displace food crops. The use of animals may instead complement the production of plants.

High quality natural fibers, such as wool, cashmere, and mohair, are unequaled by any synthetic. Another important animal product is leather, used for clothing, furniture, sports equipment, and many other goods in daily life.

Manure is the most widely used fertilizer in the world, providing essential elements of fertility to the soil and surpassing the potential of "green" manures or non-animal composts. Animals can be moved around to deposit manure where needed, further reducing the cost of on-farm fertilizer.

Livestock services

The services provided by livestock are often the only complement or alternative to the use of chemicals, energy, and machinery in agricultural systems. Grazing has acquired a bad name with environmentalists due to confusion between grazing and overgrazing. While overgrazing can rapidly deteriorate natural resources, well-managed grazing can greatly enhance grasslands. Grasses and other types of forage are part of a biological system adapted for grazing. Due to lessening numbers of wild grazing animals, livestock grazing is now necessary for grassland health. Forage production is an excellent method of healing damaged land. Much marginal farmland now in use for row crops should be put into permanent or semi-permanent forage crops, thus reducing runoff and erosion, while increasing organic matter in the soil. Controlled grazing is one means to make these marginal regions productive in both an environmental and economic sense.

Goats, sheep, and some breeds of cattle are particularly good at browsing, which is the consumption of bushes and other tall plants in preference to grass. These animals can be used to eat rapidly growing pest plants such as leafy spurge, blackberry, kudzu, poison ivy, and other tenacious woody invaders. Reduction of these pest plants allows for the recovery of native plant diversity.

Goats can be used to reduce the risk of fire through brush control. Goats love rough, rocky land, and the browse that, if unharvested, creates the greatest fire hazard. They can be an effective, economical, and environmentally sound way to establish fire breaks on such land.



Now rare worldwide, Gloucester Old Spot pigs are very hardy and produce lean meat from rough foods and forage.

Hogs can be used as self-motivated bulldozers to clear land of brush and open it up for cultivation. They can also glean fields after harvest or turn over compost to hasten its readiness for use as fertilizer.

Draft power is another important service provided by cattle, horses, donkey, mules, buffalo, and other livestock. Globally, oxen are the most widely used draft animal, though horses are far more common in North America. The common impression of Amish or Mennonites as the only farmers using horse teams is incomplete. More and more farmers appreciate the versatility,

usefulness, and economy of animal power, particularly given the rising cost of fossil fuels. In addition, draft animals are increasingly being chosen for selective logging operations on private, federal, and state lands where minimal impact on remaining trees and soil is desired.

Interest is also returning in the use of livestock as part of a system of biological pest control. Swine, sheep, geese, chickens, and other poultry have traditionally been kept in orchards to control pests, through the sifting of orchard debris and eating of windfall fruit, grubs, weeds, and other pests. (St. Croix sheep are now being used to control pests in macadamia nut plantations in Hawaii.)

The use of animal services carries double benefits in that it can also replace expensive or potentially detrimental inputs, high energy use, or labor intensive practices. At the same time the animals may yield marketable food and fiber products.

Beneficial Rare Breeds

Many rare breeds of livestock are good candidates for sustainable production systems. These breeds have characteristics and strengths very different from industrial types. They have not been selected to need high levels of inputs, such as high energy feed, air conditioning, heated barns, veterinary intervention, and antibiotics; in fact, they are most economically competitive when raised under low-input conditions. These breeds are generally characterized by good foraging abilities, strong maternal instincts, reproductive efficiency, parasite and disease resistance, climate adaptation, and overall vigor—all characteristics with value in low-input systems.

While crossbreeding has been heavily emphasized, many pure breeds have the ability to do the job just as well as hybrids and can represent a better long-term investment. Purebreds provide well-defined and proven genetics, and give the breeder consistent, desirable results from one generation to the next. They also provide the opportunity to sell breeding stock into a ready network of buyers—something essential to the development of alternative enterprises.

It is not always easy to find the right breed. Relatively little research on forage-based production has been done over the last 50 years. In fact, the narrowness of agricultural research is one reason that some breeds are rare: they have not had the opportunity to demonstrate what they do best. More research to document breed differences in low-input systems is desperately needed—research that could prove highly beneficial to farmers.

Livestock Conservation

When the long list of animal services is better understood, the complicated and rewarding interconnection between humans and livestock becomes more obvious. Agricultural systems that use these complex inter-relationships of people, animals, and specific environments to the fullest extent are also the ones that benefit most from the availability of traditional breeds of livestock.

Any consideration of livestock conservation must acknowledge this agricultural partnership between livestock and human beings. Conservation cannot be an abstract goal, but must include a substantive effort to protect all agricultural potential for the future through the active use of genetic diversity currently available in truly productive agricultural systems. Δ

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Animal Polyculture

The Farm of Many Faces

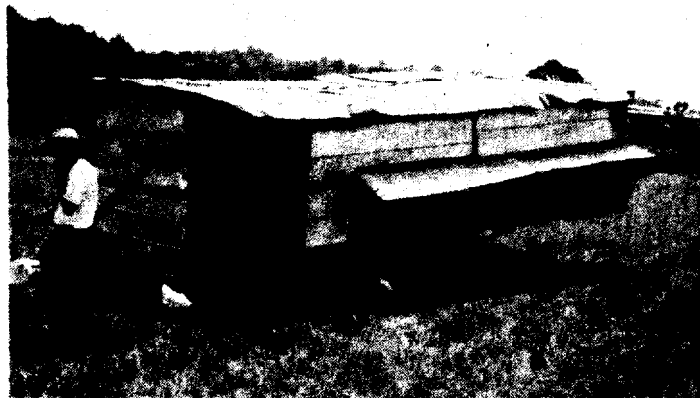
Peter Bane

The first thing that meets your eye when you drive up to Joel and Theresa Salatin's homestead outside Swoope, Virginia, is a strange contraption that looks sort of like, well...a big metal chicken on wheels, one end up and the other nosed toward the ground, sitting in the middle of lush green pasture. When the mind recovers from this surprising vision and you spot what looks like a fleet of miniature aircraft carriers steaming in perfect formation across the hillside behind the house, you know you have left the Farm Bureau far behind. Salatin, who is quick to greet you with a smile and a firm handshake, calls his coop-on-wheels The Eggmobile. I imagine by now this contraption has entered modern agricultural history, for Joel, who clearly loves what he does, has explained its clever design to hundreds of visitors.

The Eggmobile, and the fleet of chicken tractors up on the hill, are only the most conspicuous of dozens of thoughtful innovations that set Polyface Farms, nestled in the Shenandoah Valley west of Stanton, apart from the herd. In a nutshell, the Salatins use livestock to move fertility around their well-articulated farm system—paying careful attention to refining every step in the cycle—and make a tidy living selling the fruits of their labor. In the process, now 33 years along and entering its third generation in the family, they have built the natural capital of the farm, increasing its health, vitality, and carrying capacity.

Bill Mollison has said that permaculture is the application of what you observe to what you create. That simple but profound process has been the hallmark of the Salatin success story. In fact, you get the feeling that Joel, who bounces around the farm with the energy of a teenager, is thinking all the time about better ways to turn biomass into dollars, with less work, at lower cost. Which is, after all, just what a farmer should be doing.

The Salatins raise their beef cattle, broilers, and rabbits on grass, sell eggs from their mobile flock, and harvest timber for firewood from the wooded acreage up the mountain which forms a splendid backdrop to the rolling pastures at the heart of the farm. Joel and Theresa, their two children, and Joel's mother all seem to share an unabashed enthusiasm for their family enterprise and are quick to



The Eggmobile at Polyface Farms

photos by Peter Bane



Joel Salatin indicates the proper grazing length for his pastures

credit Joel's father, Bill, with the vision that launched Polyface almost half a century ago. The elder Salatin was an agricultural economist who, in the late 40s, already understood that the U.S. economy was beginning a long-term decline. He foresaw the future of agriculture in the tropical countries of South America and, putting his money where his mouth was, moved his family to Venezuela in 1947, buying a large property to begin a dairy operation. What Bill Salatin didn't foresee were the consequences of U.S. foreign policy: when revolution toppled the government of Venezuela in 1961, and the Salatin ranch was expropriated, he was forced to return to the U.S. Long-drawn negotiations and, ultimately, political pressure yielded a meagre settlement from the Venezuelan authorities, money which became the downpayment on the Virginia farm.

Grass farming

The Shenandoah Valley, nestled between the Blue Ridge front range and the folded valley and ridge province of West Virginia, is drier than most of the surrounding territory—rainfall averages 32" a year—and has been managed since pre-Columbian times as a grassland, first by the native Americans who burned it regularly to increase habitat for game animals, and later by the European settlers who broke the sod with plows. Until westward migration opened up new lands in Ohio and Indiana, the Shenandoah was a major grain-growing area.

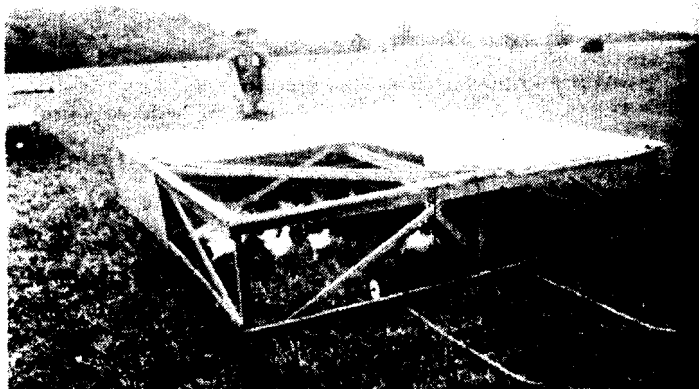
Grass forms the backbone of the operation at Polyface, a name

which makes explicit the many complex connections between soil, plants, and animals that the Salatins have crafted into their lives. Beef cattle, a hardy and elegant cross between Shorthorns, Brahma, and Angus, are moved daily from April through October across the entire 95 acres of pasture surrounding the farmhouse. Electric fencing and a simple gravity-fed watering system make this a relatively minor chore. "Fence is the cheapest fertilizer you can buy," opines Salatin. As they move through the rotation, the cattle are followed within four days by the Eggmobile.

Parked in the midst of a recently grazed paddock, the mobile coop disgorges 150 laying hens, a mix of White Wyandottes, White Rocks, Barred Rocks, and Rhode Island Reds, which range out during the day to clean up the cowpies. It seems the hens love to eat fly larvae and, in so doing, kick the fresh manure piles apart, leaving almost no visible residue on the ground. Salatin reports that since he initiated this system he has had no incidence of heel fly parasites in his cattle. Indeed, he insists that even apart from the yield of eggs, which he sells, the eggmobile would pay for itself in improved herd health and pasture sanitation.

From observation—which good management gives him a great deal of time to do—Joel has discovered that heel flies will pupate within 2-3 days of manure dropping, and that flies will hatch in four days, thus the timing. The layers thrive on this live protein, and derive 70 percent of their feed requirements from the pasture. For the balance, they get free choice of whole corn, whole oats, oyster shell, and meat/bonemeal. Salatin has found that feeding them grain with the husk on keeps the chickens free of parasites. Does he ever miss a grazing deadline? Yes, sometimes things just get too busy, but the poultry catch most of the flies anyway.

In addition to beef and laying hens, during the warm months the Salatins raise broilers in 30 mobile "tractors" moved daily across the pasture, ensuring the chicken manure is well-distributed (each spot in the field only has one cage on it for one day each year), and that the broilers get some 30 percent of their requirements from forage. Each 10' by 10' pen houses 50 birds and is designed to be moved by one person. Joel can shift the whole flock of 1500 in half an hour using a two-wheeled hand dolly. Water from the gravity lines and from a supplemental mobile tanker is dispensed just as quickly. The birds get a minute dose of hydrogen peroxide and Basic H, a mild detergent, in the water to prevent parasites.



One man can move 30 chicken tractors in 30 minutes.

photo credit Chuck Marsh

In a system so functionally interwoven, it is difficult to discern which are primary and which are side benefits of any given component. Raising poultry on pasture may be unusual, but it yields consistently healthy birds at low cost, while eliminating the problems of handling manure.

Up and coming

Problem-solving and initiative are two hallmarks of the Salatin family culture. Son Daniel, 13, is his father's eager helper, and has his own segment of the farm operation to manage, the rabbitry. Rabbits are a good product for the Salatins. They bring \$2.50/lb. and average 3 lbs. dressed out. Now raising 300 rabbits a year, Daniel has been working for several years to adapt them to a pasture system. The problem has been that rabbits, unlike chickens, will burrow out from under their mobile cages unless the bottoms are wired. But bottoms on the cages knock the grasses down and biting into the wire discourages the rabbits from grazing. "The rabbits got gun-shy," Daniel explained. Instead of a fixed cage bottom, he and his father devised a system where they lay chicken wire on the ground in strips six feet wide, and let the grass grow up through it. They then move the rabbit cages back and forth on the wired ground. The bunnies seem perfectly content. Pasturing the bunnies, or young fryers as they are called, has cut feed costs by 65 percent. Used in this way, the pasture yields \$4500/ac.



The key to pasturing rabbits was laying wire on the ground.

Direct Marketing

The Salatins take pride in their work and their products, which they sell directly to customers on the farm. Because small volumes of poultry and rabbits are not subject to federal inspection requirements, Joel and his family are able to butcher these animals at home. Working together, Joel and Daniel can dress 20 rabbits in an hour, making the equivalent of \$90/hour for their processing work. Economics like that are compelling. Likewise, slaughtering chickens has become an important part of their farm economy. A simple but well-designed open shed equipped with killing cones, mechanical de-feathering equipment, and stainless steel sinks allows them to process

several hundred birds in a morning, something they do every second or third week during the season. Broilers are raised on a 60-day cycle, moving from the incubator house to the pasture and finally to the abattoir where Polyface customers arrive Saturday mornings to claim their dressed birds. What stays on the farm, besides the butcher's profit, are the offal and blood, important nutrients reclaimed for the compost piles.



Chicken processing plant at Polyface Farms.

photo credit Chuck Marsh

Because of inspection requirements, Polyface beef is slaughtered at a local butcher's. Salatin, however, retains a high degree of control of this process. Beeves are pre-sold to individual customers, either as fore- or hind-quarters. Hindquarters bring a premium price which helps balance the greater demand for them with the obvious limitation in supply. Each animal is tagged and the carcasses are tracked scrupulously from birth to final sale, establishing a clear trail of ownership which allows Polyface to avoid onerous processing costs. Customers too, are well-regulated. They are notified well in advance of the day their beef will be available (it is slaughtered and raked in the butcher's cold room), and are expected to claim it without delay. If anyone fails to appear as scheduled, Salatin sends them a stern warning, and drops them from his list after a second offense. He can't afford to jeopardize good relations with the butcher or his status under law. If he sold his beef after slaughter, instead of on the hoof, Salatin would have to take it much further away to a federally inspected meatpacking plant, adding significant cost with no obvious benefit.

Self-reliance

Salatin began his farming career selling eggs by bicycle. He is still passionate about the importance of direct marketing. When USDA officials impounded some of his beef last year (allegedly for selling uninspected meat), he responded by forming an organization (FARM, Food Alternatives for Relationship Marketing) to lobby for farmers' rights to sell directly to consumers, and stepped up his already vigorous criticism of big agriculture. "When we don't have community to set parameters for decision-making, government has to regulate food production. When you are selling to people you know, it's not possible to pass off bad food." The government eventually backed down and released the impounded beef, but not before they had let Salatin know that his criticisms were beginning to sting.

Salatin, who trained as a journalist, is not bashful, and he has a flair for presentation. In addition to writing a regular column for *Stockman Grassfarmer*, he makes more than a dozen speaking

engagements and workshops a year, chiefly in the cool months, and has become a very visible exemplar of a better way to farm.

Waxing Jeffersonian in his praise of the small farm, Salatin advocates self-reliance, community bonds, and what has been called good old-fashioned (American...) ingenuity. "There are no VICTIMS here!" he laughs. "We can only change ourselves."

Salatin's work is testimony to his convictions. When we viewed Polyface fields in early July, the sward was in fine condition, green and lush despite a dry spring, the difference between them and the neighbor's browned fields dramatically evident at the fence line. Polyface land has had no seed or fertilizer applied to it since 1961. Yet the forage has increased in diversity and productivity continuously. Pointing out the many forage plants thriving in his paddocks, Joel describes his product as "Salad B Beef. They enjoy the finest greens..." The Salatins' 95 acres normally carry 50 cow equivalents, with 22 calves born this year. Heifers are raised to a carcass weight of 400-500 lbs., steers to 500-600 lbs. Besides forage from the diverse and healthy pasture, the Polyface herd gets only kelp, a seaweed, as a mineral supplement, and springwater, flowing by gravity to movable tanks in the corner of each paddock.

Custom genetics

The hardy Brahma-Shorthorn-Angus cross are handsome animals with pretty brown and black striped coats. They are what Salatin calls "thrifty, doughty" meaning thriving and strong. He admires the long-life, heat tolerance, and aggressive grazing abilities of the *Bos indicus* Brahmas, which have lower milk production, but of a higher butterfat content. The *Bos taurus* Shorthorns are stockier and their genetics improve milk production in the herd. He uses purebred semen and has refined his genetic mix to suit the conditions at Polyface. "Eventually, we see a different breed on every farm."



Brahma-Angus-Shorthorn cow/calf herd fattens on grass alone.

photo credit Chuck Marsh

In selecting for best fit with his conditions, Salatin ranks the factors in priority:

1. parasite resistance
2. thrifty coat—prettiness
3. temperament
4. aggressive foraging, heat-tolerance
5. ease of birth
6. size

He works to allow these genetics "full expression." Compost for nothing...

The heart of Polyface's fertility cycle is the composting of

winter manure from the cattle herd and its distribution back onto the pastures. No external fertilizer is used on the farm, though poultry feed, diesel fuel, and waste biomass are still imported.

Asserting that mud is the greatest stress on cattle in winter, Salatin explains that he confines them to the open-walled barn (really a big hay mow under roof) from November until early April. Besides sparing the pastures from pugging damage, this saves time, hay, and energy required to feed the animals. Salatin spends about 15 minutes a day on chores during the winter, leaving him plenty of time to read aloud to his son and daughter, who school at home.

Manure spread or dropped from November 1st to mid-March is not taken up by soil organisms, and nutrients are leached by heavy winter rains. This wastes the fertilizer value of the manure and contributes to groundwater and stream pollution. Accumulating and composting the nutrients from farm-grown hay instead allows timing their reapplication for maximum impact. The finished compost is spread in June, just following haying, and again in October, when cool-season grasses are just beginning to slow their growth. "Feed grass when it's hungry," says Joel. This extends the growing season and helps even out the annual forage cycle.



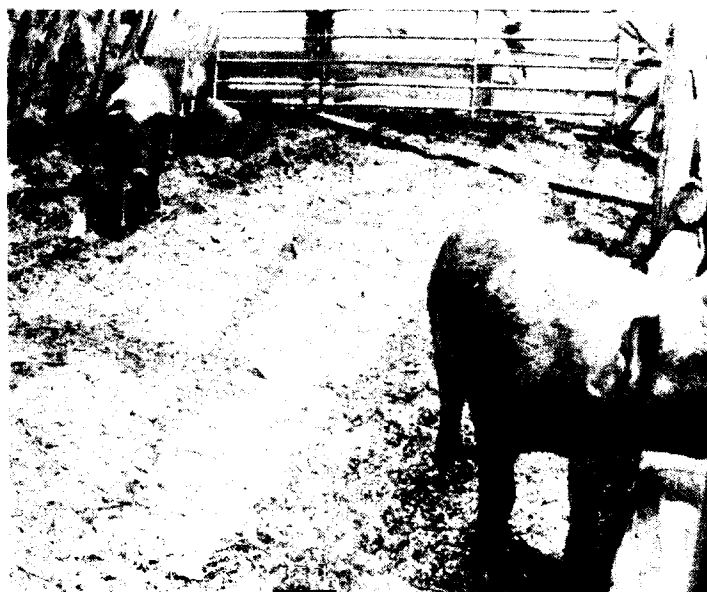
Hayrack rises as bedding and manure accumulate during winter confinement.

Manure and urine are laid down on bedding consisting of leaves, hay, wood chips, sawdust, or other carbonaceous material. Sawdust and woodchips are preferred because they have very high carbon/nitrogen ratios (500:1) and can absorb the greatest amounts of urine. Salatin gets about 25 truckloads of woodchips from a local utility trimming crew, for which he pays \$10/load. He also gets leaves and chipped Christmas trees from the Stanton dump and whatever other high-carbon biomass he can lay hands on. Salatin has both a chipper and a dumptruck, but he insists it's not yet economical to use them—as long as people are still throwing away organic matter. His advice to other farmers: "Identify your local resources."

And your hogs for free...

Every week or so, 100 pounds of grain are spread on the growing bedding stack, which rises steadily to a height of three feet by spring. The hay feeding racks have been designed to rise with the packed bedding and manure. Why on earth throw good grain onto a manure pile? Because come spring, when the cattle are turned out onto pasture, Salatin buys in two 150 lb. hogs to work over the accumulated manure piles. The grain—barley in

the lower layers because it holds longer and ferments slower, and corn in the upper layers—having sprouted and malted, entices the hogs to do what they just love to do, root down into the earth. Two hogs working as a team will dig to three feet to retrieve the sweet morsels of fermented grain. In the same way corn planted with an augur around stumps encourages hogs to root them out of the pasture.



Young hogs turn winter cattle bedding in search of malted grain.

This year Salatin employed eight hogs in four teams. It seems that with serious rooting hogs, two's company, but three's a crowd. The third hog just seems to loaf, get in the way, and winds up undoing much of the work the first two achieve.) In the process each team turns 75 yd³ of compressed straw and manure pack, allowing the ensiled hay, wood chips, cattle and (now) hog manure and urine to begin aerobic decomposition.

Compression during the winter keeps the piles in largely anaerobic conditions, binding otherwise volatile nitrogen. Nevertheless, some decomposition goes on, giving off enough heat to reduce the feeding requirements of the cattle by 20-25 percent.

Salatin figures the cost of two hogs plus 1000 pounds of grain is about equal to the value of diesel fuel and his own time that would be required to turn each pile mechanically. And he gets the profit of the fattened hogs when he sells them in the spring. Finished compost is spread "as finely as we can fling it, with the tractor running flat out."

Reaping the excesses of nature

Spreading work evenly throughout the year is as important as spreading compost evenly on the fields. Salatin manages to employ himself and his family quite well while still having time for observation, learning, and visitors. To spread both the early flush of grass growth and the chore of haymaking, he grazes his pastures heavily in the spring, turning the herd out about the 3rd or 4th of April, weather permitting, and continues heavy grazing "until the meadowlarks have their babies." By mid-May, the main pastures may have been grazed as many as four times. He begins cutting hay as early as possible, holding some fields back by short-rotation grazing at weekly intervals. In this way he is able to harvest May-quality hay in June.

Every operation on the farm is considered for its demands on time and for how it fits with all the other pieces. Laying hens are butchered in the fall of their second year. Chicks are hatched and

the one-year hens begin laying in the fall, replacing the previous year's birds. Chickens lay most of their eggs early in their life cycle. By beginning egg production in autumn, 60 percent of it will come during the cool months. The Salatins eat eggs during the winter. Hens which begin laying in the spring, lay 90 percent of their year's total eggs that season. Having eggs to sell in winter helps even out the cash flow and the work of gathering, while reducing workload during the otherwise hectic spring. To every thing there is a season

Joel explains the rhythms of his agricultural year: "Poultry is a cooling meat: we eat it during the spring and summer. Broilers are hatched in the spring, raised on pasture and slaughtered in an open shed during summer, so they are a seasonal product. Beef is a warming meat, and we harvest it in October and November before the deer go into rut. When frost hits the fall grass growth, the sugars double. In just this brief few weeks the cattle put on a real burst of growth and the meat becomes much more succulent."

Timbering, which gradually adds more cleared acreage to the farm, is a winter activity that yields a good income. Timber valued at \$300/acre as sawlog harvest yields \$3000/ac when cut for firewood. Salatin has calculated the costs of fuel, and time to deliver, and figures that it's not worthwhile for him to leave the farm. Instead he and Daniel section the timber into stove lengths and stockpile it near the road. Customers who come for meat and egg pick-ups, and others just needing firewood, buy it off the stack and

split their own. Finding the right market niche made all the difference. Salatin sells to customers who don't own a chainsaw like to warm themselves swinging a maul, adding a little heat to their fuel. By not selling off farm, he can offer lower prices than other vendors, but still come out ahead. The buyers are willing to drive a few miles out to the farm to save money on cordwood. What's next?

Salatin's next project, besides experimenting with pastured hogs, is fish. He has his eyes on a couple of ponds lying adjacent to his main pasture, and wants to figure out a way to harvest fish with minimal effort. While we sat in the parlor of the restored antebellum farmhouse that is the Salatin home, Joel and Theresa and their children picked our brains about aquaculture system design, permaculture design, and a dozen other subjects. Clearly, the more excitement in store.

Joel Salatin has demonstrated the effectiveness of many permaculture principles and strategies: polyculture, functional relationships, biological resources, observation, direct market. That he's done so using primarily animals and grass makes his work an important example for millions of American farmers would-be farmers. We need more such farmers; we need more such examples.

Joel Salatin is the author of Pastured Poultry Profits, available from Polyface Farms, Rt 1, Box 281, Swoope VA 24479.

Commentary on Animals In Permaculture

Michael Howden

If for no other reason, we need animals for their non-human presence: their goofiness, their colors, their sounds, their excrement.

However, we don't need animals inappropriate to the land and the stage of permaculture development in which we are working. Geese (often seen as an important weapon in permacultural systems) can be most destructive. Not only are their temperaments—which are helpful in keeping hippie guest/lowlife populations down—difficult, they also seem to eat or, at the very least, chew on everything on the land. Geese loved our pineapples; not simply the full ripening yellow ones, but the small green *keikis* (babies). They would rip young plants out of the nursery and attack young trees and shrubs with great abandon throughout our landscape. If you take the time either to herd or confine them, or if you have open space needing to be attacked (which can also be fenced), then great. We, however, have now banned geese from the land until our trees are better established and we can fence our new pineapple plantings.

Ducks are more mellow than geese, and are easy to care for, though they are also susceptible to predation. Ducks require more care in the first year than geese. The geese seemed right away to care for their young (unless they were allowed to fall into uncovered planting holes), whereas the ducks were a tad blasé about their offspring.

Chickens, especially with a chicken coop so one can sleep on moonlit nights, are the least concern of all; except for the smaller, tropical chickens which, although better able to take care of themselves, often fly into our smaller bananas and start to eat the fruit, ripe or unripe.

The presence of a mixed poultry flock has cut down insect/pest populations on our land considerably, as well as providing us

with manure (enriching our ponds, etc.). If one is prepared to design and set up these systems (a little reading is a useful thing), poultry, especially free-range birds, can be essential to a well-rounded permaculture. Two helpful references are: American Livestock Breeds Conservancy (only \$30/year, a valuable source of useful animals), PO Box 477, Pittsboro, NC 27312; and the Holderreads Waterfowl Farm & Preservation Center, PO Box 492, Corvallis, OR 97339 (a GREAT source for geese and ducks).

Michael Howden farms a small banana/citrus orchard at Ulukou, Maui. When not digging ponds or planting bananas, he practices acupuncture and traditional Chinese medical arts.



French Rouen ducks foraging at Kanahena Farm, Maui.

Small-Scale Cattle Raising

Liz Richardson

Cattle are large, heavy animals that move relatively slowly through the landscape. Although they benefit from lush pasture, bovines also browse on shrubs and trees. Their lips and tongues are remarkably agile as they nibble on blackberries, spirea, ninebark, salal, salmonberries, and red alder.

At Linnaea Farm we have a herd of cattle averaging 10-12 animals, including a breeding bull. We have chosen cattle because of their hardiness and size. Size is important because there are natural predators on Cortes Island, including wolves and cougars, that can present a threat to smaller animals. The cattle herd converts 30 acres of pasture into dairy products, meat, and fertilizer.

Management Practices

We make hay to feed our cattle through the winter, harvesting different parts of the field each year. I have spent the last few years concentrating on improving the pastures and reducing pollution to an adjacent creek. I use electric fencing to control animal movement—it is cheap, easy to move, and has low visual impact. In the spring the herd is rotated through a series of paddocks—about 20 in total. Each paddock is grazed evenly for a 24-hour period and then rested. The grass recovers quickly, compaction is reduced, and legume growth enhanced. Previously, the animals had access to the creek and loved to stand in the cool water in mid-summer. Great for them, not so good for downstream water users. The creek is now fenced off with a 30-ft. setback from the bank. Brush species are establishing themselves and providing cover for cut-throat trout in the creek.

Reaping the Benefits

We process all the products from the cattle on our farm. We make butter, yogurt and cheese from the milk. We do our own butchering, which provides meat for farm residents plus some for sale. Demand for our beef exceeds supply, and Island customers are willing to pay a good price for high quality, organic meat. Soap is made from kidney fat, a neighbor helps us treat the hides, and the bones and guts are buried under fruit trees. Manure collects in the barns during the winter, where it is piled up until ready to use on the gardens in spring.

Despite the challenge of managing and

integrating animals into a system (the mobility of animals can be an asset, but can also be devastating!), we find the cattle to be a vital part of the web of life at Linnaea Farm. We use very few outside inputs (a small amount of grain for milk cows and machinery for haying). Our garden benefits from the manure and hay produced. We also gain a greater understanding of the cycles of birth and death through our involvement with the cattle. **Letters Anyone?**

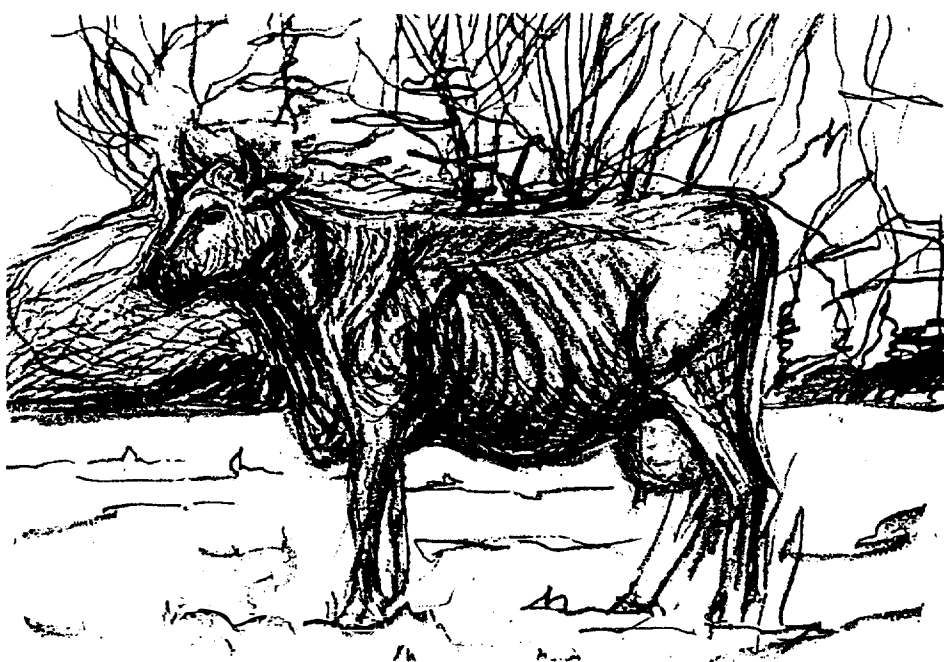
I am interested in corresponding with folks who are working with animal sys-

tems, particularly cattle, to exchange ideas and information. Write me at PO Box 98, Linnaea Farm, Mansons Landing, Cortes Island, BC, Canada VOP 1K0.

Recommended Reading:

The Family Cow by Dirk Van Loon
Better Grassland Sward by Andre Voisin
Fertility Pastures by Newman Turner
The Stockman's Handbook by M.E. Ensminger
Herbal Handbook for Farm and Stable by Juliette de Bairacli-Levy

Liz Richardson teaches permaculture design in British Columbia.

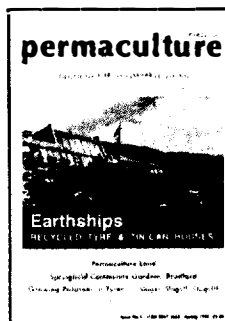


I believe we can design our way out of the present ecological crisis. About four years ago, it seems there was a shift from denying that we had environmental problems to the awareness we have now. What we're working for now is a shift from people knowing that there are problems to knowing that there are already solutions.

— Lea Harrison, 1993

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Power of Gentle Beasts

Jessica Laub

In the United States and other developed countries, attempts to achieve low-input and self-sustaining farm systems that are independent of costly machinery and fossil fuels often founder on the lack of appropriate power systems. High-energy technologies not only exploit the natural resource base, but contaminate it with destructive pollutants. (Unlike automobiles, lawn mowers and farm machinery are not required to comply with emissions regulations or standards, and so contribute a significant quantity of toxins to their environments.) Replacing destructive technologies with ecological and biological sources of power requires that we rediscover the nearly lost arts of working with draft animals.

Until the automotive revolution of the 1920s, draft animals provided almost all farm traction in the U.S. While draft animal power has all but disappeared in this country, its continued importance in other parts of the world is startling. In Africa and Asia, 85-90 percent of the farm power is supplied by animals or humans. In developing countries with limited resources, increasing populations demand increased energy for food production, much of which could be met through draft animal power.

The many functional benefits of animal traction were neglected or deliberately swept aside in the rush of past generations to take the "miracle-cure" offered by chemical inputs, plant breeding, and irrigation. In the sorry aftermath of the so-called Green Revolution, some countries (such as the Philippines) find themselves disillusioned with agriculture's newest heroes: toxic chemicals and introduced farm machinery. Today, Filipino farmers are confronted with degraded, worn-out lands, deadly diseases, and impossible debt for expensive machinery. Many farmers are trapped in a vicious cycle of dependence on hybrid seed, pesticides, and the upkeep of extravagant Western equipment.

Farmers' best hopes for escaping this cycle involve a return to traditional, sustainable farming methods—rediscovering native seed varieties, integrated pest control methods, and nutrient cycling through animals. Animals provide not only precious manure to help restore worn-out soils, but the draft power to cultivate the fields. And draft animals reproduce themselves—something no tractor has yet been able to accomplish.

While new directions for agriculture seem clear, action is not always forthcoming. In some cases, farmers are intimidated by huge multinational pesticide corporations, their own governments, and what now equates to inexperience with these formerly common, sustainable methods. Farmers also find that native seed may be harder to access than imported hybrid seed, and that breeding stock of native draft animal species is scarce. Even when farmers can get their hands on the animals, the question of how to control, care for, and maximize their beneficial aspects remains.

Keeping the Roots Alive

Farmers in America seeking to restore biological integrity to their operations face many of the same challenges as do farmers in the Philippines. Our own sustainable future is dependent on the preservation of traditional plant and animal species and farming techniques. Howell Living History Farm in Titusville, New Jersey, and Tillers International in Kalamazoo, Michigan, are two organizations dedicated to preserving traditional draft animal practices and to developing new designs and methods based on present knowledge.

Howell Living History Farm practices farming methods commonly used in America at the turn of the 20th century. Hanc horse, ox, steam, and gas engine power are used to operate field, barn, and other equipment. Forty of its 126 acres are cropped using horses, oxen, and related equipment. Some haying and harvesting operations are tractor-drawn, while some harvesting operations are performed manually. The "power mix" that characterizes the present operation reflects the reality that most animal traction extension agents encounter in the field: the integration of hand- and animal-powered operations. Because Howell Farm depicts a time period when agricultural technology was changing, it is a natural setting for training people who will now be working with change.



Draft animals provide most of the transport and farm traction in Two-thirds World countries like Nepal.

photo credit Peter Ban

Howell Farm offers real solutions to real challenges faced by farmers everywhere. The horse-powered 20th century American farm was geared to producing food for the family without the drudgery of hoeing and cultivating land by hand. Today, millions of farmers in Africa and Asia have yet to replace their hoes with animal-drawn plows. When and if they do, they can capitalize on proven designs and on animal training, hitching, and driving systems perfected over time in countries with a history of draft animal use. They can also employ modern technology: nylon

harnesses, lightweight steel, rubber tires, life-saving veterinary products, and more. Thousands of North American farmers are also looking to horse- and oxen-powered tools for answers to the tough questions of economy on the small farm. Howell is a place where generations meet and technology is compared. There is a continuing emphasis on the relevance—and application—of farm history.

Tillers International, a non-profit training and research organization specializing in small farm and rural economic development, is also a working farm and has unique access to the Abbey Collection of historical, animal-powered farm implements. The collection boasts a wide variety of tools adapted to many different and specific conditions.

Training Opportunities

Both Tillers International and Howell Living History Farm welcome interns and provide them with valuable training in animal care, selection, and use.

The Howell Farm Internship is a ten-week program teaching how to harness animal energy and use it to power farm equipment. The program is designed to equip persons with the skills needed to help small farmers introduce or

upgrade animal-powered farm systems. Training is integrated with the overall needs of the historical farm, which include cropping, equipment restoration and repair, site maintenance, and educational programs for schools and the general public. Technical training includes general care of oxen, harnessing and hitching procedures, use of animal-drawn field implements and vehicles, and construction and maintenance of equipment. Within the limitations of the season, implements are used in realistic cropping situations that reflect farming practices found in developing countries.

Tillers works with trainees from the U.S. and around the world to blend contemporary knowledge with the best of highly refined, low-cost, historic rural technologies and skills such as animal power, blacksmithing, and yoke building. Tillers develops and shares a rising standard of adapted small farm and rural skills with a diverse audience. Tillers also offers student internships, as well as a series of workshops open to animal power enthusiasts.

△

Contact Information:

Tillers International, 5239 South 24th Street, Kalamazoo MI 49002. ph. 616-344-3233, fx/-385-2329

Howell Living History Farm, 101 Hunter Road, Titusville, NJ 08560. ph. 609-737-3299, fx/-6524.

Please Pass the Goat Cheese...

Peter Bane

Many of us aspire to live in the country, to have a small farm, to make a living from the land. As any who have tried to live this dream can testify, it is often a rewarding, but rarely an easy path. There are, however, some things which make the daunting task of learning new skills, creating markets and support networks, and managing complex systems less formidable.

Having a wide-range of life experience helps. If you've survived blown-up cars, little children, power outages, divorce, tax audits, or middle age, the chances are you may have what it takes. Good humor, especially the ability to laugh at oneself, is essential. Farming is often a ludicrous occupation. Bees swarm unexpectedly, goats get into the garden, the roof leaks all over your desk, mice eat the seedlings, and despite your best efforts the tree you were trimming out of the front yard falls on the power line and catches on fire. Without humor you are lost. Patience counts for much but, increasingly, the ability to promote and present oneself and one's products is crucial to success. Farmers of today and tomorrow will not prosper by selling bulk commodities to faceless buyers at the end of a rail line. Unlike most of modern life, farming will always be up front and personal.

This is the tale of one woman's dream.

Virginia Tate is a farmer's daughter. After many years working as a nurse, she's ready to be a farmer herself. At home on 43 acres of rolling Carolina Piedmont fields and woods, about 20 miles southeast of Greensboro, Tate raises ducks, chickens, and Nubian goats. She hopes the Nubians, which give a rich milk, will become the basis for a dairy in another year or two. To start a dairy from scratch might seem like a huge task, but she is a thoughtful and energetic woman who is accustomed to getting what she wants.



Ginnie Tate strains fresh milk from her Nubian goats.

Sitting on the porch of the modest blue farmhouse, looking out at the goat pens, the tiny milking shed, and the great Muscovy drake waddling across the yard in pursuit of his harem, you could easily get the impression that this bucolic scene has been here forever. But the aura of timelessness belies the hard work and determination it's taken to achieve this restful quality.

Nestled under an enormous spreading walnut, the house is indeed old, as a quick glance at its interior reveals. Through the sliding glass doors of the modern kitchen wing, we can see 200-year-old hand-hewn logs that form the walls of the central room. These have been lovingly cleaned of decades of smoke and wallpaper, plaster, and paint, and their chinking carefully restored. In the corner, an open wooden stair—almost a ladder—leads to a bedroom loft above. “When I bought the place,” Ginnie laughs, “everyone assured me I’d have to knock it down. But after I saw the timber walls, I knew I wanted to restore it.”

Restoring the old house wasn’t easy. Tate had to find a carpenter who was knowledgeable about log buildings and who would work with her, but she persisted and has created a gem of a home, its interior decorated with dried flowers, handicrafts, quilts, and period furniture.



Nubian does give about a gallon of high-butterfat milk each day.

The farm too, reflects her energy and decisiveness. The goat pens are new: four long parallel fenced runs through which she rotates the herd and the poultry. “They cost me \$4,000,” she admits, “but they make it easy for a single woman to manage all these animals.” In one of the runs, we spot a familiar 10’ by 10’ chicken pen. “It’s patterned after Joel Salatin’s mobile coops,” she confides, “but it’s about all I can do to drag it around.” She hadn’t seen Salatin’s wheeled system yet.

The milking shed is a model of simplicity. Measuring about 8’ by 12’, one end is open toward the paddocks. A bench along one side puts the goats up at working height for milking. There are two stalls, one behind the other, with simple wooden frames to restrain the goats’ heads. A small vacuum milking machine collects about a gallon of milk a day from each freshened doe. Against the other wall, an old chest-style freezer stores feed grain.

Ginnie is walking her 13-year old nephew, Gareth, through the ropes of milking goats. The boy is the son of Tate’s younger brother, Steve, and his wife Lee, of Wayzata, Minnesota. Steve is a minister and a psychologist in private practice in the Twin Cities, but he and Lee share Ginnie’s dream of living on the farm. They hope to join her within a year and eventually plan to build a home there for themselves and for Ginnie and Steve’s aging

parents. The family has its roots in the flat corn country of central Illinois. “Our parents have always been very giving people,” he explains. “We never knew a stranger when we were growing up, and our house was always filled with people. Whenever someone in the community needed help, we pitched in. Ginnie and I were both very disappointed when they finally sold their farm.” The image of a farm family, divorced from the land, re-uniting after many years is almost too poignant to bear. Yet Ginnie, Steve, and Lee are quite clear about what it will take, and how much they want it.

The goat dairy is at the hub of a set of related enterprises which the Tates hope will provide them a good livelihood from the farm. They are looking at constructing a larger barn to house a so-called “Grade B” dairy, with facilities for making cheese. In addition they plan to develop the already flourishing garden as a source of market vegetables and herbs, and to parlay these into annual festivals at the farm. Located in a densely populated region of upscale rural settlement (the Piedmont Triad: Greensboro-High Point-Winston/Salem) and within a short distance of some very lively farmer’s markets, Ginnie already attracts a good visitor population to two yearly events, a Basil Celebration in mid-summer, and a Garlic festival in mid-September. The historic farmhouse figures in the family’s economic planning as well: the annual furniture trade show at Hickory, North Carolina draws buyers from around the world, and the show’s managers are always on the lookout for bed-and-breakfast accommodations in the region. Ginnie explains, “It’s only one week out of the



Strained into plastic pails and inoculated, the milk stands overnight at room temperature to curdle.



Whey strained from the cheese is fed back to the does.

year, and renting out the house would bring in several thousand dollars. This place would be really attractive to a group of furniture executives."

For about a year, Ginnie has been making cheese for home use and for friends, while learning the different formulations and processes. She's sought out other women cheesemakers in the area as mentors, and is preparing herself for the demand of milking goats every day. It's a mature approach, one which already tastes like success. With the help of her neighbor, Lula Keel, Ginnie makes both soft and hard cheeses, some flavored with fruit, and some with herbs. Inquiries at the local farmer's markets indicate an enormous demand for chevre, and other goat cheeses, at upwards of \$8/lb. Each gallon of milk from the Nubians yields about a pound of cheese.

Getting certified as a grade-B dairy means having some rather expensive pasteurizing equipment as well as washing facilities for the milking machinery, water heating and chlorinating equipment, and a building. The Tates estimate the outlay will be close to \$50,000. Half of that pays for the pasteurizing machine, which has sophisticated monitoring sensors to record the temperature of the milk and the timing of the heat. But the dairy is foremost in their plans, for it will bring immediate and steady revenue. They are now in the design stage, not yet making detailed drawings, but looking at all the functional connections. Ginnie says she is also looking into financing. If all goes smoothly, they will begin construction this summer.

As we sit down to a table groaning with bowls of steaming green beans and platters of roast chicken, the lightning bugs flickering around us, I am reminded that indeed this is what we are dreaming, a dream called home.

For information about the annual Garlic Festival and the Basil Celebration, contact Virginia Tate, 3515 Jess Hackett Rd, Climax NC 27233.

Powdered microbial inoculant separates curds from whey in 8-12 hours. Each gallon of fresh milk yields about a pound of soft cheese.

Neighbor Lula Keel helps flavor and mold the finished cheese. Tate makes chevre, pepper cheese, and a variety of fruit- and herb-flavored soft spreads.



Lending a hand, neighbor Lula Keel flavors and molds soft cheese.

Photo credits Peter Bane

When writing The Activist or any author or organization, please remember to include a stamped, self-addressed envelope. Gracias.

Controlling Goats with the Right Fence

Elise Mitchell

We have recently concluded our multi-species project using goats for brush control. After managing them for six years, we have accumulated many stories and lots of good, practical information. The key to successfully using goats for brush control is keeping them in the desired pasture. One of the goals for the project was to determine the kinds of fencing needed to handle them. We have tried many combinations.

Fence Types

Woven wire topped by two barbed wires worked well, providing better protection from predators than other types of fencing. There are several disadvantages, however. Regular hog wire presents a good opportunity for entrapment of goats with horns. If not found and released promptly, a goat with her head stuck in the fence becomes a very loud coyote call. To prevent this problem there are types of woven wire designed for sheep and goats. For goats in rough terrain or for brush control, woven wire may be more expensive and difficult to build than is necessary. If you already have woven wire and would like to use goats, an offset hot wire should discourage them from sticking their heads through. You must also check for any areas along the bottom of the fence that leave enough room for them to crawl under. An offset hot wire may help close these holes.

Eight strands of barbed wire strung tightly and with stays (no more than three to four feet apart) held our goats. We also put two offset hot wires on existing five- and six-strand fences, and the goats respected them. We placed one of the wires 6 to 8 inches from the ground, spacing the offsets so the animals could not go under or through the fence without being forced into one of them. A big advantage of this combination is that many people already have a five- or six-strand fence, and with slight modification can add goats to their operation. When I say an existing fence, I mean a good one. Adding offset hot wires to sagging, rusted barbed wire, propped up here and there with an occasional rotting post, will do no good.

Electric fencing contained our goats as long as the voltage was kept at a high level. They did not hesitate to push through a fence when the voltage dropped below 4,000 volts. The perimeter fence around the initial pastures consisted of six hi-tensile wires, four hot and two grounded. It controlled the goats but was hard to maintain in such a rough, brushy area. It was not practical for brush control.

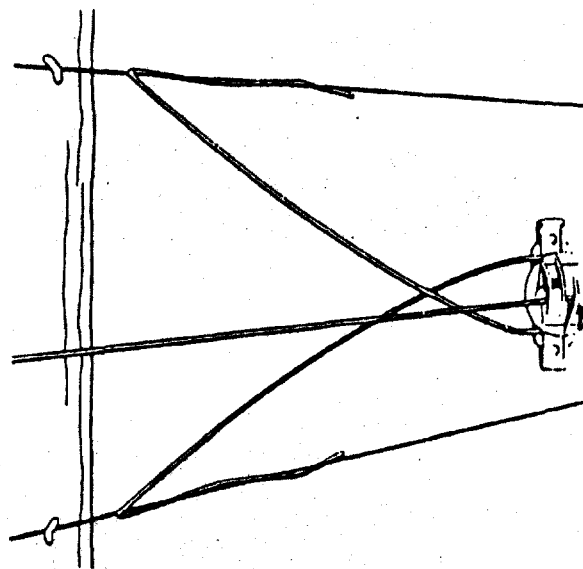
As we made more pasture available, we tried to find the least amount of fencing necessary. A four-strand fence consisting of three hot wires with a barbed wire (stretched tightly about four inches from the ground) worked well. Three hot wires without the bottom barbed wire were not effective, as we were unable to space them so the goats did not go under, over, or through.

Houdini Goat

Whether you use woven, barbed, electric wire or any combination, there are several things to remember. If goats run short of food, they will be more successful at escaping than you ever imagined. The places they can squeeze through will boggle your mind. Depressions under the fence are favorites. Check your corner braces. Can the goats use them to climb out?

Gates can also supply good escape routes. The space between

the gate and post can be an easy exit for smaller adults and kids. Barbed wire gates do not work well if they are opened often. It is almost impossible to close them tightly enough so that the goats cannot crawl through or under. For pipe gates, make sure the spacing does not let the goats get through the bars. Small mesh wire attached to one side will prevent wandering.



An example of an offset wire

Follow the Leader

This article makes fencing goats for brush control seem impossible and hardly worth the effort. They can be a challenge; however, if you know what to expect and are prepared, they are not a problem at all. Do not think goats will act like cows or sheep—they are creatures all their own. Goats are social animals and have a definite pecking order within their group. If the boss is a trouble maker (fence crawler or hood ornament), the rest of the herd will be too. If an individual gets out of or hung in the fence, sell her before she teaches the others bad habits.

If your goats need less fencing than I have described, great! When purchasing goats, solve likely problems prior to bringing them home. Once turned loose, don't expect goats to stay put if potential problems exist. If you are using electric fencing, the goats will have to be introduced to it. Even if they are accustomed to electric fencing, it will take a while for the animal to adjust to a new place.

This article first appeared in the January/February, 1994 newsletter of the Kerr Center for Sustainable Agriculture, P.O. Box 588, Poteau, OK 74953.

Sheep and Wool

Liz Richardson, Elena Wheeler, and Victoria Smith

We originally brought sheep to the farm to help in the orchards and to provide us with wool. Previously we labored for hours each year scything the grass and the ever-expanding blackberry patches. We chose Romney sheep for their long fleeces—particularly well suited to hand spinning—and because they are well adapted to our damp coastal climate. The sheep do a fine job of keeping blackberries and other shrubs in check as well as mowing the grass and fertilizing the fruit trees. (Young fruit trees must be well protected as sheep will eagerly girdle them.)



Harvesting the Wool

Shearing is an art. You cannot learn it from a book; there is no substitute for hands-on experience. The first year's shearing was a great entertainment for observers, backbreaking for myself (Liz) and my assistant, and probably not relished by the sheep. The "How-to" books have plentiful photos of shearing taking place in an orderly fashion—sheep on the ground, shearer standing. We had the process reversed much of the time. Suffice to say that over the years I have improved my technique and can now do a reasonable job of hand shearing in under an hour. After a couple of seasons of shearing, there were at least half a dozen fleeces stored in my basement. What next?

With each passing year we could see the wool piling up. Victoria wanted a real quilt to replace an old polyester comforter. Our neighbor, Elena, also had sheep and a similar stockpile of fleeces. The three of us wanted to spend time together, so there were three good reasons to take action. This evolved into regular Wednesday evening sessions where we pooled our resources and proceeded step by step to transform raw fleece into usable fiber.

From Fleece to Fiber

We are fortunate to have large, deep sinks in our barn which are ideal for washing fleeces. The fleece should be gently handled, in lukewarm water, with mild soap. It takes eight to nine rinses before the fleece comes clean. (Use this washing time to pick out any seedheads or thorns that are caught in the wool.) The wool is then dried on an 8' by 4' wire screen. We store the clean, dry fleeces in old feed sacks until we are ready to use them.



A modern spinning wheel.

Teasing the wool to separate and "fluff up" the fibers was our next step. This led to "sorting" the fleeces to put aside the high quality fibers for spinning and the shorter, lower-grade fibers for quilting. Then we borrowed a drum carder from a friend, cleaned it up, figured out how to operate it, and began to make wool bats 12" by 18". It was exciting to piece together the whole story as we went along, and each of us had a part of the puzzle to



Skeins, batts, and a knitty/knotty for removing yarn from spindle



Skeins of undyed, naturally colored wool.

contribute. Learning to turn fleeces into yarn took cooperation, research, and hands-on experience. The process would have been quite intimidating had any of us chosen to do it alone.

To begin quilting, we wrapped a wooden frame with cloth, then pinned a heavy cotton bedsheet to the frame. We spread wool bats evenly over the surface, pinned a top sheet in place and began stitching through all three layers. We felt an her-storical connection with women over the centuries who have gathered

together in this way. From Fall Equinox 1991 to Fall Equinox 1992 we made three quilts for ourselves.

Spin Offs

Spinning seemed to be the next logical step in our progression. It certainly would be an opportunity for Elena to revive her spinning skill. We continued to tease and card the wool in preparation for this next adventure. Experiments while carding yielded a diversity of natural shades. We were amazed at the tones—white through greys to black—from just four sheep! Curiosity and practice led us through the steps, and now we are crocheting and knitting sweaters for ourselves—discovering the endless possibilities of form and pattern.

Wool is an incredible material to work with because it is so alive, and the fiber is perfect for our climate. The lanolin in the fleece is great for working hands, countering the drying effects of soil and dish soap. We knew so little at the beginning of this project, but have acquired a lot of knowledge through observation and experience. Not only have we taken great pleasure in each step of the process, our yield includes cozy quilts, beautiful and functional clothing, warm friendship, and a closeness to and appreciation of sheep. Δ

Recommended Reading

Raising Sheep the Modern Way by Paula Simmons

Turning Wool into a Cottage Industry by Paula Simmons



Shorter fibers are selected for quilt batti

Photos and drawing by Liz Richardson

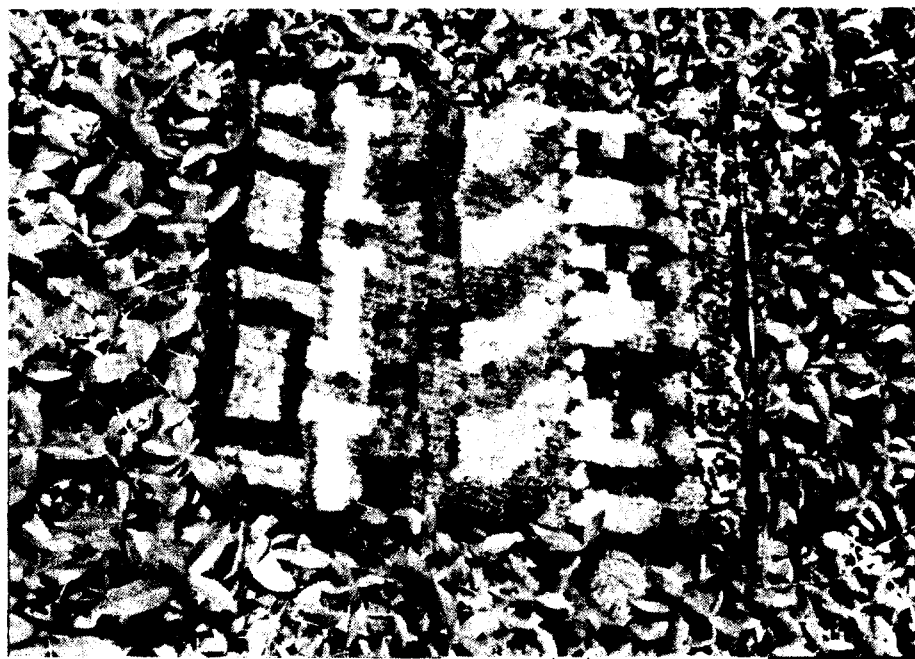
Your Handspinning by Elsie G. Davenport

The Black Sheep Newsletter, Scappoose, OR.

When not spinning wool or herding ruminants, Liz Richardson occasionally teaches permaculture design in the maritime region of British Columbia. She and co-authors Elena Wheeler and Victoria Smith live and work at Linnaea Farm, a 315-acre land trust community on Cortes Island.



Umbrella swift makes skeins into balls.



Colored yarns knitted into the beginning of a sweater.

Holding Back the Water

"All terrestrial ecosystems must work to slow the inexorable effects of gravity in progressively degrading the physical and chemical energetic potential expressed in uplifted catchment landscapes."

—David Holmgren in "Energy and Permaculture."

Peter Bane

Most people think permaculture means tree crops. Fortunately, no one told Marvin Hegge that when he set out to convert his 250-acre sheep ranch into a permanent agricultural system six years ago. The Hegge's, Marvin and Pearl, and their children, Malik and Sennen, are in the grass business. Their hilltop property in Western Oregon's Umpqua Valley north of Roseburg is distinctive in many ways: it is tiny, in a region where 1,000 acres is considered the minimum economic unit. And it is designed primarily to catch and hold back the rain, rain which falls amply at some times of the year and sometimes not at all.

"Creek Bank Farm is a mainly wild ecosystem," comments Keyline consultant and permaculture designer Guy Baldwin. Baldwin, former editor of this magazine, lives in California's Sacramento Valley (a similar, but drier area). He has visited the Hegge ranch often over the past half dozen years and has helped the family design water catchment structures and soil improvement plans. (Ed: For a summary of Guy's impressions, see *Permaculture Intl. Journal* 48:23.) About a quarter of the Western Oregon ranch is forested with oak, fir, and madrone, and the Hegges use these acres too. Stock graze on poison oak, salal, leaves of oak and fir trees, gorse, and other woody browse. As a result of being cropped back, the shrubby areas, which would otherwise become impenetrable thickets, remain accessible and productive. In fact, browsing the understory increases the availability of the resource. Due to quick rotations, and the abundance of green browse, the animals do not damage the trees.

Grass Farming

The bulk of Hegge's acreage is in permanent pastures, growing ever-increasing volumes of high-quality forage. Hegge, a soft-spoken man, describes himself as a *grazier*. About ten years ago he began adapting his operation to Intensive Grazing Management, a system where large numbers of animals are moved into small paddocks, or grazing cells (typically using movable electric fencing), for very short periods, forcing them to graze everything in the pasture to a near uniform level.

IGM, or rotational grazing, based on the original work of Frenchman André Voisin (*Grass Productivity*, 1955), has been widely adopted in recent years both in this country and abroad. It incorporates a number of benefits, while it solves a number of

problems associated with static confinement of animals in fixed paddocks. Rotational grazing mimics the action of large herding ruminants in nature. Buffalo, antelope, wildebeest, and others move into an area, grazing everything available and trampling the residues, along with manures, and presumably seedheads of the prairie or veldt vegetation, into the soil. The herds then move on, not to return for many months. The grassland recovers with vigor. Under intensive grazing pressure (Hegge ran 180 steers on 3-acre cells last year, for example), animals eat not just the most succulent plants, but everything in the pasture. This prevents degradation of the sward. Instead of leaving unpalatable plants to grow and seed, increasing their dominance (as in conventional pasture management), uniform grazing followed by a long period of rest encourages the development of diverse forage stands. Graziers like Hegge sometimes aid this process by seeding ahead of the animals.

What makes Creek Bank Farm different from its neighbors is the approach the Hegge's have taken to the landscape. The area's



Retention of water in swales and dams is the key to extended forage yields. Note standing water in swale left of center.

rainfall is generous by western standards, 42" in an average year, sometimes as much as 48" (27" even in a drought year). But though four feet fall from the sky each winter and spring, "...by July we're dry," say Marvin. Holding water in the soil and in reservoirs, terraces, and ponds has been the key to extending the forage season.

Improving Water Quality

Inspired by P.A. Yeomans, the Australian originator of Keyline planning, Hegge set out to sculpt his mostly south-facing hillsides into water harvesting structures. With the help of conservation agencies, which granted \$42,000 of an estimated \$75,000 spent on the improvements, the Hegges have installed over 17,000 feet

of terraces, five ponds and reservoirs, and 16 sediment basins and gravel filters to slow, spread, and hold water running over the landscape and to retain the formerly thin soil which used to wash into Calapooia Creek. Commenting on the transformation which they set in motion in 1989, Marvin says, "Before we began, even an inch of rain would carry heavy silt loads down to the creeks. Now even a 3" rain runs off clear." Runoff from the ranch watershed has a low turbidity count of 10 parts per million, while



Impoundment of seasonal rainfall in one of 21 dams and basins on Creek Bank Farm.

the streams into which this water flows are regularly measured at 60 parts per million.

Conventional ranching operations have contributed significantly to stream turbidity in Oregon—so often, in fact, that Water Watch (a local environmental group) first opposed Hegge's application for a water right permit. They felt that any projects done on that hillside would surely worsen water quality below. After all, most ranching did just that, and what good were those bulldozers going to do? It took Hegge two years and a lot of persuasion to allay their fears and to thread his application through the state bureaucracy. Water Watch no longer objects to the Hegges' water project, and in May their permit was finally granted, allowing transfer of \$25,000 in impounded funds from the Governor's Watershed Enhancement Board, money that the Hegges had already spent out of pocket.

Taking the Long View

Marvin and Pearl Hegge are patient folks. "Everything we've done has been concentrated on making *permanent improvements*. Once an improvement is made, it has to be able to function without a lot of extra input from us. Most of the improvements are things that prolong the life of the watershed." They are persuasive in a quiet way. After wrestling for two years with Oregon's Water Resources Department for a water right, Hegge recently received glowing praise from the agency: "Thanks so much for taking the time to give us a tour of your property and explain the watershed enhancement project. It makes an incredible difference to be able to see it in person." Fortunately, through the Hegges' persistence, the slow, sometimes invisible processes of soil-building and moisture retention had begun to show themselves. "We made sure they all came here. Once they saw and touched it, they were obliged to recognize what

we were doing was not a danger, and even possibly had merit."

Their efforts have impressed local officials and others in the area. The family was named Conservationist of the Year in 1993 by the Douglas County Soil Conservation District. Agricultural students from Roseburg High School have volunteered on the terracing and erosion control projects. Oregon Tilth, the state's organic certifying organization, plans to conduct research on the Hegge ranch, and Marvin has been granted funds by Oregon State University to study the impact of three livestock management systems on water quality.

The accolades are welcome, but the Hegges have made their choices to improve the profitability of their land. They operate what Guy Baldwin calls "a grass feedlot." They got rid of their sheep six years ago and now fatten other people's animals under contract. This allows them to move animals on and off the land according to the availability of forage: about 120 days in spring and another 30 days in autumn, depending on the rainfall. Their wetter climate gives them a slight edge over ranchers in the eastern part of the state and in northern California (both areas with longer dry seasons), and their location, just a few miles from Interstate 5, makes transferring the herds economical. Their niche consists of high-quality forage in what is, to their customers, the off-season. Rather than buy or make hay, ranchers in eastern Oregon prefer to move their cattle to new pasture

over the mountains.

Hegge is responsible for grazing the animals while they are on his land. And he is good at it. He moves them through paddocks of from 1-5 acres every 12-24 hours, sometimes in as little as four or five hours. No square foot of the ranch has animals on it more than 72 hours in total during the whole year. Besides forage, livestock, including steers, cow/calf pairs, dairy calf replacements, and sheep, get only kelp, a seaweed mineral source and, sometimes, vinegar. They flourish on a lush mix of grasses and herbs which Hegge has encouraged by seeding just ahead of the rotations. Profit comes from fast weight gain on a maximum number of animals in an extended growing season. One hundred and eighty steers averaged 1.72 lbs/day of weight gain last spring



Cattle fatten on lush pasture. Hegge makes money selling grass

in a season of 110 days. Fall weight gains are less, but still significant.

Seed and Water Only

Oregon is a major grass-seed production area, and Hegge has used a waste product of this industry to improve his own pastures.

"Weed" seeds such as chicory, mint, burnet, and the native bemis grass are culled from the cleaned commercial seed and discarded or sold at nominal cost. He has introduced these species along with orchardgrass, and such exotics as tagasaste (*Chaemacyparis spp*), a shrubby legume native to the Canary Islands and widely planted in New Zealand and Australia. These plants pull up diverse nutrients which grass alone would not make available to the animals, improving nutrition. Normally, these plants wouldn't endure long exposure to grazing, but under Hegge's rapid rotations, they hold up well. Using cheap seed purchased with savings from owning no equipment (he has employed only a rented draft horse and hand implements), Hegge has been able to afford heavy applications of seed (up to 150 lbs/acre) to enhance his sward.

More water spread during the dry season means more days of forage, and that translates directly into profit. The \$75,000 the



Increased water infiltration below swales (to right) means better growth of forage.

Hegges have spent on catchment structures works out to \$28/acre/year, based on 25-year amortization at 9 percent. "That's less than some ranchers spend per acre on fertilizer," he notes. And the terraces, ponds, and settling basins are there to stay. They just keep working year after year. Hegge estimates that pasture 150 feet downslope from each terrace is beneficially impacted. More than three miles of terrace meander across the steep hillslopes at grades of 0.5-1.0 percent. Eventually he thinks the effect may spread 500 feet from the watercourses. Forage production (and income) have increased 25 percent each year since the beginning of the project, and the largest two reservoirs were just completed last year. Knowledgeable graziers viewing the ranch have remarked that its potential is far from realized.

Hegge marks his progress by the increase in the ranch's wildlife, both above and below ground. Deer graze heavily in the spring until the cattle are brought in. The population of moles has increased too. These carnivores feed on worms, which indicate more organic matter in the soil. The moles do their part to increase aeration by burrowing, too.

Future Prospects

And what of the future? The Hegges have planted some chestnuts and practiced selective timber stand improvement on their wooded acreage. The entire district was once planted to prune orchards, until loss of local markets led to a decline in the fruit industry. The future of Creek Bank Farm, says Guy Baldwin, lies in developing multiple livings from the land. Perhaps 30-40 acres near the creek have surplus water and are suitable for high-value crops such as vegetables or small fruits.

Hegge wants to continue in the line of work he has demonstrated so well: grazing, and landscape improvement. Perhaps sensing the influx of settlers to Oregon, perhaps eyeing greater challenges elsewhere, he says he would like to sell (or trade) the ranch for another spread—wider spaces east of the mountains, or back in his native South Dakota. The long view sees no problems, only challenges.

Marvin and Pearl Hegge may be reached at Creek Bank Farm, 149 Rolling Ridge Road, Oakland, OR 97462.



Permaculture Books

Introduction to Permaculture

30.00

Bill Mollison w/Rene Mia Slay. 2d ed. (1994) 198pp. paper. illus. The basic argument for permanent agriculture honed to a keen edge by 15 years' teaching and thousands of demonstrations. How to feed and house yourself in any climate with least use of land, energy, and repetitive labor. Replaces *Permaculture I & II*.

Introduccion a la Permacultura **NEW!**

30.00

Bill Mollison w/Rene Mia Slay. 1st ed. (1994) 202pp. paper. illus. Translation of *Introduction to Pc* (1st ed.) into Spanish by a team of N. & S. American students of Mollison. Includes glossary, species lists, and translators' notes on Pc nomenclature.

Permaculture in a Nutshell

8.00

Patrick Whitefield. (1993) 75pp. paper. illus. A back-pocket gem, this book draws on the best examples in Britain and elsewhere to show how permaculture works.

The Permaculture Designers Manual

55.00

Bill Mollison. (1990) 576pp. cloth. 450 illus. + 130 color photos. Global treatment of cultivated ecosystems. A resource for all landscapes and climates. New printing/new price.

Urban Permaculture: A Practical Handbook

13.00

David Watkins. (1993) 152pp. paper. illus. New from the UK. Gives the how-to's of growing food and saving energy in the urban household. Domestic waste, green economics, non-toxic cleaners, garden layouts, species lists, breeds of small animals.

Living Community: A Permaculture Case Study **NEW!**

13.00

Ben Haggard. (1993) 152pp. paper. illus. A lyrical and moving reflection of the author's discovery of harmony and connectedness in the desert landscape of his native Santa Fe, told against the backdrop of a visionary permaculture project at Sol y Sombra, the former estate of painter Georgia O'Keeffe. Insightful remarks on pattern and the subtle but profound interplay of observation and design by a skilled teacher.

The Best of Permaculture: A Collection

18.00

Max O. Lindegger & Robert Tap, eds. (1986) 136pp. paper. illus. Original essays in building biology, urban forestry, land restoration, health, nutrition, energy.

Western Permaculture Manual

14.00

David Brown, ed. 160pp. pap. illus. Pithy essays in ethics, ecology, design, technology, silviculture, and animals, based on 10 years work by the Permaculture Association of Western Australia.

Crystal Waters Village: Conceptual Permaculture Report

17.00

Max O. Lindegger & Robert Tap. (1989) 80pp. pap. illus. Advanced proposal for an agricultural economy at the first permaculture village in Australia. Pioneering work.

Village Owner's Manual

11.00

Nascimanere. 2nd ed. (1990) 54pp. paper. illus. Nuts and bolts for the owner/builder. Passive solar design and hard-to-find information on rammed earth, sod roofs, pole construction, building biology.

The Permaculture Book of Ferment & Human Nutrition

30.00

Bill Mollison. (1993) 288pp. paper. illus. 35 color photos. Comprehensive global survey of methods extending the author's life-long concern with core human survival issues. Treats food storage, preservation, cooking, fungi, yeasts, grain, legumes, roots/bulbs, fruits, flowers, nuts, oils, aguamiels, fish, algae, meats, birds, insects, dairy, beer, wine & beverages, condiments, agricultural ferments, hygiene, food toxins, vitamins, enzymes, trace minerals & nutrient sources, use of earths to enhance food value. In Bill's words, "A book I wished I'd had ten years ago."

Ramial Chipped Wood

Céline Caron

Wood chips made from the twigs of deciduous trees less than 7cm in diameter are known as ramial chipped wood (rcw). Twigs are easily available from home, farm, and city tree pruning operations. They are very often wasted, but positive results from some 1978 research by Messrs. Edgar Guay and R. Alban Lapointe, then working for the Government of Quebec Forestry Department, is about to change all that.

A first set of chemical analyses (from the Forestry Science Department of Laval University, under the guidance of Professor Gilles Lemieux, a member of the seven-person Coordination Group on Ramial Chipped Wood), has shown a rather high protein content, with all amino acids, plus sugar, cellulose, pectin, and starch, with a C/N ratio ranging from 30/1 to 150/1. Ramial chipped wood must not be confused with stem chipped wood which has a C/N ratio ranging from 300/1 to 600/1. Twigs seem to work better than stem wood because of the degree of lignin polymerization and polyphenol content.

Study Results

After more than fifteen years of field experiments in forestry and agriculture, this group now knows that chipping ramial wood allows a fast soil microorganism infection to capture available energy and nutrients into the humic complex. Experiments on wheat, oat, potato and strawberry fields have shown spectacular results.

The following are a few documented observations made in the last 15 years on more than 350 experimental farm and wood plots:

- Better soil water retention
- Marked increase in soil ph
- Control of weeds
- Better flavor in strawberries and higher dry matter content in potatoes
- Decrease or elimination of insect pests
- More developed and highly mycorrhized root systems
- The melanization of soil in the first season after application
- Higher tree seed germination rate

In addition, maple tree decline has stopped in one maple stand much affected by acid rain.

A more recent African experiment in

Senegal gave even more spectacular results with regard to bitter tomato (*Solanum oethiopicum*). Dr. Seck, from Cheikh Anta Diop University, has doubled fruit yield and total biomass within 43 days. He also reports much less aggressive weeds in experimental plots, an unbelievably high moisture content of the soil and, moreover, disappearance of root nematodes, one of the most costly parasites in garden vegetable growing.

Results in temperate- and tropical-climate cultures are much alike, and even better under tropical conditions. Ramial chipped wood can be seen as a universal soil upgrading material. I have sheet composted ramial chipped wood (with green leaves from June prunings of deciduous trees and shrubs) on strawberries, raspberries, potatoes, and fruit trees since 1980, and I can report the same spectacular results.

Procedure

The chips must be spread to a thickness not exceeding 10 cm (4"). They must not be composted or left in a pile to heat. A few rows of quick-growing poplars or alders could be reserved for the purpose of mulching and regenerating adjacent crop soils. Soil regeneration starts the very first year with the establishment of a mycelium network. On sandy soils, the rich mull can migrate down to 20 cm (8") and continue as deep as 30 cm (12"), a phenomenon chemical fertilizers cannot match. Δ

Céline Caron contributed these notes to Pomona (Summer 1994), the journal of North American Fruit Explorers. Membership in NAFEX, a model fruit enthusiasts organization, is \$8/yr. They may be contacted c/o Jill Vorbeck, NAFEX, Route 1, Box 94, Chapin IL 62628. The author writes from 7029 Royale, Château-Richer, Québec GOA 1N0, Canada.

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More books on page 49...

Permaculture Books

***Designing and Maintaining Your Edible Landscape Naturally* 20.00**
Robert Kourik. (1986) 370pp. paper. illus. + 19 color photos. Permaculture in the home garden. Mulch gardens, double digging, root zones, intercropping, pruning, companion crops, natural pest control. Excellent diagrams, charts, species lists.

***The Permaculture Garden* NEW! 16.00**
Graham Bell. (1994) 170pp. paper. illus. Quoting Emerson, Shakespeare, and St. Barbe Baker, Bell gives us a colorful tour of life "out back," as he tells how to look at the garden and get started: planning, landscape elements, helpful techniques, building soil, water, waste, structures, forest gardening. Includes extensive species lists.

***Chicken Tractor* NEW! 20.00**
Andy Lee. (1994) 230pp. paper. illus. A well-informed and thorough guide to the essential permaculture animal, and how you and they can build fertility in the garden. Costs, management, markets, suppliers, animal health, and building mobile coops.

***Earth User's Guide to Permaculture* NEW! 18.00**
Rosemary Morrow. (1993) 152pp. paper. illus. + 4 color plates. With clear simple language and charming illustrations by Rob Allsop, this is a basic permaculture text "for the rest of us." Ro Morrow has taught Pc from India and Cambodia to suburban Sydney. Examples cover a range of climates and should be of use to beginners and veterans alike. Large format, comprehensive, and based on years of experience.

***Forest Gardening* 15.00**
Robert A. de J. Hart. (1991) 212pp + 8 color plates, paper. illus. Seven-story permaculture for temperate climates lovingly described by the grand old man of agro-forestry. Hart's tales of tree life and forest cultures thrill to the root. A gardener's ecology: water, energy, craft, herbs & health. A perennial inspiration, with 46 pages of plant descriptions and variety choices for both temperate and tropical climates.

***The Flywire House* NEW! 10.00**
David Holmgren. (1993) 16pp. paper. illus. A large-format case study of permaculture design for fire, an often overlooked element in the landscape. Graced with scale drawings, house elevations, roof details, site plans, and photos, this slender volume is dense with essential information. A good model of permaculture design reporting.

***Tree Crops: A Permanent Agriculture* 20.00**
J. Russell Smith (1987) 408pp. paper. illus. Reprint of the 1950 ed. with a new intro. by Wendell Berry. First published in 1929 and still radical more than 60 years on, Smith's seminal work remains essential and too little heeded. His proposal for "two-story agriculture" is massively researched and equally entertaining.

***The Forest Farmer's Handbook: Natural Selection Forest Mgmt.* 8.00**
Orville Camp. (1984) 72pp. paper. illus. How to make a living as a woodcutter: forest structure & health, harvest practices, access roads & equipment, by a pioneer.

***Restoration Forestry: An International Guide* NEW! 27.00**
Michael Pilarski, ed. (1994) 525pp. paper. illus. A thick compendium of best current information on sustainable forestry practices by long-time director of Friends of the Trees. Fifty essays and 2300 resources reviewed, with contact information. Will stand for many years as the definitive guide to our most important ecological challenge.

***Cornucopia: A Sourcebook of Edible Plants* 35.00**
Stephen Facciola. (1990) 678pp. paper. Lists 3,000 species with all commercially available named cultivars, sources, descriptions, uses, cultural notes, food products; indexed by common name, families & genera. Useful to every designer & gardener.

***The Man Who Planted Trees* 7.00**
Jean Giono. (1985) 56pp. paper. This timeless and inspiring tale of one man's dedicated efforts to reverse desolation has been beautifully illustrated with 20 woodcuts by Michael McCurdy. A story for all ages.

The Carolina Bantam Chicken

The Re-emergence of the Wild

I. Lehr Brisbin, Jr.

Studies of feral domestic animals and their existence in natural habitats, free from the influence of man, have recently become a focus of research in the fields of both animal ecology and behavior. To date, however, all of this research has dealt with populations which were established in the feral state prior to the beginning of the research program. Particularly in the case of long term feral populations, such as the free-ranging pigs of the Southeast or horses of the West, there is generally little or no documentation of the genetic history or biological characteristics of the domestic animals that initially escaped or were released to form the feral population.

With the exception of the studies to be described here, there has seldom, if ever, been a systematic attempt to establish a feral population under conditions of controlled scientific observation and documentation. Such an undertaking would have the potential to provide much important information concerning the nature of adaptive changes and the rate at which they may occur when domestic animals are first faced with the necessity of adapting to life under a regime of natural selection.

Origins of the Carolina Bantam

In 1965-1967, while completing my graduate studies at the University of Georgia, I became the custodian of a mixed flock of various breeds of show-quality bantam chickens. The breeds included Black Cochins, Golden Seabrights, Silver Seabrights, Mille Fleurs, Rhode Island Reds, White Top-Knots, and Old English Silver Duckwings. A number of these birds were being used in my graduate studies along with a hybrid strain of Red Junglefowl (*Gallus gallus*), which I had obtained from Dr. Peter Klopfer at Duke University. All of these birds mingled freely in a barnyard environment for several years, producing various numbers of mixed-breed offspring. At the end of my graduate work, I released the flock on the edge of a bottomland hardwood swamp on a plantation near Milledgeville, Georgia.

I thought little about the birds for the next 12-18 months, having started work at my present job at the Savannah River Ecology Laboratory near Aiken, South Carolina. Later, however, I began to develop my thinking about research on feral animals. I particularly began to wonder why the chicken is unique among all common domestic species in never having established free-living feral populations, at least in the Western Hemisphere.

This speculation led me to recall the birds I had released more than a year earlier in central Georgia. I particularly remembered keeping careful records of the exact numbers of each breed of bantam and of the junglefowl that contributed to the founding of the group, as well as the amount of time each individual ranged freely in the barnyard flock. Perhaps I now had an opportunity to develop an experimental population to study adaptive changes during the process of return to the feral state.

Accordingly, we undertook an expedition to net, trap, or otherwise catch a sample of that population of bantams, which by that time numbered several dozen free-ranging individuals. Unfortunately, only nine birds could be retrapped (three males and six females). It was with this small founding group that formal research and propagation began in 1969 at the Savannah River Ecology Laboratory.

Documentation and Breeding Program

Over the ensuing 23 years, the founding birds were bred into a population whose numbers fluctuated between 20-100 captive birds at any one time. Periodically, young birds from this flock (usually less than one year of age) were released into various habitats both on the U.S. Department of Energy's Savannah River Site, as well as at other locations in the Southeast. At the same time, other young birds were used for replacement in the breeder flock. Throughout the whole process, careful descriptions were recorded for each bird produced in the study. A documenting color slide was made of each bird at the time of its release, for later reference as to plumage type, comb and leg characteristics, etc. One of the goals of this work was to observe what I expected would be changes of the birds in free-living populations, from generation to generation, both in general appearance and behavior, and to compare these with the "control" birds from the same founding stock being propagated under "henhouse" conditions.



Released birds were initially established in a natural habitat, usually a bottomland swamp hardwood forest near a natural water source, in a small shed/chicken coop. The birds were allowed to adjust to life in the release coop for several weeks and were provided with clean drinking water and commercial feed at all times. Later, the door of the coop was left open and the birds allowed free access to the bush.

Invariably, the birds would return nightly to their roosts in the release coop, for periods as long as a year, until a major predator attack occurred. After 60-70 percent of the birds had been killed by the predator (usually hawk, owl, fox, raccoon, or snake), the other birds became much more wary and ceased sleeping in the release coop at night—seeking rather the seclusion of tangled vines and safer perches high in the trees nearby. In most cases, however, they continued to visit the coop and eat the commercial feed which we left for them.

Those birds that made it through this initial period of predator attack had a greatly increased life expectancy, and we designated them as "survivors." However, the colony has always come to functional extinction when the hens reached reproductive age during their first spring, since at that time they invariably fell prey to predators while incubating or tending their chicks on the ground.

As a result, it has not yet been possible to compare the characteristics of birds in a truly feral population to those in the captive control population. Rather, we began to focus on the "survivors," who were brought back to the laboratory and bred into the captive flock in an effort to see if their characteristics could

produce changes in appearance and/or behavior of the next generation.

While this new scheme has still not produced a completely successful return to the feral state, birds (in the latter generations, from the mid to late 1980's) released into barnyard environments around horse farms in the Aiken, South Carolina area have now managed to reproduce and are successfully raising offspring with only minimal predator protection. (Generally, this protection involves fencing out free-ranging dogs from areas of the barnyard where the birds lay, and trapping and removing certain predators, such as raccoons and opossums, that have targeted the flock.

Observations and Analysis

Over the years, a number of interesting observations have contributed to an understanding of how much the behavior patterns of the birds may be modified when they are faced with "an open barn door" and no longer confined to the limits of a chicken coop. While the establishment and implications of a rigid, "pecking order" social system have been well studied in confined flocks of chickens, observations of the released flocks suggest that many of those studies may not be valid when the flock is released into a free-ranging feral state.

In the confined flocks, for example, a typical peck-order social system is established with one linear hierarchy in the males and another one in the females. Preliminary observations suggest that the high-ranking males command higher and more choice night-time roosting positions in the coop. Social rank in the hens, however, does not appear to be related to the choice of night-time roosting position; females perch on high or low perches regardless of their social status.

However, simply opening the door to allow the birds free access to a natural environment apparently caused the peck-order

privilege of night-time roosting locations of males to disappear. Although more data is needed on this point, the peck-order itself did not appear to change with release. But allowing the birds access to the out-of-doors apparently did change the way in which night-time roosting privilege was distributed among the male members of the flock.

Parting Remarks

It is important to emphasize that conducting long-term studies of this kind has required careful husbandry of the particular breed of chicken that has been the basis of the work. At the current time, there are only a few breeders who maintain flocks of the Carolina Bantam. The main flock continues to be propagated at the Savannah River Ecology Laboratory, with two smaller flocks in barnyard situations in nearby Aiken, South Carolina.

If any other fanciers would like to establish flocks as well, eggs, chicks, and even adult birds can be supplied at no charge, with the understanding that progeny of the flock will be kept pure and will be available to other fanciers to continue the preservation of the breed, if necessary. Because of the nature of these birds and their history of development, they are extremely resourceful and hardy, and make an ideal barnyard fowl that can be left at free-range in almost any situation. At the same time, they offer a unique opportunity to improve our understanding of the return of domestic animals to life in the wild. △

Persons wishing more information on this work or who might be interested in acquiring birds and participating in the conservation of the Carolina Swamp Chicken should contact Dr. I. L. Brisbin, Savannah River Ecology Laboratory, PO Drawer E, Aiken SC 29801, phone (803) 725-2475.

Why Pig Farmers Should Love a Duck

Jessica Laub

Put a duck in with your calves and piglets, and you could make huge savings on insecticides and the vet's bill. According to Canadian researchers, the Muscovy duck (*Cairina moschata*) is a simple, effective control for the housefly, a serious pest for farmers who rear calves or piglets. The fly spreads disease and costs farmers in the U.S. alone an estimated \$60 million a year.

Barry Glofcheskie and Gordon Surgeoner of the University of Guelph, Ontario carried out experiments on several local farms where pigs and dairy cattle were being raised. In some of the rearing pens they installed a four- to five-week old Muscovy duck, while they left other pens empty. The researchers then compared the number of adult houseflies (*Musca domestica*) and fly maggots in the two types of pens.

Glofcheskie and Surgeoner found that each Muscovy duck reduced the number of flies 80 to 98 percent. Oddly, female ducks were found to devour houseflies three times as rapidly as drakes. Muscovy ducks are also helpful in controlling grasshoppers, locusts, snails, and slugs.

Muscovy ducks can be distinguished from other types of ducks by the large patches of puffy red skin around their eyes and over their bills. Muscovies can be white, greenish black, chocolate, blue, or a combination of these colors. They are raised in many countries around the world and have a variety of names. In southern Europe and northern Africa they are called the Barbary duck. In Brazil, they are known as the Brazilian duck, in Spain



Fond of flies and slugs but easy on mulch, ducks can become a gardener's best friend.

the *pato*, and in the Guianas as the Guinea or Turkish duck.

Raising Muscovies

The Guelph researchers found the ducks' maintenance costs were low—they did not even need any extra food. Muscovies forage well for their own food, eating grass and other vegetation. However, they grow much faster if you give them extra protein feeds for the first two to three weeks. You can use broiler starter

mash or chicken growing mash, cooked eggs chopped into small pieces, or cooked soybean meal. Low-cost feed can also be made by soaking empty grain hulls overnight, or by mixing crushed banana trunk with rice bran. Muscovy ducks are easy to care for: they don't require a pond, just clean water to drink. A small shelter where the ducks can go during a heavy rainfall is also helpful.

Nesting boxes can be made from wooden crates or buckets turned on their sides, and are more likely to be used if they are dark inside. A simple nest requires dried grass or other soft material and shelter from rain. If predators are a problem the nest boxes should be put in a protected place, such as a shed that can be closed at night.

Muscovies will lay up to 80 eggs a year, and hatch about four sets of ducklings, if they get lots of high protein feed. If the ducks forage for all their own food, they will lay fewer eggs, probably 20 to 30 a year, and hatch one or two batches of ducklings.

The first eggs a duck lays are usually infertile, so you can remove them from the nest and eat them. Usually a duck will lay up to 20 eggs before starting to sit. A duck can sit on 15-18 eggs at a time. Extra eggs may be removed and placed under a broody chicken. A chicken will hatch out the duck eggs even though they take longer than chicken eggs (33-35 days as opposed to 21 days), and will treat the ducklings the same as her own chicks.*

During the first few weeks of their lives, ducklings require dry shelter and warmth. Until they get their feathers, ducklings should be kept away from streams and ponds, and prevented from swimming lest they drown. Ducklings still require small, shallow dishes of water for drinking, however, and to clean out the breathing holes in their bills.

Multiple Benefits

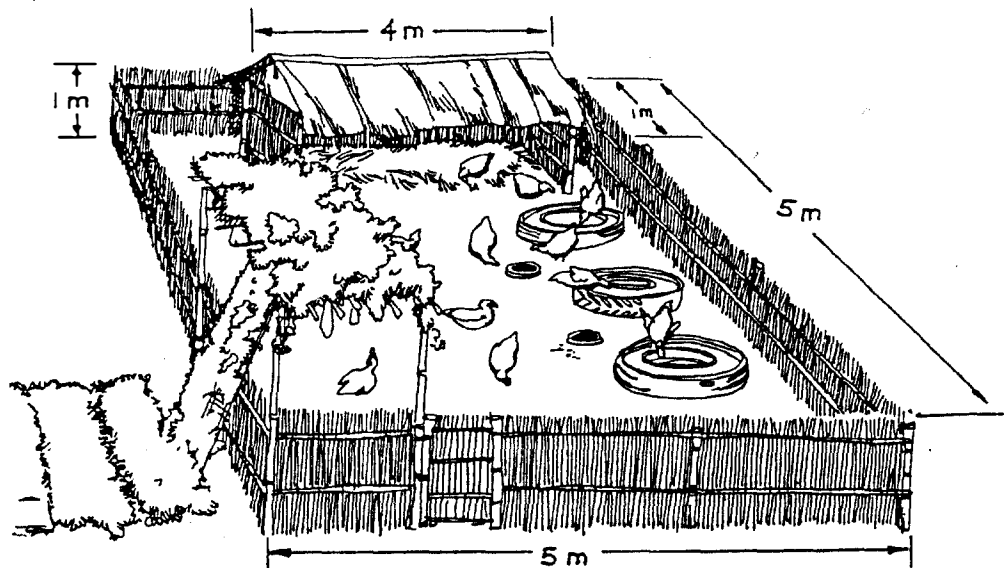
The farmers involved in the experiment were very much in favor of this novel insect control method. Not only were the Muscovy ducks easy to care for, but the farmers also saved money by not having to buy insecticides. In the end, the ducks, which cost only \$2 each, were fit to eat and could be sold, at a profit, for between \$4 and \$9. Muscovy meat is tasty and low in fat. Its flavor goes well with fruit and rice, and it requires less cooking time than other duck meat. What more could you ask?

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* Do not, however, attempt to raise chicks under ducks, as they will drown when their foster mothers lead them into the pond.

Low Input Muscovy Duck Project



Low-Input Muscovy Duck Housing

1. Materials

- a. Housing frame: bamboo, willow, leucaena, etc.
- b. Roof: grass, reed, or rushes.
- c. Fence: bamboo, willow, leucaena, etc.

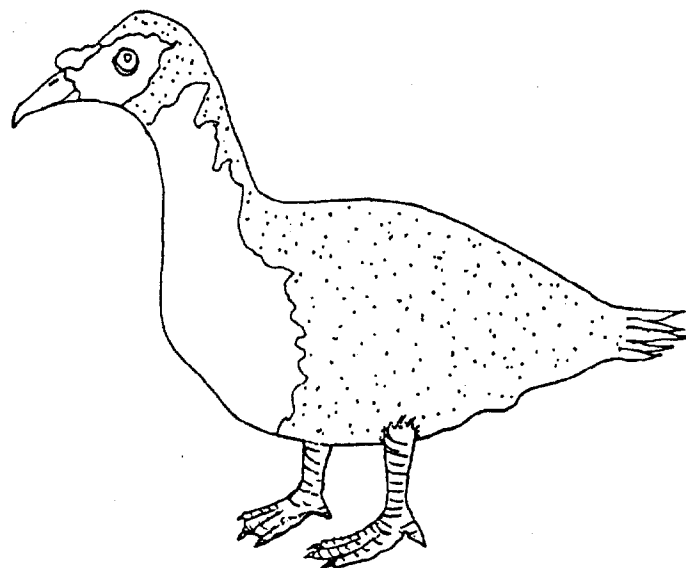
2. Equipment/Facilities

- a. Feeding troughs and bath tubs - old tires cut open
- b. Drinking containers - jars or pots.

3. Other features

- a. Trellis for climbing garden plants may be constructed within the fence to provide additional shelter for the ducks.

Adapted from *Agroforestry Technology Information Kit*
International Institute of Rural Reconstruction
Silant, Cavite, Philippines



Amazing Duckweed

Jessica Laub

A plant that grows so well it can be called a weed, is environmentally friendly, and can convert sewage waste into inexpensive, highly nutritious animal feed: sound too good to be true? It's a bird, it's a plane, it's a permaculturist's dream... amazing duckweed!

Basic Biology

The duckweed family (Lemnaceae) is made up of small, stemless floating plants which lack true leaves but have thickened or rounded fronds. Duckweed fronds have very little fiber because they do not need structural tissue to support leaves or stems. As a result, virtually all tissue is metabolically active and useful as feed or food product. This important characteristic contrasts favorably with many terrestrial crops such as soybeans, rice, or maize, from which most of the total biomass is left behind after the useful parts have been harvested. The Lemnaceae include the smallest of all flowering plants and consists of four genera, *Lemna*, *Spirodela*, *Wolffia*, and *Wolffiella*, among which about 40 species have been identified so far.

Fresh duckweed contains 92-94 percent water, but the solid fraction is high in protein (30-45 percent) and high in essential amino acids, particularly lysine. Its amino acid profile is comparable to soy protein, and its high trace minerals and pigments, including beta carotene and xanthophyll, are particularly valuable for poultry feed because they help give yolks their color. Nutrients are absorbed through all surfaces of the plant, and duckweed's photosynthetic efficiency (about 4.5 percent) is higher than that of most other plants.

Reproduction of the plant is primarily vegetative, resembling exponential microbial growth more than that of terrestrial plants. Duckweed species may be cultivated continuously in semi-tropical and tropical climates, yielding 30 to 40 metric tons/hectare/year (13-17 tons/acre/year) of solid material. In temperate regions, duckweed proliferates during warmer months and copes with low temperatures by forming a special starchy "survival" frond known as a turion. With cold weather, the turion forms and sinks to the bottom of the pond where it remains dormant until rising temperatures in the spring trigger resumption of normal growth.

Duckweed Farming

Duckweed species grow most rapidly on still waters with high concentrations of fermenting organic material, i.e. swamp-like environments. Therefore, intentional duckweed propagation requires the re-creation of such an environment. Almost any land may be suitable for duckweed culture if the soil holds water well. Even waterlogged or salinized land will work, since duckweed will grow in brackish waters. Strips of land may be found along roads or paths that would not normally be cultivated because of their elevation or shape. The preferred pond shape is a channel, so that the duckweed may be easily harvested from both sides. Depth of the water in the culture plot determines how quickly it will warm up in the sun and cool off at night. Duckweed species will grow in as little as one centimeter of water, but good practice is to maintain a depth of 20cm or more to moderate potential temperature stress and to facilitate harvesting. Groundwater, surface water, irrigation or waste water are all potential media for duckweed cultivation.

Acute heat stress can be managed by spraying water on the crop, physically immersing the crop, inducing better mixing, or flooding the plot with cooler water. Shading with vegetation, such as bamboo, can also moderate temperature extremes. Intercropping also increases overall yield and buffers against high wind. Rooted aquatic crops such as taro, with its tasty leaves and tubers, do not need to be as tall as perimeter plants to help break the wind. Other candidates such as lentils, bananas, and squash thrive on levees because water and nutrient constraints are removed. The choice of intercrops should be based on local market demand and the relative need for wind and temperature buffering.



Duckweed is almost all nutrient with very little fiber.

Crop containment to prevent dispersal by water or wind currents is essential to the success of duckweed cultivation. Crop containment is a function of three factors: wind diffusion, pond size, and floating barrier grid size. The larger the pond, the greater the average wind speed, and the smaller the recommended grid size. Large diameter bamboo, contained by vertical bamboo guides, may serve adequately as grid barriers. Sealed PVC pipe or polyethylene pipes, similarly guided, will last longer but are more expensive.

Currently, the only source of duckweed is from wild colonies. Seed stock should be taken from all available native species of duckweed growing near the farmstead or in the same region. These species will be best adapted to the local climate and water chemistry. Frequently, two or more duckweed species will be growing together in wild colonies. Such polyculture increases the range of environmental conditions within which the crop will grow.

The collected duckweed seed stock should be put into containment plots at a density of 600 to 900 g/m² (wet weight). The newly seeded crop may need a week or more to recover from the shock of handling and may grow slowly. During this time, a relatively dense cover will prevent significant algae growth which may compete with the duckweed for nutrients in the water.

Harvesting

Daily harvesting of the incremental growth of the duckweed plot—averaging approximately 100 g/m²/day—is recommended, not only to achieve the best production rate, but to maintain a healthy standing crop. Plants can be skimmed with a floating mechanized harvester or with hand-held dip nets. Passive solar drying (spreading the fresh material on bare ground or a grassy pasture), is the simplest form of post-harvest processing. Sealable, opaque plastic bags are recommended for long-term storage. Dried duckweed, with a residual moisture of 10 percent, can be stored without deterioration for at least five years without special precautions. Dried duckweed is a light, fluffy material, the density of which must be greatly increased for efficient handling. The dried, whole meal can be pelletized in standard equipment without the need to add a binding agent.

Cheap Feed

The nutritional requirements of tilapia and carp species are met in ponds receiving only fresh duckweed (thus eliminating processing costs) despite a relatively dilute concentration of nutrients in fresh plants.

Duckweed meal can be substituted for soybean and fish meal as the protein in prepared rations for several types of poultry, including broilers, layers, and chicks. Acceptable levels of duckweed meal in the diets of layers range up to 40 percent of the total weight of the feed. Duckweed-fed layers produce the same amount of eggs of the same or higher quality as control birds fed recommended formulated diets. Levels of up to 15 percent duckweed meal produced growth

rates in broilers equal to those fed the control feeds. Diets for chicks containing up to 15 percent duckweed meal are suitable for chicks under three weeks of age.

Wastewater Treatment

Duckweed species bioaccumulate as much as 99 percent of the nutrients contained in wastewater and produce valuable, protein-rich biomass as a by-product. Cultivation of duckweed on wastewater is a special case of duckweed aquaculture known as "aquas sanitation." Duckweed-based waste water treatment uses a lagoon system modified to support optimal duckweed growth and water harvesting. Aquas sanitation differs from conventional waste water treatment processes in its simplicity, high efficiency, and generation of revenues from its several products, including fish, duckweed meal, and a high quality treated effluent sufficiently free of nutrients and dissolved solids to be returned to the environment.

Aquas sanitation systems are more effective than waste stabilization lagoons because they actively suppress algae and remove nutrients from the waste water stream. Algae account for most suspended solids in lagoon effluents. The aquas sanitation-treated effluent typically contains less nitrogen, phosphorus, and algae than the receiving streams. The treated effluent contains relatively few organic compounds and human enteric pathogens. A pilot wastewater treatment plant in Mizapur, Bangladesh, has been in operation since July 1990, treating an average of 120m³/day of wastewater from a population of 3,000. The final treated effluent from the 0.5 hectare plant exceeds the highest quality standards mandated by

the Environmental Protection Agency in the U. S.

An aquas sanitation system is also a duckweed farm. The rapidly growing plants assimilate nutrients from the wastewater: nitrogen, phosphorus, calcium, sodium, potassium, carbon, and chlorine ions, among others. Harvesting creates a nutrient sink, as the nutrients are permanently removed from the system. Toward the end of the treatment process, depletion of nutrients slows duckweed growth. The starved plants begin to mineralize heavily as they process water in search of growth nutrients, and they absorb virtually everything dissolved in the waste water stream. A one hectare waste water treatment plant in Bangladesh will typically produce about one ton/ha/day of fresh plants. This daily harvest converts to about 80-100 kg of high protein duckweed meal. At a yield rate of 10 tons/ha/yr (4t/ac/yr), net revenues from duckweed-fed carp farming in Bangladesh average over \$16,000/ha/yr (\$64,000/ac/yr).

The multiple functions of the duckweed plant make it an ideal permaculture tool. It can be grown on marginal land and can serve in waste water treatment, as pig, poultry, and fish feed, and even as green manure. Duckweed, one of nature's simplest plants, is helping to provide a solution to one of humankind's most common problems: water pollution.

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Free Bees

C. L. Parker

Early Spring of '92 I traded several old clay chimney flues for a bee hive, but in the rush of spring planting, my bee plans were forgotten. This Spring I again had thoughts of bees, but I reluctantly decided to put those plans on hold—not enough time, I thought.

Mother nature and fate knew differently. A bunch of bees decided they needed more room and swarmed, landing on top of a billboard by the restaurant where my husband works. After moving several times, the bees located in the shrubbery surrounding the parking lot.

Each time a vehicle pulled in, the bees would rise. Then the vehicle would restart and move to the opposite side of the building, or just plain leave! The restaurant decided the bees were bad for business and my husband called to tell me their death was imminent.

The Big Decision

I have always been a sucker for strays and unwanted creatures and so immediately began to try to find a rescuer for the swarm. My first (and last) call was to Weaver's Apiary. Weaver's knew of hobbyist beekeepers in the swarm's area, but had no way to quickly contact them. I explained to the gentleman on the phone



Smoking the bees before opening the hive.

that I really wanted those bees rescued and regretted I had no knowledge of bees myself, although I did have an unused hive. Minutes later, armed with expert knowledge, I was calling my husband and telling him to "hold off the pesticides. I'm on my way to the bee's rescue."

His objections were strong. Doubts of my sanity and dire predictions of an emergency hospital visit were voiced. My adrenaline was pumping, however, and I brushed aside all objections. Those were my bees now! Arriving at the site, I asked for supplies—a box, a soft bristled brush, tape. While these were gathered I went to take a look. I remembered the man at Weaver's explaining that bee swarms are very docile, except when hungry. None of their stingers were partially out, which would indicate hunger, and the bees were buzzing happily—at least I hoped they were happy! Retrieving my requested supplies and declining the long, heavy coat which was offered me as protection against this ferocious swarm of bees, I took off my sunglasses (so no bees would get stuck behind them), plopped my straw hat on my head (so no bees would get stuck in my hair), tucked my pants into my socks (so no bees would crawl up my pants legs) and strode out the door. To all appearances I was sure of myself, but inwardly I was quaking. I hoped these bees would appreciate that they were being rescued!

Saving Grace

They buzzed their awareness of me as I drew near. I set the box down and timidly began brushing them off the hedge. The man from Weaver's had not lied! While they changed the tone of their buzzing and numerous bees flew up off the hedge, bumping and brushing against me, nary a one stung. I was immediately enamored—the feeling of the softness of their little bodies brushing me and the gentleness of an insect I usually expect to be

aggressive was captivating. Delighting in the task I had set myself, I began chattering, telling the bees about their soon-to-be new home, apologizing for its inadequacies—all sorts of foolishness. Soon I was scolding the bees already in the box as they began climbing out, attempting to rejoin their siblings on the hedge. I ended up using three boxes, as they didn't pay the least attention to my instructions to stay in the first box!



Removing comb from the top "super."

Customers coming into the restaurant were commenting on the "bee expert" outside collecting the bees with no protective suit nor even a veil. My husband came out to make sure I wasn't



Cutting wax from the comb to release the honey.

writhing on the ground in anaphylactic shock from massive bee stings, and reluctantly explained to a father filming the bee rescue instead of his son's birthday party that, no, that crazy woman was not a bee expert—she was his wife!

The Home Front

The sound emitted by three boxes of bees is impressive. When I arrived home my numerous pets were attracted to the racket. After realizing that the noise and my excitement were generated by stinging insects, they promptly turned tail and left. I hastily set up my old hive on a stump near our little pond and began the process of transferring bees from boxes to hive. I suffered the only sting of the entire process while moving the swarm to their new home. Hurrying to get them all safely housed before dark, I inadvertently caught one between my fingers. The injured bee promptly expressed her distress by stinging me. My first reaction was sadness, knowing the bee would die as a result of her efforts to protect herself. Then it started to hurt!

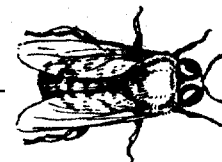
The swarm seemed to like its new home. After making numerous short investigative flights the next day, they settled down. They now zoom in and out of the hive, doing what bees do. Their busyness is somehow relaxing, and I've spent some peaceful moments watching them flit in and out, glad to have been a part of their rescue. Δ

C. L. Parker keeps bees in southeast Texas. This article first appeared in the newsletter of the Peaceable Kingdom School. Membership is \$15 per year. Contact them at P.K.S., P.O. Box 313, Washington, TX 77880.



Cleaning out the separator after spinning out the honey.

Africanized Honey Bees: Q & A



Gretchen Sanders

Q: What can you tell me about the African or "killer bees" that isn't hype?

A: African Honey Bees (AHB) were brought to Brazil in 1956 for research aimed at imparting more vigor and activeness to the rather complacent imported European bees.

Some were also given to local beekeepers there. It was hoped that a hybrid of the best of both types could be raised. The hybrid bees at first appeared to demonstrate the desired results. They built up large populations quickly, gathered more honey, were effective as crop pollinators, but were more defensive around the hives and swarmed often. European honey bees (EHB) did not swarm in the tropics. The swarms spread throughout sparsely inhabited environments and mated with their own relatives until they became genetically similar to their imported African ancestors. It is this population of feral AHBs that has expanded all the way to the southern United States.

In tropical habitats, nectar flows are light and irregular. Tropically adapted honey bees can utilize those flows for building populations very quickly, but they usually store very little as honey. When food sources become scarce, tropical honey bees abscond and go to a place with a better food source. Under similar conditions, EHBs simply stay in the hives and starve to death. After AHBs became abundant in tropical South America, EHB's could not survive the competition for food. Beekeepers were forced to keep AHBs so their colonies could compete and survive.

Q: Will I be able to tell the Africanized honey bee by sight?

A: Probably not. The Africanized bee is slightly smaller, but even side by side, you couldn't tell the difference.

Q: When will these bees be in my area?

A: The Africanized honey bees are now in Mexico, Texas, New Mexico, and Arizona. They were seen in Arizona, one-fourth of a mile from the California border, in October, 1993, and are presumed now to be in southern California, since they travel 100-300 miles a year. They are slower crossing deserts and mountains in drought years. They are expected to travel up the coast and central valley and reach Northern California late in 1995.

Q: What should I do if AHBs are in my yard?

A: Don't disturb them! The Africanized hybrids are easily aroused. The vibrations of small motors such as lawn mowers, chain saws, chippers, and pets barking can set them off. Unlike our European bees, Africanized bees can stay angry for up to eight hours. Don't start up small machines if you see them around. Phone for someone to remove them who has had special training in removal of Africanized bees.

Q: Can't I just call a beekeeper service to remove them?

A: You must ask if they have had special training in Africanized bee removal. One woman got a beekeeper who brought the equipment he uses with European bees and started to smoke them. The smoked bees gave off an alarm signal and the whole swarm went into action, stinging. The beekeeper realized that he

was being stung through and under his protective clothing and ran away, leaving others in the area to be stung by enraged bees. Since these bees can stay aroused for eight hours, he made the situation worse.

Q: What should I do if my pets are attacked?

A: Call your pets inside. Dogs can be killed if they are left outside and stand and snap at the bees. Cover your pet with a towel or jacket and wash the animal with shampoo. Scrape or flick the stingers aside. Each bee can only sting once and then flies around for a while before it dies. If the dog has had many stings, take it to the vet.

Q: How should I remove a stinger?

A: Don't just pull it out! That will release all the venom into your system at once! When the bee stings you, the ripped out stinger pulses for nearly 60 seconds releasing venom. Use your fingernail and flick the stinger to one side.

Q: What should I remember to do if I am attacked?

A: RUN! Don't swat at the bees and don't stand still. Honey bees tend to sting around the face, so pull some clothing over your head. But leave enough of an opening to see where you're running. Stings emit an odor called "alarm pheromone" that attracts more bees to the area to sting. If you run away far enough, the alarm odor no longer attracts bees to you. If you have been stung 15 or more times, or if you are allergic to honey bee stings, have someone drive you to a doctor.

Q: Are the stings more dangerous than ordinary bee stings?

A: Each sting is exactly like an ordinary bee sting. Each worker bee can only sting once. What makes these stings so dangerous is that the victim is more likely to be stung by many more bees.

Q: How far can these bees chase a victim?

A: These bees can chase a victim the length of four football fields or about a quarter of a mile.

Q: Can I do anything to lessen the chances that the AHB will find a home in my yard?

A: They can nest almost anywhere, in a hole in the ground, under the eaves of a house, in a pile of logs, an old tire, or in bushes. They can swarm under houses. They only need a crack one-fourth of an inch big to squeeze through! Keep bushes trimmed and thinned, seal off cracks in walls; use one-eighth inch mesh to cover attic and under house air circulation areas, fill in dirt holes, get rid of old tires and trash that could be used as nesting sites.

Q: Can these bees be managed in hives?

A: South and Central American beekeepers have successfully managed AHBs. However, the apiaries are kept in isolated locations and the bees are not appropriate for beekeeping conditions in the U.S. Our beekeepers are going to be able to keep EHBs in their bee hives through a process called "requeening."

Prepared by Gretchen Sanders for Fruit Gardener, Journal of the California Rare Fruit Growers, June 1994. Membership in this excellent organization (includes subscription to their journal) is \$16/yr to U.S. addresses, \$25/yr to Canada and Mexico, \$30/yr foreign surface mail, and \$40/yr foreign air mail. Write Sue Irvine, CRFG Administrative Asst., 9872 Aldgate Ave., Garden Groves, CA 92641.

Honey Bees in Our Future



Eric C. Mussen

The general public—and the readers of this magazine—must be reassured that having a hive of bees kept nearby is not a threat to their well being. Particular beekeepers in California (and in the Gulf States from Texas to Florida) who specialize in selecting and rearing good stocks of bees consider minimizing defensive behavior as one of their top breeding goals.

Beekeepers can purchase from breeders queens that have been raised from the best stocks, and mated with drones from the best stocks. Matings take place randomly in the air. If there are no Africanized drones (from Africanized colonies) in the area, then all the matings are appropriate and the offspring of that queen will always be European.

While flying, queens mate between 12 and 20 times before returning to their nests, but that is it for their lifetime. A queen stores sperm inside her body in an organ called a spermatheca. Those sperm can remain viable up to five years, if she lives that long.

The life expectancy of worker bees (which serve as guards to sense disturbances and soldiers who fly out to sting in defense) is only six weeks during the active season. Each worker spends about three weeks working inside the hive, then the next three weeks as a forager (or soldier). Replacement bees are needed on a regular basis, so the queen is laying more than 1,000 eggs per day. Twenty-one days later, around 1,000 worker bees will emerge.

A beekeeper can remove the old queen from a colony and replace it with a newly purchased, mated queen. Around six weeks later, all the old queen's workers will have died off and the new workers will be offspring of the new queen. In this manner, California beekeepers can, and will, keep European queens and bees in their hives, even if there are Africanized bees in the neighborhood.

This fact is important to understand so that fearful individuals will not demand that their elected officials "protect" them by establishing ordinances restricting or prohibiting beekeeping. The presence of European honey bees is important for local pollination of tree, bush, and garden crops; for providing drones that will carry European genes into the Africanized bee populations, diluting their defensiveness; and to provide competition for food supplies that might cause the Africanized honey bees to move on in search of more abundant pollen.

Playing up the positive role of our current bees is extremely important. The potential impacts of AHBs need to be kept in their proper perspective.

Eric C. Mussen, Ph.D., is Extension Apiculturist at the University of California at Davis. This article first appeared in Fruit Gardener.

Bee Plants of the Mid-South by Season of Bloom

COMMON NAME	LATIN NAME	MONTH OF BLOOM	HABIT
Maples	<i>Acer spp</i>	Feb.-April	tree
Winter Jasmine	<i>Jasminum nudiflorum</i>	March	sm. shrub
Dandelion	<i>Taraxacum officinale</i>	March-April	per. herb
Japonica	<i>Camellia japonica</i>	March-April	sm. shrub
Phacelias	<i>Phacelia spp</i>	March-April	per. herb
Flowering Quince	<i>Cydonia oblonga</i>	March-April	shrub
Hairy Vetch	<i>Vicia villosa</i>	March-April	bienn. herb
Oregon Grape	<i>Mahonia spp</i>	March-May	shrub
Apple	<i>Pyrus malus</i>	April	med. tree
Dutch White Clovers	<i>T. repens</i>	April	per. herb
Crab Apple	<i>Malus spp</i>	April	sm. tree
Elm	<i>Ulmus spp</i>	April	tree
Tulip Poplar	<i>Liriodendron tulipifera</i>	April	tree
Peach	<i>Prunus persica</i>	April	sm. tree
Pear	<i>Pyrus communis</i>	April	sm. tree
Azalcas	<i>Rhododendron spp</i>	April-May	shrubs
Barberry Juliane	<i>Berberis julianae</i>	April-May	shrubs
Lilacs	<i>Syringa vulgaris</i>	April-May	shrub
Redbud	<i>Cercis canadensis</i>	April-May	sm. tree
Crown Vetch	<i>Coronilla varia</i>	April-May	per. herb
Willows	<i>Salix spp</i>	April-May	trees
Bush Honeysuckle	<i>Diervilla lonicera</i>	May	shrub
Crimson Clovers	<i>Trifolium incarnatum</i>	May	bienn. herb
Sweetclovers	<i>Melilotus spp</i>	May	bienn. herb
Eleagnus	<i>Eleagnus spp</i>	May-June	shrubs
Tupelo Gum	<i>Nyssa sylvatica</i>	May-June	tree
Milkweed	<i>Asclepias syriaca</i>	May-June	per. herb
Blackberry	<i>Rubus allegheniensis</i>	May-July	shrub
Wisteria	<i>Wisteria spp</i>	May-July	shrubs
Basswood	<i>Tilia americana</i>	June	tree
Hollies	<i>Ilex spp</i>	June	med. tree
Black Locust	<i>Robinia pseudoacacia</i>	June	tree
Persimmon	<i>Diospyros virginiana</i>	June	tree
Hedge Privets	<i>Ligustrum spp</i>	June	sm. shrub
Catalpa	<i>Catalpa spp</i>	June-July	tree
Soybeans	<i>Glycine max</i>	June-July	ann. herb
Alfalfa	<i>Medicago sativa</i>	June-August	per. herb
Watermelon	<i>Citrullus vulgaris</i>	June-August	ann. herb
Sumac	<i>Rhus glabra</i>	June-August	shrub
Cucumbers	<i>Cucumis melo</i>	June-September	ann. herb
Smartweed	<i>Polygonum spp</i>	June-September	per. herb
Spirea	<i>Spirea spp</i>	June-September	shrub
Abelia	<i>A. grandiflora</i>	June-October	shrub
Cotton	<i>Gossypium spp</i>	July	ann. herb
Crepe Myrtle	<i>Lagerstroemia indica</i>	July	shrub
Beggarweed	<i>Desmodium purpureum</i>	July-August	ann. herb
Corn	<i>Zea mays</i>	July-August	ann. grass
Sourwood	<i>Oxydendrum arboreum</i>	July-August	med. tree
Goldenrod	<i>Solidago spp</i>	July-September	ann. herb
Lima Beans	<i>Phaseolus limensis</i>	July-September	ann. herb
Sunflower	<i>Helianthus annuus</i>	July-September	ann. herb
Cantaloupe	<i>Cucumis melo</i>	July-October	ann. herb
Spanish needle	<i>Bidens bipinnata</i>	July-October	per. herb
Squash	<i>Cucurbita spp</i>	July-October	ann. herb
Thistle	<i>Cirsium lanceolatum</i>	July-November	per. herb
Golden Rain Tree	<i>Koelreuteria paniculata</i>	August	sm. tree
Asters	<i>Aster spp</i>	August-October	per. herb
Vitex	<i>Vitex agnus-castus</i>	August-October	shrub



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Sustainable Fish Culture

Kenneth Williams

Fish consumption in the United States is increasing at a rate of 4 percent a year. Since natural sea fisheries have reached their maximum potential yield (and some have collapsed or are in decline—Ed.), almost all increases in fish production will come from aquaculture, primarily from freshwater ponds.

As fish become more of a staple item on the American table, consumer demand will increase the market for a reasonably priced product. Lower retail costs will, in turn, sponsor increased consumer demand.

Energy Use and Fish Culture

Catfish (*Ictalurus spp*) is the leading cultivated fish crop in the U. S. today, with production topping 14,000 tons per year (1984 fig.) At present prices, catfish are a good money-maker for commercial aquaculture. However, the long-term economics of catfish production may not be sustainable. Ecologically, the catfish is an opportunistic carnivore that generally feeds high on the food chain. Its natural diet includes insects, crawfish, minnows, and other living or dead organic matter. The catfish requires a large amount of high-quality protein and vitamins for optimal growth. With the high stocking densities of commercial aquaculture, these nutrients must be provided by high-value artificial feeds.

Carnivorous fish, such as catfish and trout, require a diet containing from 32 to 46 percent protein. At least 9 to 10 percent must come from fishmeal to maintain a proper amino acid balance. This fishmeal usually comes from menhaden (*Brevoortia tyrannus*) that have been captured by ocean trawlers. These boats require energy for their construction and energy from oil and gas for their daily use. The raw menhaden must be processed into fish meal. This processing into meal and further into fish food, also takes energy, as does all the intermediate transportation.

The fish food is further shipped to the farmer before it is finally fed to the fish. The fish convert half of it into flesh; the rest is excreted. Only 60 percent of the fish is edible, and about 86 percent of the flesh is actually water. A tremendous amount of energy is used to raise a relatively small amount of protein for

human consumption.

Appropriate Fish Species

If fish is to achieve the market popularity of poultry, then a role is warranted for alternative species that are energy-efficient and inexpensive to produce. Catfish and trout will always have their place in the U.S. market, but their requirements are such that they probably cannot be raised in sufficient quantities at a low enough price to be competitive with other meats. Other countries, in which aquaculture contributes a significant part of the diet, choose to raise fish that are low on the food chain and require much lower energy inputs per pound of production. In Israel silver carp (*Hypophthalmichthys molitrix*) and tilapia are the most often cultured fish. In Asia, India, Africa, and the Pacific Islands, favored species include carp, milkfish, tilapia, and mullet.

In the United States, with an upward pressure on energy costs and growing consumer preference, fish such as tilapia or buffalofish (*Lates niloticus*) could make up an increasing percentage of future production. These fish can eat the vegetation and microorganisms found naturally in ponds. Yields may be increased by fertilizing aquatic and wetland vegetation with manure of nearby livestock, eg. pigs, ducks, geese, or by giving the fish low-cost supplemental feeds. Duckweed and other plant species grown on nutrients from wastewater treatment ponds are a potential low- or no-cost feed source for such fish.

The key to sustainable aquaculture is to mimic the ecosystem in which the fish exist in nature. This most often entails finetuning a complex orchestration of variables to produce the optimum environment for fish growth. The Chinese, for example, have mastered the polyculture of a variety of carp species within a sustainable system.

Unfortunately, many carp species are illegal in the various American states, because of concern that if escaped, they might displace or endanger native species. Grass carp (*Ctenopharyngodon idellus*), however, are legal in many states, and are an ideal fish for sustainable culture. Grass carp can feed on naturally existing

phytoplankton and edge vegetation in pondwater, and can survive cold winter weather. Best of all, grass carp can reach a harvestable size of up to six pounds in six months.

A bluegill x sunfish hybrid is also available which can survive in small temperate-climate ponds with virtually no external inputs. This variety, however, may take up to two to three years to reach a harvestable weight. Also, this cross-bred fish cannot naturally reproduce, a factor which may save the effort expended in later culling the fish crop, but which is a definite strike against sustainable production.

Return of the Buffalo

The buffalofish is an underutilized resource for fish farmers in the United States. These fish are a native North American species that feed low on the food chain (eating plankton, benthos*, and detritus), readily overwinter, reproduce naturally, require virtually no external inputs, and may reach a weight of up to 80 pounds! In Arkansas in 1958 there were 3,032 acres of water devoted to buffalo culture.¹ Catfish were being grown in some ponds, but always as a secondary crop to buffalo. By 1963, more water was devoted to catfish than buffalo, and today, while catfish culture is a thriving industry, there is no water devoted primarily to buffalofish. Given the conditions of the economy in the 50s, economists perceived that a farmer could make more money growing a high-priced fish on a high-priced diet than by growing a low-priced fish at very low expense. Today, however, with the growing ecological crisis and increasing shortage of fish, it would be wise for aquaculturists to rediscover the buffalofish. The market for a lower-priced fish is definitely there, and the money lost by a low market price could be compensated by frequency of sale and a higher return on the initial investment. Bring back the buffalo!

Tilapia are a warm-water fish that are disease-resistant and tolerate poor water conditions. They can be raised in existing ponds built for erosion control or watering livestock and can effectively help clean

* bottom-dwelling organisms.

such ponds, thriving on cattle waste and filtering microscopic plants and animals from the water. Tilapia reproduce rapidly and fingerlings provide a food source for other fish, poultry, and hogs. Full-grown tilapia are readily saleable due to their mild flavor and boneless fillets. The fish can reach a marketable weight within six months, so fish stocked in the spring are harvestable by fall. Tilapia's only drawback is that they die when water temperatures drop below 45° F. As the water approaches this temperature, the fish become lethargic and may float to the top. They can be scooped out and eaten, fed to livestock, or "planted" in a garden or field for fertility. Though tilapia's warm-water preference may be viewed as a disadvantage, it really makes them no different than any other crop grown on a seasonal basis such as corn or tomatoes.

The cost of raising fish that feed low on the food chain are much less than those of conventional catfish culture. This can mean increased profits for farmers because of reduced off-farm inputs. Also, these kinds of fish can be raised in existing ponds, so less capital expenditure is needed. No elaborate systems need to be constructed or monitored.

Organic Fish Production

Until recently, organic food producers were mainly concerned with fruits and vegetables. Organic beef is now available, as well as poultry and mutton. Organically-certified fish will surely be on the market shelves soon. Fish already has a reputation as a healthy, low-cholesterol, high-protein food.

Organic fish culture has the potential to make small-scale aquaculture more profitable. If retail prices for organic fish follow the prices of other organic meats, net returns to farmers could more than double. The small-scale culturist also has a greater opportunity to market a specialty product. He or she can supply local health food stores with a high-quality item at a cost that is profitable to the farmer as well as the grocer. This is not possible when a producer tries to compete with nationwide distributors for a market share with a conventional product.

If a demand exists for organic fish, why is so little of it reaching the market? The greatest obstacle to organic fish production is feed.

The major species raised commercially are catfish and trout. Ten percent of their high protein feed requirements are conventionally met by fishmeal, with the rest provided by soybeans, corn, or wheat.

The scarcity of organic feed grains hinders production of an organic ration. The solution to organic fish culture is to choose a fish that can yield a good level of growth on a more readily available diet, while at the same time being culturally acceptable and easily marketed. Species of carp, buffalofish, and tilapia meet these requirements. They are herbivores and can convert low-protein foodstuffs into flesh.

Alternative Feed

Phytoplankton, or microscopic plants, could provide the basis of an organic diet. Phytoplankton is most easily increased by adding a natural fertilizer, like chicken or duck manure, to the water. However, it is illegal to feed manures directly to animals meant for human consumption. Composted chicken manure would prove to be a usable alternative. Plant materials high in nutrients such as alfalfa and other legumes, can also be put directly in the pond. The fish will eat some of the leaves, and the rest will fertilize the water. Organically produced beans and grains are currently too scarce and expensive to use as fish food.

Spirulina algae, which is highly nutritious, could also be used as an organic feed source. Considerable research has been done with spirulina because of its potential as a human food. Production methods may seem too complicated for fish culture, but pure strains would not be needed in aquaculture, a factor that could simplify techniques.

Cottonseed meal and peanut cake are excellent feeds for tilapia. They are both nutritious and cause a heavy plankton bloom that can serve as another food. Cotton is rarely grown organically, so the use of cottonseed meal may be restricted or require composting.

The best approach may be to get a variety of potential feeds, particularly leguminous leaves, and add generous quantities of composted manures to maintain a heavy plankton bloom. Phosphorus is the key limiting element required to achieve a good population of phytoplankton. Therefore, any organic material that contains a large amount of available phosphorus (manures of all types most obviously) will increase phytoplankton and therefore fish production.

Organic fish culture will demand some trial and error. Depending on the type of fish and what is fed to them, feed

costs could be higher than for conventional aquaculture (organic feed grains), and appropriate ingredients may be difficult to find or grow. On the other hand, supplemental feed requirements may be very minimal (if fish feed on phytoplankton). Production times could be longer, or fish could be smaller than with commercial rations. However, good markets would seem to exist for organic fish, and the profit potential is high.

Integrating Ponds

An important challenge for the agricultural ecologist is to integrate farm components, such as ponds, into the whole farm system. The goal is to combine elements in a way that best uses ecological cycles and interactions for food and fiber production while maintaining or enhancing natural resources.

A pond can be made multi-functional by building it in a location that enhances its utility. Ponds placed up slope can supply water to other enterprises by gravity-flow. Gravity-flow water from large ponds can be used on a limited basis with hydropower generators to produce electricity.

Ponds can be built to reflect heat and light into a house, to store water for irrigation and fire control, to create a microclimate, to control erosion, and for recreation. Existing ponds can be stocked with fish, regardless of their location.

With careful management, a pond can supply more than water for livestock. When combined with other enterprises, it can benefit the entire farm. Δ

Notes

1. McLarney, W. *The Freshwater Aquaculture Book*. Point Roberts, WA. 1984.

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Constructed Wetlands

A Permaculture Approach to Wastewater Treatment

Tad Montgomery

Over the past 20-30 years, constructed wetlands (CWL) have been developed in first world countries as a technology for the purification of municipal wastewaters, acid mine drainage, landfill leachate, and other contaminated waters.

Many indigenous and subsistence cultures have used aquatic ecosystems for wastewater purification, with varying degrees of success, for millennia. New CWL technology has most often been used to treat wastewaters contain toxic or pathogenic components. Concerned primarily with mitigating the worst effects of material and energy extravagance, planners and engineers have not paid serious attention to the potential human use of the biomass generated by constructed wetlands, i.e. how the technology might be designed specifically to generate edible

or useful plant material.

A company in Amherst, Massachusetts called Bioshelters, Inc. is designing a wastewater treatment system for their production facility which combines aquaculture with hydroponics in a greenhouse. Originally inspired by work done at the New Alchemy Institute, the Bioshelter rears *Tilapia* species and various vegetables and herbs for profit. They have developed a recirculation technology which uses different biofilters to remove sludge and transform toxins.

At present, wastewaters are pumped onto adjacent fields of organic crops, which benefit from nitrogen in both organic and soluble forms, as well as phosphorus, potassium, and micronutrients. A large expansion is planned, and my

Index of Potential Cash Crop Wetland Species

LATIN NAME	COMMON NAME	NOTES
<i>Apios americana</i>	ground nut	Indigenous; tubers nutritious with high protein; prolific growth, known to overgrow cranberry bogs, producing 30 tons/acre of tubers unattended; staple of the Indians in this area; presently being researched as a potential new cash crop.
<i>Aronia melanocarpa</i> <i>Aronia butefolia</i>	black chokeberry red chokeberry	Indigenous; developed in Russia as high value fruit.
<i>Cyperus esculentus</i>	nut sedge	Known in some areas as a noxious weed, one form is not invasive and produces large edible tubers.
<i>Eleocharis dulcis</i>	water chestnut (#1)	Commercial canned product; needs a long season (greenhouse crop?); good demand, high value.
<i>Equisetum</i> spp.	horsetail	Reputed to accumulate metals and minerals; established market with herbalists as a medicinal.
<i>Viburnum trilobum</i> , or <i>V. americanum</i>	high-bush cranberry	Questionable market value.
<i>Matteuccia pensylvanica</i>	ostrich fern	Indigenous, edible fronds in spring; established market.
<i>Mentha</i> spp.	mints	Many species of edibles, medicinals, and ornamentals.
<i>Nasturtium officinale</i>	watercress	Can be grown outdoors or indoors; grows exceptionally well in cold water (down to 48°F); has an abundance of roots.
<i>Nelumbo lutea</i>	lotus	Indigenous, hardy; tubers edible, comparable to sweet potato in flavor; showy flowers; edible seedpods; potentially high value.
<i>Nelumbo nucifera</i>	Chinese lotus	Larger, leaves 1-3'; huge flowers; hardy; specialty crop in Asian markets.
<i>Pontederia cordata</i>	pickerel weed	Quite edible but doubtful market; attractive plant; invasive.
<i>Sagittaria</i> spp., esp. <i>latifolia</i>	arrowhead	Indigenous.
<i>Sambucus canadensis</i>	elderberry	Used commercially as a specialty wine.
<i>Trapa natans</i>	water chestnut (#2)	Eaten by Chinese, questionable market for food crop; ornamental plant in aquaria; hardy.
<i>Typha</i> spp.	cattail	Indigenous; commonly used in CWL's and fairly well studied for nutrient assimilation and habitat requirements; many edible uses but no developed market; valuable as wildlife habitat.
<i>Vaccinium corymbosum</i>	high bush blueberry	Well established markets; plant is used as a wetland indicator; roots can survive year-round submersion; plant can survive submersion during dormant season; abundance of fine roots; used as a species for wetland restoration.
<i>Vaccinium macrocarpon</i>	cranberry	Indigenous; well developed cash crop on the coast; tolerant of acidic waters; adaptable.
<i>Zizania aquatica</i>	wild rice	Indigenous; high commercial value (\$7-8/lb); prefers shallow moving water; annual plant which grows to 7-8'; domestication in California has increased yields; can tolerate high mineral levels in water; prefers soft alluvial soils.

involvement is to design treatment and reuse systems for wastewater generated by the new facility. The challenge, of course, is treatment in the winter, when field crops are not able to soak up the nutrients, and contamination of the ground water would be a problem. This is also the time of year when activity in any biological filtration mechanism is at a lull.

We are looking at a number of treatment options for the new facility, but the most interesting from a permaculture standpoint is to incorporate edible or useful plants that have a market value into a CWL purification system. We are proposing to undertake studies on a number of aquatic plant species which will include research into markets, required habitat, suitability for our project, and nutrient uptake capabilities. The list on the preceding page is our first pass at species which we feel have good potential. They are mostly cold-hardy species indigenous to the Northeast. Pharmaceutical and medicinal plants are being investigated as well. Once preliminary studies have been performed on these plants, the list will be narrowed down to a number which show promise, and controlled experiments will be undertaken. Small bench-scale systems will be built in a greenhouse and planted

with the different species, and Bioshelter's wastewater will be introduced, in order to measure the reaction rate coefficients of the various species in removing different pollutant components of our specific kind of wastewater. We would like to perform these studies in conjunction with the Plant and Soils Science Department at the nearby University of Massachusetts at Amherst, utilizing their greenhouses and research facilities, but we are a fish farm, and capital for such research is extremely limited.

We have published this list in *The Permaculture Activist* in order to solicit a peer review. People having experience with any of the listed species or others which might be applicable—especially in a wetland environment, are encouraged to write and describe their experience. This could save us years of trial and error. We are also seeking sources of funding which would enable us to undertake this research using scientifically rigorous methodologies. Δ

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Municipal Reed Bed Sewage Treatment

Every human settlement must deal with sewage. Sludge de-watering, dessication, and disposal are major problems across the United States. A case study tells how one community is testing options.

Michael Hylton

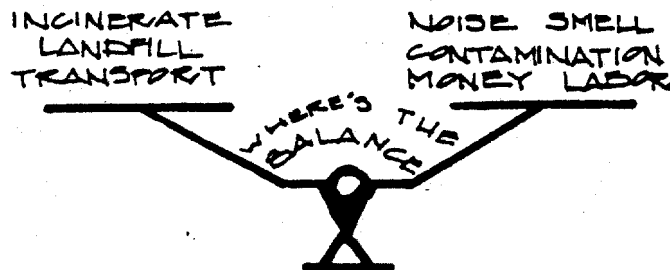
"Constructed wetlands are the cutting edge of environmental technology today," according to Ron Levine, Professor in Plant and Soil Sciences at the University of Massachusetts, Amherst. Levine is one of a growing number of land use professionals designing and promoting biologically engineered wetlands for wastewater treatment. Economical, low-tech, and environmentally sound, constructed wetlands offer a desperately needed alternative to conventional wastewater technology.

Only two constructed wetlands have been approved and are operating in western Massachusetts today. One, in the village of Shelburne Falls, has been described by treatment plant controller Dan Fleuriel. The other is located in nearby Sunderland. A third reed bed system is being built across the state to the east, in the town of Ipswich. Similar reed bed systems exist elsewhere, but regulations and lack of public understanding have prevented widespread construction and testing.

To appreciate the persistent commitment of creative environmental designers and engineers, and before looking at the Shelburne Falls treatment systems, it may be useful to characterize wastewater, conventional treatment systems, and sludge.

Wastewater

Wastewater typically consists both of potentially useful greywater and "blackwater" (containing human waste). Greywater (from sinks, showers, and other sources) can be and is currently used for non-vegetable irrigation around the country. Additionally, greywater can be returned to drinkable quality with ultraviolet exposure, even at the residential scale. (Buck, 1993) However, grey- and blackwater flow into the same plumbing system in the vast majority of homes and businesses around the country. Fairly benign greywater is most often combined at the source with toilet flushes and commercial wastewater to form the total volume of sewage requiring treatment. In the future we may



Removing water from sludge lowers landfill bills but the ultimate cost is more than monetary.

be separating wastewater at its source, as we now do other recyclables. But greywater use will remain stymied in building and health inspection bureaucracies until enough pilot projects prove the logic of its use.

Conventional Wastewater/Sewage Treatment

Different levels of sewage treatment attempt to "clean" wastewater to different degrees. Sewage treatment is classified into three categories, according to the quality of the effluent (post-treatment water). Primary treatment, the most basic level, involves screens, settling ponds, chemicals which induce precipitation, and bacterial digestion to separate water from the other sewage components. Secondary treatment makes use of anaerobic bacteria for further decomposition, rendering sludge more biologically stable and inert to the receiving environment. Tertiary treatment, the most complex and expensive, removes 95 percent or more of the solids.

A federal water quality law was passed in 1972 requiring all treatment plants in the United States to reach tertiary quality by the end of the century. A 1990 study by the Environmental

Protection Agency estimated that it would cost three trillion dollars to reach that goal with conventional methods.

Sludge: Opportunity or Liability?

Sludge, the main by-product of sewage treatment, is mostly water. The remaining few percent consists primarily of organic matter with a sprinkling of nutrients: nitrogen, phosphorus, and potassium, as well as heavy metals. Sludge's richness in organics and nutrients suggests potential for beneficial uses, yet relatively few uses are currently permitted or even attempted.

Sludge de-watering (separating wastewater from waste solids), dewatering, and disposal are major problems across the United States. (Krueger, 1989) Though many systems already exist for removing solids from "digested" sludge, the easiest and potentially most beneficial disposal method is "land application," such as spreading them on agricultural fields (as Sunderland did before switching to reed beds). Difficulties with land application of sludge run the gamut from permitting nightmares, NIMBY (not in my back yard) pressures, build-up of heavy metals in soil, groundwater pollution liability for farm owners, and loss of suitable agricultural land to development. Presently, the state of the art lies in sludge de-watering and removing heavy metals (primarily from metal pipes and solder).

CASE STUDY: Shelburne Falls, Massachusetts

Shelburne Falls is a community of approximately 2,000 people, located on the Deerfield River in western Massachusetts. A former mill town, Shelburne Falls has always made use of its abundant water resources. At first glance, its wastewater treatment facility appears similar to treatment plants in small communities around the United States. Yet a walk around back reveals their latest improvement: an approximately 6,000 square foot reed-covered lagoon.

Only a few years ago, raw sewage generated by Shelburne Falls spilled untreated into the Deerfield River for most of the long New England winter. The plant's digester, a 63,000 gallon tank for aerobic sludge digestion, held only six weeks' accumulated sludge. So every year, six weeks after the sand drying beds became covered with snow, sludge de-watering

operations ceased. Sludge was then expected to wait out the winter in the plant's settling ponds—big pools with aeration sprayers which add oxygen to the water "to keep the bugs (aerobic bacteria) happy," but soon began pouring untreated into the scenic river (just below the "glacial potholes," a popular attraction).

"As fresh water becomes increasingly scarce, and as cities bid more supplies away from farmers, the use of treated urban wastewater for irrigation is likely to become commonplace."

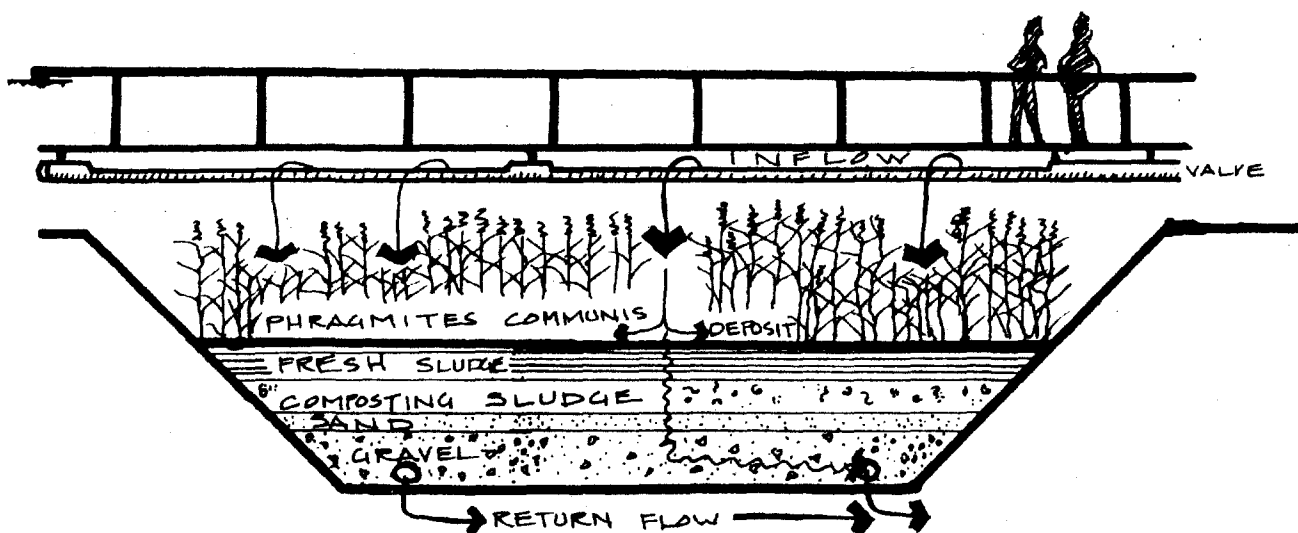
—Sandra Postel

Belt Filter-press

What steps has Shelburne Falls taken to deal with sludge, and how well do they work? The town recently acquired a second-hand belt filter-press, a commonly used machine which mechanically squeezes water from sludge. This method of sludge de-watering adds an additional expense to the present \$2,500 monthly utility cost, already an undesirable burden for a small town economy. The belt filter-press consumes energy, is susceptible to mechanical failure, and isn't very good at what it is designed to do. Inefficient belt filter-presses yield heavy sludge, (80-85 percent water, by weight) which is costly to landfill or requires additional drying. With the cost of waste disposal high and dependent upon refuse weight, drier sludge means lower landfill costs. (Fleuriel, 1993) In Shelburne Falls this drying is done on sand beds.

Sand Drying Beds

Sand drying beds are plastic-lined retention ponds fitted with drain pipes and filled with sand. Decomposed sludge is pumped out of the digester onto the sand. Water drains through the sand and into pipes leading back to the beginning of the plant. In warm, dry weather—not an overly common occurrence during a



Section through sludge de-watering lagoon in Shelburne Falls, Massachusetts.

New England winter—the combination of quick draining sand and evaporation can allow apply-dry-remove landfill cycles in as little as five days. Recent expansion of the digester, and glassing over of the sand beds, enabled Shelburne Falls to increase drying efficiency and extend season length. But the treatment facility is still unable to de-water sludge much of the winter. Additionally, the town is saddled with the task of weekly removal of dried sludge and rising landfill costs. (Fleuriel, 1993)

Sand drying beds are more efficient than belt filter-press machines, leaving only 10 to 50 percent water, by weight, and resulting in dramatic landfill cost reductions. Moreover, the drying process uses passive solar energy and is free from utility and maintenance or repair problems and costs.

Labor intensity and landfilling are the main limitations with sand drying beds. Inmates from the Franklin County Jail are often used to load dried sludge "cake" (decomposed, nutrient-rich, organic sludge), which is landfilled at a cost of over \$1,000 per month. (Fleuriel, 1992) In addition, the monthly electricity bill is approximately \$2,500, mostly to run aeration and transfer pumps. With the cost of waste disposal high and dependent upon refuse weight, drier sludge means lower landfill costs. (Fleuriel, 1993)

Like many small Massachusetts towns concerned with rising operational costs, federal requirements, and budgetary constraints, Shelburne Falls could no longer afford to be content with business as usual. As one of their biggest costs has been separating the water from sludge (98-99 percent water), town officials decided to try a more natural system: reed beds.

The lagoon at Shelburne Falls is expected to last into the next century before the composted remains need removal. Once every decade or so the pit will require excavating and replanting with young phragmites roots.

Finally, the phragmites, or "phrag" beds, yield a harvestable crop of reeds. Although traces of heavy metals found in the stems suggest shoots should not be used as forage, reed bed systems yield many beneficial products: purified effluent after each application of sludge, reed stalks whenever harvested (potential for biogas, chipboard, and paper), and composted sludge/reed rhizomes for soil amendment. (Krueger, 1989; Dunn & Clery, 1992)

Especially in combination with land application and tertiary effluent treatment, reed bed and other constructed wetland

methods offer a cost-effective and sustainable option.

Moving Ahead

The example of Shelburne Falls helps illustrate the sense of natural treatment systems. Low cost, low maintenance, low tech, and attractive to humans and wildlife, constructed wetlands are "the cutting edge of environmental technology today."

Translated, that means there is a lot of room for innovation. Change from antiquated zoning regulations and ill-conceived designs is crucial. Outstanding pilot projects exist on many scales to guide designers seeking integration of resources and cost efficiency, biodiversity, aesthetics, and multiple functions. Small- and large-scale greywater separation systems also hold promise for alleviating groundwater pollution and water shortages. Water is a problem when it comes into contact with the poorly conceived designs of 30 years ago. As Pliny Fisk notes, "What we have is a crisis of creativity in the midst of a dilemma...the creativity depends on lifting ourselves up to a different level of tools." (Thompson, 1992) Δ

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Michael Hylton has a B.S. in Environmental Biology and an M.A. in Landscape Design. He is currently working in residential/commercial design and land use planning in Seattle, Washington.

A Pilgrim's Guide to North American Permaculture Sites

Chuck Marsh

It's time for North American permaculture sites to be identified, their creators honored and the lessons they have learned shared, and a national travel- and worknet established. If you have been or are establishing a rural, urban, or suburban permaculture demonstration site and would like to host (at your discretion) occasional permaculture travellers and workers, I invite you to list your project in the "Pc Pilgrims Guide" I'm developing.

It's been fourteen years since Bill Mollison brought the permaculture virus to America and inoculated the first generation of permaculturists. Since then, thousands of others have been exposed to the permaculture way; in some it has taken immediately, in others it has lain dormant. In some, it is slowly ripening.

Many of us have been working steadily, learning to go to ground in that place we call home. Along the way, we have gained an incredible wealth of experience, knowledge, and understanding. We are creating the indigenous, bioregional culture and information base for the 21st century in our own backyards right now!

Permaculture may just be Earth's most exciting living and learning experience, a bountiful gift to all who participate in it. As Earthkeepers for future generations, it is our responsibility to share the fruits of our learning with others. Sharing is what keeps the gift moving and growing.

This sharing can take many forms; we can each find the way that best suits our needs. But if we're going to shift the dominant paradigm toward an ecological/permacultural worldview, we need to be sure to have lots of fun doing what we do—spreading the word, sharing in the work, getting help where we can—sharing stories, plants, and information. I've often benefitted by the news, views, good cheer, knowledge, and friendship of the permaculture travellers who've passed through my life over the years. This informal pilgrims network is actually one of our best, unacknowledged means of staying connected, given the widely dispersed nature of our American Pc tribe. What's needed, in my opinion, is just a tweak of two to expand access to even richer opportunities for mutually beneficial exchange.

Thus, the "Pilgrims Guide." I foresee the Guide also providing an opportunity for them that's doin' to inspire them that ain't yet but want to be. Experiencing permaculture on the ground with those already practicing it is the most empowering way to tune in.

If you're interested in a listing, or know of a permaculture practitioner (with site) I should contact about a listing, please drop me a card, letter, or fax, and I'll get back to you (or them) with details. Write Permaculture Pilgrims Guide, POB 1209, Black Mountain, NC 28711, fax (704) 683-4946.

Rock-Reed Filters: On-Site, Sustainable Waste Treatment

Dan & Cathy Schellenberg

We are now testing the use of an integrated on-site wastewater treatment and disposal system at our home that emphasizes resource conservation and recycling.

The system we have designed treats about 40 gallons of effluent from the master bathroom each day. To limit effluent volume, we use bath water to flush the toilet, which recycles water and reduces each flush from 3.5 to 1.5 gallons. We add bacteria monthly to counter the soap build-up.

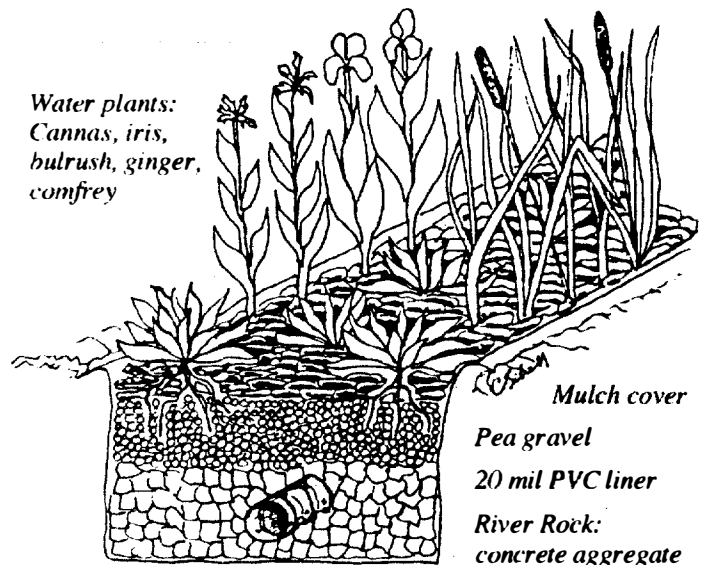


The author at home, April 1993.

The water flows from the bath suite, bypassing a failed septic tank, to a two-story, 20 ft.³ facultative chamber where solids liquify or turn to gasses (carbon dioxide and methane) in the open, lower compartment. The gas and the liquid effluent rise up through the second story gravel bed and plant root zone. The plants take up nutrients and water as the effluent flows through this 6' long and 2' wide topmost gravel bed to an outlet pipe into two 25' leach lines. It is not necessary to install a septic tank, but some sort of solids-settling tank must be there or the solids will fill up the rock leach lines quickly.

These leach lines are plastic-lined trenches, 18" deep and 12" wide, filled with pea gravel and plants such as cannas, elephant ear, and local marsh grasses, spaced one foot apart. Design requirements state that we need at least one square foot of filter surface area per gallon of water to be treated to secondary quality, that is, under 30 mg/l of BOD (biological oxygen demand).

Water plants:
Cannas, iris,
bulrush, ginger,
comfrey



Schematic of typical rock-reed filter bed

In order to meet tertiary treatment standards (BODs under 5 mg/l), however, we are adding another 25' leach line that is only 12" deep, with a water depth of only 6", so that the necessary 1.5 mg/l of oxygen can infiltrate this gravel and root zone. Unlike most other plants, true wetland plants transfer oxygen to the root zone, thus providing the oxygen required for tertiary treatment. The final discharge will overflow into a small fruit orchard. We will also experiment with growing corn and cherry tomatoes in the trenches. NASA research indicates certain foods grown in such conditions help filtration and are safe for human consumption. Full cycle design from food to waste, back to food, can create a highly sustainable on-site system for earth as well as in space!

A Household System

If we were to build a rock/reed system for our family of four, we would need to manage about 400 gallons of water each day. We want to reduce that to 250 gallons by using low-flush and low-flow plumbing fixtures and recycling. We could then reduce the size from 400 square feet of filter to about 300, saving water, materials, and labor, while producing a beautiful flower garden for free. Little maintenance is required, as the plants flourish in organic fertilizer and, even after a frost, can be left to decompose on the trenches, as rotting material feeds the microbes below.

Price Wise

Typical material costs are estimated to run about \$1,000 for a full-scale system. Our little test unit, including a greenhouse for the first winter, cost us only \$300, since most of the materials and labor were provided by us on-site. Δ

Dan and Cathy Schellenberg are permaculture consultants and homesteaders in the Piney Woods of East Central Texas. A summary version of this article first appeared in their home-grown newsletter, The Propagelle Report. Contact them at Rt #1, Box 163-C, Kennard TX 75847.

REVIEWS

Chicken with Vegetables, To Go

Review by Kay Barnes

ANDY LEE

Chicken Tractor

Good Earth Publications, 1994. \$19.95 paper

Chicken Tractor is backyard chicken raising with a new twist, including advocating the humane treatment of poultry and all livestock—a permaculture hallmark. The text, replete with graphs, diagrams, and tables of informative data, gives guidance in combining past methods of poultry raising with today's intensive gardening techniques.

Lee, a permaculture instructor in market gardening and biointensive gardening techniques at the University of Vermont, has contributed his knowledge in articles to major gardening and news journal magazines.

Animal tractors in permaculture design are a tool for placing every element in relationship to others so that they assist and support each other. As Mollison put it "It is how the human, the chicken and the garden are connected."

The idea behind the chicken tractor is to avoid contamination by a chicken house that stays in the same place year after year: cumulation of potentially toxic manure, odors, rats and mice attracted to fallen food, lack of availability of fresh greens, dust, dirt, and flies.

The chapter titled "Recipe for a Chicken Tractor" tells exactly how to build the simple shelter, which is applicable for almost any breed of poultry and other small livestock. Simple tunnels from the fixed henhouse to the tractors cleverly allow chickens to move themselves to the lightweight coops. From there they can easily be set on the garden beds, where they function as tillers and fertility cyclers—thus the name, "chicken tractors." And then there is the chicken tractor, moving with beef cattle on range. "Pastured poultry" is a distinct and definite money-maker. (See *Animal Polyculture*, pg. 6)

The results are that chickens clean your garden beds by eating grass, weeds, weed-seeds, bugs, and plant debris; they incorporate residues by scratching the ground (tilling); and they add valuable fertilizer. This system nearly eliminates flies and smells.

The chicken in the tractor becomes a biomass recycler; the manure then returns to the earth as fertilizer for following crops. The eggs and meat nourish the gardener, while the viscera, feathers and carcass add tremendous value to compost heaps.

The book offers much detail on the types, care, and uses of chickens, and on their functions and environments, good and bad. Soils are discussed in detail as well as how to develop "super-rich" soil with animal manure.

An appendix concludes with a several page listing of recommended books for small scale agriculturalists, a resource guide listing, publications, and associations to join.

The chicken tractor approach fits the small flock grower and hobbyist very well and provides habitat for endangered poultry breeds. These breeds possess the very traits needed for the chickens to thrive out of doors. They should be considered superior to commercial hybrids for your garden. A useful chart offers data on endangered breeds of poultry and information on how to get involved in livestock conservation.

The author states he has tried to contain all the philosophical, environmental, and humane background, combined with the practical, everything-you-need-to-know information to get started with a chicken tractor in your garden in the "little book."

A chicken tractor is simple to build and its rewards are many:

- It's a system that solves several problems in the conventional raising of poultry.
- Appropriately scaled and practical, it can be used for as few as one chicken or as many as the grower can handle.
- It's a way to get good nutritious food inexpensively.
- It prepares the soil for optimal yields of vegetables and small fruits.
- It encourages self-reliance for the grower.
- It enables market gardeners and small-scale family farms to expand their menu and enhance profitability.
- It is a humane way to raise poultry.
- It will stimulate interest in the heritage poultry breeds that are good foragers.
- Potentially, chicken tractors can have a positive global impact on how people reclaim land and produce their food, and will encourage local self-sufficiency.

Reading this delightful, unique and informative book, one can easily see where chicken tractors bring into play the harmonious relationships between (you) the gardener, the chickens, and the garden. Δ

Modelling Nature:

A Permaculture Family Tree

Review by John Todd

WALTER ADEY and KAREN LOWLAND

Dynamic Aquaria: Living Ecosystems

Academic Press. 1991. Cloth \$39.95.

In 1971, the ecologist H. T. Odum, in his seminal book, *Energy, Power, and Society*, proposed an extraordinary new direction for human societies. He suggested that it was now theoretically possible to develop human support systems founded on the workings of natural ecosystems. Dubbed "ecological engineering," his ideas have since come of age in numerous applications including those found in the new book, *Dynamic Aquaria: Living Ecosystems*.

Branches of Growth

Odum's seminal idea generated quickly, and in just two decades has given rise to five distinct branches. The first of these grew out of design considerations for the exploration of space, as Bill Wolverton at the NASA laboratories began to develop waste recycling systems and plant-based communities for maintaining air quality in confined spaces. The second branch consists of a broad-based group of ecological engineers from Europe, the Far East, and North America who are developing "natural" alternatives, especially created marshes, to purify sewage and other wastes. The third branch of the tree deals with the means to grow luxury foods in hostile or arid environments. Its primary exponent was Carl Hodges, of the University of Arizona, who built the "contained ecosystems" for food culture in Saudi Arabia and on the shores of the Gulf of California in Mexico. In subsequent years, he and his associates incorporated salt-tolerant plants into their artificial systems. Most recently, the designers of the Biosphere 2 experiment in Arizona have used this knowledge to design their food-producing zones.

The fourth branch is the one with which I am associated. Beginning in 1971, William McLarney and I created the first Living Machine for the culture of foods in a small, solar-heated environment. Out of this work at the New Alchemy Institute, and other work during the 1980s and 1990s here at Ocean Arks International, we began to develop the theoretical foundations for Living Machines that could be used to culture foods, treat wastes, heat and cool buildings, generate fuels, and integrate architecture with ecosystems for mutual benefit.

Civilized Wilderness

The fifth branch of the seed Odum planted is the subject of this review. Essentially, this branch involves the re-creation of wild systems in a domestic environment. Its chief exponent is Walter Adey of the Smithsonian Institution. For almost two decades, he has been brilliantly crafting model ecosystems of mangroves, coral reefs, and other marine, brackish, and freshwater systems. He has also developed ecologically engineered and photo-synthetically-based subsystems called "algal scrubbers" to support and internally regulate his model ecosystems. Adey is a stickler for bringing all the forces impinging upon the wild system into his models. For example, he once told me that he considered lightning a determinant in the ecology of mangroves and that the equivalent electrical charges might be necessary for the artificial systems in order for them to function optimally over time.

Dynamic Aquaria, by Walter Adey and Karen Loveland, is a tour de force from this latter perspective. It is remarkably thorough in its treatment, in part because it is based upon systems that have actually been built at the Smithsonian and elsewhere. Part One of the book provides insights into creating physical

environments for model systems, and includes sections on water quality as well as normally overlooked components, such as waves and tidal motions. The second part of the book is an excellent overview of the biochemical environment. Any person interested in the dynamics of living systems will gain from reading this section. In Part Three, the authors examine the biological structure of model ecosystems. This may be the best description of biological organization and design in the existing literature. It alone is worth the price of the book.

World in Miniature

In Part Four, Adey and Loveland describe the development of specific models, including a coral reef ecosystem, a Maine coast microcosm, and estuary systems including Chesapeake Bay and the Florida Everglades. They also characterize a variety of freshwater model ecosystems, including a fascinating 265 liter (70 gallon) "African" pond model developed to accommodate fishes native to that continent. The final section of the book is a summary of the basic principles involved in ecological engineering. It is also a call to begin experimenting with model systems on any scale within one's means, since models can be built even on zero budgets. Rightly, Adey and Loveland suggest that even the simplest of systems can reveal the dynamics, wonder, and mystery that reside in the natural world.

Multiple Lessons

This is the kind of book that all restoration ecologists should read, no matter what their field of interest. It not only provides insights into how ecosystems work, but also brilliantly illustrates the value of constructing ecosystems as a means of raising questions and testing ideas. What Adey, Loveland and their colleagues are doing is not dissimilar to what restorationists do on a larger scale under field conditions: assemble ecosystems. Only they are building models that can be easily pulled apart when a system doesn't work. In this way, model builders gain insights, often unexpected and counter-intuitive, into the structure and functions of ecosystems.

The accounts of ecosystem model building in this superb book should encourage restorationists, both professional and non-professional, to seize upon the value of their own ecosystem construction work as a way of raising questions and testing ideas as they repair the health of badly degraded environments. Δ

John Todd, founder of New Alchemy Institute, and co-author, with Nancy Jack Todd, of Bioshelters, Ocean Arks, City Farming: Ecology as the Basis of Design, works with Ocean Arks International, One Locust Street, Falmouth MA 02540. This review appeared originally in Restoration & Management Notes, 10:2 Winter 1992, available by subscription from University of Wisconsin Press-Journals, 114 N. Murray St., Madison WI 53715-1137.

Seeing the Forest...

MICHAEL PILARSKI, ed.

Restoration Forestry:

An International Guide
to Sustainable Forestry Practices
1994. \$26.95 illus. paperback.

Restoration Forestry is the most comprehensive, up-to-date sourcebook on sustainable forestry ever published. It distills 15 years of dedicated educational work by Michael Pilarski and Friends of the Trees into a thoroughly researched and indexed reference manual, listing hundreds of books and periodicals and over 1,000 forest-related organizations (with addresses and telephone numbers).

Pilarski has assembled over 120 articles from professional foresters, ecologists, and resource planners—including Gordon Robinson, Chris Maser, Orville Camp, and Gary Nabhan—providing insight and results from forest ecosystem restoration projects in North America, Latin America, and Asia.

In addition to a geographic and bioclimatic review of forestry around the world, this volume includes sections on Forest Ecology, Sustainable Timber Products, Agroforestry, Social Forestry, and Native Americans & the Forest.

Restoration Forestry should become a standard text for college-level classes covering ecological forestry, agro-ecology, and sustainable development, as well as a handy desk reference for use by concerned citizens and environmental activists.

Michael Pilarski is an international networker for forest restoration, with roots in the interior Pacific Northwest. A dedicated natural historian, seed saver, organic farmer, and tree planter, in 1978 Pilarski founded the Friends of the Trees Society, whose mission is to double the world's forest cover. He is also the editor of Actinidea: The Kiwifruit Enthusiasts' Journal.

"In a world being torn apart by human emphasis on cultural differences and destructive competition, Restoration Forestry is a vital link in uniting our global community around the theme of healing the world's forests—an absolute necessity for the survival of human kind."

—Chris Maser
The Redesigned Forest.

Eat Your Lawn

©1994 Russell Blalack
(all proceeds to plant trees)

(country feel)

A

I've got a chicken in my yard.

D Eb E

I don't work, but the chicken works hard.

D (D,Eb,E) E A

It's a feature... of my permaculture.

2. I've got a tank beside the roof,
when it rains I get zero proof,
tox-un's don't feature in my
permaculture.

(A7 bridge to chorus:)

D

A

Everybody, everywhere: show the earth
that you care

D

E

Everyone, where you are: get right down,
make a start...

(E7 bridge to verses:)

3. I've got a tree sits out back,
it gives me anything I lack.
It's a feature of my permaculture.

4. I've got a bush under the tree,
plenty of berries for the birds and me.
We all feature in the permaculture.
(chorus)

5. I built swales running 'cross the hills,
when it rains it never spills.
That's a feature of my permaculture.

6. I got a vine grows up the side,
when it's hot it stays cool inside.
It's a feature of my permaculture.
(chorus)

7. First I read about him,
then I read his book,
then I took a plane just to get a look
at the teacher of the permaculture.

8. One with yourself, one with the land,
learn Bill's lessons
and give us a hand.
We're gonna feature
world permaculture.
(chorus)

Russell Blalack plants rainforests in eastern Montana and composes software for permaculture design. Write 1081 Milky Way, Cupertino, CA 95014.

Earthaven Village: Permaculture Settlement in the Southern Appalachians

Chuck Marsh

Earthaven Village, the first known permaculture-based ecovillage settlement in North America, is coming to life in the mountains of western North Carolina. Located on 325 acres of diverse, magical forest land near the town of Black Mountain, Earthaven is dedicated to living, learning, and demonstrating the skills for creating a spirit-based, ecologically regenerative tribal culture adapted to the Katúah (southern Appalachian) bioregion. The project has widespread implications for the creation of ecovillages and regenerative communities elsewhere.

From its inception, Earthaven has been envisioned as a living example of permaculture principles, design, and practice. Permaculture consultants Chuck Marsh, Peter Bane, Valerie Naiman, Andrew Brown, and Tom Moestl are guiding the site planning process and training other community members to understand the land so that they can co-create with the local ecosystems in sustainable and regenerative ways.

The planning process is well underway. Survey work, including aerial photography and contour mapping, as well as the digitizing of this information for use in GIS (geographic information systems) mapping and analysis, is nearing completion. From this work, and from data gathered in the field, a comprehensive, permaculture-based site plan to guide the village's growth will be completed by the summer. Infrastructure development and the construction of the community center will commence thereafter. Over the summer, experimental gardens and a village camp will be established to begin practicing site-appropriate, earth-friendly building and gardening techniques, the most successful of which will be used in the development of permanent structures and agriculture systems.

Central to Earthaven's vision is the creation of a land-based learning center and permaculture institute. The learning center will coordinate programs in permaculture design and practice, the creative and healing

arts and crafts, earth-friendly building and energy (e.g. solar) technologies, ecological agriculture and aquaculture, earthenware and landscape restoration techniques, village design and community development, community living skills, group process, and alternative economics. Our goal is to practice and teach the myriad skills needed to build the new eco-spiritual culture being called forth in our times.

Earthaven property covers a rich and complex topography with many microclimatic variations. The land lies between 2000 and 2600 feet elevation in the southern Appalachian mountains, and consists of several converging stream valleys of varying size. Water flowing through Earthaven joins the Broad River drainage and reaches the Atlantic Ocean at Charleston harbor, South Carolina. Mixed hardwood forest between 50 and 150 years old covers the slopes and valleys of the land. Wide bottoms and many gentle lower slopes make up more than a quarter of the property, providing opportunities for diverse, small-scale permaculture projects, agriculture, and settlement.

Currently, some 20 individuals are members who have committed to developing residential and business siteholdings. Another 25 to 35 residential siteholdings are anticipated (depending on the site plan) to become available in the village on a first-come, first-served basis, along with a number of agricultural and business sites. We are interested in additional, ecospiritually-hearted members who are committed to the regenerative lifestyle and cultural transformation process that permaculture implies, and who have the skills and energy to co-manifest their vision.

If you are called to join with us in this exciting and challenging project, please send \$10 for an information package and sample newsletter to: Membership Council, Earthaven Village, PO Box 1107, Black Mountain, NC 28711. Δ

A Permaculture Seed and Plant Exchange

Joe Hollis

The Permaculture Seed and Plant Exchange is intended to cover useful perennial plants of the temperate zone, worldwide. "Useful" includes plants for food, medicine, fiber and dye, fragrance, sacred and magical uses, as well as for other crafts. Annuals are very well covered by the Seed Saver's Exchange (for vegetables) and Flower & Herb Exchange, and there is no reason to duplicate their efforts. Self-sowing annual vegetables (e.g. *Brassica spp*) and weeds (e.g. lambsquarters), however, would be most welcome.

The listing form will be designed to provide some information about the material offered, including plant type, hardiness, size, uses, and potential problems. Contributors may add further comments on cultivation and use gleaned from personal experience. Information about plant habitat (light, soil, moisture, etc.) will be solicited where appropriate.

The membership fee will be reduced or waived for *Activist* subscribers. (A listing form will be included with the next issue.) The catalog will be sent free to all contributing members who are also *Activist* subscribers and will be available at a reduced rate to other subscribers.

Please send comments and suggestions to the Permaculture Seed Exchange, c/o Joe Hollis, 3020 Whiteoak Creek Rd., Burnsville NC 28714 USA.

Save seeds. Spread the word. If we start with a good list, this project will immediately become indispensable and self-sustaining. Δ

Permaculture Seed and Plant Exchange

Mission:

- To promote the exchange of useful perennial species and selected varieties of seeds, tubers, scions, plants, etc.;
- To facilitate communication between persons interested in the same types of plants;
- To collect information about permaculture plants directly from growers;
- To encourage seed-saving and plant-sharing within the permaculture community;
- To provide an opportunity for collectors and breeders to earn extra income.

Proposed rules and procedures (comments solicited):

- Membership will cost \$7. Members will receive (in September) a form for listing material they have to share, and (in January) a catalog listing all of the offerings, names and addresses of the contributors.
- Material offered will be either available to anyone or, for rare or short supply items, available only to other contributors.
- Buyers will correspond directly with contributors. We will publish standard price and sample size guidelines for seeds, tubers, scions, etc., but contributors will be free to override these and to indicate their own asking prices. In every case, the price to contributing members will be one half the price to the general public. Δ

from the Regions...

Australian Seed Savers Network Flourishes

The Seed Savers' Network of Australia, a non-governmental organization (NGO) formed in 1986, works with thousands of seed savers to ensure the long-term survival of Australian plant heritage. The seed bank retains viability by sealing seeds in oxygen- and moisture-proof packs, and a by use of a cold-storing facility. Their spring newsletter, containing a list called The Permaculture Exchange, carries more than a thousand offers and requests for seed, including frost-hardy open-hearted lettuce, perennial beans, hard-to-find edibles like water chestnut, cassava, lemongrass, Vanilla Orchid, Tree Onion, and Taro. Also on offer are medicinal herbs, permaculture plants such as Tree Lucerne, Sunn Hemp, Pigeon Pea, and Arrowroot, as well as edible Australian native

plants and rare fruit tree seeds (Longan, Inga, Rose Apple, Brazilian Cherry, etc.).

Available too, is *The Seed Savers' Handbook*, by founders Michael and Julia Fanton—a reference for growing, saving, and storing traditional varieties of food plants—containing 176 pages with stunning illustrations.

A Seed Saver's Education Kit, comprising hands-on learning activities suitable for grades five to nine, emphasizes preserving the biodiversity of useful plants with information on why and how to save seeds. The Education Kit includes *The Seed Savers' Handbook*, packets of non-hybrid seeds, and a colored poster of the world showing the origins of today's food plants.

Newsletter subscriptions and copies of *The Seed Saver's Handbook* and the Seed Saver's Education Kit may be ordered from: The Seed Saver's Network, Box 975, Byron Bay, NSW 2481 Australia. tel/fax 61-66-856-624. Δ

Sun and Moon: A North-South Cooperation

news from the Sun & Moon Permaculture newsletter (7 Dec. 94):

After returning from the 5th Intl. Permaculture Conference, we formed a small study group, grew vegetables on our small plot in the middle of Oslo, and are receiving recognition for our work with other Norwegian NGOs. Several of us attended David Holmgren's Permaculture course in Sweden this summer past. An exchange program has been started between north and south, and 15 people have traveled to Latin America, returning with renewed hope for planetary transformation. Darien Foundation, our sister organization, have several projects in the Choco region of Colombia, working with local communities, building alternative models, and joining forces with other grassroots organizations in an emerging bioregionalism, working to preserve cultural traditions and other life forms. Claudio Madaune spent 10 months there, and plans to return in spring 95 (for maybe forever).

Due to our strong belief in Permaculture, we are organizing Permaculture courses in Chile and Bolivia, to be taught by Alejandra Caballero from Mexico in early spring of 95.

Mauricio Deliz became a father recently, and all traveled to Chile to help arrange the course, and look for a piece of land to start a pilot project around Santiago.

To get in touch with us or with our southern friends, contact:

Sol & Måne Organisasjon, c/o Oslo Internasjonale Senter, Torggatan 26-28, N-0183 Oslo, Norway. tel. 47-22-116934.
Fundación Darién, A.A. 700-Turbo-Antioquia, Colombia. Fax 57-4-250-1172
Movimiento Ecologico Pachakamac, P.B. 5292 - La Paz, Bolivia. Fax 591-2-314457. Δ

Reviving Self-Reliance in Hawai'i

Permanent Agriculture Resources, a non-profit organization supporting sustainable agriculture and island resource self-sufficiency, is sponsoring a series of workshops in Honaunau, including: Species & Strategies for Small Scale Abundance, Conserving and Restoring Farm Fertility, Tropical Food Plants and Permaculture, and Reviving the Culture of Agriculture. This series brings together expertise in sustainable agriculture, agroforestry, multi-purpose trees and plants, Polynesian plants, and indigenous farming systems.

For further information, contact Permanent Agricultural Resources, PO Box 428, Hōlualoa HI 96725. Δ

EcoVillage Project Underway in Hungary

from the second issue of the Gyűrűfű yearly, *Equinox*:

The equinox, representing transition, is a good symbol for Gyűrűfű, now and for a long time to come—transition, a celebration of motion and change. We have survived the critical initial period in the building of the Pioneer House, and the skeleton structure provided winter shelter for three people. Initial (and last moment) support arrived in the form of volunteers and financial contributions from all corners of the world.

Grants from the European Commission and the Gaia Trust of Denmark supported efforts to make an access road, create a master plan, buy

Agroforestry Demonstration Site in Nicaragua

Recently returned from Nicaragua, Jerome Osentowski, of the Central Rocky Mountain Permaculture Institute, reports the creation of a one-acre permaculture demonstration plot in the small town of Teotecacinte near the Honduran border, site of previous years' gardening projects. Establishment of the new site culminates two years of grant writing, seed collecting, and careful organizational work. The project was supported by major funding from the Threshold Foundation and the combined efforts of Osentowski and fellow permaculture designers Michael Moore, formerly of Altertec in Guatemala, and Daniel Howell of New Mexico. The three experienced teachers had the assistance of the Sister City Brigade of Glenwood Springs, CO.

Focusing upon simple soil building technologies such as green manures, alley cropping, mulches, and composting, the project aims to model sustainable agriculture for the local community. Scale and scope of the project are meant to be both ecologically sound and economically accessible. Under the present economic crisis, up to 70% of nearby agricultural land is out of production—due to dependence upon and the high cost of commercial inputs, and the inaccessibility of credit.

During the six weeks when the U.S. permaculture team was in Teotecacinte, the site was fenced, plowed, and mulched. A 40 sq. meter tile-roofed, adobe house and patio is being built there as living quarters for promoters and other workers. The patio will double as a classroom. Several local people have been enlisted as caretakers in an effort to ensure continuation of the project, which includes growing nitrogen-fixing trees and cover crops of many varieties, and teaching classes on composting, alley cropping, and other forms of agroforestry.

At the beginning of June, 1995 Moore and Osentowski will return, regrouping with local villagers to plant the nitrogen-fixing trees and initiate alley cropping and green manure plantings. The Teotecacinte Agroforestry Project requires both continuing financial support and volunteer assistance. If you would be interested in contributed to the effort, please contact Central Rocky Mountain Permaculture at PO Box 631, Basalt CO 81621. Δ

some additional land, finance a small portion of the Pioneer House, and organize agricultural activities, reforestation, and erosion control.

Six new adults have joined us, and the local community has acknowledged us. (After elections, we are represented in the local council).

Visits can be arranged with advance notice, and information, including a color aerial photograph of Gyűrűfű, a project description, a video, and postcards, is available. For more information contact: Gyűrűfű Foundation, H-7935 Ibafl, Kossuth u.4., Hungary. tel/fax 36-6-73-354-107. Δ

EVENTS

Fundamentals of Permaculture Eastern Massachusetts

Dates: May 26-June 4
Location: Plainville, MA
Description: 10-day course providing context and process for learning and designing systems using 38 acres in care of Dominican Sisters devoted to earth education and spirituality. Course ends with celebration of Earth Sabbath.

Instructors: David Jacke, Diane Villemure, Jeannie Abi-Nade
Cost: \$480 incl. materials, meals, priv-semi-priv. room
Contact: Crystal Spring
76 Everett Skinner Rd.
Plainville MA 02762
508-699-7197

Dancing Green Permaculture 1995 Pennsylvania Design Courses

Dates: June 2-18, 1995
Description: Womyn's Design Course
Location: Western Pennsylvania
Instructors: Dawn Shiner, Barb Fath
Cost: \$650, sliding scale

Dates: July 10-26, 1995
Description: Men's and Womyn's PDC
Location: Western Pennsylvania
Instructors: Frank Hyldahl, Dawn Shiner, Bob Kornegay
Cost: \$750, work exchange, or scholarships

Dates: August 11-27, 1995
Description: Men's and Womyn's PDC
Location: Central Pennsylvania
Cost: Send SASE with request for course brochure.

Contact: Dancing Green
PO Box 157
Cochran, PA 16314
814-425-8210

Walking And Reading The Land: Women's Weekend in Ohio

Dates: July 28-30, 1995
Location: A 140+ acre women's intentional community near Athens, Ohio
Instructors: Joni Smalle and Liz Hoag
Description: For women having completed an introductory or basic design course in Permaculture (or who have read *Introduction To Permaculture*). Workshop is focused upon applied Permaculture principles.
Cost: \$50 incl. food and camping.
Contact: Karen Amelia Arnett
2406 Ashland Ave
Cincinnati, OH 45206
513-861-2075

Permaculture Fundamentals at The Farm Two Courses in Middle Tennessee

Dates: April 7-15, September 24-October 2

Location: The Farm, Summertown, TN

Description: Co-sponsored with the Eco-Village Training Center at The Farm, these 8-day courses will explore the permaculture path to an ecological society. We will gain practical skills in the observation, understanding, and design of landscape and human habitat while dancing at the fertile edge of cultural transformation. Resources for learning will include The Farm's 20-year experimental alternative community with examples of low-tech solar energy design, cottage industry, cooperative economics, and mushroom cultivation within existing hardwood forest. Completion of this workshop and an 8-day design practicum fulfills the requirements for the Permaculture Design Course Certificate.

Instructors: Chuck Marsh, Peter Bane, Patricia Allison, Andrew Brown

Cost: \$525. Discount of \$50 for full payment before Aug. 15 (2nd course). Register early to reserve a place.

Contact: Vickie Montagne, tel. 615-964-3574
Permaculture Course
105, The Farm
Summertown TN 38483

Permaculture Fundamentals Course in Upper Canada Niagara Escarpment, Southern Ontario

Dates: July 7-15

Location: Hockley Valley, Ontario

Instructors: Peter Bane, Chuck Marsh, Suzanne Richman

Description: This lively course will provide a thorough grounding in the core permaculture concepts along with practical applications and strategies for developing bioregional culture, gardening in cold climates, using medicine plants, and cultivating food forests. Centered in the heart of the Great Lakes on the Niagara Escarpment about halfway between Toronto and Georgian Bay, Hockley Valley Ecology Retreat Center offers comfortable accommodations and excellent vegetarian meals amidst a magical setting of dramatic skies, wooded hills, and rolling farmland.

Cost: C\$700

Contact: Richard Griffith
104 Bridlewood Blvd.
Agincourt, ON Canada M1T1R1. Telephone 416-497-5746

Permaculture Design Course Northeastern New York

Dates: September 8-24

Location: near Saratoga Springs, NY

Instructors: Christopher Robin Healy, Dave Jacke, Dawn Shiner

Description: Fish Creek Inn offers not only great food and accommodations, but diverse opportunities for implementing permaculture design: river front, wetlands, a pond, the bed and breakfast facility, upland forests, and open fields. A full-certificate course.

Cost: \$750, work exchange and scholarship available.

Contact: Fish Creek Inn
120 Hughes Rd.
Grangeville, NY 12871
518-695-6879

Permaculture Fundamentals Michaela Farm, Southern Indiana

Date: July 28-August 6

Location: Oldenburg, IN

Instructors: David Jacke, Jeanie Abi-Nader, Marion Farrior

Description: Principles and practices of permaculture in a rich setting of community. Historic Michaela Farm has been the site of previous Ohio River bioregional conferences. This is their third annual permaculture course.

Cost: \$525 before June 1st
\$575 after June 1st

Contact: Sr. Claire Whalen
Michaela Farm
Oldenburg, IN 47036
812-934-5016

Permaculture Design Course on the Canadian Atlantic Coast

Dates: July 2-16

Location: The Ovens Natural Park near Lunenburg, Nova Scotia

Instructors: Michael Pilaraki, Garry Lean, David Jacke

Description: This course will be held in the spectacular coastal setting of The Ovens Natural Park. A group camp will be established, although oceanview housekeeping cottages and an RV park are also available nearby at additional cost. Price includes camping and three meals/day.

Cost: C\$700-775 sliding scale. U.S. residents C\$775. Please add 7% GST

Contact: Institute for Bioregional Studies
449 University Ave.
Charlottetown, PEI, Canada C1A 8K3 Telephone: 902-892-9578

Urban Fundamentals Course

Greensboro, North Carolina

Dates: November 3-11

Location: Glenage Retreat Center
Oak Ridge, NC

Instructors: Chuck Marsh, Peter Bane, Charlie Headington

Description: Living well in the city while promoting the development of regenerative systems, the 21st century urban dweller will be creating resources for city markets, farming abandoned shopping centers, raising fish on recycled wastewater, tending the urban food forest, grazing meadows in the park, or making salsa from the rooftop. From edible bike trails to hanging gardens at the community bank we will explore the hidden resources of the city and the permaculture pathways that lead towards a sustainable urban society. Based on the core permaculture design concepts with special attention to applications for the extended Triad urban bioregion. Completion of this workshop and an 8-day design practicum fulfills the requirements for the Permaculture Design Course Certificate.

Cost: \$525, \$50 discount for full payment before September 15th.

Contact: Charlie Headington
515 N. Mendenhall
Greensboro NC 27401
910-273-7292

Urban Fundamentals Course

Eight Days in Toronto, Canada

Dates: August 25 - September 2

Location: Toronto, Ontario

Instructors: Cynthia Edwards, Monica Kuhn

Description: A course for teachers, social workers, city planners, health workers, and urban dwellers of all kinds to experience new ways of seeing and living in the city.

Cost: C\$700

Contact: Richard Griffith
104 Bridlewood Blvd.
Agincoourt, ON
Canada M1T1R1
416-497-5746

Creating the Home System

An Introduction to Permaculture
Southeastern Minnesota

Dates: August 25-27

Location: Crandall Farms, Ramsey, MN

Instructors: Peter Bane, Kathleen Plunkett-Black, Bruce Bacon

Description: Simple ways of connecting the house, the garden, and the surrounding landscape can enhance our comfort, save energy, labor, and maintenance costs, and return increasing yields of delicious and nutritious foods. With examples from a working market garden and illustrations from town and country, we will learn how the principles of permaculture can help us design edible landscapes, manage water, increase soil fertility, and create comfortable, economical and appealing dwelling spaces. For homeowners and those hoping to buy or build, this workshop will provide conceptual and practical foundations for creating a productive and healthy home place.

Cost: \$150

Contact: Bruce Bacon
Crandall Farm
7363 - 175th Ave NW
Ramsey MN 55303
612-753-5099

2nd Annual Southeastern Permaculture Gathering

On the Slopes of Mount Mitchell, North Carolina

Dates: August 11-13

Location: Arthur Morgan School, Celo, NC

Description: A summer festival of friendship celebrating the bounty of the earth, this weekend will be filled with circles within circles: discussions, dancing, hikes in the cool green mountain glens of the Southern Appalachians, a riot of excellent food provided by Carolina's best organic growers, visits to nearby paradise gardens, bonfires, and endless storytelling. Jointly sponsored by Carolina Farm Stewardship Association and the Southeastern Permaculture Institute and held on the grounds of the Arthur Morgan School at Celo, one of America's oldest living intentional communities, the Gathering is sure to draw widely. Places are limited. Please register early.

Cost: \$15-20/day includes camping and meals

Contact: Gred Gross
346 Seven Mile Ridge Rd
Burnsville NC 28714 Telephone: 704-675-5918

Introduction to Permaculture Workshop

Windwalker Farm in Central Kansas

Dates: May 5-7, 1995

Location: Windwalker Farm, Ottawa, KS

Instructors: Jerome Ocantowski and Sandy Cruz

Description: Extensive site tour, slide presentation, and hands-on experience designing a site plan for your own acreage, garden, or patio.

Cost: \$180 (\$75 deposit); \$200 after April 17. Includes camping space, organic meals, materials, and t-shirt. Limited to 15.

Contact: Windwalker Farm
1981 Indiana Rd.
Ottawa, KS 66067
913-746-8885

PERMACULTURE EARTH WORKS & DESIGN COURSES

With Bill Mollison and Scott Pittman
Beginning April 18 & April 21, 1995

For the second year in a row, permaculture founder Bill Mollison leaves his Australian home and ventures to the Fossil Rim Wildlife Center to share his knowledge. Two courses are being hosted by the newly formed Cross Timbers Permaculture Institute and are suited to gardeners, educators, landscapers and any one with an interest in sustainable living.

Mollison and associate Doug Dorrrough will first give a three day earth works course on how to create soil and water conservation structures with a bulldozer. Swales, ponds and wetland water treatment systems will be built to capture and harvest the natural flows of water through the landscape.

Then Mollison and Scott Pittman will teach sustainable living principles in an intensive two week permaculture design course. Permacultural landscapes provide food, housing, and energy by modeling natural ecosystems. Plants, animals and natural energy flows interlink to create gardens which have the diversity, stability and resilience of natural ecosystems.

The cost of the earth works course is \$300. The enrollment fee for the two week design course is \$750 (\$795 if received after April 1, 1995). Meals are provided. Please contact:

Fossil Rim Wildlife Center
PO Box 2189, Glen Rose, TX 76043
Ph: (817) 897-2960 / Fax (817) 897-3785

EVENTS

Black Mesa Permaculture Project 4th Annual Permaculture Intensive Navaho-Hopi Reservation

Dates: May 27-June 4

Location: northeastern Arizona

Instructors: Dan Dorsey, Justin Willy, George Crittendon

Justin Willy and George Crittendon are Native American graduates of the Permaculture Design Course and students of ecoforestry. George is experienced in fire suppression and reforestation. Both men consult in their local areas and have presented permaculture to schools and local groups for nearly three years.

Dan Dorsey has a degree in forestry and ten years' work in water harvesting, revegetation of damaged areas, and the integration of people with landscape. He has designed regenerative homesites and projects for Tucson City Parks, the Tucson Community Food Bank, and the Tohono O'Odham Indian Nation.

Description: A project of Indigenous people living on Black Mesa reservation lands in the Four Corners region and their allies, the BMPP has been applying permaculture in ways that enhance traditional awareness of the land. The BMPP assists indigenous peoples throughout the Southwest with permaculture training and programs. Admission to this complete certificate course is free to Native Americans. Course fees from others provide scholarships for indigenous participants. Bring camping gear, food, raingear, notebooks, and work gloves.

Contact: BMPP
PO Box 26195
Tucson, AZ 85726
602-629-9122, fax 745-7888

Permaculture Design Course Bill Mollison in No. California

Dates: May 20-June 3, 1995

Location: Sebastopol, CA

Instructors: Bill Mollison, Scott Pittman

Description: This intensive overview offers practical training in Permaculture design practices fostering understanding of these methods and development of skills for the benefit of your home property and local community. Geared towards anyone interested in sustainable living practices. Certification upon completion of course.

Cost: \$750 early registration (\$800 after May 1) \$200 deposit with \$50 non-refundable. Includes all meals, camping or dormitory.

Contact: La Tierra Community
708 Gravenstein Hwy N#120
Sebastopol, CA 95472
(707) 829-8191

Fun, Sun, & Permaculture: Two Courses in Baja, Mexico

Dates: April 18-25, 1995 and

April 25 - May 2, 1995

Location: A 30-acre farm, 25 miles south of Todos Santos, on the Pacific coast of southern Baja. An existing mango and citrus orchard and a new papaya orchard are being converted to organic and integrated operation. In November '94, a large garden was planted for commercial trials and free range chickens were introduced.

Instructors: Jerome Osentowski, Gabriel Howearth, and Susan Mullin

Description: A fun, hands-on practical introduction to Permaculture, covering seed saving, medicinal herbs, alley cropping, small animal forage systems, food drying, boogie boarding, and margaritas on the beach made from fresh organic limes.

Cost: Course 1: \$350 for the low budget camper, includes solar showers and composting toilets.

Course 2: \$650 double occupancy, \$800 single, includes van rides to site and lunch. (If you arrange your own accommodations and travel, cost for either session is \$200). Airfare and travel not included, except as noted.

Contact: Central Rocky Mtn. Permaculture
PO Box 631
Basalt, CO 81621
(303) 927-4158

Central Rocky Mountain Permaculture Institute 9th Annual Permaculture Design Course

Dates: Sept. 25-Oct, 1995

Location: Basalt, CO

Instructors: Jerome Osentowski, Sandy Cruz, Dan Howell, and John Cruickshank

Description: This 14-day certificate course provides hands-on experience with many aspects of permaculture, including market gardening and the forest garden.

Cost: \$850

Contact: Central Rocky Mountain Permaculture Institute (CRMPI)
PO Box 631, Basalt, CO 81621 Telephone: (303) 927-4158

Additional CRMPI workshops: Fundamentals of Permaculture

July 22-29 Crestone CO

Traveling Advanced Design Course,

Oct. 16-30 CO & Utah

followed by an optional 3-week adventure to the Sea of Cortez and the Baja. For more information, contact CRMPI.

Sandy Bar Ranch 1995 Permaculture Workshop Series

June 21 Earth Wall Construction with Penny Livingston. Light clay and cob construction. Cost \$35 (includes one night lodging and one vegetarian meal).

June 21-25 2nd Annual PC Convergence. One-day Earth Wall Construction practicum (see above) followed by three days exploring Permaculture and other appropriate themes. Good opportunity to exchange skills and information, and strengthen the alternative network. Cost: \$100 for practicum and convergence (\$75 convergence alone), includes hostel-type lodging, and one vegetarian meal per day, with kitchen facilities.

July 16-23 Native and Edible Landscaping and Forest Farming with Tom Ward and Penny Livingston. An advanced hands-on, permaculture course for designers, farmers, gardeners, etc. Cost: \$425 early registration, (\$475 after June 15).

Aug. 20-27 Alternative Technology and the Ethics of Technology Transfer, with Tom Ward and Penny Livingston. An advanced hands-on permaculture course for designers, homesteaders, urban survivalists, etc. Cost: \$425 early registration (\$475 after July 20).

Sandy Bar Ranch, PO Box 347
Orleans CA 95556
916-627-3379

Permaculture Design Course Garberville, California

Dates: April 1-14

Location: Garberville, CA

Description: A two-week design course offering alternative architecture and water system emphasis.

Instructors: Tom Ward, Penny Livingston and team.

Contact: Island Mountain Institute
220 Harmony Lane
Garberville, CA 95542
707-923-2021

Straw Bale Building Courses Sebastopol, California

Dates: April 8, May 13, June 10, July 8, and Aug. 12, 1995

Location: La Tierra Community
Sebastopol, CA

Instructor: Stan Welch

Description: These one-day seminars focus upon the practical applications of strawbale, with hands-on building of a demonstration wall.

Cost: \$80 (state desired date)
Contact: SRW Construction
1075 Montgomery Rd
Sebastopol, CA 95472
(707) 829-8296

Be the Change You Expect... Teaching Permaculture and Sustainability

Dates: Sept. 11-16, 1995

Location: Menchua Retreat Center,
overlooking the western mouth of the
Columbia River Gorge, near Portland, OR.

Instructors: Peter Renner and Ruth Miller

Description: An advanced hands-on
Permaculture training course for those
interested in improving and developing more
effective teaching skills.

Cost: \$375 early registration (\$425
after July 15, except \$485 for last minute) In-
cludes dorm accommodations and meals. Semi-
private rooms available for an additional \$60.

Contact: The Learning Community
of Portland
1110 SE Alder
Portland, OR 97214
503-236-5325

Introduction to Permaculture Interior British Columbia

Date: May 26-28

Location: McBride, BC

Contact: Grégoire Lamoureux
Box 43
Winlaw BC Canada V0G 2J0

Permaculture and Bio-Architecture Spanish Language Workshops in Mexico

Location: Taller de Agricultura Organica
Malinalco, Mexico

Description: Informacion en Permacultura
y Arquitectura Sana en Malinalco.

Contact: Ana Ruiz Diaz
A. Postal 16
Malinalco, 52440
Edo. de Mexico, Mexico
Tel/fax: 525-714-701-77

"Designing for a Sustainable Future" 6th Intl. Permaculture Conference Perth, Australia

Dates: late Sept-early Oct., 1996

Location: Perth, Australia

Description: Includes orientation tours, a
4-day conference, Permaculture property tours,
and a Convergence in a rural area (for holders
of a PC Design Certificate). Input and support
desired. (Conducted in English).

Contact: Coordinator - Pat Dare
Intl. Permaculture Events '96
8 Palana Rd,
City Beach, WA 6015
Telne/fax: 61-9-385-7228
e-mail:converg@ccpo.com.au

Permaculture Directory Taking Shape, Deadlines Set

John Irwin

The hunting-gathering phase of creating a
Permaculture Directory for North America is
nearing a close. Letters and calls to instructors
and networkers have drawn a cooperative
response. Send in your information by Earth
Day, April 22, if you haven't already done so
(big hint!). I will then do a mass mailing to all
graduates I haven't heard from. Biographies
arriving past publication date (May 14) will
become part of the permanent registration
record and may be used in future updates or
publications. Even if you think you're past
the deadline, send in your response!

I have a list of some 150 permaculture
design courses given in North America since
1981, and about 1200 names of PDC graduates.
This appears to be one-third to one-half of all
Canadian, Mexican, and U.S. graduates. I have
not received lists prior to 1987, nor any from
1994! If you have an address list from your
own course, please send me a copy.

The survey form serves 4 purposes:

#1 - [Permaculture Directory] To enhance
networking among PDC Graduates;

#2 - [Permaculture Directory] To provide
information to any person or group looking for
Permaculture expertise;

#3 - [Registration] To serve as a record of all
Certified Permaculture Design Course Graduates;

#4 - [Research] To provide data for my
Master's Thesis in Sustainable Systems for
Slippery Rock University.

Directory: Only the essentials will be
printed: How to contact you, Pc courses taken,
teaching or designing experience, affiliations,
permaculture services and products offered,
your skills, biographic notes, interests.

Registration: Information gathered will be
used for verification and registration and made
available to the Permaculture community for
research and networking, but will not
necessarily be published. The addresses
accumulated will be used for Permaculture
purposes only—to promote large Pc gatherings,
course information, the Directory, etc., and will
not become part of other mailing lists. Class
lists will be very useful: 1) to let graduates
know about the Directory; 2) to study (as part
of my thesis) who taught whom and how

Downunder Permaculture Courses Crystal Waters Village, Australia

Dates: May 21-June 3

Aug. 27-September 9

Oct. 22-November 4

Description: Courses are all Permaculture
Design Certificate Courses run at Crystal
Waters by Max Lindegger and Frances Lang of
Eco-Logical Solutions. Course Administrator:
Jeff Michaels.

Contact: Green Harvest
52 Crystal Waters
MS 16, Maleny
Queensland 4552, Australia
61-74-944676, fax/944578.

permaculture has grown, and to get a sense of
how many generations of teachers we now
have; and 3) to create a Permaculture Design
Course Graduate Registry. This accords with
Bill Mollison's plan of certifying those who
have taken the basic course based on his
original outline, and serves as a check against
those who would use the term "Permaculture"
but have not taken the basic course.

Thesis: "Original occupation" and some of the
course and teaching information are for research.

Note: The fine print on the top of the form
(on page 48) advises that you may pre-empt
any portion of any of the survey response
form appearing in the Directory.

Most data about designs completed and Pc
sites (for Chuck Marsh's "Pilgrim's Guide")
won't be printed. The format (not yet fixed)
will allot each respondent a certain amount of
space. Spaces left blank may be filled by
enlarging other categories. (The format may
allow as much as one extra handwritten page to
those who write big or have a lot to offer.)

NOTE: Sections for Permaculture-related
businesses, publications & organizations
include name, address, phone, etc., and a 35-
word description! Other elements I'd like to
include if there's interest: paid advertising of Pc
services (rates available by April 30 or sooner),
maps of specific bioregions, non-profit Pc
groups accepting tax-deductible donations,
sustainable and socially responsible investment
opportunities, a travel network listing, and a
separate list of Pc teachers.

Printed on recycled or non-tree paper, the
Permaculture Directory will be marketed to
the Pc Community, other grassroots,
sustainable organizations, educators, and
community planners.

Don't forget to send those descriptions of
Permaculture organizations, publications, bus-
inesses. Updates, cartoons, graphics, Macdials,
suggestions, and network help are welcome! Δ

The Humanure Handbook

1994, J.C. Jenkins, 198pp. pap. illus.

"...provides basic and detailed information
about recycling human excrement, without
the need for chemicals, technology, or
environmental pollution..."

\$15.00 + 10% shipping

Available from

The Permaculture Activist

The Permaculture Edge

An international journal aimed at
professionals designing sustainable
land-use and community systems.

4 issues / \$20

Back issues also available at \$5 from

The Permaculture Activist
Box 1209, Black Mtn NC 28711

PERMACULTURE Design Course Graduate and Teachers Directory

Official Registration and Survey Response Form

Please indicate with parentheses "()" any information you want omitted from the published Directory.

Date_____ First Registration/Survey? _____ Update? _____ YES, put me in the PC Directory _____ No Thanks _____

1
Full Name_____ Bioregion_____

Address _____

Home Phone_____ Work Phone_____ Fax #_____

Name of your Business/Farm/Organization_____

Group Affiliations_____

Date+Location+City+State+Instructors of 1st Permaculture Design Course_____

Additional Courses (eg. TX 10/93) _____

Occupation at time of 1st PC Design Course: _____

If changed from above, Current occupation: _____

Teachers: Date+Location+City+State of 1st certificate PDC you taught: _____

_____ Co-Instructors: _____

Other Teaching experience: _____

Permaculture related Services you offer: _____

Permaculture related Products: _____

Permaculture related Skills: _____

Permaculture Designs Completed/Available: _____

Permaculture Site owned or managed: _____

Other Biographical Info + Languages: _____

Additions/Interests/Comments/Suggestions: [Use back or extra sheet for more detail] _____

Please copy for Permaculture Design Course Grads and return to:

John Irwin - PD,
104 Gaywood Dr, St. Clairsville OH 43950-1006.
tel. (614) 695-3008

Letters

Fixing "Nitrogen-Fixing..."

Dear Peter,

I'll try to correct my mistakes before someone else does. Since writing the article "Some Temperate Nitrogen-Fixing Trees and Shrubs" (PCA #31) I have found that yellowwood (*Cladrastis lutea*) and Japanese pagoda tree (*Sophora japonica*), which I claim are nitrogen-fixing, have not been found to nodulate and are therefore not nitrogen-fixing. On the flip side, maackia (*Maackia amurensis*), a temperate leguminous tree, has recently been found to be nitrogen-fixing. Research continues.

Thanks to Janet M. Batzli of the University of Illinois for copies of her 1992 articles on this subject.
Bob Fairchild
Dreyfus, KY

Request for Info on Dams & Water

Editor:

I desperately need:

1. Kenneth D. Nelson's 1935, *Dams and Catchment Book*
2. P.A. Yeomans, *Water for Every Farm*
3. Anything on building and designing "swales" water catchment.
4. Aquaculture/pond info books

Thank you,
William W. Kelly
PO Box 519
Belville, TX 77418

A Rainforest in Eastern Montana

Dear Peter:

I return from the Fossil/Rim Permaculture course of '94 inspired by Bill Mollison to build a rainforest on 320 acres of semi-arid shortgrass prairie in eastern Montana. I had been building a forest there, and I always thought it would lead to more precipitation. Now Bill has demonstrated to me that the site succession can continue past a lowland prairie community, to a riparian community with closed canopy, to a rainforest!

There are many considerations, and there are design details to fill in. But I am sure about the next step. I'll be seeding 500 cottonwood and willow cuttings into 5 acres of cordgrass wetlands, and the nucleus of the rainforest will be set. Other crucial steps include two miles of livestock exclusion fencing and chisel plowing of compacted soils. I will continue with annual planting of seedling stock from the Montana State Forestry nursery, until the whole thing starts taking off. I expect to see that happen in about two seasons.

I want to especially thank Larry Santoyo, Scott Pittman, and above all,

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Bill Mollison for taking time away from home and their own projects to teach us what can be taught, inspire us about what can be done, and let us respect what can never be known. It was intense, it was awakening, and it was just the beginning.
Yours for the earth again,

Russell Blalock
1081 Milky Way
Cupertino, CA 95014

Can't Afford Apprentices

Permaculture Activist

Please drop the ad we had for apprentices in your classifieds.

At this time we are in a state of change and don't want apprentices to apply until we transform the working farm into a teaching organism.

The realities of economic survival have made the paying of trainees non-sustainable. Most of the persons applying here have had the reality of farming work be more than they can handle, either physically, mentally, or emotionally. At least one of these faculties falter before the growing season is complete, the harvest in, and the profit for the year's labor has been made. This means the missing energy needs to be supplied by myself or my husband. After three years, the situation has become too draining to continue in this same system.

Being a highly successful organic farm except for the labor problems, we very much want to pass on the 50 years knowledge we have between us. Perhaps the answer is to charge those coming here for the opportunity to learn. Then the situation would be less pressured by profit requirements.

I share these ideas with you, Permaculture Activist, because I know

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Living Communities:

13.00

A Permaculture Case Study at Sol y Sombra

Ben Haggard. (1993) 152 pp. paper. illus. Permaculture through the eyes of a master gardener and the design of a particular place, the Miller estate at Santa Fe, NM. Valuable for its insights into the observation process. Haggard's prose is lyrical and his conclusions reach beyond his desert home.

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Newly Revised (1994) 326+ pp. paper. illus. More than 450 North American and 50 international communities, 250 alternative resources, 35 articles on community living. Comprehensive, exciting survey of a maturing movement for cultural transformation. Available June 1995.

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18.00

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Michael Potts. (1993) 300pp. paper. illus. Weaves 27 inspiring stories of the new energy pioneers and how they did it—nuts and bolts, with explanations of theory and practice. Replete with diagrams and photos. Chapters on economics of permanence, siting and building the home, repair & maintenance, biological energy, and community cooperation. A treasure trove of useful information. Clear language, exceptional value.

Boundaries of Home: Mapping for Local Empowerment

Doug Aberley, ed. 138 pp. paper. illus. Mapping is the first step toward reclaiming the territory. How to envision the landscape of home: 19 passionate essays on bioregional mapping, theory & examples from city and country, USA, Canada, Britain. Info on using GIS, resource assessments, review of cartographic sources, many and varied example maps.

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Sacred Land, Sacred Sex: Rapture of the Deep

Dolores LaChapelle. (1988) 386pp. paper. illus. "How do we begin moving toward a real culture? All we have to do is raise one generation of children right—according to the pattern laid down by hundreds of thousands of years of our mammalian ancestors." A manual of deep ecology, a guide to ritual, an essential history of our species.

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More Permaculture Books on pages 22-23

you care and are therefore a good sounding board.

This year we farmed 22 acres, and plan next year to fallow, covercrop, and in other ways rest all but about 4 acres which the two of us can do ourselves...to establish a joyful workable atmosphere doing what we do best with love. I lament the decrease in product that will result, as do our customers.

So until we communicate again, know the appreciation I hold for your journal. It holds more information

truly pertaining to the future than any other publication I know.

An up-beat project for the next season is our haybale construction home. The foundation will be our main work this winter. We are on a river delta flood zone so there will be a lot of foundation. Toward solutions,

Charlotte & Glen Johnson
Mother Flight Farm
12185 Seigler Canyon Rd
Mount Vernon, WA 98273

Back Issues of 55 *The Permaculture Activist*

- I, 1 July '85 Permaculture In Oz
- I, 2 Nov. '85 Fruit & Nut Trees
- II, 1 Feb. '86 Garden Design
- II, 2 May '86 IPC 2 & PC Design Courses
- II, 3 Aug. '86 Int'l PC Conference Program
- II, 4 Nov. '86 Fukuoka; Keyline; Genetic Cons'vn; City Farms; Oceanic PC
- III, 1 Feb. '87 Networking; Natural Farming; D-Q Univ.; Children's PC
- III, 2 May '87 PC Restoration of Wild Lands; Design for Sacramento Farm
- III, 3 Aug. '87 Annual Planting Cycle
- III, 4 Nov. '87 Trees for Life
- IV, 1 Feb. '88 Marketing PC Products; Bamboo; Home Wastewater Treatment
- IV, 2 May '88 Urban-Rural Links; Economics & Community Development
- IV, 3 Aug. '88 Social Forestry; Gabions; Jap. Org. Ag.; Prodc/Cons. Coops
- IV, 4 Nov. '88 Multi-Story Tree Crops; Greening Dom. Repb; Runoff Gardens
- V, 1 Feb. '89 Permaculture: A Designer's Manual; Tree Bank; Water in PC
- V, 2 May '89 Plant Guilds; Roof Gardens; Small Livestock
- V, 3 Aug. '89 Rainforest Conservation in Ecuador; Gaia; Weed Gardens
- V, 4 Nov. '89 PC Defs; Water Conservation; Small Dams; Ponds; Keyline
- VI, 1 Feb. '90 Household Greywater Systems; Soil Imprinting
- VI, 2 May '90 Insectary Plants; more Greywater; Land Use for People
- VI, 3 Aug. '90 Forests & Atmosphere; Catchment; Nepal; Pond Design
- VI, 4 Nov. '90 Urban Permaculture; Ecocity Conf; Soil Detox; Suburbs & PC
- #23* May '91 Politics of Diversity; Greenhouse Mkt Gdn; PC in Nepal
- #24 Oct. '91 Creativity in Design: Examples; Index Issues #1-23;
- #25 Dec. '91 Design for Community: CSA's, Restoring Forest; Garden Ecol.
- #26 May '92 Soil: Our Past, Our Future: Fertility, Worms, Cover Crops
- #27 Aug. '92 Deconstructing Utopia; Grassroots Orgnz; Garden Polyculture
- #28 Feb. '93 Structures: Comm'ty Dsgn; LETS; Industry; Strawbale/Timber-frame Bldgs.
- #29-30 July '93 Networks: Special Media Rvw; Rural Reconstr'n; Leaf Concl; Comm'ty Food Initiatives; Pc in Palestine; Do-Nothing Ed'n; Feng Shui; Companion Gdng; Nature Spirits; Wilderness; Biogeog.; Network Theory; Pc Acad. Forest Gdng; Energy & Pc; Mushrm Cultn; Robt Hart's F.G.; Spp for N. CA; Alders; Agroforestry in Belize; China; Honeylocust; N-fixers
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Barbados & Permaculture

Hello,

My name is Adam and I've read one of your magazines before and found it quite fascinating.

I live on a small farm on the island of Barbados. We have about 50 acres of arable land which we presently use for dairy farming. Being in a tropical climate and situated on a water zone on good land, I would like to get some information from you about permaculture.

My knowledge at present is very little but we do have quite a selection of fruit trees planted for personal use. Unfortunately, we do not have a lot of capital for irrigation systems or tilling equipment so the concept of using the land in a natural state is appealing.

We are situated between two ravines with gentle rolling hills and a few flat plains with some water holes in the lowland regions. Our topsoil in Barbados is quite shallow on average about 18-24" deep with a layer of porous limestone underneath into which we dig wells to draw water. The water is very pure as it is filtered by the limestone.

We have land taxes which are payable each year so must have some

form of cash crop to cover these expenses. The predominant agriculture is sugar cane for export, but I would like to try and establish an area of self-sufficiency on a few acres of good land.

I have been planting a borderline of mahogany trees which seem very durable against drought and can penetrate our limestone with their roots easily; they grow very quickly and give excellent lumber. Neems also have been incorporated as these give excellent shade for man and beast.

Any information focusing on a self-sufficient environment would be greatly appreciated. Our climate is very mild, averaging about 85 degrees year-round. Rainfall is predominantly in June to December, but well water is available.

If you would send me information on how to subscribe to your magazine, I would be grateful. I feel we need to get back to basics more here in the West Indies. We have also got a terrible garbage problem. There is no recycling here at present. Hoping to hear from you.

One Love,
Adam Bishop
Greenwich House
St. James, Barbados, West Indies

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Books & Publications

West Coast Permaculture News & Gossip and Sustainable Living Newsletter, the quarterly newsletter and network for PC on the West coast. \$5 for four issues. PO Box 45472 Seattle WA 98145.

Portable Dwelling Info-letter: about living in tents, yurts, domes, trailers, boats, remote cabins, other mobile or quickly-made shelters plus plans for simple low-cost, low-impact comforts and conveniences. Sample \$1. Box 190-pa, Philomath OR 97370.

Eco-City Cleveland, the monthly bioregional newsletter for Northeast Ohio. Subscriptions \$20/yr at 3145 Berkshire Rd, Cleveland Hts OH 44118. (216) 321-6478. Sample copy free.

The Last Straw journal is an information-sharing forum created for and by individuals involved in straw-bale construction. It is published quarterly by *Out on Bale* (Un) Ltd., whose purpose is expanding and sharing the knowledge, techniques, and experience of straw-bale and promoting its wider use, so that the need for durable, inexpensive, energy-efficient housing can be integrated with the need for increasingly sustainable agricultural and industrial systems, for the betterment of the environment and all life forms on a planetary level. *The Last Straw* is available for \$28/year in the U.S. (add \$15. outside U.S.; add \$5. for Canadian subscriptions), from *Out on Bale* (Un) Ltd., Drawer PAN, 1037 East Linden, Tucson, AZ 85719. 602/624-1673. Submissions welcomed.

The Bead. A Journal of coherence. A quarterly dialogue on beads, bits and beats. \$24/year. 6845 Hacker Place, Martinsville IN 46151. SASE for info.

Miscellaneous

Permaculture and Water stories from Africa? Tell me more. S. Garrett, PO Box 8021, Honolulu HI 96830. A West Coast Permaculture Teacher Training Guild is forming. Looking for mentors and apprentices in the west to network with. Mike Lockman, PO Box 45472, Seattle WA 98145

The Western Shoshone Defense Project needs volunteers, supplies, and money. Support Shoshone sovereignty! Help restore the land! PO Box 211106, Crescent Valley NV 89821. (702) 468-0230.

Rural Culture is a network of gay and lesbian farmers, gardeners, and other homesteaders interested in sharing alternatives to both urban lifestyle and rural isolation. Currently we are a group that meets regularly in Vermont and communicates with farther-flung members via a newsletters. For more info, write Rural Culture, PO Box 72, East St. Johnsbury VT 05838.

Green Goods

Clivus Multrum composting toilet, complete, fan, pump, vents, commode, 8'6" long, 3'11" wide, 6'8" high, one 12" midsection, \$1000, you haul. (616) 347-7434. Petoskey, Michigan.

Custom-bent greenhouse hoops - all steel, perfect for greenspace on house or in garden. \$2/sf. Going Concerns Unlimited, 5569 N. City Rd 29, Loveland CO 80538. (303) 629-4342.

Green Earth Office Supply carries a full line of environmentally friendly office & school supplies at competitive prices. Some of our products include hemp and kenaf paper; refillable corn & recycled rubber tire pens; stationery made from obsolete maps; nontoxic, cruelty-free correction fluid & art supplies; recycled computer diskettes; remanufactured toner cartridges; solar portable computer chargers; recycled plastic & steel desk accessories; recycled filling & mailing supplies. Free catalog. PO Box 719, Redwood Estates CA 95044. (800) 327-8449, (408) 353-2096.

Permaculture design software, 100% IBM DOS-compatible, \$35. Appropriate Systems Design, 1081 Milky Way, Cupertino CA 95014.

Feed and Seed

Edible Landscaping, rare and unusual fruit and nut trees. Send \$1 for catalog. Hidden Springs Nursery, 170 Hidden Springs Ln, Cookeville TN 38501.

Internships

Market garden/homesteading apprenticeships in beautiful British Columbia. Extensive PC library, alternative energy, greenhouses, orchard. Write for details and application: Rainwalker Farm, Lasqueti Island BC Canada V0R 2J0.

Hands-on intern experience. Coast Range Valley organic farm, seed-saving, orchard, wild-crafting, poultry, propagation, agro-technology. K. Andersen, M. Fahy, 9320 Gopher Valley Sheridan, OR 97378. (503) 843-4760.

Hidden Springs Nursery. We propagate, grow, and sell edible landscape plants, 8-acre orchard and solar greenhouse. Room, board, and stipend in exchange for hard work. 170 Hidden Springs Ln, Cookeville TN 38501. (615) 268-2592.

Business Opportunities

Micro-business development practitioner seeks existing group to help hatch new socially and environmentally responsible businesses. I bring experience, existing business, labor, need help finding 3-6 board members and 2-3 co-workers who don't mind outdoor winter work (local trucking) and possible seasonal relocation till we start something better next spring. Will train & help orient & certify people as needed. Prefer linking/living with/in an existing group, hopefully practising permaculture in model intentional community or planning to. Other values I hope we share some of: simple living, right livelihood, love of nature, nonviolence and legal avoidance of war taxes, local self-reliance, ongoing reflection and dialogue, clear group process & conflict resolution, personal growth, support for marginalized populations. David Nuttall, Box 971, Wilmington DE 19899-0971. (302) 654-3068.

Permaculture Center in the Southwest? 9 irrigated, certified organic acres of 21.61 ac with hwy. access on the Rio Grande River between Santa Fe and Taos, NM. 8-9 ac are rich river bottom land. Main building, 2-story state-of-the-art greenhouse 3200 s.f. designed for climate controlled growing of seedlings. Post-and-beam constructed in 1989, was formerly owned by nursery and landscaping business. All utilities, radiant heat, security system, several other structures on land formerly carpenter shop, offices, and storage. \$595,000. Boni Bryant, Taos NM. Bus: (505) 758-1924 or (800) 530-8899, fax (505) 758-4833. Res: (505) 751-0627.

Help Wanted

Solar/Permaculture Designs, Wild Gardens - Larry Kulick. Seeking volunteers for local community gardening collective and Food Not Bombs. PO Box 971, San Jose CA 95172. (408) 947-7356. Administrative assistant for **The Permaculture Activist**. Must be well-organized, able to type, spell, and write well. Good communications practices a must. Variety of duties including telephone work, answering correspondence, editorial assistance with magazine, research, librarianship. Entrepreneurial opportunities teaching permaculture, workshop organizing, occasional travel. The successful candidate will have completed the permaculture design course, be personally clean, mature, and responsible, and desire to practice permaculture journalism. publishing, sustainable rural development. Small salary, fringes. Letter and resume to 205 Jones Rd, Leicester NC 28748.

Situations Wanted

I'm searching for 5-10 acres in Tennessee—moderately priced. I will be driving there in August '95. Can you help me? Mike Littlejohn, 21 Diamond St., Brooklyn, NY 11222.

Knowledgeable Nurse/Crone in company with several savvy permaculture Earth-animals seeking permaculture community in harmony with each other and the planet. Kay Barnes, Rt. 1 Box 38, Primm Springs TN 38476.

Seeking Permaculture Partner: SWM knowledgeable in permaculture wanted. Would like to have partner pay half of land cost in S. Oregon in on e-year's time. I am 32 and would

like to do this with someone near my age. If interested, please write Erin. 3867 SW 198th, Aloha OR 97007.

Seeking farm/craft, internship/employment in woods of PA/NY. Goal: simple living, room for individuality. Maria Gabrielle Reznikoff, 238 Field St, Rochester NY 14620. (716) 461-3901.

Experienced organic farmer seeks internship. Debby, PO Box 277, Kent CT 06757.

Services Offered

Downunder Permaculture Experience. Enjoy a learning holiday at Crystal Waters, the world's first Permaculture Village. This Permaculture Certificate Course emphasizes practical solutions and techniques with strategies for all climate zones and examples from around the world. Tutors Frances Lang and Max Lindegger have taught over 2,500 people in 15 countries. Act now because your money goes further in Australia and we will help you make contacts to visit on your travels. 1994: Sept., Oct. 1995: Jan., May, Aug., Oct. For a course brochure: Green Harvest, 52 Crystal Waters, MS 16, Maleny, Queensland 4552, Australia. Tel.: 61-740-944676 or FAX: 61-74-944578.

Land imprinting, consultation on the "Dixon" land imprinter. No-till seed drilling and brush-hogging: Pan Southwest. Legacy Revegetation/Restoration, PO Box 1507, Taos NM 87571. (800) 513-SEED.

Communities

intentional Community homes for sale. Historic Gold Rush town of 22 houses on public land. Starting mountain bike recreation area with hostel, micro-brewery, hut-to-hut system and more.

4600' elevation at headwaters of Oregon Creek with 32 gravity fed springs. Seeking progressive family to manage CSA, orchard, and trout farm. Located 16 miles N.E. of Nevada City. Call (916) 265-3512.

Earth in Clover: A sacred community on the Skagit River. Seeking women and men to actively participate in developing a new community on the Skagit River in the N. Cascades, devoted to the restoration of the fertility, beauty, and fecundity of Mother Earth. We are starting spring planting, building, well-digging, power generation, and creation of loving relationships. Write H. Wechsler. 4628-B Yeager Road, Concrete WA 98237 for more detailed information.

Forming community in NE West Virginia (260 acres) for environmentally sensitive, allergic & such. Self-sufficiency, organic gardening & permaculture. Teaching center, perhaps. High Horizons, RR2 Box 63-E, Alderson WV 24910. (304) 392-6222.

PROTOTYPE Permaculture community needs 50 acres, water, near freeway. Need 20 volunteers: 12 workers, 8 lenders. James D. Wyker, 306 Estill, Berea KY 40403. (606) 986-8000.

Travellers

B.C. Canada. Two new permaculture communities. North central, wilderness camping in "Clearwater"; Urban Vancouver permaculture sanctuary: \$10/night or service exchange for earth-loving travellers. Appreciate letters, especially information about Northern Zone 4, wetland sustainable cultivation. Lydia Travers, 338 E. Fifth St, No. Vancouver BC Canada V7L 1L9. (604) 984-9929.

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CALENDAR

April 1-14. Garberville, CA. Third Annual Permaculture Design Course. Island Mountain Institute, 220 Harmony Ln., Garberville, CA 95542. (707) 923-2021.

April 7-15. Summertown, TN. Fundamentals of Permaculture. EcoVillage Training Ctr., Vickie Montagne, 105 The Farm, Summertown, TN 38483. (615) 964-3574.

April 8-29. Kalamazoo, MI. Tillers International workshop and international development course. Ox Training, April 8-9; Woodwrighting—Forks & Rakes, April 8; Blacksmithing, April 11-15; Animal-Powered Development, April 25-29. Tillers, 5239 S. 24th St., Kalamazoo, MI 49002. (616) 344-3233.

April 18-25. Baja, Mexico. Permaculture Workshop. Jerome Osentowski, Central Rocky Mtn. Permaculture, PO Box 631, Basalt CO 81621. (303) 927-4158.

April 21-May 4. Glen Rose, TX. Permaculture Design Course. Fossil Rim Wildlife Ctr., Box 2189, Glen Rose, TX 76043. (817) 897-2960, 1-3785 fax.

April 22-23, May 6-7, 20-21, June 3-4. Durango, CO. Weekend Permaculture Design Course. Karen Brooks. (505) 281-8425.

April 25-May 1. Baja, Mexico. Permaculture Workshop. Jerome Osentowski, CRMPI.

May 5-6. Ottawa, KS. Forest Gardening Workshop. Jerome Osentowski, CRMPI.

May 6-7, 20-21, June 3-4, 24-25. Sedona, AZ. Weekend Permaculture Design Course. Carol Luhman. (602) 634-1913.

May 21-June 3. Sebastopol, CA. Permaculture Design Course. Vital Technologies, Box 279, Sebastopol, CA 95473. (707) 829-8348.

May 21-June 3. Crystal Waters Village, Queensland, Australia. Permaculture Design Course. Jeff Michaels, Green Harvest, 52 Crystal Waters, MS 16, Maleny, Queensland 4552, Australia. tel. 61-74-944676, fax.

May 26-28. McBride, BC. Introduction to Permaculture. Grégoire Lamoureux, Box 43, Winlaw BC Canada V0G 2J0.

May 26-June 4. Plainville, MA. Fundamentals of Permaculture. Crystal Spring, 76 Everett Skinner Rd., Plainville MA 02762. (508) 699-7167.

May 27-June 4. Navajo/Hopi Reservation. 4th Annual Permaculture Drylands Design Course. Black Mesa Permaculture Project, PO Box 26195,

Tucson, AZ 85726. (602) 629-9122, 745-7888 fax. June 2-18. Northwestern PA. Women's Permaculture Design Course. Dancing Green, Inc., PO Box 157, Cochranton, PA 16314. (814) 425-8210. June 4-10. Jalisco, Mexico. Consejo de Visiones. Annual gathering of bioregional visionaries and activists. Contact Cress Spring Farm, 4035 Ryan Rd., Blue Mounds WI 53517. (608) 767-3931.

June 17-18, July 1-2, 15-16, 29-30. Taos, NM. Weekend Permaculture Design Course. Karen Brooks. (505) 281-8425.

June 23-25. Epping, NH. Earth Conscious Design. Green Pastures Estates, 38 Ladd's Lane, Epping, NH 03042. (603) 679-8149.

June 24-26. Orleans, CA. Second West Coast Permaculture Convergence. Sandy Bar Ranch, Box 347, Orleans, CA 95556. (916) 627-3379.

July 1-13. Cottage Grove, OR. Sustainable Development for the World. Zopilote, Box 123, Cottage Grove OR 97424. (503) 942-3021.

July 2-16. Lunenburg, Nova Scotia. Permaculture Design Course. Institute for Bioregional Studies, 449 University Ave., Suite 126, Charlottetown, PEI, C1A 8K3, Canada. (902) 892-9578.

July 7-15. Hockley Valley, Ontario. Fundamentals of Permaculture. Richard Griffith, 104 Bridlewood Blvd., Agincourt, ONT. M1T 1R1, Canada. (416) 497-5746.

July 10-26. Heathcote, MD. Permaculture Design Course. Heathcote Ctr., 21300 Freeland Rd., Freeland, MD 20153. (410) 343-0280.

July 16-22. Orleans, CA. Permaculture Fundamentals Course. Sandy Bar Ranch.

July 22-29. Crestone, CO. Fundamentals of Permaculture. CRMPI.

July 28-30. Athens, OH. Walking & Reading the Land (Women's Weekend). Karen Amett, 2406 Ashland Ave., Cincinnati, OH 45206. (513) 861-2075.

July 28-30. Orcas Island, WA. Pacific NW Permaculture Rendezvous and 3rd Annl. Bog Toss. Friends of the Trees, PO Box 1064, Tonasket, WA 98855. (509) 485-2705.

July 28-August 6. Oldenburg, IN. Fundamentals of Permaculture. Michaela Farm, Oldenburg, IN 47036. (812) 934-5016.

July 31-August 5. Dexter, OR. Advanced Permaculture Design: "Water in the Landscape." Lost Valley Center, 81868 Lost Valley Ln., Dexter, OR 97431. (503) 937-3351.

August 6-19. Tlaxcala, Mexico. Sustainable Development for the World. Zopilote Assn.

August 7-12. Dexter, OR. Advanced Permaculture Teaching Course. Lost Valley Center.

August 11-13. Celu, NC. Second Annual

Southeastern Permaculture Gathering. Gred Gross, 346 Seven Mile Ridge Rd., Burnsville NC 28714. (704) 675-5918.

August 11-27. Central PA. Men's and Womyn's Permaculture Design Course. Dancing Green.

August 17-20. Toronto Isl., Canada. Great Lakes Bioregional Congress. Whitney Smith, 158 Crawford, Toronto, Ontario M6J 2V4 Canada. (416) 538-3377.

August 19-27. Orleans, CA. Permaculture Practicum. Sandy Bar Ranch.

August 25-27. Ramsey, MN. Creating the Home System. Bruce Bacon, Crandall Farms, 7363 - 175th Ave NW, Ramsey, MN 55303. (612) 753-5099.

August 25-September 2. Toronto, Ontario. Urban Permaculture Course. Richard Griffith.

August 26-27, September 9-10, 23-24, October 7-8. Albuquerque, NM. Weekend Permaculture Design Course. Karen Brooks.

August 2-September 9. Crystal Waters Village, Queensland, Australia. Permaculture Design Course. Jeff Michaels, Green Harvest.

September 8-24. Grangeville, NY. Permaculture Design Course. Fish Creek Inn, 120 Hughes Rd., Grangeville, NY 12871. (518) 695-6879.

September 11-16. Portland, OR. Permaculture Teachers Training. The Learning Community of Portland, 1110 SE Alder, Portland, OR 97214. (503) 236-5325.

September 24-October 2. Summertown, TN. Fundamentals of Permaculture. EcoVillage Training Center, Vickie Montagne.

September 23-24, October 7-8, 21-22, November 4-5. Tucson, AZ. Weekend Permaculture Design Course. Barbara Rose. (602) 744-9305.

September 26-October 9. Basalt, CO. Ninth Annual Permaculture Design Course. Jerome Osentowski, CRMPI.

October 16-30. CO & UT. Fundamentals of Permaculture Course. CRMPI.

October 22-November 4. Crystal Waters Village, Queensland, Australia. Permaculture Design Course. Jeff Michaels, Green Harvest.

November 3-11. Greensboro, NC. Urban Permaculture Fundamentals. Charlie Headington, 515 N. Mendonhall, Greensboro, NC 27401. (910) 273-7292.

November 4-5, 18-19, December 2-3, 16-17. Phoenix, AZ. Weekend Permaculture Design Course. Greg Peterson. (602) 279-3713.

December 15-January 15, 1996. Maruata, Mexico.

"Welcoming the New Year in Mexico." Bioregionalists gathering on the beach to refresh spirits and work on ecological projects. Contact Cress Spring Farm.

Late November-Early December, 1996. Jalisco, Mexico. Tentative dates for TIBG 7. Contact Cress Spring Farm.

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