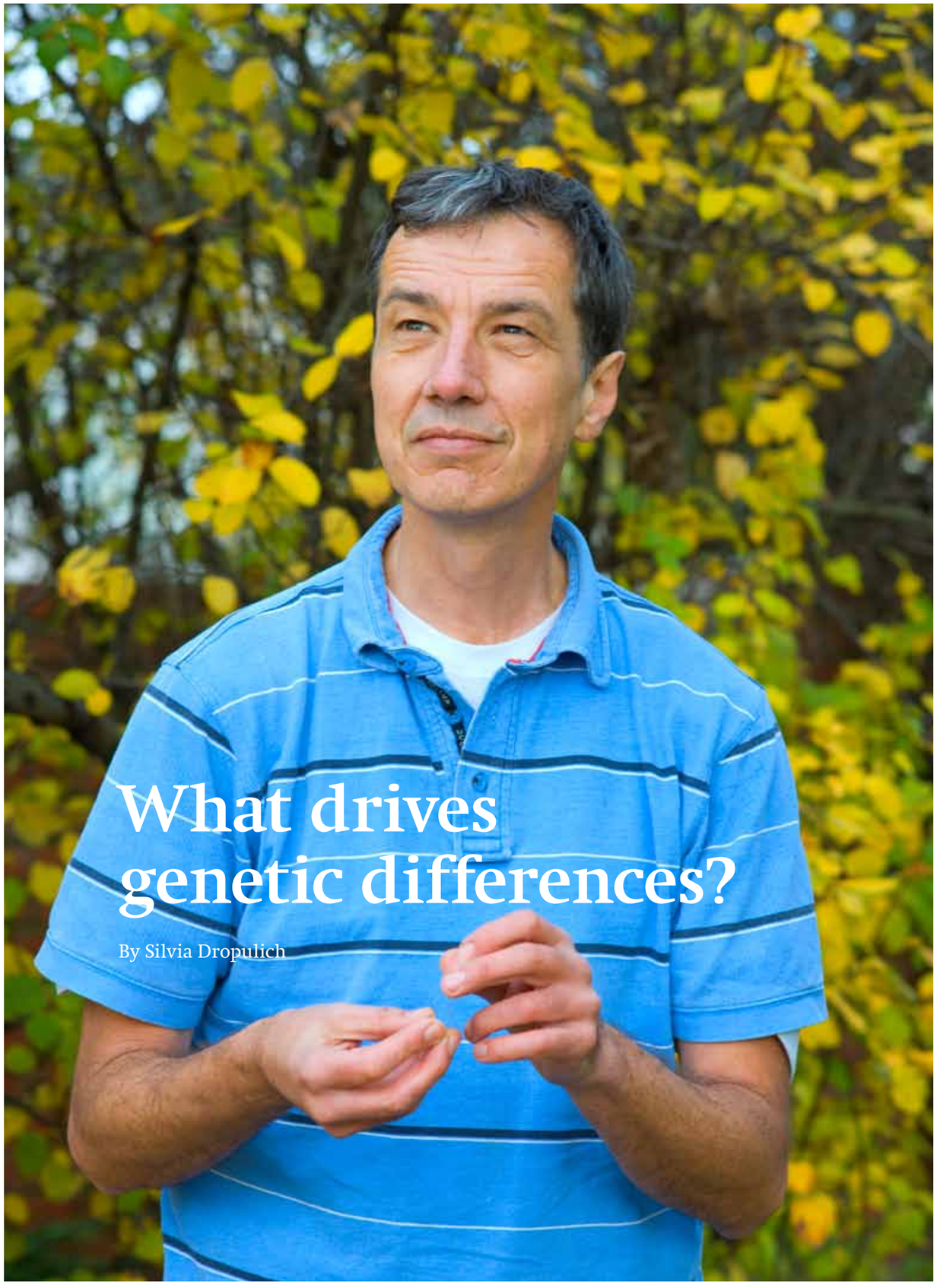

What drives genetic differences?

By Silvia Dropulich

PROFESSOR HOFFMANN has always been interested in natural variation among organisms, how it creates the diversity of life and how it is harnessed in our food production. It is his driving passion.

He traces this passion to growing up on a farm and seeing first hand different varieties of vegetables and crops and insects.

"I was always interested in variability and evolution – how organisms fit their environment," Professor Hoffmann told *Research Review*.

"What I am excited about at the moment is trying to understand what makes one organism become very restricted and very threatened and stuck in one environment while a very closely related species that genetically may not differ that much may be able to tolerate a wide range of environments.

"What I'm trying to do is to try and understand what makes those differences at a genetic and physiological level."

Professor Hoffmann's research addresses the way organisms (particularly insects) deal with environmental stresses. He has published widely on the genes involved in adapting to warming and cooling climates, the way stressful environments influence evolution, and the use of insects as a way of monitoring stressful conditions including those due to pollutants.

Professor Hoffmann's team is currently testing what drives genetic differences and how insects adapt to stressful conditions.

"We think it has a lot to do with the fact that when an organism finds itself in one environment for a long period of time, its genes start to decay.

"We suspect that biodiversity may actually be driven by a DNA decay process."

If this turned out to be the case it might be possible to predict whether an organism is particularly susceptible to not being able to survive certain environments. It will also help identify organisms useful for monitoring environmental deterioration.

Using different species of Australian vinegar flies as models, scientists at the University of Melbourne have already found that the common species is able to evolve and adapt to climate change but their cousins – who only inhabit tropical rainforest – are not able to. They are now also testing this idea in alpine grasses and aquatic insects.

"The danger that species in threatened environments, like tropical rainforests and alpine meadows, may not survive climate change now appears more acute than previously thought," Professor Hoffmann said.

For Professor Hoffmann, the work he is engaged in makes him appreciate the detrimental effects that human activities are having on the environment. One lesson that wider engagement has taught him is that scientific approaches can be used to develop creative solutions to many problems facing humanity but you still need political solutions to implement them.

"By using new genetically-based techniques we will undoubtedly become better at suppressing pest populations, but implementing these will be challenging because of the inherent fear of these technologies" Professor Hoffmann said.

"One of the things I feel quite strongly about is maintaining genetic and species biodiversity for future generations. Most of us live in sterile urban environments where we are disconnected from the diversity of life that provides water, food, and other essentials for our survival.

"We have shown that biodiversity helps to keep the pests in our environment in check; and that genetic diversity is needed for all sorts of organisms to evolve and persist under climate change and other stresses. Yet it is difficult to get managers and decision makers to think about the value of this diversity.

Professor Hoffmann says that the human species has already done an awful lot of damage to the environment, not just through destroying natural habitats but also by introducing invasive species, disrupting natural ecological and evolutionary processes, and releasing pollutants.

"If you consider the State of Victoria, then most its natural environments are under some form of stress at the moment."

"And yet we don't quite appreciate that we need these environments for our life support systems. We simply don't place enough value on them"

Professor Hoffmann's research has led to new methods of using genes and insects to monitor for environmental pollutants, new ways of controlling pests, and new ways to promote the conservation of species and communities threatened by climate change.

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Professor Ary Hoffmann, ARC Laureate Fellow, Director of Melbourne's Centre for Environmental Stress and Adaptation Research (CESAR), Fellow Australian Academy of Science, Research Director Victorian Centre for Aquatic Pollution Identification and Management.