

Putting Invasive Species Management in Perspective



By David Pimentel, Ph.D.



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There are more than six billion people on earth. We add a quarter of a million people every 24 hours. The World Health Organization reported recently that more than three billion people are malnourished on earth, or more than half of the world's population. But that is not our problem here in the U.S. because we have an abundance of high quality, diverse foods. If there is any problem, it is eating too much. The average American consumes over a ton of food per person per year. Where do we get our food? More than 99.7% of our food in the U.S. and in the world comes from the land. Less than 0.3 of 1% comes from the oceans or other aquatic areas. We demand more and more on our land for food.

Costs of managing invasives

There are good invasive species. For example, 100% of our livestock are introduced species and 99% of our crops, such as corn, are introduced species. We have insect problems, weeds, plant pathogens, and rodents that share our food with us. We use large quantities of pesticides.

In the U.S. we use more than one billion pounds of pesticides per year on our lands. Worldwide we use about five billion pounds. Nearly 80% of the pesticides are actually used in the developed countries, with two billion people, whereas, four billion people are using about 20% of the pesticides applied worldwide. Despite the use of one billion pounds of pesticides, we lose nearly 40% of all potential food production in the U.S. to pests.

From 1945 to date, there has been a ten-fold increase in insecticide use in the U.S. The United States Department of Agriculture (USDA) reports that we were losing 7% of our potential production to insects in 1945 before we started using large quantities of synthetic pesticides. Today USDA re-

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ports that we are losing 13% of our crops to insects, with a ten-fold increase insecticide use.¹

World Health Organization data reports that pesticides poison 26 million people annually. Of these, three million result in hospitalization and 220,000 result in death, many of these in developing countries. In the U.S., about 110,000 pesticide poisonings occur annually and 25 result in death. All these numbers are conservative.²

The honeybee is one of the invasive species in the U.S. The use of pesticides and loss of habitat has caused the bee population to decline rapidly. Pollination has a value in the U.S. of \$40 billion annually. You have heard the expression "a busy bee." A bee on a bright sunny day will visit 1,000 blossoms. That is an enormous effort that we humans do not appreciate. My calculations show that on a bright sunny day in New York State bees pollinate 12 trillion blossoms a day. If we used all the man and womanpower in New York State to pollinate blossoms, we could not even do one one-hundredth of 1%. I can also tell you it is damn boring, but not to the bees.

Pesticide Use Costs

Public Health = \$1 billion
Environmental = \$8 billion

We poison our birds, including the common loon, which is a threatened species. We are also poisoning our fish. Due to the contamination in New York State, it is recommended that pregnant women should not eat any fish, and anglers are limited to one fish per month. Roughly, we have estimated that the public health cost of pesticide use is one billion dollars annually and the environmental cost of pesticides is eight million dollars annually. These are very conservative estimates.

The evaluation of invasives

The Japanese beetle was introduced years ago. We have introduced in the U.S. either intentionally or unintentionally 50,000 species of plants, animals, and microbes. The numbers of pests associated with the introduction of these pests are causing \$137

ECONOMIC AND ECOLOGICAL COSTS OF WEED CONTROL

billion in damages annually. That is a conservative estimate because we cannot put an amount on extinction.

In Florida alone, they have introduced 25,000 plant species. Their native plants number only 2,500 plant species. Of course, these new introductions have negative impacts on the environment in many cases.

In the U.S., for example, the purple loosestrife that was introduced as a plant in vegetable gardens causes \$45 million in damages annually. Aquatic weeds cause \$110 million in damages annually. The melaleuca tree that was intentionally introduced as an ornamental cost six million dollars in damages annually. 73% of the weeds in our crops are introduced species causing approximately \$33 billion in damages and control costs, mostly damages despite the use of all the herbicides we are using. (I am not counting the negative impact of the herbicides but only the application of herbicides.) In crop disease, for example, 65% of plant pathogens are exotic and are costing approximately \$23 billion annually. Weeds, plant pathogens and insects, native and introduced, cost \$100 billion in the U.S. despite the application of one billion pounds of pesticides. This is a serious problem.

Only 40% of insect pests are exotic species. Most of the insect pests are actually native insects that moved from feeding on native vegetation to feeding on introduced crops. An example is the Colorado potato beetle, a native insect. It was feeding on a weed called the wild sand bur, before the potato's introduction in the U.S. After the potato was introduced, the beetle found it more tasteful than the sand bur so it moved on to the potato. The Colorado potato beetle is now the number one pest of the potato.

We examined the number of introduced crops in the U.S. and then determined how many crops we intentionally introduced that actually became pests. It turned out that 128 weed species were intentionally introduced as crops which finally became listed as pests. Johnson grass is the number one weed in the southern U.S., and it was introduced as a forage crop. Even though you have an organism, in this case a plant, you do not know what it is going to do when you release it in the environment.

Pigeons and starlings, primarily starlings, are causing \$2 billion of damage annually in the U.S.

We have introduced 4,500 species of primarily insects, some intentionally, some by chance. Someone who was interested in developing a better silk worm unintentionally introduced the gypsy moth. A windstorm knocked over one of the cages and the moth escaped. The investigator realized how serious this

was and told the politicians that they should try to get rid of those that escaped, but they put it off and now the gypsy moth is the number one pest. We have introduced 40 natural enemies to attempt to control this pest, but none are doing an effective job.

Secondary impacts of chemical controls

When you use herbicides to control weeds, in some cases, you can end up with an insect or plant pathogen problem. I chaired a study for the U.S. EPA on the environmental impact of herbicides. I suggested that 2,4-D and its use on corn might be having an impact on insect and plant pathogen problems. My herbicide colleagues who were on the committee said absolutely not. So, I went back to Cornell and ran tests using the corn leaf aphid, the corn borer, the southern corn leaf blight and the corn smut disease. All four organisms increased on the corn when exposed to 2,4-D, in contrast to the untreated corn. With the aphids alone, we had three times as many on the treated corn in contrast to the untreated corn. These findings were published in *Science*.³ We were hoping to encourage other entomologists, plant pathologists and weed specialists to look at the non-target effect when you use these chemicals. I must admit it has not happened.

Aphids on Corn	
Untreated	618
2,4-D	1,679

Now one serious problem we have with all these invasive species is that they are competing with and preying on our native species. The best data we have indicate that these invasive species are the reason why we have endangered species. This is a serious issue since 42% of all endangered species are due to invasive plants, animals and microbes.

Pesticide reduction pays

The first case of biological control in the world is working. The cotton crushing scale introduced in California was devastating citrus trees. They introduced beetles that feed on the scale. It cost \$5,000 and is now saving us about \$170 million annually.

We should reduce the use of pesticides in the U.S. Several countries have reduced the use of pesticides by at least 50% or more. It was one of my former students that became in charge of all pest control in Indonesia. He was able to reduce pesticide use on rice by 65%, while increasing rice yields 12%. You do not need a big economist to tell you that you are doing the right thing. We could reduce pesticide use in the U.S. by 50% without any reduction in yields and without any change in cosmetic standards. The question is why aren't we doing it.

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50% Reduction in Pesticides
Sweden, Denmark, Netherlands Ontario, Canada, and Indonesia

¹ Pimentel, David and Hugh Lehman (1993). *The Pesticide Question: Environment, Economics and Ethics*, Excerpt: Environmental and Economic Impact of Reducing United States Agricultural Pesticide Use.

² World Health Organization (1992). *Our Planet, Our Health: Report of the WHO Commission on Health and the Environment*.

³ Oka, I. N. and David Pimentel (1976). *Herbicides (2,4-D) Increase Insect and Pathogen Pests on Corn*. *Science*, Vol. 193, 239-240.