

## Management of Japanese Hops on Forest Regeneration Sites

### Background

Japanese Hops or Japanese Hop (*Humulus japonicus*) is an invasive exotic weed that has created problems in recent years on tree planting sites near waterways in Maryland and nearby States. The lack of adequate information on Hops control resulted in a project in 2006 & 2007 to determine more effective management practices. The project included a survey of known Hops locations within the Monocacy watershed in MD and PA, discussions with foresters, weed control agencies and landowners who had been dealing with this species, testing of various methods of control, and actual control work on Hops-infested sites. The results have provided better information on Hops life-cycle and growth habits, and the effective application of various manual, mechanical and chemical controls.

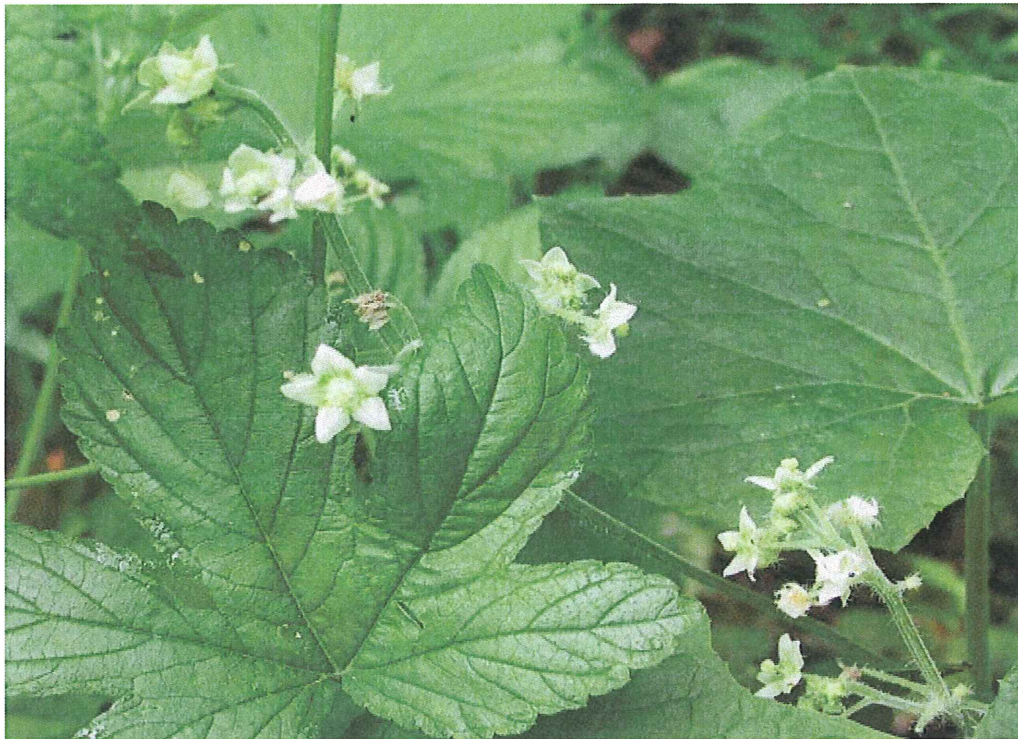
### Description

This herbaceous vine was imported in the late 1800's for use as a tonic in Asian medicine and as a climbing landscape vine, and is still sold for these purposes today. However, as happens with many exotic plants, it soon escaped into the wild, and is now found throughout the Eastern United States.



*Japanese Hops in typical riparian edge habitat*

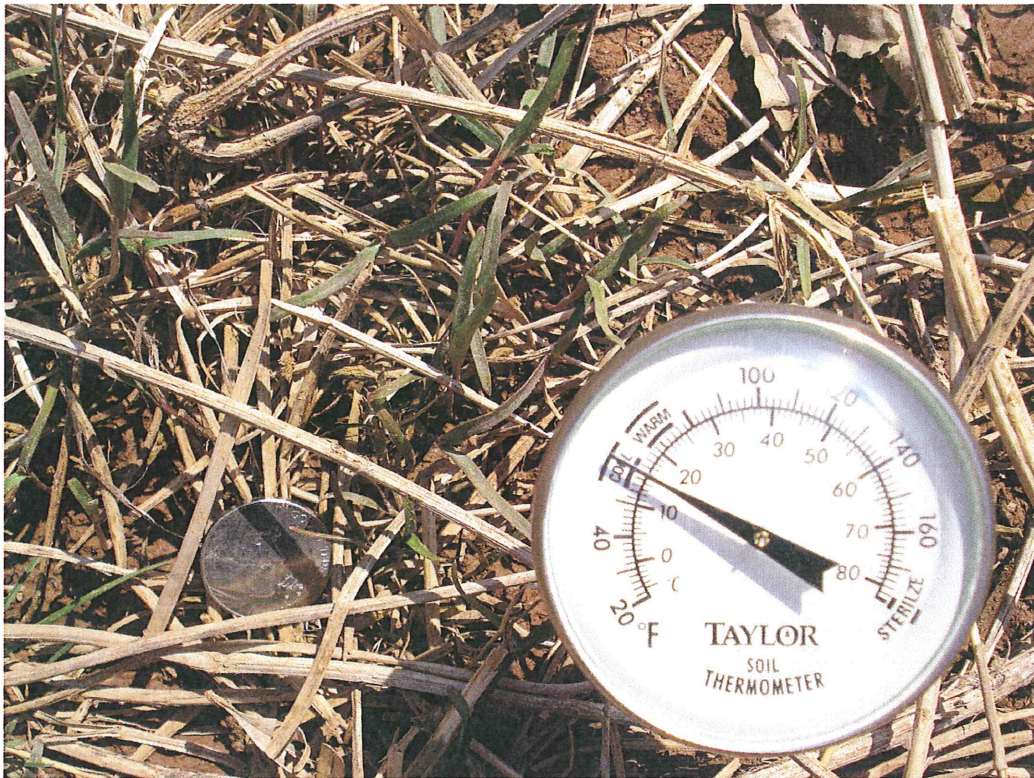
The plant is identifiable by the rough-textured leaves and stems, the stems being covered with short, sharp, irritating prickles that make handling the plant difficult. The tooth-edged leaves are typically 5 lobed, though they sometimes have 7 or 9 lobes. The small green flowers are inconspicuous. Hops are sometimes confused with bur cucumber (*Sicyos angulatus*), though that plant has leaves with less pronounced lobes, has tendrils along the stem and lacks the sharp downward-angled prickles of Japanese Hops. Cinquefoil (*Potentilla spp.*) can also be mistaken for young Hops plants.



*Japanese Hops on left, Bur Cucumber on right (with Bur Cucumber flowers).*

### **Life Cycle**

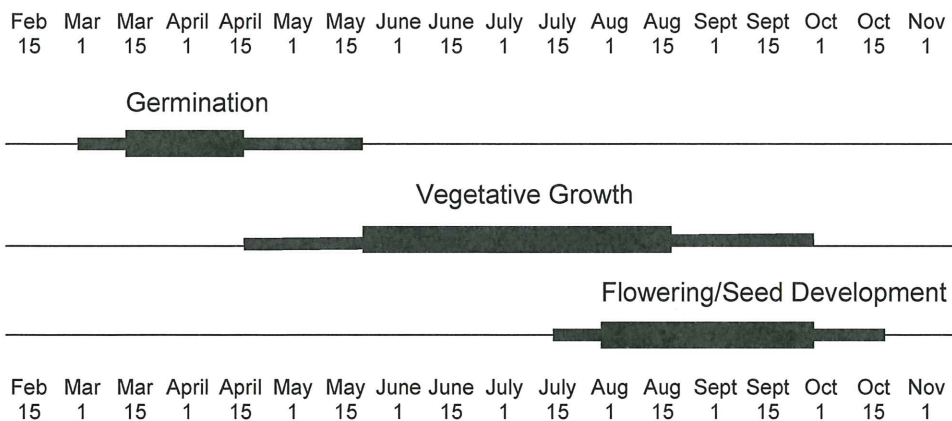
Seeds from this annual vine begin to germinate in early spring (in 2007 this was about April 1, in 2008 in mid-March). Most seeds germinate in early spring, but a few new plants may continue to emerge if conditions allow. Hops likes plenty of sun and moist, rich exposed soil, and is most commonly found along streambanks and floodplains, where the seeds are brought in on floodwaters. Newly germinated seeds may spend several weeks in the tiny 2-leaf cotyledon stage, but once hot weather arrives they grow very rapidly. The aggressive vines can climb to ten feet in height and spread out to completely cover a large area. Many thousands of Hops plants per acre may be produced, eventually blanketing the land and vegetation. Flowering and seed production starts in August. Growth slows and plants begin to decline in September, due either to cooler temperatures or maturity after producing seeds. The first hard frost of autumn kills the vines, at which time they quickly disintegrate. By this time the Hops already have produced a crop of seeds to continue and spread the infestation the next year.



*Most Japanese Hops seeds germinate in March or early April.*

### Life Cycle of Japanese Hops

Based on Observations in Frederick County, Maryland  
(Mid-Atlantic USA, USDA Plant Hardiness Zone 6b)





*Japanese Hops can be very damaging to young trees in riparian forest buffer plantings.*

### **Effects on Tree Regeneration**

Japanese Hops grows rapidly during the summer, forming a mat of vines up to 4 feet thick, and climbing up and over tall grasses, forbs, shrubs and trees to a height of 10 feet or more. The vines cover, smother and twine around trees and shrubs, often breaking or pulling them down. Attempts to mow, or even drive a vehicle through tree planting sites that have Hops vines climbing the trees often result in the vines pulling and breaking down the trees and tree shelters. Hops can quickly cover small trees, hiding them from view and preventing mowing or application of non-selective herbicide.

### **Control Options**

#### **Prevention**

Since Japanese Hops seed is sold for landscape and herbal uses, it would be valuable to discourage people from planting it through public education and contacts with suppliers. Education is also important in helping people identify the plant, look for it on their property and to learn how to control it before it spreads further. Since most of the transport of Hops seed seems to be by water, it would be particularly valuable to seek out and control Hops growing along waterways. It is also appropriate to check for Hops in areas that have flooded in the previous year since these areas are the most likely to have new Hops infestations.

#### **Biological Control**

The only insect observed feeding on Japanese Hops were adult Japanese beetles (*Popillia japonica*). While common, the beetles never did enough damage in any one area to noticeably reduce the Hops growth. The only disease observed affecting

Japanese Hops was powdery mildew (*Sphaerotheca spp.*), which was only seen during periods of wet weather. While this disease certainly limited the growth during those times, when drier conditions returned the Hops recovered and grew rapidly.

There are no bio-control insects or diseases that we are aware of that are suitable for treatment of a site infested with Japanese Hops.

*Powdery Mildew often affects Japanese Hops for short periods during wet weather, but usually does it little long-term damage.*



### **Cultural Control**

Japanese Hops prefers direct sunlight and does not tolerate heavy shade. As soon as the tree canopy closes the Hops will cease to be a problem. Practices that favor fast tree growth, early crown closure and heavy shade will help the new stand survive and outgrow the Hops. This includes planting fast-growing species adapted to the site, effective weed control measures, closely spaced planting, and planting tree species that cast a dense shade in spring and summer.

Japanese Hops does not readily germinate in grassy areas, particularly in tall, sod-forming perennial grasses such as Tall Fescue/Tall Ryegrass (*Festuca arundinacea/Lolium arundinaceum*) or Reed Canary Grass (*Phalaris arundinacea*). It is much more likely to germinate and grow in an area where the soil is exposed or dominated by sparse broadleaf weed cover. However, once germinated it will overtop and kill grass, leaving a bare area for the next year's Hops seedlings to grow. Consideration should be given to avoiding practices such as non-selective herbicide use that would reduce or remove the grass cover. It should also be noted that these sod-forming cool-season grasses are among the worst weeds from the standpoint of tree growth, so this presents a challenge that land managers will need to address on a case-by-case basis. Establishing or favoring other groundcover vegetation that is thick and vigorous in early spring could possibly reduce Hops germination and seedling survival. Fall planted vetch, wheat, barley or cereal rye might serve this purpose.

Japanese Hops likes to climb up and over shrubs and small trees, but it needs a “ladder”, such as tall weeds, shrubs and low tree branches to climb. To minimize the ability of Hops to climb, reduce the proportion of shrubs and small trees planted in favor of tall-growing trees. As trees grow taller prune the lower limbs and basal sprouts to interrupt the ladder available for the Hops to climb.

Use of tree shelters can assist hops control in several ways – by marking the location of the seedling, protecting from herbicide spray, reducing low branching and providing a more difficult ladder to climb (though the shelter is smooth Hops can still climb a shelter via the stake or adjacent vegetation). Try to prevent Hops vines from growing inside or overtop the shelters and depositing seed inside the shelter that will be a problem the following year. Practices such as adequate site preparation, pre-emergent herbicide application or hand weeding inside the shelter, and herbicide application around the shelter can be used. Where shelters are not used it is especially important to prevent Hops entirely or to detect and act on infestations early, before the vines climb onto the trees.

### **Manual Control**

Japanese Hops does not quickly develop an extensive or deep root system and is fairly easy to pull or dig early in the season, especially when the soil is moist. This is an effective method, but care must be used to remove the root, not just break it off at the ground line. It is important to start the hand weeding process early in the growing season (April – May) while the vines roots are small and before the vines become tangled with other vegetation, and repeat it periodically thereafter. Manual control is the most targeted method, with the least likelihood of damage to other plants. However, it is slow and labor-intensive, best used in fairly small, readily accessible areas. It is important to wear gloves, long pants and long sleeves as needed to avoid skin contact with the plant, since it is very irritating. Started early enough, and using proper precautions, this is a good method for use by homeowners, or parks with a source of volunteers.

### **Manual or Mechanical Cutting**

Cutting the Hops vines as close to the ground as possible is an acceptable control as long as the cutting is started early, the entire site is thoroughly cut, and the practice is repeated frequently. Cutting can be done with hand tools, mechanized (weed-eater type) brush-cutters, lawn mowers, or tractor-mounted mowers. Aside from the usual difficulties, common problems found with this method are that vines become tangled in the trees and shelters resulting in the equipment pulling them over, and that the vines quickly re-grow from the cut stems and from uncut vines around the trees. This method tends to retain and promote the development of perennial grasses. A combination of mowing between the tree rows and spraying around the trees could be one effective approach.

## **Herbicide Application** **Pre-Emergent Herbicide**

The use of pre-emergent herbicides, which typically are applied early in the year and kill weed seeds as they germinate, is potentially very valuable in controlling Hops. The advantages are that (depending on product, rate and timing) they may be used safely over and around young trees, generally cause minimal or no damage to other perennial groundcover vegetation, and prevent the weed problem from occurring rather than needing to “rescue” the trees from an established Hops infestation. When combined with post-emergent herbicides applied later in the season they may provide a longer period of control that may prevent successful production of seeds before frost.

If Hops were present the previous year it is probable that they will return. Pre-emergent application should be applied in early March, though those products that possess both pre and early post-emergent properties may be used through early May. Alternatively, if the window of opportunity for pre-emergent application is missed, using a combination of a pre-emergent herbicide with a fairly low rate of a post-emergent herbicide may kill off any newly-germinated Hops seedlings (thoroughly applied since these will be tiny and may be shielded by other vegetation or debris) and prevent new weed seedlings. Calibration of spray equipment and procedure to uniformly apply the targeted amount per acre is vital when using pre-emergent herbicide.

Hops seeds are large, about 3 mm (1/8<sup>th</sup> of an inch), so it was thought it would be harder to prevent their successful germination than for smaller seeds. While this may be true, most of the products tested provided good control until July, after which Hops seeds began to germinate and grow rapidly. The exception was Oust XP @ 1 oz/ac, which was still providing good control at mid-July. When Hops were grown in pots in a “laboratory” situation, the herbicide typically did not prevent a few hops seeds from germinating, but did prevent successful growth of the tiny seedlings, and eventually caused them to die off. The difference in these two results may be the more extreme weather conditions, flooding, and the large seed bank of the field site.

Below is information on some pre-emergent products that were tested in March 2008. Results shown are for 3 months after treatment. At 4 months after treatment - all laboratory sample pots were 100% controlled except for Goal; all field sample plots exhibited 30% or more Hops coverage, except for Oust, which still had very low Hops coverage.

*Once warm weather begins Hops plants produce a fibrous root system that is more conducive to digging than pulling.*



Chemical	Product	Rate/Acre	Effectiveness*	Cost per acre**
sulfometuron	Oust XP	1 oz.	Good	Inexpensive
metsulfuron	Escort XP	½ oz.	Good	Inexpensive
simazine	Simazine 4L	4 qts.	Good	Moderate
imazapic	Plateau	8 oz.	Good	Moderate
pendimethalin	Pendulum AquaCap	4.2 qts.	Good	Expensive
flumioxazin	SureGuard	12 oz.	Good	Expensive
oxyfluorfen	Goal 2XL	2 qts.	Fair	Expensive

* Effectiveness of Control of Hops 3 Months after Treatment	
% Volume Reduction	Effectiveness Rating
80 - 100%	Good
50 – 80%	Fair
30 – 50%	Poor
0 – 30%	Very Poor

** Cost per Acre (approx., for herbicide only, at rates indicated)	
< \$5	Very Inexpensive
\$5 - 15	Inexpensive
\$15 - 25	Moderate
> \$25	Expensive

### Tentative Recommendations for Pre-Emergent Herbicide Treatment

Chemical	Product	min rate/ac	Site Prep	Seedlings	Wetlands	Non-crop sites
sulfometuron	Oust XP	1 oz.	x	x		x
metsulfuron	Escort XP	½ oz.	x	x		x
simazine	Simazine 4L	4 qts.	x	x		x
pendimethalin	Pendulum AquaCap	4.2 qts.	x	x		x
imazapic	Plateau	8 oz.	x			x

### **Post-Emergent Herbicide**

The use of post-emergent herbicides, those that kill plants that are already growing, is one of the most common approaches for control. The ideal situation would be to make application after most seeds have germinated (April - mid-May) but before Hops vines are covering the trees (early June – late July, depending on tree size) or seed formation starts (August). Treatments applied in August or later can still reduce the damage from the plants that year and reduce the number of seeds produced. The later the application is made before seed formation starts the more certain it is that it will prevent successful seed production before frost. In our study plots, where post-emergent treatments were applied in June, no newly germinated Hops seedlings were observed for the remainder



of the growing season. However, at least some seeds were produced in all plots, even ones where the treatments were most effective. These seeds were formed on Hops vines that were not badly damaged or that died back but re-grew from the roots later in the summer.

Below is information on some post-emergent products that were tested by application in June 2007.

Chemical	Product	Rate/Acre	Effectiveness*	Cost per acre**
metsulfuron	Escort XP <sup>®</sup>	1 ounce	Good	Inexpensive
glyphosate	Accord Concentrate <sup>®</sup>	1 quart	Good	Inexpensive
glyphosate	Accord Concentrate <sup>®</sup>	1 pint	Fair	Very inexpensive
aminopyralid	Milestone VM <sup>®</sup>	8 fl. oz.	Fair	Moderate
dicamba	Vanquish <sup>®</sup>	1 quart	Fair	Moderate
2,4-D	2,4-D LV 4 <sup>®</sup>	1 quart	Fair	Very inexpensive
triclopyr	Garlon 3A <sup>®</sup>	1 quart	Fair	Moderate
triclopyr	Garlon 3A <sup>®</sup>	1 pint	Poor	Inexpensive
sulfometuron	Oust XP <sup>®</sup>	1 ounce	Poor	Inexpensive
clopyralid	Transline <sup>®</sup>	16 fl. oz.	Very Poor	Expensive
imazapic	Plateau <sup>®</sup>	8 fl. oz.	Very Poor	Moderate

* Effectiveness of Control of Hops 3 Months after Treatment	
% Volume Reduction	Effectiveness Rating
80 - 100%	Good
50 - 80%	Fair
30 - 50%	Poor
0 - 30%	Very Poor

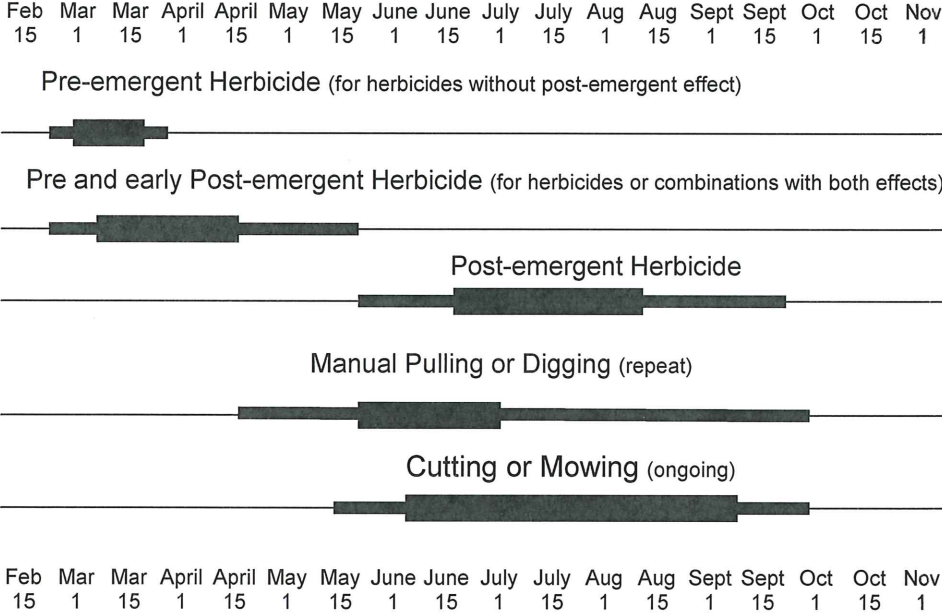
** Cost per Acre (approx., for herbicide only, at rates indicated)	
< \$5	Very Inexpensive
\$5 - 15	Inexpensive
\$15 - 25	Moderate
> \$25	Expensive

### Tentative Recommendations for Post-Emergent Herbicide Treatment

<u>Chemical</u>	<u>Product</u>	<u>min rate/ac</u>	<u>oz./ gal</u>	<u>Site Prep</u>	<u>Seedlings</u>	<u>Wetlands</u>	<u>Non-crop sites</u>
metsulfuron	Escort XP	1 oz.	N/A	x	x		x
glyphosate	Roundup, Accord, Rodeo, etc.	1.25 qt. (5# prod)	1	x	x	x	x
aminopyralid	Milestone VM	7 fl.oz.	N/A				x
dicamba	Vanquish	1.25 qt.	1	x			x
2,4-D	2,4-D, etc.	1.25 qt.	1	x			x
triclopyr	Garlon 3A	1.25 qt.	1	x		x	x
sulfometuron	Oust XP	1.5 oz.	N/A	x	x		x

Always include a non-ionic surfactant in the mix at ½%, or as per label. The mixing rate for oz/gal in the table above is intended as a general guide for spraying to thoroughly wet the Hops in small areas.

**Timing of Control for Japanese Hops**



*Control of Japanese Hops should be started before the vines climb and become tangled with trees or other desirable vegetation.*



Generally two herbicide treatments may be needed, or manual or mechanical controls repeated several times, during the growing season in order to protect trees from damage by the Hops vines and to prevent or reduce seed production. Delaying the first treatment until the Hops are thick and tangled may mean damage to the trees or poor control and the need for re-treatment soon afterward. Generally any Hops plants starting growth in mid-September or later should be killed by frost before developing viable seed.

1. Manual Control – Start checking the site in late April. Pull or dig any small Hops seedlings observed. Repeat this process at least monthly until October.
2. Manual or Mechanical Cutting - Start checking the site in late May. Cut or mow any areas where Hops are observed. Repeat at least monthly until October. More frequent cutting may be needed.
3. Herbicide
  - a. Pre-emergent Herbicide + Post-emergent Herbicide – Spray the entire area where it is suspected that Hops may occur with a pre-emergent herbicide in early March (slightly later if using a herbicide or combination that also has post-emergent properties). Evaluate Hops population and growth stage in June or early July. Spray any hops with a post-emergent herbicide before August. Check again in late August or early September and treat any re-occurring.
  - b. Post-emergent Herbicide Twice – Spray any existing Hops in June or early July. Evaluate and spray again in late August or early September.
4. Combination – use any combination of the methods and timing above, such as using pre-emergent and/or post-emergent herbicide in the tree rows while regularly mowing between tree rows and/or manually pulling any vines that climb onto desirable plants.

### **Summary of Recommendations**

Based upon what we know now, Japanese Hops can be controlled in a variety of ways, but regardless of the methods used it may take a repeated effort - a one-shot treatment by any method will usually not be sufficient. When herbicides are to be used it is vital to read and follow label precautions and directions before purchase or use and to check with other sources and knowledgeable persons in your area. Be sure that a product is suitable for your situation, as limitations apply for most of the products listed here.

### **Prepared 9/16/2008 by:**

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Photos are by the Authors.