Green Invaders

Study Guide

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Introduction: What are Green Invaders?

Green Invaders kill our native plants.
We can't let this happen to chance.
Those vines, trees and weeds
Start out as just seeds
Before you know it, they're grabbing your pants!

What are Green Invaders?

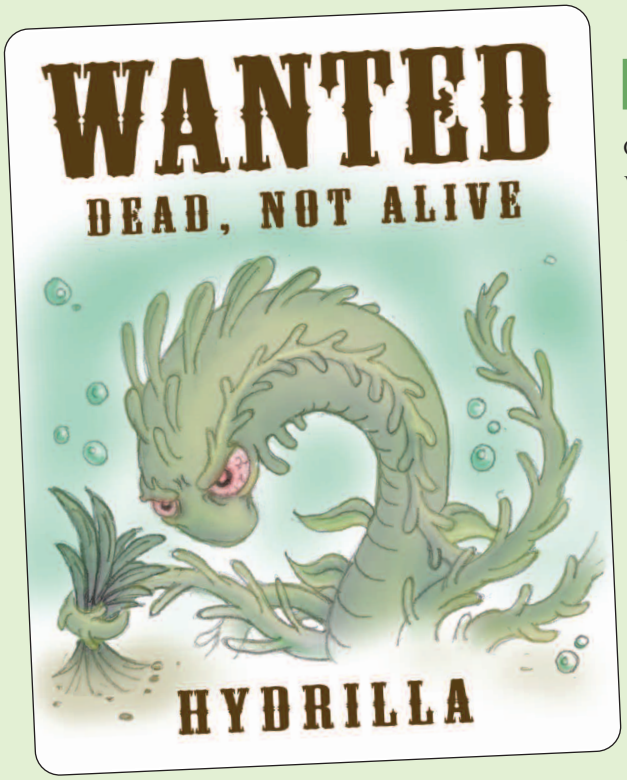
He was such a nice plant until he left home; then he just went haywire. How can a plant be out of control? Moving away to a new country and escaping the limits that kept them in line in their home environment, some plants go on a destructive rampage. We call them **invasive exotic plants** or Green Invaders. Exotic in this case meaning: non-native, alien, introduced, foreign, non-indigenous or not from here. Invasive meaning: super aggressive, weedy, intruding, annoying and causing harm. Not all exotic plants become destructive. In fact, most plants that come here from other countries never escape into the wild. Of those that do escape, only a small percentage become Green Invaders. That small percentage, however, poses a HUGE problem! As they spread rampantly and take over the landscape, Green Invaders cost our country billions of dollars and seriously harm the environment.

The big bucks

Green Invaders clog waterways, take over wetland areas and fields, and spoil croplands. They degrade our parks, roadsides, lakes, woodlands and urban areas, reducing property values and increasing maintenance costs as they create a tangled mess. Across all 50 states, Green Invaders have taken over more than 100 million acres, an area roughly the size of California. And they aren't slowing down. They continue to spread at a rate of approximately 3 million acres every year. That's twice the size of Delaware. A 2004 estimate by Cornell University researchers places the combined economic impact of all invasive species – plants, animals and microorganisms – at 120 billion dollars annually. And the costs are increasing each year as governments, businesses and individuals try to control Green Invaders and stop the loss of crops, forestry products and other valuable land and water resources.

The hidden cost

While the monetary cost of controlling Green Invaders is huge, the harm that invasive plants do to the environment is immeasurable. As they silently invade **natural areas** and displace native plant communities, **habitats** are altered and can no longer support the array of birds, insects and other animals that once lived there. When bulldozers strip all the vegetation from a piece of property to make way for a new shopping mall or residential development, the loss of habitat is dramatically obvious. Most people, however, do not realize the subtle but insidious damage that Green Invaders cause. To the untrained observer, a field overrun with invasive plants can look like a lush green landscape when, in fact, it is an environmental wasteland. Scientists now realize that invasive species are one of the leading causes of endangerment and **extinction** among the world's species, second only to habitat destruction.



Rhymes with Godzilla

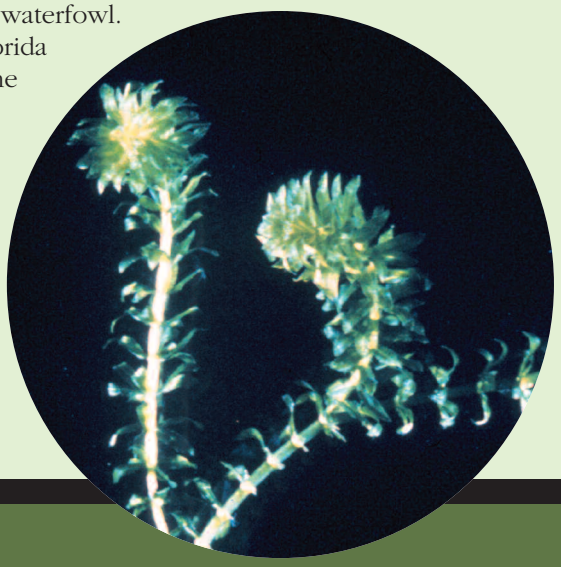
Clogging waterways, halting hydroelectric power plants, contaminating water supplies, entangling boats and scaring swimmers, hydrilla ***(Hydrilla verticillata)*** is an underwater monster. Its thick, green vegetation fills water bodies, blocking light and depriving other lake dwellers of oxygen. This aquatic plant will grow in shallow water as well as deep, producing massive amounts of vegetation on a low budget of nutrients. Like strip malls that spiral out from cities and cover the suburban landscape, hydrilla perpetrates a sub-aquatic sprawl that causes big headaches.

This Green Invader also keeps some questionable company. Aside from creating just the right conditions for mosquito larvae to thrive, hydrilla has most recently been discovered to host a pond scum accused of killing more than 100 bald eagles and thousands of waterfowl. The scum, a blue-green alga, hides out in the tangles of hydrilla. As waterfowl eat the hydrilla, they ingest the alga's toxic poison, get sick and are unable to fly. Eagles prey on the struggling birds and, in turn, get sick and die. Thus, the toxins move up the **food chain** from plant to prey to predator and the illness spreads. Researchers say the cure is simple: get rid of the hydrilla.

That's easier said than done. Florida alone spends about $15 million a year to control hydrilla and hasn't come close to getting rid of it. The plant first entered the United States there in the 1950s when an aquarium dealer tossed six bundles of it into a Tampa canal. More recent infestations have been traced back to shipments of water lilies sold to beautify municipal ponds and backyard water features.

Hydrilla spreads from place to place on boat trailers, bait buckets and the feet of waterfowl. Using these avenues, it quickly expanded to cover more than 140,000 acres in Florida and has now taken up residency in virtually all the southern states. Despite all the money and effort expended to control it, hydrilla still invades lakes, rivers and ponds, causing millions of dollars in lost revenue and lowering property values.

Chemical controls are one way to curb hydrilla. Another approach is to release **herbivores** like carp or insects that chow down on the plant's tendrils. But getting rid of the profuse vegetation solves only a part of the problem. Lodged in the mud underneath the waters are millions of tubers per acre – all ready to sprout and grow again. Just like the many-headed hydra from which hydrilla derives its name, it will take a Herculean effort to slay this beast.



"Extinction by habitat destruction is like death in an automobile accident: easy to see and assess. Extinction by the invasion of exotic species is like death by disease: gradual, insidious, requiring scientific methods to diagnose."
E. O. Wilson

Our garden is run over with kudzu.
It covered my swing set and bike too.
When it started out growing
We had no way of knowing
Just what this awful vine could do.

A place to call home

Plants are not inherently bad. Every plant has a home somewhere in the world where it has grown for hundreds of thousands of years, evolving in relationship with the physical environment and other living organisms such as bacteria, fungi, animals and other plants. The region where a plant originated is called the plant's **native range.** Over the span of ages, a system of checks and balances evolves to keep a **native plant** from overwhelming other species in its neighborhood. Limiting factors such as competition for resources and containment by pests and diseases are ways the balance is maintained.

When natives go abroad

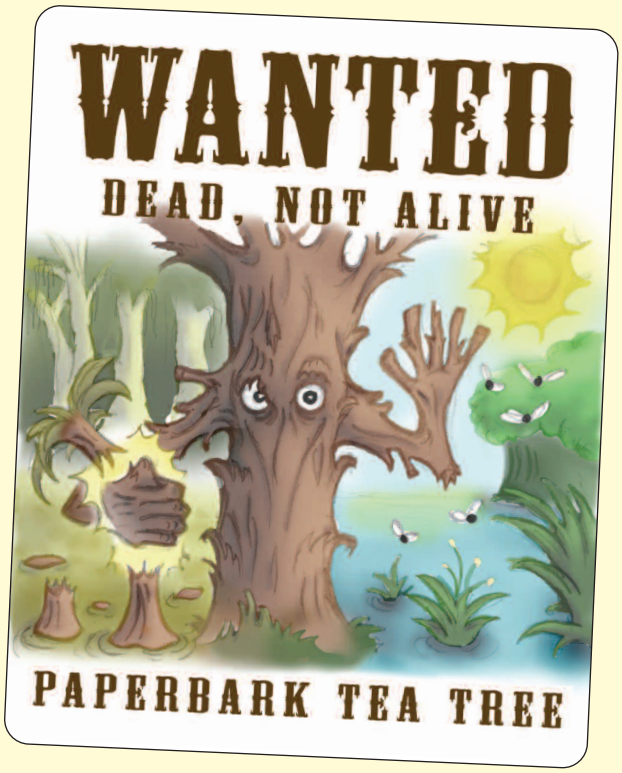
When a plant is introduced by human intervention to a location outside of its native range, it is referred to as an exotic species. Exotic simply means that the plant is non-native, not that it is especially rare or unusual. Most **exotic plants** move into their new neighborhoods without a problem, quietly minding their own business. In the United States most crop plants like wheat, cotton and apple trees are exotics that rarely reproduce outside **cultivation**. When a plant is able to reproduce and sustain itself in its new environment without the help of humans, the plant is said to be **naturalized.** For example, dandelions and white clover were brought to America by European settlers and have since escaped into the wild. They are able to grow and spread on their own, but do not overtake other plant communities. These naturalized plants are still called exotics because North America is not their native, or first, home. Plants are generally recognized as being native to North America if they were found on this continent prior to European settlement and presumably evolved here.

Wearing out their welcome

However, some exotic plants that become naturalized do end up as obnoxious guests. Released from the pests, diseases and other limits present in their native home, they take over and upset the balance in their new environment. Like an out of control houseguest, these pesky plants can quickly wreck a happy home. The Plant Conservation Alliance reports that of the 4000 exotic plants that have become naturalized in the United States, over 1000 are a threat to our native flora and fauna because of their invasive characteristics. These invasive exotic plants are the ones we call Green Invaders.

Activity: Plants of the Melting Pot

Hometown Hero Becomes Botanical Bully



At home in its native Australia, the paperbark tea tree (***Melaleuca quinquenervia)*** is quite respectable. Paperbark finds its niche growing in low areas prone to flooding or along streams and rivers on the northern coast of Australia. A handsome ornamental, paperbark is widely planted in parks and along avenues across Australia because of its distinctive papery bark and bottlebrush shaped flowers. And good looks aren't its only virtue. The paperbark tea tree also makes a useful contribution to society. The essential oil found in its leaves is used to make a variety of medicines and commercial products.

But paperbark's most important job is as a member of the coastal swamp ecosystem. The coastal melaleuca swamp wetlands play an important part in the Queensland region of Australia by filtering water and removing contaminants. They provide nesting or roosting sites for a number of bird and bat species and are a significant food resource for migratory species. Over 400 different types of insects feed on the trees and are in turn eaten by other wildlife. Like wetlands all over the world, melaleuca swamps are shrinking due to development. Several have been declared endangered habitats.

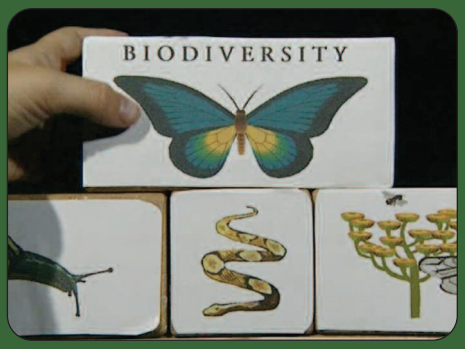
It is hard to believe this hardworking plant could be a botanical bully, but a sad thing happened when the paperbark tree traveled abroad to the United States. In the swamps of south Florida where it was introduced in an attempt to drain the Everglades, this Australian visitor found a permanent vacation paradise. With no pests, no competition and no limits in its new environment, paperbark went wild. It quickly covered hundreds of thousands of acres displacing native vegetation in pristine wetlands. The biodiversity of these areas plummeted as the number of different plant species went from around 70 to just three or four. Native birds, insects and other wildlife were forced to leave as they found little to eat in the thickets of paperbark. Many high quality habitats were converted to biodiversity ghost towns.

Photo by Tony Pernas, National Park Service

Over a century after its introduction, the paperbark tea tree is seen as one of the Florida's worst enemies, causing as much as $168 million in environmental losses every year and costing the state millions more in an attempt to control it. Australians would be shocked to know how one of their homeland helpers has turned into an ecosystem oppressor.

It is tempting to take useful plants from their home environment to new places to turn a profit, but get-rich-quick schemes involving invasive exotic plants have often turned out to be disasters.

Variety of life is the spice.
Such diversity makes our world nice.
But with more species bereft
We may find that we're left
With cockroaches, privet and lice.



What sets a Green Invader apart from other introduced species is its ability to spread rampantly and seriously damage its new environment. As Green Invaders take hold and exponentially expand across the landscape, they threaten biodiversity and tremendously increase the stress on native species and the ecosystems that support them.

Premier performance

An **ecosystem** is simply a community of living organisms interacting together with the physical environment. Forests, deserts, grasslands, tundra, rainforests, lakes, streams, wetlands, coral reefs and oceans are all types of ecosystems that support distinct groups of plants and animals in a dynamic symphony of life. Healthy ecosystems clean the world's air and water, create soil, recycle nutrients, keep insect and other animal pests under control and even regulate the world's climate. These essential functions are called **ecosystem services.** People also directly depend on healthy ecosystems to provide the food, shelter, clothing and medicine that we need to survive. Because we buy life's necessities neatly packaged from a wide variety of stores, many Americans may be out of touch with the fact that the products we buy are either directly or indirectly derived from something found naturally on our Earth. It is estimated that at least 40,000 different species of plants and animals are the source materials for the necessities of today's human daily life. No one knows which of the more than 2 million species on earth will be needed for our future survival.

One-plant show

The non-living components of an ecosystem, such as climate, soil composition, light intensity and moisture set the stage for a complex environmental dance. The performers in this dance are the living organisms that interact with each other in an ever-changing choreography. When an aggressive Green Invader barges in and steals the show, the ecosystem's original cast of species is reduced or replaced. The music falters and cues are missed as the interactions between native plants and animals such as **food chains**, seed dispersal, natural **succession** and **pollination patterns** are disrupted. Scenes are shifted and props disappear as invaders are able to alter the physical part of the ecosystem by changing things like soil chemistry, natural **fire cycles**, water levels, or the availability of nutrients. By disrupting natural ecosystems to create a one-plant show, Green Invaders reduce **biodiversity** and degrade our **biological resources.**

Activity: Diversity Index

Extinction - the final curtain

The amazing diversity of life on our planet is in great peril. The acronym, **HIPPO**, identifies five related threats responsible for the sharp decline in biodiversity: **H**abitat destruction, **I**nvasive species, **P**ollution, **P**opulation pressure and **O**ver-harvesting. HIPPO pressure has accelerated the present extinction rate to a point where some scientists say that over a quarter of the world's current species will be extinct within the next one hundred years. Invasive species alone are responsible for the decline of close to half of the United States' threatened and endangered species. In some parts of the world nearly 80% of the endangered species are at risk due to non-native species.

HIPPO illustration: Sophie Wimberley

Although **extinction** has been a part of our Earth's history since the beginning of time, this alarming acceleration of species loss has led to the prediction that we are heading toward an extinction episode comparable to the demise of the dinosaurs 65 million years ago. The difference is that the next **mass extinction** is being precipitated by human activities rather than natural events. Life has always had to adapt to change, and extinction is a natural part of the process, but the present rate of species loss is continuing to rise dramatically. At what point could the loss of a critical number of species lead to a cascading effect that sets off a mass extinction?

Will the show go on?

When an ecosystem gets out of balance, it can lose its quality and effectiveness. Because there is much we don't understand about **ecological interactions**, it is hard to predict all the results of the damage caused by invasive species, including how the loss of biodiversity impacts the ecosystem services. Once ecosystems are damaged, we may not be able to completely restore them. Environmental protection, though costly, may be far more affordable than environmental redemption, which may not be possible at any cost.

Biodiversity bows out

Biological diversity, or biodiversity, refers to the incredible variety of living organisms that exist worldwide. The term biodiversity includes the variety of individual species, the genetic variation within each species and the variety of ecosystems that foster them. Green Invaders can push natives toward extinction and threaten biological diversity at all levels.

Species biodiversity is impacted when an invader diminishes the variety of species in a habitat. Chinese privet, a popular landscape shrub, has taken over many floodplain forests in the Southeast creating dense impassable stands. The privet infestations not only severely reduce the diversity and abundance of other plants in the forest understory, but also impact the next generation of trees by suppressing the growth of tree seedlings.

The collection of genetic material present in a population of organisms is like a library of gene information. Like a well-stocked library, a rich variety in the genetic pool is an information resource that allows populations of species to respond to changes and pressures in the environment. **Genetic biodiversity** is reduced when an invader is able to **interbreed** or hybridize with a closely related native counterpart. The distinct character of the native player is diluted as its **genes** mix with invader genes. Eventually the native can go extinct as its **genetic pool** gradually evolves to become that of the ubiquitous invader. Oriental bittersweet, a highly invasive vine popular in the floral industry for its red berries, is threatening to push our native bittersweet into extinction through interbreeding.

Ecosystem biodiversity is impacted when an invader is able to transform the physical characteristics of the ecosystem. The exotic saltcedar has converted over a million acres of wetland habitat into ecological wastelands. As its name suggests, saltcedar exudes salt from glands in its leaves, making the soil around it inhospitable to other plants. Its long taproot reaches the water table to suck natural springs dry and increase the frequency, intensity of fires. This alteration of the physical environment impacts biodiversity at the ecosystem level as it changes the very conditions that gave rise to a unique set of flora and fauna.

When ivy takes over your yard,
Your native plants get hit so hard.
They get poisoned and strangled,
Their root systems mangled,
This ivy sure needs to get barred.

What makes a bully?

Green Invaders are aggressive environmental bullies, but how exactly do these pushy plants get the upper hand? Each invader packs its own set of weapons that enable it to overpower other plants - blocking the access to sunlight, water, space and nutrients – the resources all plants need to survive.

Gang up

Many invaders like kudzu grow so rapidly that native plants are engulfed. Others like cogongrass dominate by filling the soil with a massive tangle of underground stems and roots that tie up nutrients. Princess tree crowds out its native neighbors through its incredible reproductive power, producing millions of seeds per plant within a single growing season. The resulting mob of invaders is then able to create dense colonies where no other plants grow.

Poison, anyone?

Tree-of-heaven produces toxic chemicals that concentrate in its leaves. When these leaves drop to the ground and decompose, the toxins enter the soil and can prevent other plant species from growing in that area. Garlic mustard releases chemicals that attack a soil fungus necessary for the growth and survival of hardwood trees.

Burn out

Altering the fire cycle is how some invaders like European cheatgrass take control of new territory. Before this annual grass took over shrub habitats in the west, naturally occurring fires burned on average once every 60 -100 years. Since cheatgrass was introduced, spontaneous fires are now occurring about every 3-5 years. Native shrubs that had adapted to the old pattern of fires do not have a chance to re-grow, thus favoring the cheatgrass expansion.

Sex appeal

A profusion of beautiful or fragrant flowers is the lure a few Green Invaders use to upstage the competition. By diverting pollinators like bees, wasps and butterflies away from their long time local associates, some invaders like autumn olive gain a reproductive advantage. The exotic butterfly bush has been widely planted to attract butterflies, but butterflies filled up with nectar from the invasive butterfly bush may no longer be interested in delivering their pollination services to neighboring native plants. A similar situation occurs when the fruits of invaders like privet or Asian bush honeysuckle have greater appeal to birds than the more nutritious fruits of native plants. The invaders are propagated while native plants, which fill a more complete role in the ecosystem, are jilted.

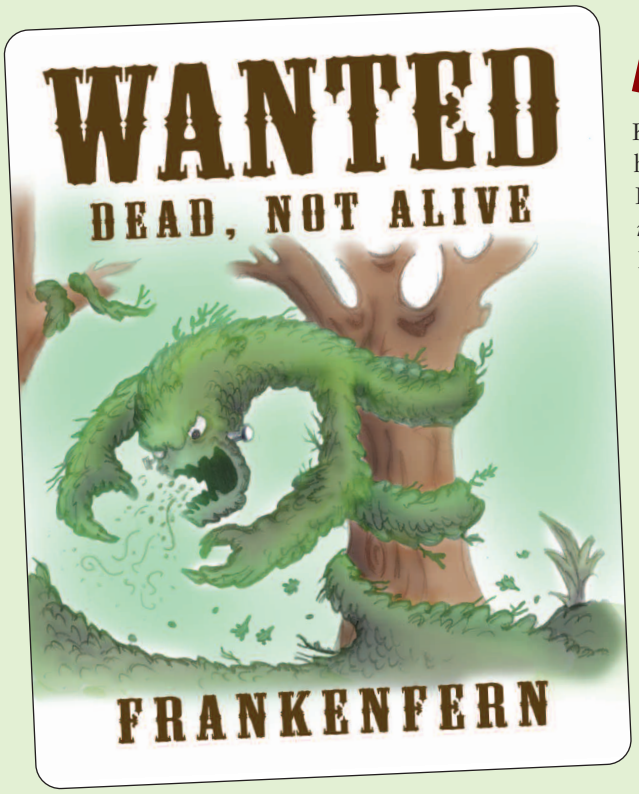
Tough guys

Most of all, Green Invaders are survivors. Rough and ready – they are able to tolerate a wide range of harsh conditions. Many can thrive in full sun or shade, wet or dry situations or in poor soils that would cause other plants to faint. Outlasting the competition, Green Invaders tough it out through fire, flood, drought and gloom of night to live and fight another day.

Exotic plants can become dangerous to the environment when they exhibit a combination of these characteristics:

- Tolerate a wide range of conditions.
- Grow rapidly.
- Spread easily to new areas by wind, water or wildlife.
- Attain reproductive maturity very quickly; which means they are able to bear seeds at an early age.
- Produce an extremely large number of seeds.
- Have seeds that are able to remain viable for a very long time.
- Have adaptations that give them a competitive advantage, such as deep root systems that reach water before other plants, the production of toxins, or the ability to leaf out earlier.
- Are particularly difficult to control or eradicate once established.

Activity: Super Plant Bullies



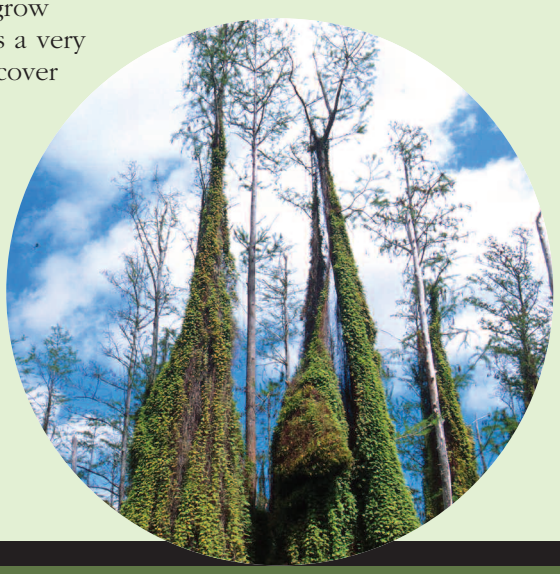
Armed and Dangerous

Kudzu, though often referred to as the vine that ate the South, is hardly a match for the vine that has land managers in southern Florida trembling in their boots. Old world climbing fern ***(Lygodium microphyllum)*** snuck into Florida disguised as an innocent houseplant. It escaped into the wild around 1965 and, nearly unnoticed, began to proliferate. Nicknamed Frankenfern, this invader now covers more than 150,000 acres.

Sure, kudzu can cover entire buildings in just one growing season, but the green giant's long reach is limited. Because it produces very few seeds, kudzu is mainly confined to disturbed areas adjacent to places where it was widely planted in the 1930's to control erosion. But like a squadron of paratroopers, Frankenfern's millions of dust-like spores can go airborne to spread far beyond their original location. Carried by the wind up to 40 miles away, the spores are able to land on pristine island hammocks deep in Everglades National Park where they germinate and start growing in less than a week. Frankenfern's 90-foot lime green fronds can quickly blanket pine forests, swamps or roadside ditches with a heavy mat of vegetation that smothers entire plant communities.

Once established, Frankenfern turns up the heat. Fires that are a naturally occurring part of the ecosystem are able to burn higher, longer and faster when Frankenfern is there to fuel the blaze. Trees that are adapted to survive the normal ground fires are killed when ladders of old fern fronds carry fire up into the tree canopy. Able to grow year-round in wet soil or standing water, in full sun or shade, Frankenfern is a very serious threat to ecosystems. Land mangers say that if not checked it could cover south Florida in just a few years and then head on over to Louisiana and Texas. Fortunately, Frankenfern is limited by climate to areas south of Orlando. Is that a relief?

Watch out! Its invasive cousin, Japanese climbing fern ***(Lygodium japonicum),*** has already landed in the U.S. and is showing up in southern states as far north as the Carolinas. But there is always hope. Scientists are in the process of testing several of Frankenfern's natural enemies including a tiny moth, a small beetle and a mighty mite to use as biological controls. With luck, Goliath can be felled!



Peggy Greb, USDA Agricultural Research Service

Kudzu may be the Southeast's best known Green Invader, but it is definitely not the worst. Invaders that spread rampantly to new areas through seeds, spores or tiny plant fragments often pose more serious problems.

What starts as mere innocent seeds
Spreads out when each little plant breeds.
They're so darned pervasive
We call them invasive.
These plants aren't just any old weeds.

Break and enter

Everybody needs a break. Green Invaders are no exception. Sometimes that lucky break happens by accident and sometimes it's a planned event, but in any case, human beings are always there to lend a hand. Modern transportation, international travel and the global economy have made it a lot easier for people to move plants from their natural habitat to a strange place where they can become a problem. As global trade continues to expand and the number of imports increase, so does the probability that a Green Invader will get through.

Slipping in the back door

Riding in ship ballast water, hiding in wooden packing material and hitchhiking on horticultural plants are common **pathways** Green Invaders use to gain access. Tourists may not realize that they are carrying a potential invader in the package, fruit or vegetable that they bring back from overseas. The exotic pet trade is another ticket into the U.S. People dumping their aquariums have unknowingly infested streams and rivers with aquatic invaders. The U.S. Department of Agriculture and other federal agencies go to great expense to monitor shipments and people entering the country to try to "weed out" potential invasive species, but some still sneak by.

Rolling out the red carpet

The majority of Green Invaders did not have to sneak in; we commissioned plant hunters to seek them out and we paid for their passage. Specially screened for their good looks, toughness and suitability to our climate it is no wonder that a larger percentage of horticultural introductions turned out to be bullies. Many fast-growing, pest-resistant plants such as multiflora rose and Chinese privet were introduced by the nursery industry as landscape plants for homeowners. Japanese honeysuckle was selected as an ornamental ground cover for its fragrant showy flowers. Some were brought to solve a problem; beach vitex was planted on coastal sand dunes to stop erosion. Other invaders were recommended by experts as beneficial to wildlife. In fact, many agencies are still recommending the highly invasive autumn olive as a food source for birds because of its prolific fruit production. While some birds may seem to benefit, other animals, especially insects, stand to lose as their native plant hosts are displaced. The food chain is disrupted as native birds that depend on those insects for their food must forage elsewhere.

The great escape

Once they are in, Green Invaders move up and out. Some like kudzu, bamboo and periwinkle, are ground troops highly effective in taking over adjacent territories. More dangerous are the mobile invaders that can move virtually unnoticed into areas far beyond where they were originally planted. They spread by natural means; carried by the wind, or in streams, or by birds and other small animals that swallow the fruits, then defecate the seeds. Porcelain vine, for example, produces an abundance of fruits each year that birds distribute widely.

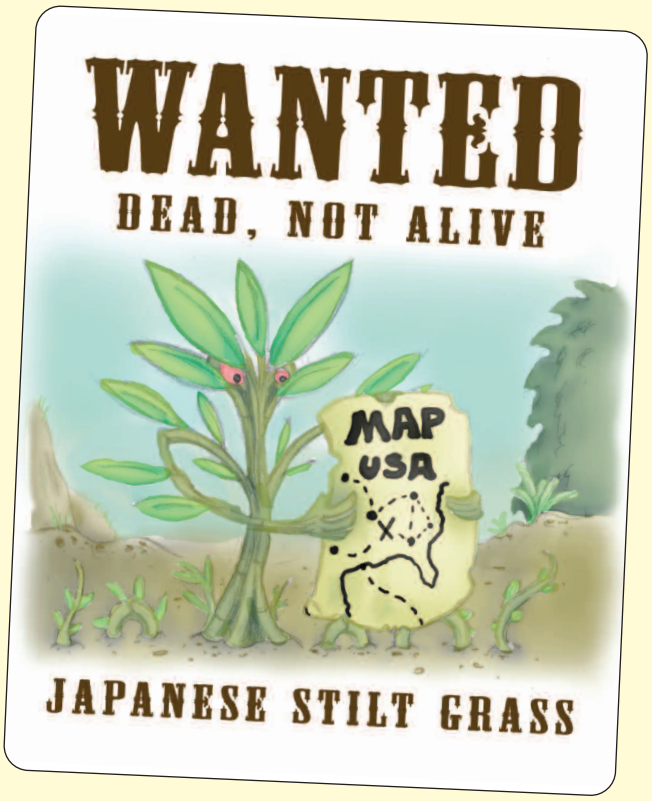
Mass transportation

In addition to spreading by natural means, many Green Invaders master new modes of transportation – people and their machines. The seeds of many invaders can ride into pristine natural areas on the boots of unwary hikers. Eurasian water milfoil, an aquatic invasive plant, can spread from one body of water into another when small pieces of the plant are caught on boats and trailers. Mowers along highways are another way that invasive seeds are dispersed. People who dump yard waste in parks and natural areas can unintentionally spread Green Invaders. Giant salvinia, an aquatic invader, can hitchhike unnoticed on water lilies or other aquatic ornamentals that people buy for their garden ponds or water features. Wildflower seed packets often contain invasive weeds. Soil that has been disturbed by activities such as road building or new development paves the way for invasive species to take root. Utility rights-of-way and roads cut through natural areas become superhighways for the spread of Green Invaders.

Activity: Bane or Blessing

The Accidental Tourist

Unlike many Green Invaders such as English ivy and kudzu, Japanese stilt grass ***(Microstegium vimineum)*** arrived in the United States by accident. Also known as Chinese packing grass, it was used as material to cushion porcelain shipped from Asia. Once it had served its purpose, it was discarded.



Its traveling days, however, were far from over. The seeds of Japanese stilt grass can remain viable for up to five years. When tossed into the right conditions, the plant sprouted and began a whirlwind tour of the eastern US. First identified in Tennessee in 1919, it took only forty years to send postcards from up and down the coastal states, from Florida to New Jersey and farther inland to Pennsylvania and Ohio.

These days, stilt grass does its sightseeing in almost every state east of the Mississippi River as well as Louisiana, Arkansas and Texas. How has this plant spread so rapidly? Well, like any good tourist, it accepts a ride whenever and wherever it can find one. Unlike invasives like autumn olive and privet, which rely largely on one mechanism – birds – to spread their seed, Japanese stilt grass utilizes many. Biologists suspect that the original mode of transportation out of Tennessee was through soil and hay. Since then, it has expanded its relocation repertoire.

David J. Moorhead, University of Georgia

Disturbed areas – places where people, animals, floods or other movement have unsettled the soil – are favorites of Japanese stilt grass, so it is no surprise that the plant has traveled by way of mowing equipment, hiking boots and the coats of animals. These plants are not picky about where they crash or how they get there. Making themselves at home in roadside ditches means that cars are a convenient way to tour the countryside.

The thousands of stilt grass seeds produced each growing season persist for years and can even sprout after being submerged in flood waters. Wherever they end up, they are happy to settle in.

Much like those annoying second cousins who invite themselves over and outstay their welcome, Japanese stilt grass has taken advantage of its new digs. Native plants are overwhelmed, and it will take more than a few rude hints to get this tourist to go home.

Green Invaders have been described as a slow-motion explosion spreading through the landscape. Most people would be shocked to learn how actions as small as tossing out a berry wreath, planting a pretty flower, or using pine straw imported from another state may be like throwing a lighted match into the woods.

They are right before your eyes,
Masquerading in green disguise.
Just as bad as pollution,
We need a solution
Before another habitat dies!

Not all green is good

Green Invaders go unnoticed because to most people they look like any other plant. Many of the tangled thickets we call natural areas are often filled with non-native invasive plants. Because we have become accustomed to seeing Green Invaders, we may not realize our natural landscape is NOT supposed to look like that. Unmasking the invaders means taking the time to learn how to identify them and to recognize some of their disguises.

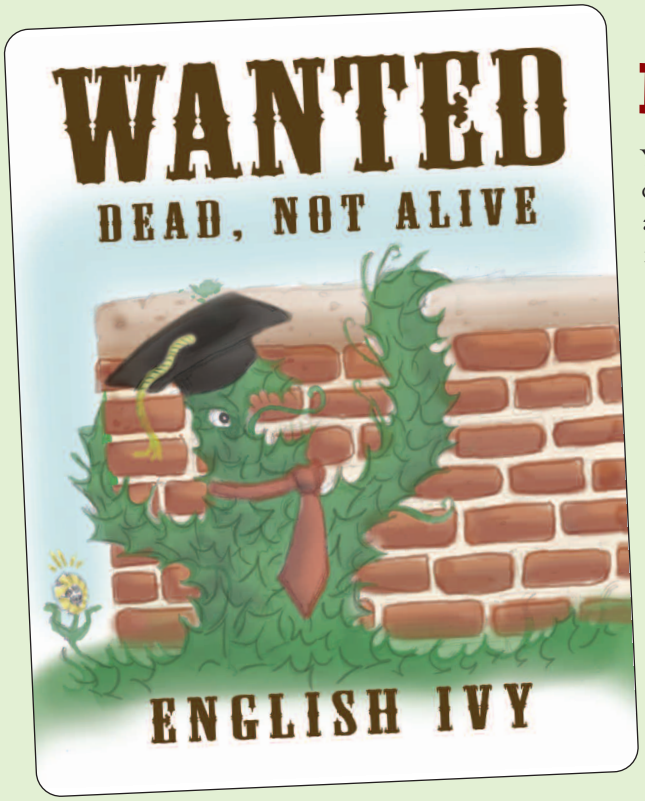
Getting to Know you

Since many Green Invaders resemble native plants that fit into the landscape, it is important to be able to correctly identify them. Green Invaders even have tricky names. For example, the exotic invasive Japanese honeysuckle ***(Lonicera japonica)*** that strangles trees and infests natural areas has a native counterpart called coral honeysuckle ***(Lonicera sempervirens)*** that does not harm the environment. Some exotic plants masquerade as symbols of southern culture. The state flower of Georgia, Cherokee rose, is actually an exotic invader from China. It has become a severe weed problem in pasturelands in the black belt region of Alabama, causing a huge economic loss. Asian wisterias (***Wisteria sinensis*** and ***Wisteria floribunda***), beloved in southern gardens for their handsome purple flowers, are strong-arm bandits that resemble in appearance their mild-mannered non-invasive cousin, American wisteria ***(Wisteria frutescens).*** Ironically, invasive English ivy, so familiar as a charming topiary or rugged groundcover, escapes to consume woodland wildflowers while the unpopular native, poison ivy, is an important food source for many types of wildlife.

To aid and abet

Many invasive exotic plants satisfy our desire to have something new and different, fast and foolproof. The very qualities that characterize invaders – fast growing, tough, pest-free and prolific – appeal to homeowners and commercial growers alike. Most plant invasions start gradually and may take decades before reaching the point of **exponential growth.** By the time their rampant spread is detected, the culprits are familiar landscape choices and a lucrative part of our economy. Unfortunately, even when the dark side of these plants is exposed, it is often hard for people to face the reality of their harm.

Activity: Wanted Posters



Ivy League Invader

You know the type: gorgeous, full of life, accepted at the best colleges and universities. Seen at exclusive garden parties. Sought after by many; controlled by few. On the surface, an impeccable reputation, but underneath a criminal.

Although this might describe many white-collar felons, the reference here is to English ivy ***(Hedera helix)***. Brought to this country in 1797 as an ornamental from Europe, it has made a name for itself here. By clinging to buildings at Harvard, Princeton and Yale, it has become synonymous with the finest in higher education. By appearing in holiday songs and symbolizing eternal life, it offers comfort. By spreading through so many backyards, it has duped us with the familiar.

What could be wrong with so respectable a plant? A lot. According to the National Forest Service, English ivy is one of the most abundant and insidious invasive plants in America. While homeowners and gardeners looked the other way, English ivy escaped into natural, non-cultivated areas. Once free, it took over. Because it is a climbing vine, every level of the forest from floor to canopy is adversely affected.

English ivy creates a thick mat on the forest floor that shades out seedlings and smothers other understory plants. Once established, ivy finds trees to climb. It covers so completely that light is blocked from the tree's food factories: its leaves. The tree slowly starves. The ivy can also harbor bacterial leaf scorch, a disease that affects oaks and maples.

Even so, many are still taken in by English ivy's good looks and charm. Its willingness to cover the ground in deeply shaded areas makes it a seductive choice for some gardeners. Nurseries and garden centers across the country sell flats of it. In fact, in the southeastern US, English ivy and Carolina jessamine make up 95% of the market in evergreen vines. The jessamine is native; leaving English ivy as the sole exotic vine with a huge market share.

The news, however, is not all bad. Many have caught on to English ivy's split personality. Organizations such as the No Ivy League have sprouted to combat spread of the vine where it is worst, in the Pacific Northwest. In the summer of 2005, a pilot program was launched in the Puget Sound area to educate consumers. Without removing English ivy from their shelves, cooperating nurseries gave out information regarding less harmful alternatives to invasive plants. It turned out that customers appreciated getting the information. Sales of invasives declined by almost half, and sales of forest-friendly alternatives rose by more than twenty percent.

Americans are now seeing English ivy for what it really is: not an old friend from song and storybook, but an aggressive, non-native life form that threatens the future of **indigenous** plants and animals.

Chris Evans, River to River CWMA

More than half the Green Invaders flooding into natural areas in the United States were introduced as ornamentals. Many continue to be available for purchase – supplied to a public who seek fast-growing, pest-free plants. The good news is that each person has the power to stem the tide by choosing to plant a non-invader.

To stem the invasive plant tide
More folks must be won to our side.
The flood's overwhelming
But the cause is compelling.
Too many species have died.

A battle plan

Wherever birds fly, winds blow, streams flow, vehicles travel and people visit, Green Invaders can invade and conquer. Despite a myriad of federal and state agencies designed to stop or control them, the attempts to deal with invasive species until recently tended to be isolated and narrowly focused on certain types of invaders like agricultural and aquatic pests. In 1999, President Clinton issued an Executive Order directing all federal agencies to prevent and control introductions of invasive species. The Invasive Species Council was created to coordinate a comprehensive national effort. The National Invasive Species Information Center, established in 2005, creates and manages a Web site that serves as a reference gateway reaching out to all citizens with information about invasive species at www.invasivespeciesinfo.gov.

Bar the door

The best way to keep Green Invaders from becoming out-of-control is to prevent them from becoming established in the first place. Several federal agencies monitor ports of entry into the country to intercept unintended foreign introductions. In 2003 Early Detection and Rapid Response Teams were established to detect and stop known invaders from getting a foothold in new territories. These teams are partnerships of local, state and national experts that assess reports of suspected plants and coordinate efforts to eradicate them. Citizens can help by reporting suspicious plants and joining local monitoring groups. The Southeast Exotic Pest Plant Council's web site provides one way to report suspected invasions in southeastern states.

Don't buy in

Barring the door and setting up an alarm system helps reduce accidental introductions, but a number of Green Invaders continue to be sold and spread intentionally. It is reported that 85% of invasive trees and shrubs in North America have been introduced through the landscape industry. It is easy to unfairly blame the horticultural industry, but the fact is that exotic plants are popular with the public. Some nursery and landscape associations are actively addressing the issue by adopting **voluntary codes of conduct** that call for the phasing out of the most troublesome Green Invaders. Meanwhile, screening procedures are being developed to predict which new landscape plants are likely to turn out to be pests. Looking closely at a plant's natural history, relatives and aggressive tendencies can help to identify potential invaders. Before buying an exotic plant, people should ask nursery owners, "Will this plant stay where I put it? Does it spread easily by water, wind or wildlife? Will it escape to natural areas?" If the answer is that it spreads easily and has aggressive tendencies, it may be best that the consumer purchase a different plant.

Hand-to-hand combat

For many invasive exotic plant species, however, prevention is no longer an option. They have already escaped from cultivation and firmly established themselves in our woodlands and waterways. These plants have to be actively controlled to keep them from completely taking over and further degrading natural areas. Control methods vary and must be specific to the circumstances. Protecting our biological resources from invasion can seem overwhelming, but taking better aim at Green Invaders through careful research will undoubtedly uncover new ways to manage them and restore damaged ecosystems.

Recruit for defense

Education should be the first step in the battle against Green Invaders. While the invasive plant problem is well documented, not even all land managers, horticulturalists, or landscape professionals fully understand the extent of the problem and how to combat it. Most attention has been paid to invasive plants that interfere with agriculture and livestock because of the obvious and immediate economic impact. Awareness of the dangers of Green Invaders to parklands, wilderness areas and natural places has developed more slowly. Often individual citizens are not familiar with the issue at all and therefore unwittingly help Green Invaders proliferate. Ultimately, the greatest key to solving the invasive species problem is an informed and involved public.

Activity: Sizing Up Invaders

One Person Can Make A Difference

When a certain Green Invader started messing with the turtles, Betsy Brabson drew a line in the sand. As a volunteer with South Carolina United Turtle Enthusiasts (SCUTE), Betsy participates in the monitoring of sea turtle nests in her beach community. An incident involving a newly hatched group of sea turtles added to her suspicions about a particular plant. Sea turtle volunteers had been called in to rescue hatchlings that were confused by the bright lights of nearby condominiums. Betsy was distressed to learn that the tiny turtles had become tangled in a thick stand of woody stems and died from dehydration.

For several years Brabson had been noticing the same plant, beach vitex, around beach communities near her home in Georgetown County, South Carolina. Its pretty purple flowers and tolerance of sea spray made it a popular landscape choice. The North Carolina State Arboretum had introduced beach vitex, ***(Vitex rotundifolia)*** to cover dunes damaged by Hurricane Hugo, but Betsy noticed that it seemed to be taking over everything. Once she had even sent in a sample to Clemson University for identification. They wrote back saying, "Beach vitex is an invasive plant and should not be planted at the beach". But nothing ever came of it. After all, Betsy thought, "I'm just a regular person. What can I do about it?" She put the letter in a drawer.

Then in 2003 Betsy found new beach vitex seedlings on an undeveloped beach just north of Georgetown. "That's it", she thought. Brabson documented 167 new plants in half-mile stretch of the beach and when she got home she started making phone calls. Finally, she reached Dr. Randy Westbrooks, an invasive species prevention specialist with the U.S. Geological Survey. Dr. Westbrooks was aware of beach vitex. Other scientists had been watching its spread and were concerned that it was rapidly displacing native dune species such as sea oats and seabeach amaranth that are important for dune stabilization. Betsy's call provided the impetus to take action.

Dr. Westbrooks immediately organized a symposium bringing together people from state and federal agencies and nonprofit organizations. Betsy called her network of contacts and rallied the local citizenry. Connections were made and the electricity began to flow. As a result the Carolinas Beach Vitex Task Force was formed to address the plant nicknamed beach kudzu. Through Betsy, a vital link was made between researchers and the local community.

Betsy Brabson, who once questioned whether a regular person could do something significant to stop the spread of invasive plants, is now the South Carolina Coordinator for CBVTF and communicates with people all over the country about the issue (see www.beachvitex.com). She spearheads education and identification workshops and provides coordination between Task Force agency members and the public. Betsy shows the power of pulling together as a team for the sea turtles and for the environment.

Take Control

Control strategies vary for each situation depending on the species, the degree of infestation, the soil conditions, the time of year and the presence of desirable native plants. Land managers also have to take into account their resources like money, tools and personnel. **Integrated Pest Management (IPM)** is often the best approach as it combines several of the following methods.

Mechanical controls include hand-pulling, cutting and the use of various kinds of machinery to physically remove invaders.

Chemical controls employ herbicides to destroy invaders. Methods include spraying the leaves, painting the stumps of cut trees and shrubs, or injecting herbicides into trunks and stems. Herbicides cannot be used in places where they may kill desirable plants.

Biological control uses a natural enemy, usually an insect or disease from the invader's native habitat, to keep the invasive species in check. Before a biological control can be used, a thorough risk assessment must be completed to minimize the chances of the control species itself becoming a pest.

Ecosystem management involves changing the environment to make it less favorable to the invader. Using fire and manipulating the soil chemistry or water levels to favor native species over the invader are all ways to manage at an ecosystem level.

Education methods attempt to modify people's behaviors and attitudes that favor the spread of invaders. Increasing awareness of Green Invaders, finding alternatives for consumers to plant and encouraging people to minimize actions that introduce and spread invasive species can make a difference.

PREVENTION IS THE BEST CONTROL STRATEGY.

There was an old man named Michael Finnegan,
Pulled up some weeds, but they just grew in again.
He kept on pulling 'cause he knew he'd win again.
Good old Michael Finnegan, begin again!

There are many ways in which individuals and groups can help control and prevent the introduction of Green Invaders in their communities. Become involved in protecting natural areas in your community, whether it is your school grounds, backyard or public park. Nearly every community faces the problem of invasive plants.

Learn how to identify Green Invaders. Look for them when you travel around your community. Report suspicious plants to the local environmental resource agencies. *See appendix B for a list of resource agencies.*

Consult an invasive species list for your region to find out what plants you should avoid buying and planting in your yard. Take a list with you when you go to the nursery to purchase plants. If you already have invasive species in your yard, consider removing them and planting native plant alternatives or non-invasive exotics.

Educate others about Green Invaders' tendencies to grow out of control. Surprisingly, many of these plants are still sold despite their invasive characteristics. Beware of "pass-a-long plants". Not realizing their long term consequences, many gardeners like to plant and share Green Invaders because they are easy to grow.

Challenge your local school or neighborhood association to support a resolution to bar new plantings of invasive exotic plants. Check online at www.centerforplantconservation.org/invasives to see if your organization has adopted the voluntary codes of conduct to reduce plant invasions. The codes suggest best practices for various groups including the gardening public, nursery professionals, landscape architects, botanical gardens and governments.

Examine your everyday activities to determine if you may be unintentionally introducing or spreading invasive plants. Purchasing plants through mail-order services; bringing plants, fruits, soil or animals into the country from abroad; transporting pests on boats, boating equipment, boots and camping gear; using feed that contains weed-seeds on horse-packing trips; dumping aquariums or yard clippings containing seeds into natural areas are all ways that people accidentally spread Green Invaders.

Participate in an organized weed roundup at a public park, wildlife refuge, nature preserve, schoolyard or your own backyard. Make sure you work with someone who has been trained to identify and safely remove these exotic invasive plants without harming people or the environment.

Take action! Keep pulling!

Activity: Weed Out

Weed Warriors

In the fall of 2004, 300 sixth graders from Piedmont Open Middle School in Charlotte, North Carolina joined forces with Mecklenburg County to take action against Green Invaders. Prior to the experience, students spent time in their classrooms investigating invasive exotic plants and the damage they do to ecosystems. The students then traveled to one of the county's nature preserves to participate in a service learning experience – a working project, where they spent a half day learning to identify and control Japanese stilt grass by hand-pulling it out of the bottomland forests it had overtaken. Divided into teams, the students competed against one another to see who could pull the most Japanese stilt grass over the course of three days. At the end of the experience, the sixth graders had pulled over 2,000 pounds of stilt grass.

After the weed pull, students helped to identify and mark Green Invaders growing on their school grounds. They developed an action campaign to make other students, parents and administrators aware of the Green Invaders issue at their school.

The Weed Warriors Service Learning Program was developed by Mecklenburg County Park and Recreation Department's Division of Natural Resources in response to a growing problem in the county's nature preserves. Though protected from development, the beautiful woodlands, prairies and wetlands in the preserves are not protected from degradation by invasive plants. Educating the community about the issue is the first line of defense. Students involved in the Weed Warriors program have the opportunity not only to learn first hand about invasive exotic plants specific to their region, but also to make a difference. Their experience removing Green Invaders from particularly troubled areas in Mecklenburg County leads them to a greater awareness of one of the most pressing problems for natural communities around the world.

Since those first students cleared several parcels of land in 2004, many other student groups have taken part in the Weed Warriors Program, both in nature preserves and on their own school grounds.

For more information, please contact:
Reedy Creek Nature Center
2900 Rocky River Road
Charlotte, NC 28215
704-598-8857

The current budget to control invasive plants in our state parks and wildlife refuges is often barely enough to monitor their presence, let alone eradicate them. Typically one or two staff persons are charged with trying to keep invaders from spreading through hundreds of thousands of acres of protected habitat. Without the help of volunteers to watch for and remove Green Invaders, the battle will be lost.

Words to Know: **Glossary**

Alien plant – See exotic plant.

Biological control – The use of living organisms such as insects or bacteria to suppress the population of a specific pest plant or animal making it less abundant or less damaging than it would be otherwise.

Biological diversity or Biodiversity – The variety of all life on earth. Biodiversity includes the variety of genetic material, individual species and ecosystems.

Biological resources – The living components of ecosystems with actual or potential use or value for society.

Cultivation – The growing of plants or crops by humans. Cultivated plants are ones in which the genetic material has been manipulated through breeding to meet human needs and desires. Most of these highly bred plants do not sustain themselves in the wild without human help.

Ecological interactions - The variety of ways that species relate with each other in an ecosystem either through competition, predation or mutually beneficial actions.

Ecosystem – A dynamic relationship between the physical environment (including the soil, climate, access to light, availability of water and other physical characteristics) and the organisms that live in that environment.

Ecosystem services – The essential functions which are produced by active ecosystems such as the cleaning of our air and water, climate regulation, soil production, pollination, the recycling of nutrients and the creation of raw materials.

Evolution – Changes in the traits of living organisms over generations including the emergence of new species.

Exotic plant – A plant that has been introduced either intentionally or accidentally into an area that is not part of its original native range. Synonymous with alien, introduced, non-indigenous, foreign or non-native plant.

Exponential growth – Extremely rapid growth in which the rate of growth accelerates as the population increases.

Extinction – The process in which a species or related group of species dies out and is lost forever.

Fire Cycle – The average time between fires in a given area. Invasive plants can alter this cycle to change the ecosystem.

Food chain – A sequence of plants and animals, each depending on the next for food. Food chains illustrate the transfer of material and energy from one species to another within an ecosystem. A food chain usually forms part of a more complex food web.

Genes – The basic units of heredity capable of transmitting specific traits from parents to offspring.

Genetic pool or gene pool – The complete set of genetic information contained within all the individuals of a species. A large gene pool usually contains a greater diversity of genetic information that can help species to survive periods of intense environmental change.

Green Invaders – Invasive exotic plants that are able to proliferate and seriously damage ecosystems in their new environment.

Habitat – The environmental or natural conditions that provide the home for a living organism.

Herbivore – An animal that eats plants.

Indigenous – Native

Integrated Pest Management (IPM) – A pest control strategy that looks at the natural history of a pest and uses a combination of different approaches to try to keep pest damage to acceptable levels while minimizing the use of chemical controls.

Interbreed – To crossbreed or hybridize two or more species or varieties.

Introduced species – A species brought to an area outside its native range either intentionally or accidentally.

Invasive exotic plants – Non-native plants that escape into the wild, spread rapidly and displace native species resulting in damage to their new environment. Synonymous with Green Invaders.

Invasive exotic species - Plants, animals and microorganisms that overtake and severely alter their introduced habitat due to their ability to spread rampantly.

Mass extinction – Catastrophic event or phase when entire families or other major groups of organisms die out.

Native plant – A plant that is living in the region in which it originally evolved. According to the USDA National Arboretum, a native plant lives or grows naturally in a particular region without direct or indirect human intervention. Synonymous with indigenous.

Native range – The region that a plant naturally inhabits exclusive of human intervention.

Natural area – Non-cultivated or undeveloped areas that contain native plant and animal communities. Examples include woodlands, prairies, marshes and lakes.

Naturalized – An exotic or introduced plant that lives and reproduces in a new environment without the help of human beings.

Non-indigenous plant – Non-native plant. See Exotic plant.

Noxious weed – Plants that by federal or state law cannot be sold, traded or transported. Many seriously harmful invasive plants are listed as noxious weeds because they are already too widespread to control or they have an economic value that makes them politically difficult to ban though legislation.

Pathways – Ways or vectors by which invasive species can enter a new area. Pathways can include nonliving means such as ballast water, cargo or transportation equipment as well as living forms such as birds, fish or humans.

Pollination patterns - The established relationships between flowering plants and their pollinators. Pollination is necessary for sexual reproduction in flowering plants.

Species – A distinct group of organisms which share the same characteristics and are able to breed among themselves, but are not usually able to breed with members of another species. Species is the basic unit of biological classification.

Succession – The gradual development of an ecosystem through a predictable progression of plant and animal communities until a final, stable climax community is established.

Weed – A highly subjective term that usually means any aggressive plant that is growing where it is not wanted. One person's weed may be another person's wildflower. All invasive plants are weeds, but not all weeds are invasive in natural areas.

Voluntary Code of Conduct – Suggested list of best practices to reduce the introduction or limit the spread of invasive exotic species. This includes the setting of voluntary standards for governments, industries, associations and individuals.

RESOURCES

National Invasive Species Information Center
www.invasivespeciesinfo.gov
This Web site hosted by the United States Department of Agriculture serves as a reference gateway to invasive species information covering federal, state, local and international sources.

Invasive Species
www.invasive.org
A joint project of The University of Georgia's Bugwood Network, USDA Forest Service and USDA APHIS PPQ, this site is an excellent source for images and information on invasive and exotic species and provides links to online publications and related resources.

Weeds Gone Wild
www.nps.gov/plants/alien
The National Park Service hosts this Web site which is a project of the Plant Conservation Alliance's Alien Plant Working Group. It provides a list of invasive plants infesting natural areas throughout the United States, background information on the problem of invasive species, illustrated invasive plant fact sheets and selected links to relevant people and organizations.

The Nature Conservancy – Global Invasive Species Initiative
www.tncweeds.ucdavis.edu/
This site provides detailed information on invasive species identification, management and control methods. Good background information is provided in the Invasive 101 tab and other tabs contain interesting stories about invasive projects around the country.

North Carolina Botanical Garden
www.ncbg.unc.edu/conservation
This site provides information for the gardening public about invasive exotic plants. It includes an online copy of their publication, "Controlling Invasive Plants", a list of plants to avoid in the southeastern United States and information about native plants recommended for the home landscape.

Southeast Exotic Pest Plant Council
www.se-eppc.org
SE-EPPC is a non-profit organization supporting the management of invasive exotic plants in natural areas of the southeastern U.S. by providing a forum for the exchange of scientific, educational and technical information. The website contains publications, regional lists of invasive plants and a link for reporting suspicious plants or invasive infestations.

Voluntary Codes of Conduct
www.centerforplantconservation.org/invasives
Developed at the 2001 Workshop Linking Biology and Horticulture to Prevent Plant Invasions, these suggested best practices for groups ranging from landscape professionals to the gardening public were designed to curb the distribution of invasive plants through self regulation.

Aliens in Your Neighborhood
www.nps.gov/invspcurr/alienhome.htm
The National Park Service's invasive plant curriculum uses the inquiry method and works within the framework of the standard school science curriculum to give concrete experiences that make learning come alive. Downloadable text and activities are aimed at middle school and high school students and tie into programs at the National Parks.

Invaders of the Forest
http://dnr.wi.gov/org/caer/ce/eek/teacher/invasiveplantguide.htm
The Wisconsin Department of Natural Resources produced this excellent downloadable curriculum for K-12 educators. The activities can be easily adapted for many ages and locations.

North Carolina State Parks Workshops
www.ncsparks.net
The NC State Parks Web site gives information on programs and services for teachers. Invasive exotic plant workshops are offered every year at multiple parks across the state. Participants will learn how to identify, control and educate others about the top invasive exotic plants affecting the southeast.

Pushy Plants and Alien Animals
www.naturalsciences.org/conservation/invasives/
This site, provided by the North Carolina Museum of Natural Sciences, helps North Carolina students learn how to survey their school grounds for invasive plants and animals.

Volunteers and Invasive Plants – Learning and Lending a Hand
www.fws.gov/invasives/volunteersTrainingModule/
The National Fish and Wildlife's educational Web site focuses on what students and citizens can do to understand and respond to the invasive plant problem. Learning modules explain the big picture of invasive plants and highlight the many ways volunteers are making a difference.

List of Invasive Plants Mentioned in the Guide

Common Names	Scientific Names	Native Home
Autumn olive	*Elaeagnus umbellata*	East Asia
Beach vitex	*Vitex rotundifolia*	Japan and Korea
Bush honeysuckles	*Lonicera maackii, L. morrowii, L. tatarica, L. fragrantissima*	Asia
Butterfly bush	*Buddleia davidii*	China
Cheatgrass	*Bromus tectorum*	Europe, Africa, Asia
Cherokee rose	*Rosa laevigata*	Asia
Chinese privet	*Ligustrum sinense*	East Asia
Chinese wisteria	*Wisteria sinensis*	Asia
Cogongrass	*Imperata cylindrica*	Southeast Asia
English ivy	*Hedra helix*	Europe
Eurasian watermilfoil	*Myriophyllum spicatum*	Eurasia
Garlic mustard	*Alliaria petiolata*	Europe
Giant salvinia	*Salvinia molesta*	Neotropics
Golden bamboo	*Phyllostachys aurea*	Asia
Hydrilla	*Hydrilla verticillata*	Eastern Hemisphere
Japanese climbing fern	*Lygodium japonicum*	Japan
Japanese honeysuckle	*Lonicera japonica*	Japan
Japanese stilt grass	*Microstegium vimineum*	Asia
Japanese wisteria	*Wisteria floribunda*	Asia
Kudzu	*Pueraria montana*	Asia
Multiflora rose	*Rosa multiflora*	Asia
Old world climbing fern	*Lygodium microphyllum*	Wet tropics in Africa, Australia, Southeast Asia
Oriental bittersweet	*Celastrus orbiculatus*	Asia
Paperbark tea tree	*Melaleuca quinquenervia*	Australia
Periwinkle	*Vinca major, V. minor*	Europe
Phragmites; common reed	*Phragmites australis*	Eurasia; Africa
Porcelain berry vine	*Ampelopsis brevipedunculata*	Northeast Asia
Princess tree	*Paulownia tomentosa*	China
Salt cedar, tarmarisk	*Tamarix spp.*	Eurasia
Tree of heaven	*Ailanthus altissima*	China

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