Late

March 18, 2013

RE: Testimony to State Senate Committee on Energy and Environment

Dear Sir or Madame:

Aloha. Please note that I am submitting testimony in strong support of SCR 74 and SR41 entitled, “Urging the Department of Agriculture to add the albizia tree to its noxious weed list and urging the invasive species council to develop and implement a comprehensive interagency plan for the control and eradication of albizia on the island of Hawaii”. This resolution is sorely needed. I include the following documentation of the management issues surrounding this fast-growing and hazardous tree.

Invasive alien species have caused untold damage to the ecology and economies of areas they have invaded (Elton 1958). Where invasive species introduce new biological processes or disturbance regimes into ecosystems, they have the potential to profoundly alter both community characteristics and ecosystem functions, often to the extreme detriment of the native flora and fauna being invaded (Vitousek et al. 1987, D’Antonio and Vitousek 1992). The invasive alien tree, *Falcataria moluccana* (Miq.) Barneby and Grimes (synonyms: *Paraserianthes falcataria* (L.) I.C. Nielsen, *Albizia falcataria* (L.) Fosberg, *Albizia falcata* auct) is a very large, fast-growing, nitrogen-fixing tree in the legume family (Fabaceae) (Wagner et al. 1999). It is a daunting invasive species, in that it is considered to be the fastest growing tree species in the world, capable of growing ca. 2.5 cm in height per day (Footman, 2001, Walters 1971). Further, individuals reach reproductive maturity by the age of four years and subsequently produce copious amounts of viable seed (Parrota 1990) contained within seed pods that are wind-dispersed and can be carried substantial distances (i.e., > 200 m) up- and down-slope during windy conditions. When mature, the canopy of an individual tree is capable of extending over a one-half hectare area, and the broad umbrella-shaped canopies of multiple trees commonly coalesce to cover multiple hectares and even up to square kilometers (Hughes and Denslow 1995). Perhaps the single most important constraint to *Falcataria* seedling recruitment is light availability; seedlings are very sensitive to shade and germinate in abundance only where the overstory canopy is open enough to allow sufficient light penetration (Soerianegara and Lemmens 1994).

Although valued by some, *F. moluccana* has become invasive in forests and developed landscapes across many many parts of our Hawaii Islands and other Pacific islands as well. Native to the Moluccas, New Guinea, New Britain, and Solomon Islands (Wagner et al. 1999), *F. moluccana* was imported to a wide variety of islands across the Pacific, typically for the purpose of providing shade for, and litter-derived nitrogen additions to, crop species. It is currently considered invasive in the Republic of Palau, Pohnpei, Yap, New Caledonia, Fiji, Independent Samoa, American Samoa, the Cook Islands, the Society Islands, and the Hawaii Islands, and it is present though not yet considered invasive in the islands of Guam, Wallis and Futuma, and Tonga. Given the widespread presence of *F. moluccana* across the Pacific Islands, this species poses a serious threat to the highly diverse biological hotspot that these islands collectively constitute (Myers et al. 2000). An archetypical early successional (i.e., pioneer) species, *F. moluccana* is generally found in mesic to wet forest environments and

favors open, high light environments such as disturbed areas; its capacity to readily acquire nitrogen via its symbiotic association with *Rhizobium* bacteria makes it able to colonize even very young, highly N-limited lava flows such as those found on Hawaii Island (Hughes and Denslow 2005).

F. moluccana was first introduced to the Hawaiian Islands from Borneo and Java in 1917 by the explorer botanist – and champion of native Hawaiian species – Joseph F. Rock (Rock 1920). Rock noted the rapid growth rate of *F. moluccana*, stating that it is capable of reaching a height of over 35 m in 25 years' time and that, "trees nine years old had reached a height of over a hundred feet, a rapidity of growth almost unbelievable". Ironically, Rock also commented on the life cycle of *F. moluccana*, stating that, "the only objection to the tree is its short-lived period, but as it is an abundant seeder, there should always be a good stand of this tree present" (Rock 1920). Regarding the life span of *F. moluccana*, individuals planted by Rock in 1917 remain living, nearly 100 years later, on the grounds of the Lyon Arboretum on Oahu, Hawaii. Following its introduction, *F. moluccana* was one of the most commonly planted tree species in the concerted, long-term, and wide-ranging non-native tree establishment efforts conducted by Hawaii Territorial and State foresters during the early to mid-1900's; approximately 140,000 individuals were planted throughout the Forest Reserve systems across the Hawaiian Islands, and populations have spread extensively from those intentional plantations.

ECOLOGICAL IMPACTS

Previous research on the impacts of *F. moluccana* on native forests in Hawaii have demonstrated that wherever it invades, this species profoundly transforms our native forests by dramatically increasing inputs of nitrogen, facilitating invasion by other weeds while simultaneously suppressing native species. Hughes and Denslow (2005) described the impacts of *F. moluccana* invasion on some of the last intact remnants of native wet lowland forest ecosystems undergoing primary succession in Hawaii. They found that primary productivity in the form of litterfall was more than 8 times greater in *F. moluccana*-dominated forest stands compared to stands dominated by native tree species. More importantly, nitrogen and phosphorus inputs via litterfall were up to 55 and 28 times greater in *F. moluccana* stands compared to native-dominated forests (Hughes and Denslow 2005), and rates of litter decomposition - as well as rates of N and P release during decomposition - were substantially greater in *F. moluccana* invaded forests relative to native-dominated forests (Hughes and Uowolo 2006). These nitrogen inputs of up to 240 kg N ha^{-1} y^{-1} in *F. moluccana* stands exceed typical application rates of N fertilizer documented for industrial, high output corn cropping systems of the US Midwest (Jaynes et al. 2001). As a consequence, soil N availability was 120 times greater in *F. moluccana* forests relative to native-dominated forests on comparably-aged lava flow substrates. Simultaneously, *F. moluccana* invasion increased soil enzyme activities - particularly acid phosphatase (AP) activities – and converted the fungal-dominated soil communities of native stands to bacteria-dominated soil communities in *F. moluccana*-invaded stands (Allison et al. 2006). These profound functional changes coincided with dramatic compositional and structural changes as well; *F. moluccana* facilitated and explosive increase in densities of understory alien plant species – particularly *Psidium cattleianum, Clidemia hirta, Miconia calvescens,* while native species – particularly the overstory tree, *Metrosideros polymorpha* – suffered widespread mortality to the point of effective elimination from these areas that they had formerly dominated. Based on these findings, Hughes and Denslow (2005) concluded that

the continued existence of native-dominated lowland wet forests in Hawaii largely will be determined by the future distribution of *F. moluccana*.

SOCIO-ECONOMIC IMPACTS

F. moluccana is also a roadside, urban forest and residential pest of major significance. Because individuals rapidly and routinely reach heights of up 40 m and their weak wood breaks easily in storms or with age, catastrophic failure of massive limbs create significant hazards in residential areas and across infrastructure corridors such as roads and power lines, and their management is extremely costly for landowners, utilities, and local governments. For example, on April 16, 2010, a 25 to 30 m tall *F. moluccana* tree fell across a residential street in the Puna District of Hawaii Island that destroyed power lines and fences and landed in a backyard area where children often play (Hilo Tribune Herald, May 6, 2010). The economic burden posed by removal of large *F. moluccana* individuals from high-use public areas is profound.

The potential economic burden posed by *F. moluccana* is staggering. In 2009, on the island of Kaua'i the Hawaii Department of Transportation (HDOT) was compelled to act on two unconfirmed near fatalities involving large branches of *F. moluccana* dropping onto cars and on an adjacent house located close to the road right-of-way. In response, the HDOT spent one million dollars to remove approximately 1,500 *F. moluccana* individuals growing along a single mile of roadway. Because *F. moluccana* has such soft wood and unstable branches, arborists were forced in this case to employ expensive cranes and lifts to remove these trees. As a consequence the larger trees cost in excess of $10,000 per individual to remove safely. Across the state of Hawaii, it has been estimated that over 40% of HDOT damage claims involving falling trees and branches are due to *F. moluccana* individuals and populations. Even where F. moluccana individuals grow at some distance from roads, they are considered problematic and hazardous because limbs can fall into waterways and accumulate against bridges, potentially causing flooding and physical damage to critical infrastructure. In addition, natural events such hurricanes or storms often cause extreme damage to *F. moluccana* stands which in turn contribute to road closures, electrical outages, and property damage, thus exacerbating post storm and cyclone cleanup and repair work all across the state of Hawaii. It is currently estimated that there are between 50 to 100 miles of state roads along which *F. moluccana* populations are maturing, growing in size and reaching high densities (personal communication, Christopher A. Dacus, Landscape Architect and Certified Arborist, Hawaii State Department of Transportation). With no natural predators to constrain them, both the size and areal extent of *F. moluccana* populations are increasing in both stature and areal extent, with concomitant maintenance costs increasing annually as well.

CONTROL MEASURES

Herbicides have proven to be highly effective in controlling saplings and larger, mature *F. moluccana* individuals. On the Hawaiian Island of Molokai, the Molokai-Maui Invasive Species Committee spearheaded a multi-agency effort in July, 2008 to eliminate a large stand of *F. moluccana* who's large and extensive root systems were threatening to damage significant and sensitive cultural sites. Field crews girdled the trees with chainsaws and applied Garlon 3A mixed with crop oil. Significant canopy defoliation was noted within weeks of treatment and mortality of treated trees was 98% one year following application, and 100% mortality with no subsequent seedling recruitment 4 years post-treatment. As of this writing, all known populations of *F. moluccana* on Molokai have been killed, providing a compelling

example of island-wide eradication of this highly invasive tree. As in American Samoa, the *F. moluccana* control project proved highly successful in bringing together disparate community members, interagency staff, and cultural practitioners, and participants are determined to use this project as a model for community involvement and creating a proper emphasis on Hawaiian cultural practices.

Encouraging recent advances in the development and use of another herbicide, Milestone® (EPA reg. no. 62719- 519; active ingredient aminopyralid), has also provided a highly effective means by which to quickly and efficiently kill mature *F. moluccana*. Milestone is administered by injection of very low volume, metered doses of the undiluted formulation to kill and control infestations of *Falcataria moluccana.* This new method - a method demonstrated to be much more effective and hygienic than current conventional methods now being employed – appears to be a "game changer", allowing for efficient, safe, and successful control of *F. moluccana* populations across broad landscapes of Hawaii (personal communication, James Leary, Invasive Weed Management Specialist, University of Hawaii). Trials indicate that very low dosage treatments resulted in 100% mortality in less than one month's time. As such, herbicide approaches employing Milestone application should prove to be an important component to future *F. moluccana* control efforts do to its efficacy, and ease of application.

CONCLUSIONS

Previous research and recent experience demonstrates that, left unchecked, *F. moluccana* invasion poses significant threats to both the integrity of native ecosystems and human health and welfare across Hawaii. Successful containment of *F. moluccana* with chemical control measures also result in savings of many millions of dollars throughout Hawaii by avoiding damage and maintenance costs associated with these trees growing near utilities, roads, homes and workplaces.

Thank you for your thoughtful consideration of my testimony. I hope it will help inform your decision making process.

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