

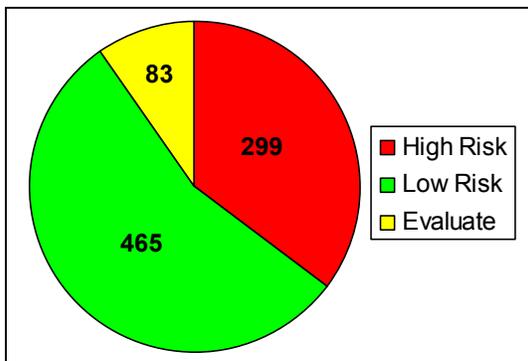
## HAWAII-PACIFIC WEED RISK ASSESSMENT (HPWRA)

Two ongoing objectives of the HISC Strategic Plan for 2008-2013 are to “develop a comprehensive ‘approved planting list’ to ensure that invasive species are not being planted in State projects or by any state contractors, e.g. screened by the Weed Risk Assessment protocol” and to “develop collaborative industry guidelines and codes of conduct, which minimize or eliminate unintentional introductions.” In accordance with these objectives, two Weed Risk Assessment Specialists are presently employed through funding provided by the Hawaii Invasive Species Council. Charles Chimera, based in the Maui Invasive Species Committee office on the island of Maui, was hired in September 2007 and has continued in that capacity to present. Patricia Clifford, based out of the Bishop Museum on the island of Oahu, has been employed as a WRA Specialist from August 2008 to present.

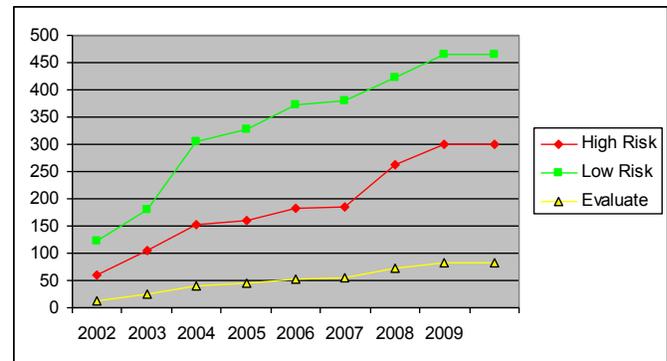
Continued effort is being put into assessments so that a growing number of the 10,000+ species in Hawai`i and the many other species that could be introduced from around the World can be assessed and documented. As of September 2009, 847 assessments, assigned to categories of “High Risk”, “Low Risk”, or “Evaluate”, have been completed and posted on the website at:

<http://www.botany.hawaii.edu/faculty/daehler/wra/default2.htm>).

An additional 34 assessments have been completed and will be posted pending review by Dr. Curt Daehler.



847 posted assessments by risk category



Cumulative assessment total by year and risk category

The following is a list of highlights and accomplishments from the period of Sep 2008 through September 2009:

## WEED RISK ASSESSMENT REQUESTS BY AGENCY AND ORGANIZATION

### Department of Tropical Plants and Soil Sciences, CTAHR, and Botany Department, University of Hawaii at Manoa

WRA specialists continued working with Dr. Andy Kauffman and graduate student Alberto Ricordi to identify a selection of viable ornamental trees and shrubs to replace ones currently on the invasive species list. The plants identified as low risk will be promoted for use in both private and public landscape planting projects. Assessments have also been provided upon request from UH Botany Department students interested in the invasiveness of medicinal ginger species.

WRA Specialist Patti Clifford worked with the College of Tropical Agriculture and Human Resources at the University of Hawaii to have the WRA incorporated into three documents. The documents are available online at:

<http://www.ctahr.hawaii.edu/ctahr2001/PIO/FreePubs/FreePubs06.asp#Landscape>

The publications are: Barrier Plants, Green Plants for Hawaii's Tropical Landscapes and Salt and Wind Tolerance of Landscape Plants for Hawaii.

### Island Invasive Species Committees (ISCs)

WRA Specialists have screened requests from Oahu (OISC), Kaua'i (KISC), Maui (MISC) and the Big Island (BIISC) Invasive Species Committees to aid in early detection and prioritization for control of potential invasive plants. Assessments provide a concise and consolidated source of current references useful in implementing management decisions. Detection of the invasive milk thistle (*Silybum marianum*) by retired forester Bob Hobdy was followed by a rapid weed risk assessment and presentation by Charles Chimera to the Maui Invasive Species Committee, and the ultimate inclusion of milk thistle as a target species for localized control. Another assessment for Spanish Heath (*Erica lusitanica*) was completed upon request from MISC outreach staff to provide supplementary information for the monthly newspaper column "Kiai Na Moku O Maui Nui (Guarding the Islands of Maui County)" in March 2009.



Milk thistle (Photo by F.&K. Starr)  
WRA Score = 17.5 (High Risk)

### Early Detection and Rapid Response Team – Bishop Museum

HPWRA continues to be an integral part of plant species prioritizing efforts by the Early Detection team of the Bishop Museum and of the Big Island Invasive Species Committee and has provided assessments on over 40 requests from Oahu, Maui and Big Island early detection staff.

### Pacific Islands Outside Hawaii

Other Pacific Islands continue to actively use the HPWRA Program to make plant importation, propagation and control decisions. In the previous year, WRA specialists have provided assessments on behalf of the quarantine services of the Federated States of Micronesia for such species as *Tradescantia spathacea*, *Festuca*



*arundinacea* and *Poa pratensis*, among others. WRA specialist Patti Clifford also gave a presentation at the Pacific Invasives Learning Network (PILN) workshop to raise awareness and encourage adoption of the HPWRA by workshop attendees from Micronesia, Polynesia, Melanesia and Hawai'i

### Federal Agencies

Assessments have been completed and technical information provided for federal government agencies including the US Fish and Wildlife Service, the US Forest Service, the O`ahu Army Natural Resource Program (OANRP) and the Pōhakuoa Training Area Ecosystem Management Program. Of particular importance was an assessment by Patti Clifford for *Sphagnum palustre*, a native moss invading bog habitats in the Mount Ka`ala Natural Area Reserve on the island of Oahu. Results of this assessment, completed on behalf of OANRP staff, were included in a poster presentation at the 2009 Hawaii Conservation Conference.

### Watershed Partnerships

Several assessments have been completed on behalf of the various island watershed partnerships to aid in prioritization and management decisions for known and potentially invasive plant species. An important assessment of *Paraserianthes lophantha* (Mountain albizia) was also recently completed on behalf of the Leeward Haleakala Watershed Restoration Partnership, to raise concern for and awareness of this incipient watershed invader spreading out of the Polipoli Forest Reserve on Haleakala, Maui.

### Private Organization, Individual Plant Growers, Landscape Professionals, Environmental Consultants

The HPWRA program is continuing to receive plant information and screening requests from plant growers and landscape professionals, including several requests from Maui Land & Pineapple Company, Haleakala Ranch, the Honolulu Botanical Gardens, Regenerations Botanical Garden, Carol Kwan Consulting LLC, the Nature Conservancy of Hawaii and others to assess individual species as well as new development planting lists for known or potentially invasive plant species.

### BIOFUELS ASSESSMENTS & PUBLICATIONS

The Weed Risk Assessment system has been utilized as an objective tool to identify both low and high risk crops proposed for biofuel development in the Hawaiian Islands and other tropical island ecosystems. WRA Specialists have continued to attend meetings and have given presentations to inform the public and conservation agencies of the biofuel assessments and findings. These include a presentation on invasive biofuels by

OPEN ACCESS Freely available online

PLOS one

#### Assessing Biofuel Crop Invasiveness: A Case Study

Christopher Evan Buddenhagen\*, Charles Chimera, Patti Clifford

Pacific Cooperative Studies Unit, University of Hawaii at Manoa, Honolulu, Hawaii, United States of America

**Abstract**

**Background:** There is widespread interest in biofuel crops as a solution to the world's energy needs, particularly in light of concerns over greenhouse-gas emissions. Despite reservations about their adverse environmental impacts, no attempt has been made to quantify actual, relative or potential invasiveness of terrestrial biofuel crops at an appropriate regional or international scale, and their planting continues to be largely unregulated.

**Methodology/Principal Findings:** Using a widely accepted weed risk assessment system, we analyzed a comprehensive list of regionally suitable biofuel crops to show that seventy percent have a high risk of becoming invasive versus one-quarter of non-biofuel plant species and are two to four times more likely to establish wild populations locally or be invasive in Hawaii or in other locations with a similar climate.

**Conclusions/Significance:** Because of climatic and ecological similarities, predictions of biofuel crop invasiveness in Hawaii are applicable to other vulnerable island and subtropical ecosystems worldwide. We demonstrate the utility of an accessible and scientifically proven risk assessment protocol that allows users to predict if introduced species will become invasive in their region of interest. Other evidence supports the contention that propagule pressure created by extensive plantings will exacerbate invasions, a scenario expected with large-scale biofuel crop cultivation. Proactive measures, such as risk assessments, should be employed to predict invasion risks, which could then be mitigated via implementation of appropriate planting policies and adoption of the "polluter-pays" principle.

**Citation:** Buddenhagen CE, Chimera C, Clifford P (2009) Assessing Biofuel Crop Invasiveness: A Case Study. PLoS ONE 4(4): e5281. doi:10.1371/journal.pone.0022343

**Editor:** Dennis Matruh Hansen, Stanford University, United States of America

**Received:** February 25, 2009; **Accepted:** March 19, 2009; **Published:** April 22, 2009

**Copyright:** © 2009 Buddenhagen et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

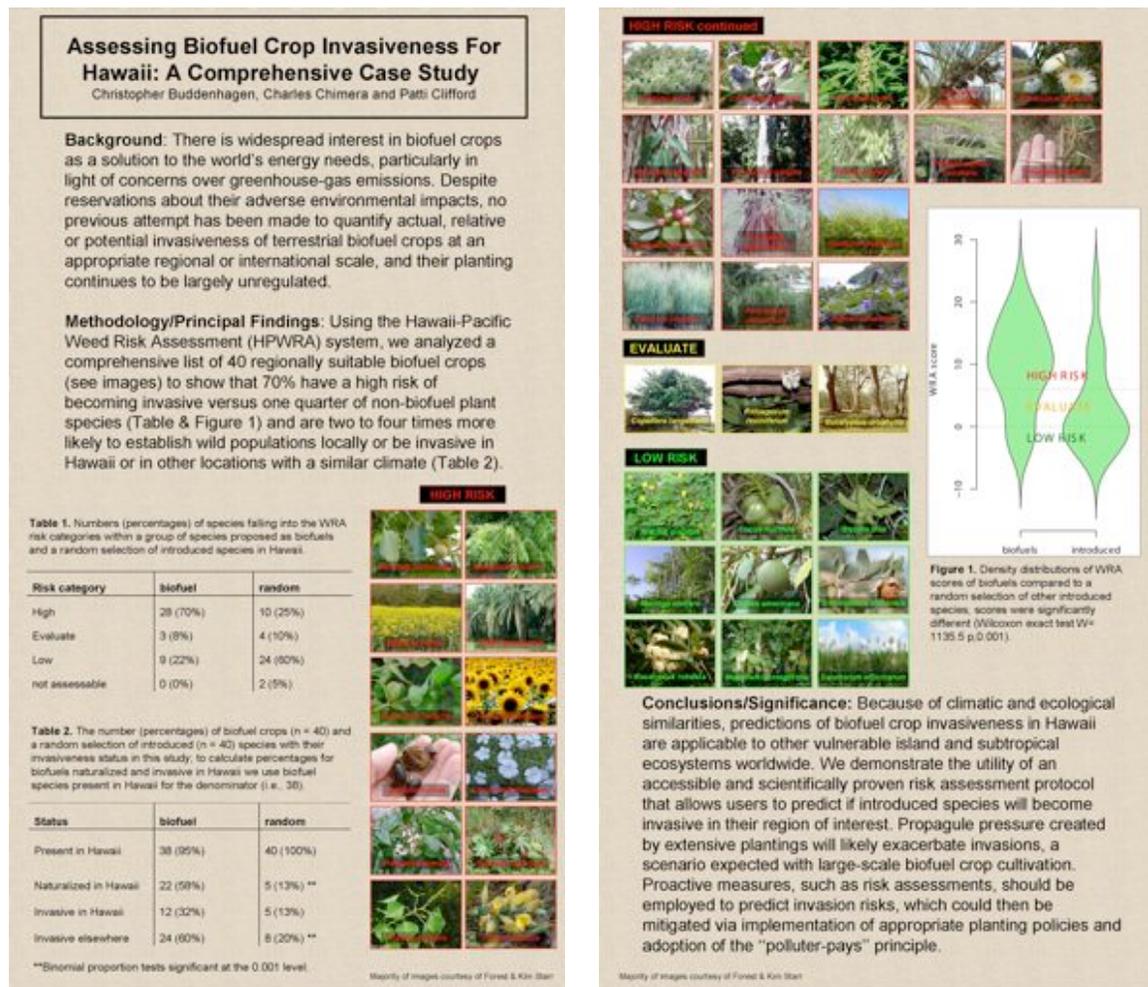
**Funding:** The Hawaii Invasive Species Council provided funds through the Hawaii Department of Land and Natural Resources to carry out weed-risk assessments for introduced species. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

**Competing Interests:** The authors have declared that no competing interests exist.

\* [cehb@hawaii.edu](mailto:cehb@hawaii.edu)

Charles Chimera at the annual meeting of the Native Hawaiian Plant Society in March 2009 and a poster on biofuel risk assessments presented by Chris Buddenhagen, Charles Chimera and Patti Clifford at the 2009 Hawaii Conservation Conference. Charles Chimera also wrote an article for the Maui News entitled “Introducing biofuel plants: it isn’t all good”, published in the August 2009 edition of the monthly newspaper column *Kiai Na Moku O Maui Nui* (Guarding the Islands of Maui County)”.

Chris Buddenhagen, Charles Chimera and Patti Clifford also published the results of an analysis of risk and invasiveness of biofuel crops in the April 2009 edition of the on-line peer-reviewed journal *PLoS One* (Buddenhagen C. E., C. Chimera, and P. Clifford. 2009. Assessing Biofuel Crop Invasiveness: A Case Study. *PLoS ONE* 4(4): e5261. doi:10.1371/journal.pone.0005261).



**Biofuel Poster Presentation at 2009 Hawaii Conservation Conference**

## HPWRA OUTREACH

To continue to promote awareness and encourage adoption of the HPWRA system, WRA Specialists Charles Chimera and Patti Clifford have been involved in additional outreach activities with partner agencies, signatories of the Codes of Conduct and other interested parties. As previously mentioned, Chimera gave an invasive biofuel presentation to the Native Hawaiian Plant Society in March 2009 and wrote a Maui News article in August 2009, and Clifford gave an informative talk on the HPWRA at the PILN workshop in June 2009. In addition, Chimera and Clifford attended a meeting of the Kauai Landscape Industry Council in Lihue, Kauai on December 2008 in which information was presented both on the WRA and on species included in the "Do Not Plant" list.

Clifford has been active in contacting agencies about the HISC Resolution to have State Agencies consult the HPWRA before using a plant in landscaping. She has also created maps and wrote the section on GPS quality for a grant that the Bishop Museum has submitted to FWS for a botanical survey on the Oahu National Wildlife Refuge. She has further collaborated with HISC and the Herbarium Pacificum to arrange a field trip to the herbarium and the entomology department at the Bishop Museum for the PILN Workshop. Clifford's efforts on behalf of the Bishop Museum are provided in exchange for use of office resources and space in the museum facilities.

In collaboration with the Maui Invasive Species Committee, Chimera has led multiple backcountry trips with MISC staff into Haleakala National Park's Kipahulu Valley. On these trips, he has provided training in field identification of invasive species targeted for control as well as of native rainforest flora. He also gave a talk to high school science teachers in August 2009 on island biota as part of MISC's Ho'ike environmental curriculum.

Both WRA specialists continue to provide on-call technical information and advice on invasive plant species to both members of the conservation community and the general public.

## CURRENT WORKLOAD

Most of the individuals, agencies and programs previously mentioned submit plant species for screening on a regular basis, and the WRA specialists continue to produce new assessments and answer technical questions relating to particular species and their invasive potential. WRA specialists also provide recommendations on utilization of low risk alternatives to invasive plants in both public and private landscape and horticultural projects.



Maui News, August 9, 2009

## **FUTURE NEEDS**

At present, all HPWRA data continues to be entered into Excel spreadsheets. Incorporating all data into a searchable database such as 'Access' would help in analysis of general data trends and would be a first step towards assessing how HPWRA could better serve the conservation and nursery communities. The contract to design this HPWRA database and convert existing spreadsheet-based data to the new format was awarded in the summer of 2008. Work is currently proceeding on the database development and an end user interface is expected to be ready in November or December 2009. WRA specialist Chimera has enrolled in a database application and design class at Maui Community College for the Fall 2009 semester in anticipation of continued work and manipulation of the prototype WRA database.

Development of a user-friendly web interface is still recognized as a critical need for the promotion and adoption of the HPWRA. A grant to design and develop such a website was submitted in the early spring of 2009 but was not funded at that time. WRA staff will continue to explore other funding possibilities in pursuit of this worthwhile endeavor.

Due to budget restrictions and the state's recent economic crisis, only one WRA position has been funded beyond February 2010. WRA collaborators and staff are actively pursuing additional sources of funding so that core productivity is maintained at current levels. As such, Patti Clifford submitted a grant proposal to the Horticultural Research Institute for the weed risk assessment of species in the Acanthaceae family, members of which can be both popular ornamentals but also naturalized and invasive weeds. Notification of grant awards is expected by late November 2009. Other avenues and alternative, non-HISC sources of funding continue to be sought.