

A photograph of a lush green field filled with numerous small pink wildflowers. In the background, a dense line of tall, leafy green trees stretches across the horizon under a clear blue sky. The text 'Herbicide Impacts on Wildlife' is overlaid in the center of the image.

Herbicide Impacts on Wildlife



CEH

center for environmental health

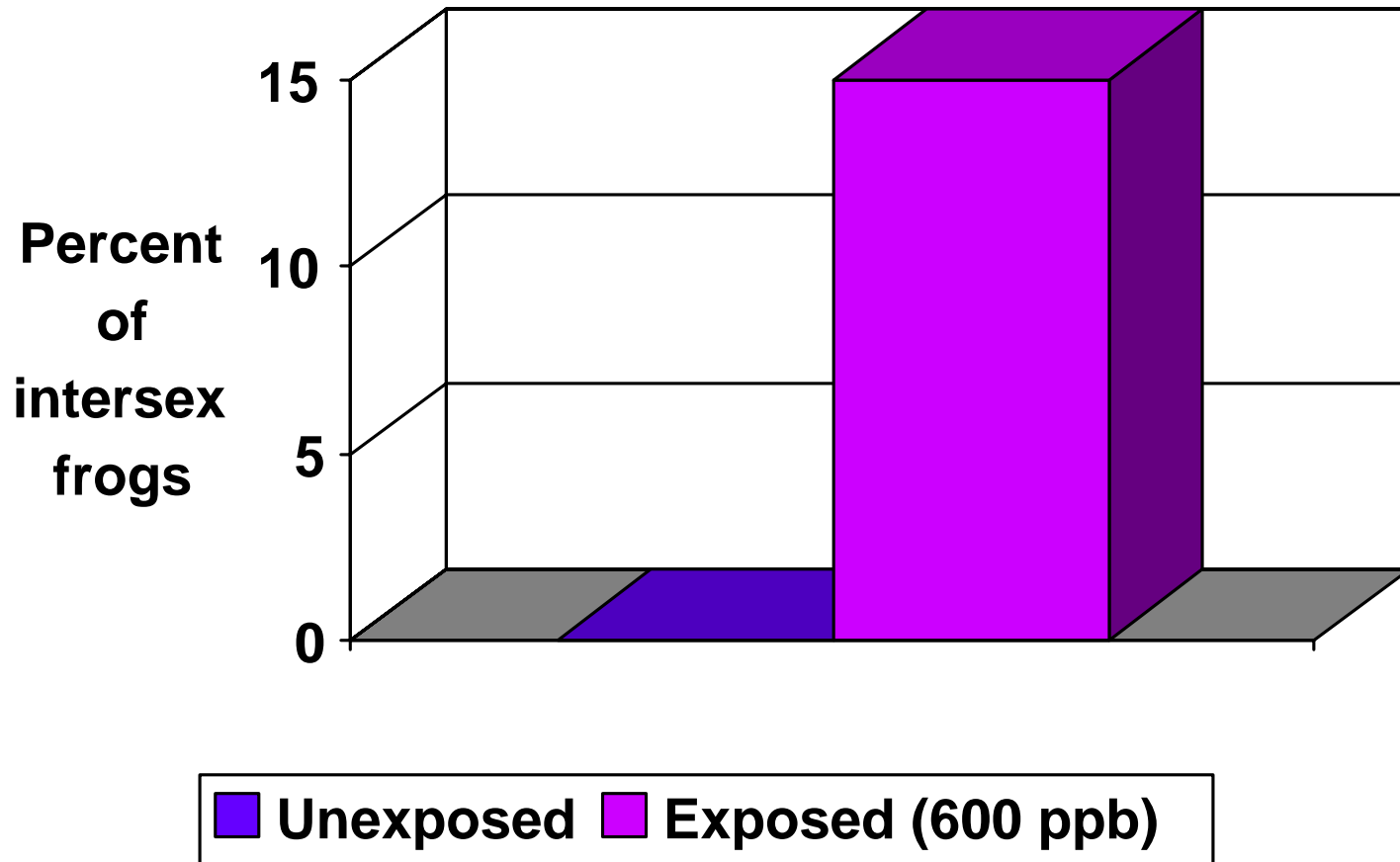
Caroline Cox
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A landscape photograph showing a vast, dry field of yellowish-brown grass and low-lying shrubs. A wire fence runs across the middle ground. In the background, a range of mountains is visible under a clear blue sky. The text "Emerging Issues" is overlaid in the center of the image.

Emerging Issues

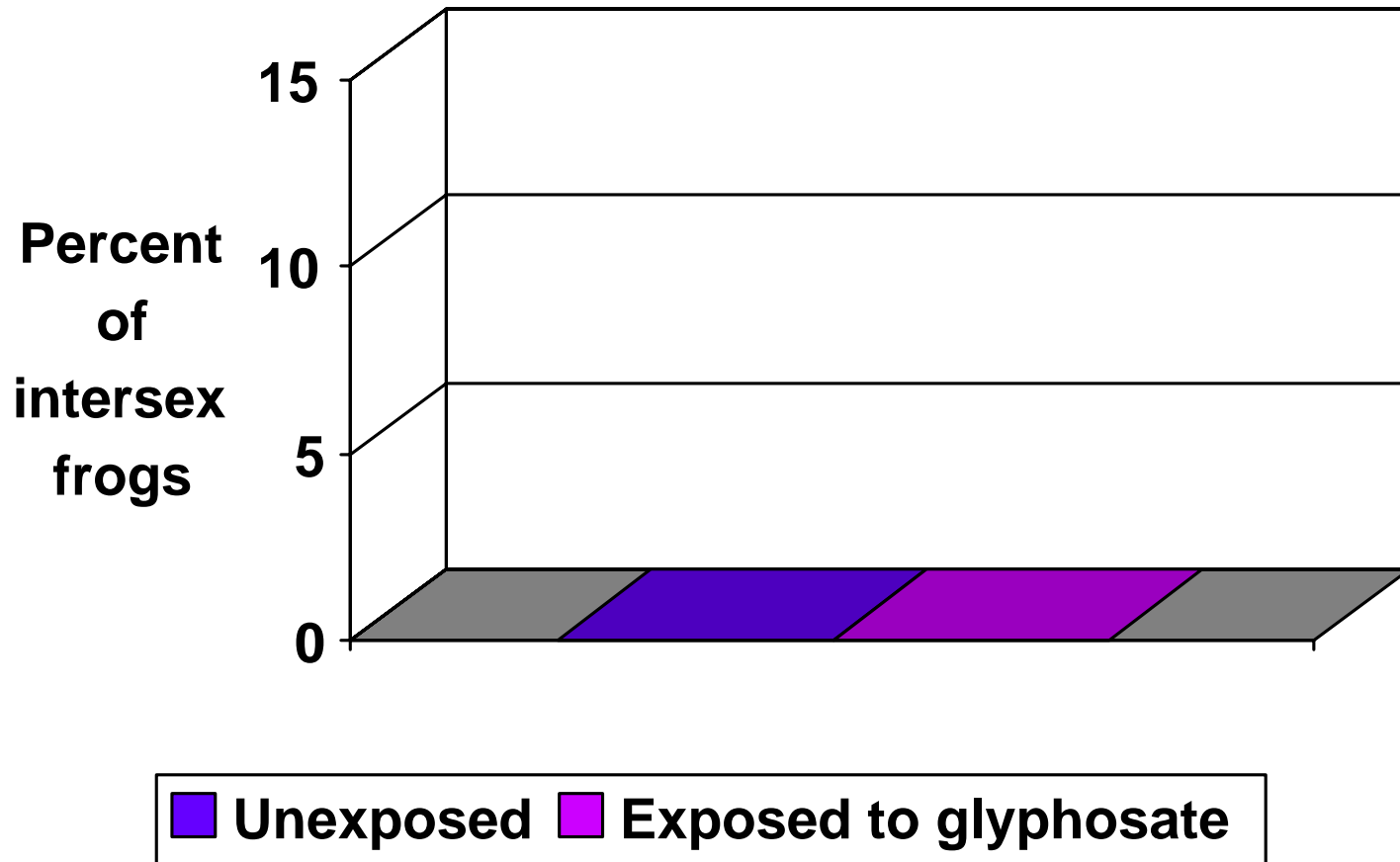


A glyphosate-containing herbicide caused intersex in *Rana pipiens* (the northern leopard frog).



Source: Howe, C.M. et al. Toxicity of glyphosate-based pesticides to four North American frog species. *Environ. Toxicol. Chem.* 23(8):1928-1938.

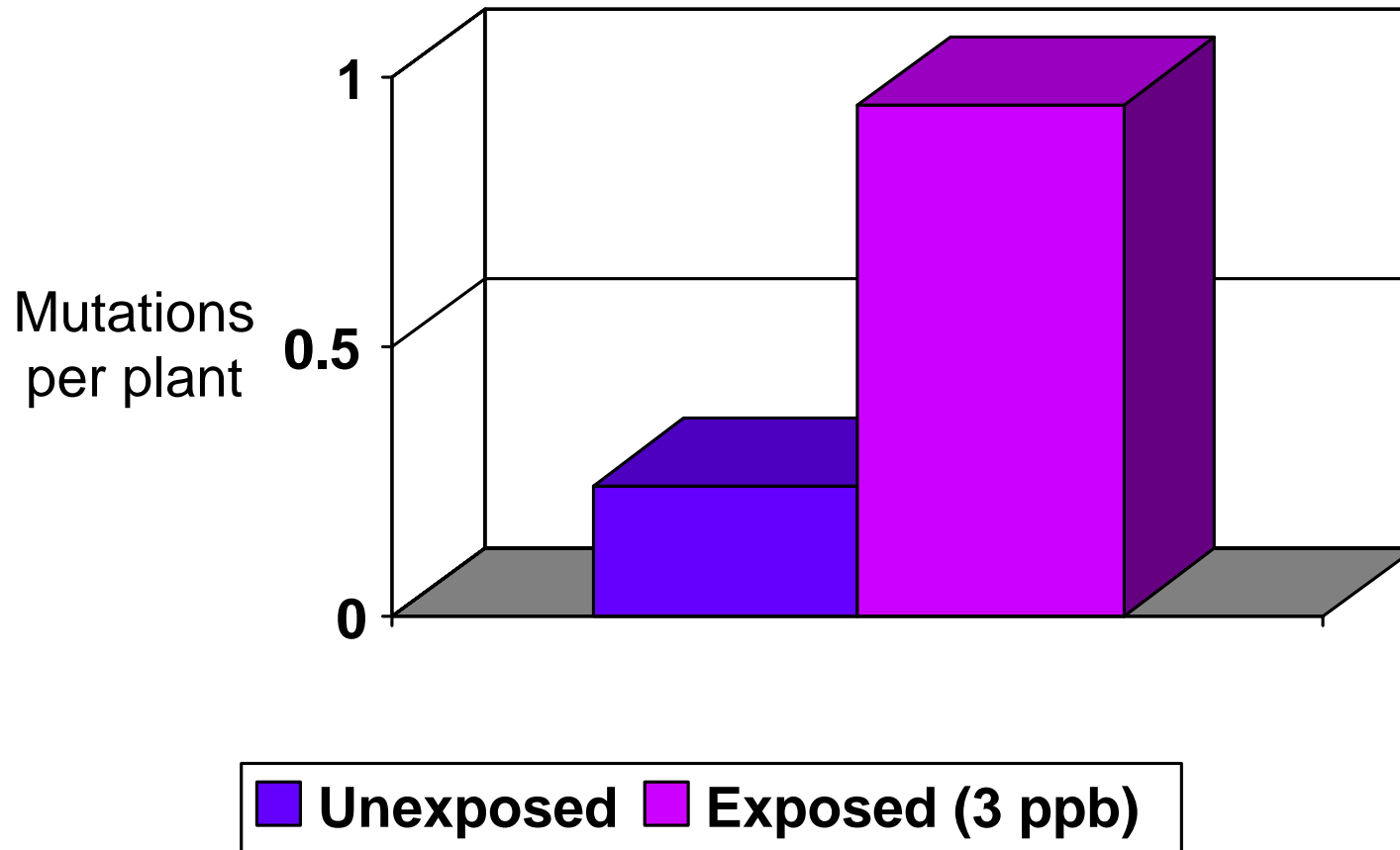
Glyphosate, alone, did not cause intersex.



Source: Howe, C.M. et al. Toxicity of glyphosate-based pesticides to four North American frog species. *Environ. Toxicol. Chem.* 23(8):1928-1938.

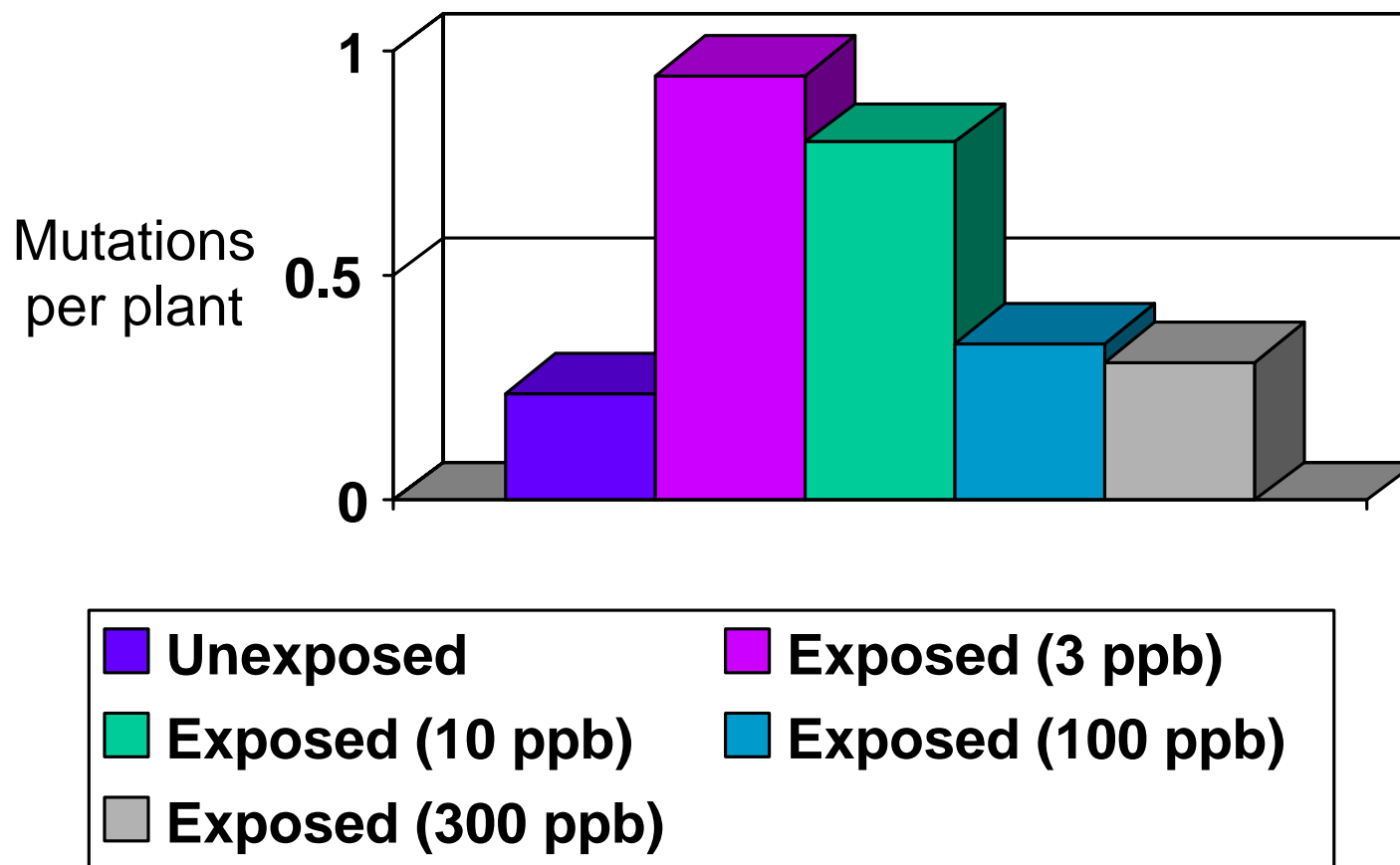


Low concentrations of 2,4-D increased mutations in *Arabidopsis*.



Source: Filkowski, J. et al. 2003. Genotoxicity of 2,4-D and dicamba revealed by transgenic *Arabidopsis thaliana* plants harboring recombination and point mutation markers. *Mut. Res.* 542:23-32.

Higher concentrations of 2,4-D did not cause an increased number of mutations.



Source: Filkowski, J. et al. 2003. Genotoxicity of 2,4-D and dicamba revealed by transgenic *Arabidopsis thaliana* plants harboring recombination and point mutation markers. *Mut. Res.* 542:23-32.

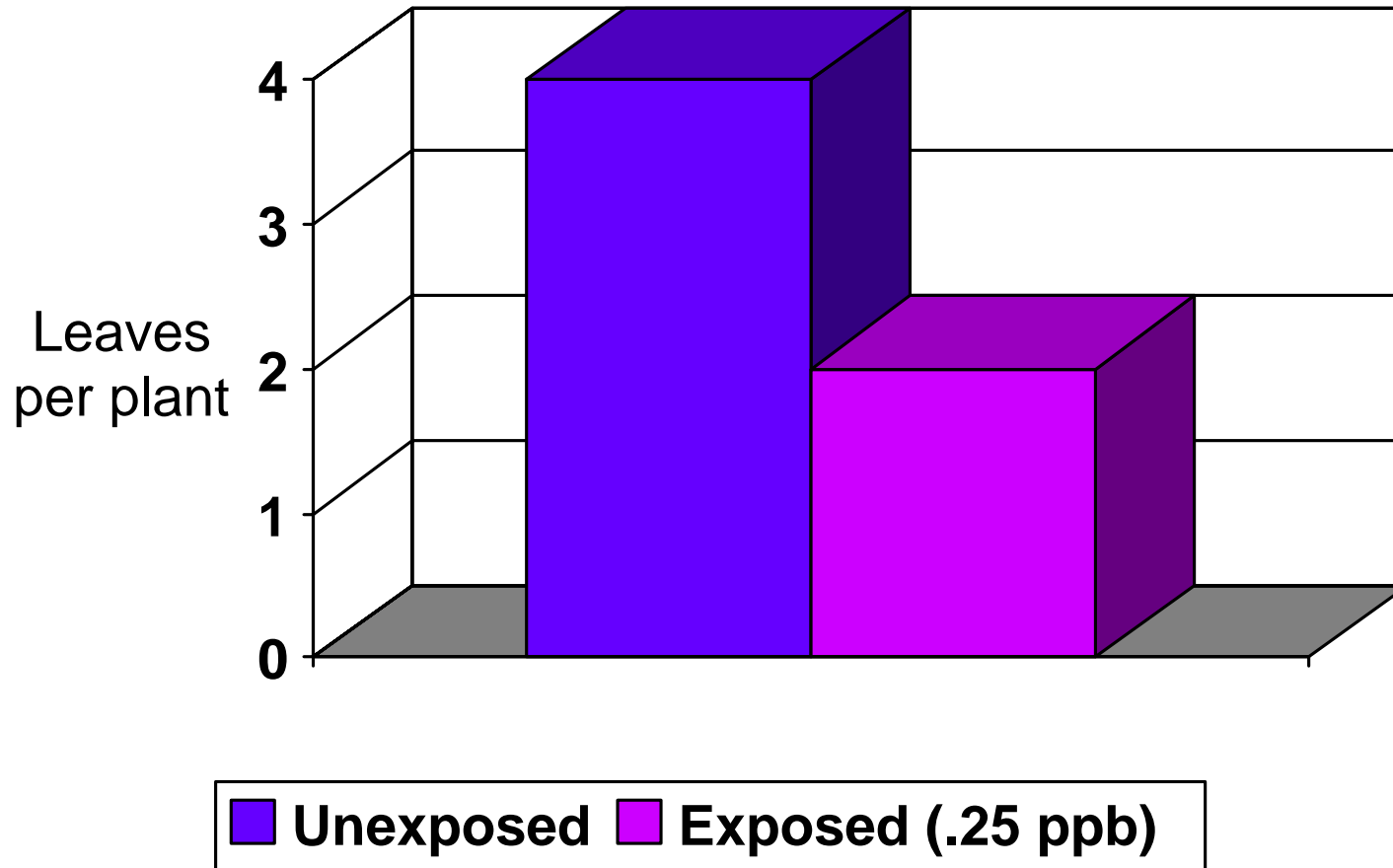
The concentrations of 2,4-D that increased the number of mutations was so low that it did not cause “visible physiological effects” on the *Arabidopsis*. These low concentrations are also “within the range of those permissible” under national and international drinking water guidelines.



Source: Filkowski, J. et al. 2003. Genotoxicity of 2,4-D and dicamba revealed by transgenic *Arabidopsis thaliana* plants harboring recombination and point mutation markers. *Mut. Res.* 542:23-32.

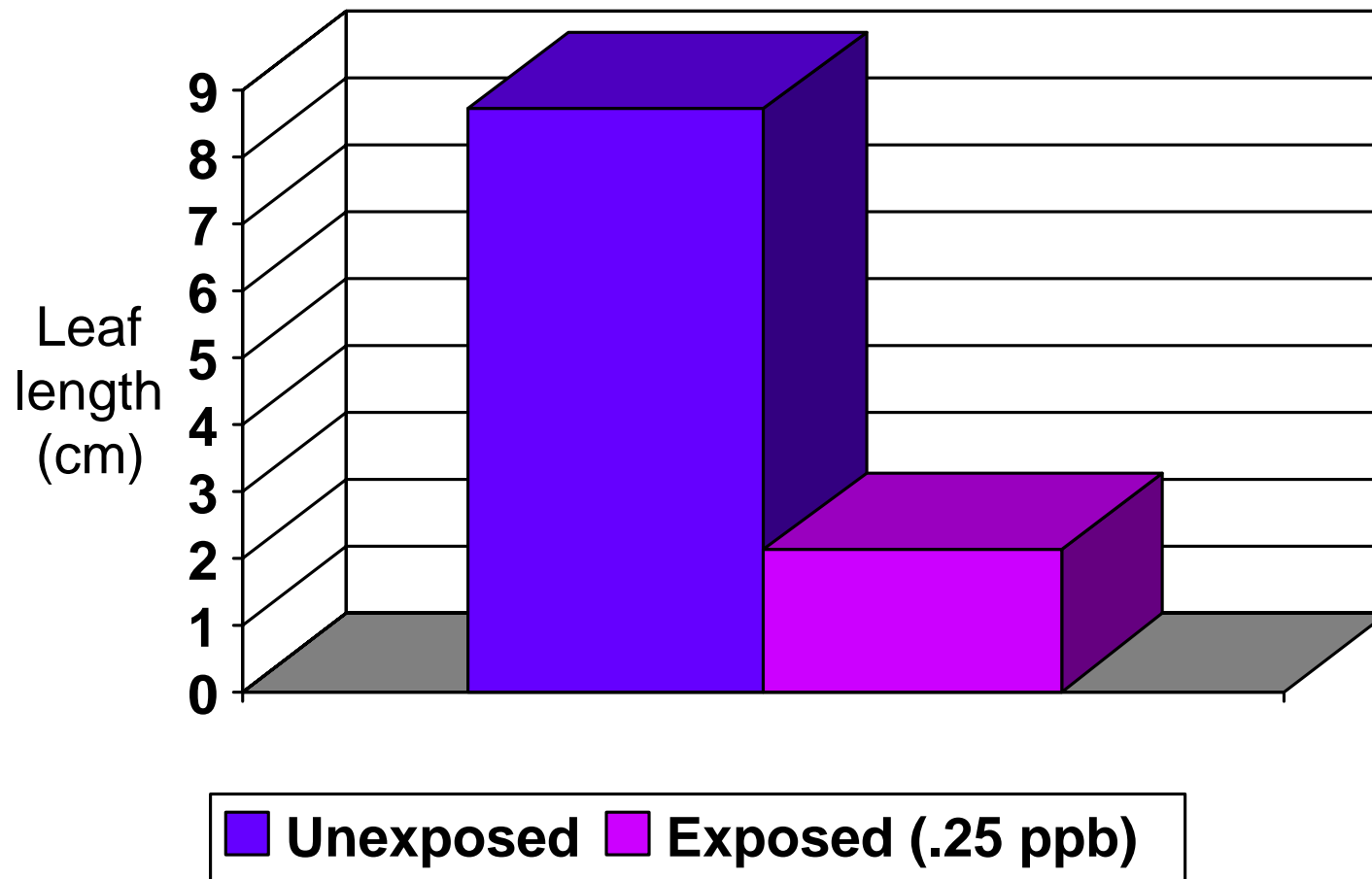


Minute concentrations of chlorsulfuron reduced growth of *Potamogeton*.



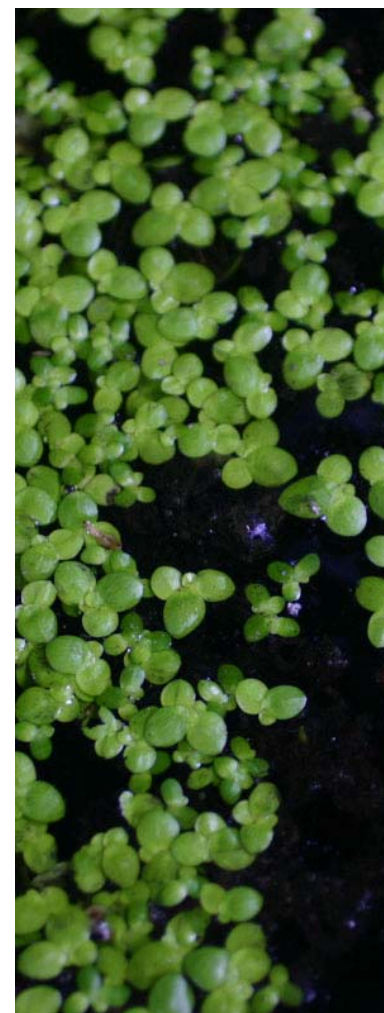
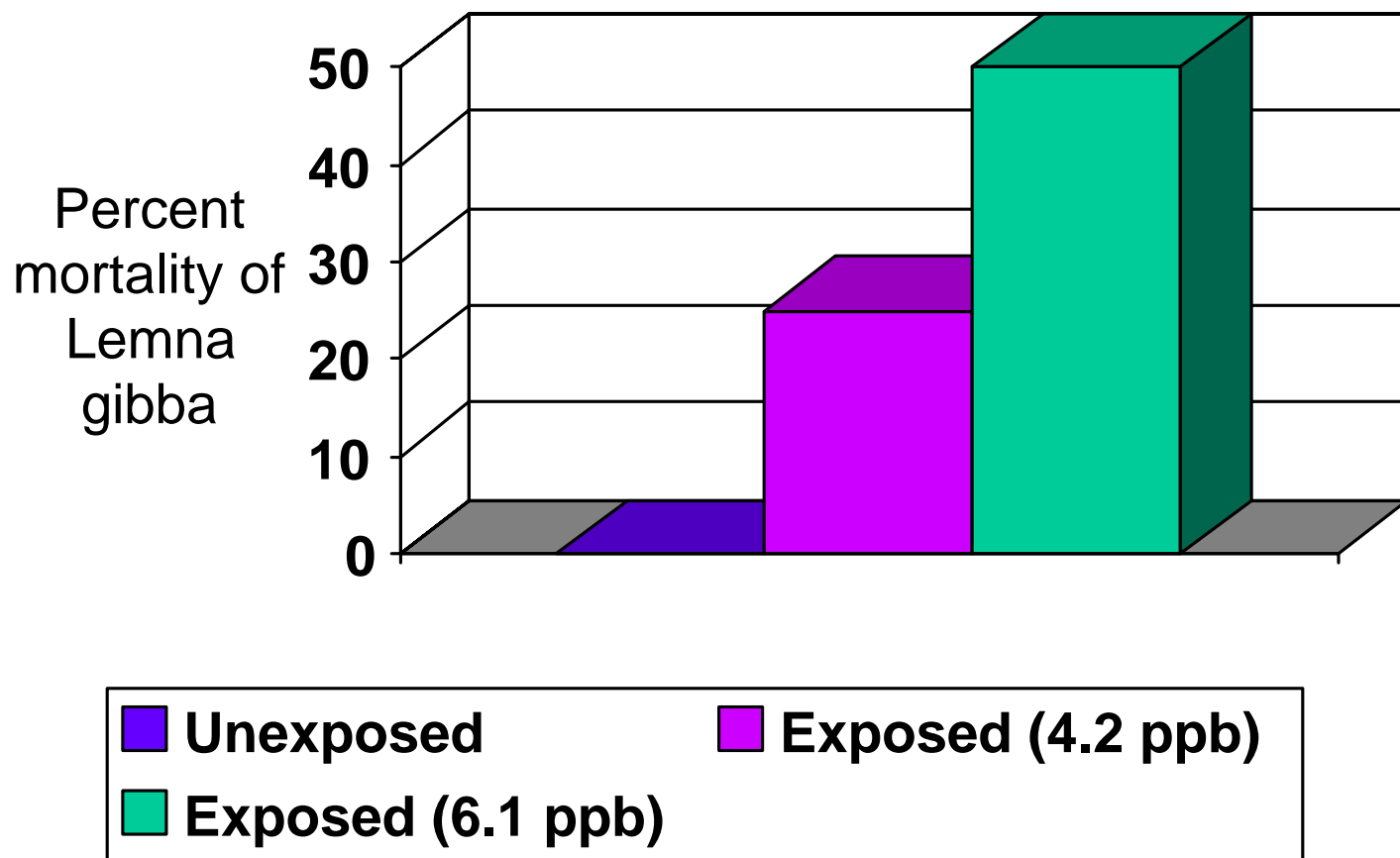
Source: Coyner, A, G. Gupta, and T. Jones. 2001. Effect of chlorsulfuron on growth of submerged aquatic macrophyte *Potamogeton pectinatus* (sago pondweed). *Environ. Pollut.* 111:453-455..

Chlorsulfuron had similar effects on other growth parameters.



Source: Coyner, A, G. Gupta, and T. Jones. 2001. Effect of chlorsulfuron on growth of submerged aquatic macrophyte *Potamogeton pectinatus* (sago pondweed). *Environ. Pollut.* 111:453-455.

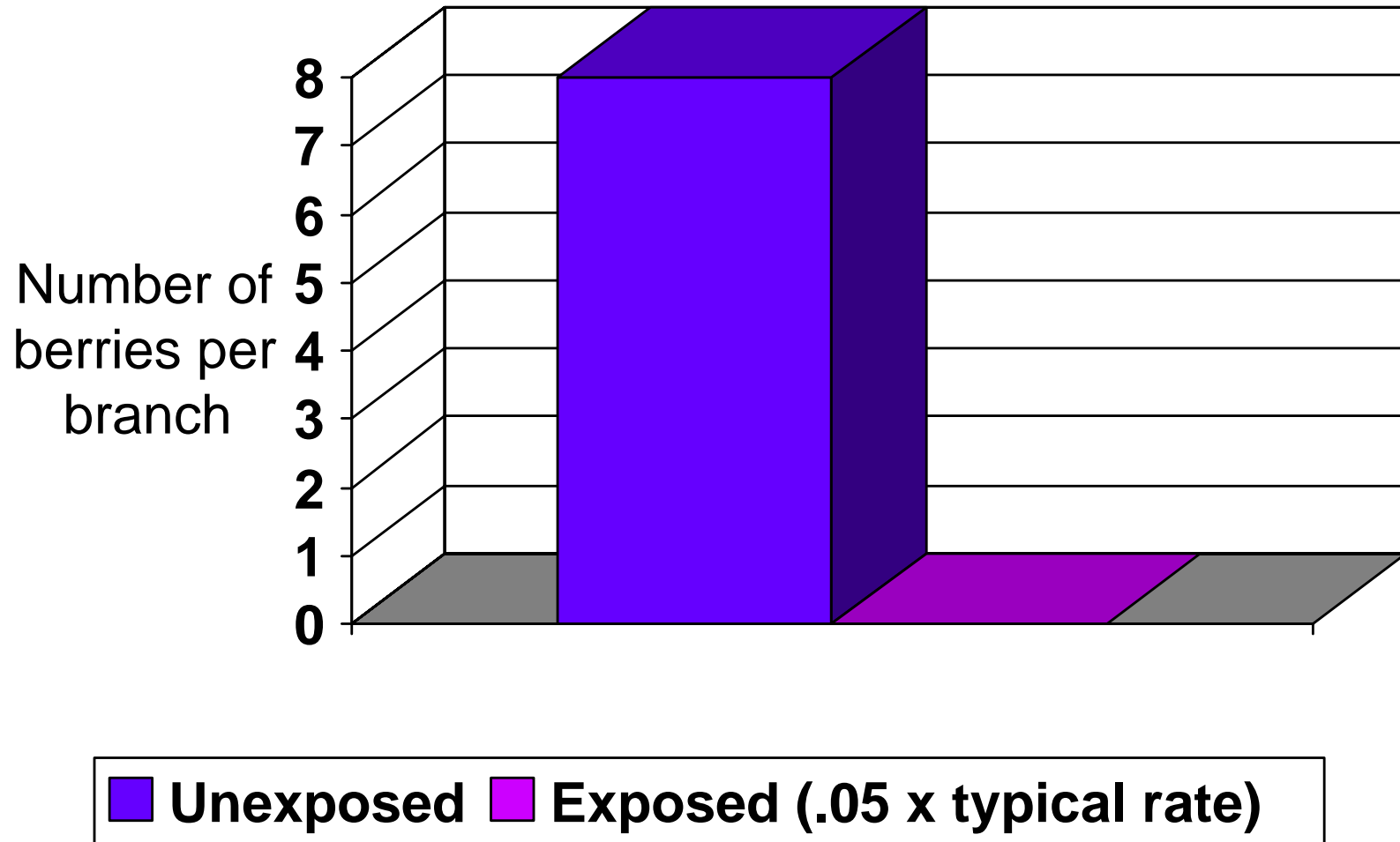
Low concentrations of imazapic caused mortality of an aquatic plant.



Source: Standard toxicity tests submitted to U.S. EPA in support of the registration of imazapic. Cited in Syracuse Research Corporation. 2004. Imazapic - Human health and ecological risk assessment - Final report. www.sera-inc.com.



Small amounts of metsulfuron-methyl eliminated hawthorn berry production .



Source: Kjaer, C., M. Strandberg, and M. Erlandsen. 2006. Metsulfuron spray drift reduces fruit yield of hawthorn (*Crataegus monnogyna* L.) *Sci.Total Environ.* 356:228-234.

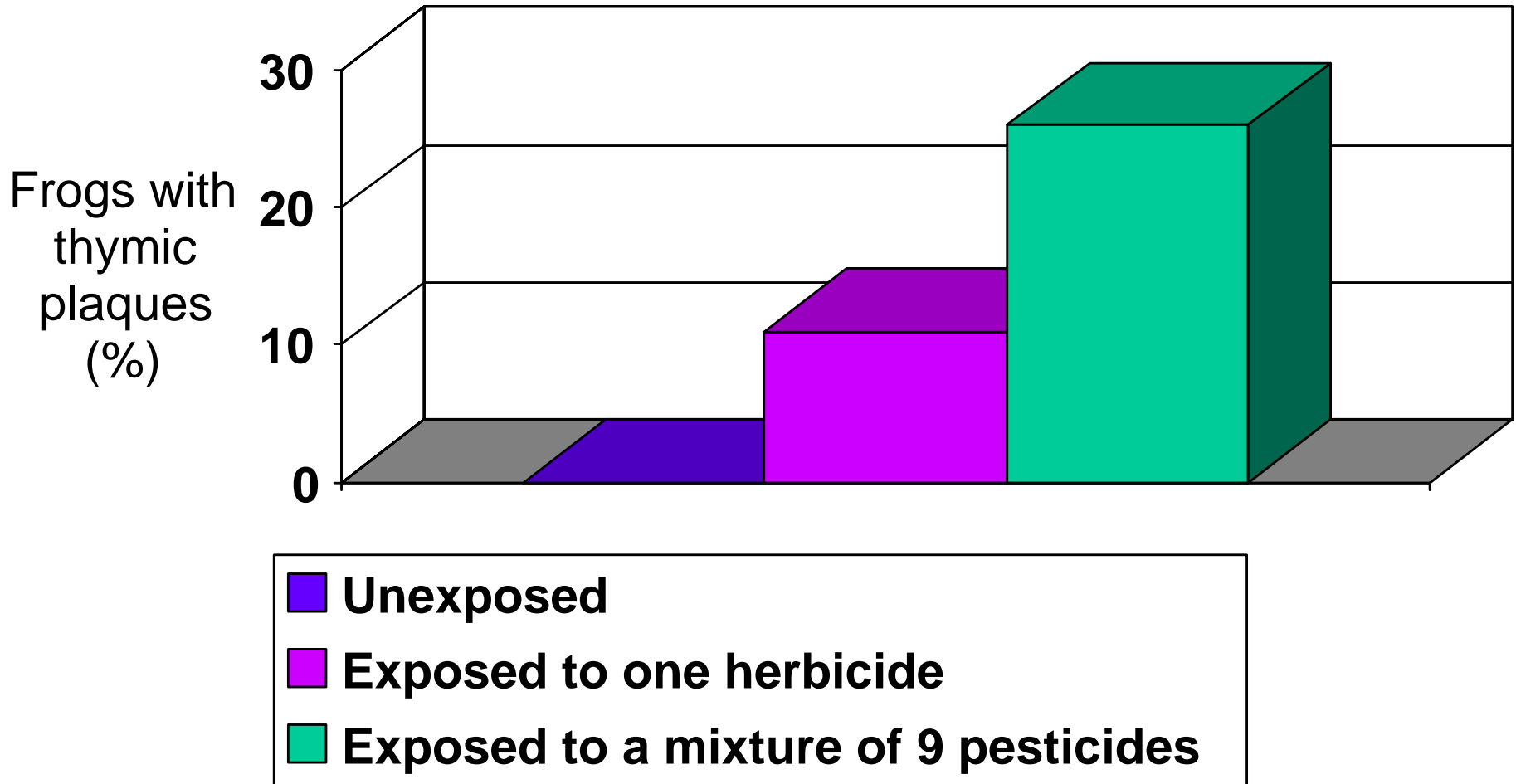


Mixtures of pesticides cause unexpected disease in frogs.



Source: Hayes, T. et al. 2006. Pesticide mixtures, endocrine disruption, and amphibian declines: Are we underestimating the impact? *Environ. Health Persp.* 114:(suppl. 1):40-50.

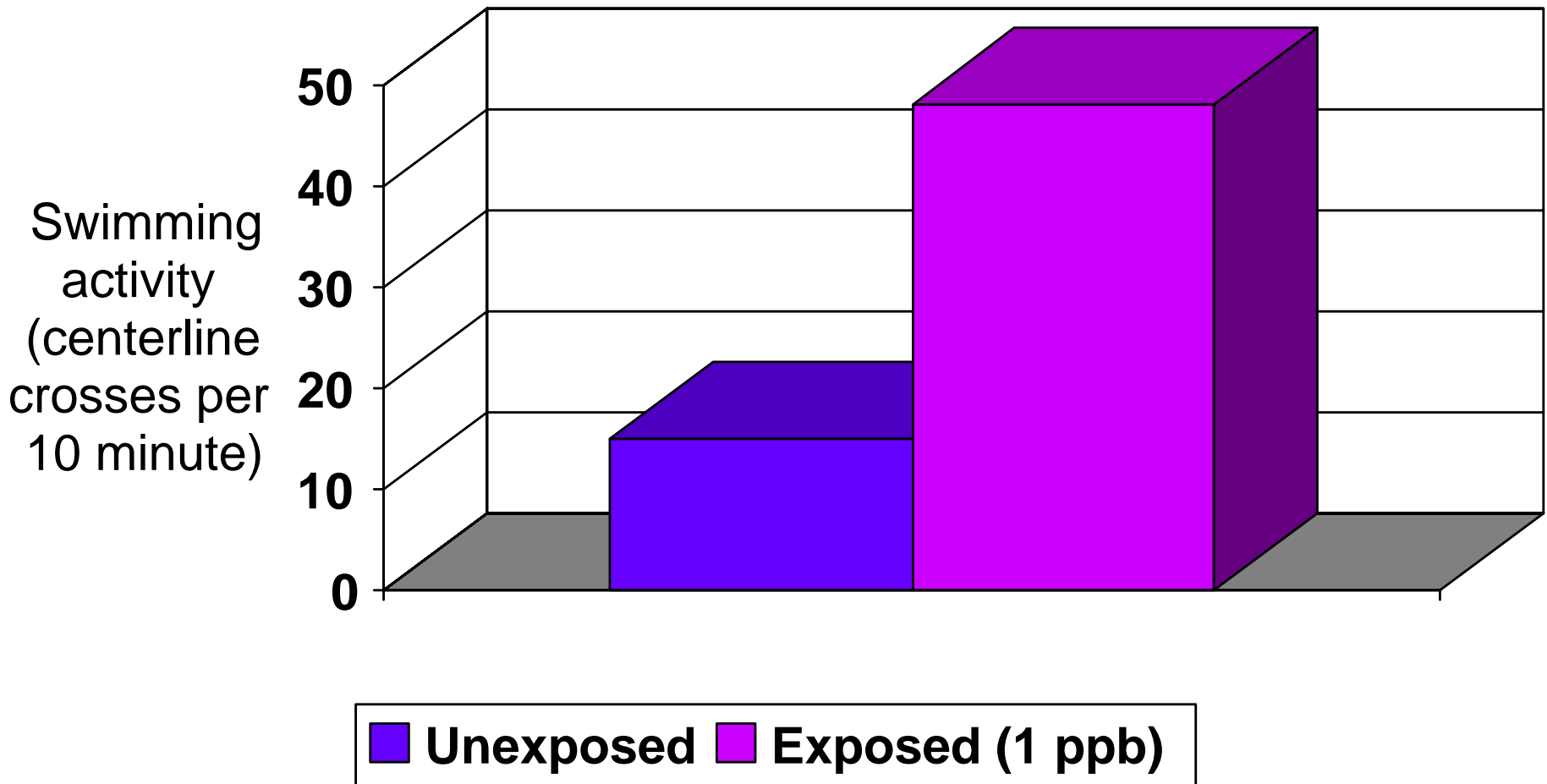
A pesticide mixture damaged frog immune systems at low concentrations .




Source: Hayes, T. et al. 2006. Pesticide mixtures, endocrine disruption, and amphibian declines: Are we underestimating the impact? *Environ. Health Persp.* 114:(suppl. 1):40-50.



Low concentrations of the herbicide atrazine disrupted fish behavior.



Source: Tierney, K.B. et al. 2007. Relating olfactory neurotoxicity to altered olfactory-mediated behaviors in rainbow trout exposed to three currently-used pesticides. *Aq. Toxicol.* 81:55-64.

A photograph of a dense field of yellow flowers, likely a non-native invasive species, growing among green foliage. The text is overlaid on the image.

Preventing invasive plant problems is a crucial part of successful management efforts.

Address causes, not symptoms

“An underlying philosophy ... should be to establish why nonindigenous species are flourishing in a region and to address the underlying causes rather than simply destroying the most oppressive invaders. System management, rather than species management, ought to be the focus.”

***—Richard Mack
Washington State University***

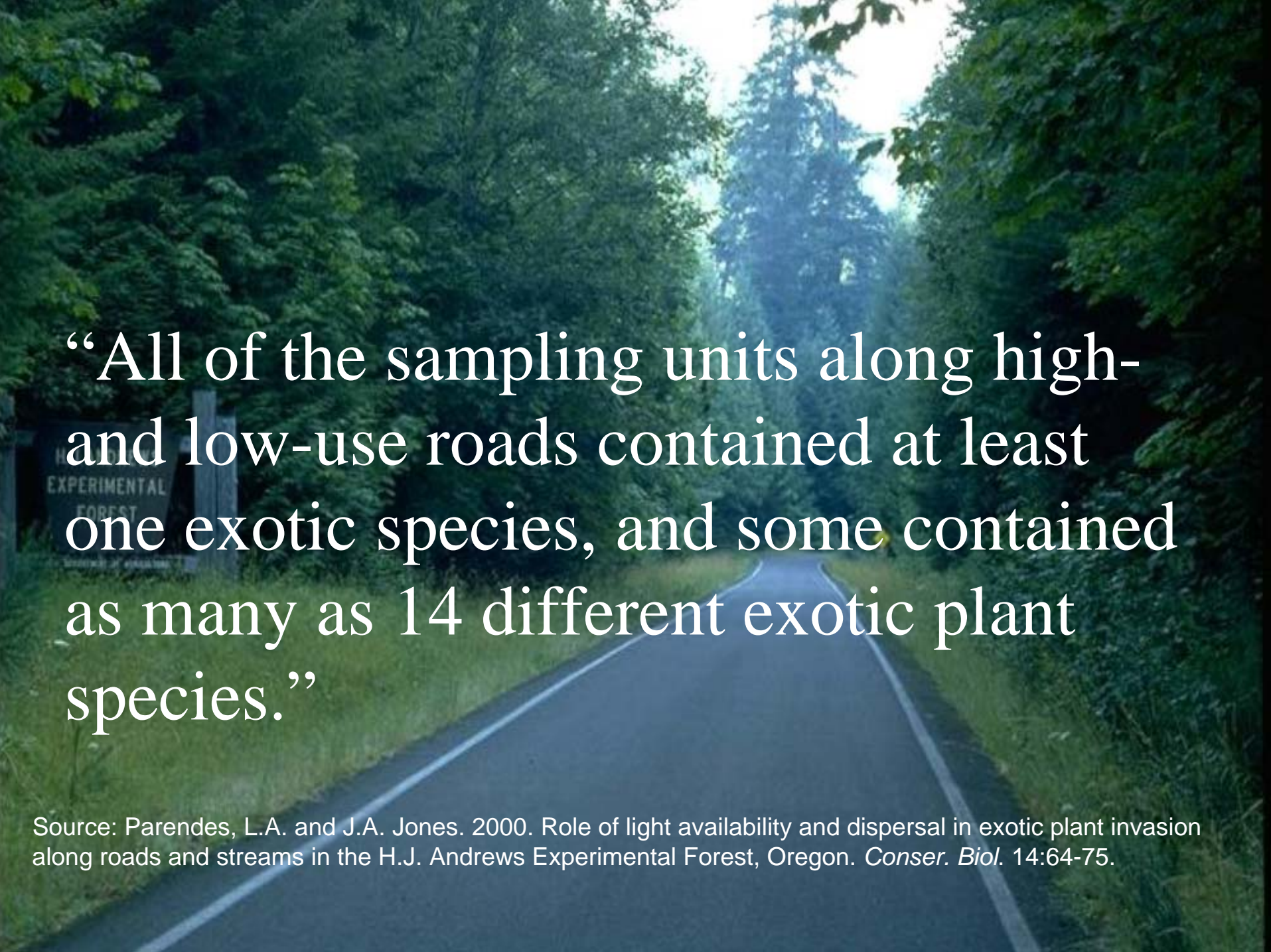
Source: Mack, R.N. et al. 2000. Biotic invasions: causes, epidemiology, global consequences, and control. *Ecological Applications* 10(3): 689-710.

Causes of invasive plant problems are often ignored

“Yet weed infestations are not a problem that arrived overnight, and will not be cured overnight. Too often our most common weed control techniques address the symptom of a land management problem, not the cause. If the cause of the problem is not addressed, weeds will continue to spread.”

—Bret Olson
Montana State University

Source: Olson, B.E. 1999. Grazing and weeds. In *Biology and management of noxious rangeland weeds*, ed. R. L. Sheley and J.K. Petroff. Corvallis OR: Oregon State Univ. Press.



“All of the sampling units along high- and low-use roads contained at least one exotic species, and some contained as many as 14 different exotic plant species.”

Source: Parendes, L.A. and J.A. Jones. 2000. Role of light availability and dispersal in exotic plant invasion along roads and streams in the H.J. Andrews Experimental Forest, Oregon. *Conser. Biol.* 14:64-75.

A photograph of a dense forest. In the foreground, there are large, moss-covered tree trunks. The ground is covered with a thick layer of green ferns and other low-lying vegetation. The background shows more trees and a slightly hazy sky. The text "Focus on restoring healthy ecosystems." is overlaid on the lower left portion of the image.

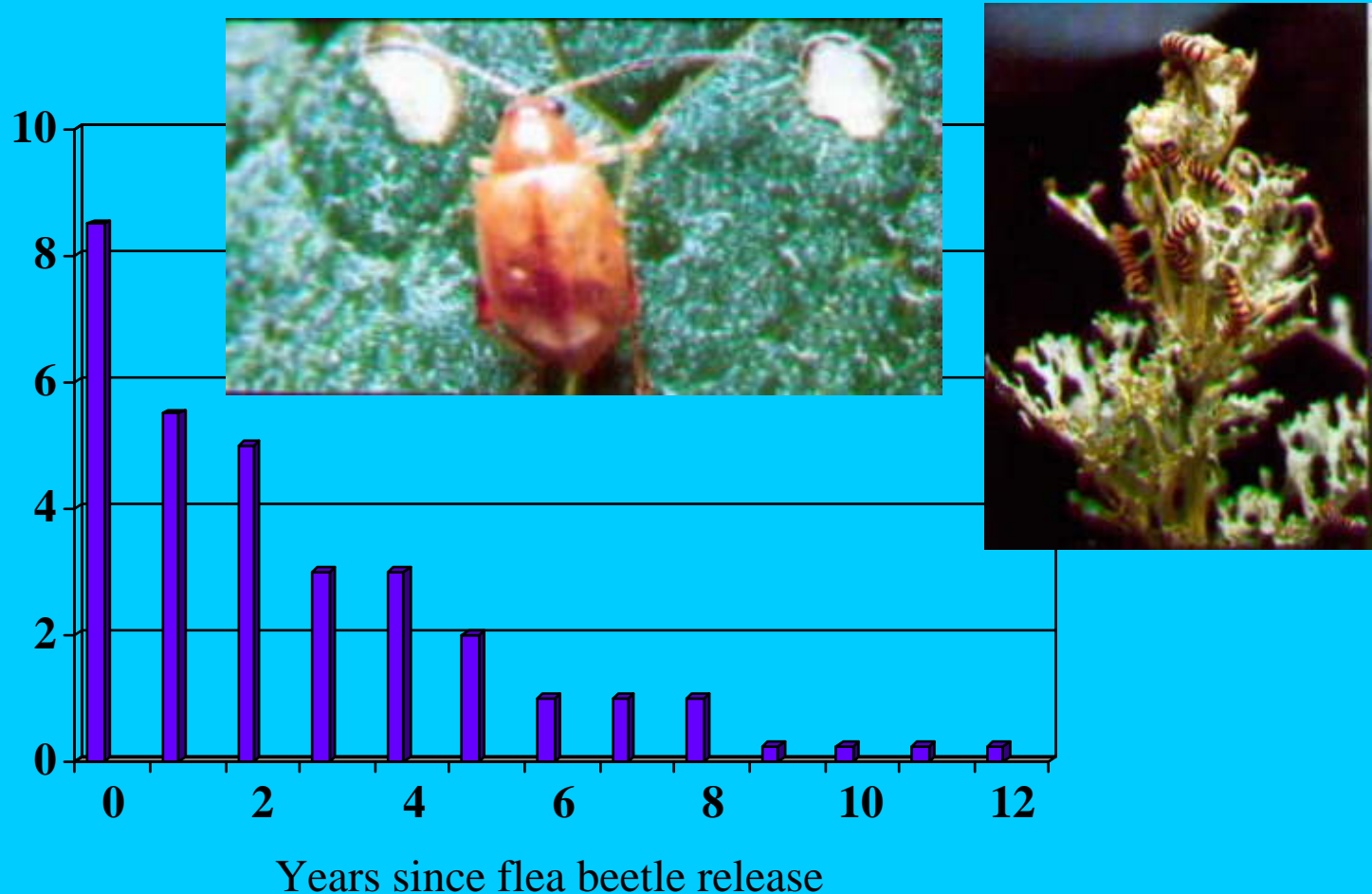
Focus on restoring healthy
ecosystems.




Regional weed problems need
regional solutions.

Successful biological control

Ragwort
density
(plants/square m)
at 42 sites in
western Oregon



Source: McEvoy, P., C. Cox, and E. Coombs. 1991. Successful biological control of ragwort, *Senecio jacobaea*, by introduced insects in Oregon. *Ecol. Appl.* 1:430-442.

A photograph of a helicopter in flight, viewed from below, spraying a large area of land with a white substance, likely for pest control or fire suppression. The spray creates large, swirling patterns of white mist against a clear blue sky. The helicopter is positioned in the center of the frame, with its rotors visible. The overall scene is dynamic and captures a moment of aerial activity.

Photographs:
The Nature Conservancy
Bureau of Land Management
U.S. Forest Service
U.S. Fish and Wildlife Service